From made in to created in

A new paradigm for the Portuguese economy

Fernando Alexandre, coord.

The ageing of the population and the climate transition will have a strong impact on the Portuguese economy. Responding to these major challenges requires a new paradigm of wealth creation based on knowledge, skills and innovation: the *created in* paradigm. This new model of economic development needs an economic environment that favours the birth and growth of innovative companies: competitive markets; labour legislation which encourages the qualification of workers and their rapid adjustment to technological changes; efficient financial markets; excellent rail, port and airport connectivity; and the production of scientific knowledge at the highest international standards. A closer connection between the Portuguese scientific and technological system and national and global *frontier firms* could accelerate the dissemination of innovation and the convergence of the Portuguese economy's productivity towards the levels of more developed countries.

From made in to created in

A new paradigm for the Portuguese economy

Fernando Alexandre, coordination

FUNDAÇÃO
FRANCISCO MANUEL DOS SANTOS

Largo Monterroio Mascarenhas, n.º 1, 7.º piso
1099-081 Lisboa
Tel: 21 001 58 00
ffms@ffms.pt

Director of publications: António Araújo
Director of the series Foundation Studies: Gonçalo Saraiva Matias
Title: From made in to created in: A new paradigm for the Portuguese economy
Authors: Fernando Alexandre (coordination), João Tovar Jalles, Joaquim Oliveira Martins, Pedro Brinca, Tiago Neves Sequeira, Lars Montelius, Paulo Ferrão, José Varejão, Miguel Portela, Joana Vasconcelos, João Cerejeira, Hélder Costa, Carlos Oliveira Cruz, João Januário, Luís Catão, Pedro de Faria, António Martins, Til Dietrich, Flora Marchioro, Renato Rosa, Maria Antonieta Cunha e Sá, Ana Carina Silva e Catarina Frazão Santos
Proofreading and translation: Sara Nogueira and TT
Design: Inês Sena
Typesetting: Guidesign

ISBN: 978-989-9064-71-3
Legal Deposit: 489 993/21

Preface

The Francisco Manuel dos Santos Foundation, with the support of the Sociedade Francisco Manuel dos Santos, decided to carry out a major study on the new paradigm to develop Portugal in the next decade.

This decision was largely motivated by the conviction that a study with these characteristics corresponds entirely to the Foundation's mission and its Founder's desire to contribute, with hard facts, towards a free debate in Portuguese society.

The country is at a decisive moment. After various years of economic and financial crisis, it was surprised, and so was the whole world, by a terrible global pandemic, which had, and is still having, serious social, political and economic consequences.

Without prejudice to this reality, the present moment also represents an opportunity. Between the PT2020 Programme, still to be implemented, the Recovery and Resilience Programme, and the new PT2030 Programme, Portugal will have access to an unprecedented amount of funds in recent history.

This is probably the last great opportunity to set the country on a path of development using European funds, making it less dependent on external sources of financing and less dynamic economic sectors.

Without a political or ideological agenda, as is the Foundation's hallmark, the aim was to not only produce an exact diagnosis of the Portuguese economy in recent decades, mainly thinking about its favourable and adverse factors, and seeking to indicate ways of avoiding the adverse factors and enhancing the favourable ones.

An essential line that has always guided the Foundation in this and other studies, and was at the origin of this study, is social concern. Very recently the Foundation launched a study on poverty in Portugal, which reported, among other aspects, that 20% of the country lives in poverty. Not even the fact of having a job is any guarantee that someone is not living in poverty. So, the very clear conviction is that poverty can only be avoided through development, education and economic growth.

A Foundation concerned with the development of the country and its social well-being could not fail to contribute towards the debate on how to put Portugal on the path towards growth in the next decade. And it did so the way it knows best: by bringing together a team of over twenty of the country's best economic and other specialists, and assembling a prestigious steering committee, comprised by some of the world's most renowned economists, to monitor the work of these specialists.

I can personally testify to the unceasing commitment of the teams that worked on the seven papers which comprise this study, as well as the constant monitoring and determined involvement of the members of the steering committee. This experience proves it is possible to put different players and fields of knowledge, from different countries, at the service of a common goal.

All this work and its outcome would not have been possible without Fernando Alexandre's exemplary coordination and in-depth knowledge of the Portuguese economy. He was responsible for the conception, coordination and preparation of the study's final report.

The study, as mentioned, doesn't only provide an accurate diagnosis of the current state of the Portuguese economy. It goes further and, based on this diagnosis, strives to formulate public policy proposals on how Portugal can develop decisively over the next decade, relying on existing factors and its access to financing.

As is its habit, the Foundation seeks to foster debate, without conditioning it, and always in a free manner. In any case, it is essential that the country reflects and debates on the development model it wants for the next decade, which will be decisive for our collective future. This is our contribution.

Gonçalo Saraiva Matias
Director of Research Studies

Contents

Part I
From *made in* to *created in*: a new paradigm for the Portuguese economy

Executive summary

The last decades were characterised by an exponential acceleration of technological evolution and by an increase in the complexity of global trade relations, with a major impact on the structure and processes of production, on the location and competitiveness of sectors of activity, and on the demand for skills. Climate transition and the measures to address it affect territories and sectors of activity in different ways, from agriculture and forestry to the industries that make the most intensive use of fossil energy. The COVID-19 pandemic accelerated many of these changes, altering, in a way that is anticipated to be persistent, many dimensions of the organisation of societies, namely the ways of working and education. The adaptation of the Portuguese economy to these changes, accompanying and incorporating new technologies, retraining managers and workers, and repositioning itself in the large global value chains, will determine its response capability to the major challenges of climate transition and ageing and the sustained improvement of levels of well-being.

At the turn of the 21st century, Portugal failed to keep up with the pace of globalisation imposed by the revolution in information and communication technologies, and its economy stagnated and diverged from the European average. The progress of recent decades has not prevented child poverty and poverty among the elderly, as well as youth unemployment, from remaining at very high levels. On the other hand, the COVID-19 pandemic reversed the downward trend in public debt, which in 2020 once again exceeded 130% of GDP. Raising taxes, which are already among the highest in the EU, is not a sustainable solution for those problems. Among other negative effects, higher taxation, in a context of low income growth, will make it more difficult to attract and retain the most skilled workers, generating a vicious circle of low growth, more emigration and less immigration.

The COVID-19 pandemic interrupted a five-year cycle of economic growth, marked by an increase in the share of exports in GDP and a balanced current account between 2013 and 2019. These changes signal a structural change, with a more open economy and greater importance of tradable sectors.

Climate transition and population ageing are two global challenges that will mark the coming decades. The threats and opportunities of these transformations will depend on each country's context, their productive structure and the policies adopted to address them. If the demographic dynamic is one of the most negative in the EU, the new paradigm of renewable energies can give Portugal a competitive advantage for the first time since the Industrial Revolution.

The industrial revolution 4.0 — digitalisation, Big Data and artificial intelligence, the life sciences and biotechnology, new materials and robotics — has been changing the way of life, the organisation of societies, production processes, and globalization. Agglomeration economies, large concentrations of talent, research and innovation centres, excellent infrastructures and access to financial markets made location more relevant, showing that the world is not flat. In this new paradigm, will Portugal manage to be a relevant location in the global economy?

Besides technology, the political decisions of the main economic regions, in particular of the EU, which seeks to ensure its technological sovereignty in the face of competition from China and the United States, also influence the course of globalisation. Portugal's place in the post-COVID-19 world will depend on the use of its resources (e.g., the ocean), the choice of infrastructures (e.g., ports, airports, 5G), and of the quality of its institutions (e.g., regulatory bodies, system of qualifications, organisation and efficiency of the state).

The companies that will transform the structure of the Portuguese economy either do not yet exist or are not on the investors' radar. The economic context has to favour the appearance of innovative companies with global ambition and meet the conditions for their growth.

Efficient product, labour and financial markets, and insolvency and corporate recovery procedures are essential for an economic environment favourable to the growth of the more innovative enterprises. The economic environment should also create the conditions so that Portuguese companies can compete on the same footing as their European and global counterparts. Lastly, the economic environment, in which the dimension of fiscal competitiveness cannot be overlooked, should create favourable conditions to attract and retain qualified human resources and foreign direct investment.

Aggregate productivity growth, a necessary condition for economic growth in a context of demographic contraction, requires national companies positioned at the productivity frontier to align their performance with global frontier firms. This alignment requires the fostering of the diffusion of innovation, which can be accelerated through the strengthening of relations between large multinational companies, SMEs and entities of the scientific and technological system.

Since the 1980s, foreign direct investment (e.g., Renault, Autoeuropa) has played a crucial role in developing sectors such as automobiles, metal products and tools or moulds and plastics, through the constitution of nationally based supplier networks. There is a positive correlation between the share of foreign direct investment in GDP, the participation of global value chains in exports and overall export growth.

Foreign direct investment is therefore an essential tool for leveraging the integration of Portuguese companies in the global value chains, which represent more than 50% of international trade, and, thus, for the growth of exports. Portuguese exports are poorly integrated in the global value chains, and the sectors of activity of these exports are still of reduced relevance in the national economy (e.g., computers, electronics and electrical products; chemicals and pharmaceutical products; electrical equipment). Competitive conditions, human resources, financing and foreign direct investment in these sectors must be guaranteed.

The revolution in information and communication technologies and the concentration of engineers and scientists outside the more innovative regions of the globe, have in recent years led to the relocation of the areas of R&D&I to countries which were not on the frontier of technology and innovation. This new positioning of the global value chains creates opportunities for the enhancement of the knowledge generated in the scientific and technological system, for the diffusion of innovation in the neighbouring business environment and to develop a new paradigm in the Portuguese economy (e.g., the Bosch-UMinho partnership).

Besides the economic environment and the infrastructures mentioned above, the production of science according to the highest international standards and the qualification of the workers, particularly in STEM areas (Science, Technology, Engineering and Mathematics), are necessary conditions for attracting the development centres of multinational companies.

The existence of symbiotic relationships between multinational companies, the business community and entities of the scientific and technological system requires programmes that foster co-promoted projects, reducing the risk inherent to innovation projects and promoting externalities, along the lines of the 'Interface Programme' or of the 'Mobilising Agendas' of the Recovery and Resilience Plan, leveraged by European funding. The development of these ecosystems can speed up the processes of diffusing knowledge, technology and innovation between universities and research centres of excellence, multinationals and SMEs.

Climate transition and population ageing, two major societal challenges for the coming decades, will produce profound changes in the structure of the Portuguese economy. The labour-intensive social support and health sectors will continue to grow. Mobility will be increasingly based on electricity, reconfiguring urban spaces, and the changes in the productive structure will be felt in sectors as diverse as construction, agriculture and the financial sector. For this transformation process to succeed a new paradigm will have to emerge, the *created in* paradigm, based on knowledge and innovation and generating value for the global market.

Achieving the climate transition objectives, set for the European Union, will be based on an increased importance of renewable energies, on new forms of mobility more centred on public transport, on the energy efficiency of buildings, on the circular economy and on new forest management models. Taking advantage of the availability of renewable energy sources — rivers, the Sun and wind — will only constitute a competitive advantage if Portugal is an active part of the international network for generating knowledge and technology for their production.

Besides its importance for the objectives set for decarbonisation, the access to energy from renewable sources will be an increasingly relevant factor of competitiveness for companies based in Portugal and to attract foreign direct investment.

Robotics and automation, combined with the reskilling of human resources and attracting skilled immigrants, may compensate the negative effects of the reduction of the working population in the coming decades. Increased life expectancy at birth will increase the incidence of dementias (e.g., Alzheimer) and dependence (e.g., arthritis, Parkinson's). The response of society and the economy to this challenge implies a major reallocation of resources to the very labour-intensive health and social support sector. Demand for new medicines and therapeutics will increase. Portugal has some advantages in confronting this challenge. Highly competent medical and nursing staff, a relevant hospital sector, internationally benchmarked health science research (e.g. some 3,500 PhDs in research functions), relevant pharmaceutical and medical device companies, and emerging biotech companies. These starting conditions will help to meet the needs of an increasingly significant and vulnerable part of the population. Given that ageing is a global trend, the development of the different relevant sectors to meet this challenge may benefit from a very large market, which can create synergies with the tourism sector, leveraging the famous Florida model.

The following public policy proposals aim to exemplify dimensions of fragility in the conditions for the competitiveness of the Portuguese economy, the solution of which is feasible in the short or medium-term, through the implementation of appropriate incentives and the use of European funding, that will contribute to the transition to the *created in* paradigm.

Institutions and economic environment

1. Review the appointment procedures for regulatory bodies, ensure their autonomy in budgetary terms, as well as accountability mechanisms for the results achieved in improving competitive conditions in markets and in creating conditions for innovation.
2. Negotiate and create the conditions, in very close articulation with the scientific and technological system, so that, by 2030, all multinationals based in Portugal belonging to the group of the world's largest investors in R&D have established R&D&I centres in national territory.
3. Include representatives of the regions in the organisation and governance of the entities that manage European funds (*Compete*) and are relevant for attracting FDI (AICEP) within a timeframe that enables the effects to be produced in the Multiannual Financial Framework 2021-27.
4. Eliminate Portugal's tax disadvantage vis-à-vis its direct competitors when it comes to attracting FDI by reducing the corporate income tax rate to 21%.

Research, higher education and qualifications

1. Establish partnerships with companies and higher education institutions, introducing digital and programming skills from primary school, making the continuation of studies in secondary and higher education in STEM areas attractive.
2. Increase flexibility and create budgetary incentives so that higher education institutions open new courses in emerging areas and increase places in courses with higher demand.
3. Review the funding criteria for higher education by creating incentives to increase places in STEM areas.
4. Create scholarship systems for international students in higher education in order to enhance the attraction and retention of talent.
5. In areas relevant to addressing climate transitions and ageing, reinforce the budgets of research centres, associated and collaborative laboratories.
6. Establish programme contracts between MCTES and universities so that, by 2030, Portugal will have at least one university among the 100 best in the world, and 5 scientific areas among the 75 best in the world, in the Shanghai ranking.

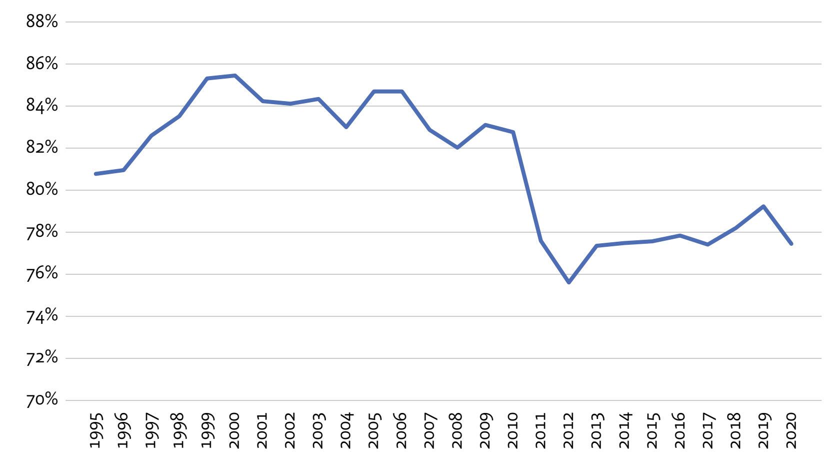
Infrastructures

1. Make port and airport customs services among the five most efficient in the World Bank's international logistics performance index by 2025.
2. Guarantee 5G coverage throughout the entire national territory by 2025.
3. Reduce rail travel times on the Setúbal-Lisbon-Oporto-Braga-Vigo route by 50% by 2030.
4. Reinforce metro and train lines in the Lisbon and Porto metropolitan areas and introduce tolls for cars entering these areas.

Chapter 1
The challenges of and need for a new paradigm

After four decades of high economic growth and convergence, in 2000, Portuguese GDP per capita reached its highest level as a percentage of EU-27: 85% (figure 1). Entry in the 21st century represented a shift in the regime of economic growth, ushering in a period of low economic growth and divergence with the EU-27. The first two decades of the 2000s were marked by four economic recessions (CDCEP, 2020). In 2012, Portuguese GDP per capita was 76% of GDP per capita of the EU-27 (78% in 2019). The major impact of the COVID-19 pandemic on GDP (-7.6% GDP, 2020), partly explained by the high importance of the tourism sector, interrupted the resumption of the convergence process in recent years, making recovery and economic growth in 2020-30 even more urgent.

Figure 1 **GDP per capita of Portugal as a percentage of GDP per capita of the EU-27 (PPS)**



Source: Pordata, Eurostat, European Commission.

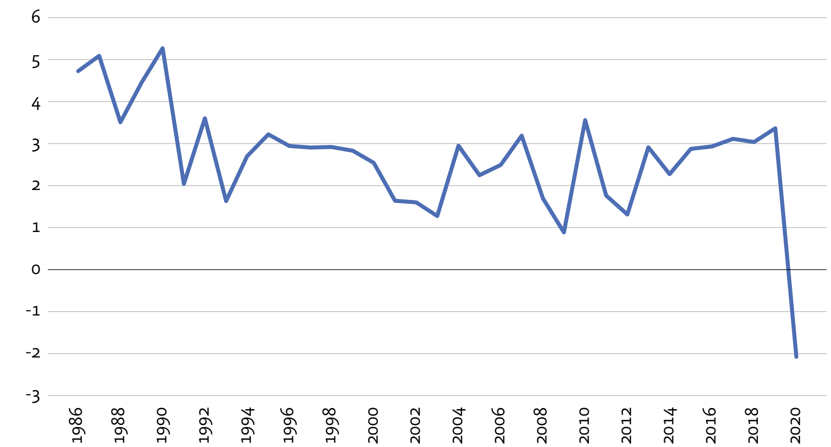
The long stagnation and interruption of the convergence process in the 21st century reflect the exhaustion of a development model (e.g., Alexandre *et al.*, 2019) and suggest that the Portuguese economy may have fallen into the 'middle-income country trap' (Jalles, Martins and Brinca, 2021, FFMS). The way out of this trap is only possible by giving knowledge, skills and innovation a central place in the wealth creation process (e.g., Aghion *et al.*, 2021).

The opening of the Portuguese economy to the outside world in the 1960s, with accession to EFTA, and in the 1980s, with accession to the European Economic Community (EEC), favoured the import of technologies and the replication of practices and models from developed countries, as well as access to the European markets.

Participation in the Economic and Monetary Union generated an intense inflow of credit. However, bank credit was concentrated in the non-tradable sectors (60% of the total credit in the period 2004-2012), reflecting, on the one hand, the existing incentives (e.g., Reis, 2013) and, on the other hand, inefficiencies of the banking system in the allocation of credit (e.g., Gopinath *et al.*, 2017). The growth of the non-tradable sectors was also driven by a set of policies created by a system of 'revolving doors' between governing authorities, former governing authorities, regulatory bodies and the financial system (e.g., Alexandre *et al.*, 2019).

The concentration of resources in non-tradable sectors — sectors protected from international competition and that are characterised by lower potential for productivity growth — was one of the causes of low productivity growth in recent decades (figure 2). In 2020, productivity in Portugal, in terms of productivity per hour of work, represented 60% of the productivity of Germany (Pordata).

Figure 2 **Total productivity of factors, rate of annual growth, Portugal (%)**

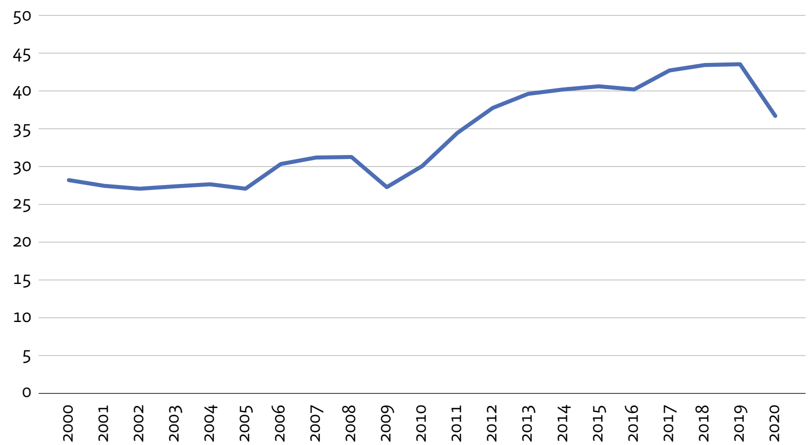


Source: AMECO.

In a period of strong growth in world trade, Portuguese exports performed poorly, losing market share. The accession of the People's Republic of China to the World Trade Organisation in 2001 and the competition from Eastern European countries were among the main causes of the poor performance of the Portuguese economy (e.g., Amador and Cabral, 2014).

In the first decade of the 2000s, the share of exports in GDP was around 30% (figure 3) and the balance of trade deficit varied between a maximum of 10.9% of GDP in 2000 and a minimum of 6.8% in 2009. External imbalances would come to be at the root of the 2011 sovereign debt crisis (e.g., Eichenbaum *et al.*, 2016) and continue to represent a high risk for the economy. The negative net international investment position peaked at 125% of GDP in 2013 (100% in 2019). Despite the growth in exports since 2010 and the increase in their share of GDP (44% in 2019), the share of exports in the net external debt was still very low, being the second lowest in the EU (Catão, Faria, Portela and Martins, FFMS, 2021).

Figure 3 **Share of exports in GDP (%)**



Source: Own computations with AMECO data.

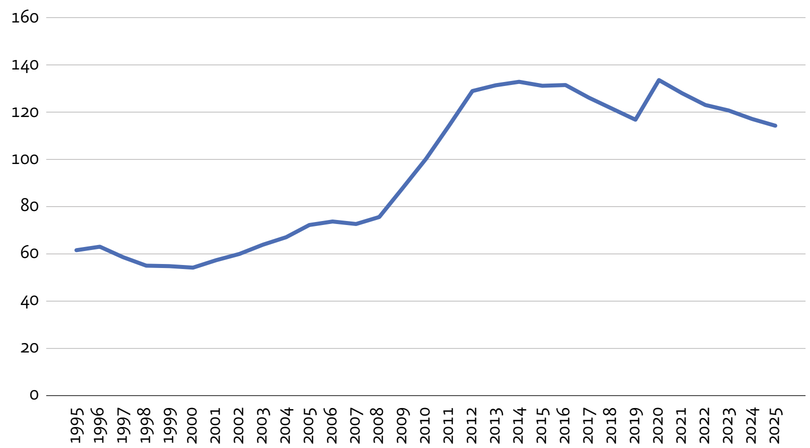
Joining the euro, in 1999, eliminated the possibility of using the exchange rate as an instrument to regain competitiveness. However, in the new context of globalization, resorting to currency devaluation would only contribute to preserving an economy with low wages and low qualifications. Resuming the process of convergence and catching up with the income levels of the more developed EU-27 countries requires a new development model. In this new paradigm, the competitiveness of Portuguese companies has to be based on innovation, highly qualified work, and exports have to incorporate higher added value (e.g., Aghion *et al.*, 2021).

The fact that economic growth is an imperfect measure of well-being (e.g., Coyle, 2014), does not allow us to devalue the negative effects of low growth and the economic divergence in relation to the EU-27.

First of all, the relative impoverishment of Portugal, in the context of a large economic area with freedom of circulation of people, can speed up emigration flows, in particular of better educated young people, weakening the country's growth potential and thus creating a vicious circle of lowered expectations for improved living conditions, more emigration and lower growth potential.

Secondly, high public debt, which in 2020 reached a new all-time high of 133.6% of GDP (figure 4), as a result of the COVID-19 pandemic. Budgetary consolidation and economic growth allowed a reduction in the weight of public debt in GDP from 132.9% in 2014 to 116.8% in 2019. The forecasts included in the Stability Programme indicate that in 2025 public debt will correspond to 114.3% of GDP. Besides the burden it represents for future generations, high public debt is a risk factor for the Portuguese economy, namely in the context of an increase in interest rates. Given the high tax burden already imposed on families and companies, tax increases do not seem a viable solution to reduce public debt, which weight should be reduced by increasing GDP (Jalles, Brinca and Martins, FFMS, 2021).

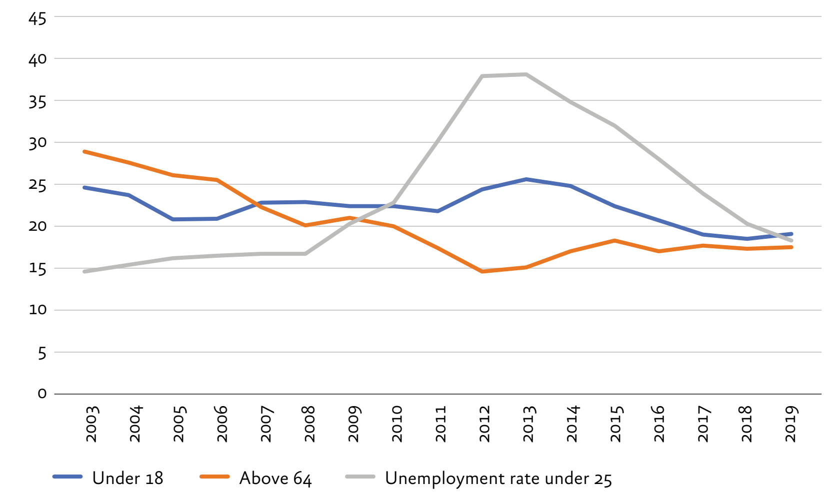
Figure 4 Public debt as a percentage of GDP, Portugal



Source: INE and Stability Programme 2021-2025 (Portuguese Government)

Despite the progress registered in recent decades in terms of social policies, Portugal still has very high levels of child and youth poverty, as well as among the elderly (figure 5) — see, for example, Diogo (2021). The tragic forest fires of 2017 and the COVID-19 pandemic showed the highly vulnerable conditions in which many households live and revealed the persistence of inequalities in Portuguese society. On the other hand, the low birth rates co-exist with very high youth unemployment rates.

Figure 5 Poverty in the population under 18 and over 64 years of age and unemployment rate of under 25s



Source: Pordata, INE

The coexistence of poverty and youth unemployment with low social mobility (e.g., D'Uva and Fernandes, 2017) makes economic growth a necessary condition for a significant part of the population to escape the low income trap.

In short:

- the long stagnation and interruption of the convergence process in the 21st century reflect the exhaustion of a development model and suggest that the Portuguese economy may have fallen into the 'middle-income country trap';
- escaping from that trap requires a transition from the *made in* paradigm to the *created in* paradigm, based on knowledge and

qualifications and where innovation occupies a central place in the wealth creation process;

- despite the significant increase of the share of exports and balance of the current account since 2013, external imbalances continue to represent a high risk for the economy;
- public debt represents a burden for future generations and constitutes a risk factor for the Portuguese economy. Given the high tax burden already imposed on households and companies, the weight of the debt has to be lessened through an increase in GDP;
- the relative impoverishment in relation to the EU-27 can speed up emigration flows, in particular of better educated young people, weakening the growth potential of the country and thus creating a vicious circle of lowered expectations of improved living conditions, and more emigration;
- the coexistence of poverty and youth unemployment with low social mobility makes economic growth a necessary condition for a significant part of the population to escape the low income trap;
- stronger economic growth requires a new paradigm.

Chapter 2
Headwinds and tailwinds

In defining the strategy to meet the challenges and achieve the objectives for the Portuguese economy, the political decision-makers, the public heads of education and research institutions, regulators or business leaders have to assess the forces for and against their realisation. In this section, two headwinds are identified: high indebtedness and population ageing. Just as in the Discoveries of the 15th century the Portuguese adopted the Latin sail to cope with headwinds, in the next decade new strategies and technologies will be necessary. Also, taking advantage of favourable winds requires a sense of orientation and strategy. Four tail winds are identified: improvement of qualifications; the new energy paradigm; extension of the continental shelf; and a large wave of European funding.

2.1. Headwind #1: indebtedness

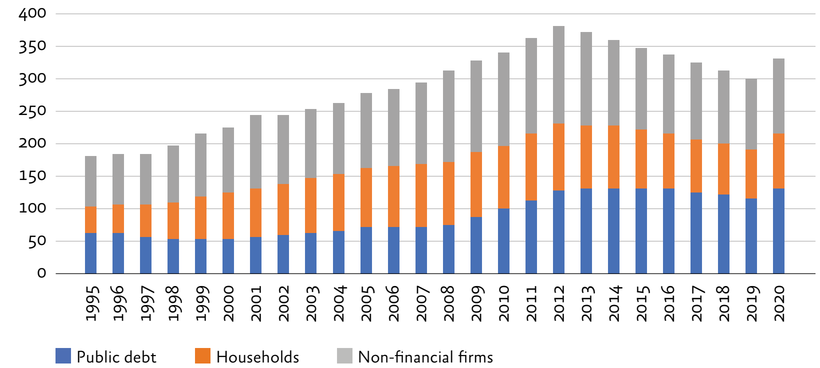
The recessions of 2008: Q1 — 2009: Q1 and 2010: Q3 — 2013: Q1 (CDCEP, 2020) were crises of excessive public and private, domestic and external debt (Alexandre *et al.*, 2017a). The total debt of the state, non-financial corporations and individuals declined from a peak of around 380% of GDP in 2012 to around 300% in 2019 (figure 6).

High public indebtedness limits the possibilities of using counter-cyclical budgetary policies and exposes the state to the risk of interest rate shocks, which may jeopardise the economy's financing capacity. The COVID-19 pandemic caused an increase in public indebtedness and deteriorated the financial condition of companies in the sectors most affected by the crisis (Bank of Portugal, 2021, p. 11). The European Central Bank warns of the risk of an increasing incidence of zombie companies and the importance of well-functioning insolvency mechanisms (European Central Bank, 2021).

Corporate debt limits corporate investment capacity and, thus, corporate restructuring, innovation and growth (e.g., Alexandre *et al.*, 2017b). A fragile financial condition can limit the ability to invest in a capital-intensive context, such as the climate and digital transition. In 2020, the Portuguese economy's capital stock per capita corresponded to only about 50% of that of the Euro Area, which contributes towards low labour productivity and low wages.

The shift to a paradigm based on knowledge, qualifications and innovation requires investment in physical and intangible assets, posing challenges to the forms and sources of funding for business.

Figure 6 **Public indebtedness, of non-financial firms and households (% GDP)**



Source: AMECO and Bank of Portugal.

2.2. Headwind #2: population ageing

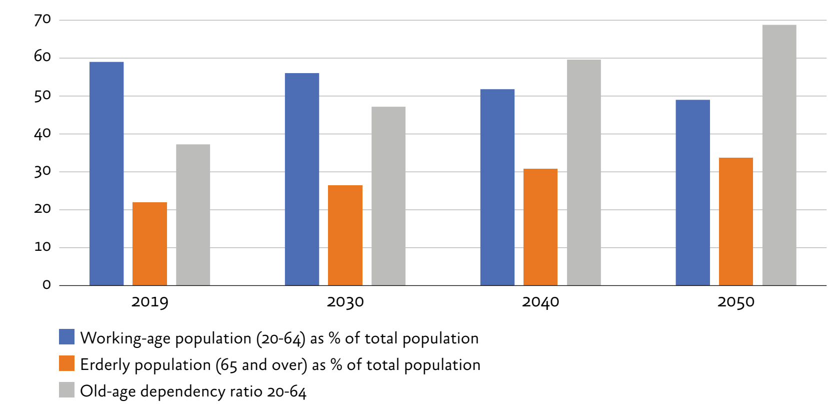
The results of the 2021 confirmed the very negative demographic dynamics of the Portuguese population in the last decade. Since 2010, the population has reduced as a result of natural balances (negative since 2009) and negative migration balances. Between 2010 and 2019, the population reduced by around 27 thousand people annually (Pordata, INE). The reversal of the migration flows in recent years was reflected in positive balances since 2017, reaching 44.5 thousand in 2019 (Pordata, INE), and population growth for the first time since 2009.

Although ageing is a global trend with a higher incidence in the northern hemisphere (e.g., Goodhart and Pradhan, 2020), the ageing of the Portuguese population is among the fastest in the EU-27. According to the forecasts of the European Commission's Ageing Report (2021), Portugal, Italy, Finland and Greece form the group of countries of the EU-27 with the worst demographic dynamics.

According to the forecasts of the Ageing Report, the Portuguese population should reduce from 10.3 million in 2019 to 8.5 million in 2070.

It is expected that between 2019 and 2050 the working population will decrease from 4.9 million to 3.9 million, or rather, by more than 20%. The working-age population, as a percentage of the total population, will decrease from 59% to 49%. The elderly population, as a percentage of the total population, will increase from 22% to 34%. In this period, the old-age dependency ratio (≥ 65 years over 20-64 years) should increase from 37% to 69% (figure 7). In 2019, Portugal was in 4th position among the countries of the EU-27 in the old-age dependency ratio. However, according to the forecasts of the Ageing Report, in 2050, Portugal should lead this classification.

Figure 7 **Dependency ratios (%)**



Source: Ageing Report, European Commission, 2020.

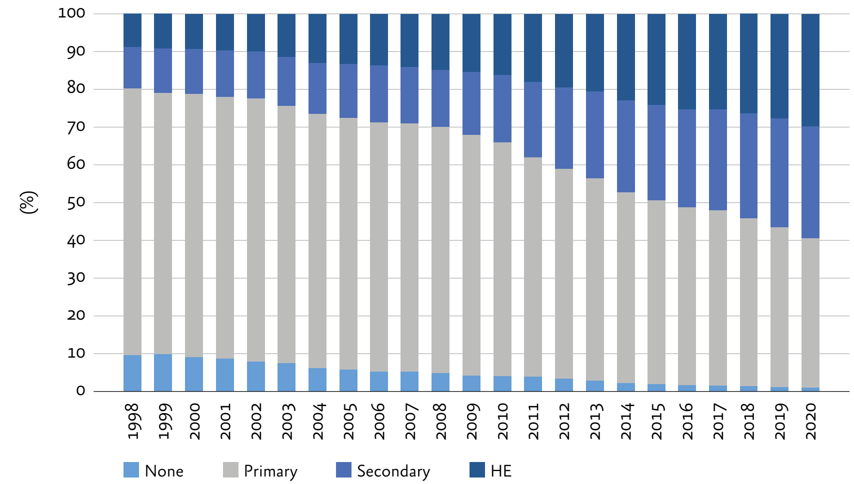
An ageing population poses challenges for the sustainability of the Social Security and Health system. The care required by the older population is very labour intensive, which will lead to an increasingly significant allocation of resources to the social support and health sectors.

A decrease in the working-age population reduces the potential for economic growth, which may be partially offset by the increase in the employment rate and by the increase in the qualifications and reskilling of workers, and by the use of automation. However, all these changes require a set of transformations and reforms that may be more difficult to achieve with an ageing population.

2.3. Tailwind #1: improvement of education levels

The massive investment in education in recent decades and the results achieved in terms of schooling stand out as one of the more positive aspects of the evolution of Portuguese society (figure 8). Workers with basic education or below represented around 80% of the workforce in 2000 and around 40% in 2020. On the other hand, workers with a higher education diploma represented 9% in 2000 and 30% in 2020. Also, the percentage of workers involved in lifelong learning activities increased from 31% in 2007 to 50% in 2016 — see Varejão, Cerejeira, Portela and Vasconcelos (2021, FFMS).

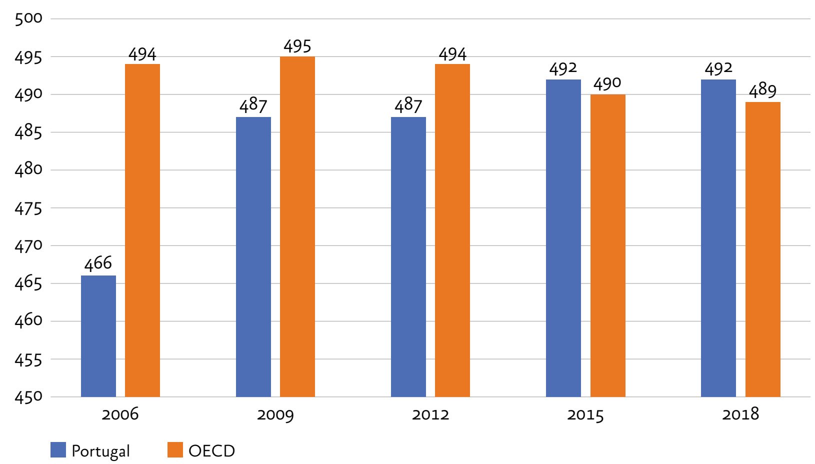
Figure 8 **Education levels of the workforce, Portugal**



Source: Pordata, INE, from Varejão *et al.* (2021, FFMS)

The results of the investment in education are also visible in terms of the quality of education, which can be assessed by the evolution of the results in international evaluations like PISA — Programme for International Student Assessment, which since 2015 have been above the OECD average in the three dimensions assessed (figure 9).

Figure 9 PISA: literacy in mathematics



Source: OECD

The return on investment in education in Portugal remains among the highest in the OECD (OECD, 2020). Cardoso *et al*. (2018) estimate a return of 8.2% for each additional year of study. However, it should be mentioned that a high percentage of young people who concluded higher education is not employed or is employed in occupations that do not require a degree (FJN, 2021). These results indicate that there is a skills mismatch between supply and demand.

The data in table 1, presented in Alexandre *et al*. (2021), show a profound structural change in the schooling of Portuguese workers in the period 2006-2018, with a major reduction in all the sectors of activity of the percentage of workers with only basic education and a very significant increase in the percentage of workers with higher education. Although this structural change is not yet reflected in aggregate productivity growth, and is one of the paradoxes of the Portuguese economy in the last decade, it represents an enormous potential development. Alexandre *et al*. (2021) show that the reduced impact of the increase in schooling on aggregate productivity is due to the fact that the new better qualified workers are concentrated in sectors that still have a low share in the structure of the economy.

Table 1 Structural change in the education of workers, sectors of economic activity, 2006 and 2018 (% of the total)

	Basic education		College degree	
Sector	**2006**	**2019**	**2006**	**2019**
Food, bev., tob.	81.5	63.4	5.6	10.9
Textiles, dressing, leather	90.4	75.4	2.3	5.2
Wood, cork, paper, no furniture	72.1	53.5	10.2	19.3
Manuf. of non-metallic products	74.2	54.2	9.3	16.5
Manufacture of metals products	75.8	53.2	7.4	14.6
Manuf. of furniture, and manuf.	86.6	69.7	3.1	8.5
Elect., gas and water supply	53.5	34.2	22	34.1
Construction	82.1	71.7	6.4	9.6
Wholesale & ret. trade; Rep. veic., motorc.	64	44.2	8.5	16.1
Hotels and restaurants	79.2	57.4	2.9	7.3
Transport, storage, and comm.	68	51.1	8.5	14
Post and telecomm.	38.6	25.8	25.6	31.3
Real est., rent. & business act.	52.1	33.3	18.8	34.3
Education	31.9	18.9	45.9	54.7
Health and social work	42.8	26.1	31	41
Other community, soc. & pers. serv. act.	62.2	42.1	12.8	24.1

Source: Alexandre, Bação, Cima, Costa, Portela and Simões (2021)

Autor *et al.* (2003), in their seminal analysis of the effects of automation on skill demand, recall that in technological revolutions it is common to exaggerate the effects of replacing technology and underestimate the effects of complementarity between technology and work. David Autor, Frank Levy and Richard Murnane, in order to assess the effects of automation and robotisation on the labour market, divided the tasks into 'routine' and 'non-routine'. For routine tasks it would be possible to define rules and automate them. However, rapid advances in Artificial Intelligence (AI) made a highly complex distinction between routine and 'non-routine'. The new generation of AI, with machine learning, allows machines to learn for themselves, from rules defined by themselves. So, many of the tasks defined as 'non-routine' by David Autor and his co-authors in 2003 were, meanwhile, automated.

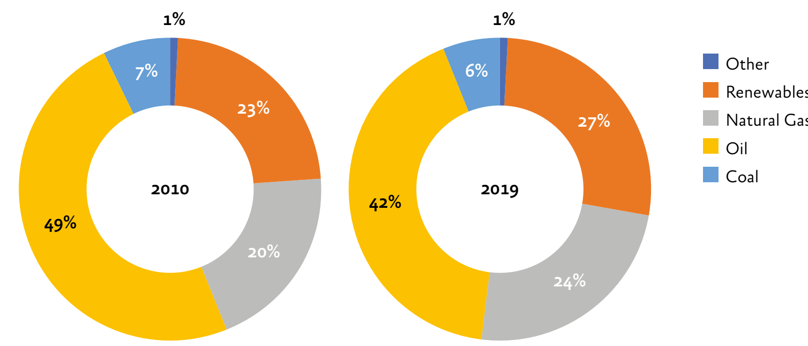
Biagi and Sebastian (2020) place Portugal in the group of countries with the highest 'routine task intensity index'. This condition, on the one hand, represents a vulnerability of the workforce to digitalisation, automation and robotisation and places high demands on the qualification and reskilling of workers (e.g., Varejão, Cerejeira, Portela and Vasconcelos, 2021, FFMS). Rapid technological evolution poses enormous challenges for education systems: what education? which strategies? what can be taught? (e.g., Susskind, 2021).

On the other hand, a high rate of routine tasks represents strong potential for productivity gains via the digitalisation, automation and robotisation of tasks, which may make it possible to offset the negative impacts of the dynamics of demography in Portugal.

2.4. Tailwind #2: a new energy paradigm

In the age of fossil fuels, Portugal is one of the most energy-dependent countries, making its economy very vulnerable to oil shocks. Oil had a high negative impact on the balance of trade and was associated with balance of payments imbalances. Despite the reduction of 83.3% in 2008 to 76% in 2018, Portugal was still 'the 7^{th} most energy-dependent country of the EU-28, around 20 p.p. above the average of the EU-28.' DGEG (2020, pp. 45). The portion of renewable energies in primary energy increased from 23% in 2010 to 27% in 2019 (figure 10).

Figure 10 **Primary consumption of energy**



Source: Directorate-General for Geology and Energy

The shift to solar, wind and hydro energies, where Portugal has abundant natural resources, may be a favourable factor for the Portuguese economy, contributing towards the end of energy dependence since the first Industrial Revolution.

To benefit from this change in energy paradigm, Portugal needs to have benchmark research and innovation in renewable energies and to become relevant in the development and production of technologies in these areas and in related areas such as batteries.

2.5. Tailwind #3: extension of the continental shelf

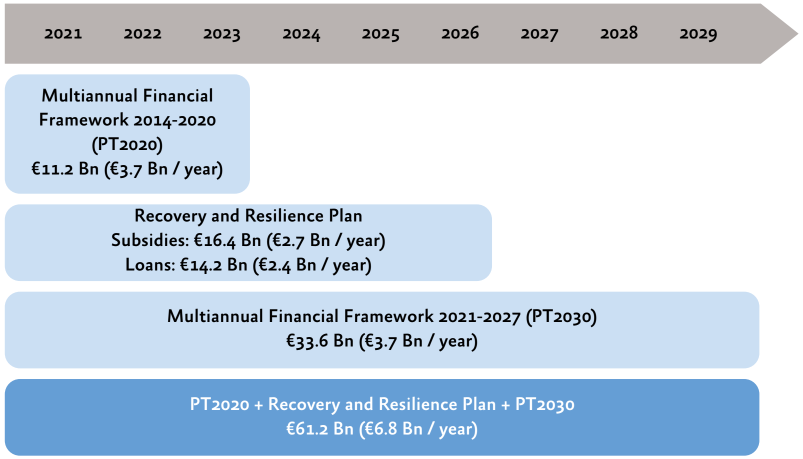
The proposal to extend the continental shelf, submitted to the United Nations, aims to expand the maritime territory under national jurisdiction to almost 41,000,000 km2, or rather, around 40 times the land area of Portugal, 1% of the surface of the Earth's water, 4% of the Atlantic ocean or the size of the territory of the European Union (Cunha-e-Sá, Dietrich, Marchioro, Rosa, Santos and Vieira da Silva, 2021, FFMS). In this context, seabed mining has raised much discussion, partly because of the resources that will be available in the case of the extension of the continental shelf, many of which of great value for achieving the objectives set for the decarbonisation of economies. However, their exploitation will have to guarantee the preservation of natural capital.

2.6. Tailwind #4: new wave of European funding

In this decade, Portugal will benefit from various European funding programmes: conclusion of the Multiannual Financial Framework 2014-2020 (PT2020), the Recovery and Resilience Programme, and the new Multiannual Financial Framework for 2021-2027.

The average annual amounts of European funding in the period 2021-2027 will exceed 3% of GDP. This inflow of enormous amounts of funds from the European Union, which will only have parallels with the exploitation of gold from Brazil in the first half of the 18th century, may be an important engine of support for the Portuguese economy.

Figure 11 **European funding 2021-2029**



Source: Recovery and Resilience Programme, Portuguese Government (February 2021)

The application of this new, and probably unrepeatable in the near future, wave of funds has as its starting point the *Strategic vision for Portugal's Economic Recovery Plan 2020-2030* prepared by António Costa Silva (Silva, 2021).

In order for these funds to contribute to a structural change in the Portuguese economy, they must result in a marked increase in the exports of goods and services with high added value. For 2030, the Portuguese Government has set a target of 3% of GDP for R&D investment and 60% for the ratio of exports to GDP.

The success of the application of European funding to support business investment should be assessed based on its impact on exports and on productivity. In an analysis of the impact of European funding to support business investment, Alexandre (2021) concluded that the funds have contributed to productivity growth at municipal level and to convergence between municipalities. However, that analysis also concludes that a significant part of the funds, particularly those that are intended for micro companies, do not have relevant effects on their performance. This analysis suggests that the design of the programmes for accessing funds in the next Multiannual Financial Framework should be revised.

The wave of funds that will reach the Portuguese economy in the coming decades will, due to its size, produce relevant economic effects, making a significant contribution to economic growth in the coming years. However, so that the funds can attain the objective of structurally transforming the Portuguese economy it is essential that their implementation is accompanied by institutional reforms.

In short:

- in the coming decades two headwinds stand out: high indebtedness and population ageing;
- high public indebtedness limits the possibilities of using counter-cyclical budgetary policies and exposes the state to the risk of interest rate shocks, which may jeopardise the economy's financing capacity;
- corporate debt limits corporate investment capacity and, thus, corporate restructuring, innovation and growth;
- the shift to a paradigm based on knowledge, qualifications and innovation requires investment in physical and intangible assets, posing challenges for the forms and sources of funding for business;
- the ageing of the Portuguese population is among the fastest in the EU-27. According to the forecasts of the Ageing Report, in 2050, Portugal should lead in the old-age dependency ratio;
- an ageing population poses challenges for the sustainability of the Social Security and Health system;
- the reduction in the working-age population reduces economic growth potential;
- four tailwinds are identified: improvement of qualifications; the new energy paradigm; extension of the continental shelf; and a large wave of European funding;
- the massive investment in education in recent decades has resulted in a profound structural change in the education of Portuguese workers;
- the results of investment in education are also visible in terms of the quality of education;
- the return on the investment in education in Portugal remains among the highest in the OECD, although there is still a mismatch between the supply and demand for qualifications;
- Portugal belongs to the group of countries with the highest 'routine task intensity index';
- this condition places high demands on the qualification and reskilling of workers. On the other hand, a high rate of routine tasks represents strong potential for productivity gains via digitalisation, automation and robotisation of tasks;
- Portugal is one of the most energy-dependent countries, making its economy very vulnerable to oil shocks;

- the shift to solar, wind and hydro energies, where Portugal has abundant natural resources, may be a favourable factor for the Portuguese economy, contributing towards the end of energy dependence since the first Industrial Revolution;
- the proposal to extend the continental shelf, submitted to the United Nations, aims to expand the maritime territory under national jurisdiction to around 40 times the land area of Portugal. The exploitation of offshore energy and seabed mining are of great value for achieving the objectives set for the decarbonisation of economies;
- in this decade, Portugal will benefit from various European funding programmes, with average annual amounts in excess of 3% of GDP.
- this new wave of funds, due to its size, will produce relevant economic effects, making a significant contribution to economic growth in the coming years;
- in order for European funding to attain the objective of structurally transforming the Portuguese economy, increasing its growth potential, it is essential that their implementation is accompanied by institutional reforms.

Chapter 3
The world is not flat: infrastructures, technology and talent

Geography is not destination. Up to the start of the 15th century Portugal was *finisterra* (the end of the world). In the 15th and 16th centuries, Portuguese and Spanish explorers ushered in the Age of the Ocean (Sachs, 2020), which placed the Atlantic ocean at the centre of the globe until the 20th century.

A country's place in the world economy depends on its available technology, infrastructures, institutions and resources. All these factors influence a country's economic specialisation (e.g., Sachs, 2020). Baldwin (2016) elects three distance-related costs: the cost of moving merchandise, the cost of moving ideas and the cost of moving people. Globalization, in its different forms, resulted from the reduction of these three costs. The Information and Communication Technologies (ITC) revolution in the 1990s sped up globalization by reducing the costs of remotely coordinating complex activities, resulting in the revolution of global value chains (Baldwin, 2016).

3.1. Portugal's port, airport and digital connections to the world

Cruz and Januário (2021, FFMS) analyse physical and digital connectivity to the main hubs of the world economy. Given Portugal's geographical position, maritime and air transport connectivity plays a central role.

Cruz and Januário (2021, FFMS) highlight Portugal's place at the crossroads of the main international sea lanes: South America — Europe; Mediterranean routes; North America — Mediterranean. The analysis of those authors shows that the ports of Leixões and Lisbon occupy the 24th and 36th places among the most important in the world. After an adjustment to consider GDP, Leixões and Lisbon rise to the 7th and 10th positions worldwide, and 2nd and 3rd positions in Europe, respectively. Also worthy of note is the fact that the port of Sines was the one that that grew most in Europe (291.5%) between 2011 and 2018. In relation to the size of the country's economy, Portugal has significant port connectivity.

Cruz and Januário (2021, FFMS) also highlight the central role that air transport plays in a geographically peripheral country like Portugal. Those authors, using data from 2019 provided by the International Air Transport Association, conclude that Portugal is the 6th country in terms of connection among EU countries.

Cruz and Januário (2021, FFMS) present the World Bank's Logistics Performance Index (table 2). The authors mention the general improvement in the index, from 28th place to 23rd, between 2007 and 2019. However, they highlight two criteria in which Portugal systematically underperforms: customs services and infrastructures.

Table 2 International Logistics Performance Index

Country	LPI Rank	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
Germany [EU]	1	1	1	4	1	2	3
Sweden [EU]	2	2	3	2	10	17	7
Belgium [EU]	3	14	14	1	2	9	1
Austria [EU]	4	12	5	3	6	7	12
Japan	5	3	2	14	4	10	10
Netherlands [EU]	6	5	4	11	5	11	11
United Kingdom	9	11	8	13	7	4	5
Finland [EU]	10	8	11	16	15	1	8
United States	14	10	7	23	16	6	19
New Zealand	15	13	13	27	8	16	9
France [EU]	16	19	12	17	17	12	14
Spain [EU]	17	17	19	6	18	19	20
Italy [EU]	19	23	18	21	24	18	17
Norway	21	21	24	26	23	14	24
Czech Republic [EU]	22	30	26	10	20	24	16
Portugal	23	35	32	7	22	23	18

Source: World Bank LPI database.

Cruz and Januário (2021, FFMS): 'Despite the increase in capacity and operational efficiency of the loading and unloading of cargo, there is an administrative bottleneck in the customs services. This bottleneck was fully documented, discussed by the stakeholders and recognised by the Port Authority in its Strategic Master Plan (Portuguese Catholic University and Sines Port Authority, 2020). However, the problems remain and affect all the main ports.'

Cruz and Januário (2021, FFMS) also analyse the country's digital connectivity, underlining that despite the efforts in recent years to increase national coverage, there is still room for improvement.

Based on data from ANACOM, the authors report that the coverage of NGA networks was, in 35.32% of the total number of parishes, less than 1% of the territory, and the global coverage of the Portuguese territory (83%) is slightly below the average of the EU-28 (85.8%).

Cruz and Januário (2021, FFMS): 'Despite having been one of the pioneers in the adoption of the NGA network in the early 2010s, the growth rate stagnated after 2013, leaving Portugal below the European average. Since 2016, the country has made an effort to converge with its European counterparts.' The authors also highlight the fact that Portugal has average fixed broadband connection prices that are 12.7% and 23.6% higher than the EU average for mobile broadband, which has a negative impact on the competitiveness of the Portuguese economy.

Lastly, Cruz and Januário (2021, FFMS) highlight the relevance of institutional quality — planning and evaluation capacity, the predictability of infrastructure management policies or the ability to implement efficient management — for the infrastructures' impact on the development of the regions and countries.

3.2. Global value chains

Global value chains (GVC) participate directly or indirectly in more than 50% of world trade (Cadestin *et al.*, 2018). The growth of companies and the economic growth of the country require greater integration in GVC, which are the most efficient vehicle for exporting goods and services.

Considering the increasing and diverse risks of disruption in global value chains (for example, natural disasters, cyberattacks), the McKinsey Global Institute estimates that, in the next five years, up to 26% of the global exports of goods may be relocated to other countries. The trade tensions between China and the USA, aggravated by the COVID-19 pandemic, raised discussions on the relocation of the GVC. Reducing dependency on products, services and technologies and regaining or strengthening technological and industrial sovereignty is set out in several EU strategic documents (e.g., European Commission, 2020).

Agglomeration economies, taking advantage of a high concentration of talent, research and innovation centres, efficient infrastructures and access to financial markets, have made location more relevant. The production of goods and services of the GVC has been concentrated in regional terms, looking for locations where research centres and a highly skilled workforce are concentrated (e.g., MGI, 2020; Diamandis and Kotler, 2020). In particular, the new R&D centres promoted by multinational companies are located in regions with large concentrations of human capital specialised in the IT area. Branstetter *et al.* (2021) highlight the benefits of the combination of the existing talent in less developed countries with the innovation capacity of multinationals as a way to promote productivity growth.

In the last two decades, multinational companies have expanded the geographic distribution of their R&D activities (Foley, Hines and Wessel, 2021). The relocation of the R&D activities of multinationals focuses on regional hubs that concentrate a critical mass of highly qualified scientists and engineers (Branstetter, Glennon and Jensen, 2021). This change in the factors that determine the relocation of R&D activities creates new opportunities to integrate the GVC and to move upstream in the value chain.

Portugal has accompanied this new paradigm of location of the activities of multinationals — see, for example, partnership between Bosch Car Multimedia and University of Minho (Braga) and between BMW and Critical Software (Porto). The results of the partnership between Bosch Car Multimedia and University of Minho seem to confirm the forecasts of Branstetter *et al.* (2021) in relation to their benefits — see section 5.

3.3. Portugal needs 'star' regions

The world population is becoming increasingly concentrated in urban regions, a trend that will increase in the coming decades: in 2015, 48% of the world population lived in urban regions; in 2050, that percentage should increase to 55% (OECD/European Commission, 2020).

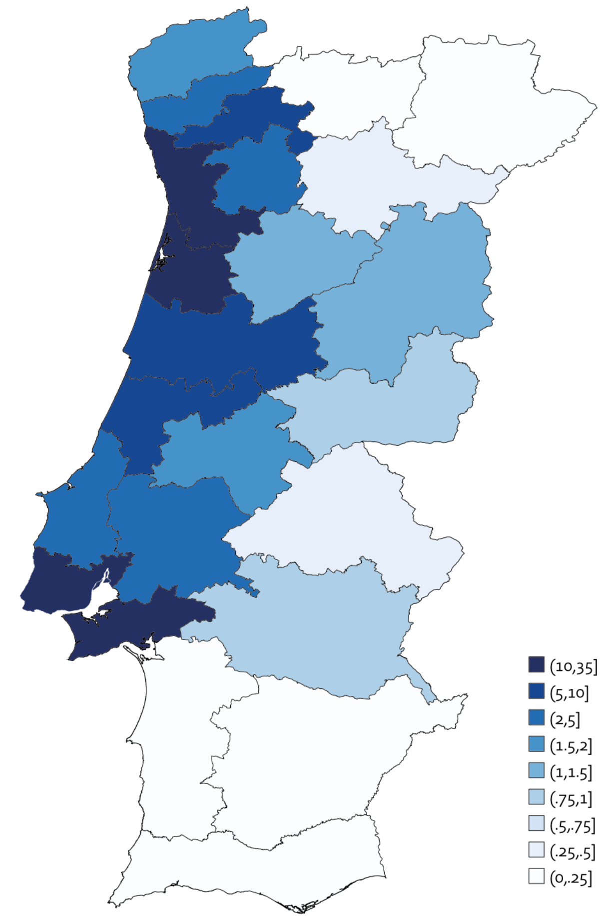
The importance of agglomeration economies has magnified asymmetries between a narrow set of regions — 'superstar' regions (e.g., MGI, 2018) — and the rest of the world. According to the criteria defined by the McKinsey Global Institute, 50 'superstar' cities represent 8% of the population and 21% of world GDP (MGI, 2018). 'Superstar' regions have very high levels of digitalisation, skilled labour and innovation; strong connection with the global flows of trade, services and capital; and a major concentration of intangible assets (MGI, 2018). Diamandis and Kotler (2020) highlight the fact that two thirds of economic growth happens in urban environments and also the role of the 'pollination of ideas' that takes place there. Aghion et al. (2021) highlight the virtuous circle resulting from children who grow up in more innovative regions being more likely to actively participate in innovation processes in the future.

One of Portugal's challenges in the next decade is to affirm some of its regions as 'star' regions.

Using the classification of the National Statistics Institute (INE, 2014), in 2014, in Portugal, predominantly urban municipalities represented 88.7% of total employment and 91.4% of the added value of non-financial firms, respectively.

Classifying innovative companies as those that spend 1% of total sales on R&D investment or that have at least one worker dedicated to R&D activities during two consecutive years, in 2018, 1,209 companies are identified, corresponding to 6% of total employment, 11% of added value and 23% of exports. This group of innovative companies is concentred in the NUTs III regions of Ave, Porto, Aveiro, Coimbra, Leiria and Lisbon — figure 16. These regions concentrate around 90% of research facilities classified as *excellent* by the Foundation for Science and Technology and around 80% of patents. Furthermore, those regions are adequately equipped with port, airport and road infrastructures, albeit with a deficit of rail infrastructures (Cruz and Januário, 2021, FFMS).

Figure 12 **Regional distribution of innovative companies in industry, 2018**



Source: Own computations with SCIE database

In 2020, the European Innovation Scoreboard of the European Commission classified Portugal as a 'highly innovative' country, including three regions in this category: Lisbon Metropolitan Area, Centre and

North. These three regions concentrate more than 80% of the country's population. The 2021 update, however, once again ranked Portugal as a 'moderately innovative' country, dropping seven places.

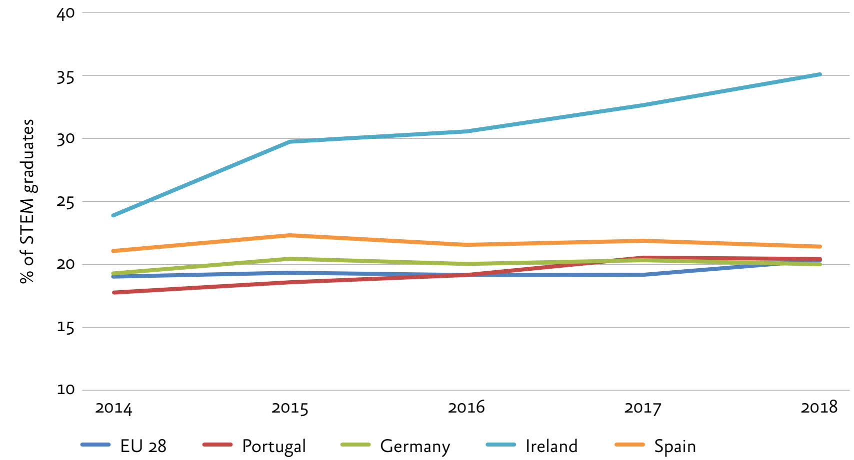
Another positive indicator of the evolution towards an economy with more innovation capacity is the increase registered in recent years in the share of medium-high and high-tech manufacturing exports from 37% in 2014 to 43% in 2019.

3.4. STEM graduates — Science, Technology, Engineering and Mathematics

The need for human capital in STEM (Science, Technology, Engineering and Mathematics) areas is the subject of study in the main economic areas of the globe, in Asia, the United States and Europe. In attracting FDI, the availability of human capital in STEM areas is a highly relevant factor. Skills in STEM areas are also essential for innovation processes (e.g., UK, 2021).

Sequeira, Ferrão and Montelius (2021, FFMS) analyse the evolution of the number of graduates in STEM (Science, Technology, Engineering and Mathematics) areas and conclude that the percentage of graduates in those areas is in line with the EU average and the average of countries like Germany, and slightly below that of Spain (figure 13). However, Ireland, a success story in attracting FDI (e.g., OECD, 2020), has a much higher share of graduates in STEM fields than the EU average, having increased from 24% in 2014 to 35% in 2018.

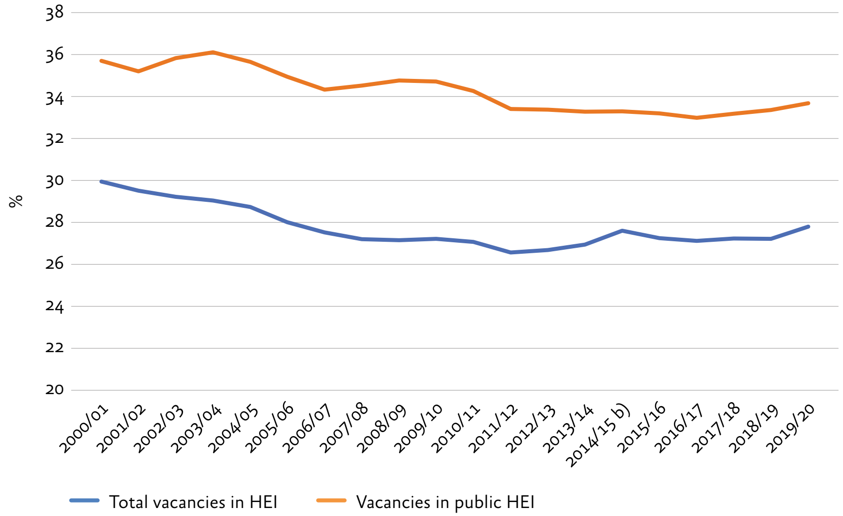
Figure 13 Percentage of graduates (ISCED 5-8) in STEM areas



Source: Eurostat

Analysis of the evolution of places offered by public higher education shows that they have remained relatively stable at around 35% of the total (figure 14). In 2018/2019, 22,707 degrees were awarded in the CTEM areas.

Figure 14 Vacancies and graduates in STEM (% total)



Source: DGEEC

The stability in the supply of places in STEM areas by higher education institutions reflects the rigidity of supply, largely determined by the existing teaching staff in the different scientific areas. The Portuguese government has introduced a degree of flexibility in recent years so that universities can increase places on courses with higher demand and in the areas of digital skills. However, the response of institutions has fallen short of the potential, with the justification of lack of capacity, or rather, of resources, to increase places (see for example, news in the Público newspaper on places in 2021: link).

3.5. Funding and position of Portuguese universities in international rankings

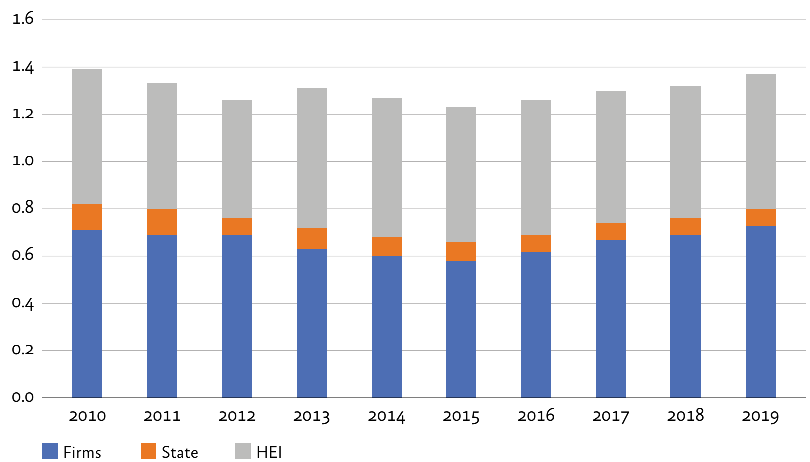
A necessary condition for the affirmation of the Portuguese economy as an innovative economy, which bases its competitiveness on highly skilled labour, is the existence of benchmark institutions of the scientific and technological system, that are among the best in Europe and the world (Sequeira, Ferrão and Montelius, 2021, FFMS). However, despite the progress made in recent decades, Portuguese universities continue to occupy low-ranking positions in the main international rankings. For example, in 2020, in the Academic Ranking of World Universities (Shanghai ranking) the best position of a Portuguese university was achieved by the University of Lisbon, the biggest Portuguese university, which was positioned in the 151–200 range. However, it should be noted that in diverse scientific areas, various Portuguese universities were positioned among the 100 best and 150 best.

The legal framework and the system of incentives, among other factors, condition the performance of higher education institutions (e.g., Aghion *et al.*, 2010). However, the low level of funding (and budgetary autonomy) of Portuguese universities cannot be ignored. Aghion *et al.* (2021) highlight the strong correlation between the position of universities in the Shanghai ranking and expenditure per student. As Sequeira *et al.* (2021, FFMS) point out, financing continues to be regulated by an outdated law (Law No. 37/2003) that is not enforced, and a fraction of financing is determined by historic data that distort incentives for the efficiency of institutions and their growth.

The international comparison of the financing of Portuguese universities with other international institutions of reference makes their low level of financing evident. For example, the public financing of Imperial College (United Kingdom) is close to the total funding of the Portuguese public higher education system and the funding per student of the Instituto Superior Técnico is around 16 to 30 times less than the funding per student of MIT or Cambridge (Sequeira *et al.*, 2021, FFMS).

On the other hand, in 2019, R&D investment was 1.4% of GDP (2.2% EU-27), the same value as 2010. Companies contributed with 0.73% of GDP and higher education institutions with 0.57% of GDP (a value that remained fairly constant in the last decade).

Figure 15 **R&D investment**



Source: Pordata, DGEEC, INE

In short:

- the place of countries in the world economy and their specialisation depends on the available technology, infrastructures, institutions and resources;
- given Portugal's geographical position, maritime and air transport connectivity plays a central role;
- in relation to the size of the country's economy, Portugal has significant port connectivity;
- in terms of air transport, Portugal is the 6th country in terms of connection between the countries of the EU;
- in the World Bank's international logistics performance index, Portugal's performance is systematically lower in customs services and infrastructures;
- despite the efforts in recent years to increase national coverage, there is still room for improvement in the country's digital connectivity;
- planning and evaluation capacity, the predictability of infrastructure management policies or the ability to implement efficient management is essential for the impact of infrastructures in the development of both regions and countries;
- the growth of companies and the economic growth of the country require greater integration in GVC, which are the most efficient vehicle for exporting goods and services;
- the production of goods and services of the GVC has been concentrated in regional terms, looking for locations where research centres and a highly skilled workforce are concentrated;

- the importance of agglomeration economies has magnified asymmetries between a narrow set of regions — 'superstar' regions — and the rest of the world;
- one of Portugal's challenges in the next decade is to affirm some of its regions as 'star' regions;
- in attracting FDI, the availability of human capital in STEM areas is a highly relevant factor. The number of graduates in STEM areas is in line with the EU average. However, the number of places has remained stable, indicating rigidity of supply in relation to the increase in demand;
- despite the progress made in recent decades, Portuguese universities continue to occupy low-ranking positions in the main international rankings. The legal framework and the system of incentives, among other factors, condition the performance of higher education institutions. However, the international comparison of the funding of Portuguese universities with other international institutions of reference makes their low level of financing evident.

Chapter 4
Growth of productivity and firms: entrepreneurs and their circumstances

The Portuguese business structure, such as that of the EU-27, is characterised by a high incidence of micro and small-sized firms (table 3). In 2018, Portuguese micro and small firms represented 97% of companies, 54% of employment and 38% of added value. On the other hand, large-sized companies, being only 0.6% of all companies, represented 29.6% of employment and 44% of added value.

Table 3 Percentage of companies, employment and added value by company size, Portugal and EU-27, 2018

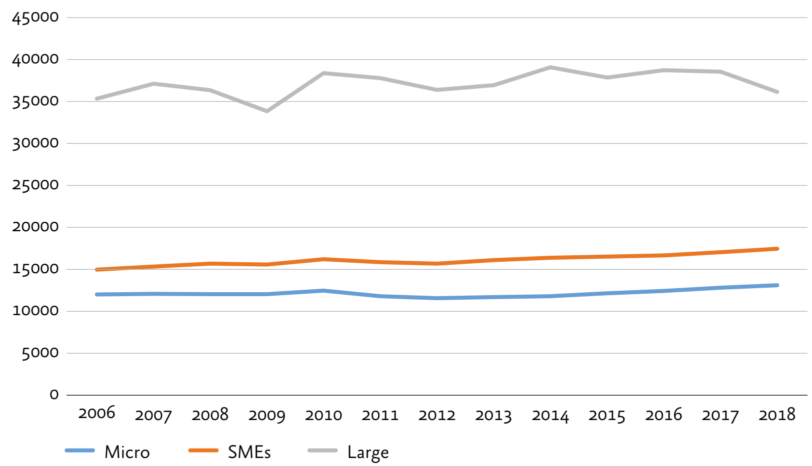
	Micro and small		Medium-sized		Large	
	Portugal	EU	Portugal	EU	Portugal	EU
Companies	97 %	98.9 %	2.0 %	0.9 %	0.6 %	0.2 %
Workers	54 %	49.0 %	16.2 %	16.0 %	29.6 %	35.0 %
Added value	38 %	35.8 %	18.5 %	17.0 %	44.0 %	47.2 %

Source: Own computations with SCIE data (INE) and Eurostat data (2011)

Only a small group of micro and small-sized firms want to innovate and grow in their market (e.g., Hurst and Pugley, 2012). The structural transformation of the Portuguese economy and its growth will depend on the ability to create an economic environment that favours the birth and growth of innovative companies, with the ambition of conquering global markets. Examples of success are the companies of Portuguese origin that reached unicorn status (Outsystems, Talkdesk, Farfetch and Feedzai), as well as many other technological and innovative companies that have managed to attract capital from the main international investors (e.g., FairJourney or Vision-Box).

An economic context that favours the concentration of resources in micro and small firms can limit the growth of aggregate productivity (e.g., Garicano *et al.*, 2016). Most micro and small companies have low productivity levels and weak productivity growth. Productivity increases with the size of firms (figure 16).

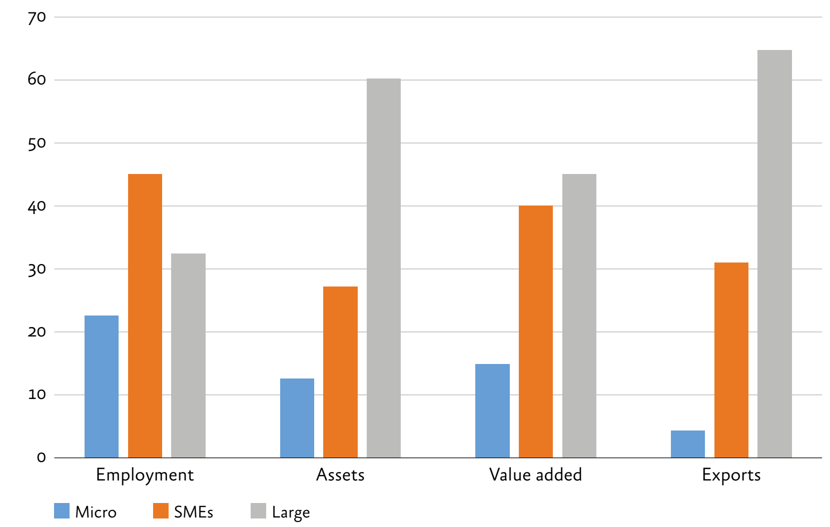
Figure 16 **Labour productivity in the manufacturing industry, 2006–2018 (€, prices 2011)**



Source: Own computations with SCIE data (INE)

Size is also crucial for companies' export capacity. For example, in 2018, large companies represented 65% of total exports (figure 17). R&D investment and, thus, innovation capacity, is also associated with larger firms (e.g., Portela *et al.*, 2021, FFMS).

Figure 17 **Percentage of employment, assets, added value and exports, 2018 (% of the total)**



Source: Own computations with SCIE data (INE) and Lists of Personnel (MTSSS)

4.1. Frontier firms

Andrew, Criscuolo and Gal (2015) attribute the slowdown in productivity in developed countries to the divergence between global frontier firms, that is, the group of companies that are at the top in terms of productivity, and the rest of the economy. Those authors show that frontier firms exhibit robust productivity growth, are bigger, more profitable, younger, have more patents and have a high probability of being part of a multinational group. The Mckinsey Global Institute highlights the following characteristics of superstar companies: high levels of digitalisation, highly skilled workers, highly innovative, many connections to global trade, financial markets and services, and investment in intangible assets (MGI, 2018).

In their analysis of the conditions necessary for the growth of Portuguese companies and their productivity, Portela, Alexandre and Costa (2021, FFMS) highlight the importance of creating a business context that favours the convergence of the productivity of non-frontier firms towards the productivity levels of national frontier firms. Secondly, they mention the need to design incentives that foster the growth of frontier firms, so that they can become large companies. Lastly, productivity growth of the Portuguese economy requires that national frontier firms move closer to the performance of European and global frontier firms.

The data in table 4, presented by Portela *et al.* (2021, FFMS), show the significant differences between the labour productivity of frontier firms, defined as firms belonging to the group of the 10% most productive, and non-frontier firms in Portugal and in economies of other European countries.

The distance between the productivity of national and European frontier firms suggests that Portugal has not yet managed to escape from the 'middle-income' country trap. The way out of this 'trap' involves the creation of a business environment that favours the birth and growth of innovative companies.

However, in sectors like 'vehicles', 'textile and clothing' or 'rubber and plastic', frontier firms have productivity levels which are very close to those of frontier firms in other European countries.

Table 4 **Labour productivity in Portugal and European countries: frontier and non-frontier firms (m€, 2018)**

	Labour productivity	
	All sizes	SMEs
Frontier: PT	115	72
Frontier: EU	193	134
Non-frontier: PT	22	21
Non-frontier: EU	46	44

Source: Own computations with data from Orbis.

Table 5 shows operational and financial characteristics of frontier SME, non-frontier SME and large companies in the manufacturing sector in Portugal. In 2018, there were 1,371 frontier SMEs, which represented 8.5% of total employment, 15.8% of total added value and 12.6% of total exports. The average labour productivity of frontier SME was 3.7 times the labour productivity of non-frontier SME and was slightly less than the labour productivity of large companies. Frontier SME are larger, export 4.7 times more than non-frontier SME, have a higher percentage of managers and workers with university degrees and are much more lucrative. 15% of frontier SME were foreign-owned (Portela *et al.*, 2021, FFMS).

Table SMEs and large companies, manufacturing industry, Portugal, 2018

	Non-frontier SME	Frontier SME	Large
Average age of the company	22	25	37
Average productivity (unweighted) (m€)	17	63	67
Average employment	32	40	429
Average asset value (m €)	1.857	7.506	77.408
Average sales (m €)	1.910	7.964	92.713
Average exports (m €)	683	3.201	52.637
Percentage of companies with graduate workers	7.3 %	20.5 %	17.7 %
Percentage of companies with graduate managers	32.9 %	63.0 %	96.1 %
Average hourly wage (€)	5	8	9
Average price of exports (€)	85	446	295
Profitability (EBITDA/ total assets)	0 %	12 %	7 %
Indebtedness	77 %	49 %	53 %
Foreign ownership (>50 %)	3 %	15 %	42 %
Number of companies	10029	1371	424
Percentage of total employment	49.4 %	8.5 %	27.8 %
Percentage of total added value	31.4 %	15.8 %	43.7 %
Percentage of total exports	19.6 %	12.6 %	64.0 %

Source: Own computations with SCIE data (INE) and Lists of Personnel.

Portela *et al.* (2021, FFMS) analyse the impact of the business context and the characteristics of managers on the growth of companies and their productivity, and on the probability of joining the group of frontier firms.

4.2. Entrepreneurs and their circumstances

Marchese *et al.* (2019) divide the decisive factors of productivity growth of SMEs into internal and external. Internal factors include the quality of management and workers' human capital, the adoption of technologies and digitalisation, the existence of innovation processes or participation in commercial networks. External factors include product market competition, labour market institutions, financial markets, infrastructures and access to markets, the technology and qualifications available.

Since the adoption of the Euro in 1999 and the recession that followed in 2002/2003, structural reforms have been at the centre of the discussion about economic policies for growth and convergence. Structural reforms can increase productivity growth, contributing towards a more efficient allocation of resources (e.g., Acemoglu and Robinson, 2012). The Economic and Financial Assistance Programme (2011-2014) (PAEF), following the bailout of the Portuguese economy in 2011, included a set of structural policies which, among other objectives, aimed to increase product market competition and the flexibility of the labour market (for example, Eichenbaum *et al.*, 2017). On the other hand, the European Semester — the budgetary framework of the euro area launched in 2011 to coordinate the budgetary policies of EU Member States — aims to implement structural reforms to increase employment and foster economic growth.

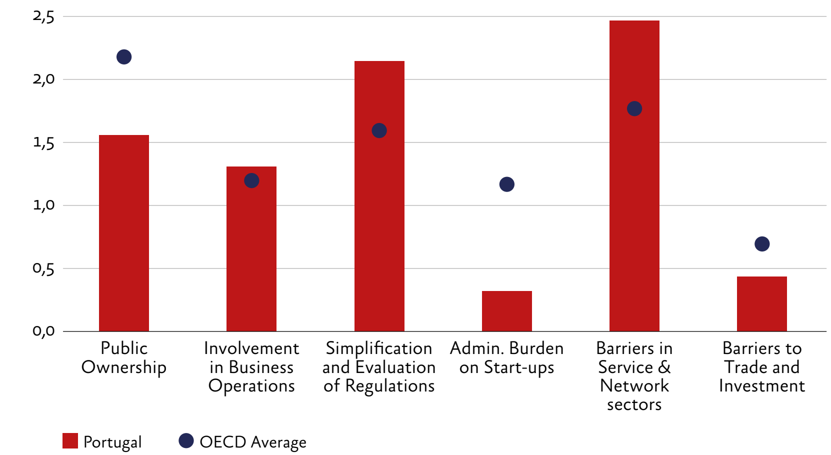
Among the causes identified for the slowdown in productivity growth in developed countries is reduced economic dynamism, or rather, the entry and exit of companies. Decker *et al.* (2017 and 2020) conclude that an increase in distortions in the functioning of markets has prejudiced the allocation of resources to companies with the greatest growth potential, reducing the likelihood that the most productive firms will grow and the most inefficient firms will exit markets.

4.3. The circumstances: product market

Philippon (2019) attributes the low productivity growth to the reduction in competition and to the increase in entry barriers that protect the incumbents. Monteiro *et al.* (2017) analysed the reforms in the product market implemented during the PAEF and concluded that they contributed towards a more efficient resource allocation and productivity gains.

Jalles *et al.* (2021, FFMS), using OECD data, show that, in general, regulatory barriers to product market competition are slightly below the OECD average. However, the services sector is less favourable to competition than in many other OECD countries. Also, in the area of regulation simplification and assessment, there are still numerous restrictions on competition within the regulatory framework of the transport sector. The authors also mention the fact that energy is relatively highly priced, affecting the competitiveness of companies.

Figure 18 Indicators of product market regulation by components, 2018 (Scale of 0 to 6, from the most pro-competitive to the least pro-competitive regulation)



Source: OECD 2018 PMR database.
Note: the averages only include OECD countries. The information refers to laws and regulations in force on 1 January 2018.

Competition in markets, innovation and productivity are intrinsically linked (e.g., Philippon, 2019; Aghion et al., 2021). Competitive markets create incentives for companies to innovate and develop innovative products and services, with better quality and lower price.

4.4. The circumstances: labour market

In a context of accelerated technological change and reorganisation of the large global value chains, the efficient allocation of productive factors for the sectors with greater potential for economic growth requires labour market institutions that are sufficiently flexible to enable firms to adjust their workforces and their skills to the new market conditions (e.g., Diamandis and Kotler, 2020).

The rigidity of the labour market has occupied a central place in the debate on the causes of low productivity growth in the Portuguese economy (e.g., Blanchard, 2007). For example, very restrictive legislation on dismissals can make restructuring and the adoption of new technologies more difficult (e.g., Andrews and Cingano, 2014).

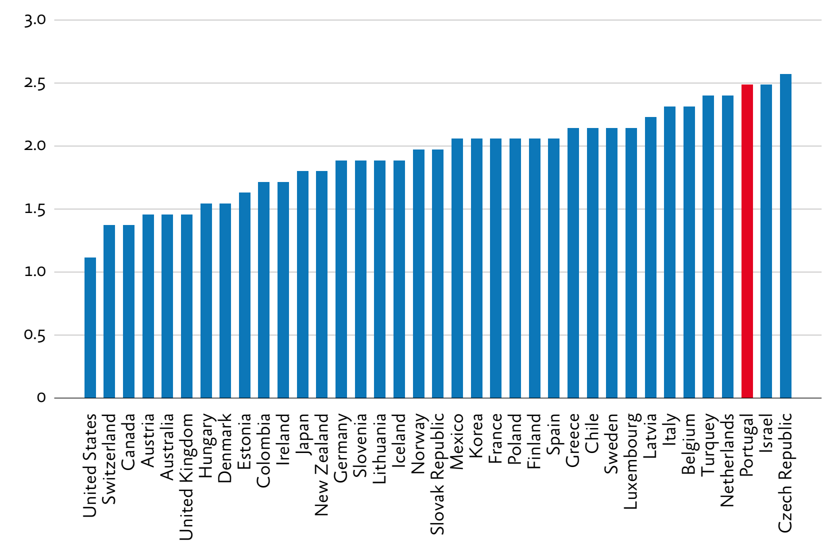
Blanchard and Portugal (2017) highlighted the importance of increasing flexibility in the Portuguese labour market to facilitate the reallocation of workers to high growth sectors. The PAEF included various measures intended to increase flexibility in the labour market, among others, the reduction in the level and duration of unemployment benefit; the reduction of severance pay; increased flexibility of work schedules; the reduction of holidays and public holidays and limitation of automatic extensions of collective agreements. Many of these reforms contributed towards a more flexible, although still very segmented, labour market — see Varejão, Cerejeira, Portela and Vasconcelos (2021, FFMS).

In the new version of the OECD's Employment Protection Legislation (EPL) index, Portugal ranks third in terms of labour market rigidity (after Israel and the Czech Republic) (OECD, 2020). However, the EPL value for Portugal (2.9) is not very far from the OECD average (2.3) and Spain has an EPL of 2.4 (figure 19).

The new version of the OECD EPL index includes four components. The first relates to the procedural requirements in the dismissal of workers (PT 8th in labour rigidity: 2.3 vs OECD average 1.8). The second component concerns notice and severance pay (PT: 18th in labour rigidity: 1.7 vs OECD average 1.7). The third component refers to the regulatory framework for unfair dismissals (PT: 1st in labour rigidity: 4.2 vs OECD average 3.2). Lastly, it also includes the application of the regulations on unfair dismissals (PT: 16th in labour rigidity: 3.3 vs OECD average 2.6).

According to Varejão, Vasconcelos, Cerejeira and Portela (2021, FFMS), the fact that labour market regulation requirements are currently limited to specific aspects, leads employers to not consider labour law among the major obstacles to investment, at least no more than European employers (6th place in the EU and 7th in Portugal).

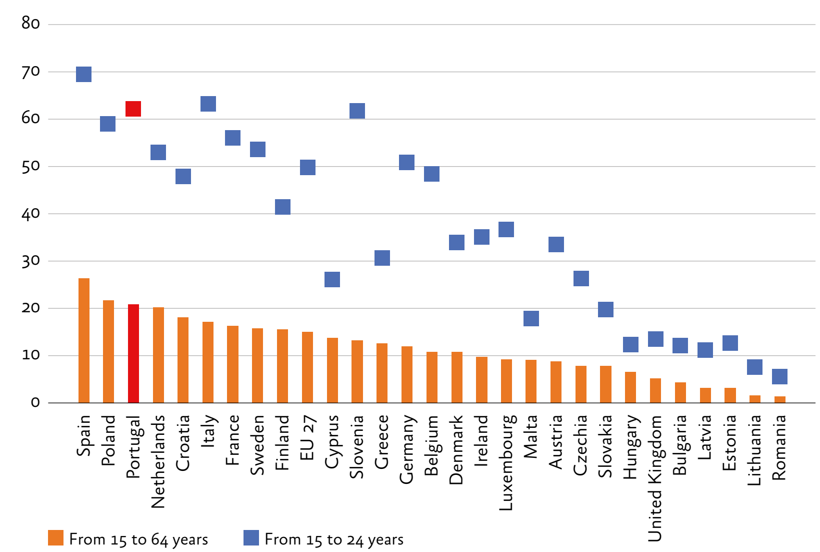
Figure 19 OECD Employment Protection Legislation Index, 2019



Source: OECD

Varejão, Vasconcelos, Cerejeira and Portela (2021, FFMS) highlight the fact that employment under temporary contracts (fixed-term or otherwise) represent a non-trivial fraction (around 20%) of total employment, raising concerns regarding the segmentation of the Portuguese labour market. In fact, Portugal occupies third place in the European ranking of incidence of temporary work (figure 20).

Figure 20 **Percentage of workers with temporary contracts**



Source: Eurostat

Several studies have shown that there is a positive relationship between increased labour market duality, that is, a labour market segmented between workers with high contractual protection and workers with low contractual protection, and low productivity growth levels (Dolado *et al.*, 2016).

In the context of accelerated change, the state should create conditions so that workers can move to the sectors and regions where there are more jobs and better salaries. So, social protection for workers should be promoted, regardless of their employment relationship, along with access to training and reskilling programmes, and conditions that foster mobility in access to transport and housing. In this context, the large investment programme in council housing included in the PRR may become a source of labour market rigidity, limiting the mobility of workers.

4.5. The circumstances: financing

Efficient financial markets and availability of credit are crucial for creating new companies, investment and the adoption of new technologies and, therefore, for productivity growth (e.g., Akcigit *et al.*, 2019). Companies in financial difficulties, also known as zombie firms, have been associated with high indebtedness and weak economic performance (e.g., Caballero *et al.*, 2008). A high incidence of companies in financial difficulties may be due to recurrent bank lending to inefficient firms (e.g., Caballero *et al.*, 2008; Acharya *et al.*, 2019); bad allocation of credit due to underdeveloped financial markets, particularly in the assessment of the credit risk (e.g., Reis, 2013; Gopinath *et al.*, 2017; Azevedo *et al.*, 2018) and inefficient insolvency regimes (e.g., Andrews *et al.*, 2017). Companies in financial difficulties divert resources from more efficient firms, distort competition in the market and are, therefore, detrimental to productivity growth.

The incidence of zombie firms in the Portuguese economy increased during the financial, banking and debt crises (2008–2014). In this period, companies in financial difficulties represented a high fraction of companies, added value, employment and total exports (Gouveia and Osterhold, 2018). The impact of the COVID-19 pandemic raises concerns in relation to the increase in incidence of zombie firms in the Portuguese economy.

The availability of venture capital is a factor that contributes towards the probability of success of the most innovative companies (e.g., Aghion et al., 2021). This source of financing is still very incipient in Portugal and is an obstacle to the establishment of high potential start-ups, namely in the embryonic stage of projects originating from universities or research centres where patent holders may have difficulties accessing capital.

4.6. Business context and business dynamics

Portela, Alexandre and Costa (2021, FFMS) assess the importance of the level of product market competition, flexibility of the labour market and efficiency in the allocation of credit on efficiency and productivity growth at the sectoral level. The authors analyse the impact of the entry and exit of companies and reached the following conclusions:

i. the entry of new companies in sectors with a more flexible labour market contributes towards a more efficient allocation of resources and, therefore, productivity growth;
ii. the entry of new companies improves the allocation of resources and contributes towards productivity growth in the sectors characterised by greater product market competition;
iii. the entry of new companies in sectors with a higher incidence of zombie firms has no impact on the efficiency of resource allocation and on productivity growth. This result suggests that zombie firms may be a source of distortion that prevents the entry and growth of new companies;
iv. the exit of companies does not affect the efficiency of resource allocation, regardless of the degree of flexibility of the labour market, concentration in the product market, profile of the exports or incidence of companies in financial difficulties. This result suggests that firms' insolvency procedures are not very efficient, or rather, they do not promote the rapid exit of less efficient firms from the market.

The results of Portela *et al.* (2021, FFMS) show the importance of the institutional context for the efficient allocation of resources and for productivity growth.

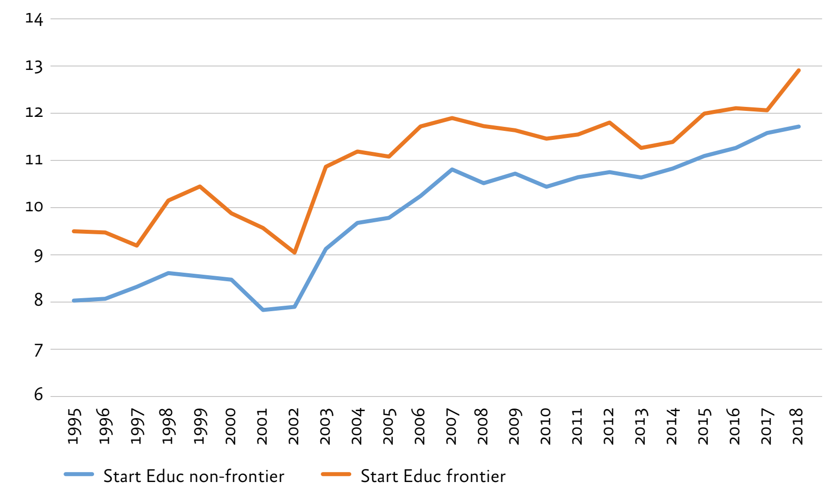
4.7. Quality of management, business context and growth of firms

In a seminal line of research, Nicholas Bloom, John Van Reenen and co-authors conclude that the best management practices are positively associated with higher levels of education. On the other hand, companies with the best management practices tend to be larger, more efficient, grow more rapidly and have higher survival rates (e.g., Bloom and Van Reenen, 2007; Bloom *et al.*, 2013). Queiró (2018), using data for the Portuguese economy, concluded that companies founded by better educated entrepreneurs tend to be larger at entry and also exhibit higher growth. Alexandre *et al.* (2021) conclude that the formal education of the management teams reduces the probability of micro and small companies falling into difficult financial situations and increases the probability of their subsequent recovery.

Varejão *et al.* (2021, FFMS) mention Portugal's weak position in the rankings of management practices (Bloom *et. al.*, 2012), especially in the areas of personnel policies and incentives. The authors mention that despite recent advances, the level of formal education of the managers of companies in Portugal is still low and only 1/3 of all companies in 2018 had a manager with university education (45% for SMEs).

Portela *et al.* (2021, FFMS) assess the characteristics of the entrepreneur based on the education of the founder, measured by years of schooling, in the year the company was founded. Figure 21 presents the average years of schooling of the founders of companies that reached the group of frontier firms, or rather, which at some time belonged to the class of the 10% most productive in the economy, and of the founders of non-frontier firms. It is worth noting the improvement in the formal education of entrepreneurs in general and the fact that entrepreneurs who created companies that reached the statute of frontier firms have, on average, another year of schooling.

Figure 21 Education of founders: frontier firms and non-frontier firms14



Source: Own computations with data from the Lists of Personnel

The following results stand out from the empirical analysis of Portela *et al.* (2021, FFMS):

- the higher the schooling of the company founders' management team, the greater the probability of the company becoming a frontier firm;
- companies that enter sectors with a higher market concentration are less likely to be part of the group of frontier firms;
- companies that enter sectors with a more flexible labour market are more likely to become frontier firms.

The results of the article by Portela *et al.* (2021, FFMS) show that the low level of schooling of the management teams of Portuguese companies jeopardises their growth and productivity.

In short:

- the Portuguese business community is characterised by a high incidence of micro and small-sized firms;
- only a small group of micro and small companies want to innovate and grow in their market. The structural transformation of the Portuguese economy and its growth will depend on the ability to create a business environment that favours the birth and growth of innovative companies, with the ambition of conquering global markets;
- the distance between the productivity of national and European frontier firms suggests that Portugal has not yet managed to escape its status as a 'middle-income' country;
- the business context is essential so that the productivity of non-frontier firms can converge towards the levels of frontier firms, so that frontier firms can grow, and so that national frontier firms can converge towards the productivity levels of global frontier firms;
- competition in markets, innovation and productivity are intrinsically linked. The entry of new firms improves the allocation of resources and contributes towards productivity growth in the sectors characterised by greater product market competition;
- in the new version of the OECD Employment Protection Legislation Index, Portugal ranks third in terms of labour market rigidity. In a context of accelerated technological change and reorganisation of the GVC, the efficient allocation of productive factors for the sectors with higher economic growth potential requires labour market institutions that are sufficiently flexible;
- efficient financial markets and availability of credit are crucial for creating new companies, for investment and the adoption of new technologies and, therefore, for productivity growth. Zombie firms may be a source of distortion that prevents the entry and growth of new companies;
- there is a need for efficient business insolvency procedures, which facilitate the rapid exit of less efficient companies from the market;
- companies founded by better educated entrepreneurs tend to be larger at entry and also exhibit higher growth.

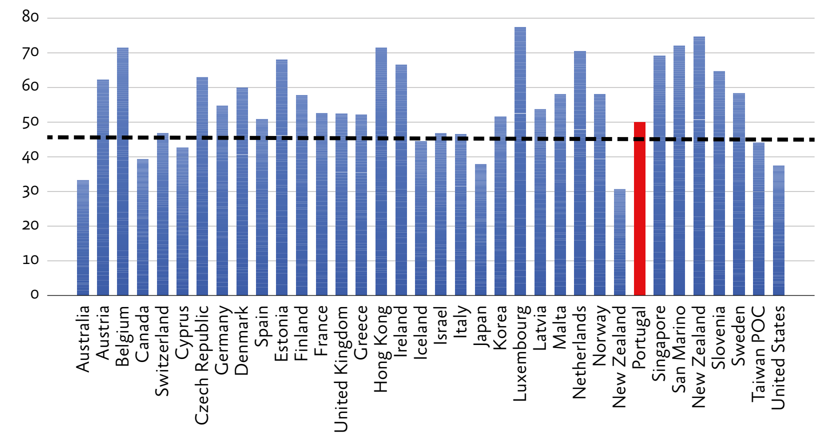
Chapter 5

Foreign direct investment, global value chains and a new paradigm

Large global value chains (GVC) directly or indirectly control more than 50% of world trade (Cadestin *et al.*, 2018). The increase in Portuguese exports requires greater integration of the Portuguese economy in large GVC.

Catão, Faria, Martins and Portela (2021, FFMS) highlight the fact that the fraction of national exports related with GVC is lower than the European average, quoting a study of the European Commission that places Portugal in the group of countries with lower participation in GVC (European Commission, 2020).

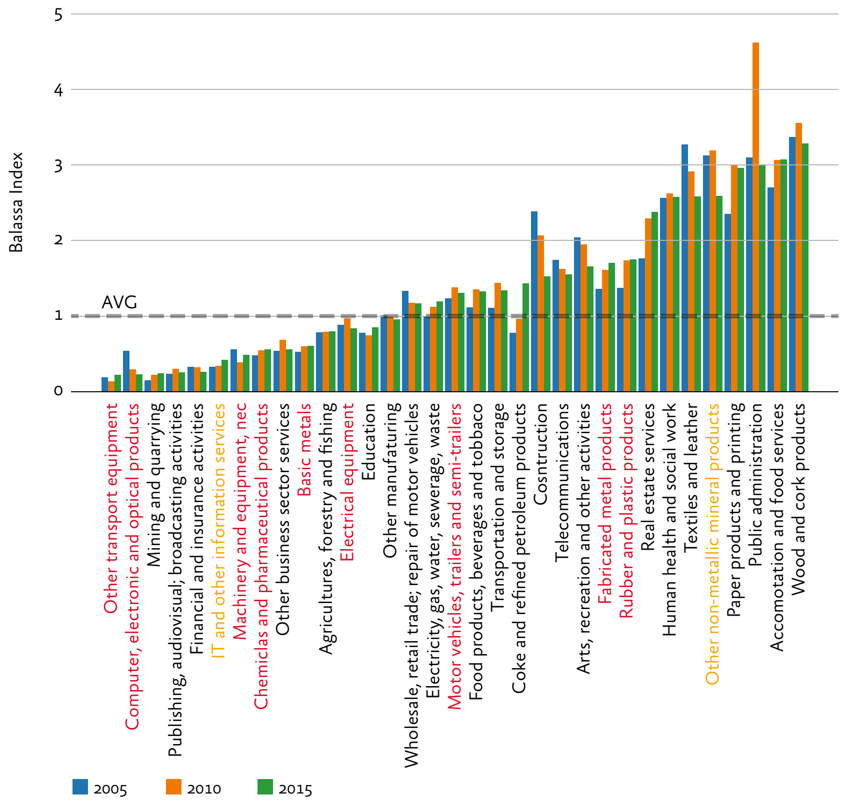
Figure 22 **Participation in Global Value Chains (% of gross exports in advanced countries)**



Source: Catão et al. (2021, FFMS)

Catão *et al.* (2021, FFMS) show that there is a generally positive correlation between the share of FDI in GDP, the participation of GVC in exports and overall export growth. However, these authors show that sectors with greater insertion in GVC still have a low share in the Portuguese economy — sectors in red in figure 23. Given that exports associated with GVC have had higher growth, GVC have contributed to speed up the structural transformation of the economy.

Figure 23 Share of GDP by sector



Source: Catão et al. (2021, FFMS)

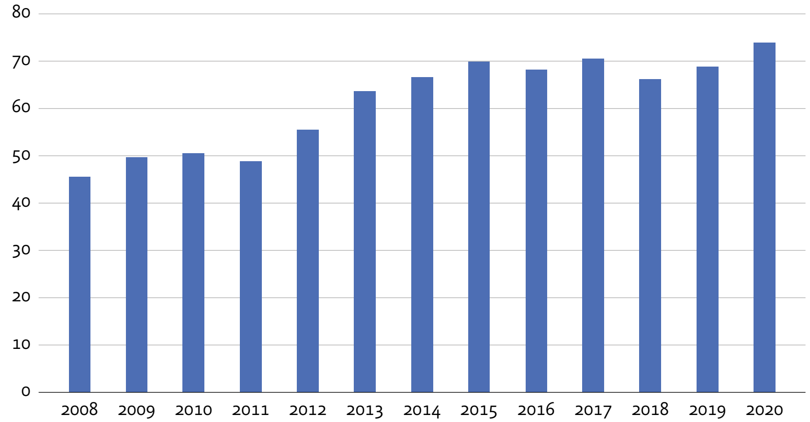
Catão *et al.* (2021, FFMS) also highlight the fact that greater participation in GVC is positively associated with growth in FDI flows at the sectoral level.

5.1. Foreign direct investment

FDI from multinational companies plays a fundamental role in a strategy to intensify the integration in GVC. Renault's investments in the 1980s, and those of Autoeuropa/Volkswagen in the 1990s, were decisive for the development of sectors like 'transport equipment', 'basic metals and fabricated metal' or 'rubber and plastic', contributing towards the structural change of the economy and an upstream movement in the value chain. Inditex was crucial for the modernisation of the 'textiles, clothing, leather and related products' sector. Ikea became a net exporter due to the development of a strong network of Portuguese suppliers. Fortunately, there are more good examples of a fruitful relationship between multinationals and Portuguese companies.

The stock of FDI increased significantly in the last decade, from 50.5% of GDP in 2010 to 73.9% in 2020 (figure 24). The sovereign debt crisis and external imbalances have motivated the alienation of national assets, particularly in the banking and insurance sectors (representing 33% of total FDI stock in 2018) and through privatizations (for example, EDP, ANA, CTT), resulting in a marked increase in the entry of FDI.

Figure 24 Stock of FDI as a percentage of GDP



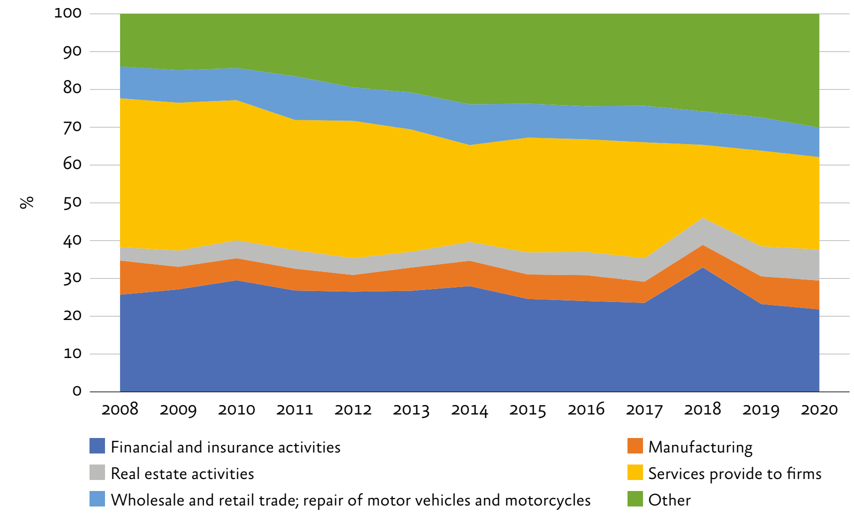
Source: Own computations with data from the Bank of Portugal.

Catão *et al.* (2021, FFMS) highlight the fact that larger FDI inflows have placed Portugal in the group of countries with the highest ratio of stock of FDI to GDP.

Besides flows and stock, the sectors of activity on the one hand and the type of activities that are relocated on the other are also relevant for country's development strategy.

Figure 25 shows that the 'services provided to firms' (25% in 2020) and 'financial and insurance activities' (22% in 2020) sectors are those with the highest concentration of foreign assets.

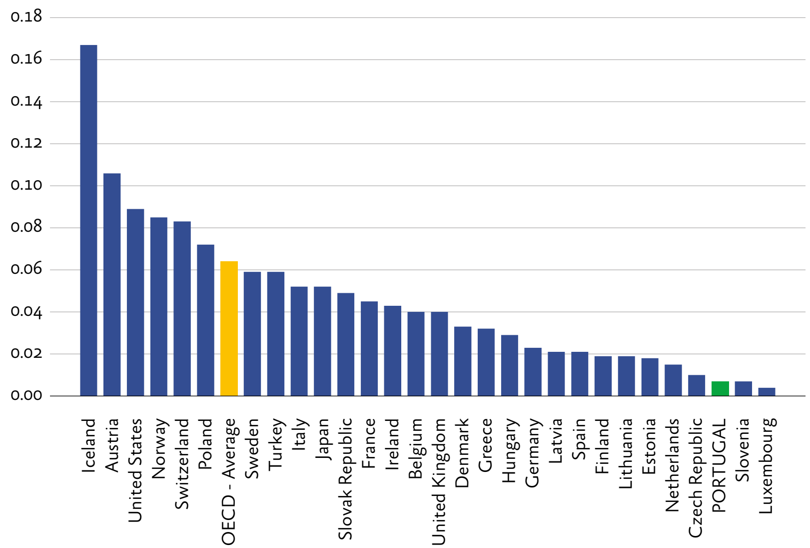
Figure 25 Stock of FDI by sector of activity



Source: Own computations with data from the Bank of Portugal

Jalles, Martins and Brinca (2021, FFMS) conclude that Portugal has one of the most open regimes to FDI among OECD countries (figure 26), although there is room for improvement in some sectors (financial services, transports and fisheries). These authors also mention the high tax burden, in particular the corporate tax rate, which can reach a maximum of 31.5%, the highest value among European OECD countries. Jalles *et al.* (2021, FFMS) propose a progressive reduction of this rate to improve the competitiveness of the Portuguese economy.

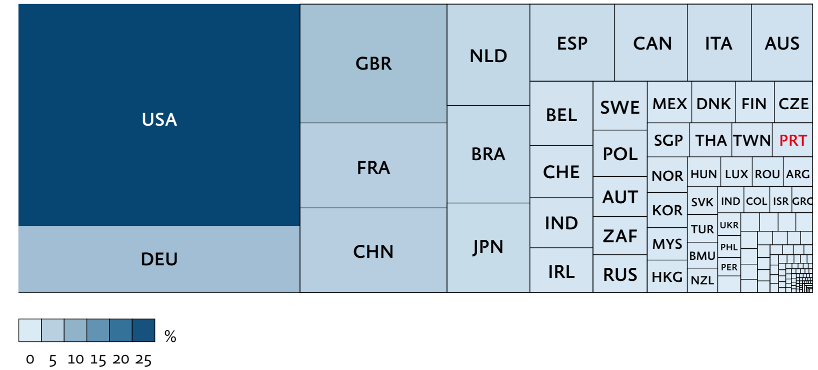
Figure 26 Index of regulatory restrictions on FDI, OECD, 2019 (open=0; closed=1)



Source: OECD

Sequeira, Ferrão and Montelius (2021, FFMS) mention the success in attracting FDI, mainly comprising factories that assemble differentiated products, although without high incorporation of R&D. The authors highlight the fact that subsidiaries of R&D-intensive multinationals are based in Portugal (including from among the 1% of the world's largest investors in R&D) (figure 27).

Figure 27 Location of the subsidiaries of the world's largest investors in RDI



Source: JRC and OECD (2019)

As discussed in section 3, the existence of highly skilled workers, in particular in STEM areas, and of universities and research centres that produce knowledge to the highest international standards, are key elements in attracting the technology development centres of multinational companies.

5.2. Scientific and technological system, multinationals and SMEs

A strong interconnection between scientific and technological systems, innovative SMEs and multinationals can function as a growth accelerator for Portuguese companies and for the transition from the *made in* to the *created in* paradigm.

In 2017, the Portuguese Government launched the 'Interface Programme', a programme supported by European Structural Investment Funds, which contemplated the following objectives:

enable SMEs to integrate innovative and internationally competitive global supplier networks; speed up the integration of technologies that facilitate adaptation to Industry 4.0; promote transformation to the technological requirements of processes and products that provide specialised know-how, critical resources and knowledge, higher productivity, more flexibility and higher product quality; replace imports, increasing national added value and exports.

The 'Suppliers Club' initiative, which includes the 'Interface Programme', has three types of partner: a multinational; a group of suppliers, particularly SMEs; and institutions of the Scientific and Technological System. The 'Suppliers Club' includes 30 companies, which form part of the network of suppliers of three important multinational companies: Autoeuropa, Bosch and PSA.

The data relating to the performance of the companies belonging to the group of suppliers of large multinational companies illustrates the potential benefits of SMEs forming part of GVC (table 6).

Table 6 Operational indicators of the members of the 'Suppliers Club', 2010 and 2018

	Employment	Assets (m€)	Sales (m€)	Exports (m€)
2010	2,813	393,154	310,455	182,064
2018	4,662	740,656	640,024	387,013
% Growth rate	**65.7%**	**88.4%**	**106.2%**	**112.6%**

Source: Own computations with data from *Compete* and SCIE (INE)

The partnership between the Bosch Group and University of Minho, which started in 2013, has been mentioned in various government documents as an excellent example of industry-university collaboration (see, for example, National Reform Programme). In 2013, Bosch had 1,900 employees, a turnover of 446 million Euros, and 104 employees in R&D activities. In 2018, the number of employees increased to 3,700, turnover exceeded 1,100 million Euros and 600 employees in R&D activities were in two R&D centres. This partnership resulted in more than 40 patents and new technologies already on the market.

The evidence provided by various case studies suggests that a stronger university-industry relationship, bringing together SMEs and multinationals, can speed up the dissemination of technology and innovation (e.g., Alexandre, 2021). Accordingly, the Recovery and Resilience Plan (PRR) presented by the Portuguese Government, includes Reindustrialisation Mobilisation Agendas, aimed at 'identifying and supporting a limited number of industrial and technological development alliances, of relevant size, consisting of consortiums of companies, entities of the scientific and technological system, higher education and other institutions, in strategic areas to speed up the structural transformation of the Portuguese economy.'

The funds made available by the PRR are thus an opportunity to strengthen relations between the scientific and technological system, multinational companies and SMEs. These may thus have access to technology, innovation in production processes, moving up the value chain and extending the market for their products.

In short:

- an increase in Portuguese exports requires greater integration of the Portuguese economy in large GVC;

- there is a generally positive correlation between the share of FDI in GDP, the participation of GVC in exports and overall export growth. The sectors most strongly included in the GVC still have a small share in the Portuguese economy. However, given that the exports associated with GVC have had higher growth, the GVC contributed to speed up the structural transformation of the economy;
- the FDI of multinational companies plays a fundamental role in a strategy to intensify integration in the GVC;
- Portugal has one of the most open regimes to FDI among OECD countries, although there is room for improvement in some sectors (financial services, transports and fisheries);
- the high tax burden, in particular of the corporate tax rate, which, considering taxes and surcharges, can reach a value of 31.5%, the second highest value among European OECD countries, jeopardises Portugal's competitiveness, particularly in attracting FDI;
- although FDI is concentrated in factories that assemble differentiated products, albeit without high incorporation of R&D, the advantage of having multinational subsidiaries with the highest investment in R&D based in Portugal (including the 1% world's largest investors in R&D) should be highlighted;
- a strong interconnection between scientific and technological systems, innovative SMEs and multinationals can function as a growth accelerator for Portuguese companies and for the transition from the *made in* to the *created in* paradigm;
- the evidence provided by various case studies suggests that a stronger university-industry relationship, bringing together SME and multinationals, can speed up the dissemination of technology and innovation.

Chapter 6
The new paradigm and the challenges of Portuguese Society

The transition from the *made in* to the *created in* paradigm has to be aligned, on the one hand, with the major challenges of Portuguese society in the next decade; and on the other hand, it has to take into account the dynamics of the competitive advantages of the Portuguese economy.

In section 2, we saw that population ageing and climate transition are two global trends, which will be strongly felt in society in the coming decades and will profoundly transform the supply and demand conditions of the Portuguese economy.

Demographic changes and the new energy paradigm affect the productive structure and accelerate technological changes. On the other hand, the increased attention on and requirements of environmental issues, and the needs of the elderly population, generate opportunities to develop new products and services. For example, demand for new forms of electric mobility, and energy-efficient solutions for buildings and healthcare will increase sharply in the coming decades.

The Portuguese economy must adapt to respond to those two social challenges, shared by European society and many countries on other continents. Portuguese companies should be able to contribute with innovative solutions, developed in collaboration with universities and research centres, and designed for the global market.

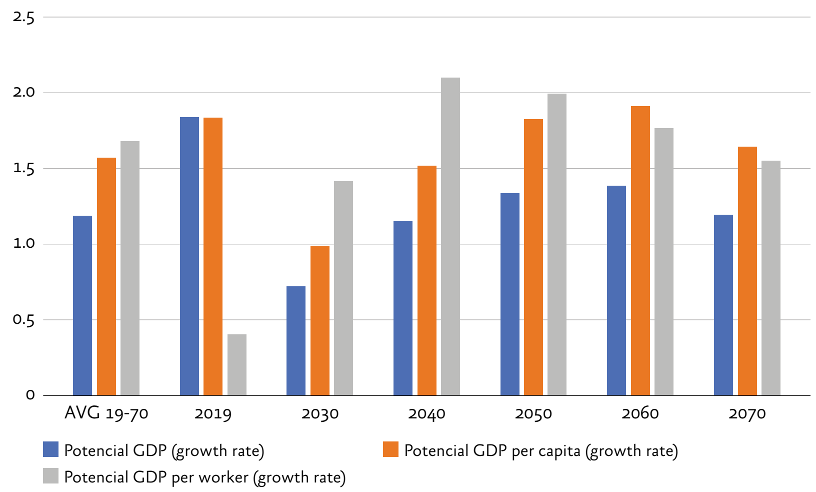
6.1. The challenge of ageing and the *created in* paradigm

Population ageing is a European problem (or of the northern hemisphere) that requires an interdisciplinary approach (Goodhart and Pradhan, 2020). In the Portuguese case, the high incidence of poverty among the elderly and the vulnerable conditions in which a significant part of this population lives should be a factor for the mobilisation of society and the definition of public policies.

The change in the demographic structure of the population has implications for the value and composition of public expenditure, particularly expenditure on health, homes and caregivers, for the structure of household consumption and for the future productivity and growth of the Portuguese economy. Population ageing also raises challenges for the sustainability of the pension system and, thus, for the income and future well-being of all pensioners. On the other hand, an ageing population is expected to become more conservative, opposing change, reform and innovation. All these effects have implications for the welfare levels of society, for the organisation of public services, and for the structure of the economy.

The reduction of the working-age population reduces the growth potential of GDP. Increases in the rate of employment can compensate part of this negative effect on growth in the short and medium-term, but not in the long term. Figure 28 presents the forecasts of the European Commission's Ageing Report for aggregate and per capita economic growth. Education, retraining and new technologies that promote productivity growth (automation, robotisation and digitalisation) will be crucial to offset the negative effects of demographic decline on the growth of the economy.

Figure 28 **Portuguese GDP growth forecasts**



Source: Ageing Report, European Commission.

Swift population ageing implies a reallocation, already in progress, of resources to the 'Health and Social Service' sector, a very labour-intensive activity (in the context of a shrinking workforce). These services require specialised qualifications. Portugal has highly qualified doctors and nurses. Many thousands of nurses have emigrated in recent decades, particularly to the United Kingdom.

The increase in life expectancy is associated with higher rates of dementia, like Alzheimer, and other causes of dependence (for example, arthritis or Parkinson's) of the elderly population, which create disability and the need for care in different dimensions, physical and psychological. Age-related diseases will increase demand for new medicines and medical services.

These challenges require an economy with the capacity to meet those needs, providing quality, innovative and affordable goods and services. The fact that ageing affects the northern hemisphere creates global opportunities for Portuguese companies.

A high quality healthcare sector can improve the supply of services to European retirees (developing the so-called Florida model) and the offer of specialised services to insurance companies. The provision of high-quality health services will be a key factor in the affirmation of the country's capabilities in this area.

However, the great opportunities for value creation are in areas within the health cluster, a cluster with a significant activity (link). The existence of high quality universities and research centres in the area of health sciences provides a solid basis to develop the new *created in* paradigm that addresses the challenges of ageing.

Portuguese universities and research centres produce internationally renowned science in areas like Biomedical Engineering (U Porto and U Minho, positions 76-100 and 101-150 in the ARWU, respectively) or Pharmaceutical Sciences (U Porto, position 150 in the ARWU). In the last decade, 'health technologies' represented more than 30% of the total of patents in Portugal (Sequeira, Ferrão and Montelius, 2021, FFMS). On the other hand, according to the DGEEC, in 2015, there were 3,542 PhDs in health sciences in Portugal, a very relevant critical mass that makes a decisive contribution to attracting FDI, particularly from large multinationals in the sector, to develop products and services in the health sector.

The partnership between Universidade Católica — Porto with Amyris Bio Products Portugal in the area of biotechnology, financed with European funding, reveals the potential of closer university-industry collaborations in life sciences.

A promising set of start-ups in the area of health sciences (for example, FairJourney — Antibody tayloring is success, or Sword Health) managed to attract venture capital investments of reference such as Forbion, which shows that the Portuguese medtech sector, similarly to what occurred with the software industry some years ago, is already on the radar of large international investors.

It is also worth noting the growth of companies in the pharmaceutical area (e.g., Bial, Bluepharma and Hovione) and in the area of devices and other medical technologies (e.g., Take The Wind).

6.2. The challenge of climate transition and the *created in* paradigm

The risks of climate transition for humanity are today recognised by most countries. The EU should achieve carbon neutrality in 2050, and in 2030 it will have to achieve the goal of 55% in relation to 1990. The European Green Deal points out the directions to a new growth strategy for making Europe a competitive and resource-efficient economy: the decarbonisation of the energy sector — the main source of greenhouse gases in the EU; the renovation of buildings to make them more energy efficient; the decarbonisation of polluting industries and heavy transport, notably the role that green hydrogen may come to represent; industrial conversion based on the circular economy; and mobility based on electricity from increasingly renewable sources.

The concentration of population in urban areas makes energy and mobility central for achieving the objectives of the Paris Agreement. To achieve these objectives, new solutions for mobility, energy and its storage will be implemented, including a more central role for public transport, the decentralisation and digitalisation of the energy system and a shift towards shared mobility and autonomous driving (*World Economic Forum*, *Industry Agenda*, 2018).

6.3. Renewable energies

The consolidation of the role of renewable energy sources (solar, wind and hydro), in which Portugal is relatively abundant, may terminate the long cycle of energy dependence started with the Industrial Revolution. Following the European Green Deal, and in view of the new target defined for the EU decarbonisation goal in 2030, both the EU ETS (European Trading System) and the EU ESL (European Sharing Legislation) have inevitably become more restrictive. Given that the ETS market is the main instrument of decarbonisation for the electricity and heavy industry sectors, the setting of more demanding targets will lead to a significant rise in the price of carbon, which is already having important consequences in the energy sector, with an impact on investments in new technologies. In fact, the change in the (relative) opportunity cost of CO_2 abatement for different technologies will necessarily influence the respective competitiveness, by increasing the price of fossil energy in the wholesale market. In particular, and, depending on the composition of the energy sector in the different economies, these developments are already contributing and will contribute to the phase-out of coal and shortening of the lifetime of natural gas, the fossil fuel of transition. In this context, the opportunity cost of abating CO_2 can reduce in relative terms in favour of renewables.

The renewable energy sector has had significant growth in recent decades. To take advantage of the new energy paradigm, Portugal needs to have relevant R&D&I in the areas of the environment, biotechnology, renewable energies, smart cities, software, among others, and have a relevant role in the development and production of technologies in these areas. There is, for example, export potential in the area of wind energy. Partnerships between national and foreign companies can perform an essential role in innovation capacity and development of new technologies.

An interesting and promising example is that of the Windplus consortium (EDP Renewables, ENGIE, Repsol and Principle Power Inc.), which developed an innovative technology for the exploitation of wind energy at sea, installing three turbines that comprise the first semi-submersible floating wind farm in the world, with floating platforms anchored to the seabed with a total combined capacity of 25 MW — equivalent to the energy consumed by 60,000 households in one year (Project Windfloat Atlantic). However, the possibility of exporting this technology depends on the ability to reduce its respective costs, in contrast with onshore wind energy which is a more mature technology. On the other hand, the decision to locate the platforms in marine space will necessarily have to take into account a multiplicity of factors, including potential conflicts of interest with other activities in the marine space. Thus, it is essential to ensure their framing within the regulatory framework of the Marine Spatial Plan (MSP) to reduce potential conflicts, and minimise associated costs.

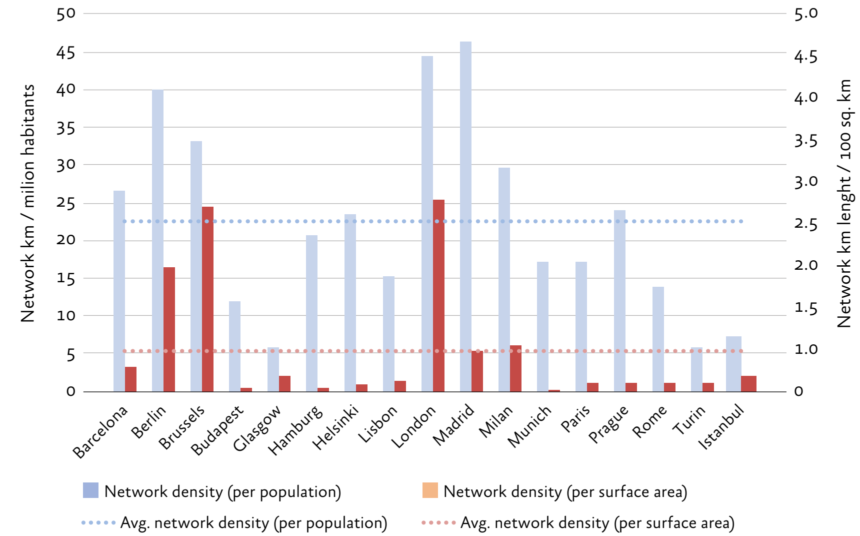
In the case of solar energy, the significant reduction of the technology's cost on the international market in recent years, combined with the country's abundance of natural resources and the incentives policy (feed-in-tariffs) that Portugal has been enjoying, have been decisive for the increase of interest in installing photovoltaic plants in national territory. However, from the point of view of preserving green natural capital, and given the relatively low efficiency per unit of land, the quantity of land necessary for the installation of these plants is very high. It is therefore crucial to take into account the opportunity cost of the land used for this end (besides other negative externalities, such as temperature increase and its consequences). This is aggravated by the fact that some currently envisaged projects are concentrated in regions where ecosystem services of a provisional, regulatory and cultural nature have a high local, regional and national value.

Cunha-e-Sá *et al.* (2021, FFMS) underline the need to estimate the net benefit to society of investments in renewable energies, in order to guarantee consistency between the definition of public policies and the goals to be achieved. The analysis of the relative competitiveness of different alternatives has to take into account the incentives provided under EU policies. The biggest reform of the ETS market since its launch in 2005 is underway, extending the allowance market to other sectors not previously included, such as commercial aviation, maritime and land transport, among others. The proposed package aims to accelerate the emission reduction process with a view to achieving the intermediate decarbonisation target of 2030. In addition, grandfathering (the allocation of cost-free allowances) will be eliminated, the operation of the market stability reserve will be tightened and a border carbon tax will also be established. As these proposed changes aim to speed up the decarbonisation process, it is expected that allowance prices will continue on their upward path. The effects on the relative competitiveness of the different sectors of activity will have consequences throughout the economy including technological innovation and employment. So, the estimation of this strategy's economic cost (opportunity cost) should be based on a general equilibrium approach.

6.3.1. Public transport

According to Cruz and Januário (2021, FFMS), the transport sector in Portugal is responsible for a quarter of total CO_2 emissions. Thus, the reduction of greenhouse gas emissions will have to involve the reorganisation of mobility in metropolitan areas, which account for most travel. The density of the metro network has had limited development when compared to similar European cities. Lisbon and Porto have 1.48 km and 3.28 km per 1,000 km², respectively, against an average of 5.15 km per 1,000 km² in the EU (figure 29).

Figure 29 Density of European metro networks



Source: Cruz and Januário (2021, FFMS) using data of the European metro networks.

In counter-cycle with the options of the large European metropolitan areas, the policy options in recent decades have led to the increase in use of individual transport and a reduction in public transport: in 2001, in Lisbon, the modal share of private transport (individual vehicles) was 39% and the modal share of public transport was 34%; in 2017, the participation of private transport increased even more to 58.9%, and that of public transport reduced to 15.8%. Cruz and Januário (2021, FFMS) also mention that the share of private transport, in the overwhelming majority of municipalities within the Lisbon Metropolitan Area, is higher than 50%.

The relevance of the transport sector in terms of greenhouse gas emissions and the imbalances in the Metropolitan Areas of Lisbon and Porto in favour of private transport make it inevitable that mobility in these large areas be reorganised, with a greater focus on electric mobility and public transport. The investments foreseen in the RRP for the extension of the metro networks in Porto and Lisbon are therefore a step in the right direction.

6.3.2. Electric car

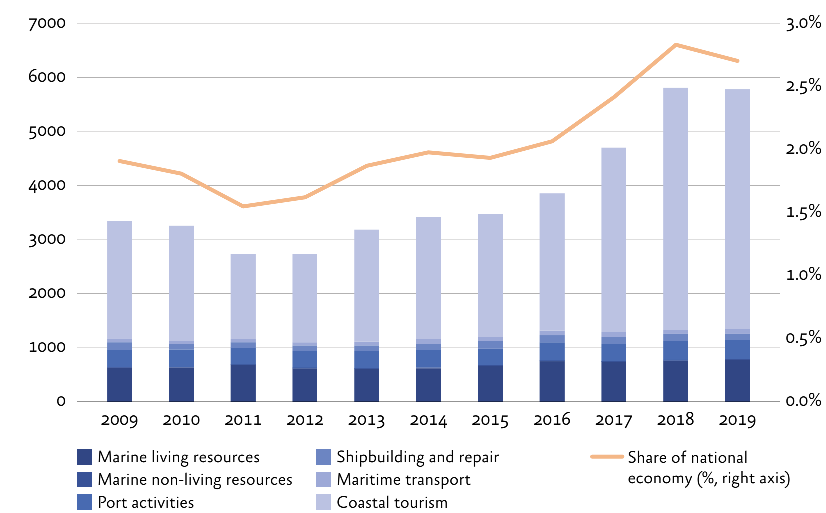
The automotive sector has a significant share in the national productive structure and in exports. The new energy paradigm will have a strong impact on the automotive industry, from combustion engines to hybrid and electric engines, where the car of the future will be one big computer, in which the software component will become increasingly important. It is thus fundamental that a national automotive industry follows the paradigm shift underway in order to protect or improve its position in the value chains.

6.3.3. Blue Economy

Cunha-e-Sá *et al.* (2021, FFMS) analyse the performance of the different sectors of activity of the Economy of the Sea in Portugal: coastal tourism, fisheries, maritime transport and shipyards, maritime biotechnology, energy from the sea, and seabed mining. Figure 30 presents the contribution of the different sectors of the blue economy for the Portuguese economy. Cunha-e-Sá *et al.* (2021, FFMS) highlight the growth of the global added value of 79%, in the period 2009-2019, with the share in the national economy approaching 3%, notably the contribution of coastal tourism. Portugal's wealth of marine and coastal resources, as well as its geostrategic and geopolitical position, suggest a potential for growth, but one that has not yet been realised.

Cunha-e-Sá et al. (2021, FFMS) identify two key challenges to the implementation of a sustainable strategy for the sea: (i) the need to adopt an ecosystem approach, that is, one that takes into account the dynamics of the feedbacks between the natural environment and human activities, with a view to preserving the condition of marine and coastal ecosystems and (ii) the promotion of a systematic assessment of the opportunity costs of investments in different sectors of the economy of the sea. Once the objectives to be achieved have been defined, and, given that resources are scarce, this assessment is essential to allocate these resources efficiently, or at least in a cost-effective manner.

Figure 30 **Added value in the blue economy, Portugal (€M, left-hand axis)**



Source: European Union Blue Indicators in Cunha-e-Sá et al. (2021, FFMS)

6.3.4. Forestry and agriculture

Forestry and agriculture are among the sectors of activity most affected by climate change (e.g., Santos, 2021). Rising temperatures and changes in rainfall affect the conditions necessary for the development of different species. Forests and their associated industries are an important sector of economic activity, with a significant share in added value and exports. On the other hand, forests also play a very important role in decarbonisation, particularly through carbon capture. The management of forests and their protection against the risks of fire, which are more likely to occur following long periods of drought and high temperatures, is essential to protect populations, the environment and a very important sector of activity. In this context, water policy and its efficient management also play a very important role for social, economic and environmental sustainability

In short:

- the transition from the *made in* to the *created in* paradigm has to be aligned, on the one hand, with the major challenges of Portuguese society in the next decade; on the other hand, it has to take into account the dynamics of the competitive advantages of the Portuguese economy;
- population ageing and climate transition are two global trends, which will be strongly felt in society in the coming decades and will profoundly transform the supply and demand conditions of the Portuguese economy;
- the change in the popultion's demographic structure has implications for the value and composition of public expenditure, particularly expenditure on health, homes and caregivers, for the structure of household consumption and for the future productivity and growth of the Portuguese economy;
- rapid population ageing implies a reallocation, already in progress, of resources to the 'Health and Social Service' sector, a very labour-intensive activity (in the context of a shrinking workforce);
- education, retraining and new technologies that promote productivity growth (automation, robotisation and digitalisation) will be crucial to offset the negative effects of demographic decline on the growth of the economy;
- a high quality healthcare sector can improve the supply of services to European retirees (developing the so-called Florida model) and the offer of specialised services to insurance companies;
- the great opportunities for value creation are in the areas integrated in the health cluster. The existence of high quality universities and research centres in the area of health sciences, and start-ups that have already attracted the attention of major international investors, provides a promising basis for the development of the new *created in* paradigm to meet the challenges of ageing;
- the EU should achieve carbon neutrality in 2050, and in 2030 will have to achieve the goal of 55% in relation to 1990. The European Green Deal points to the directions for a new strategy of growth aimed at making Europe a competitive and resource-efficient economy;
- the concentration of population in urban areas makes energy and mobility central for achieving the objectives of the Paris Agreement. To achieve these objectives, new solutions for mobility, energy and their storage will be implemented;
- the consolidation of the role of renewable energy sources (solar, wind and hydro), in which Portugal is relatively abundant, may

terminate the long cycle of energy dependence which began with the Industrial Revolution;

- to take advantage of the new energy paradigm, Portugal needs to have relevant R&D&I in the areas of the environment, biotechnology, renewable energies, smart cities, software, among others, and have a relevant role in the development and production of technologies in these areas. There is, for example, export potential in the area of wind energy, onshore and offshore;
- the objectives for decarbonisation make increasing the renewable-based energy component a factor in attracting FDI;
- the transport sector in Portugal is responsible for a quarter of total CO_2 emissions. Thus, the reduction of greenhouse gas emissions will have to involve the reorganisation of mobility in metropolitan areas, which account for most travel;
- the automotive sector has a significant share in the national productive structure and in exports. The new energy paradigm will have a strong impact on the automotive industry. The national automotive industry has to accompany the paradigm shift in progress in order to protect or improve its position in the value chains;
- Portugal's wealth of marine and coastal resources, as well as its geostrategic and geopolitical position, suggest a potential for growth of the Blue Economy, whether in the production of offshore energy, aquaculture or biotechnology;
- forestry and agriculture are among the sectors of activity most affected by climate change. Forests also play a very important role in decarbonisation, particularly through carbon capture. The management of forests is essential to protect populations, the environment and a very important sector of activity. Water policy and its efficient management, particularly in agricultural activities, also play a very important role for social, economic and environmental sustainability.

Chapter 7
General conclusions: the construction of a new paradigm for the Portuguese economy

The long stagnation and interruption of the convergence process in the 21st century reflect the exhaustion of a development model and suggest that the Portuguese economy may have fallen into the 'middle-income country trap'.

The strategy for escaping that trap should be based on the creation of conditions for the transition from the *made in* paradigm to the *created in* paradigm, based on knowledge and skills and where innovation occupies a central role in the wealth creation process.

The most innovative and transformative projects are usually led by new companies. The entry of new companies, investment in new products, technologies, and management models underpins increased incomes and improved quality of life.

The quality of institutions is essential to promote the entry of new companies in the markets and for their growth, thus contributing to an efficient allocation of resources and growth in productivity (Portela, Alexandre and Costa, 2021, FFMS).

This study shows that the entry of new companies produces greater impact on the efficiency of the use of resources and on productivity when product market competition is more intense. This results in a very important role for the regulators in the creation of a context that favours the growth of economies.

The results of this study also show that the entry of new companies has more impact on efficiency and on productivity growth when the labour market is more flexible. These results illustrate how matching workforce to market and technological conditions is important for firms' competitiveness.

Portela, Alexandre and Costa (2021, FFMS) show that in sectors with a higher incidence of zombie firms, new firms find it more difficult to grow and contribute to productivity growth, confirming the crucial role of institutions in building a new paradigm. These data corroborate the results of other studies, which show that inefficient credit policies and insolvency procedures have a negative effect on the growth of firms and productivity. In the current context, where the number of companies in financial difficulties is expected to increase, efficient credit policies and insolvency procedures that lead to the exit of less efficient companies from the market will be a key element in the recovery of the economy.

On the other hand, the financial markets should evolve in order to provide financing to the companies with greater innovation and growth potential, including start-ups and investment in intangibles.

Cruz and Januário (2021, FFMS) highlight the relevance of the quality of institutions — planning and evaluation capacity, predictability of infrastructure management policies or ability to implement efficient management — for the impact of infrastructures in the development of regions and countries.

The distance between the productivity of national and European frontier firms suggests that Portugal has not yet managed to escape its status as a 'middle-income' country.

A closer connection between national frontier firms and global frontier firms may accelerate the diffusion of innovation and the process of convergence of the Portuguese economy's productivity to the levels of the most developed countries.

The connection between national frontier firms and global frontier firms involves integrating large global value chains.

Attracting FDI is essential for improving integration in GVC (Catão, de Faria, Martins and Portela, 2021, FFMS). Regions that concentrate universities and research centres of excellence, highly qualified human capital and efficient logistics networks are on the radar of large multinational companies (Sequeira, Ferrão and Montelius, 2021, FFMS).

An international reputation for excellence in a scientific area is one of the most important assets for beating the competition for FDI. Investment in higher education and R&D in relevant areas, namely to respond to the challenges of climate transition and population ageing, are essential to the international affirmation of Portugal as an innovative country.

Improving the positioning of Portuguese universities in the main international rankings (e.g., Shanghai Ranking) is a necessary condition for being recognized as an innovative country.

The results already achieved in the area of software should be replicated in the area of life sciences, where the quality of the research and excellence of the human resources available has not yet fulfilled its potential in terms of adding value and transferring generated knowledge to the industry.

European funds, namely through the financing of co-promoted projects, involving SMEs, multinational companies and entities of the scientific and technological system, can create incentives for more intense and fruitful university-industry relations.

In the competition for FDI, a central public administration which is both transparent and efficient through its investment support agencies, as well as a local government with instruments able to unblock obstacles to investment and its efficient exploitation, are important.

Companies' conditions for competitiveness, in terms of context costs and tax burden, should provide advantages that compensate Portugal's peripheral position in relation to the main markets. In this context, the high tax burden must be emphasized, namely on company profits, as it is the second highest among European OECD countries.

A country located at the western end of the European continent needs excellent airport and port infrastructures. Cruz and Januario (2021, FFMS) identify bottlenecks in customs services as an obstacle to the efficiency of Portuguese ports.

Cruz and Januário (2021, FFMS) also highlight a toll system that lacks economic rationality, is socially unjust and promotes regional inequalities.

Greater proximity between decision-making levels of public policies and territories can ensure speed and flexibility in responses to the needs of investors. Agencies such as AICEP Portugal Global or institutes such as *Compete* should include regional representations in their governance structure, in order to be closer to the territories, and have access to better knowledge regarding the competitive advantages of different regions.

The Portuguese higher education system is characterised by a high level of rigidity in its educational offer, largely determined by the scientific areas of its teaching staff. One of the results of this rigidity is reflected in the fact that vacancies in the STEM area, an area of qualification that is very relevant for the competitiveness of national companies and for attracting R&D centres of multinational companies, have remained practically unchanged for two decades.

More competition between higher education institutions, a system of allocation of places and incentives that would result in a reallocation of places between scientific areas could make the system more responsive to demand and the needs of the economy.

The opening of new courses in emerging areas and the increase of places in courses with higher demand should be stimulated by strengthening the funding of higher education institutions.

The wave of retirements in public higher education should be used to reconfigure the weight of the different scientific areas and thus the supply of higher education places to the needs of the market.

We must review the funding criteria for higher education, which is long out of date.

The transformations in the productive structure as a result of climatic transitions and the ageing of the population, and technological changes, require a good system for forecasting skill needs and adequate investment in the qualification and reskilling of human resources, as well as immigration policies to attract and retain foreign workers.

To attract skilled foreign workers, universities and polytechnics should strengthen their focus on international students. A scholarship system to attract high-potential international students can be an effective instrument to attract and retain talent.

In relation to investments in infrastructures for the next decade, Cruz and Januário (2021, FFMS) stress the need to add the objective of environmental sustainability to the objectives of growth and territorial cohesion.

Cruz and Januário (2021, FFMS) identify the need to improve rail transport, shortening the time distance on the Setúbal-Lisbon-Porto-Braga route.

The decarbonisation goal requires a greater density of metro networks in Lisbon and Porto and a reduction in individual transport.

Forestry and agriculture are among the sectors of activity most affected by climate change. The management of forests is essential to protect populations, the environment and a very important sector of activity. Water policy and its efficient management, particularly in agricultural activities, also play a very important role for social, economic and environmental sustainability.

Cunha-e-Sá *et al.* (2021, FFMS), suggest the need to take advantage of existing research capacity, related with the marine environment, to develop an innovation strategy that can support the decision-making process of public policies for the ocean. In particular, this strategy should define a set of criteria that help to assess the maturity of national research in areas relevant to the definition of these policies. Based on this information, the country should allocate public funds accordingly, thus building a cost-effective national research capacity while contributing to the growth of the blue economy.

Chapter 8
Public policy recommendations

The following public policy proposals aim to exemplify dimensions of fragility in the conditions for the competitiveness of the Portuguese economy, whose solution is feasible in the short or medium-term, through the implementation of appropriate incentives and the use of European funding, creating the environment necessary for the development of the *created in* paradigm.

8.1. Institutions and economic environment

1. Review the appointment procedures for regulatory bodies, ensure their autonomy in budgetary terms, as well as accountability mechanisms for the results achieved in improving competitive conditions in markets and in creating conditions for innovation.
2. Negotiate and create the conditions, in very close articulation with the scientific and technological system, so that, by 2030, all multinationals based in Portugal belonging to the group of the world's largest investors in R&D have established R&D&I centres within national territory.
3. Include representatives of the regions in the organisation and governance of the entities that manage European funds (*Compete*) and are relevant for attracting FDI (AICEP) within a timeframe that enables the effects to be produced in the Multiannual Financial Framework 2021-27.
4. Eliminate Portugal's tax disadvantage vis-à-vis its direct competitors when it comes to attracting FDI by reducing the corporate income tax rate to 21%.

8.2. Research, higher education and qualifications

1. Establish partnerships with companies and higher education institutions, introducing digital and programming skills from primary school, making the continuation of studies in secondary and higher education in STEM areas attractive.
2. Increase flexibility and create budgetary incentives so that higher education institutions open new courses in emerging areas and increase places in courses with higher demand.
3. Review the funding criteria for higher education by creating incentives to increase places in STEM areas.
4. Create scholarship systems for international students in higher education in order to enhance the attraction and retention of talent.
5. In areas relevant to addressing climate transitions and ageing, reinforce the budgets of research centres, associated and collaborative laboratories.
6. Establish programme contracts between MCTES and universities so that, by 2030, Portugal will have at least one university among the 100 best in the world and 5 scientific areas among the 75 best in the world in the Shanghai ranking.

8.3. Infrastructures

1. Place port and airport customs services among the five most efficient in the World Bank's international logistics performance index by 2025.
2. Guarantee 5G coverage throughout the entire national territory by 2025.
3. Reduce rail travel times on the Setúbal-Lisbon-Oporto-Braga-Vigo route by 50% by 2030.
4. Reinforce metro and train lines in the Lisbon and Porto metropolitan areas and introduce tolls for cars entering these areas.

References

Acemoglu, Daron, and James A. Robinson (2012). *Why Nations Fail: The Origins of Power, Prosperity and Poverty*. 1st ed, Crown, New York.

Aghion, Philippe, M. Dewatripont, C. Hoxby, A. Mas-Colell, A. Sapir e B. Jacobs (2010). *The governance and performance of universities: evidence from Europe and the US. Economic Policy*, January 2010, Vol. 25, No. 61 (January 2010), pp. 7-59.

Aghion, Philippe, Céline Antonin and Simon Bunel (2021). *The Power of Creative Destruction — Economic Upheaval and the Wealth of Nations*. Harvard University Press.

Alexandre, Fernando (2021). *Avaliação dos incentivos financeiros às empresas em Portugal: QREN (2007-2013) e PT2020 (2014-2018)*. Working Paper, 9, 2021, Núcleo de Investigação em Políticas Económicas e Empresariais, Universidade do Minho. Link

Alexandre, Fernando, Pedro Bação, Joana Cima, Hélder Costa, Miguel Portela e Marta Simões (2021). *Structural change in human capital and sectoral specialization*. Mimeo.

Alexandre, Fernando, Sara Cruz and Miguel Portela (2021), "Financial distress and the role of management in micro and small-sized firms", OECD Productivity Working Papers, No. 27, OECD Publishing, Paris, link.

Alexandre, Fernando, Luís Aguiar-Conraria, Pedro Bação e Miguel Portela (2017a). *Poupança e Financiamento da Economia Portuguesa*. Imprensa Nacional e Associação Portuguesa de Seguradores.

Alexandre, Fernando (Coordenação) (2017b). *Investimento Empresarial e o Crescimento da Economia Portuguesa*. Fundação Calouste Gulbenkian.

Alexandre, Fernando, Luís Aguiar-Conraria e Pedro Bação (2019). *Crise e Castigo e o Dia Seguinte — Os desequilíbrios, o resgate e a recuperação da economia portuguesa*. Fundação Francisco Manuel dos Santos. Preface by José Manuel Durão Barroso.

Amador, J., e M. Cabral. 2014. *A economia portuguesa no contexto global*. F. Alexandre, P. Bação, P. Lains, M. M. F. Martins, M. Portela e M. Simões (Coordination), *a Economia Portuguesa na União Europeia: 1986-2010*. Actual.

Andrews, D. E F. Cingano (2014). *Public policy and resource allocation: Evidence from firms in OECD countries, Economic Policy*, Vol. 29/78, pp. 253-296.

Andrews, D., Criscuolo, C., e Gal, P. N. (2015). *Frontier firms, technology diffusion and public policy: Micro evidence from OECD countries*. OECD Productivity working papers, No. 02, November.

Autor, David, Frank Levy, and Richard Murnane. *The Skill Content of Recent Technological Change: An Empirical Exploration*. Quarterly Journal of Economics 118, no. 4 (2003): 129–333.

Baldwin, Richard (2016). *The Great Convergence: Information Technology and the New Globalization*, Cambridge, MA, United States: Harvard University Press.

Bank of Portugal (2021). Economic Bulletin. June. Link

Biagi, F., and R. Sebastian. (2020). *Technologies and "Routinization"*. In Handbook of Labor, Human Resources and Population Economics, Springer, pp. 1–17.

Bloom, Nicholas, Eifert, B., Mahajan, A., McKenzie, D., and Roberts, J. (2013). *Does management matter? Evidence from India*, *The Quarterly Journal of Economics*, Vol. 128 (1) 2013, pp. 1–51.

Bloom, N. and Van Reenen, J., «Measuring and explaining management practices across firms and countries», *The Quarterly Journal of Economics*, Vol. 122, No. 4,2007, pp. 1351–1408.

Branstetter, L., B. Glennon, e J. B. Jensen (2021). *The New Global Invention Machine. A Look Inside the R&D Networks of U.S. Multinationals*. In Foley F., J. Hines e D. Wessel (2021). *Global Goliaths — Multinational Corporations in the 21st Century*. Brookings Institution Press, Washington.

Cadestin, C., K. De Backer, I. Desnoyers-James, S. Miroudot, M. Ye and D. Rigo (2018). *Multinational enterprises and global value chains: New Insights on the trade-investment nexus*. OECD Science, Technology and Industry Working Papers 2018/05.

CDCEP. 2020. *Datação dos Ciclos Económicos Portugueses*, Comité de Datação dos Ciclos Económicos Portugueses, Fundação Francisco Manuel dos Santos, link.

Cardoso, Ana Rute, Paulo Guimarães, Pedro Portugal and Hugo Reis (2018). *The Returns to Schooling Unveiled*. IZA DP No. 11419. IZA Institute of Labour Economics.

Catão, Luís, Pedro de Faria, António Martins and Miguel Portela (2021). *Foreign Direct Investment and Global Value Chains in Portugal*. Fundação Francisco Manuel dos Santos.

Cruz, Carlos Oliveria and João Januário (2021). *Infrastructure and territory: on the next 10 years of public policy*. Fundação Francisco Manuel dos Santos.

Cunha-e-Sá, M. A., T. Dietrich, F. Marchioro, R. Rosa, C. F. Santos e C. Vieira da Silva (2021). *Contributions for a National Ocean Strategy*. Fundação Francisco Manuel dos Santos.

Dolado, J., S. Ortigueira and R. Stucchi (2016). *Does dual employment protection affect TFP? Evidence from Spanish manufacturing firms*, SERIEs: Journal of the Spanish Economic Association, Vol. 7/4, pp. 421-459.

D'Uva, Teresa B. E M. Fernandes (2017). *A Mobilidade Social em Portugal*. Fundação Francisco Manuel dos Santos.

DGEC (2020). *Energia em Números*. Direção Geral de Energia e Geologia.

Diamandis, Peter H.; Kotler, Steven (2020). *The Future Is Faster Than You Think: How Converging Technologies Are Transforming Business, Industries, and Our Lives*. Simon & Schuster.

Diogo, Fernando (Coordenação) (2021). *A Pobreza em Portugal — Trajetos e Quotidiano*. Fundação Francisco Manuel dos Santos. Link

European Banking Authority (2020). *First evidence on the use of moratoriums and public guarantees in the EU banking sector*. European Banking Authority Thematic Note EBA/Rep/2020/31. Available at here.

European Central Bank (2021). *Financial Stability Review*. Third Issue, May. Available here.

European Commission (2021). *The 2021 Ageing Report: Economic and Budgetary Projections is the EU Member States (2019-2070)*. European Commission. Link

Eichenbaum, Martin, Sérgio Rebelo e Carlos de Resende (2017). The Portuguese Crisis and the IMF. In M. Schwartz and S. Takagi (eds.) *Background Papers for The IMF and the Crises in The IMF and the Crises in Greece, Ireland, and Portugal*. International Monetary Fund.

European Commission (2020). *Foreign Direct Investment, Global Value Chains and Regional Development in Europe*. Available here.

European Commission. (2020). *Annual Sustainable Growth Strategy 2021 — Communication from the Commission*. Brussels, link

FJN (2021). *Estado da Nação — Educação, Emprego, Competências*. Fundação José Neves. Link

Foley, F., J. Hines e D. Wessel (2021). *Global Goliaths — Multinational Corporations in the 21st Century*. Brookings Institution Press, Washington.

Garicano, L., Lelarge, C., & Van Reenen, J., "Firm size distortions and the productivity distribution: Evidence from France", American Economic Review, Vol. 106, No. 11, 2016, pp. 3439–79.

Gopinath, Gita, Kalemli-Özcan, Şebnem, Loukas Karabarbounis, and Carolina Villegas-Sanchez. 2017. "Capital allocation and productivity in South Europe." The Quarterly Journal of Economics 132(4): pp. 1915-1967.

Goodhart, Charles, and Manoj Pradhan. 2020. *The Great Demographic Reversal — Ageing Societies, Waning Inequality, and an Inflation Revival*. Palgrave, MacMillan.London, UK.

Gouveia, A. and C. Osterhold, «Fear the walking dead: zombie firms, spillovers and exit policies», OECD Productivity Working Paper 13, 2017.

Hurst, E. and B. Pugsley, «What do small businesses do?», Brookings Papers on Economic Activity, Vol. 43 (2) 2012, pp. 73–142.

INE (2014). Type of Urban areas — Technical report. National Statistics Institute. Link.

Jalles, João T., Joaquim O. Martins and Pedro Brinca, *Business Environment: Competition, Markets and Taxation*, Francisco Manuel dos Santos Foundation, Lisbon, 2021.

Marchese, M., E. Giuliani, J. C. Salazar-Elena, I. Stone (2019). *Enhancing SME Productivity –Policy highlights on the role of managerial skills, workforce skills and business linkages*, OECD, Paris.

MGI (2018). *Superstars: the Dynamics of Firms, Sectors, and Cities Leading to the Global Economy*. McKinsey Global Institute.

Monteiro, G., Gouveia, A.F. and Santos, S. (2017). *Product markets' deregulation: a more productive, more efficient and more resilient economy?*, OECD Economics Department Working Papers, no. 9, Paris.

OECD (2020). *Recent Trends on Employment Protection Regulation, in Employment Outlook 2020*, available online here.

OECD (2020). *FDI Qualities Assessment of Ireland*. Link

OECD (2020). *Education at a Glance 2020: OECD Indicators*. OECD Publishing, Paris, link.

OECD/European Commission (2020). *Cities in the World: A New Perspective on Urbanisation*, OECD Urban Studies, OECD. Publishing, Paris, link

Philippon, Thomas, *The Great Reversal — How America Gave Up on Free Markets* (2019). The Belknap Press of Harvard University Press.

Portela, Miguel, Fernando Alexandre and Hélder Costa (2021). *Growing to the frontier: the entrepreneur and their circumstances*. Francisco Manuel dos Santos Foundation.

Reis, Ricardo (2013). *The Portuguese Slump and Crash and the Euro Crisis*. Brookings Papers on Economic Activity 44(1): pp. 143-210.

Sachs, Jeffrey (2020). *The Ages of Globalization: Geography, Technology, and Institutions*. Columbia University Press.

Santos, Filipe D. (2021). *Alterações Climáticas. Foundation Essays*. Francisco Manuel dos Santos Foundation.

Sequeira, T., P. Ferrão and L. Montelius (2021). *National Scientific and Technological System*. Francisco Manuel dos Santos Foundation.

Silva, António Costa (2021). *Visão Estratégica para o Plano de Recuperação Económica de Portugal 2020-2030*. XII Government of the Portuguese Republic. Link

Susskind, Daniel (2021). *A World Without Work — Technology, Automation and How We Should Respond*. Henry Holt and Co.

Ufuk Akcigit, Emin Dinlersoz, Jeremy Greenwood, and Veronika Penciakova (2019). *Synergizing ventures*. NBER Working Paper No. 26196, National Bureau for Economic Research, Cambridge, MA.

UK (2021). *UK Innovation Strategy — Leading the future by creating it*. Department for Business, Energy & Industrial Strategy.

Varejão, José, João Cerejeira, Miguel Portela and Joana Vasconcelos (2021). *Building the New Paradigm: Skills and Labour Markets*. Francisco Manuel dos Santos Foundation.

Parte II
Policy papers

Paper 1

Business environment: competition, markets and taxation[1]

João Tovar Jalles, Lisbon School of Economics and Management (ISEG)
Joaquim Oliveira Martins, University of Lisbon
Pedro Brinca, Nova School of Business and Economics

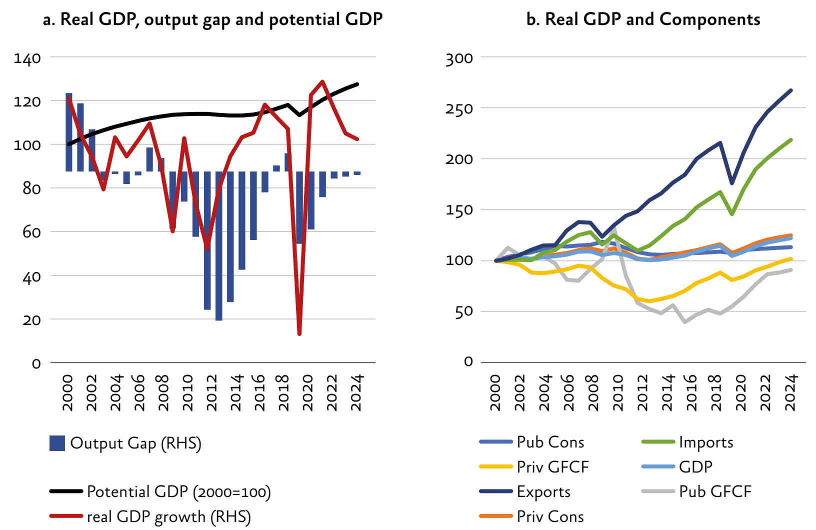
1.1. Introduction

The COVID-19 pandemic has cost lives and disrupted economic activity worldwide, including in Portugal. To prevent the spread of the virus, governments have imposed lockdowns with varying degrees of stringency, and the general population reduced exposure to the virus through voluntary social distancing. The result has been a dramatic contraction in economic activity in 2020, with global GDP estimated to have declined by 3.5 % (IMF, 2021). The projected rebound in 2021 is not expected to restore the pre-crisis GDP until 2022.

At the same time, the growth rate of potential output has declined in major advanced economies, and is likely to remain subdued. This came at a time when most economies had just recently fully recovered economically, financially and socially from the 2008 Global Financial Crisis, but the overall productivity record was kept at historically low levels (Adler et al., 2017). And Portugal was no exception. In fact, since the late 1990s, total factor productivity (TFP) growth in Portugal has been, on average, zero — which led many national economists to name it the *lost decade* (Amaral, 2010), now having completed a full two decades. The recent COVID-19 crisis is generating concern that productivity growth may further decline (Mauro and Syverson, 2020 and Baldwin and Weder di Mauro, 2020).[2] More worrisome is the set of divergent recoveries that will follow (IMF, 2021).

The Portuguese economy has stagnated in the last two decades. In figure 1.1, panel a), we observe that potential real GDP only increased by an accumulated 13 % over the 2000-2020 period. Moreover, it is expected that the economic activity will rebound strongly after 2020's COVID-19-led recession to then converge to rates of growth below 2 % yearly by 2025 (and by then, the output gap will still be negative). In panel b), we see the internalisation component flashing out, with both real exports and imports, much above the level of the year 2000 (both variables with cumulative growth above 100 %). In contrast, we have a persistent decline in real public and private investment while real public and private consumption practically did not grow over a 20-year time horizon.

Figure 1.1 **Evolution of Portugal´s economy, 2000-2025**



Source: authors with IMF WEO data. Right hand side chart with real GDP components also expressed in constant real terms. Index with 2000=100. 2021–2025 data points denote WEO forecasts as of January 2021.

Although the COVID-19-led crisis (and, previously, the Global Financial Crisis) can be thought of as a factor in Portugal´s slowdown/stagnation, not least through its effect on investment, the decline in potential growth started in the early 2000s (figure 1.1), which suggests that deeper structural factors have been at play. This paper aims to identify key weak links in terms of the structural reform package and coordination failures across levels of government, which have hindered growth and catching-up potential. Adopting the right regulation for product and labour markets, as well as for finance and trade, while simultaneously creating a business-friendly (i.e., internationally attractive tax system) and a fair local and regional competition environment, are all important avenues going forward. These are the key aspects this paper aims to explore in more detail.

The remainder of the paper is organised as follows. Section 2 provides an overview of the Portuguese macroeconomic context over the past two decades. Section 3 elaborates on the outward developmental strategy with a focus on the structural reform response. Section 4 explores the inward developmental strategy elaborating on regional governance and urban policies. And the last section concludes and elaborates on policy recommendations.

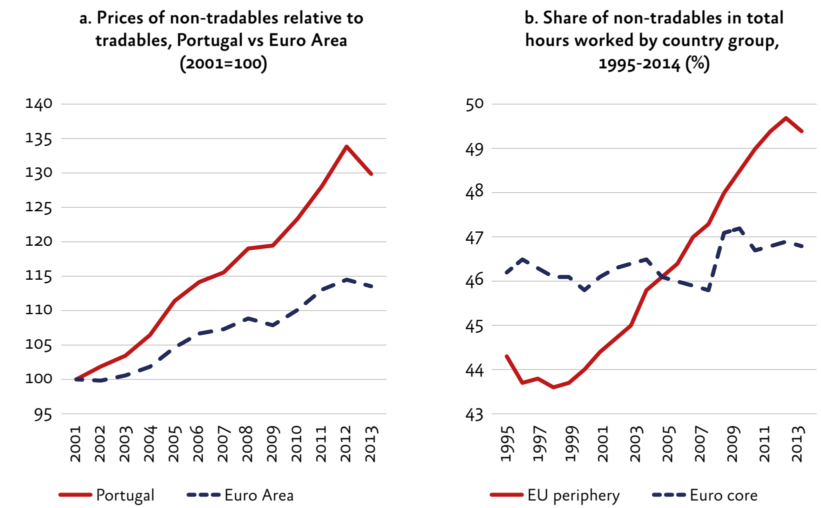
1.2. Portugal´s macroeconomic context

Over the past 30 years, the process of Portugal's increased integration into the global economy was strongly conditioned by the creation of the European Single Market, in 1992, and the Eurozone in 1999. These processes had an influence on a fundamental determinant of the outward orientation of an economy: the relative price of the non-tradable (NT) vs the tradable (T) sector (P_N/P_T). It is not easy to define an appropriate level for this relative price[3], but its increase clearly generates incentives for the supply-side to shift to non-tradable activities, while the demand-side of the economy reacts exactly in the opposite manner. Without enough structural flexibility in the economy, particularly in its exchange rate regime, there is a tendency for external deficits to emerge. Obviously, the latter only materialises to the extent that international financial markets are willing to finance them.

During the 1990s, the process of nominal convergence of the Portuguese economy was anchored in the limitation of exchange rate fluctuations relative to its European partners. The positive inflation differential with core European countries induced an appreciation of the Real Exchange Rate (RER). As it is well-known, the fluctuation of the relative prices P_N/P_T approximately follow those of the real exchange rate.[4] Therefore, since the beginning of the 1990s, there have been price incentives to develop the supply of non-tradable activities. While there is nothing wrong with the development of non-tradable services, when this process is premature and exaggerated, it may lead to a slowdown in the productivity catching-up process, as suggested by Rodrik (2016).

After 2000, the economy was stabilising, and inflation was converging towards the European average, but the real exchange rate appreciation continued, this time driven by the strong nominal appreciation of the Euro (from parity with the dollar in early 2000, the euro reached nearly $1.6 in July 2008).[5] According to the OECD (2014), the relative price P_N/P_T further increased by 34 % between 2000 and 2012 [figure 2.1, panel a)]. The rising share of the non-tradable sector before the Global Financial Crisis, which Portugal experienced, was also followed by other EU periphery countries [figure 2.1, panel b)]. Such increase was concomitant with a steep rise in the TFP in the T vs NT sectors and a collapse in the long-term interest rates (Piton, 2017). Moreover, a large current account deficit (above 10 % of GDP) emerged for the Portuguese economy during the 1999-2011 period. Such large current account deficits and associated capital inflows often exacerbate deindustrialisation and the risk of a subsequent economic slump (Benigno et al., 2015). Geerolf (2020) also suggests that there is a trade-off between relative prices (real exchange rates) and unemployment, which is coherent with the strong rise of Portuguese unemployment during the period of real exchange rate appreciation.

Figure 2.1 **Development of the tradable vs non-tradable sector in Portugal and comparators**



Note 1: panel a), Ratio of harmonised index of consumer prices (HICP) of non-tradable sectors to HICP of tradable sectors. Source: OECD, Economic Survey of Portugal (2014).
Note 2: Panel b), a threshold of 10 % is used for the measure of tradability. Averages over countries weighted by the number of hours worked. The periphery includes: Greece (EL); Spain (ES); Ireland (IE) and Portugal (PT). The core countries are: Austria (AT); Belgium (BE); Germany (DE); Finland (FI); France (FR); Italy (IT); Luxembourg (LU) and the Netherlands (NL). Source: Piton, 2017

In regard to these developments, the recent increase in export intensity (X/GDP) and reduction of trade deficits are good news. Following 2011–2014 macroeconomic adjustment programme, aggregate demand was compressed without the possibility for a nominal exchange rate adjustment.[6] With no compensation between domestic and foreign demand, the economy entered a very deep recession. However, the external account was adjusted and turned into a surplus in 2013. Between 2014–2017, the euro depreciated by roughly 25 % against de dollar. This helped resume parts of the tradable sector. A large boom of the tourism sector further increased foreign demand and helped stabilise the current account.

However, the specialisation structure of the Portuguese economy suffers from important shortcomings. To assess the revealed comparative advantages (RCA), we used a simple indicator measuring the difference between the export (X) and import (M) shares for each product.[7] This normalisation allows a structural reading of trade specialisation less influenced by the short-term developments and fluctuations of the current balance. The evolution of the top-20 comparative advantages and disadvantages of Portugal between 1970 and 2018 is displayed in table 1.1.

Since the 1970s, the Portuguese economy has evolved from a specialisation in low-differentiation goods, such as textiles, clothing, paper, leather or wood articles, to more sophisticated products, such as vehicle components, consumer electronics or electrical apparatus. Nonetheless, in 2018, the main comparative advantages (by decreasing order) were still refined oil products, paper, knitwear, leather, furniture, wood articles, rubber articles and beverages. On the comparative disadvantage side, crude oil appears consistently at the top, since it is used as an intermediate to produce refined products, followed by high-tech or more sophisticated goods, and also by edible agricultural and food products, such as meat, fish and cereals.

The Portuguese specialisation structure is the result of both market mechanisms and policy-driven factors. The dominance of low-differentiation segments in the manufacturing sector is coherent with the low endowments of human capital and innovation capacities. The emergence of new, more sophisticated sectors has been driven by a sustained investment in Science & Technology, and Tertiary Education, notably through the use of EU structural funds and the integration in Global Value Chains (hereafter, GVCs). All these investments take time to materialise, but they provide a basis for an upgraded economic structure in the future. The fact that refined oil appears as the main comparative advantage is definitely the result of specific policies, which started in the early 1970s, around the port of Sines (south of Lisbon) and the development of a petrochemical complex.

However, given the ongoing global transition towards a low-carbon economy, currently with refined petroleum products as one of the main sources of export revenues, refined oil does not seem sustainable over the medium term. It would be important to consolidate the emerging comparative advantages on more sophisticated tradable goods as they are the result of the increasing integration of the Portuguese economy in Global Value Chains. The attraction of Foreign Direct Investment (FDI) is a requirement for this change to materialise (discussed below).

Table 1.1 **Comparative advantages and disadvantages of the Portuguese economy, 1970–2018**

TOP-20 Comparative advantages of the Portuguese economy

	1970		1980		1990		2000		2010		2018
Yarns fabrics	10,22	Clothing	7,20	Knitwear	9,89	Knitwear	5.68	Paper	3,73	Refined petroleum products	4.21
Beverages	7,79	Wood articles	6,06	Clothing	9,68	Leather	4.84	Refined petroleum products	3,21	Paper	2.90
Wood articles	5,03	Knitwear	5,78	Leather	6,04	Electrical apparatus	3.70	Knitwear	2,65	Knitwear	2.10
Clothing	4,52	Beverages	5,29	Wood articles	4,49	Wood articles	3.47	Wood articles	2,15	Leather	1.97
Paper	4,23	Carpets	5,08	Paper	3,68	Clothing	3.24	Leather	2,12	Miscellaneous hardware	1.86
Preserved fruits	3,34	Yarns fabrics	4,84	Carpets	3,61	Paper	3.20	Miscellaneous hardware	1,88	Furniture	1.80
Knitwear	3,00	Paper	4,79	Beverages	2,28	Carpets	2.98	Beverages	1,74	Wood articles	1.72
Carpets	2,99	Refined petroleum products	3,63	Non ferrous ores	2,00	Cars and cycles	2.84	Vehicles components	1,61	Rubber articles (incl. tyres)	1.20
Preserved meat/fish	2,63	Leather	3,41	Refined petroleum products	1,53	Consumer electronics	2.41	Non ferrous ores	1,59	Beverages	1.16
Paints	1,74	Jewellery, works of art	2,09	Ceramics	1,37	Miscellaneous hardware	1.35	Furniture	1,58	Non ferrous ores	1.13
Leather	1,63	Preserved meat/fish	2,08	Cement	1,06	Beverages	1.33	Consumer electronics	1,29	Vehicles components	1.12
Non ferrous ores	1,13	Consumer electronics	1,48	Miscellaneous hardware	0,81	Ceramics	0.85	Ceramics	1,15	Metallic structures	1.05
Fats	1,07	Preserved fruits	1,46	Electrical apparatus	0,54	Furniture	0.59	Rubber articles (incl. tyres)	1,12	Ceramics	1.01
Cement	0,95	Miscellaneous hardware	1,04	Furniture	0,50	Non ferrous ores	0.58	Electrical apparatus	1,11	Manufactured tobaccos	0.87
Unprocessed minerals n.e.s.	0,78	Arms	0,95	Glass	0,39	Glass	0.48	Carpets	1,09	Carpets	0.83
Glass	0,69	Paints	0,82	Fats	0,36	Cement	0.36	Manufactured tobaccos	0,80	Consumer electronics	0.78
Refined petroleum products	0,55	Electronic components	0,78	Jewellery, works of art	0,34	Electrical equipment	0.34	Glass	0,76	Electrical apparatus	0,65
Electronic components	0,51	Ships	0,77	Preserved fruits	0,28	Electronic components	0.26	Metallic structures	0,75	Fats	0.55
Miscellaneous hardware	0,42	Cement	0,73	Electronic components	0,17	Refined petroleum products	0.22	Cement	0,72	Cement	0.52
Fertilizers	0,39	Ceramics	0,72	Unprocessed minerals n.e.s.	0,16	Preserved fruits	0.18	Clothing	0,68	Glass	0.41

TOP-20 Comparative disadvantages of the Portuguese economy

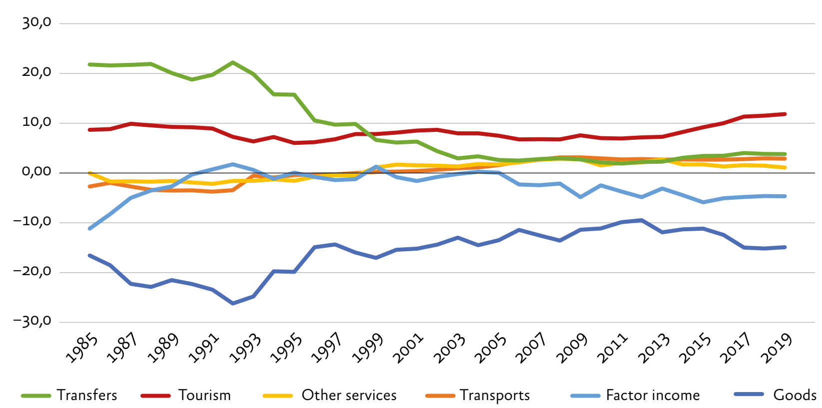
	1970		1980		1990		2000		2010		2018
Specialized machines	-4,82	Crude oil	-21,01	Crude oil	-7,53	Crude oil	-6,28	Crude oil	-8,69	Crude oil	-7,73
Cars and cycles	-4,54	Cereals	-5,44	Specialized machines	-4,37	N.e.s. products	-3,70	N.e.s. products	-3,26	Toiletries	-1,82
Crude oil	-4,14	Specialized machines	-3,92	Cars and cycles	-2,87	Computer equipment	-2,03	Pharmaceuticals	-2,58	Pharmaceuticals	-1,72
Iron and steel	-4,01	Engines	-2,76	Other edible agricultural products	-2,57	Telecommunications equipment	-1,88	Natural gas	-1,58	Natural gas	-1,68
Cereals	-3,23	Plastic articles	-2,40	Yarns fabrics	-2,46	Specialized machines	-1,69	Ships	-1,48	Meat and fish	-1,67
Engines	-2,76	Non-ferrous metals	-2,17	Vehicles components	-2,23	Meat and fish	-1,68	Meat and fish	-1,38	Non-ferrous metals	-1,14
Non-ferrous metals	-2,71	Basic organic chemicals	-2,15	Computer equipment	-1,96	Other edible agricultural products	-1,45	Computer equipment	-1,38	Computer equipment	-1,09
Commercial vehicles	-2,36	Iron and steel	-2,11	Iron and steel	-1,95	Commercial vehicles	-1,37	Cars and cycles	-1,33	Aeronautics	-0,98
Other edible agricultural products	-1,94	Other edible agricultural products	-2,09	N.e.s. products	-1,40	Construction equipment	-1,21	Miscellaneous manuf. articles	-1,09	Telecommunications equipment	-0,97
Plastic articles	-1,80	Cars and cycles	-1,94	Non-ferrous metals	-1,35	Iron and steel	-1,16	Toiletries	-0,98	Cereals	-0,91
Sugar	-1,79	Construction equipment	-1,92	Commercial vehicles	-1,34	Pharmaceuticals	-1,15	Cereals	-0,96	Specialized machines	-0,91
Aeronautics	-1,71	Commercial vehicles	-1,64	Construction equipment	-1,34	Engines	-1,12	Telecommunications equipment	-0,92	N.e.s. products	-0,88
N.e.s. products	-1,57	Agricultural equipment	-1,25	Engines	-1,27	Yarns fabrics	-1,04	Non-ferrous metals	-0,89	Miscellaneous manuf. articles	-0,84
Agricultural equipment	-1,40	Vehicles components	-1,25	Cereals	-1,02	Miscellaneous manuf. articles	-1,03	Engines	-0,72	Electronic components	-0,66
Domestic electrical appliances	-1,34	Sugar	-1,21	Telecommunications equipment	-0,96	Non-ferrous metals	-0,97	Precision instruments	-0,69	Other edible agricultural products	-0,60
Plastics	-1,31	Natural gas	-1,06	Miscellaneous manuf. articles	-0,96	Precision instruments	-0,92	Other edible agricultural products	-0,60	Iron and steel	-0,56
Vehicles components	-1,25	Animal food	-0,96	Meat and fish	-0,93	Cereals	-0,88	Iron and steel	-0,51	Machine tools	-0,49
Construction equipment	-1,25	Pharmaceuticals	-0,93	Precision instruments	-0,90	Vehicles components	-0,87	Specialized machines	-0,39	Engines	-0,49
Basic organic chemicals	-1,16	Machine tools	-0,77	Coals	-0,88	Non-edible agricultural products	-0,82	Electronic components	-0,38	Paints	-0,48
Pharmaceuticals	-0,98	Plastics	-0,74	Machine tools	-0,86	Natural gas	-0,78	Construction equipment	-0,36	Construction equipment	-0,48

Note: Revealed Comparative Advantages are measured as $RCA_i = (X_i/\Sigma X_j — M_i/\Sigma M_j).100$. Source: CEPII–CHELEM International Trade Database and authors' calculations.

Looking at the current account of the Portuguese economy in broader terms, using the same approach, we observe that the external accounts depend critically on invisible trade to compensate a structural trade deficit and a growing structural deficit on factor income (figure 2.2). The latter is the result of a significant level of net external debt. In the early 2000s, tourism replaced transfers (both public and private[8]) as the main contribution to the current account, and its weight further increased after 2014–2015.[9]

The specialisation in services and tourism can be a long-term source of external revenues, but, again, it would be important that the Portuguese economy developed a stronger diversification on other tradable sectors. Indeed, the COVID-19 pandemic showed how fragile an almost exclusive specialisation on tourism flows could be.

Figure 2.2 **Contributions to the current account balance, Portugal, 1985–2019**

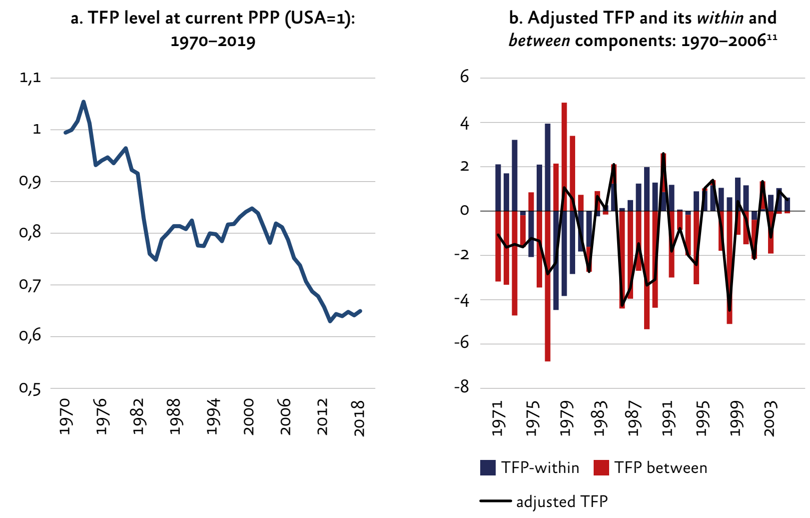


Source: CEPII–CHELEM Balance of Payment database and authors' calculations.
Note: the contributions to the current account balance are measured as $CCA_i = (C_i/\Sigma C_i - D_i/\Sigma D_i).100$, where C_i and D_i are the credits and debits for operation i, respectively.

The view that the Portuguese economy needs to rebalance towards tradable sectors and, concomitantly, increase their domestic value-added content is also supported by the dismal productivity performance in recent decades. Since a large part of the productivity catching-up potential in a small open economy is associated with tradable sectors, an important consequence of the structural shift experienced by the Portuguese economy towards non-tradables was the loss of a window of productivity catching-up associated with the production of tradable goods and services.

Portugal's Total Factor Productivity (TFP) is at historically low levels [figure 2.3, panel a)] relative to the world´s frontier economy, the USA. Figure 2.3, panel b), plots the capacity utilisation adjusted TFP and its two components: growth of productivity within the different sectors (the *within effect*) and growth of productivity stemming from the reallocation of labour between sectors (the *between effect*).[10] We observe that, in the case of Portugal, the between component (resource misallocation between sectors) was the one, on average, pushing TFP downwards since the late 1980s. In 2019, the average level of value-added per hour worked in Portugal was around $40 (constant prices, PPPs), compared to $54 for the OECD and the EU, $60 for the Euro area, $52 for Spain, $66–67 for France and Germany, $102 for Ireland and $72 for the US.[11] However, the Portuguese economy still has a significant productivity catching-up potential with ample room to improve its economic efficiency.

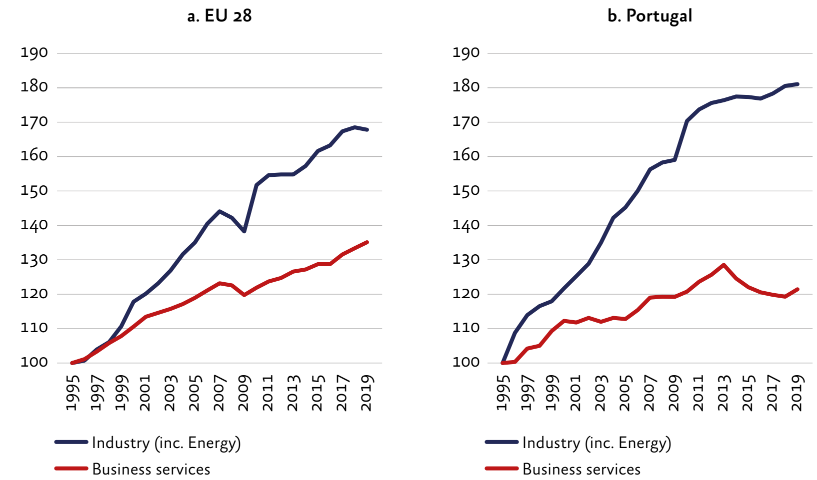
Figure 2.3 **Total Factor Productivity in Portugal**[12]



Note 1: panel a) TFP level at current PPPs (USA=1). Source: Penn World Tables 10.0.
Note 2: panel b) capacity-utilisation adjusted TFP with *between* and *within* sector components. Source: authors with Furceri et al. (2020) data.

There is evidence that labour productivity tends to be higher in tradable sectors. Between 1995–2019, in EU countries, labour productivity growth in the industry more than doubled the growth rate of productivity in business services (figure 2.4). In Portugal, the productivity gap between the two sectors is even bigger. According to Rodrik (2013), industry (and, by extension, tradable sectors) can also provide an *unconditional convergence* mechanism, meaning that it is less dependent on specific country factors related to endowments (physical and human) or the quality of institutions, for example.

Figure 2.4 **Labour productivity in industry vs business services, EU-28 vs Portugal: 1995–2019**



Note: Gross Value Added per hour worked. Source: OECD Statistics, OECD.Stat, Mar 2021.

In the context of the COVID-19 pandemic, some state aid rules to companies covered by the European Union Treaty have been suspended, allowing member states to provide state aid to national companies that would not be allowed under normal circumstances. In table 1.2 below, we can see the amount of discretionary spending in response to the COVID-19 pandemic by category of support. As depicted, there is a large degree of heterogeneity, with countries like Germany and France having a much more decisive action regarding discretionary spending.[13] In the case of these two countries, the support programmes amounted to 8.3 % and 5.1 % of their GDP, respectively. Germany, Belgium, Italy and the UK also stood out by the massive aid in the form of export guarantees, direct liquidity provision and credit lines, representing about 24.3 %, 21.9 %, 32.1 % and 15.4 % of their GDP, respectively.

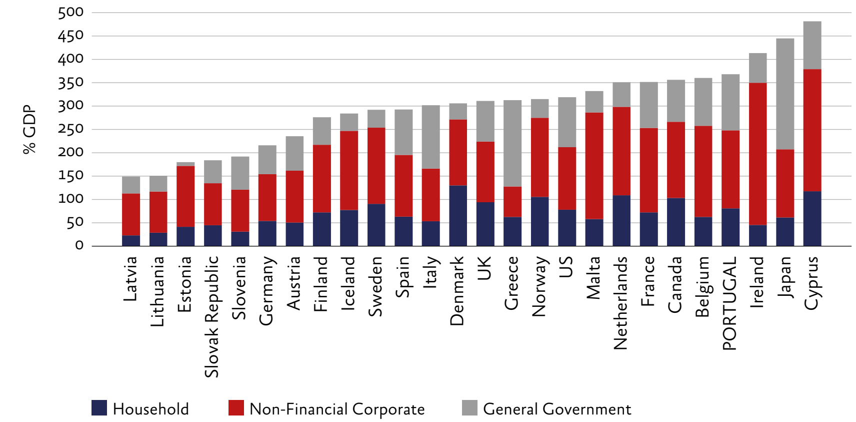
Table 1.2 **Discretionary fiscal measures in response to COVID-19 (in %)**

Country	Immediate Fiscal Impulse	Deferral	Other Liquidity/ Guarantee	Last update
Belgium	1.4	4.8	21.9	22/10/2020
Denmark	5.5	7.2	4.1	01/07/2020
France	5.1	8.7	14.2	05/11/2020
Germany	8.3	7.3	24.3	04/08/2020
Greece	3.1	1.2	2.1	05/06/2020
Hungary	0.4	8.3	0.0	25/03/2020
Italy	3.4	13.2	32.1	22/06/2020
Netherlands	3.7	7.9	3.4	27/05/2020
Portugal	2.5	11.1	5.5	04/05/2020
Spain	4.3	0.4	12.2	18/11/2020
UK	8.3	2.0	15.4	18/11/2020
US	9.1	2.6	2.6	27/04/2020

Note: discretionary fiscal measures adopted in response to the COVID-19 pandemic by 18 November 2020 expressed in % of 2019 GDP. Source: Anderson et al. (2020)

Portugal seems to have followed a different path, with a stronger bet on deferrals. These deferrals reached about 11.1 % of GDP, and even though they provide much-needed liquidity to the economy, they are support instruments that consist of future liabilities, thus adding debt to what was already a very high level of indebtedness of the private corporate sector. The Portuguese private corporate sector debt reached 167 % of GDP in 2018 (figure 2.5). The fact that the Portuguese corporate sector is heavily indebted makes it especially vulnerable to systemic shocks and can impair economic growth.[14]

Figure 2.5 **Household, non-financial corporate and general government debt, 2018**



Source: IMF Global Debt Database

The motivation behind the regulation of state aid by the European Union Treaty has to do with the good functioning of the common market as the main factor of improvement in people's welfare, firms' performance and the society at large, therefore avoiding competition restrictions and distortions. In a context with such a large degree of heterogeneity in state aid among different countries, with Portugal being the most frugal in this dimension, it is expected that the systematic competitiveness problem of Portuguese firms in the common market will only get worse. Given that the Portuguese sovereign debt interest rate is at an historical minimum — as a result of the current sovereign debt purchase programmes by the European Central Bank and the threat posed by recent economic dynamics in terms of job and firm destruction — it is hard to imagine any other time when a more decisive support could be so determinant in sustaining the productive capacity of the Portuguese economy, as well as it's medium-run competitiveness.

To sum up, the COVID-19 crisis has put a strong break on a still fragile development model. The GDP shock of 2020 was around –8 to –9 %. The near-collapse of international tourism in 2020 may explain a significant part of this shock. Based on preliminary OECD projections, the expected recovery of the Portuguese economy for 2021–22 may remain somewhat subdued compared with other OECD countries. The idea that COVID-19 is a short-term shock and that the Portuguese economy will rebound quickly becomes ever more unlikely. Pandemic risks are here to stay, at least in the medium term. A more competitive economy leads to higher incomes, and more and better jobs. Portugal should, therefore, adopt a highly strategic view regarding its long-term future. To evolve towards a *created in* model, overcome negative incentives to develop a more diversified supply of tradable products and services, re-boost productivity convergence and develop the resilience of the supply towards possible future relative price shocks, Portugal needs to generate flexibility in the economy and enhance business conditions through appropriate structural reforms. These issues will be explored in more detail in the remainder of this paper.

1.3. An outward look: the structural reform response

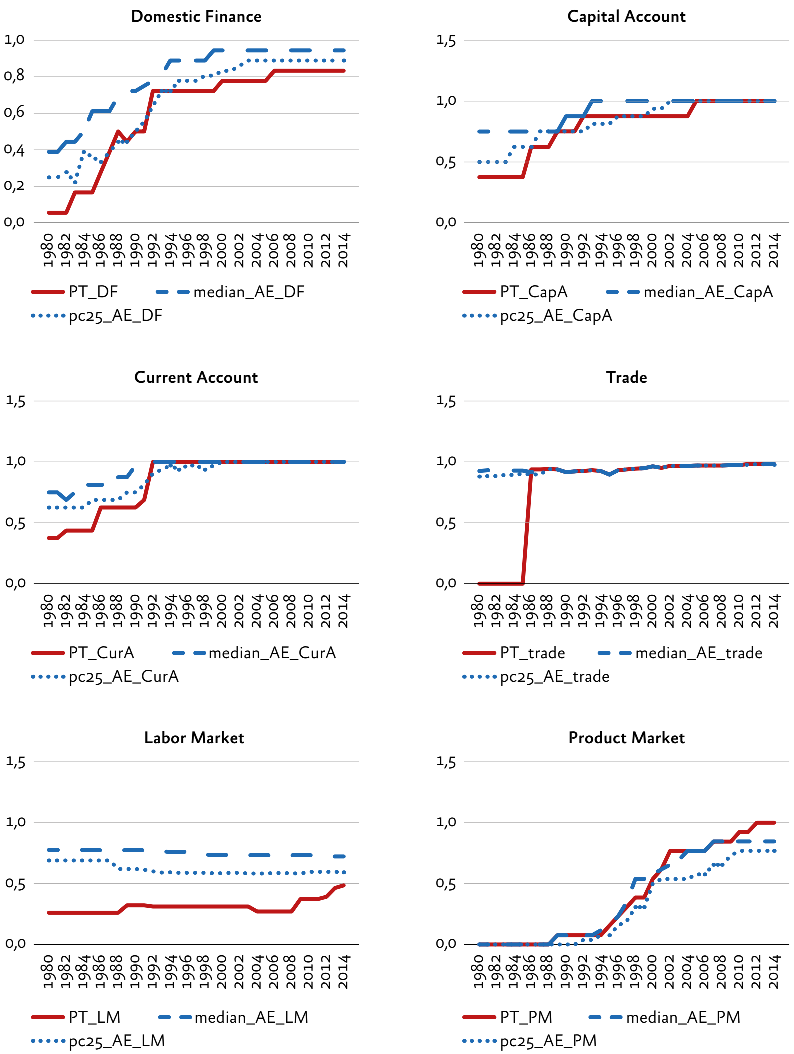
Without nominal exchange rate flexibility, a small open economy needs increased macro-structural flexibility. This entails a sustained programme of structural reforms to increase the resilience of the economy (IMF, 2019a) to external shocks, and the creation of incentives to develop the tradable sectors, both goods and services. The latter are essential to reopen the possibility of resuming part of the convergence process with more advanced countries. This will help both short-run recovery and medium to long-run potential growth catching-up. The priorities of the structural reforms' agenda should include: i) business-friendly regulation; ii) an internationally competitive tax system; iii) efficient private-public sector relationships and; iv) attraction of FDI for GVC integration. In what follows, we will elaborate on each of these aspects.[15]

1.3.1. Resurrecting the structural reform momentum

There exists a consensus on the desirability of making markets more efficient to increase productivity, international competitiveness and employment, and improve future growth prospects (OECD, 2012; European Commission, 2013; IMF, 2013, 2016). Weak growth and shrinking macroeconomic policy space in several euro area countries, including Portugal, led international organisations to emphasise the importance of structural reforms, which are motivated by multiple policy objectives.[16]

Portugal has made progress in many policy and regulatory areas over time (particularly in the context of the bailout financial assistance programme), but its convergence towards the average of other advanced economies stalled.[17] Using recent data from Alesina et al. (2019), figure 4 plots the reform developments in six regulatory areas.[18] More specifically, we plot the evolution of composite indicators of domestic finance[19], external finance[20], trade[21], product[22] and labour market.[23] Less progress has been made in labour market reforms. This may be because labour market regulations importantly aim to protect workers from the risk of income loss — even though this may be best pursued by shifting from stringent employment protection legislation toward unemployment insurance (Duval and Loungani, 2019). There is also some scope to do more in domestic finance regulations.

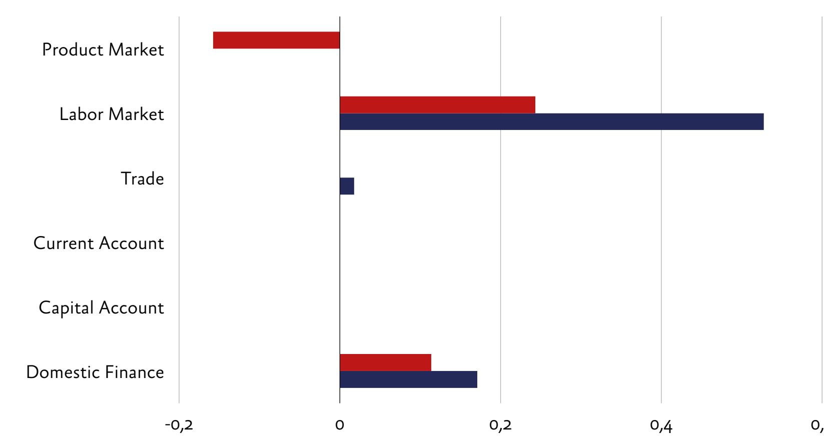
Figure 3.1. **Structural reforms in Portugal over time, 1980–2014**



Source: authors, based on Alesina et al. (2019) data. All indices are normalised to vary continuously between 0 and 1, with 0 indicating the most restrictive regulations in a given policy area and 1 indicating the most unrestricted or liberalised ones.

Figure 3.2 shows average liberalisation gaps in Portugal for all policy areas under analysis with two different metrics.[24] Relative to other advanced economies, it outperforms in domestic finance and product markets. A notable exception is the labour market liberalisation indicator, which still displays a gap of about half of the indicator's range (blue bar). The employment protection for permanent contracts remains one of the strongest in the euro area, leading to labour market segmentation. It is important to make permanent contracts more flexible rather than costlier temporary contracts, as this would help Portugal better address adverse shocks. With growth declining due to the COVID-19 pandemic, some of these rigidities are becoming more binding, which means that it is paramount to have wage growth consistent with productivity developments in order to maintain competitiveness.

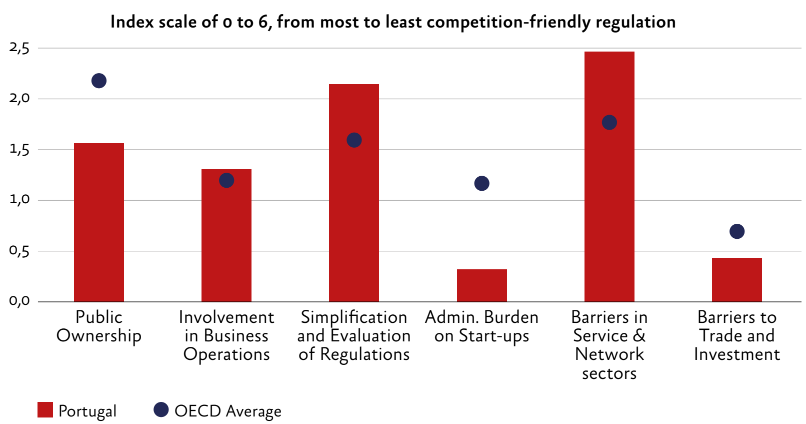
Figure 3.2 **Portugal liberalisation gaps: scale, 0–1; higher scores indicate a greater gap in liberalisation, 1980–2014**



Note: blue bars represent the distance of Portugal's level in 2014 from 1 in each index; red bars represent the distance of Portugal's level in 2014 from the advanced economies' median in each index. Sources: authors with Alesina et al. (2019) data.

While overall product markets´ regulatory barriers to competition in Portugal are slightly below the OECD average, there still exists scope for improvement in some sub-areas and sectors (Vitale et al. 2020). More specifically, the regulatory framework of the Portuguese service sector is less competition-friendly than in many other OECD countries. Similarly, more could be done to improve the area of simplification and evaluation of regulations (figure 3.3). In addition, there is room to improve the regulatory set-up in the transport sector, in particular water transportation, where there are numerous restrictions to competition. The Portuguese regulatory framework of the retail trade is also less competition friendly than in most other OECD countries.[25] Finally, energy continues to be characterised by relatively high prices, affecting the competitiveness of firms in tradable sectors (IMF, 2019).[26]

Figure 3.3 Economy-wide product market regulation indicators by components, 2018[27]

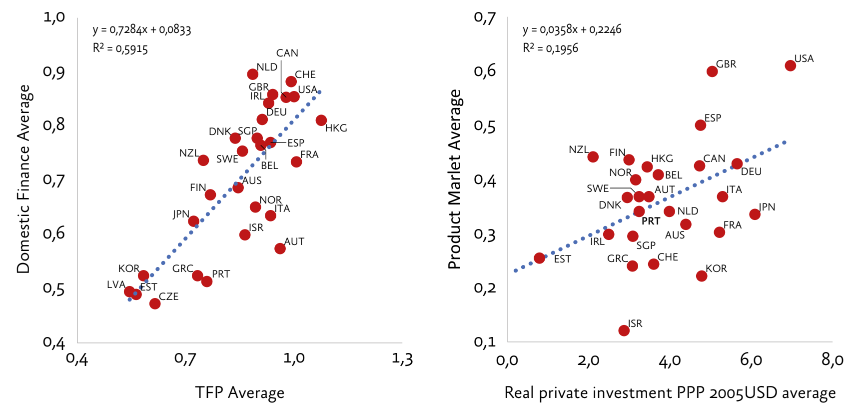


Note: all averages include only OECD countries. Information refers to laws and regulation in force on 1 January 2018. Source: OECD 2018 PMR database.

Why is it important to promote structural reforms and improve Portugal´s regulatory and business environment?

As figure 3.4 shows, using Alesina et al. (2019) data for a panel of advanced economies, there is a positive (unconditional) association between structural reforms and productivity, investment and employment. This is particularly true in the case of the product market and domestic finance, where Portugal still has room for improvement.

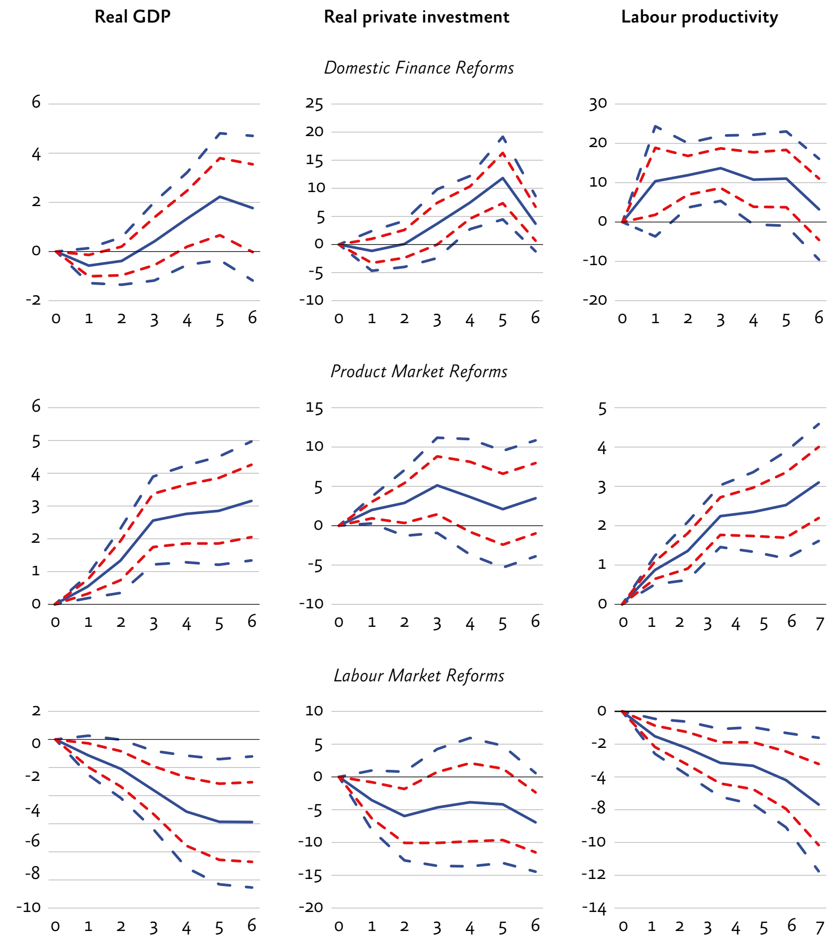
Figure 3.4 Correlation between macro indicators and selected structural reforms, advanced economies, 1980–2014



Note: average cross-country indicators of domestic finance and product market on the y-axis. Average cross-country TFP and real private investment at 2005 PPP USD on the x-axis. Source: authors using Alesina et al. (2019) structural reform data, Penn World Tables´ TFP data, and WEO investment data.

Moreover, major historical reforms have had sizable average positive effects on output over the medium term (figure 3.5).[28] In normal times, the reforms analysed here, using a sample of advanced economies, do not appear to entail short-term macroeconomic costs, except labour market analysis, which should be carried out in times of economic expansion (Duval et al., 2020). Product market deregulation pays off rather quickly. In addition, wide confidence bands around point estimates are indicative of significant cross-country differences regarding the effects of past reforms.[29]

Figure 3.5 Average effects of reforms (%)



Note: the statistical method follows the approach proposed by Jordà (2005). The baseline specification controls for past economic growth and past reforms, as well as country and time-fixed effects. The x-axis represents the years; t=0 is the year of the shock. Solid lines denote the response to a major historical reform, blue dashed lines denote 90 % confidence bands, and red dashed lines denote 68 % confidence bands, based on standard errors clustered at the country level. Source: authors, using Alesina et al. (2019) structural reform data, and WEO data for other macroeconomics variables.

Against these challenges, the economic literature recognises the important role of political economy considerations for the implementation of reforms and to foster deregulation (Duval et al., 2018; Alesina et al., 2019; Gupta and Jalles, 2020). Reforms may not happen due to the ideology of the ruling government — left-leaning governments are typically less inclined to undertake reforms. Moreover, in a government with a large number of strong players and fragmented decision making, there is a tendency to preserve the *status quo* on fiscal matters. Finally, national elections can be a source of policy volatility when the incumbents use fiscal policies for re-election purposes. Overcoming these challenges, one must be mindful that the state of the business cycle matters as reforms are (politically) penalised during contractions, unlike those undertaken during expansions, which may even be rewarded (Alesina et al, 2019). In the current juncture, recent research shows that past pandemics seemed to have propelled reforms in the same way as predicted by the Drazen and Grilli's (1993) *crisis-led reforms* hypothesis (Gupta and Jalles, 2021).

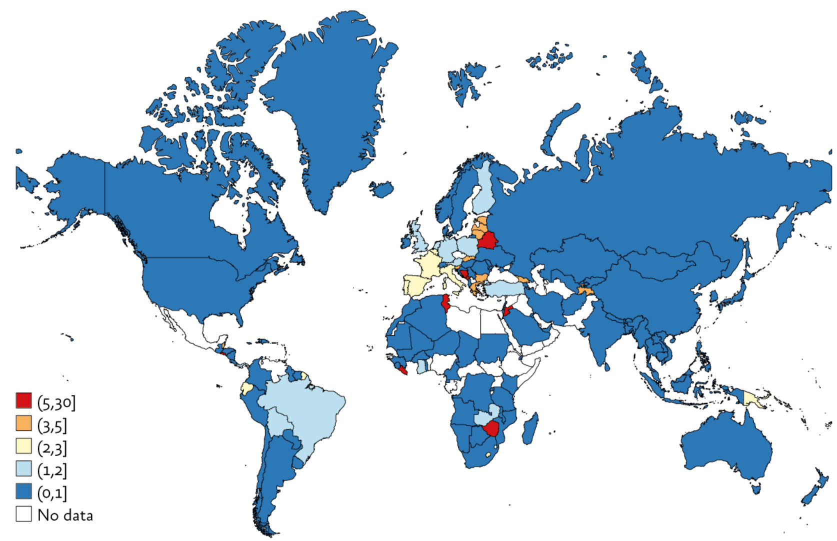
BOX 1: Key Recommendations

- Capitalise and build on past reforms, particularly on the labour market front:
  - mitigate labour market duality by reducing the employment protection legislation gap between permanent and temporary contracts, as this will improve job quality and strengthen training incentives.
  - In the context of the post-COVID-19 recovery, increase resources on the more effective labour market programmes to reinforce social protection and reduce precariousness and poverty.
- While the Portuguese Competition Authority (AdC) has taken steps towards adopting the OECD recommendations from the Competition Review (2018), more can be done in the energy, water and transport sectors as well as in retail trade.

1.3.2. Promoting an (internationally) competitive tax system

Portugal's tax burden is one of the highest in the world (figure 3.6). More importantly, Portugal's corporate sector tax competitiveness has been dropping over the years. Portugal has not only one of the largest average marginal Corporate Income Tax (CIT) rates but also one of the most progressive. Combined, these factors remove incentives to scale-up production with negative consequences for private investment, productivity and growth. These policy-induced incentives have contributed to the proliferation of Small and Medium Enterprises (SMEs) in Portugal.

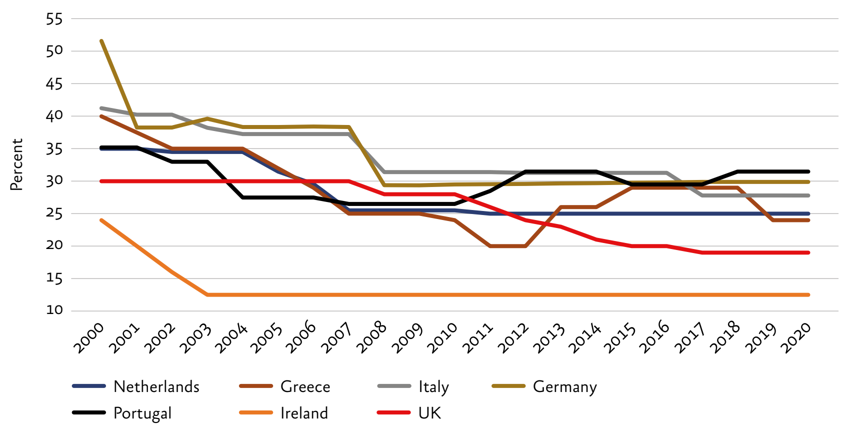
Figure 3.6. Tax burden across the world, 2017



Note: tax burden computed for all countries with sufficient available data using the Bird (1967) index. Alternatively, using the Frank's (1959) *tax sacrifice* measure yields similar results. Source: Barros, Jalles, Sarmento (2020).

In the last 20 years, Portugal has kept its fiscal burden on corporate income relatively constant, unlike other West-European economies. As it can be observed in figure 3.7, Portugal's average marginal corporate income tax rate was about 35 % at the beginning of the century, well below Germany, Ireland and Italy, though still above the UK. In the 20 years that followed, all the plotted countries decreased their average marginal tax rates, including Portugal, with Germany's[30] and Italy's rates converging towards the Portuguese one (30 %), and the UK and Ireland's rates lowering even more substantially (to about 20 % and 13 %, respectively). As a consequence, Portugal lost its competitive hedge on what corporate income marginal tax rates are concerned. On top of that, the country's highest marginal tax rate did not follow the overall decrease observed in the other countries.

Figure 3.7 **Statutory corporate income tax rates for selected West European countries.**

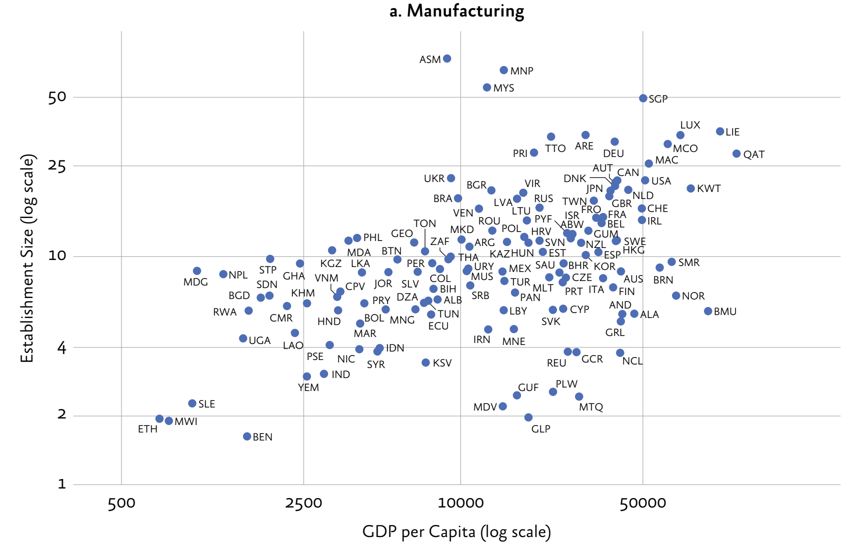


Note: for countries with progressive taxation structures, we reported the top marginal tax rate on corporate profits. Rates are computed including taxes from different government layers (local, state and central government). Source: OECD.

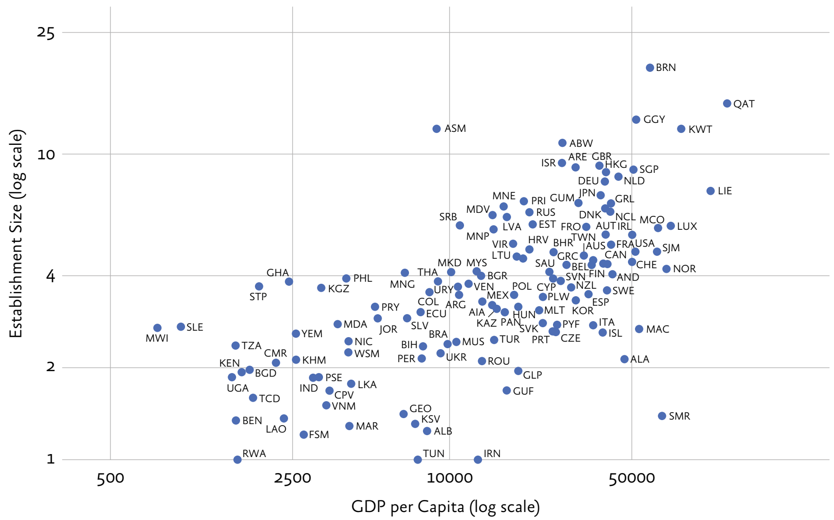
At the same time, the progressive nature of the current CIT, together with a very high top marginal bracket, disincentivise increases in scale. In a recent paper, Bento and Restuccia (2020), using establishment-level data from 127 countries, showed that productivity levels are positively correlated with the size of establishments, both in the services and in the manufacturing sector. In both cases, an increase of 10 % in the average establishment size is associated with an increase of 3 % in GDP (see figure 3.8). CIT is levied at the firm rather than the establishment level. However, this pattern is consistent with the gains from increasing scale, and data at the firm level seems to confirm this hypothesis (see Gaio and Henriques, 2018).

Figure 3.8 **Establishment size and GDP per capita**

a. Manufacturing



b. Services



Note: establishment size and GDP per capita in the manufacturing and services sectors for 91 countries. For more details, see Bento and Restuccia (2021).

This empirical relationship is far from surprising since several mechanisms support this empirical relationship, including the aforementioned economies of scale. Concomitantly, some studies have shown that entry costs have increased, contributing to the increase of the optimal scale (see Kozeniauskas, 2017). As mentioned, CIT progressivity, together with a very high top marginal CIT rate, disincentivises increases in scale and promotes capital dispersion, with negative effects on productivity and economic growth. And, in fact, Portugal is amongst the former EU–28, one of the countries with the highest share of small and medium enterprises (95.3 % vs the EU–28 average of 93 %). In this context, the loss of fiscal competitiveness relative to other member countries and the progressivity of the CIT schedule are likely to have contributed to the fact that the Portuguese economy stopped converging in terms of GDP per capita with other EU countries.

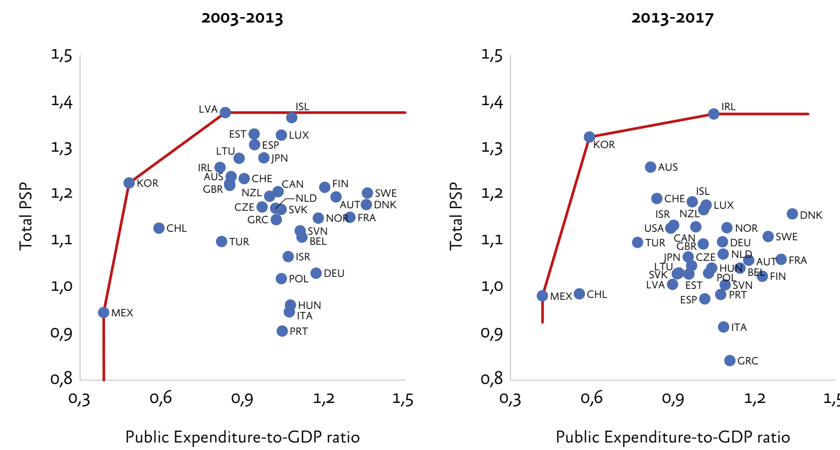
Recent political developments suggest that a consensus may be forming regarding developed economies and CIT rates. The US Treasury Secretary Janet Yellen recently suggested a floor for the minimum rate of about 21 %, mentioning that the US are «working with G20 nations to agree to a global minimum corporate tax rate that can stop the race to the bottom. Together we can use a global minimum tax to make sure the global economy thrives based on a more level playing field in the taxation of multinational corporations». The fact that such an agreement may emerge soon calls for a reflection upon Portugal's strategy regarding its ability to retain and attract businesses, talent and sustain a dynamic business sector. Among the European OECD countries, including both central and subcentral taxes, Portugal has the highest statutory CIT rates, at 31.5 %, followed by Germany at 29.9 %. On average, European OECD countries currently levy a CIT rate of about 21.7 %, somewhat below the worldwide average across 177 jurisdictions of about 23.9 %. Both are close to the numbers brought forth by Janet Yellen as possible CIT floors amongst developed economies. European OECD countries, like most regions around the world, have experienced a decline in CIT rates over the last decades, with the average tax rate declining from 31.6 %, in 2000, to the aforementioned average rate of 21.7 %. Portugal has not followed this trend and is in a much more disadvantaged position today, in terms of tax competitiveness, than in the past.

Reducing the average marginal rate and gradually eliminating CIT progressivity — bringing it back to its original proportional nature — are important steps towards improving the country´s tax competitiveness. To that end, Portugal needs to create an environment that favours increases in scale. In the current juncture, COVID-19 will also accelerate the transition towards remote working schemes, making this an element that should not be overlooked from the point of view of personal income taxes. Naturally, lowering CIT level and progressivity will have fiscal implications, and even though one can anticipate some fiscal compensation from an increase in economic activity, it is very likely that this will lead to a net fiscal loss and prompt compensatory increases in other taxes. Given Portugal´s high overall tax burden, one way to decrease the fiscal impact of such policy would be to simultaneously improve the efficiency of the public sector. Proxied by efficiency scores, computed via data envelopment analysis over the period 2007–2018 for 34 OECD countries, figure 3.9 shows that the Portuguese government spending efficiency could be improved.[31] This typically implies the provision of more public services with the same amount of public resources or, conversely, providing the same level of public services with fewer public resources. Theoretically, there would be room for improvement regarding efficiency gains for all countries inside the frontier.

BOX 2: Key Recommendations

- Reduce the average marginal CIT rate and gradually eliminate its progressivity;
- To accomplish the previous policy in a fiscally-neutral way:
- improve government spending efficiency, for example, by providing the same level of public services with fewer public resources;
  - rebalance the composition of public spending needs so as to prioritise public investment;
- increase the share of less distortionary forms of taxation in the tax mix, with a focus on property and environmental taxes.

Figure 3.9 Production possibility frontier, OECD countries

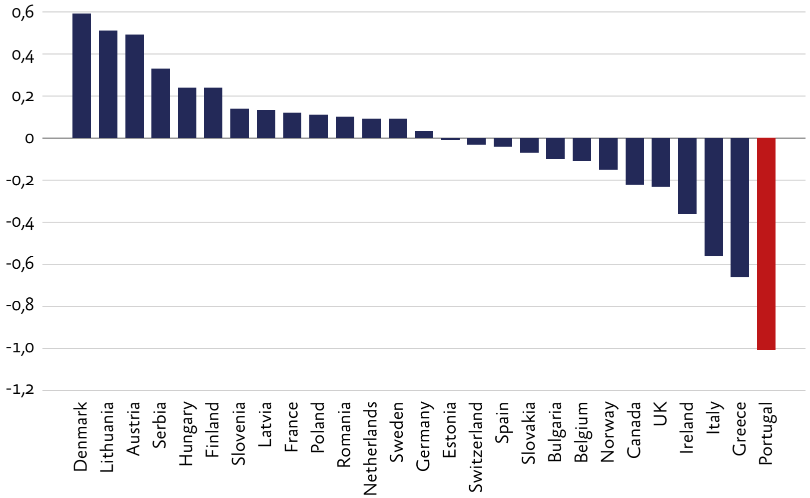


Note: Figure 3.9 plots the production possibility frontiers for the 2003–2007 and 2013–2017 periods. The vertical axis plots the composite Public Sector Performance (PSP) score. Source: Afonso, Jalles and Venancio (2021)

1.3.3. Fostering efficient and healthy public-private sector relationships

Figure 3.10, below, shows the European Payment Risk Index (EPRI), set up by *Intrum Justitia*, a leading company in the management of collectables and credit recovery, in its annual publication *European Payment Report,* for 29 European countries, most of them part of the EU. This index attempts at summarising three dimensions of the payment and collection process: i) differences between the agreed payment scheduled and the actual payment; ii) probability that any given payment is going to be delayed and; iii) impact of payment delays in firms' operations. Portugal's place in the ranking impresses, not only by being at the very bottom but also by its magnitude.

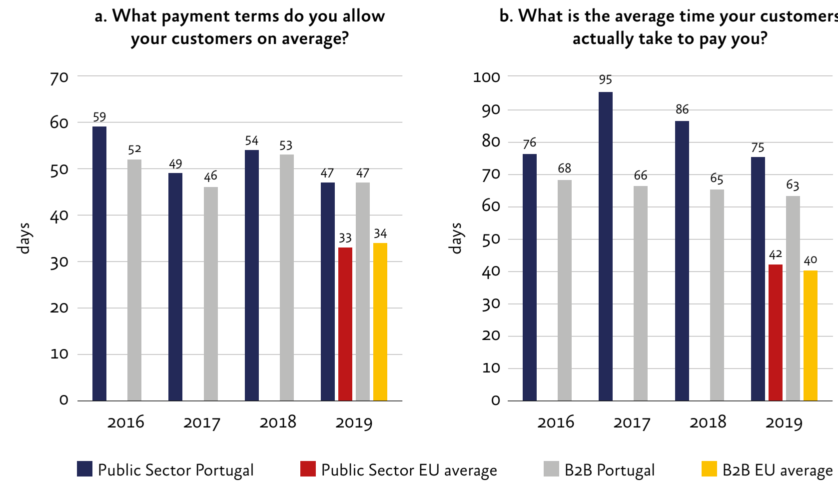
Figure 3.10 European payment risk index 2017



Note: Intrum Justitia's European Payment Risk Index (EPRI) provides a holistic view of risks and markets, as well as on actors' vulnerability towards them. Values below −1 reflect poor payment stability and high risk; values from −1 to 0 reflect limited payment stability and some risk; values from 0 to 1, reflect good payment stability and low risk, and values above 1 reflect high payment stability and very low risk. Portugal is the only country that ranks in the bottom tier. Source: Intrum Justitia, European Payment Report 2017.

Transactions with the public sector are one of the main reasons for payment risks. As depicted in figure 3.11, below, even though the average payment schedule agreed with the public sector is the as the one agreed with the business-to-business (B2B) segment, actual payments are delayed by about 12 to 28 days, on average. This contrasts sharply with the EU average payment standards. Not only the agreed deferrals in payment are shorter (33 days vs 47 on average), but the average delay is also shorter (9 vs 28 days).

Figure 3.11 Agreed vs realised payment schedule by market segment, Portugal, 2016–2019



Note: average agreed payment terms (left panel) and actual payments (right panel) by segment (public sector and business to business) and year. Source: European Payment Report 2019.

In light of these statistics, it is important to reflect upon what are the impacts of payment delays in the economy. Government payment delays (G2B) are the ones for which, naturally, the government is in a better position to act upon. At the same time, they are also the ones for which the benefits of improving the situation are straightforward (payment delays in the private sector also mean extra liquidity for debtors and their impact is harder to measure) and unarguably negative, since they:

a) reduce firms' profits if they imply liquidity issues that raise the firm's capital costs;

b) threaten firm survival, in particular SMEs, which can go bankrupt due to liquidity restrictions, with spill-over effects on risk premia, chain bankruptcies, etc.;
c) negatively affect firms' investment operations due to extra liquidity needs, depressing aggregate demand and economic activity.

Even though these effects are expected, it is also important to quantify them. Connel (2014), looking at 27 EU countries, suggested that ending late payments in the B2B and G2B segments would lead to a drop in firm exit of about 16.8 % and 16.3 %, respectively. Checherita-Westphal et al. (2016) focused only on the G2B segment and showed that, for a sample of EU countries, a standard deviation increase in the number of late payments was associated with a fall of 0.9 to 1.5 p.p. in GDP's growth rate and a slowdown in firms' profits of about 1.5 to 3.4 pp, and that an increase in the number of late payments increased a firms' probability of going bankrupt. Overton et al. (2017) showed that late payments in firms' receivables increased the volatility of tax revenues coming from sales taxes for 1075 counties in Texas, between 1998 and 2013. Bialowoski (2011) analysed the impact of payment delays by sector, in Poland, and showed that the impacts, even though subject to a large degree of heterogeneity, led to decreases in investment and employment, price increases and also worked as barriers to product innovation.

BOX 3: Key Recommendations

- Serious efforts must be made to decrease payment deferrals and delays on behalf of the public sector as the potential to increase economic activity without fiscal consequences is large;
- Better data regarding payment schedules and delays should be collected;
- More complete and systematic statistics should be compiled, and this dimension of economic activity monitored (also including the B2B and B2C segments).

1.3.4. Attracting foreign investment and enabling domestic firms to participate in global value chains

Depending on the type of market structure, it may be particularly difficult to enter certain tradable sectors. The sectors characterised by strong economies of scale/scope and a race for innovation, for instance, are typically segmented, i.e., dominated by large firms. Market growth is absorbed by the internal growth of incumbent firms rather than the entry of new firms due to strong entry barriers created by high sunk costs. This type of competition can be found, for example, in many high-tech, automotive, aircraft and pharmaceutical industries.

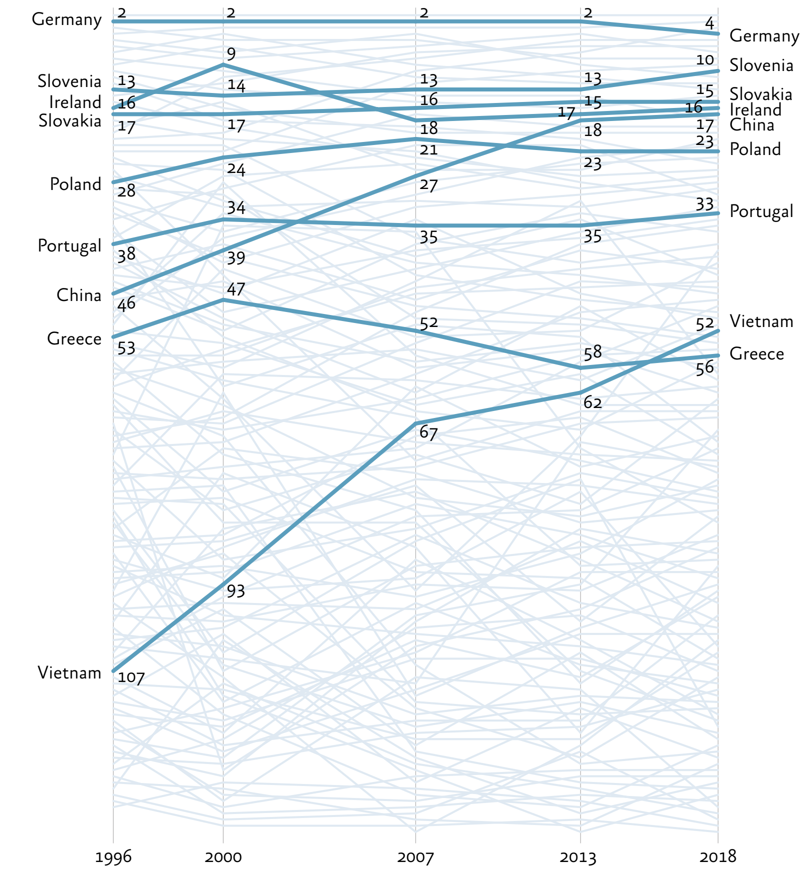
While it may be difficult to enter these types of markets, they offer a number of advantages. Namely, producing differentiated goods, which makes exports less sensitive to pure price-competitiveness. This is important in situations of possible real exchange rate overvaluation. Differentiated products are also more dynamic in terms of international demand and, therefore, exports can benefit from higher income elasticities from the rest of the world.

The exposure to more sophisticated products also contributes to the complexity of the economy, which is a determinant of potential growth (Hausmann et al., 2006). According to the Atlas of Economic Complexity, Portugal has an intermediate level of complexity (ranking 33rd among 133 countries), which has slightly improved over the recent years, but remains below its main competitors in Central and Eastern Europe and China (figure 3.12).

Integration in Global Value Chains (GVCs) enables countries like Portugal to benefit from possible spill-overs of product diversification and higher technology adoption. Despite the fact that integration in GVCs often reduces domestic content in a first phase of the process (UNCTAD, 2013), the exposure to better production techniques, organisation and working methods, and more sophisticated and complex products can have positive spill-overs for the diversification of the economy and the re-skilling of the workforce (World Bank, 2020).

This internationalisation strategy is particularly important for a small open economy characterised by small average firm size and a predominance of sectors populated by SMEs. Indeed, there are good reasons why, on average, SMEs may have a chronic productivity gap relative to large firms: i) they do not have scale economies (otherwise, they would not be SMEs); ii) their rate of internationalisation is low, as most trade flows are done by large firms and; iii) they are less prone to adopt new technologies, in particular in the area of digitalisation. Therefore, most SMEs are isolated from the main channels of productivity growth, especially small firms operating in non-tradable sectors.

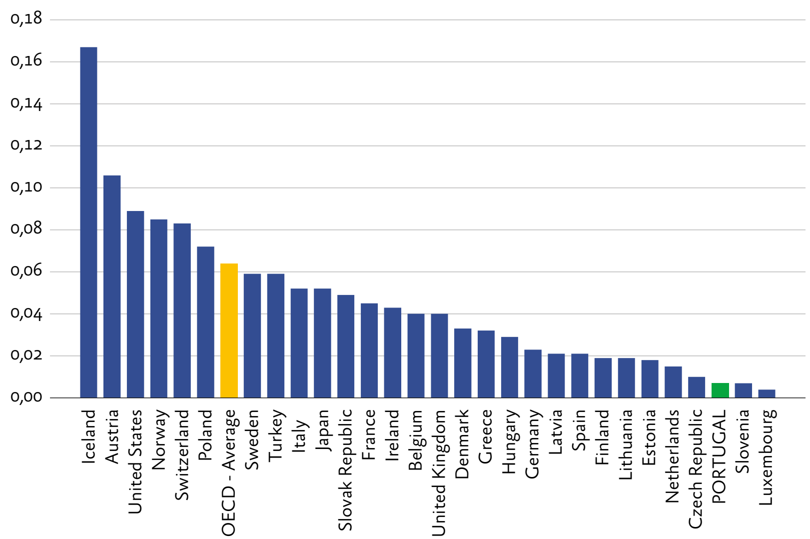
Figure 3.12 **Economic complexity rankings, 1995–2018**



Source: Atlas of Economic Complexity, 2021

The integration in GVCs typically requires the presence of multinational companies' affiliates in the national territory and hence is directly related to the attractiveness of foreign direct investments (FDI). In this regard, Portugal already has one of the most open regulations for FDI among the OECD countries (figure 3.13), although there is room for improvement in some sectors (financial services, transport and fisheries).

Figure 3.13 OECD FDI regulatory restrictiveness index, 2019 (open=0; closed=1)



Source: OECD

Portugal's very open stance on FDI is a positive aspect. However, the country also needs a strategy to attract investment and promote further integration in GVCs. Multinational companies' incentives to delocalise to a given country are often based on lower labour costs. This will obviously benefit low-skilled workers, which can enjoy higher productivity and higher wages than in domestic firms. However, such trade in tasks rather than products may not entail all the progressive integration of domestic enterprises in production processes. Evidence reported by the World Bank (2020, pp. 20–21) suggests that Portugal is upgrading its integration towards advanced manufacturing and services. This is also good news. With appropriate policies, notably the above-described structural reforms, the country can progressively continue its global integration and move from a *made in* model to regaining domestic value-added content (*created in*).

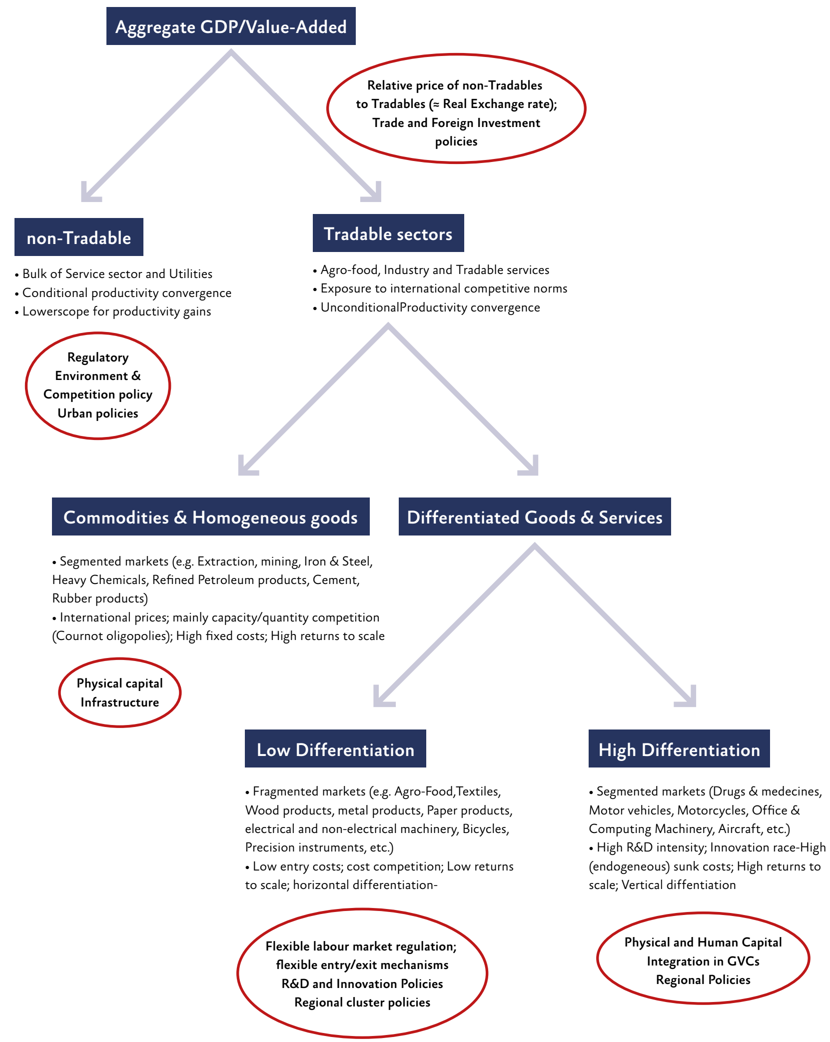
Also, increased participation in GVCs makes real exchange rate depreciation as a way of boosting exports a less appealing case, as a decrease in international export prices could be compensated by the increased import prices of all intermediate goods and components. Yet, the argument around the level of relative prices of non-tradables vs tradables developed earlier applies. When relative prices are excessively high, they generate incentives to shift the supply-side of the economy towards non-tradable activities.

The development of tradable sectors is particularly appealing because these sectors display an *unconditional convergence property* (Rodrik, 2013). This means that even if all the institutional and policy settings are not perfect, the sectors exposed to international competition tend to adopt international productivity norms and, hence, experience higher productivity growth. Obviously, the opposite may apply to non-tradable sectors.

All policies (sectoral and across layers of government) should be tied up in a system of complementarity relationships. Very often, structural reforms may not deliver on expected results, not because the specific policy was wrong or ineffective, but because it was not supported by other policy lines. The so-called *medium-income trap* may be related to these systemic effects. Governments implement many reforms and may get a lot of things right, but some bottlenecks remain that bring the entire system down. This is why the *unconditional convergence property* related to tradable sectors can be so interesting, as it makes productivity performance less sensitive to those policy failures.

An internationalisation strategy requires, therefore, a comprehensive and coherent view of the different options and associated policy settings. These strategies are schematically described in figure 3.14. First, the split between tradable and non-tradable sectors is determined by trade policy and the level of relative prices. Since those are in the hands of European institutions, Portugal has little room for manoeuvre to influence them. Concerning foreign investment, as we have just mentioned, the policy settings are rather favourable. Therefore, non-tradable sectors require particular attention in terms of competition and regulatory environment precisely because they are sheltered from foreign competition. Moreover, tradable activities use many service inputs, so their competitiveness also depends on the performance of those non-tradable sectors.

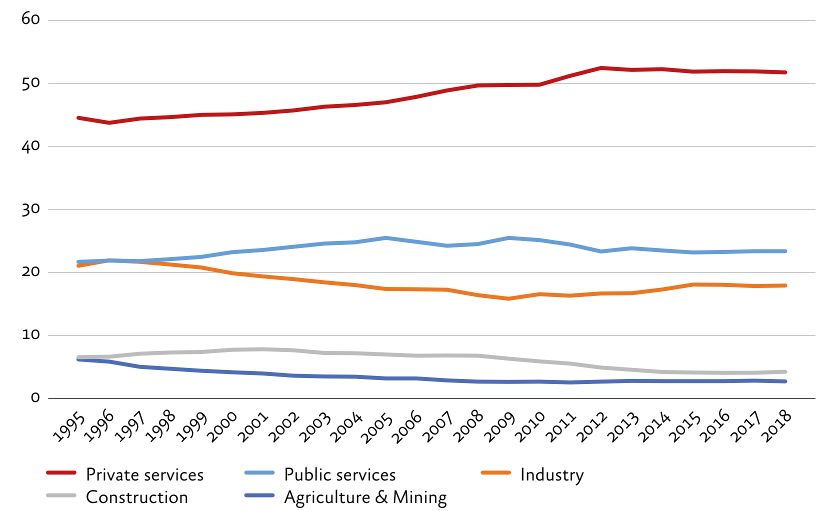
Figure 3.14 Sectoral specialisation strategies and associated policy settings



Source: authors

Urban policy settings are often overlooked aspects. A large part of non-tradables are services clustered in cities, as they require proximity between producers and consumers. Cities are supposed to develop positive externalities for firms' productivity (economies of agglomeration, see next section). Dysfunctional cities or bad urban governance may hinder this productivity effect, which is critical for all the sectors that are not exposed to the stimulus provided by international competition. These non-tradable sectors are the bulk of modern economies. In Portugal, both market and public services account for more than 75 % of Value-added (figure 3.15).

Figure 3.15 Value added by economic activity, Portugal, 1995–2018 (in % of Total)



Source: Pordata, 2021.

Once the incentives to develop the tradable sectors are at an appropriate level, there are several options, which depend on endowments and comparative advantages but also on policy choices. Tradable sectors can develop homogeneous goods. Prices are determined in international markets, and thus size effects and quantity competition dominate. Often, these sectors require heavy infrastructure (transports, ports) and large physical capital investments. Refined petroleum products, currently a dominant revealed comparative advantage of the Portuguese economy, or mining, are good examples.

As discussed above, the specialisation in more differentiated products presents advantages and is less sensitive to pure cost competitiveness. Low-differentiation industries require a moderate R&D intensity and are often dominated by small and medium firms. Portugal displays top comparative advantages in several of these sectors, such as agri-food (e.g., wine), paper, textiles, furniture or leather. Given that competition takes place through brand competition and horizontal differentiation, it is important that markets are flexible enough to accommodate the entry/exit of firms and adjust labour conditions. This favourable business environment can be provided by the structural reforms discussed above. Regional policies can also be vital to support and develop cluster effects or innovation eco-systems.

Finally, the high-differentiation sectors requiring high R&D intensity and high sunk costs require integration in global GVCs (e.g., the automotive, aircraft or pharmaceutical sectors). The progressive increase of domestic content requires sustained investments in both physical and human capital. Regional policies can play an important role by organising local attractiveness. A combination of a good quality of life, security, infrastructure and connections with universities may be critical to attracting investments in more sophisticated products. In Portugal, there are good examples of this attractiveness effects in the regions of Braga and Aveiro.

To sum up, policies can accompany the development of more diversified and sophisticated products and services, supporting a *created in* model, without falling prey to a perverse industrial policy bias.

BOX 4: Key Recommendations

- Portugal *already* has a very open regulation on FDI, but financial services, transport and fisheries have room for improvement.
- A strategy to attract investment and promote further integration in GVCs should be developed and interconnected with different areas of structural reforms, including regional policy, notably concerning the further development of tradable sectors.
- More attention is necessary to structural policies that enhance cost-effectiveness and productivity in non-tradable sectors, and they should be articulated with urban policies.

1.4. An inward look: urban policies and regional governance

An important and often overlooked aspect in discussing structural policies is the quality of urban policies and regional governance. Most non-tradable sectors are related to services that require proximity between producers and consumers, therefore they have strong local dimensions. This proximity is typically achieved in dense and agglomerated areas. Sectoral performance depends on policies decided by the central government but also largely on policies decided and implemented at the local level. An OECD report (2015) shows that the governance of metropolitan areas has a sizeable impact on the agglomeration economies generated within a metropolitan area. The more fragmented the governance is[32], the less the effect of the city size on labour productivity. To be effective, urban governance must embrace the whole functional metropolitan area, rather than each single administrative unit. As territorial reforms are often difficult to implement, the creation of Metropolitan Authorities (e.g., transportation, planning) is an alternative instrument already used by several OECD countries (OECD, 2015).

Moreover, compared with more developed countries, the Portuguese economy is characterised by the fact that a high share of employment and value-added are generated by SMEs. The role of external economies, which are generated by local conditions in cities and regions, is crucial for SMEs. Cities should generate economies of agglomeration and peripheric regions should be in a position to benefit from these agglomeration spill-overs. Remote rural regions, in turn, require a (differentiated) place-based treatment due to the high degree of heterogeneity of local conditions and specific assets.

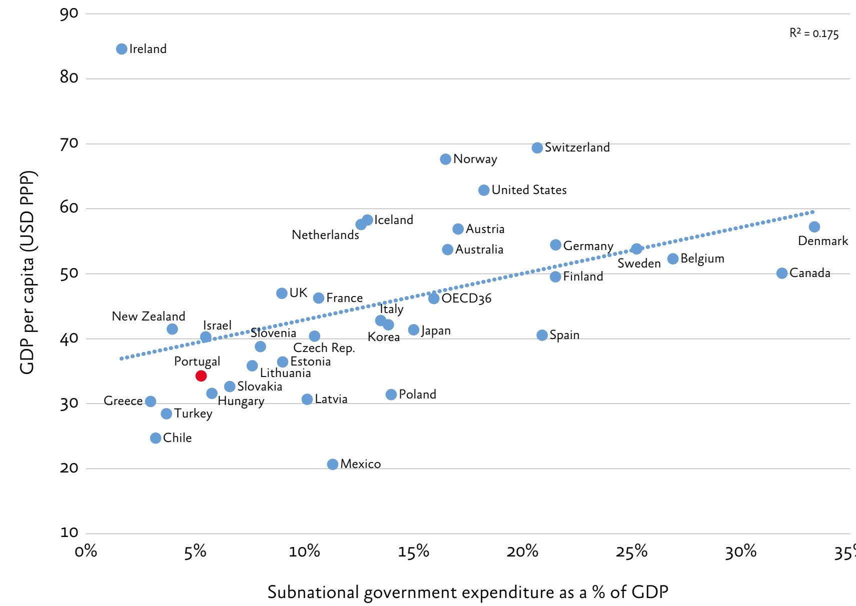
There is a strong interaction between tradable sectors and regional development. Another OECD report (2018) shows that regions that benefit from a catching-up potential have, *ceteris paribus*, a much higher intensity of tradable sectors. There is also evidence that tradable activities can have a strong multiplier effect on jobs in non-tradable activities. According to Moretti (2010), in US cities, every job created in the tradable sector generates 1.6 jobs in the non-tradable sector.

All this entails the inclusion of regional and urban policies and decentralisation reforms in the structural reform agenda. The modern economy, characterised by distributed and more distant forms of work and production[33], does not seem compatible with an excessive centralisation of decision power. To design policies that can identify the specific assets and conditions of each type of region (place-based policies), the question of decentralisation is obviously very important because central governments cannot deal with such high levels of granularity. But to effectively coordinate different ministries, institutions and layers of government, some form of alignment is required. This is the role of multi-level governance reforms.

In the group of OECD countries, there is a significant positive correlation between the levels of GDP per capita and the degree of fiscal decentralisation (share of subnational expenditures in total public expenditures), the only notable exception being Ireland.[34] In this regard, Portugal appears as one of the most centralised countries in the OECD (figure 4.1).[35]

An important additional argument on the relevance of integrating regional policies and decentralisation in the package of structural reforms had to do with the fact that most public investment is actually undertaken at the subnational level. On average, for OECD countries, roughly 60 % of the public investment is done by local governments, notably in the area of low carbon economy transition (OECD, 2020). This is an important point to consider in the context of the investment strategy for the EU Recovery and Resilience Plan.

Figure 4.1 Economic development and decentralisation, 2018



Note: GDP per capita and subnational governments' share in general government revenue are concomitant, as revenue decentralisation from the central government to subnational governments tends to increase with GDP per capita. Source: OECD/UCLG and World Observatory on Subnational Government Finance and Investment (SNG-WOFI).

Another rationale to consider regional policies and decentralisation in the structural package is related to the fact that traditional mechanisms of comparative advantage may not work at the regional level, generating persistent under-development traps (Floerkemeier et al., 2021). The regions that have experienced an adverse shock may remain unattractive for inward investments because: i) price signals are too small (due to wage equalisation mechanisms and welfare state redistribution) and; ii) the relocation of firms may involve forgoing the benefits of being in an existing agglomerated/cluster. This causes a sort of coordination failure among firms (or first-mover disadvantage) that prevents jobs from *flowing to people*. The development gaps between coastal and inland areas in Portugal illustrate such structural divergence issues.

Finally, the contributions of the different Portuguese regions (NUTS2 level) to the aggregate growth of employment, productivity and gross value added (GVA)[36] (figure 4.2) raise questions on the benefits of a highly centralised administrative model.

Over recent decades (2000–2019), there seems to have been an atypical regional imbalance between the metropolitan area of Lisbon and the other regions. The metropolitan area of Lisbon is the productivity frontier in Portugal (i.e., it has the highest productivity level), however, it has not contributed to aggregate productivity growth. On the contrary, its contribution is persistently negative, both before and after the 2008 crisis. Between 2000–2008, the Lisbon area only had the highest contribution to national GVA growth due to its contribution to employment growth. In parallel, both the Central and Northern regions were experiencing a strong industrial restructuring and had significant employment losses, however, they both contributed positively to aggregate productivity growth.

Between 2009–2019, the productivity performance of the metropolitan area of Lisbon continued to deteriorate and, despite its contribution to the creation of employment, its contribution to national GVA was much lower. In contrast, the Northern region seems to be in a path of sustained recovery with positive contributions both to employment and productivity growth, thus displaying the highest national contribution to aggregate GVA growth. The Central region continued to contribute positively to aggregate productivity but at the cost of a negative job creation rate.[37]

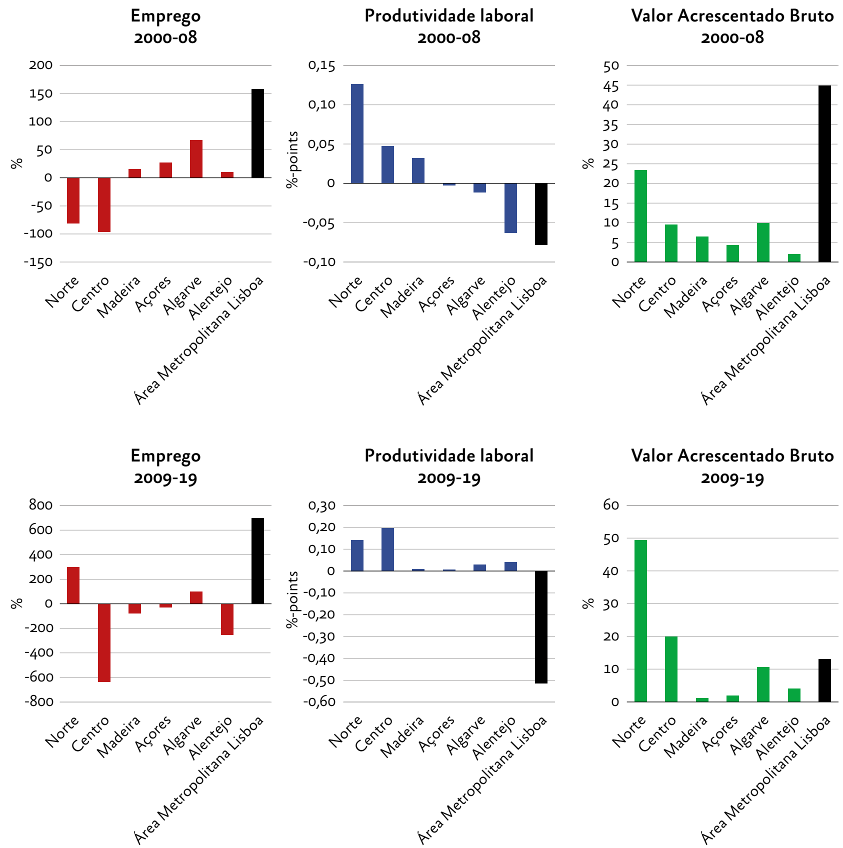
These patterns are consistent with the sectoral analysis carried above. The metropolitan area of Lisbon is mainly specialised in non-tradable services (public and private), while the North and Central regions are the main sources of tradable activities in Portugal.

A national productivity strategy for Portugal should entail differentiated regional approaches. Such a tailored approach should be viewed as complementary to traditional structural reforms[38] but could not be implemented with uniform policies Alone. It would also require a place-based component (both urban and regional).

BOX 5: Key Recommendations

- Together with national structural reforms, invest in an increased functionality of the main metropolitan areas of Lisbon and Porto (a system integrating both the core and the periphery) to maximise agglomeration economies and enhance the performance of non-tradable activities;
- Continue the restructuring of tradable sectors in the Northern and Central regions to benefit from the associated productivity catching-up potential;
- Deploy specific regional development strategies for the Alentejo region, which seems to be stagnating in economic terms, and for the Algarve region, which was one of the most hard-hit regions across the OECD by the COVID-19 shock.

Figure 4.2. **Regional contributions to employment, productivity and gross value added, Portugal, 2000–2019**



Source: OECD Regional Statistics Database, 2021

1.5. Concluding remarks

Prior to the COVID-19 pandemic crisis, Portugal had made significant progress in addressing long-standing imbalances. Alongside these macroeconomic improvements, structural policy reforms from the time of the Financial Assistance Programme (2011–2014) have begun to improve markets´ performance, opening the way to sustain stronger and more inclusive growth.[39] However, the ambitious and fast-paced reform agenda has faded out in recent years. To achieve the goal of moving from a *made in* to a *create in* Portugal paradigm, the country needs to resume, extend and deepen its structural reforms to make the country more competitive and efficient.

Portugal is slowly emerging from an historically deep recession in 2020. Recent early economic indicators suggest some positive trends. As global conditions improve and domestic demand recovers, the economy should gradually pick up strength. This should be accompanied by a renewed reform effort in the context of the COVID-19 recovery fund of the EU, including decentralisation reforms. Many of the subsisting distortions and structural rigidities impede the full realisation of Portugal´s productive potential. The shift of the Portuguese economy orientation towards the tradable sector with a view towards GVC integration has never been more urgent. The current policy contradiction seems to be that while the new *Portugal 2030 Strategy* identifies competitiveness as one of its key thematic areas, the incumbent government´s COVID-19 related *Recovery and Resilience Plan* is silent on this matter.

In sum, Portugal also needs to adopt a strategic view around four megatrends that will shape the international economy in the coming years/decades:

- engage with new forms of globalisation, such as GVCs (for goods) and globotics;
- accelerate the adoption of digitalisation, notably by SMEs.
- manage the highly differentiated impact of ageing across territories by adopting a place-based approach;
- support the energetic and climate transition in a socially acceptable manner;
- align CIT policy with international trends to regain its lost tax competitiveness;
- reduce delays in government payments to businesses to reduce stress on cash flows and improve the performance of the private sector without budget impacts.

References

Adler, G., Duval, R., Furceri, D., Kilic Celik, S., Koloskova, K., Ribeiro, M., «Gone with the Headwinds: Global Productivity», IMF Staff Discussion Note 17/04, 2017.

Alexandre, F., P. Bação, J. Cerejeira, M. Portela, «Employment and Exchange Rates: The Role of Openness and Technology», *Open Economies Review* Vol. 22, 2011, pp. 969–984.

Afonso, A., Jalles, J., Venancio, A., «Taxation and Public Spending Efficiency: An International Comparison», *Comparative Economic Studies* (forthcoming), 2021.

Alesina, A., Furceri, D., Ostry, J., Papageorgiou, C., Quinn., D., *Structural Reforms and Elections: Evidence from a WorldWide New Dataset*, NBER WP No. 26720, Cambridge USA, 2019.

Amaral, L., *Economia Portuguesa — As últimas Décadas*, Fundação Francisco Manuel dos Santos, Lisboa, 2010.

Baldwin, R. and Weder di Mauro, B. (eds), *Economics in the Time of covid-19*, a VoxEU.org eBook, CEPR Press, 2020.

Barros, Jalles, Sarmento, *Drivers of the Tax Effort: Evidence from a Large Panel*, mimeo University of Lisbon, 2020.

Basu, S., J. Fernald, and M. Kimball, «Are Technology Improvements Contractionary?», *American Economic Review*, Vol. 96(5), 1418–1448.

Benigno, G., Converse, N. and Fornaro, L., «Large capital inflows, sectoral allocation and economic performance», *Journal of International Money and Finance,* Vol. 55, 2015, pp. 60–87.

Bento, P., and Restuccia, D., «On average establishment size across sectors and countries», *Journal of Monetary Economics,* Vol. 117, 2021, pp. 220–242.

Białowolski, P., «Impact of Overdue Receivables on Economic Decisions of Enterprises», *Prace i Materiały Instytutu Rozwoju Gospodarczego SGH*, Vol. 86, 2011, pp. 67–79.

Cecchetti, S. G., Mohanty, M. S., and Zampolli, F., *The real effects of debt*, BIS WP No. 352 Switzerland, 2011.

Checherita-Westphal, C., Klemm, A., and Viefers, P., «Governments' payment discipline: The macroeconomic impact of public payment delays and arrears», *Journal of Macroeconomics*, Vol. 47, 2016, pp. 147–165.

Connell, W., *Economic impact of late payments*, Directorate General Economic and Financial Affairs (DG ECFIN), No. 531, European Commission, 2014.

D'costa, S. J.E. Garcilazo and J. Oliveira Martins, «Impact of macro-structural reforms on the productivity growth of regions: Distance to the frontier matters», *Papers in Regional Science*, pp. 1–34.

Dabla-Norris, E., S. Guo, V. Haksar, M. Kim, K. Kochhar, K. Wiseman, A. Zdzienicka, «The New Normal: A Sector-Level Perspective on Productivity Trends in Advanced Economies», Staff Discussion Note 15/03, International Monetary Fund, 2015.

Drazen, A. and Grilli, V., «The benefit of crises for economic reforms», *American Economic Review*, Vol. 83, No. 3, 1993, pp. 598–607.

Duval, R. and Loungani, P., «Designing Labour Market Institutions in Emerging and Developing Economies: Evidence and Policy Options», IMF Staff Discussion Notes 19/04, Washington DC, 2019.

Duval, R., Furceri, D., Jalles, J., «Job Protection Deregulation in Good and Bad Times», *Oxford Economic Papers*, Vol. 72, No. 2, 2020, pp. 370–390.

Duval, R., Furceri, D., Miethe, J., «Robust political economy correlates of major product and labor market reforms in advanced economies: evidence from BAMLE for logit models», *Journal of Applied Econometrics* (forthcoming), 2020.

Floerkemeier, H., N. Spatafora, and A. Venables, *Regional Disparities, Growth, and Inclusiveness*, IMF Working Paper WP/21/38, 2021.

Furceri, D., Jalles, J., Koloskova, K., Kilic Celik, S., «Recessions and Total Factor Productivity: Evidence from Sectoral data», *Economic Modelling*, Vol. 94, Iss. C, 2020, pp. 130–138

Gaio, C., and Henriques, R., «Are large firms more profitable than small and medium firms in the European Union?», *European Journal of Management Studies,* Vol. 23, No. 1, 2018, pp. 25–48.

Geerolf, F., *The Phillips Curve: a Relation between Real Exchange Rate Growth and Unemployment*, UCLA, 2020.

Gupta, S. and Jalles, J., *On the Political Economy Determinants of Tax Reforms: Evidence from Developing Countries,* Center for Global Development, WP No. 199, December 2020.

Gupta, S. and Jalles, J., *Can covid-19 Induce Governments to Implement Tax Reforms in Developing Countries?*, Center for Global Development, WP No. 567, March 2021.

Hausmann, R., Hwang, J. and Rodrik, D., «What you Export Matters», *Journal of Economic Growth*, Vol. 12, No. 1, 2006, pp. 1–25.

IM International Monetary Fund F (2019), "Reigniting Growth in Low-Income and Emerging Market Economies: What role can structural reforms play?" WEO Chapter 3, 2019

International Monetary Fund, *Time for a Supply-Side Boost? The Macroeconomic Effects of Labour and Product Market Reforms in Advanced Economies,* World Economic Outlook, Chapter 3, Washington, 2016.

International Monetary Fund, *Public Investment Management Assessment — Review and Update*, IMF Publishing, Washington DC, May 2018.

International Monetary Fund, *Reigniting Growth in Low-Income and Emerging Market Economies: What role can Structural Policies Play?,* World Economic Outlook, Chapter 3, Washington, 2019.

International Monetary Fund, *2019 Article IV Consultation — press release; staff report; and statement by the executive director for Portugal*, No. 19/221, IMF Publishing, Washington DC, July 2019.

International Monetary Fund, *World Economic Outlook — Update,* IMF Publishing, Washington DC, January 2021.

Kozeniauskas, N., *What´s driving the decline in entrepreneurship*, manuscript, New York University, 2017.

Mauro, F. and Syverson, C., *The covid crisis and productivity growth*, VOX EU piece, 2020.

Mian, A., and Sufi, A., *House of debt: How they (and you) caused the Great Recession, and how we can prevent it from happening again*, University of Chicago Press, 2015.

Moretti, «Local Multipliers», *American Economic Review: Papers & Proceedings*, Vol. 100, 2010, pp. 1–7.

OECD, *Portugal: Deepening Structural Reform to Support Growth and Competitiveness", "Better Policies*, Series, OECD Publishing, Paris, July 2014.

OECD, *The Metropolitan Century: Understanding Urbanisation and its Consequences*, OECD Publishing, Paris, 2015.

OECD, *Productivity and Jobs in a Globalised World: (How) Can All Regions Benefit?,* OECD Publishing, Paris, 2018.

OECD, *Decentralisation and Regionalisation in Portugal: What Reform Scenarios?,* OECD Multi-level Governance Studies, OECD Publishing, 2020.

Oliveira Martins, J. and B. Rocha, «Reform Design Matters: The Role of Structural Policy Complementarities», in *The Palgrave Handbook of Comparative Economics*, E. Douarin and O. Havrylyshyn (eds.), Springer, Switzerland, 2021.

Oliveira Martins, J. and Price, P. (2004), "How Market Imperfections and Trade Barriers Shape Specialisation: South America vs OECD in Trade and Competitiveness in Argentina, Brazil and Chile: not as easy as A-B-C", OECD Publishing.

Overton, M., Nukpezah, J. A., and Ismayilov, O., «Prepayments, late payments, and sales tax revenue volatility in Texas cities», *Public Money & Management*, Vol. 37, No. 7, 2017, pp. 469–476.

Park, D., Shin, K., and Tian, G., *Household Debt, Corporate Debt, and the Real Economy: Some Empirical Evidence*, Asian Development Bank Economics Working Paper Series, (567), 2018.

Rodrik, D., «The Unconditional convergence in Manufacturing», *Quarterly Journal of Economics*, 2013, pp. 165–204.

Rodrik, D., «Premature deindustrialization», *Journal of Economic Growth*, Vol. 21, 2016, pp. 1–33.

UNCTAD, World Investment Report: *Global Value Chains: Investment and Trade for Development*, UNCTAD, United Nations, New York and Geneva, 2013.

World Bank, *World Development Report 2020,* World Bank, Washington, 2020.

Appendix

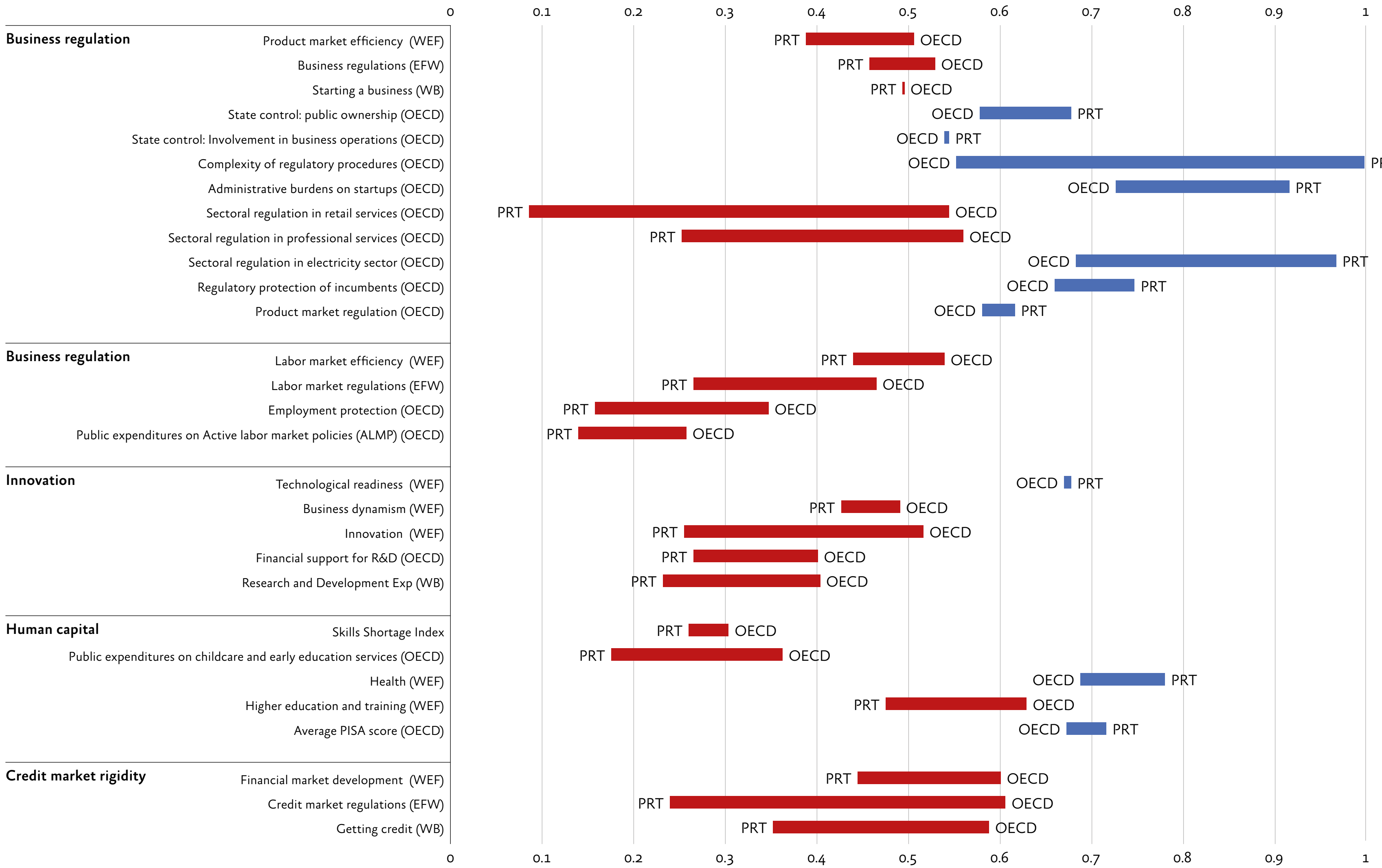
The specification of the key local projection method regression takes the following form:

$$y_t + k,i - y_{t-1,i} = \alpha_i + \gamma_t + \beta_k R_{i,t} + \theta X_{i,t} + \varepsilon_{i,t} \qquad \text{(A1.1)}$$

in which y is the log of a key macroeconomic variable (log of real GDP, log of employment, log of labour productivity), t and i are the time and country dimensions, respectively, k=0,1,2,...; α_i denotes country fixed effects, included to control for unobserved cross-country heterogeneity; γ_t denotes time fixed effects, included to take account of global factors such as shifts in oil prices or the global business cycle; $R_{i,t}$ denotes the structural reform; X is a set of control variables including past economic growth and past reforms; and $\varepsilon_{i,t}$ is an i.i.d. disturbance term satisfying standard assumptions of zero mean and constant variance.

Equation (A1.1) is estimated for each k=0,..,6. Impulse response functions are computed using the estimated coefficients β_k, and the confidence bands associated with the estimated impulse-response functions are obtained using the estimated standard errors of the coefficients β_k, based on robust standard errors clustered at the country level. The macroeconomic series used in the analysis come from the Alesina et al. (2019) database, which covers an unbalanced sample of advanced, emerging and low-income countries over the 1970–2014 period.

Figure A1. **Structural reform gaps in Portugal: a finer decomposition by policy area**



Note: the table below shows Portugal's position among OECD countries on a number of structural indicators. All indicators are normalised to take values between 0 (min) and 1 (max), with higher values indicating better outcomes. The blue bars correspond to indicators where Portugal exceeds the OECD average, while red bars correspond to indicators where Portugal falls below the OECD average.
Source: IMF (2019b)

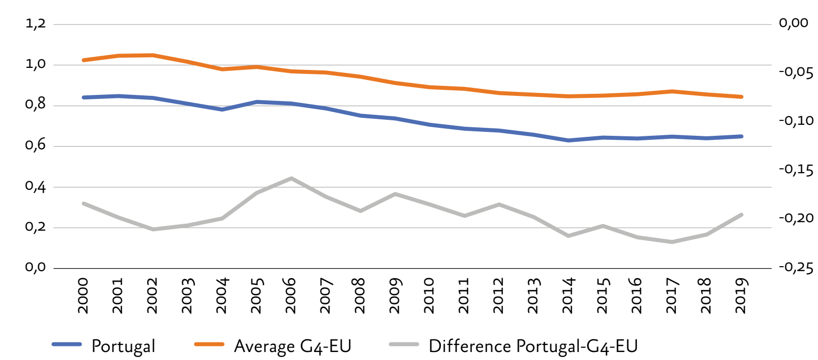
Paper 2
National Scientific and Technological System

Tiago Neves Sequeira, University of Coimbra
Lars Montelius, International Iberian Nanotechnology Laboratory
Paulo Ferrão, Instituto Superior Técnico, Universidade of Lisbon

2.1. Motivation and context

Despite the slowdown of technology growth after the fourth quarter of the 20th century, which affected almost all the developed countries, innovation is still a major driver of economic growth, and there is a high level of correspondence between countries that are successful in R&D and the level of well-being of their residents. Portugal has also invested heavily in R&D and increased the share of researchers in the (active) population in recent decades.[40] Despite that effort, Portugal has been diverging during the first 20 years of the 21st century. The Portuguese annual growth rate was 1.2 %, between 2000 and 2019, compared to 1.6 % in Germany and 1.8 % in Spain, for example (Penn World Tables 10.0). Moreover, according to the same source, in terms of relative TFP (total factor productivity relative to the USA), Portugal has lagged behind some of its European partners and the USA. Figure 1 points to this evidence. While TFP in Portugal, in 2000, represented nearly 85 % of the USA benchmark, in 2020, this value was only 65 % (falling by 20 percentage points). Figure 1 also shows that the relative TFP disadvantage is common in major economies in the EU (which we called the G-4: Germany, France, Italy and Spain). Finally, the grey line in figure 1 shows that the difference increased for Portugal, between 2006 and 2017, with an inversion in 2018–2019. This happened despite a positive investment in higher education and in the National Scientific and Technological System, which constitutes a motivation to rethink the strategy, including the contribution of the NSTS to Portugal's productivity.

Figure 1 TFP level at current PPPs (USA=1)



Source: Penn World Tables 10.0

The country has successfully attracted some Foreign Direct Investment (FDI), mainly consisting of factories that assemble imported differentiated goods and without much R&D incorporated in their country. Most of these multinationals face frequent competition to secure production in Portugal, and some have been delocalised. Another important stylised fact is that, although Portugal is not the headquarters of the main R&D-intensive multinational firms (the world's top 1 % R&D investors), it has some subsidiaries of those high-intensity R&D multinationals (figures 2a, 2b). This means that cases as the one described about Bosch, below, can be replicated given the right incentives.

Figure 2a **Location of the headquarters of the world's top R&D investors, OECD 2016**

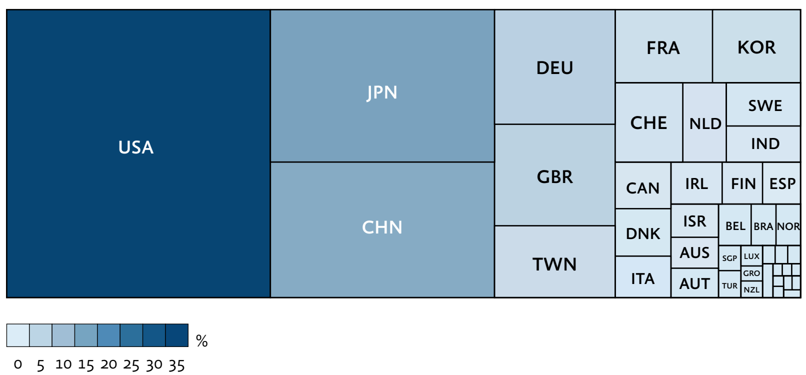
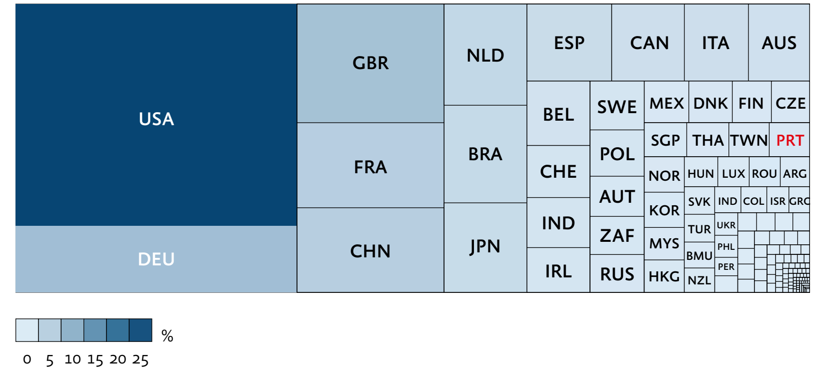


Figure 2b **Location of the subsidiaries of the world's top R&D investors, OECD 2016**



Source: JRC and OECD (2019)

Portugal also has several successful small and medium size firms striving for success in international value chains. Simultaneously, some excellent expertise has emerged within the NSTS. The new country growth and development strategy (the *created in Portugal*) should use this excellence and transfer it to the industrial sector. The goal is for multinationals with subsidiaries in Portugal to become dependent on locally developed technologies, and for small and medium sized firms to be linked with those multinationals and become part of the international value chains, creating a much greater value in the country than they do today.[41]

The main goals of this work package on NSTS are: (i) to identify the situation of Portugal regarding the production of skills and technologies within the NSTS that are suited to the new industrialisation linked with the *created in Portugal* paradigm; (ii) to present case studies of success in technology transfer from the NSTS to the market, which can be replicated, and (iii) to suggest policies that promote good practices.

It is worth noting that this work assumes that crucial technologies and skills to operate the new cutting-edge technologies — as a complement to reindustrialisation under the new paradigm (and thus attract FDI) — are those carried out within the STEAM (Science, Technology, Engineering, Arts and Mathematics) fields. This does not mean that other skills, such as those linked with management and humanities, are not important to the new industry. However, experience tells us that those skills can be easily imported and have a high relative supply within the country.

This policy paper is organised into six sections. In the following section, we describe the funding policies, funding levels and recent evolution in the NSTS. We also briefly describe the effects of the MIT and CMU-Portugal programmes in raising the overall quality of the NSTS. Then, in section 3, we present data on the most relevant skills for reindustrialisation under the new paradigm and their production structure in Portugal, and we compare the supply of STEM skills with other European countries. In section 4, we describe the production of technological knowledge in Portugal. First, we use the Web of Science to identify the major fields linked to reindustrialisation under the new paradigm, in which Portugal has production and rank the country among other scientific producers. Then we analyse the patent applications and grants to Portuguese residents in recent years. Finally, we briefly describe the excellent R&D units and their technological production using the results of a questionnaire applied directly to the R&D units. Section 5 presents two case studies that we think are good examples of the relationship between NSTS and the production of high added value tradable goods. And finally, section 6, points out the policy implications and suggestions.

2.2. Funding and inputs of the NSTS

It must be said that public Higher Education Institutions (HEI) in Portugal suffer from inbreeding, and the labour market for tenured professors is very rigid. In fact, until a few years ago, anyone who got an initial position would eventually become a tenured professor within 5 years. Nowadays, there is a dual labour market, where the position of full track professors is (almost surely) ensured by tenure, and an unregulated market (at the national level) of recent PhDs who teach with short-term contracts and earn fairly lower wages when compared with those with an established career. Generally, tenured Portuguese professors are relatively old.[42] Moreover, wage variations do not differ between different productivities and vary very little across different positions in the career track (Tavares et al., 2015). The difference between a full professor's net wage and an assistant professor's net wage (providing they get two times the highest grade in triannual evaluation) would never be more than 550 euros – see Appendix 1.A. This may also be seen as a constraint on innovation, research and hiring promising talents abroad.

Although Jørgensen and Hansen (2018) attribute more weight to competitiveness, for international skilled researchers and professors, than to wage as a determinant of productivity in higher education, neither incentive is present in most of the Portuguese system. The competitiveness for skilled international researchers (and students) may be amplified through an increase in funding that allows Portuguese schools to become more attractive to foreign talents. The reallocation of some funds within the system may also help attain the same objective.

The funding of higher education institutions is regulated by Law No. 37/2003, which determines that a given function should be dependent on variables of scale (e.g., number of students) and variables of efficiency. However, this law has rarely been applied. Most of the funding of higher institutions is dependent on the historic budget of a given institution, which constitutes a negative incentive to gradual rescaling and the improved efficiency of institutions. A proposal for a new funding formula has been published under the *Modelo de Financiamento do Ensino Superior: Formulas e Procedimentos* (Ministry of Education and Science, 2015), which has not yet been implemented.

Looking at the international competitiveness of one top school of Engineering in Portugal (see table 1), we can conclude that it is clearly underfunded to compete with other top schools in the same field. The public funding from the Portuguese government for the whole system is barely above the funding of the Imperial College. When looking at the budget per student, one of the top institutions in the field of Engineering in Portugal has nearly 16 to 30 times less budget per student than MIT or Cambridge.

Table 1 **Funding of top Engineering Schools**

Higher Education Institution	Budget (M€)	Number of Students	Budget per student (€)
Harvard	5,400	36,012	149,950
MIT	3,000	11,520	260,418
Cambridge	2,073	23,380	88,666
Imperial College	1,026	19,934	51,470
Chalmers	3,600	10,000	360,000
Delft	714	24,232	29,465
Aalto	420	12,000	35,000
Karlsruhe Institute of Technology	951	25,196	37,744
KTH — Royal Institute of Technology	550	13,500	40,741
Politecnico di Torino	223	29,628	7,527
UPC	303	33,030	9,173
Georgia Tech	1,786	36,127	49,437
IST	98	10,987	8,920
Total Budget of all Portuguese Higher Education Institutions	1,228	396,909	3,094

Source: IST (Instituto Superior Técnico) Budget 2021 and PORDATA

The *Fundação para a Ciência e Tecnologia* (the Portuguese National Science Foundation) also finances R&D units and grants. As the following table shows, the funding per researcher varies widely, and between 2003 and 2017, a positive trend is not even clear (see also Appendix 2.A).

Table 2 Funding by the FCT

Year	Funding of R&D Units	Researchers (FTE)	Financing/FTE	Financing/FTE (***)
2003	17,582,745 €	8,035.25 €	2,188.20 €	5,359.74 €
2004	56,477,627 €	8,542.75 €	6,611.18 €	9,548.37 €
2005	56,074,225 €	9,315.75 €	6,019.29 €	9,136.34 €
2006	35,946,758 €	10,027.50 €	3,584.82 €	6,169.22 €
2007	75,602,218 €	10,997.75 €	6,874.34 €	11,253.85 €
2008	89,031,622 €	12,092.55 €	7,362.52 €	12,550.33 €
2009	70,834,959 €	12,722.51 €	5,567.69 €	10,744.07 €
2010	78,433,278 €	13,417.07 €	5,845.78 €	11,848.10 €
2011	42,434,597 €	14,047.34 €	3,020.83 €	7,207.75 €
2012	49,027,041 €	14,436.39 €	3,396.07 €	9,839.91 €
2013(*)	74,315,909 €	14,526.13 €	5,116.02 €	12,087.36 €
2014(*) (**)	56,130,734 €	14,526.13 €	3,864.12 €	11,282.27 €
2015	53,857,568 €	10,645.99 €	5,058.95 €	11,348.13 €
2016	64,309,422 €	11,606.89 €	5,540.62 €	9,898.76 €
2017	75,341,580 €	12,240.59 €	6,155.06 €	9,178.42 €
Total	**895,400,281 €**			

Source: Fundação para a Ciência e a Tecnologia (FCT), November 2018.
Notes: (*) Including funding transferred through the programme Incentivo in 2013 and 2014, in a total of 9 million euros; (**) Full-time equivalent (FTE). This value, in 2013, is retained in 2014, as data were unavailable for 2014; (***) Includes funding in separate projects

Funding of R&D is far below the mystical 3 % target defined by the European Union, having risen smoothly from 1.25 % in 2015 to 1.4 % in 2019.

The effort placed in R&D is still dominated by public entities, with nearly 30 % working in business enterprises (OECD, 2017), one of the smallest percentages of OECD. Countries like Hungary, the Czech Republic, Turkey, Iceland, Spain and Poland have higher shares of researchers working in business enterprises than Portugal.

2.2.1. Long-term funding

Besides a yearly-based funding based on the number of students and demanding quality, quantity and other efficiency indicators, it is important that HEI receive long-term funding on a competitive basis. The experiments made so far (e.g., commitment contracts and contracts of confidence[43]) have almost always failed because they could not persist past each government mandate. However, most of these contracts were focused on learning rather than research aspects. Some of the international experiments, most notably the Excellence Strategy in Germany, implemented in 2016[44], are important benchmarks in this regard.[45]

The Excellence Strategy comprises calls for universities and consortia of universities to apply to Excellence Clusters and become Universities of Excellence. This stable funding can be obtained through competitive calls. The overall objective is to strengthen the university system in Germany and increase its international competitiveness in cutting-edge research. The *clusters of excellence* funding line is a project-based scheme targeting internationally competitive research fields in individual universities or alliances. The goal of the *Universities of Excellence* funding line is to strengthen universities or alliances so that they can expand their leading international position in research based on successful clusters of excellence.

This is the type of long-term funding scheme could be adapted to finance the best research units and universities in Portugal so that they could become more competitive and, even, leaders in some research fields.

2.2.2. The MIT-Portugal and CMU-Portugal initiatives

In 2006, Portugal launched four major partnerships between Portuguese and key USA universities — the Massachusetts Institute of Technology (MIT), the Carnegie Mellon University (CMU), the University of Texas at Austin and the Harvard Medical School — to strengthen the country's knowledge base and international competitiveness through a strategic investment in people, knowledge and ideas.

It may be assumed that these partnerships were intended to achieve three main goals: to conduct high-impact research and increase the international visibility of Portugal in science and technology; to strengthen the collaboration between Portuguese institutions, including universities, research centres and national research laboratories and; to promote entrepreneurship and university industry connections.

These initiatives proved highly successful in the three dimensions. Here, we discuss the results obtained by the MIT-Portugal[46] and CMU-Portugal[47] programmes, supported and financed by the FCT but independently coordinated by each programme.

The partnership with MIT focused on Engineering Systems, combining engineering questions with economic, management, policy, and social aspects of technology — an integrative approach pioneered at MIT, focusing on transportation, manufacturing, energy and bioengineering. The partnership with CMU focused on digital technologies, with a particular emphasis on the data economy and on fostering interdisciplinary collaboration between industry and academia across different levels of the Big Data development stack.

Hird and Pfotenhauer (2017)[48], gathered quantitative data on the results obtained by the MIT-Portugal programme and confirmed that affiliated researchers produced several new scientific papers per year, about 27 % more, that impact factors increased by 108 %, and that the number of citations increased by 124 % when compared to a control group. Moreover, they showed that the programme contributed to empowering a new generation of scientists, as junior faculty saw a significant increase in publication output (between 40 and 70 %) when compared to the control group. In addition, Portuguese universities worked more closely together to build domestic research clusters with critical mass, as most university university connections were two or three standard deviations above their control group counterparts.

As a trademark of the programme, students ascribed a much higher industrial and entrepreneurial orientation, a stronger education in economics and business, more working contact with industry engineers and scientists, and more course materials taught by faculty from the industry. The MIT-Portugal Programme has taken important steps to address a largely underdeveloped segment of university-based entrepreneurial and spin-off activity. One key component in this process was the Innovation and Entrepreneurship Initiative (IEI), founded in 2010 in cooperation with the ISCTE-IUL, Portugal, whose core component is a 1 million USD university-based venture competition in Portugal. In close collaboration with the MIT School of Engineering, the MIT Deshpande Center, and the MIT Sloan Business School, the IEI trained early-stage teams on go-to-market strategies and developed a USA-based catalyst (mentoring) programme, supporting the establishment of the Building Global Innovators (BGI) initiative. It is worth mentioning that by the 7th BGI edition, the initiative had accelerated 125 ventures, of which over 75 have raised more than 80 million euros and created over 450 jobs. In addition, students, researchers, and faculty have established more than twenty start-ups and engaged with industry in the Portuguese ecosystem, attaining visible impact and significant cultural change within Portugal and beyond.

The CMU-Portugal programme has an impressive record of over 150 companies partnering in projects promoted by CMU Portugal, and of having supported the creation and development of 12 start-ups, namely, Dognaedis, Feedzai, Geolink, Mambu, Orange Bird, Prisma, Red Light, Sentilant, Streambolico, Veniam and Unbabel. Together these companies have attracted more than 200 million euros in venture capital investment and created over 1000 highly qualified jobs., Feedzai, who is also part of the CMU Portugal Industry Affiliates, and Veniam, for example, are already a reference in their sector of activity.

The CMU Portugal programme supported a variety of teams through the Entrepreneurship in Residence Program (inRes), a business acceleration programme for entrepreneurial teams in the area of ICT. Some of these teams have developed into successful start-ups such as AddVolt, whose founders have been nominated on the prestigious list *Forbes 30 under 30 in Manufacturing & Industry*.

All in all, it is clear that these partnerships with USA universities brought together, in an unprecedented way, multiple institutions of the Portuguese scientific and technological system and combined multiple disciplines, promoting a new way of teaching and researching in partnership, attracting the best international talents, and bringing entrepreneurship to a whole new level in the Portuguese higher education system. If we could pick only one indicator of its impact, it is fair to say that the market value of the start-ups that were nested in these partnerships exceeds the investment made by the Portuguese government. Furthermore, the resulting modernisation of the Portuguese University is still visible today and expected to continue in the future as the partnerships develop throughout the next decade.

2.2.3. International funding: competitive ERC grants

International funding is increasingly important for the NSTS and is also a measure of its competitiveness in attracting competitive funding for national research. We looked at the different grants available from the European Research Council (Starting Grants, Consolidator Grants and Advanced Grants) and, overall, Portugal obtained 40 of the first type (nearly 1 % of the total), 33 of the second (nearly 1.7 % of the total) and 12 of the third type (nearly 0.4 % of the total). The most competitive fields in which these grants were obtained (in absolute numbers and the percentage of the total) were Cellular and Developmental Biology (LS3), Physiology, Pathophysiology and Endocrinology (LS4), Neurosciences and Neural Disorders (LS5) and Products and Processes Engineering (PE8).

2.3. The production of skills for reindustrialisation under the new paradigm

Through the higher education institutions (HEI), the NSTS produces the human capital necessary for the reindustrialisation of the country, mainly in terms of quantity.

However, the somewhat lower scale and positions in well regarded HEI rankings (most notably in the Shanghai ranking[49]) may decrease the visibility and competitiveness of the country in high skill intensive investments. The highest overall rank in 2020 was attained by the University of Lisbon but only in the 151–200 range. Overall, the institutions listed in this ranking are the major universities of Lisbon, Porto, Coimbra, Minho, Aveiro and the New University of Lisbon.[50] In comparison with Spain, the University of Barcelona is in the 151-200 ranking, but the country has four universities in the 201–300 range, while Portugal has none. Comparisons between Portugal and other European countries return even worse results. Figure 3 shows the position of Portuguese HEI compared with other countries according to the Shanghai ranking and the QS ranking[51] (mainly countries of similar dimension).[52] When we look at the best ranked university and the five best ranked universities, the conclusion is the same. Portuguese institutions are ranked lower than most small economies in Europe and the country compares poorly with some nations with similar GDP per capita, such as South Korea or Israel, or even poorer countries such as the Czech Republic or Brazil. One of the reasons for this result may be the overall under-funding of the Portuguese system when compared to international levels. As pointed out before, Portugal can obtain some improvement with allocation choices that do not necessarily impact the public budget.

Figure 3 Rankings by (ordinal) position of the best-ranked universities in different countries

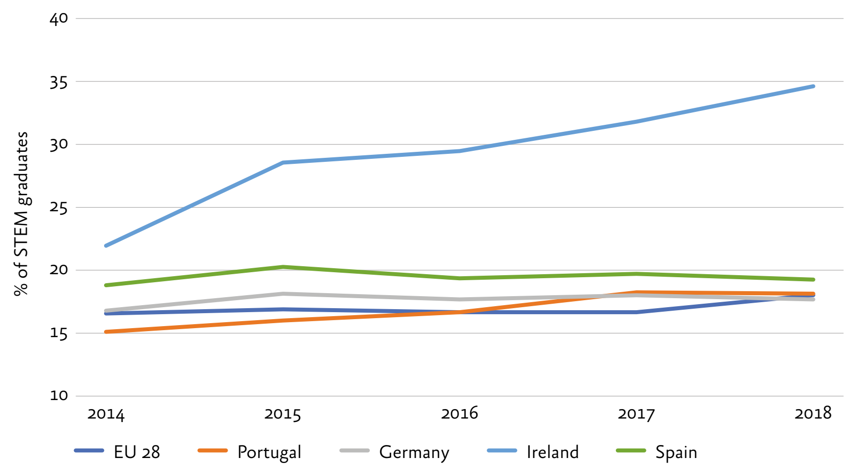
Relative Position of the 1st classified University in ARWU		Relative Position of the 1st classified Univ QS		Relative Position of the 5 best classified Univ ARWU		Relative Position of the 5 best classified Univ QS	
Switzerland	20	Switzerland	6	Switzerland	218	Switzerland	333
Denmark	33	South Korea	37	Netherlands	281	South Korea	343
Sweden	45	Netherlands	50	Sweden	292	Netherlands	448
Netherlands	52	Denmark	72	Belgium	415	Sweden	637
Norway	60	Belgium	80	Israel	446	Belgium	795
Belgium	66	Sweden	92	Denmark	554	Spain	1002
Israel	93	Brazil	116	S Korea	704	Denmark	1025
S Korea	101	Norway	119	Spain	754	Brazil	1609
Brazil	101	Spain	165	Norway	923	Norway	2030
Portugal	151	Czech Rep	291	Brazil	1104	Portugal	2069
Spain	151	Portugal	338	Portugal	1354	Czech Rep	2296
Greece	301	Greece	454	Greece	2204	Greece	3118

Source: Shanghai ranking (ARWU) and QS ranking, respectively

Higher education institutions are slowly adapting to the re-skilling and up-skilling of new generations for digital skills and more transversal ones, like creative, entrepreneurial, flexible, and open-minded thinking (Breque et al., 2021). This may pose great challenges to the higher education system over the next few years. Schwab and Zahidi (2020) argue that HEI may be able to adjust curricula quickly to include new technologies. The inclusion of computer and data science courses in most social sciences and humanities programmes may be a worthwhile path to follow.[53] In order to pursue this path, we need incentives to innovate pedagogically in the HEI. At their current level, with relatively old professors, the present signs of curricula transformation in HEI seem to indicate that something more must be done regarding innovation in the production of skills.

Figure 4 presents data for graduates from the Portuguese HEI in STEM fields and compares them to the European average and some European countries.

Figure 4 % of STEM graduates (ISCED 5-8) in selected countries



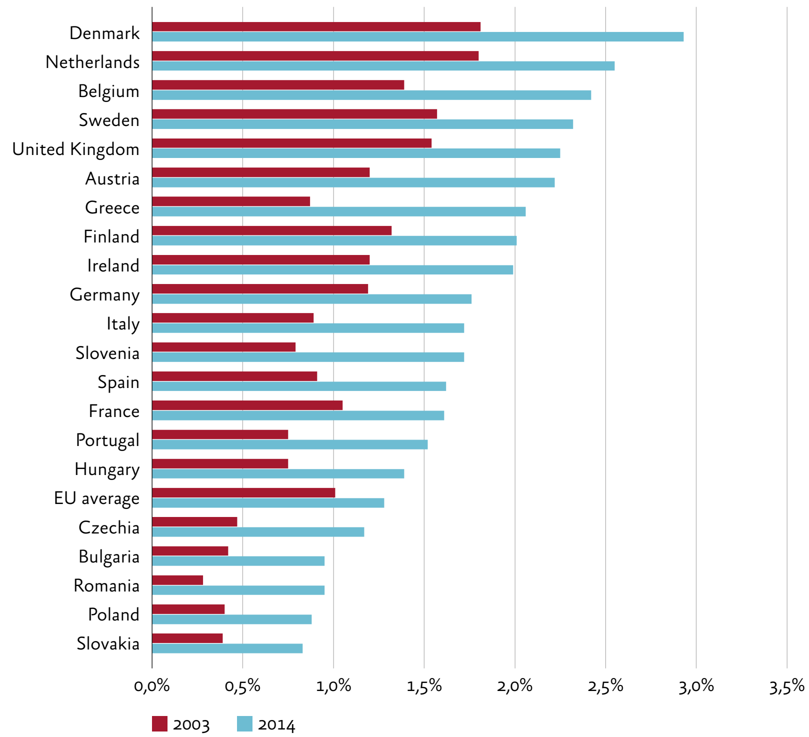
Source: Eurostat

It is worth noting that the number of Graduates in the STEM fields has been rising in the last five years (figure 4). Portugal's numbers are near the European average (20 %). However, some countries (e.g., Spain and Ireland) have higher values, and Ireland, in particular, (a relatively successful country in terms of growth patterns and crisis recovery), has been substantially rising its proportion of STEM graduates.

2.4. The production of knowledge for reindustrialisation under the new paradigm

The overall quality of scientific publications in Portugal has significantly risen in the past years. When looking at the European countries, Portugal ranked 15th in 2014 with more than 1.5 % of its publications reaching the top 1 % of citations, a share that is doubled when compared to 2003 (see figure 5). Some countries comparable in scale with Portugal, such as Slovenia, Greece and Ireland, are even better. The quality of the scientific publication seems to have an influence on the success of ERC grants attribution (Veugelers, and Baltensperger, 2021). In this regard, Portugal, with nearly 1.5 % of its publications reaching the top 1 %, has a success rate nearly 7 % below that of Spain, Denmark, France and Ireland, which have almost the same percentage of 1 % top publications.

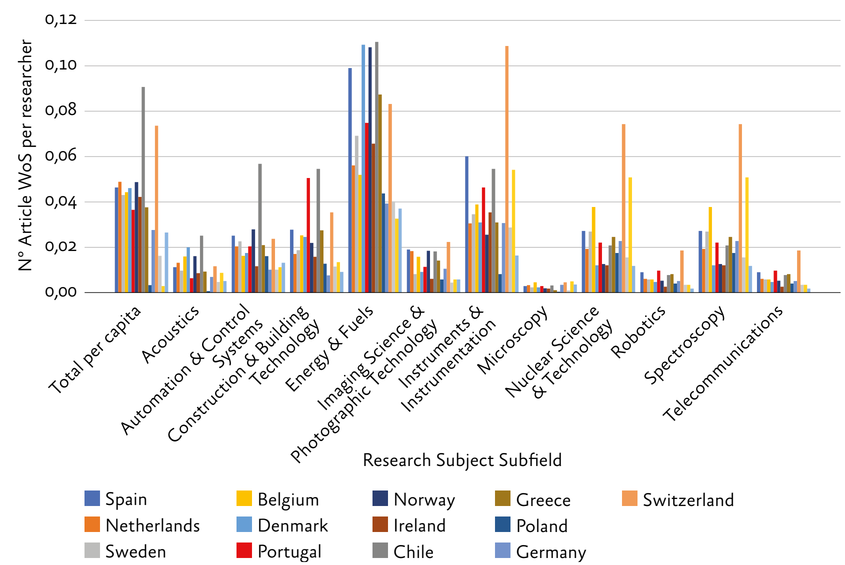
Figure 5 Share of publications in global top 1 % of cited publications

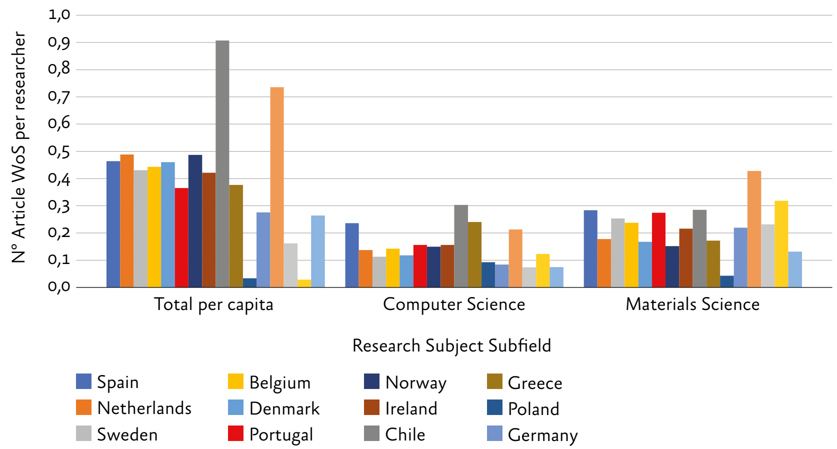


Source: Bruegel calculations based on National Science Foudation (2018)
Note: only Eu countries with a sufficient number of publications are reported (at least 1000 publication per year)

When looking at the relevant technologies for reindustrialisation under the new paradigm, we are focusing on those related to the Internet of things, the Interface of things, advanced materials, digital platforms, robotics, artificial intelligence and Big Data (e.g., FMEAE, Industrial Strategy 2030; European Commission, 2020), and extend them to related subject areas in the Web of Science. Figure 6 shows the number of articles per researcher, combining population from the PWT and the number of researches per person from World Development Indicators as well as the number of articles published (in English), between 2010 and 2021, from the Web of Science, obtaining a measure of scientific productivity. With an average scientific productivity of nearly 3.6 %, Portugal is just above Poland, Brazil, the Czech Republic and South Korea. Portugal has a higher relative productivity in the fields of Construction and Building Technologies (2nd in the set of compared countries, with 0.05 articles per researcher), as well as in the major field of Material Science (5th position) and Instruments and Instrumentation (4th in the set of compared countries, with nearly 0.05 articles per researcher).

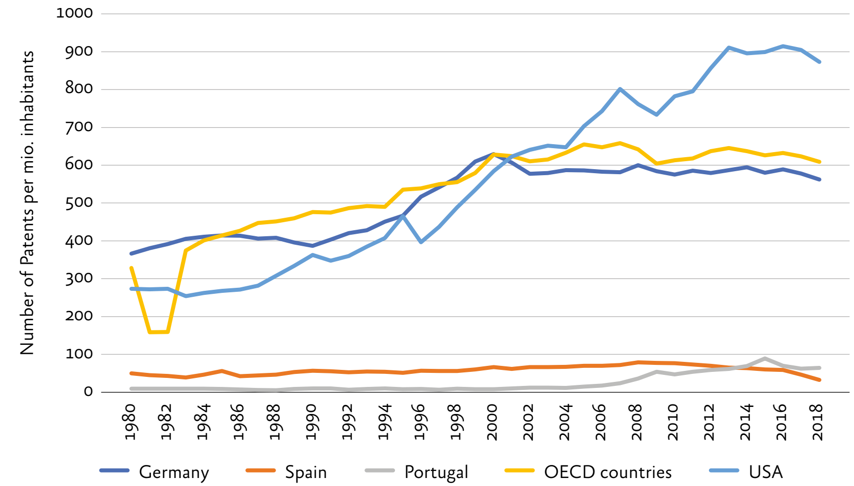
Figure 6 Relative position of Portugal in terms of Knowledge Productivity (articles in English per researcher)





Source: Web of Science (data retrieved on 27th March 2021)

Figure 7 Number of patents per million inhabitants



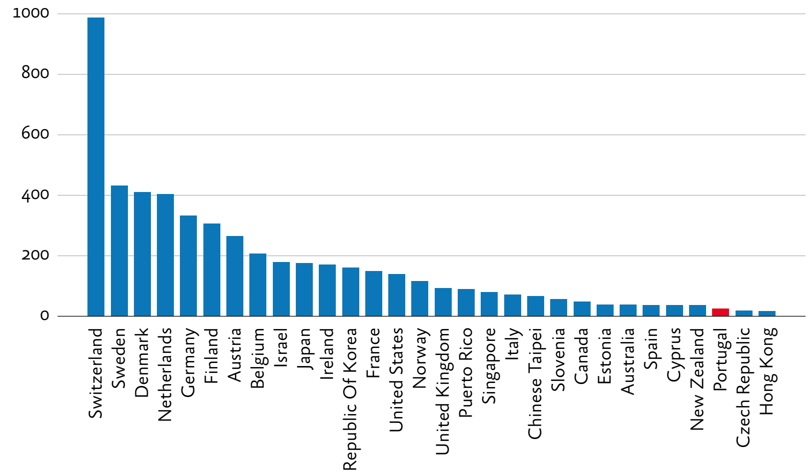
Source: World Development Indicators

2.4.1. The production of knowledge measured by patents: an international comparison

While the country has been increasing some of its technology production indicators, it is still very far behind the most developed countries, with a relatively slow path in the international comparison. When measuring the yearly patent applications per million Portuguese inhabitants, they rose nearly 5 % between 1980 and 2018. However, there is no clear convergence with the most developed countries, OECD or the USA. The Portuguese series shows an increasing path after 2008, surpassing the Spanish performance. Nevertheless, this rise in the patent dynamics coincides with a sluggish economic growth rate in the country, intensifying the puzzle mentioned before. Figure 7 shows the pattern of evolution.

When looking at the data from the European Patent Office, the overall conclusions are maintained. In 2019, Portuguese applications to the EPO represented only 0.1 % of the total. Figure 8 shows the position of the countries belonging to the European Patent System, confirming that Portugal is one of the least innovative in Europe regarding the creation of new technologies.

Figure 8 Applications for patents per million inhabitants in 2019



Source: raw data extracted from the European Patent Office

We now look at the patenting dynamics of the country after 2010, a period that has shown some convergence. Figures 9a and 9b show the data on the evolution of the number of patent applications and grants both in absolute value and as a percentage of the total.

Figure9a Applications and Grants (absolute values)

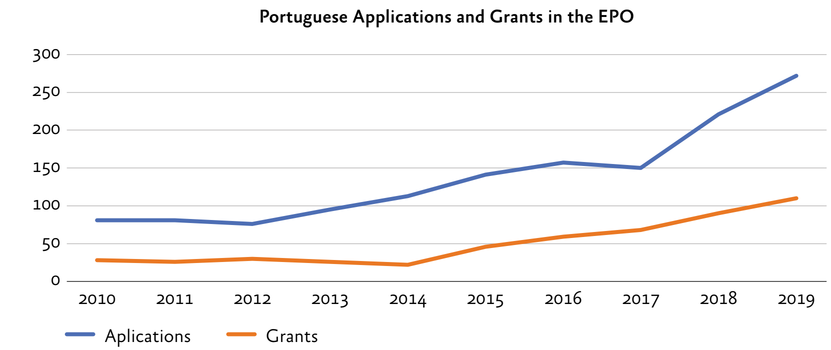
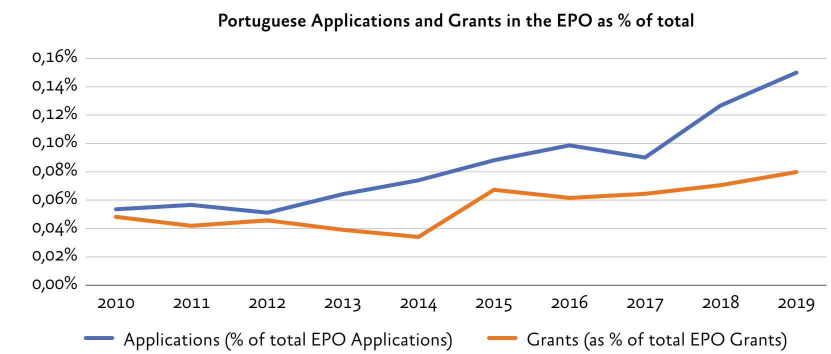


Figure 9b Applications and Grants (shares)



Source: raw data extracted from the European Patent Office

It is clear that not all applications are granted since the blue line is always above the orange line in figure 9b, in which the upward trend is to be highlighted. However, figure 9a also reveals a lower efficiency in obtaining grants, as Portuguese grants represent a lower share of the total Portuguese applications. Moreover, the most represented fields are linked with chemistry — dominated by health technologies (31 %) —, followed by Mechanical Engineering (22 %). The following most important fields are Electrical Engineering and Instruments (with almost 16 % each). This composition among fields has been relatively stable across the decade. The predominance of chemistry as a field of innovation is relatively common in Europe. In fact, according to the data from the European Patent Office, major exceptions are Sweden and Finland, with an emphasis on electrical engineering, Italy, with an emphasis on mechanical engineering, and Ireland, with an emphasis on instruments

The most innovative Portuguese region is the North, representing 43 % of all applications in 2018–19. This analysis is based on figures 10a and 10b for applications by fields and regions, respectively.

Figure 10a Applications by Fields, 2010–19

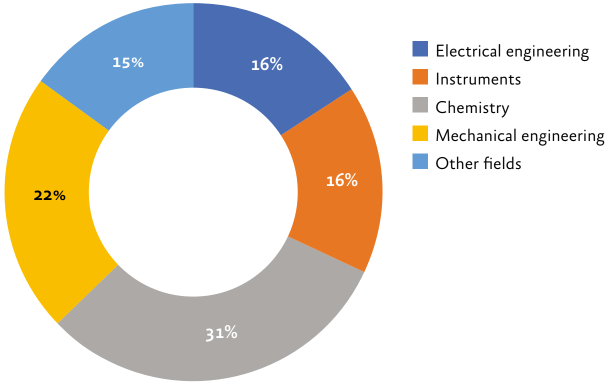
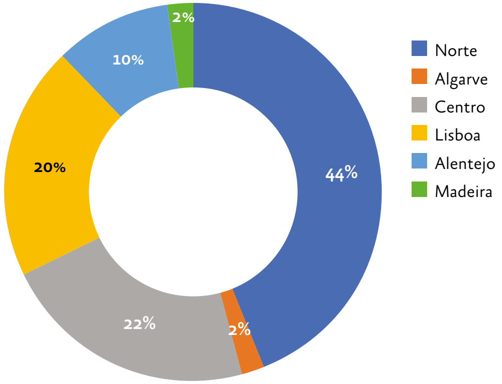


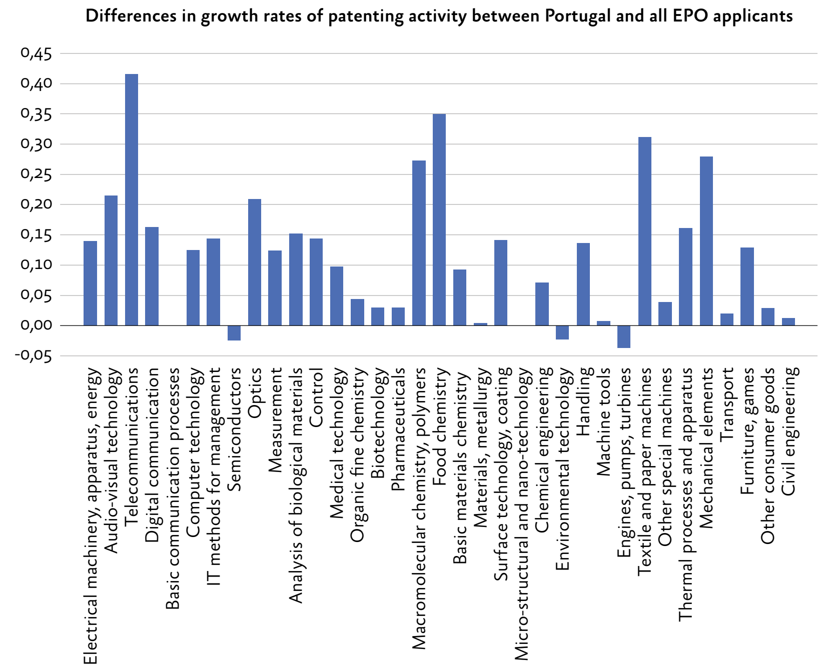
Figure 10b Applications by Region, 2018–19



Source: raw data extracted from the European Patent Office
Notes: Norte is the NUT II name of the Northern Region, Centro the NUT II name of the Central Region of Portugal, Lisboa is the NUT II name of the Lisbon Region.

Regarding the evolution of specific patent fields, those that grew most in Portugal, since 2012, were telecommunications, food chemistry, macromolecular chemistry, textile and paper machines, and mechanical elements, with an annual growth rate of more than 40 %. In terms of growth rates, Portugal has presented a higher dynamic than the total EPO patenting activity. Figure 11 compares the average annual growth rates between Portugal and all EPO applicants. Portugal showed a higher comparative patenting activity in the fields of audio-visual, telecommunications, digital communications, chemistry, and different types of machinery, some of which are linked to the textile and paper industry. On the other hand, Portugal is patenting more slowly than the general EPO applicants in semiconductors, environmental technology, engines, pumps, and turbines.

Figure 11 **Differences in patenting activity (growth rates) applications between Portugal and all EPO applicants**



Source: raw data extracted from the European Patent Office

Squicciarini, Dernis and Criscuolo (2013) studied the quality, rather than the quantity, of patents. In their own words: «This work contributes to the definition and measurement of patent quality. It proposes a number of indicators and an experimental composite indicator aimed at capturing the quality of patents, intended as the technological and economic value of patented inventions, and the possible impact that these might have on subsequent technological developments». These indicators, detailed in the source, are based on citations, scope, generality, backwardness, originality, radicalness, duration (renewals) and claims. Portugal does not appear in any of the components nor in the composite quality index, while Spain, Ireland, the Netherlands, Hungary, Belgium, Israel, Brazil, Denmark, and South Korea are listed. This may be because the study covers the year 2012, the beginning of the upsurge of patenting activity in Portugal. However, this is certainly a methodology that scientific authorities should follow regarding the analysis of the patent quality in Portugal.

2.4.2. The existing excellent science *created in Portugal*

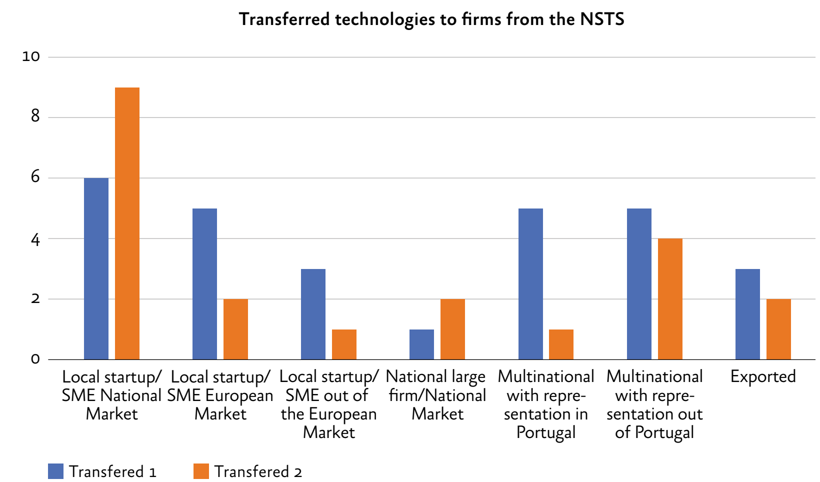
This section is based on answers to questionnaires applied to research units rated as *Excellent* according to the most recent National Science Foundation evaluation (which determined funding between 2018-2023) and to the National Laboratories network. We obtained answers to 24 out of the 51 questionnaires sent. Thus, we are focusing not only on excellence but, consequently, on the most well financed research that will be carried out in Portugal in the current period. The decision to focus only on Excellent research is based on the fact these facilities are more competitive in international terms and thus more capable of capturing foreign investors that base their production on *ideas created in* Portugal. Over the past years, there has been significant incentive to gather smaller groups into larger-scale groups. This strategy has yielded some results, especially in highly competitive international research units and laboratories.

The following analysis shows that the country has excellent science production in most of the necessary technologies for reindustrialisation under the new paradigm. Some of these technologies are already developed to help specific sectors of the Portuguese economy increase their productivity.

Figure 12 **Number of different technologies transferred from the NSTS (R&D units) to different categories of firms**

Main Conclusions from the Questionnaires

- Most technologies already transferred are classified within the *New Materials* and *New Industrial Processes* items. Even those that specified others can be placed in these categories.
- Most technologies identified as the most promising to be transferred, are classified in the *Internet of things* item, which indicates a change of pattern.
- Most of the transferred technologies are in the fields of biotechnology (or health related) and a minority in the field of robotics.
- Most of the transferred technologies (nearly one-third of those reported) apply to start-ups and SMEs operating at the national level.
- Only six technologies out of 45 were transferred to multinationals with representation in Portugal.



Source: own data from an implemented questionnaire

Regarding the technologies already transferred to the market and those with greater transfer potential, we have reached two main stylized facts. First, most technologies already transferred are classified under the *New Materials* and *New Industrial Processes* items, while the technologies identified as the most promising for transfer purposes are classified under the *Internet of things* item, which indicates a change in the pattern. Second, most of the transferred technologies (nearly one-third of those reported) apply to start-ups and SME operating at the national level. Only six technologies out of 45 were transferred to multinationals with representation in Portugal. For the strategy *created in* to have success, this last number must go up.

2.5. *Created in Portugal* — case studies

We present two case studies of success in the interaction between one subsidiary of a large multinational, and a Portuguese owned SME and the NSTS, namely the Bosh and Bluepharma cases. These are success cases, as they apply research developed within the NSTS to produce tradable goods with high value added that are well integrated in the global value chains. They also represent a change of paradigm from a multinational strategy of assembly in Portugal to an R&D-based multinational (or national) strategy.

2.5.1. Bosch Portugal

Bosch Car Multimedia Portugal, S.A. established a partnership with the University of Minho (Crossmapping the Future — Innovative Car HMI[54]) to develop new products and research for the automotive industry (more precisely, intelligent sensor systems). The project invested 98 million euros, between 2018 and 2021, produced 33 patents, involved 695 suppliers and created a club of Portuguese suppliers.

On the developed technologies

Several technologies, tools and processes have been developed under this partnership. Millions of components and devices such as infotainment displays have been manufactured and supplied to big brands such as BMW and Audi. The specific manufactured components include an Angular Position Sensor, a Rotation Position Sensor, a LIDAR System, New Quality Inspection tools for displays, software such as the BCar — car 2 car communication system, and an SMC system making it possible to trace and keep track of the parts. These technologies are now being produced in Braga for Bosch. The LIDAR system is a world-leading technology that was developed in Braga.

Effects

At the end of the financial crisis, Bosch Portugal S.A. was downsizing. From 2012 to 2013, the company experienced a reduction in sales and personnel. Then, in 2013, the company decided to change the strategic focus and entered into this joint project with the University of Minho and other partners. Table 2 shows the evolution of the main performance indicators as well as those related to investment in R&D. Not only did the R&D activity increase in terms of R&D personnel, expenditures and patents, but results (sales, profits, and value added) also more than doubled. The productivity per worker increased 230 %. And, most importantly for the *created in* Portugal paradigm, Bosch Portugal S.A. doubled its share of national suppliers (from 5 % to 11 %), meaning it is acting as a sectoral lighthouse entailing spillovers to other national firms and helping them have a part in the international value chain. The company now exports almost all of its final goods (99.8 %), which are intensive in national R&D activity (see table 2).

Table 2 **Bosch in numbers before and after the project**

Variable	2013	2019	%Δ
Sales (million €)	446.5	1,331.7	198%
Profits (million €)	11.8	36.8	212%
Value Added (VA) (million €)	19.4	80.3	314%
VA/Employee (€)	6,828.70	22,528.69	230%
Number of PhDs employed	n.d.	40	
PhDs (% of employees)	n.d.	1.11%	
National Suppliers as % of total Suppliers	5%	11%	
Exports as % of sales	97.6%	99.8%	+2.2%
Patents	n.d.	33	

Other Outcomes

- *Bosch in Braga is seen and recognised as a Lighthouse inside Bosch.*
- *Bosch is constantly challenged by its customers. It is difficult but also rewarding.*
- *Bosch in Braga is now reporting to the Automotive Electrification Business area of Bosch, being the most competitive and having the widest area in scope.*
- *Several of the software systems are used in other Bosch plants worldwide.*

Source: interview with CEO and Accounting documents

On the incentives to implement the project

For the decision to implement this project in Portugal, Bosch weighed several competitive advantages of the location. First, the CEO pointed out the existence of skills in quantity and quality. Second, the infrastructure (university, INL, roads, access to airport), which can include labour features such as a 40 hour work week and only 22 days of vacation, and therefore contribute to a relatively low skilled wage. As the last factor, the CEO pointed out subsidies to R&D and investment. In fact, Bosch Portugal is planning to double its capacity in Portugal.

2.5.2. Bluepharma

In 2002, when the industrial unit of Bayer, near Coimbra, was to be delocalised from Portugal, four entrepreneurs from Coimbra decided to buy the factory, with a licence to produce medicines from Bayer for some years. Note that Bayer was the typical multinational with representation in Portugal with a simple strategy: producing drugs without any inhouse R&D. From then on, the new owners devised a new project with the idea of supplying quality medications, but at a much lower price, to the whole population (the production of generic medicines in Portugal had been recently authorised, in 2000). To implement this strategy, Bluepharma established a good relationship with the Pharmaceutical School of the University of Coimbra and its Chemistry Department.

On the developed technologies: from Development to Innovation

Nowadays, Bluepharma dedicates 85 % of its R&D expenditure to the development of medicines and another 15 % to innovation. One of the interesting development programmes of the company is the NITECHS – Medicines Development Centre, where the firm licences medicines (preparing all the process to be submitted to the regulatory authorities). Then, the firm can decide to produce the medicine itself or sell the process to other firms.

In terms of innovation, we highlight a substantial innovation where the team uses known active principles of drugs and, together with teams of the University, develops new types of administration forms (e.g., complex injectables or dissolving films to administer drugs via absorption in the mouth — which can be very advantageous to people with psychiatric illnesses, low arm or hand mobility, and veterinary applications). Both innovations build on the idea of administering medicines to patients with a time distributed effect (e.g., one application may guarantee an administration for several hours or even days).

Furthermore, to push for disruptive innovation, Bluepharma has a start-up incubation programme involving new PhDs, for which Bluepharma supplies knowledge and equipment to invest in a disruptive idea for a new medicine.

Effects

The new vision of Bluepharma (compared with the former vision of Bayer) led to a massive increase in sales, profits, value added, productivity, R&D inputs (as PhDs and Expenditures), a great increase in exports and lower dependence on internal suppliers, as shown in table 3.

Table 3 Bluepharma in numbers in the year of Bayer's acquisition and in 2019/2020

Variable	2002	2019/2020	%Δ
Sales (million €)	4	58	1350%
Profits (million €)	0	4	
Value Added (VA) (million €)	2	22	1000%
VA/Employee (€)	33,308.87	44,527.96	33.7%
Number of PhDs employed	1	22	2100%
PhDs (% of employees)	2%	4%	100%
National Suppliers as % of total Suppliers	n.d.	26%	
Exports as % of sales	0%	87%	
R&D expenditures (million €)	n.d.	8255	
Patents	0	9	

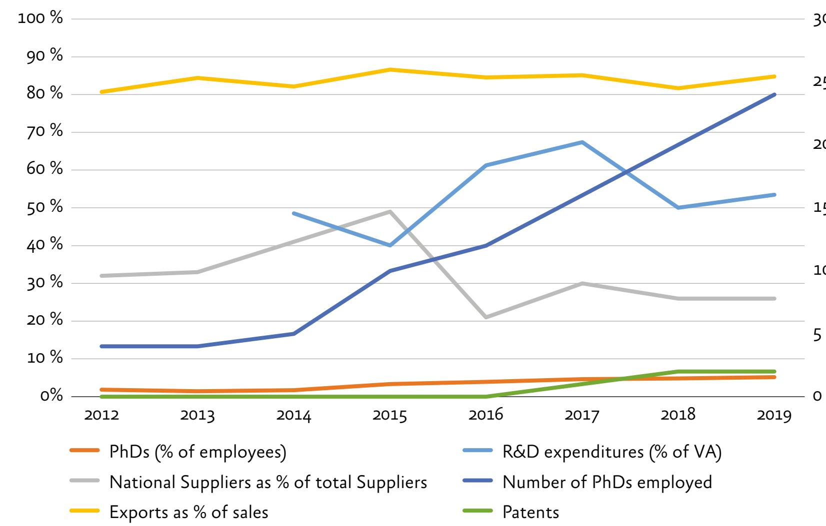
Other Outcomes

- In the next two years, Bluepharma plans to invest the same amount of money they have invested so far (50 million euros).
- Bluepharma plans to invest in a Pharmaceutical campus in Coimbra with a covered area of 35000m².
- Bluepharma was the first Portuguese pharmaceutical to be approved by the FDA.

Source: interview with CEO and data supplied by the firm

In recent years (2012–19), major inputs to R&D increased significantly (see figure 13). The number of PhDs increased more than five times, from four to 25. R&D expenditures have also seen a significant rise. Even as a percentage of the added value, they increased from around 48 % to nearly 54 %. In this last period, exports have been quite stable at more than 80 %, despite the huge increase in the previous period (shown in table 3). Due to the intensification of R&D investment and a greater focus on innovation, the number of patents has risen from 0, in 2016, to 9 in 2019. The decrease in the national suppliers, together with a very high share of exports, seems to be a sign of increased integration in the global value chain but without a higher engagement with national firms.

Figure 13 Bluepharma key indicators in recent years (2012-2019)



On the incentives to implement the project

The incentives to implement the project were mainly driven by the entrepreneurial spirit of the four partners and the proximity to a university with an adequate supply of skills. When asked about the main success driver of the project, the direct answers of the CEO were the *skills* they could gather in the team.

2.6. Suggested policies

The country's most evident strength is the production of STEM skills, which is within the European average but far from the European leader in this indicator (Ireland). Another positive aspect is the fact that there is some evidence of increased patent activity after 2008. The country's weaknesses, however, are the relatively low productivity of research in most subfields (yet higher than some Eastern European countries), the relatively low patent quality and an overall under-funded NSTS. In this regard, some relevant suggested policies include:

- increasing the funding of the best R&D units and institutions, which are capable of being competitive and excellent at the international level;
  - in particular, implement long-term calls to provide stable funding to strengthen those institutions and provide the necessary conditions to make them international leaders in specific fields;
- implementing reallocation choices that promote the efficiency and mobility of professors and researchers within the system;
- allocating funds to attract international talents (students, professors and researchers);
- subsidising PhDs in firms;
- improving the matching system between the NSTS and leading multinationals located in Portugal with a strong SME supplier network.

Acknowledgements

We thank the contributions of the members of the Steering Committee, especially those of Arlindo Oliveira and Georg Schutte; the CEO of Bosch Portugal, Carlos Ribas; and the CEO of Bluepharma, Paulo Barradas Rebelo for their suggestions and for the data supplied.

Table 4 **Weaknesses of the NSTS within the created in proposal**

Weaknesses of the NSTS for the *created in* proposal	Suggested Policies	Expected Results
	Funding and Inputs	
Low ranked HEI in comparison with countries of similar dimension, with higher and lower income per capita. Low mobility of professors between institutions leading to high inbreeding. Relatively old professors. Relatively high wages at entrance but low variations along the career. Funding of R&D (1.4 % of GDP) is still far from the mystical benchmark of 3 % of the GDP. The public funding of HEI is low compared to European standards.	Increase the funding of NSTS institutions, commit to a stable funding functional form dependent on students and efficiency/productivity measures, and implement competitive calls for long-term funding. Hire on the international job market for both HEI and R&D units, which would help reduce inbreeding and increase the share of younger professors and researchers. Specialise small institutions in fields in which they have a competitive advantage or incentivise the merging of smaller institutions. Increase the funding of the best Portuguese R&D units, strengthening international competitiveness and creating fields of excellence in the country. Increase the slope in wage patterns of university professors, dependent on excellence in research and fundraising. Give the HEI some flexibility in setting wages for hired professors to allow for competitiveness in national and international markets (subject to specific HEI conditions).	Increase the ranking of Portuguese HEI. Increase the international competitiveness of Portuguese researchers and R&D units (measured, for e.g., by the success rate in obtaining ERC grants; the success rate in granting patents; publications in top journals). Emergence of fields of research as international leaders. Contribute to increase R&D intensive investment, namely FDI and private national investment.
Different funding sources and the evaluation criteria across regions are misaligned and contribute to a bureaucratic process of funding.	FCT should be provided with stable and multiannual funding mechanisms to provide funding stability to the scientific and technological community.	Better planning in R&D activities Increase R&D productivity
	Outputs of NSTS	
Low quality of patents	Subsidise R&D, PhDs and Post-Docs in firms. Create a variable to monitor the evolution of the patent quality.	Increase the impact of patents
Most technologies are transferred to start-ups and SMEs that only work in the country	Create/develop a matching system between excellent R&D units and subsidiaries of multinationals operating in Portugal. Subsidise projects linking R&D units to SMEs with international penetration and multinationals' involvement.	More technologies helping the creation of value in exports More multinationals' subsidiaries creating value based on national R&D
Slow adaptation to re-skilling of students and general population in the necessary skills	Incentivise the creation of transversal courses on digital and Big Data skills. Incentivise students to pursue STEAM fields.	Improvement of transversal digital skills Increase the availability of STEAM supply in the labour market

Source: the authors of the paper

References

Breque, M.; L. De Nul; A. Petridis, «Industry 5.0 Towards a sustainable, human-centric and resilient European industry». *European Commission*, 2021, link

DGEEC – Direção Geral de Estatísticas de Educação e Ciência, «Perfil do Docente do Ensino Superior Público», *DGEEC*, 2020, link

European Commission, «A European Industrial Strategy. A new Industrial Strategy for a globally competitive, green and digital Europe», *European Commission*, March 2020, link

Federal Ministry for Economic Affairs and Energy (FMEAE), «Industrial Strategy 2030: Guidelines for a German and European industrial policy *Made in Germany*», Federal Ministry for Economic Affairs and Energy, 2019, link

Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer, «The Next Generation of the Penn World Table», *American Economic Review*, Vol.105, No.10, pp. 3150–3182, 2015, link.

Feyrer, J., «Aggregate evidence on the link between age structure and productivity», *Population and Development Review*, Vol. 34, pp. 78–99, 2008.

Jones, B.F., «Age and great invention», *Review of Economics and Statistics*, Vol. 92, No. 1, pp. 114, 2010.

Jørgensen, F., Hanssen, TE. S, «Research incentives and research output», *Higher Education*, Vol.76, pp. 1029–1049 ,2018, link

JRC and OECD, «World Corporate Top R&D investors: Shaping the Future of Technologies and of AI», a joint JRC and OECD report, 2019.

Ministério da Educação e Ciência, *Modelo de Financiamento do Ensino Superior: Formulas e Procedimentos*, July 2015, ISBN 978-972-729-086-4

Naudé, W., A. Surdej and M. Cameron, «The Past and Future of Manufacturing in Central and Eastern Europe: Ready for Industry 4.0? », *IZA*, 2019, DP No. 12141.

OECD, «OECD Science, Technology and Industry Scoreboard 2017», *OECD*, 2017, link

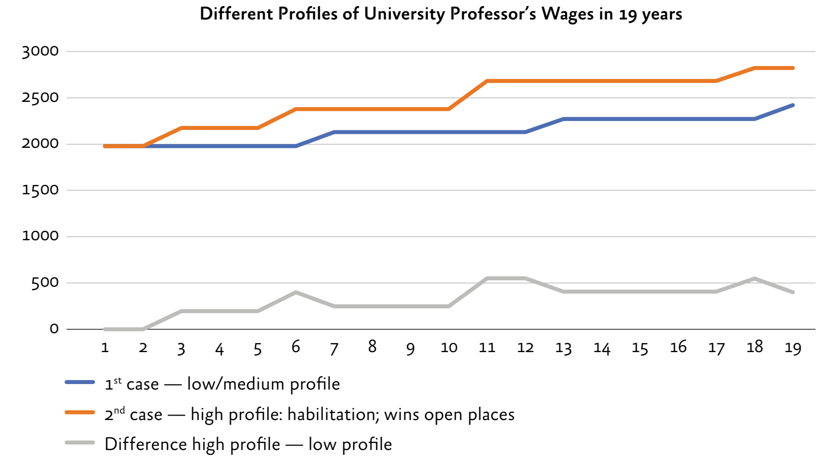
Shanghai Ranking Consultancy, «Academic Ranking of World Universities», *Shanghai Ranking Consultancy*, 2020, link

Schwab, K. and S. Zahidi, «The Global Competitiveness Report» SPECIAL EDITION 2020, *The World Economic Forum*, 2020, link

Tavares, O., Cardoso, S., Carvalho, T. et al., «Academic inbreeding in the Portuguese academia.» *Higher Education*, Vol. 69, pp. 991–1006, 2015, link

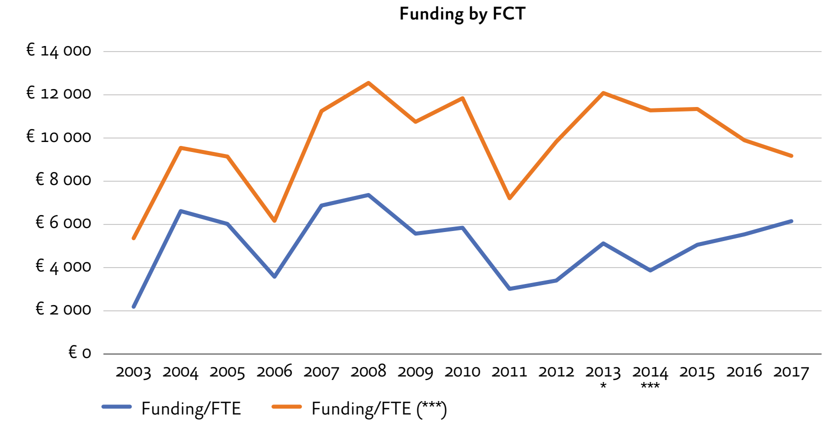
Veugelers, R. and M. Baltensperger, «Europe – the Global Centre for Excellent Research», *Policy Department for Economic, Scientific and Quality of Life Policies*, 2019.

Appendix 1.A Wage Profile of University Professors



Notes: data from 2021 remuneration tables. The 1st case simulates the net wage of a professor with the highest evaluation but no qualification or higher placements in the career track (Associated and Full Professor). The 2nd case simulates the net wage of a professor who gets qualification after two years, wins an Associated position in the following five years, and a Full position in the five subsequent years. We have applied the labour tax rate (IRS) according to the 2021 Government Budget and the social security contribution of 11 %.

Appendix 2.A Evolution of FCT funding per researcher, 2002-2017



Source: values in table 2

Paper 3

Building the new paradigm: skills and labour markets

José Varejão, FEP — Universidade de Porto
Joana Vasconcelos, Escola de Lisboa — Faculdade de Direito, Universidade Católica Portuguesa
João Cerejeira, EEG — Universidade do Minho
Miguel Portela, EEG — Universidade do Minho

Introduction

The transition from a *made in* to a *created in paradigm* is to be implemented under the auspice of the European Recovery Plan, whose main goal is to «enhance the strategic autonomy of the European economy in specific areas, including strategic value chains and reinforced screening of foreign direct investment». In the coming years, the Portuguese economy will be confronted with Europe's reindustrialisation, the reorganisation of global value chains and the underlying processes of digital and climate transition.

The *created in* paradigm starts from the assumption that the successful integration of the Portuguese economy in these processes implies moving upstream in global value chains and requires an effective collaboration between the institutions of the national system of science and technology, domestic SMEs and major European conglomerates.

Innovation and the attraction of foreign direct investment (FDI) are the key ingredients of the transition to the new paradigm. From a labour market point of view, moving upstream in global value chains implies innovation capacity (in products, processes and business models), the adequate supply of skills — required by the science and technology sector and the different sectors of the economy, in particular, the manufacturing sector —, and entrepreneurial capacity. The attraction of FDI requires good (labour market) institutions and, again, an adequate supply of skills.

From the perspective of labour markets, preparing the way for the shift from the *made in* to the *created in* paradigm implies, first of all, identifying the existing obstacles and suggesting ways to remove or alleviate them. It also implies anticipating the likely consequences of such transition and manage them in order to maximise its benefits and minimise its (social) costs. This is the purpose of this report that should be taken as a policy report rather than a research paper.

We start by briefly reviewing the evolution of the Portuguese economy from the accession to the EU (in 1986) to the end of the adjustment process (2013) that followed the international financial crisis. This section is meant as a reminder of the origin of the slow growth/low productivity path the Portuguese economy followed since the beginning of the 2000s and the persistent process of population ageing, but also of some of the country's most salient achievements during this period, most notably the progress in terms of schooling of the population and, in particular, of the youngest generations.

Next, we pay closer attention to the period between the two crises — the global financial crisis and the COVID-19 crisis. This is a period when the Portuguese economy performed reasonably well, with structural adjustments taking place at the macro and micro levels, but also a time of persisting macroeconomic imbalances and low productivity. Despite the progress observed at the micro-level, with the emergence of new, more productive and more competitive players open to international trade, to innovation and to collaborating with other institutions of the science and technology system, their job creation potential remained limited and the evolution of employment dependent on the developments occurring in the rest of the economy.

We look particularly at the evolution of the labour markets and document the evolution of the supply of education/skills and demand for labour in a period that followed major changes in labour market institutions and migration of young and skilled workers, and that started with record-high unemployment. Low wages and segmentation of labour contracts persisted throughout this period, which also saw early signs of shortage of specific skills.

In the second part of the report, we seek to anticipate the impact of the transformations that have been going on for some years in the labour markets, as well as the impact of the transformations that will be produced by the transition to the *created in* paradigm in the Portuguese labour market. We do that by looking at the literature on the impact of technical change and technology adoption on labour demand and earnings. We review the most important results of this literature and also some influential technical reports on the future of work in a world that is going through the digital transition.

Next, we use microdata from different sources to characterise the evolution of employment and wages in firms that may be considered the forerunners of the transition to a digital economy and are fully integrated into the global economy. We take their evolution as an indication of what may happen in the labour market as more firms make the transition to the *created in* paradigm.

We conclude this part of the report by looking at where we stand in international terms regarding the adoption of new technologies, the development of new business models and the readiness of the labour market institutions to face the digital transition.

The last part of the report summarises the results and makes policy recommendations.

3.1. The economy and the labour market

3.1.1. From the accession to the EU until the end of the great recession (1986–2013)

The 15 years that followed Portugal's entry into the European Union (1986–2000) was a period of rapid growth and convergence with Europe. From the year 2000 until the onset of the international financial crisis, the economy slowed down — the growth rate was systematically below the EU average and below the growth rates of most EU member states. During this period, the Portuguese economy accumulated a series of imbalances, combining slow productivity growth with large deficits of the public budget and the current account, high levels of public and private debt, and rising unemployment.

When the financial crisis hit, the government responded with the adoption of an expansionary budgetary policy that curved its immediate real impact but ultimately led to a bail-out agreement with the IMF in 2011.[55] Part of this agreement was a response plan that combined a significant reduction of public spending with an ambitious plan of structural reforms, including the reform of major labour market institutions.

In the labour market, the reforms were driven by two main objectives: (i) improve the working of the labour market (by reducing the incidence of mismatches, tackling long-term unemployment and fighting segmentation), and (ii) remove the obstacles to productivity growth and competitiveness (by facilitating the adjustment of the labour input in terms of jobs, workers or hours of work, by cutting the costs of labour and dismissals and by promoting the alignment of wage variations with the state of aggregate and firm-level business affairs).

In the domain of the labour market, the main provisions of the plan were:

i. the reform of the unemployment benefit system, by reducing the maximum duration of unemployment benefits, capping them and making them (negatively) dependent on the time elapsed since the entry into unemployment and reducing the entitlement period;
ii. the reform of the legislation on dismissals, by significantly reducing (to 40 % of its previous amount) severance pay in new open-ended contracts (thus aligning them with fixed-term contracts) and setting forth new solutions aimed at bringing dismissals due to the extinction of job positions and unsuitability closer to the employer's needs;
iii. the reduction of extra work-related costs, by significantly broadening the application scope of the bank of hours (a flexible work time arrangement) and, regarding overtime work, by cutting pay premiums to half and by abolishing paid compensatory time off as a rule;
iv. adapting the wage-setting system by temporarily suspending the annual increase of the minimum wage and revising the rules governing the extension (by administrative decision), renewal and expiry of collective agreements;
v. revising Active Labour Market Policies so as to increase their effectiveness.

The implementation of this plan in the context of an international recession led to a major internal recession, with the unemployment rate peaking at nearly 18 percent, total employment falling by more than 10 percent, and net migration flows turning negative for the first time in 15 years. Recovery signs became perceptible in 2013:

the unemployment rate entered a declining trajectory in the second quarter of the year and, in the last quarter, the GDP real growth rate set at 2.1 %, after 11 consecutive quarters of negative records.

3.1.2. Between the two crises: 2014–2019

Overview

After the financial crisis and the implementation of the Programme of Economic and Financial Assistance laid out in the MoU agreement, 2014 was the first year of positive (moderate) growth.

The decline of the domestic demand and the consequences of bank restructuring programmes, with funds, increasingly channelled to companies with higher growth potential (i.e., more productive and export-oriented), pushed domestic firms to expand or engage with international operations. The export-oriented sector of the economy also gained access to sources of funding alternative to bank lending, such as self-financing and financing by international investors. As exports of goods and services, including tourism, became the main driver of the economy, a process of structural adjustment at the micro-level was set in motion pushing forward the reallocation of production and employment between and within industries and companies.

Progress at the micro-level was accompanied by a correction of the macro-imbalances that characterise the Portuguese economy, namely the deleveraging of the economy (movements towards fiscal consolidation and the reduction of families' and private companies' debt) and the improvement of the country's external position.

Despite the positive trends observed at the micro and macro levels, significant frailties persisted. The level of public and private debt is still too high. The reallocation of production within and between sectors, albeit significant and positive, was not sufficient to induce productivity growth (which remains essentially stagnant). The creation and expansion of knowledge-intensive and more productive firms exposed to international trade generate growth but not enough to absorb the record-high levels of unemployment that were reached at the peak of the recession. A significant contribution to the reduction of unemployment still comes from other sectors of the economy, namely the more labour-intensive and less productive sectors that resumed growth in the second half of the period between the two crises. Another important contribution was the recovery of internal demand triggered by the reversion of past income losses during the process of adjustment.

The persistence of macroeconomic imbalances remains a major threat to the sustainable recovery of the Portuguese economy. Correcting those imbalances is a necessary but not sufficient condition to ensure recovery. Labour and product market institutions — that inhibit the mobility of labour or limit market competition and raise context costs — and the fiscal burden —, are commonly identified as obstacles to the reallocation of labour and the transfer of production from the low-productivity to the high-productivity sectors of the economy, and thereby to the competitiveness of domestic production and economic growth.

Labour Law

From 2013 to 2019, Portuguese Labour Law kept (and occasionally completed) most of the non-transitory MoU-based solutions adopted in 2011–2012, *inter alia*, the considerable reductions of severance pay for non-disciplinary dismissals, additional pay for overtime work and forsaking seniority as the sole factor of employee selection in the dismissal due to the extinction of job positions. The minimum wage, which had been frozen since 2011, resumed its annual updates in 2015.

During the same period, Portuguese Labour Law underwent several changes in a large number of respects, some of them with an impact on the issues covered in this paper.

In 2014, new rules were laid down to set an appropriate period for collective agreements remaining in force past their agreed term (i.e., to their *ex lege* extension whenever the parties are negotiating). This goal was mostly thwarted, firstly in 2019, by a new prerogative enabling any party to resort to arbitration and, subsequently, to mediation as a means to suspend the count to deadline (thus, to maintain the collective agreement further past its due time) and, subsequently, in 2021, by an *ex lege* suspension of such count for a period of 24 months (up to 2023).

A decisive change of course regarding the so-called bank of hours took place in 2019, as the permission to adopt it at the individual level (by agreement or internal regulation), dating back to 2012, was revoked. Consequently, this flexible work time arrangement that stands as a more adjustable and affordable alternative to overtime work can only be put into practice at the collective bargaining level (by collective agreement or its extension, when legally allowed).

A special mention is also due to the modification of rules on fixed-term contracts and the duration of the probation period that took place in 2019. Aimed at stimulating the employers' resort to open-ended employment contracts, the new framework limited the use of fixed-term contracts beyond the event of an employer's temporary need, drastically reduced their maximum duration and their renewals, and doubled the ordinary 90-day probation period in specific situations.

As a result of this reform, fixed-term contracts cannot last for more than two years (four years if the term is *uncertain*), and their renewals, which add to that count, cannot exceed the duration of the original contract (e.g., from now on a one-year fixed-term contract can only have a one-year renewal or two six-months renewals). To offset this major drawback, the probation period applicable to the long-term unemployed (i.e., for over 12 months) and to those seeking their first job (those who, regardless of their age and professional experience, have never been part to an open-ended employment contract) was increased from 90 to 180 days.

Nevertheless, a few adjustments are yet to be made, most of them related to the new challenges caused or increased by digitalisation, which may bring about unemployment but also create new and more specifically skilled jobs.

Portuguese Labour Law has long dealt with technological dismissals, i.e., dismissals caused by either the elimination of job positions as a result of automation or robotisation, or by their transformation due to technological changes, so significant that the employees previously assigned to them fail to adapt to their new features (despite being given appropriate training and time). So far, national labour law has granted a tenure-based notice period, severance pay and unemployment benefits to employees affected by technological dismissals. However, the sort of unemployment these dismissals generate (workers deemed *obsolete* or *unfit to handle innovation*), as well as the anticipation of its growth in the near future, demands a radical reshaping of professional training, which should be effectively provided by the employer during the employment relationship and mainly targeted at technological updating and reskilling. Likewise, additional professional training must be granted by the employer that moves ahead in the digitalisation path to facilitate the employees' internal replacement (as an alternative to dismissal) or outplacement (following dismissal).

Despite the recent measures that unequivocally redirected some legislative choices (such as the 60 % reduction of severance pay or the increased strictness on temporary contracts' regulation) and improved our score in some indicators of labour market rigidity, Portugal still ranks poorly at an international level, as pointed by OECD[56].

Labour market rigidity is mainly due to the four decades long decision to establish reinstatement as the natural consequence of any dismissal's non-conformity (which can only be set aside by the employee). However, two other legislative choices have contributed to that result. Firstly, in case of termination by mutual agreement, the employee is entitled to unemployment benefits only in limited situations (a choice that goes back to 2006). Secondly, the employer has little room for decision when it comes to selecting which employee or employees to dismiss in the event of extinction of one or several job positions.

However, since the strictness of the labour market regulation is now limited to specific aspects of the legislation, Portuguese employers do not place labour market regulation among the major obstacles to investment, at least not more than other European employers. The most relevant barriers to investment in Europe, as well as in Portugal, appear to be labour costs (1st barrier in the EU and 4th in Portugal), poor or uncertain economic outlook (2nd barrier both in the EU and in Portugal), complexity and stability of tax legislation (2nd and 3rd barriers in the EU and in Portugal, respectively), administrative burdens (5th in the EU and 6th in Portugal), and skills shortage (6th in the EU, 9th in Portugal).[57] Labour regulation is the 6th barrier to investment in the EU and the 7th in Portugal.

New forms of work made possible by technology, such as telework and its variations (remote work, smart or flex work), also require adjustments to the legislation.

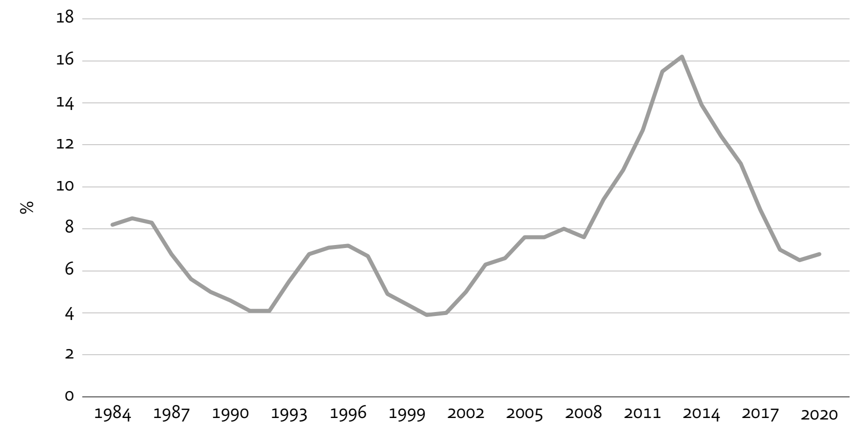
The massive use of telework during the COVID-19 pandemic has decisively proved its advantages to both employers and employees while also revealing the vulnerabilities of its legal framework in a number of respects (such as the splitting of telework-related or induced costs, enforcement of work time limits and protection of employees' privacy). A thorough revision of the applicable rules aimed at making telework attractive and rewarding to both parties is underway.

Another inescapable reality that needs to be further dealt with is platform work. Platform work is a fast-growing reality and a quite diverse one as it comprises a wide range of situations. A main distinction is usually drawn between totally remote work (often rendered from a country or continent to another) and on-location task performing (such as transport or deliveries). Although it is widely accepted that platform work is a source of new opportunities — as it creates new jobs, allows the employees more flexibility, is compatible with part-time working (thus facilitating work-family or work-study reconciliation), provides employment to certain groups deemed more difficult to hire and can even attract highly-skilled foreign professionals (if combined with other favourable factors) — there is also a disturbing downside to it. In terms of legislation, the most pressing issues are related to the rules applicable to the contract between the work provider and the platform owner, which, so far, depend on the characterisation of the service (as either employment or service provision). In 2018, Portuguese Law specifically addressed platform-based passenger transport. There is, however, a widespread consensus that new rules are soon required and that they must acknowledge the singularities of platform work and provide adequate levels of work and social protection, as well as appropriate tax and social security solutions, regardless of the actual contract qualification.

Unemployment

The period between the two crises was one of high unemployment — in 2013, the annual unemployment rate reached an all-time high of 16.4 per cent, following an increase of nearly 9 p.p. (from 7.6 per cent in 2008) since the beginning of the international financial crisis. At its peak, the Portuguese unemployment rate was 5.4 p.p. above the EU average (from 0.7 p.p. in 2008).

Figure 1 **Unemployment Rate**



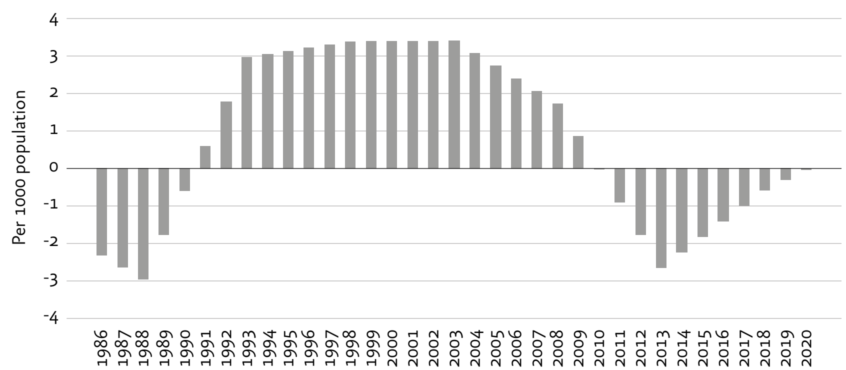
Source: PORDATA and INE

The rise of unemployment resulted from a reduction in job creation, but especially from a massive job destruction. More than 200 thousand jobs disappeared during this period. A large share of the total job destruction was due to the closing of existing firms (Carneiro et al., 2014).

Labour Force and Demography

The consequences of the economic crisis are not visible only in terms of rising unemployment. During this period, more than 200 thousand residents, predominantly men of working age (and another 80 thousand in 2014 and 2015), left the country for more than one year and for work-related reasons (source: INE). The intensification of outward migration was accompanied by a major decline in the entry of new migrants and the return of immigrants in previous years: the number of non-national citizens living in the country in 2015 was down by 15 per cent when compared to its 2009 level (source: INE).

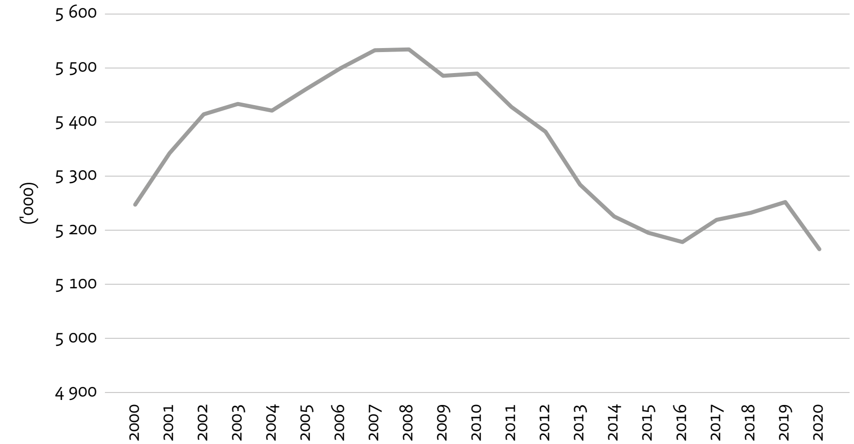
Figure 2 **Net Migration Rate**



Source: United Nations — World Population Prospects

The evolution of migration flows, together with the underlying ageing trend and increased transitions from employment and unemployment to inactivity, originated a sizable decline of the labour force during these years.

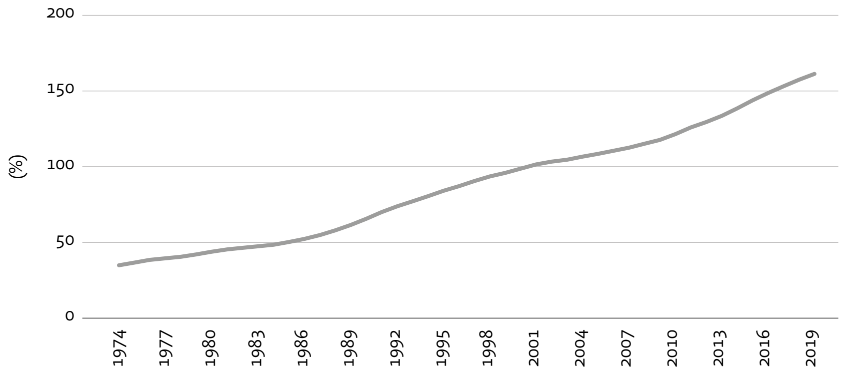
Figure 3 **Labour Force**



Source: INE and PORDATA

Ageing is a serious concern for the Portuguese economy both for its direct impact on the size of the labour force and the pressure it puts on the healthcare and social security systems. The intensification of migration flows and the age profile of outward migration (predominantly individuals below the age of 35) magnifies the increase of the ageing index that has been rising steadily since 1974.

Figure 4 Ageing Index



Note: number of persons aged 65 or more in % of those aged 15 or less
Source: INE and PORDATA

On top of its impact on the size of the labour force and the ageing index, outward migration is also a matter of concern since it drains highly educated young workers out of the country with the corresponding loss of human capital and foregone social returns to public investment in education.

In 2019, the government launched a programme designed to encourage the return of Portuguese citizens living abroad (*Regressar*) [58]. The programme combines tax benefits, financial incentives and subsidies for the creation of new ventures, and was set to remain in force until the end of 2020 but was extended up to 2023. The initial (but sparse) information available indicates that 3,5 thousand migrants have actually returned to Portugal under the auspices of *Regressar*. The majority of these (75 %) had left between 2008 and 2015; 40 per cent of them were aged between 35 and 44, and another 40 per cent had a university degree.

Total Employment

The rapid decline of unemployment initiated in 2014 had its counterpart in terms of employment and employment creation. In a recent study (Banco de Portugal, 2021), the net employment variation between 2013 and 2018 was estimated at 491 thousand. The decomposition of the overall employment change between the entry/exit margin and the expansion/contraction margin further indicates that, although both margins contributed positively to the aggregate result, the largest contribution came from the net employment variation due to the growth and contraction of incumbents (more 400 thousand net jobs, as opposed to the 82 thousand created on the entry/exit margin).

Table 1 Decomposition of employment variation (2013–18)

	Variation	Expansion	Contraction	Entries	Exits
Micro	46 973	76 816	-48 032	237 927	-184 401
Small	126 333	79 997	-24 311	134 210	-102 977
Mid-size	118 974	71 753	-16 870	69 307	-65 145
Large	198 773	145798	-19 009	51 958	-58 569
Total	**491 053**	**567 854**	**-159 111**	**493 402**	**-411 092**

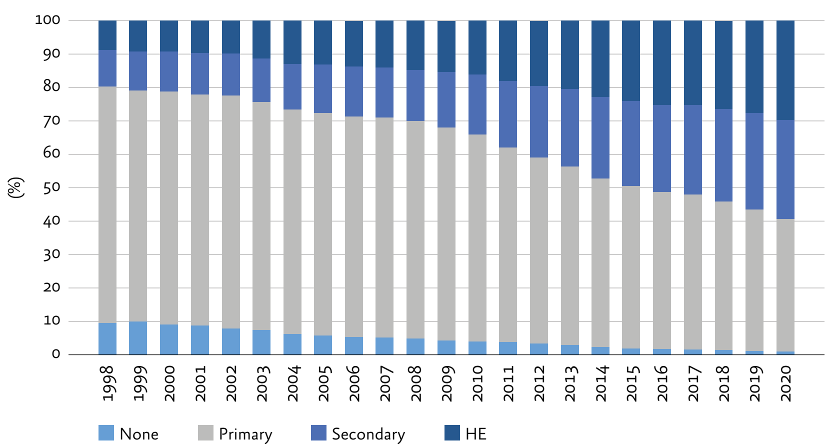
Note: reproduced from Banco de Portugal — *Boletim Económico* (March 2021), *a evolução da dimensão médias das empresas em Portugal*, p.35. Data from *Quadros de Pessoal/Relatório Único* (INE).

It is important to note that large companies are responsible for 25 % of the employment created by expanding incumbents and for only 12 % of the employment destroyed by contracting incumbents. More relevant is the fact that micro firms represent 48 % and 45 % of the employment created and destroyed by companies entering and exiting activity. Because it is a well-established fact that labour productivity is lower in smaller companies, it would be interesting to know the contribution of these micro firms to the evolution of labour productivity as well as the role labour market programmes play in encouraging the creation of these ventures.

Education and Training

The outcome of a massive investment in education over the past 40 years is one of the most salient and positive developments observed in a country with, traditionally, the lowest average levels of education in Europe. In 2000, workers with primary education or less represented 80 % of the labour force, decreasing to 62.1 % in 2013, and 39.5 % in 2020. The share of workers with higher education was 9.3 %, 20.5 % and 29.8 %, respectively.

Figure 5 **Composition of the Labour force by educational attainment**



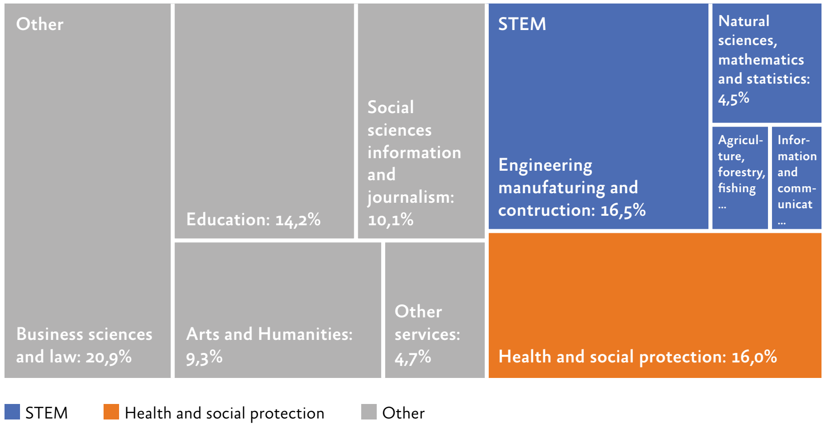
Source: INE, PORDATA

The scarcity of workers with higher education has a direct consequence on the corresponding wage premium. Returns to education remained high by international standards throughout the 1980s, and most of the 1990s, and very much stable until the end of the adjustment period (Campos and Reis, 2017). The level and evolution of the education premium and the university education premium reflect the relative scarcity of workers with higher levels of education and the fact that, during the period of rapid growth that followed Portugal's accession to the EU, the demand for skills surpassed the also rapid increase in the corresponding supply.

In the last two decades, the differential of educational levels between those entering and exiting the labour force increased the relative supply of workers with tertiary education, which contributed to a reduction of the corresponding wage premiums entirely driven by the evolution of the returns to university degrees.

There is, however, evidence of higher wage premiums for university degrees in STEM fields that are entirely driven by the fact that workers with this background have access to specific jobs and higher-ranked positions, and not because they receive higher wages than workers in similar jobs/positions with different educational backgrounds (Figueiredo et al., 2017). However, only 16.5 % of the working-age population has a degree in a STEM-related field, and women remain largely underrepresented in these areas of education.[59]

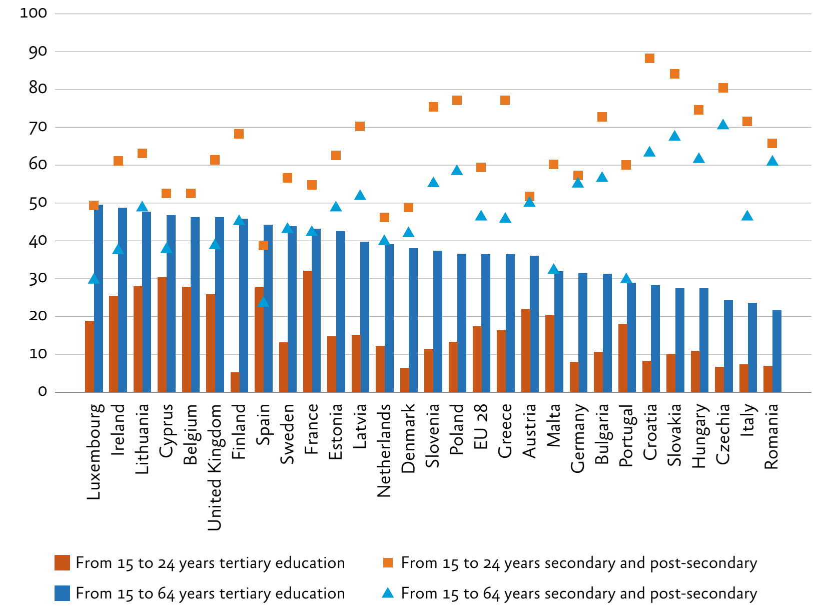
Figure 6 Population with a university degree by field (% of the population aged 25-64) — 2019



Source: INE — Employment Survey

Despite the positive evolution of educational levels, when we compare Portugal with other European countries, we can see that, even for the youngest cohorts, the country still lags behind the EU average and many member-states.

Figure 7 Labour force by educational attainment (2019)



Source: Eurostat

During the adjustment process, unemployment hit workers across the board, but core workers — mid-age men with secondary education or less — were especially affected. Although doubling from trough to peak, the rate of unemployment of workers with a university degree reached 12.6 %, well below all other education groups (between 17.0 % and 17.4 %), which evidences the higher resilience of firms employing workers with higher educational attainments and the above-average hiring of workers with university degrees during the recession. These figures are consistent with the adjustment process that took place over this period at the micro-level, namely the reallocation of jobs to firms operating in international markets, innovative firms and multinational companies that are all intensive users of skilled labour (see below, section II.2).

The existing evidence indicates that, similarly to education, training and lifelong learning increased significantly since the early 2000s[60]: the percentage of individuals aged between 18 and 64 participating in lifelong learning increased from 30.9 % in 2007 to 50.2 % in 2016. The largest contribution to this increase came from the participation in non-formal education (twice as large at the end of the period). Although the vast majority of workers in formal education are university students (65.7 % in 2016), evidence on the evolution of participation in formal education is mixed. As expected, participation in lifelong learning is more frequent among younger workers and workers with more education.

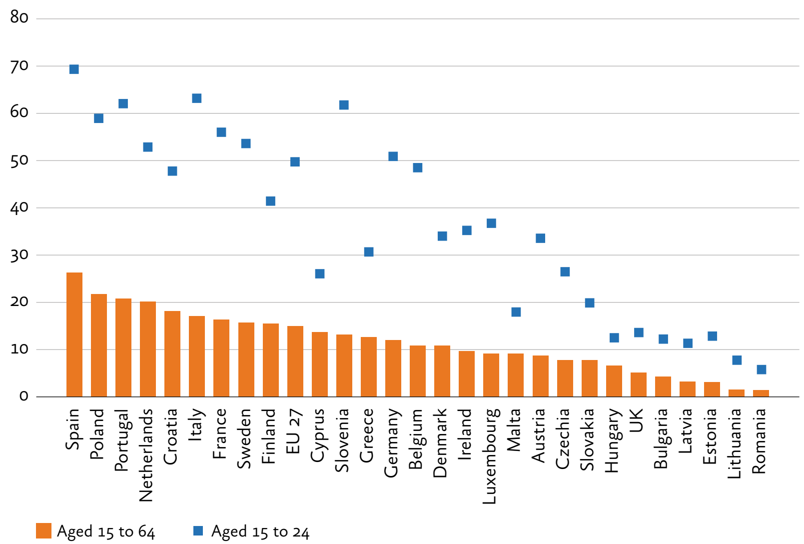
Firm-level data on employer-provided training indicates that the participation in this kind of training remained stable in relative terms between 2014 and 2018, at around 46 % of all firms with more than ten employees, and 42 % of all employees. Notwithstanding, the absolute number of firms and employees providing and participating in training programmes increased substantially in the same period (23 % of the firms and 14 % of the employees). However, it must be underlined that there is a clear training-firm size nexus: (i) the proportion of firms with less than ten employees that provide training is approximately 40 per cent, whereas the same percentage increases steadily with the class size, reaching 92 % in the case of firms with 500 employees or more; (ii) the percentage of employees undertaking training increases from approximately 25 % of all employees in smaller firms to approximately 55 % in the largest firms.

The literature on the incidence and impact of different types of training, reviewed by Varejão et al., 2014, indicates that training provided within a continuing employment relationship is the most effective in terms of career (pay) progression. Dias and Varejão (2012) also show that, considering the full list of active labour market programmes implemented in Portugal between 2004 and 2011, training programmes performed worse than employment programmes in terms of their impact on the probability of employment. Short training programmes, such as modular training, were found the most effective, essentially because the associated lock-in effect is less relevant. On a different note, it is also interesting to mention that the same authors found that employment programmes supporting the creation of new businesses or self-employment were amongst the most effective in terms of unemployment-to-employment transitions. Notwithstanding, their study did not analyse the characteristics of the jobs (or businesses) created by these programmes in terms of stability (probability of survival) or pay.

Temporary Employment

Temporary employment, understood as employment with a temporary contract (fixed-term or otherwise), represents a non-trivial fraction (around 20 %) of the total employment, which raises concerns about the segmentation of the Portuguese labour market and its long-term consequences for workers employed under such contracts. In fact, Portugal comes third in the European ranking of temporary employment incidence, despite the open and increasingly adverse legislative stand on the use of this type of hiring as a flexibility tool.

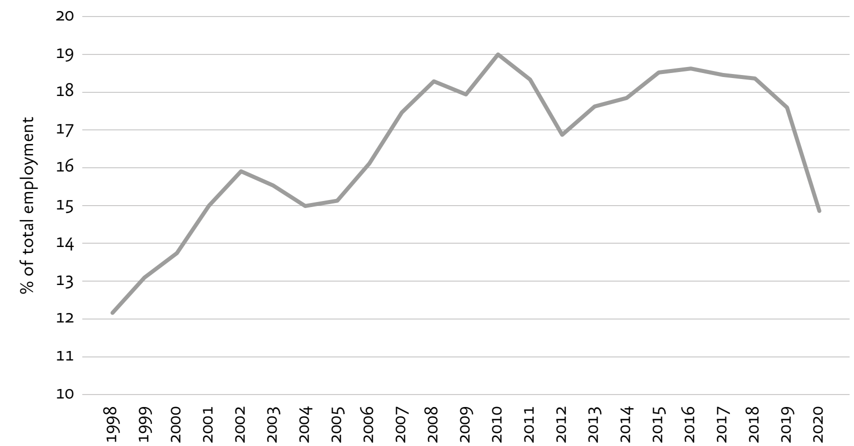
Figure 8 Temporary employment by age and country



Source: EUROSTAT

Temporary contracts are used to adjust the quantity of labour to the fluctuations of the business cycle. In the initial stage of recessions, the share of temporary employment is cut back rapidly and significantly — as was the case in 2010 (and in 2020). In the initial stage of recoveries, temporary contracts are the preferred means to respond to the increase in labour demand. It should be noted, however, that the increase in the share of fixed-term contracts after 2012 was much less pronounced than in the previous recovery period. There are no studies indicating whether this is the consequence of greater uncertainty about the speed and breadth of the recovery or the result of a structural change induced by the legislative reforms of the adjustment programme (with special regard to the dramatic reduction of severance pay for non-disciplinary dismissals) and the successive restrictive modifications of the legal frameworks applicable to fixed-term employment contracts and temporary agency work contracts (in 2009, 2013 and 2017).

Figure 9 Temporary employment (incidence of temporary contracts)

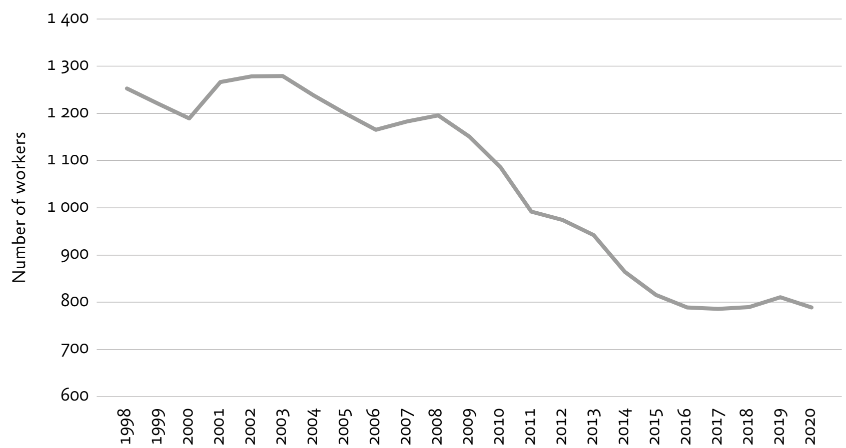


Source: INE, PORDATA

Independent work

Independent work is another form of work frequently used by employers seeking to preserve their margins of flexibility while adjusting the quantities of labour. The data available indicates that the number of independent workers (real independent work and possibly also other situations on the margins of lawfulness or beyond them) has reduced significantly since the international financial crisis — from a maximum of nearly 1.2 million independent workers in 2009 to 800 thousand in 2019. This recent development is coincident and possibly related to a progressive reinforcement of legal means aimed at preventing and prosecuting the fraudulent use of service provision contracts as a cover-up to actual employment relationships (in 2011, 2012, 2013, 2016 and 2019).

Figure 10 **Independent work**

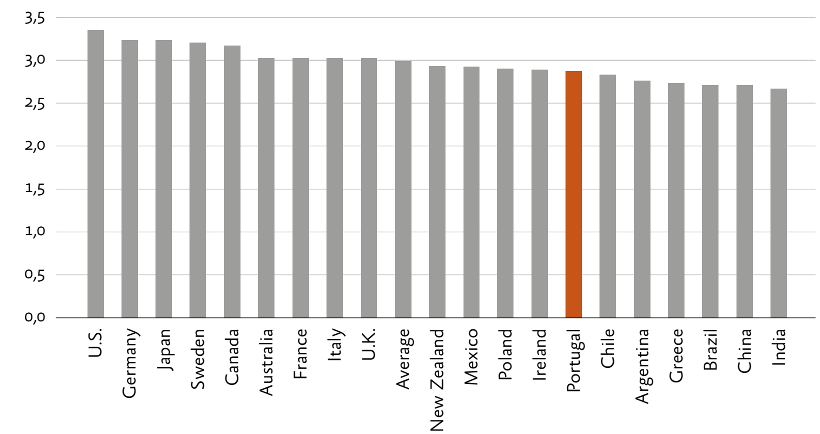


Source: INE, PORDATA

As the number of independent workers declined, the composition of this group also changed significantly. Although workers with primary education or less are still the majority (57 % of the total in 2020, well below the 90 % in 1998), the share of workers with a university degree increased many-fold between 1998 (4.3 % of the total) and 2020 (23.5 %).

Portugal does not score well in the management practices' rankings (Bloom et al., 2012), especially in the areas of personnel policies and incentives, with promotions being based mostly on tenure and with few alternative instruments to address underperformance (ibid., p.14) which is not a licit motive for demotion or dismissal.

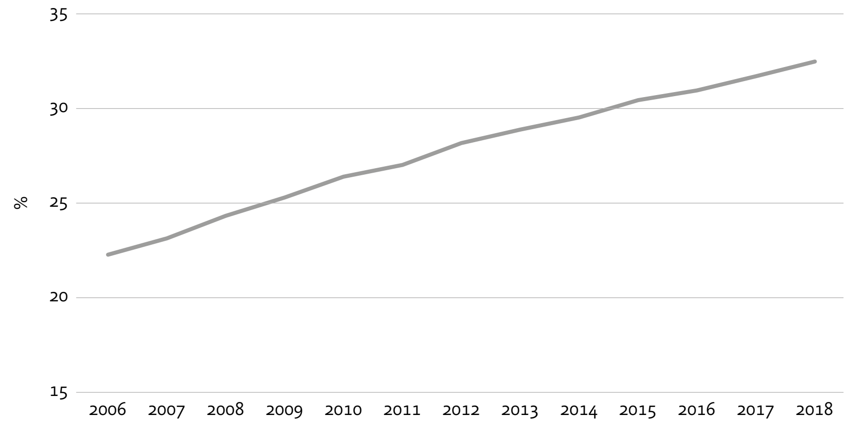
Figure 11 **Management practice scores by country (manufacturing)**



Source: Bloom et al., 2012

Despite recent progress, Portuguese business managers still have a low level of formal education (9.4 % in 2006, 11.1 % in 2018). In 2018, only as few as one-third of all firms had one manager with a university education (45 % for SMEs alone). It is well known that the human capital of managers, as measured by the proportion of those who have college degrees, is strongly and positively associated with management scores (Bloom et al., 2014, p.868).

Figure 12 **Share of firms with a manager or owner with a college degree**



Source: Personnel Records

The lower levels of education of the Portuguese firms' management teams hampers their productivity. In table 7, we report the estimates of a simple non-causal model where we evaluate the correlation between the education of the management teams and firms' performance (measured by value added per worker). The estimates are performed by fixed effects at the firm level and include a measure of workers' education, as well as time dummies. Conditional on having, at least, one worker with a college degree and on firms' unobserved specificities, management teams with, at least, one manager with a college degree seem to be more productive (about 1 %). However, when we explore the effect across different sectors, with the exception of construction, we do not find this association. In construction, the correlation is about 3 %. In table 8, we evaluate the probability of firms becoming frontier (i.e., those at the top of the productivity distribution in their sector) or exporters. The estimates of a Probit model indicate that managers' average education is positively correlated with those outcomes. This positive correlation is statistically significant for the whole economy and for the Manufacturing, Health, and Hotel and Restaurant sectors. Workers' education positively correlates with being a top productivity performer. However, the evidence on its correlation with the exporter probability is mixed. While workers' education is positively associated with firms' propensity to export in the Health and Trade sectors, we found a negative association for the whole economy and the Manufacturing and Construction industries.

3.2. The future of work

3.2.1. A brief (and selected) summary of the literature

The popularity of skill-biased technical change (SBTC) models among researchers in the past few decades is due to their ability to generate predictions consistent with a number of stylised facts that characterise the evolution of wages in the context of technical change (e.g., the introduction of computers and other ICT technologies in production since the 1980s), namely[61]: (i) the rise of the college wage premium and (in the U.S.) wage inequality; (ii) the real wage decline of low-skilled workers; (iii) the increase of wages at the lowest and highest percentiles of the wage distribution, and a stagnation in the middle percentiles (wage polarisation) and; (iv) the growth of high wage/high education jobs and low wage/low education jobs (job polarisation).

Despite the success of the SBTC model in explaining labour market trends, Acemoglu and Autor (2011) argue that a better understanding of such trends in the context of recent technology developments requires a proper account of the distinction between skills and tasks and the fact that «workers of a given skill-level can perform a variety of tasks that may change in response to changes in labour market conditions and technology» (ibid., p. 1045).

Following Autor et al. (2003), tasks may be categorised as routine (those that can be accomplished by machines following explicitly programmed rules) and non-routine (tasks that demand flexibility, creativity, generalising problem-solving and complex communications). Both types of tasks can be manual and non-manual (cognitive or abstract).

As in previous waves of technical change, new computer technology is a substitute for routine task inputs and a complement for non-routine task inputs. However, the current digital transition enlarges the scope for substituting capital, not only for routine manual task inputs (e.g., tasks in manufacturing production lines) but also for routine abstract task inputs (clerical and information processing tasks).

Since workers performing routine tasks — those more exposed to automation — tend to be in the middle of the wage distribution, the predictable effect of the digital transition is, again, the concentration of employment in high and low wage occupations.

While there is evidence of job polarisation in Portugal (Fonseca et al., 2018), Biagi and Sebastian (2020) put Portugal in the group of countries with the highest routine intensity index (RTI). The country is, therefore, among those that are most vulnerable to the digitalisation of the economy and that need to make greater reskilling efforts.

Table 2 **Routine Intensity Index — Countries with the highest and lowest scores**

	European Working Conditions Surveys (EWCS)	Programme for the International Assessment of Adult Competencies (PIAAC)	Princeton Data Improvement Initiative (PDII)	Occupational Information Network (O_NET)
The five countries with the highest RTI indexes	Greece	Bulgaria	Slovakia	Bulgaria
	Cyprus	**Portugal**	Bulgaria	Slovakia
	Latvia	Slovakia	Hungary	Poland
	Spain	Poland	**Portugal**	Hungary
	Portugal	Hungary	Latvia	Slovenia
The five countries with the lowest RTI indexes	Norway	Luxembourg	Luxembourg	Luxembourg
	Netherlands	Norway	Norway	Netherlands
	Denmark	Sweden	Sweden	Norway
	Germany	Netherlands	Netherlands	United Kingdom
	Ireland	United Kingdom	Denmark	Denmark

Source: Biagi and Sebastian (2020)

International agencies and organisations have extensively engaged in assessing the impact of the digital transition in labour markets and societies. As part of its *Going Digital Project*, the OECD developed the Going Digital Integrated Policy Framework aimed at helping governments implement policies well-suited to promote the benefits of digitalisation and address its challenges. In the report (OECD, 2020), the OECD outlines the seven dimensions of the Policy Framework — *Jobs* being one of them — and provides guidance to actually implement it. The report summarises the types of skills necessary for a successful digital transition, namely: (i) literacy, numeracy, problem-solving and generic ICT skills, (ii) ICT and data expertise, (iii) complementary skills and competences for new organisational forms and new digital-intensive sectors (ibid., p.14).

Digital transformation leads to the creation of jobs in digital-intensive sectors and, indirectly, in other sectors as well. In addition, platform work, be it services delivered online or locally, is also greatly enhanced by the diffusion of digital technology. However, some jobs will also be destroyed. Even if the proportion of jobs that, from a technical point of view, may be replaced or modified is unclear, the OECD estimates that 14 % of present jobs are likely to be automated, while another 32 % are likely to experience significant changes (ibid., p. 23). Yet, the last Future of Jobs Survey by the World Economic Forum (WEF, 2020) anticipates that the net impact of technological transformation on employment will be positive. The adoption of new technologies changes the division of labour between humans, machines and algorithms, and is expected to result in the net creation of 13 million new jobs among the surveyed industries and countries (ibid., p.29). Machines and algorithms will gain relevance in administrative tasks, in tasks such as information and data processing and retrieval, and in some manual tasks, i.e., routine abstract and some routine manual tasks, whereas humans will retain their positions in such tasks for managing, advising, decision-making, reasoning, communicating, and interacting purposes, i.e., non-routine tasks (ibid., p.28).

The response to the digitalisation of the workplace and ensuing changes in labour demand requires the facilitation of workers' mobility (across occupations, firms, regions, and even countries), including the transitions back to employment of workers displaced by investments in new technology and/or companies driven out of the market. Both may require an adjustment of the existing labour market regulation and its most relevant institutions (notably, employment protection legislation, working time regulation and active labour market policies).

So far, all reports on the necessary response to the digital transition put the emphasis on the supply of skills via a holistic approach to education (i.e., from early childhood to higher educational levels) and lifelong learning (including upskilling and reskilling training opportunities, especially provided by employers). Portugal has, in fact, a head start in this domain — the OECD mentions the Portuguese National Initiative on Digital Competences (INCoDe.2030) as an example of good practice.

However, the country does not do well in terms of digital literacy. The EU Digital Economy and Society Index (DESI) provides information that proxies for digital literacy among the population in two dimensions: the Internet user skills dimension (measuring the frequency and complexity of usage of the Internet and digital devices), and the advanced skills and development dimension (ICT specialists and ICT graduates). Portugal ranks poorly among the other EU member states in terms of overall Human Capital Index (21/28 in 2019) and percentage of individuals with, at least, basic software skills (20/28). Notwithstanding, Portugal is one of the countries where employers least frequently report difficulties in hiring or trying to hire ICT specialists — with the seventh-lowest incidence of reported difficulties in Europe (European Commission, 2020).

The WEF (WEF, 2020) also underlines skill mismatches, talent shortages and the increasing misalignment between incentives and rewards for workers as threats for prosperity and inclusion that have been building up since the beginning of the international financial crisis and that will remain a cause for concern in the post-COVID era. Against this background, the WEF highlights the need to implement upskilling and reskilling programmes, rethink active labour market policies and, in the mid-run, update the education curricula, reconsider labour laws and the social security system, and promote the diffusion of new talent management approaches (WEF, 2020, p.4). The WEF believes that the digital acceleration brought about by the COVID-19 pandemic and the ensuing unemployment problem make the response to those concerns even more important and urgent.

The emergence of the *platform economy* favours the development of new forms of (*on-demand*) work, including self-employment, frequently on a part-time basis. The OECD recognises the potential of platform work to promote the inclusion of vulnerable groups of workers but also recognises its risks (increased inequality and labour market segmentation, underrepresentation of workers and transfer of fiscal responsibilities from employers to individual workers and governments).

The COLLEEM survey administered by the European Commission Joint Research Centre offers fresh evidence on the incidence of platform work across Europe. Data referring to the years 2017 and 2018 indicate that Portugal is the country with the third-largest proportion of individuals who have ever provided services via digital platforms (Portugal stands below Spain and the Netherlands). Although the share of the population providing services via platform work declines with the intensity and relevance of such activity (as measured by the number of hours per month and share of income obtained through these activities), Portugal is in the top positions of the European rank regardless of the category of platform work (e.g., sporadic, marginal, secondary or main). In Portugal (as elsewhere), foreign-born workers are over-represented in the group of platform workers.

The outbreak of the COVID-19 pandemic and the resulting confinement measures to slow down the spread of the virus suddenly accelerated the growth of telework in Portugal. The European Commission has highlighted the important role of telework in preserving jobs and production in this context. However, telework is not for everybody, raising the possibility of a new divide between those who can telework and those who cannot.

As of the second quarter of 2020, the Portuguese Labour Force Survey conducted an ad-hoc module about working from home. This module is unique in Europe and includes a set of questions intended to supplement the information gathered from the core questionnaire of the Labour Force Survey. The main purpose of this module is to estimate the number of employed persons working from home and, among them, those working on telework.

From the second to the fourth quarter of 2020, the employed population that reported having always or almost always worked from home in the reference week, or in the three weeks before, represented 25.1 % of the total employed population. Of these, 64.7 % (16.4 % of the total employment) indicated that they were teleworking.

Table 3 **Percentage of employed population working from home and teleworking from the second to the fourth quarter of 2020**

		Teleworking (%)		
		No	**Yes**	**Total**
Working from home (%)	**No**	99,8 % [89,4 %]	0,2 % [0,7 %]	100 % [74,9 %]
	Yes	35,3 % [10,6 %]	64,7 % [99,3 %]	100 % [25,1 %]
	Total	83,6 % [100 %]	16,4 % [100 %]	100 % [100 %]

Source: INE — Labour Force Survey

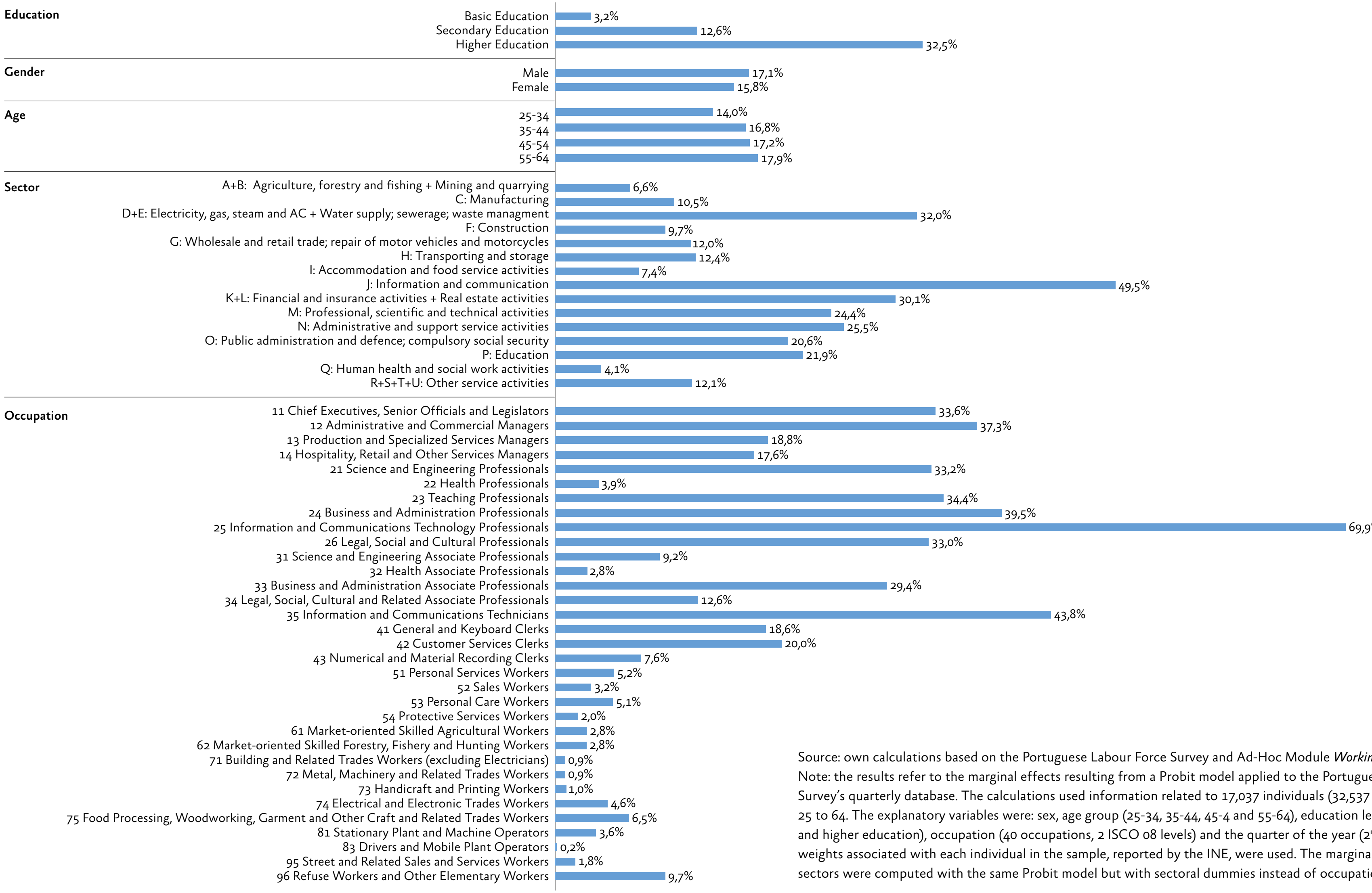
When looking at the socio-economic profile of workers in telework-able occupations, stark differences emerge according to the job hierarchy. Managers in high paid occupations (with the exception of the Hospitality, Retail and Other Services, and Health Professionals), show a higher probability of teleworking than workers in low skilled occupational groups. Young workers aged 25 to 34 have a lower probability of teleworking than older workers, with a difference of 4 percentage points when compared to the older groups (aged 55 to 64).

There are also significant differences between sectors, with some (e.g., Utilities and Information and Communication, or Financial, Insurance and Real Estate Activities) displaying probabilities of teleworking above 30 %.

The evidence of the ongoing increase in teleworking during the pandemic suggests that access to teleworking has become more evenly distributed within high skilled occupations and knowledge-based services, resulting in new possibilities for low and mid-level clerical and administrative workers, although for these intermediate occupations the teleworking intensity was lower than for managers and other high-skilled professionals.

The telework divide can be bridged by providing work agreements and digital skills that facilitate access to remote work to younger and less-skilled employees. However, jobs with a significant content of manual tasks cannot be teleworked and, therefore, a broad expansion of teleworking would inevitably increase the distance between those who need to work in physical tasks and in specific locations and those who can provide intellectual and knowledge services from anywhere (Milasi et al., 2020).

Figure 13 **Probability of teleworking by education, sex, age, sector and occupation (2nd, 3rd and 4th quarters of 2020)**



Source: own calculations based on the Portuguese Labour Force Survey and Ad-Hoc Module *Working from home*.
Note: the results refer to the marginal effects resulting from a Probit model applied to the Portuguese Labour Force Survey's quarterly database. The calculations used information related to 17,037 individuals (32,537 observations), aged 25 to 64. The explanatory variables were: sex, age group (25-34, 35-44, 45-4 and 55-64), education level (basic, secondary and higher education), occupation (40 occupations, 2 ISCO 08 levels) and the quarter of the year (2nd, 3rd and 4th). The weights associated with each individual in the sample, reported by the INE, were used. The marginal effects for the sectors were computed with the same Probit model but with sectoral dummies instead of occupation dummies.

3.2.2. Top-performers as forerunners

To anticipate how labour demand will look like if Portugal succeeds in moving to the *created in* paradigm, we looked at companies that currently stand out for their performance in different domains. As this paradigm implies the ability to compete successfully in international markets, we looked at companies that are either larger, more productive, regularly involved in exporting activities, owned, at least partially, by foreign companies or with higher profits.

Our assumption is that these firms are the main actors of the structural adjustment process that is taking place in Portugal, at the micro-level, since the early 2010s. As such, we look at the composition of employment and the level of pay in these firms, as well as the corresponding changes between 2013 and 2018, and take it as an indication of the changes that labour demand will go through as more employers make the transition into the *created in* paradigm.

For that purpose, we combine data from two sources: (i) the Integrated Business Accounts System (SCIE — *Sistema de Contas Integradas das Empresas*) and the Personnel Records (QP — *Quadros de Pessoal*). Data sets from these two sources can be merged at the level of the firm as they use the same firm identifier.

The SCIE contains firm-level administrative data, including balance sheet and other accounting data, information on turnover, value-added, labour costs, total costs, leverage, debt, total assets, number of employees and value of exports. These data are available on a yearly basis for the population of firms in the private sector, from 2006 to 2018 (about 400 thousand firms per year).

The QP database is a linked employer-employee dataset, available between 1985 and 2018, gathered through a mandatory annual survey. It provides data on all workers in all Portuguese firms (excluding the public sector) with, at least, one wage earner (about three million workers each year). The available data include information on workers' formal education, age, gender, occupation, monthly wage (distinguishing between base wage, regular and irregular components), hours of work (regular and overtime), and the type of labour contract.

The first thing to notice from table 4 is that exporting (*Export > 5 %*) or innovative companies (*Have R&D activity*), as well as companies at least partly owned by foreign companies (MNE) represent a small fraction of the total number of existing firms in these years — around 10 % of these companies obtain, at least, 5 % of their sales revenues from exports; 0.4 % to 0.8 % have some R&D activity; and 1.7 % to 2.4 % are at least partially owned by a non-domestic company.[62] However, large and exporting firms account for nearly 30 % of the total employment, while innovative firms, despite larger than the average, account for 6 %, and firms with foreign capital account for 16.4 % of the same total. The share of large firms and firms with foreign capital in the total employment has increased between 2013 and 2018, while exporting firms and firms with R&D activity saw their contribution to total employment decline in the same period. The number of workers employed in companies with top productivity levels, as measured by value-added per worker, also increased in absolute terms, although not as rapidly as in the rest of the economy, making their relative contribution to total employment decline.

Overall, the evidence shows that the micro-level adjustment process that took place in this period is limited to a restricted (and volatile) group of companies that, while performing well in operational terms, do not grow sufficiently to outperform other companies in terms of job creation and net employment growth. The economy's capacity to create jobs, absorb unemployment and place new labour market entrants remains, for the most part, dependent on employers that do not match the profile of the *created in* paradigm.

Employers in the groups of exporting, innovative, foreign-owned or most productive companies are the ones who use fewer temporary contracts (table 5). This is consistent with the fact that firms in the new paradigm employ more skilled workers and rely more on human capital investments, especially match-specific human capital. However, all of them followed the overall trend towards the reduction of open-ended contracts. Regarding standard forms of employment, the evidence does not justify concerns about the possibility of a growing segmentation of the labour market along types of contracts lines.

The same groups of companies, and especially foreign-owned and large companies (table 4), are also those that pay the highest salaries, regardless of their employees' educational attainment. The differential between the wages paid by companies in these groups and the remaining companies is wider in the case of foreign-owned and innovative companies. Mid-sized and large companies are the ones that pay the highest premiums to employees with a university degree (table 6). However, between 2013 and 2018, these premiums declined for all groups.

Firms with more debt in relative terms (higher financial leverage) pay lower wages than their counterparts. Although they pay a relatively large premium to employees with a university degree, these companies followed the overall trend of declining wage premiums for all educational levels.

Regarding within-firm wage differences between groups of employees defined by nationality and gender, the figures show that unlike what happens in the economy at large, mid-size, large and exporting companies and, especially, innovative and foreign-owned companies pay higher wages to non-national employees. On the contrary, within these same groups of companies, the gender wage gap is wider than elsewhere in the economy, especially in foreign-owned companies. The wage gaps and the overall wage inequality between nationality and gender groups reduced during this period. Note that these results refer to unconditional (raw) wage differences and must be interpreted as such.

3.3. Conclusions and recommendations

The digitalisation of the economy is expected to have a major impact in Portugal, one of the European countries with the largest share of jobs at risk, mostly routine task intensive jobs, manual and, especially, non-manual tasks. However, the digital transition will also lead to the creation of new jobs. From a labour market perspective, managing this transition is crucial.

To that end, labour market institutions must facilitate (or, at least, do not impede) the reallocation of workers and jobs across businesses, industries and regions. They must also not limit the potential for job creation associated with new business models and new forms of work made possible by the new technologies.

The most relevant labour market institutions have changed as part of the structural reforms programme implemented in the early 2010s. At this stage, no major changes seem necessary, other than fine-tuning previous changes (and avoiding their reversal), and evaluating the need to regulate new forms of work that will emerge with new technology and the shifts brought about by the pandemic.

The segmentation of the labour market remains a cause for concern, although there is no indication that the *new economy* will aggravate it. Addressing the demand for flexibility without encouraging persistent and generalised temporary forms of employment should be an important policy objective.

It is essential to ensure the adequate supply of skills to the new jobs emerging in the *new economy*. The supply will come from new entrants to the labour market, from those currently unemployed (due to the COVID-19 crisis) or from those that will lose their jobs during the transition. In this respect, education and training policies are key.

Future generations of labour market entrants must have the necessary skills, including basic digital skills, to succeed in the *new economy*. Likewise, workers already in the labour force (employed or not) must go through upskilling and reskilling processes to keep up with the emerging opportunities. Active (training) and passive (unemployment insurance) labour market and employment services policies are key to addressing this issue.

It is also necessary to invest in the training of ICT specialists. Portugal already has good examples of programmes designed for some of the above-mentioned purposes. However, schools at all levels, universities included, must be able to design and manage flexible and easily adaptable *curricula*.

Focusing on the production of digital skills should not distract the country from its continuing effort to increase the level of schooling of the population, which, despite past successes, is still low. In the same vein, other areas of skill shortage, including management, where the country still lags behind most developed countries, should also be developed. The system should be flexible enough to promote an adaptation to the changing skills required by the labour market at all levels of education and via lifelong learning and training programmes.

The retention of skilled workers and the return of those who migrated during the previous crisis is also essential to guarantee the proper supply of skills in a country confronted with a major demographic challenge due to the rapid ageing of the population. New forms of work, including telework and platform work, combined with the country's natural assets, offer new opportunities to attract foreign skilled professionals and, if properly managed, may also help attract workers for *standard* jobs. The migration policy is also key — it is necessary to ensure that it is designed to attract (and integrate) people with the skills the economy needs.

Differences (inequalities) are the ingredient and the outcome of any process of transformation. Transitioning from the *made in* to the *created in* paradigm in a context of digital and climate change and amidst a major recession will certainly require a thoughtful consideration of its implications for inequality within and between groups of workers. The evolution of inequality, not only in terms of pay but also in terms of working conditions, should be closely monitored. Corporate social responsibility, including all things related to human resource management, should be actively promoted.

The focus on the *new economy* and its demand for skills and the *right* types of institutions should not make us forget that other sectors will remain the main employers of those currently unemployed, and the source of new employment opportunities for those that may lose their jobs during the current crisis. Up-skilling and reskilling the workforce is not only necessary for the changes occurring within these sectors but also for the job reallocation resulting from the paradigm change.

Finally, the design of public policies (and social concertation) should balance the objectives of productivity growth and employment creation, maintaining the incentives for the voluntary reallocation of employees from the low productivity-low pay to the high productivity-high pay employers and sectors as employment is created in the latter sectors.

References

Acemoglu D., and D. Autor, «Skills, Tasks and Technologies: Implications for Employment and Earnings», in *Handbook of Labor Economics*, Volume 4b, O. Ashenfelter and D. Card (eds.), North Holland, 2011, pp. 1043–1171.

Autor D., F. Levy, and R. Murnane, «The Skill Content of Recent Technological Change: An Empirical Exploration», *The Quarterly Journal of Economics*, Vol. 118, 2003, pp. 1279–1333.

Biagi, F., and R. Sebastian, «Technologies and "Routinization"», in *Handbook of Labor, Human Resources and Population Economics*, Springer, 2020, pp. 1–17.

Bloom N., C. Genakos, R. Sadun, and J. van Reenen, «Management Practices Across Firms and Countries», *Academy of Management Perspectives*, Vol. 26, 2012, pp. 12–33.

Bloom N., R. Lemos, R. Sadun, and D. Scur, «The New Empirical Economics of Management», *Journal of the European Economic Association*, Vol. 12, 2014, pp. 835–876.

Campos M. M., and H. Reis, «Revisiting the Returns to Schooling in the Portuguese Economy», Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies, Banco de Portugal: Economics and Research Department, 2017.

Carneiro A., P. Portugal, and J. Varejão, «Catastrophic Job Destruction», *Journal of Macroeconomics*, Vol. 39, 2014, pp. 444–457.

Dias, M.C., and J. Varejão, «Estudo de Avaliação das Políticas Ativas de Emprego — Relatório Final», Faculdade de Economia da Universidade do Porto, 2012.

European Commission, «The Digital Economy and Society Index (DESI)» on Human Capital», European Commission, 2020.

Figueiredo H., M. Portela, C. Sá, J. Cerejeira, A. Almeida, and D. Lourenço, *Benefícios do Ensino Superior*, FFMS, Lisbon, 2017.

Fonseca T., F. Lima, and S. Pereira, «Job Polarization, Technological Change and Routinization: Evidence for Portugal», *Labour Economics*, Vol. 51, 2018, pp. 317–339.

Milasi S., I. González-Vázquez and E. Fernandez-Macias, «Telework in the EU before and after the covid-19: where we were, where we head to», JRC Science for Policy Briefs, European Commission, 2020.

OECD, «Going Digital Integrated Policy Framework», Digital Economy Paper No.262, OECD Publishing, 2020.

Varejão, J., J. Cerejeira, and M. Portela, «Mercado de Trabalho», in *A Economia Portuguesa na União Europeia: 1986–2010*, F. Alexandre, P. Bação, P. Lains, M.M.F. Martins, M. Portela, and M. Simões (eds.), Conjuntura Atual Editora, Coimbra, 2014.

World Economic Forum, «The Future of Jobs Report 2020», World Economic Forum, 2020

Table 4 Firms and Employment

			No. Firms		Employment		% Firms		% Employment	
			2013	**2018**	**2013**	**2018**	**2013**	**2018**	**2013**	**2018**
Efficiency and Operational	Export > 5 %	No	183 623	205 977	1 601 433	1 989 374	88,9 %	90,5 %	71,4 %	72,9 %
		Yes	23 002	21 537	640 580	738 105	11,1 %	9,5 %	28,6 %	27,1 %
	Top 10 Return on Assets	No	186 016	204 804	2 043 178	2 537 288	90,0 %	90,0 %	91,1 %	93,0 %
		Yes	20 609	22 710	198 835	190 191	10,0 %	10,0 %	8,9 %	7,0 %
	Top 10 Return on Revenues	No	186 418	205 200	2 040 506	2 518 693	90,2 %	90,2 %	91,0 %	92,3 %
		Yes	20 207	22 314	201 507	208 786	9,8 %	9,8 %	9,0 %	7,7 %
	Top 10 TFP	No	198 508	217 688	2 162 098	2 630 748	96,1 %	95,7 %	96,4 %	96,5 %
		Yes	8 117	9 826	79 915	96 731	3,9 %	4,3 %	3,6 %	3,5 %
	Top 10 Value Added per worker	No	185 979	204 776	1 812 660	2 269 882	90,0 %	90,0 %	80,8 %	83,2 %
		Yes	20 646	22 738	429 353	457 597	10,0 %	10,0 %	19,2 %	16,8 %
Innovation	Have R&D activity	No	205 043	226 305	2 076 502	2 565 134	99,2 %	99,5 %	92,6 %	94,0 %
		Yes	1 582	1 209	165 511	162 345	0,8 %	0,5 %	7,4 %	6,0 %
Organisational	MNE	No	203 015	222 089	1 940 861	2 280 296	98,3 %	97,6 %	86,6 %	83,6 %
		Yes	3 610	5 425	301 152	447 183	1,7 %	2,4 %	13,4 %	16,4 %
	Micro		170 280	183 311	560 847	624 285	82,4 %	80,6 %	25,0 %	22,9 %
	Small		30 775	37 310	588 120	718 783	14,9 %	16,4 %	26,2 %	26,4 %
	Medium		4 822	5 944	468 359	581 004	2,3 %	2,6 %	20,9 %	21,3 %
	Large		748	949	624 687	803 407	0,4 %	0,4 %	27,9 %	29,5 %
	Top 10 Fixed Assets per Worker	No	185 979	204 776	1 895 880	2 348 029	90,0 %	90,0 %	84,6 %	86,1 %
		Yes	20 646	22 738	346 133	379 450	10,0 %	10,0 %	15,4 %	13,9 %
Dynamic	Top 10 Sales Growth	No	188 921	207 762	2 119 152	2 557 723	91,4 %	91,3 %	94,5 %	93,8 %
		Yes	17 704	19 752	122 861	169 756	8,6 %	8,7 %	5,5 %	6,2 %
	Top 10 Employment Growth	No	190 180	209 980	2 059 942	2 523 680	92,0 %	92,3 %	91,9 %	92,5 %
		Yes	16 445	17 534	182 071	203 799	8,0 %	7,7 %	8,1 %	7,5 %
Financial	Top 10 Leverage	No	185 979	204 776	2 147 439	2 626 364	90,0 %	90,0 %	95,8 %	96,3 %
		Yes	20 646	22 738	94 574	101 115	10,0 %	10,0 %	4,2 %	3,7 %
	Top 10 Return on Equity	No	186 001	204 793	2 109 326	2 575 699	90,0 %	90,0 %	94,1 %	94,4 %
		Yes	20 624	22 721	132 687	151 780	10,0 %	10,0 %	5,9 %	5,6 %

Table 5 Job quality and wages

			Job Quality				Wages											
			% Open-ended contracts		% Full Time		Gross Wage		Hourly Wage		Hourly Wage Below Secondary Education		Hourly Wage Secondary Education		Hourly Wage Higher Education	
			2013	2018	2013	2018	2013	2018	2013	2018	2013	2018	2013	2018	2013	2018
Operational	Export > 5 %	No	54,4 %	50,8 %	67,5 %	69,4 %	678	701	4,36	4,52	4,00	4,14	4,58	4,56	6,65	6,35
		Yes	59,4 %	56,4 %	79,6 %	80,5 %	920	943	5,73	5,90	4,86	5,00	5,91	5,76	8,63	8,25
	Top 10 Return on Assets	No	55,6 %	52,0 %	69,1 %	70,9 %	705	726	4,51	4,66	4,10	4,24	4,78	4,71	7,01	6,65
		Yes	49,8 %	45,7 %	66,5 %	66,4 %	720	718	4,60	4,65	4,15	4,19	4,86	4,68	7,18	6,72
	Top 10 Return on Revenues	No	55,0 %	51,4 %	69,0 %	70,6 %	701	719	4,48	4,62	4,08	4,21	4,75	4,68	6,92	6,56
		Yes	54,4 %	51,1 %	67,8 %	68,4 %	766	778	4,94	5,05	4,31	4,43	5,16	5,02	7,95	7,52
	Top 10 TFP	No	55,0 %	51,4 %	68,6 %	70,1 %	692	711	4,44	4,58	4,06	4,19	4,70	4,63	6,85	6,50
		Yes	54,8 %	50,5 %	76,3 %	76,3 %	1049	1029	6,46	6,39	5,27	5,16	6,48	6,15	9,80	9,11
	Top 10 Value Added per worker	No	54,4 %	50,9 %	67,9 %	69,7 %	656	681	4,23	4,41	3,94	4,09	4,45	4,46	6,29	6,08
		Yes	60,7 %	55,9 %	77,7 %	76,8 %	1143	1113	7,06	6,91	5,65	5,57	6,97	6,59	10,48	9,74
Innovation	Have R&D activity	No	54,9 %	51,3 %	68,7 %	70,3 %	704	723	4,50	4,65	4,09	4,22	4,77	4,69	6,97	6,61
		Yes	67,0 %	64,8 %	86,6 %	90,4 %	1078	1131	6,66	7,00	5,21	5,45	6,42	6,41	10,02	9,81
Organisational	MNE	No	54,7 %	51,1 %	68,5 %	70,0 %	688	704	4,41	4,54	4,05	4,18	4,65	4,58	6,71	6,34
		Yes	71,3 %	62,9 %	91,3 %	88,3 %	1625	1510	9,93	9,31	7,02	6,65	8,88	8,13	13,52	12,13
	Micro		52,5 %	49,9 %	64,2 %	65,5 %	668	691	4,30	4,46	3,90	4,04	4,44	4,43	6,22	6,08
	Small		66,1 %	57,0 %	90,0 %	89,8 %	833	822	5,23	5,20	4,60	4,63	5,35	5,12	7,79	7,15
	Medium		69,5 %	60,3 %	95,2 %	95,1 %	1002	976	6,29	6,17	5,26	5,27	6,23	5,87	9,87	8,84
	Large		71,1 %	64,0 %	90,9 %	91,4 %	1113	1093	7,02	6,98	5,79	5,82	6,59	6,41	11,27	10,10
	Top 10 Fixed Assets per worker	No	54,4 %	50,9 %	68,2 %	69,9 %	691	711	4,43	4,57	4,04	4,18	4,69	4,63	6,81	6,48
		Yes	60,2 %	55,7 %	75,2 %	75,4 %	849	848	5,36	5,41	4,66	4,73	5,51	5,34	8,32	7,74
Dynamic	Top 10 Sales Growth	No	55,7 %	52,1 %	69,0 %	70,5 %	708	725	4,53	4,66	4,11	4,24	4,81	4,72	7,08	6,68
		Yes	47,3 %	44,1 %	67,6 %	69,2 %	691	723	4,43	4,64	3,97	4,16	4,60	4,60	6,47	6,39
	Top 10 Employment Growth	No	55,7 %	52,1 %	68,5 %	70,1 %	711	727	4,54	4,67	4,12	4,24	4,83	4,73	7,12	6,70
		Yes	46,3 %	42,9 %	73,3 %	74,6 %	664	701	4,31	4,53	3,93	4,13	4,43	4,50	6,07	6,16
Financial	Top 10 Leverage	No	55,7 %	51,9 %	69,8 %	71,3 %	715	733	4,57	4,70	4,14	4,27	4,83	4,74	7,08	6,67
		Yes	48,5 %	46,7 %	60,3 %	62,1 %	621	643	4,03	4,24	3,70	3,80	4,26	4,24	6,17	6,36
	Top 10 Return on Equity	No	55,8 %	52,3 %	69,4 %	71,0 %	711	728	4,54	4,67	4,12	4,25	4,81	4,72	7,04	6,67
		Yes	47,4 %	43,2 %	63,7 %	65,0 %	669	695	4,32	4,52	3,88	4,01	4,56	4,54	6,83	6,52

Table 6 Wage premium and wage inequality

			Inequality							
			College Wage Premium		Foreign Wage Ratio		Wage Gender Ratio		Manager Premium	
			2013	2018	2013	2018	2013	2018	2013	2018
Efficiency and Operational	Export > 5 %	No	1,41	1,34	0,97	0,97	0,96	0,97	1,63	1,64
		Yes	1,49	1,45	1,07	1,06	*0,92*	*0,94*	2,29	2,30
	Top 10 Return on Assets	No	1,43	1,36	0,99	0,98	0,95	0,97	1,76	1,77
		Yes	1,43	1,35	1,01	1,00	0,95	0,97	1,82	1,68
	Top 10 Return on Revenues	No	1,42	1,35	0,99	0,98	0,95	0,97	1,74	1,74
		Yes	1,50	1,42	1,00	0,99	0,95	0,96	1,98	1,94
	Top 10 TFP	No	1,42	1,36	0,99	0,98	0,95	0,97	1,74	1,74
		Yes	1,50	1,42	1,05	1,03	0,91	0,94	2,15	2,08
	Top 10 Value Added per worker	No	1,40	1,34	0,98	0,97	0,96	0,97	1,63	1,64
		Yes	1,54	1,48	1,06	1,05	*0,92*	*0,93*	2,43	2,39
Innovation	Have R&D activity	No	1,42	1,35	0,99	0,98	0,95	0,97	1,74	1,74
		Yes	1,65	1,62	1,16	1,10	*0,92*	*0,90*	2,85	2,94
Organisational	MNE	No	1,42	1,35	0,96	0,96	0,96	0,97	1,69	1,68
		Yes	1,61	1,53	1,44	1,32	*0,85*	*0,89*	3,02	2,90
	Micro		1,34	1,29	0,98	0,98	0,97	0,98	1,36	1,36
	Small		1,44	1,37	0,96	0,96	0,93	0,95	2,02	1,95
	Medium		1,65	1,55	1,09	1,03	0,90	0,92	3,07	2,89
	Large		1,77	1,66	1,18	1,16	0,89	0,91	4,09	3,87
	Top 10 Fixed Assets per worker	No	1,41	1,34	0,98	0,98	0,95	0,97	1,69	1,70
		Yes	1,53	1,45	1,03	1,01	0,95	0,96	2,20	2,13
Dynamic			1,41	1,34	0,98	0,98	0,95	0,97	1,69	1,70
	Top 10 Sales Growth	No	1,43	1,36	0,99	0,98	0,95	0,97	1,78	1,78
		Yes	1,36	1,32	1,00	0,99	0,97	0,97	1,59	1,58
	Top 10 Employment Growth	No	1,44	1,37	0,99	0,98	0,95	0,97	1,78	1,78
		Yes	1,33	1,30	1,01	0,98	0,97	0,98	1,58	1,60
Financial	Top 10 Leverage	No	1,43	1,36	0,99	0,98	0,95	0,97	1,79	1,79
		Yes	1,40	1,38	1,02	1,00	0,96	0,98	1,42	1,36
	Top 10 Return on Equity	No	1,43	1,36	0,99	0,98	0,95	0,97	1,78	1,78
		Yes	1,42	1,36	1,00	1,01	0,96	0,99	1,53	1,55

Table 7 Regression analysis (fixed effects) — (Log) Productivity

	All sectors	Manufacturing	Communications	Health	Trade	H. & Rest.	Construction
Managers with a college degree	0.0098**	0.0030	0.0088	0.0054	0.0068	0.0070	0.0263*
	(0.0042)	(0.0076)	(0.0168)	(0.0164)	(0.0077)	(0.0171)	(0.0147)
Workers with a college degree	0.0238***	0.0262***	0.0166	0.0170	0.0213***	0.0036	0.0232***
	(0.0031)	(0.0056)	(0.0136)	(0.0208)	(0.0056)	(0.0121)	(0.0074)
Observations	1189620	217619	67657	45301	356433	120326	166339
Firms	182433	29989	10636	6611	52730	20515	27948
R-sq-within	0.0212	0.0114	0.0153	0.0102	0.0213	0.0984	0.0294
R-sq-between	0.0033	0.0106	0.0020	0.0033	0.0004	0.0034	0.0132
Rho	0.7481	0.7374	0.7631	0.7897	0.7599	0.6682	0.6437
corr(u_i,Xb)	0.0199	0.0840	0.0137	0.0204	-0.0138	-0.0629	0.0218

Notes: robust standard errors in parenthesis (clustered at the firm level). Significance levels: *, 10 %; **, 5 %; ***, 1 %. All regressions include time dummies.

Table 8 Regression analysis (Probit) — Frontier and Exporter

	All sectors	Manufacturing	Communications	Health	Trade	Hotels & Restaurants	Construction
				Frontier			
Managers' average education	0.0096***	0.0255***	-0.0024	0.0726***	0.0037	0.0312***	-0.0002
	(0.0013)	(0.0029)	(0.0057)	(0.0107)	(0.0025)	(0.0040)	(0.0028)
Average education	0.0708***	0.1271***	0.0407***	0.0223*	0.1558***	0.0376***	0.1265***
	(0.0017)	(0.0047)	(0.0065)	(0.0116)	(0.0035)	(0.0058)	(0.0044)
				Exporter			
Managers' average education	0.0639***	0.1074***	0.0179***	-0.0165	0.0226***	0.0742***	0.0334***
	(0.0016)	(0.0028)	(0.0059)	(0.0173)	(0.0034)	(0.0110)	(0.0037)
Average education	-0.0474***	-0.0571***	0.0094	0.0637**	0.0788***	-0.0250	-0.0298***
	(0.0022)	(0.0046)	(0.0069)	(0.0257)	(0.0050)	(0.0167)	(0.0054)
Observations	1189620	217619	67657	45301	356433	120326	166339

Notes: robust standard errors in parenthesis (clustered at the firm level). Significance levels: *, 10 %; **, 5 %; ***, 1 %. All regressions include time dummies.

Appendix

Table A.1.

Efficiency and Operational	Export > 5 %	Exporting firm: defined as a firm that exports for two consecutive years and exports, at least, 5 % of total sales
	Top 10 Return on Assets	Firms in the 10th percentile of returns on assets (ROA=EBIT/Total assets)
	Top 10 Return on Revenues	Firms in the 10th percentile of returns on revenues (RoR=EBIT/Total operational revenues)
	Top 10 TFP	Firms in the 10th percentile of TFP (Average of measures of TFP methodologies by Olley & Pakes (1996), Levinsohn & Petrin (2003) and Levinsohn & Petrin (2003) with Ackerberg, Caves, & Frazer's (2015) correction.
	Top 10 Value Added per worker	Firms in the 10th percentile of value added per worker
Innovation	Have R&D activity	Firms that spend more than 1 % of total sales in R&D or have, at least, one worker dedicated to R&D
Organisational	MNE	Firms with more than 50 % of foreign equity
	SME definition following the EU recommendation 2003/361. Link	
	Top 10 Fixed Assets per worker	Firms in the 10th percentile of fixed assets (Tangible + Intangible) per worker
Dynamic	Top 10 Sales Growth	Firms in the 10th percentile of last year percent growth in turnover
	Top 10 Employment Growth	Firms in the 10th percentile of last year percent growth in employment
Financial	Top 10 Leverage	Firms in the 10th percentile of leverage (Total debt/Total assets)
	Top 10 Return on Equity	Firms in the 10th percentile of returns on equity (ROE=Net profits/Shareholders' equity)

Paper 4
Growing to the frontier: entrepreneurs and their circumstances

Miguel Portela, Universidade do Minho and NIPE
Fernando Alexandre, Universidade do Minho and NIPE
Hélder Costa, Universidade do Minho and NIPE

4.1. Introduction

I am myself and my circumstances.
José Ortega Y Gasset

This paper evaluates how the business environment and the human capital of firm founders affect firms' growth prospects and their probability of becoming part of the top productivity or frontier group. Product market competition, labour market flexibility, openness to trade and the prevalence of zombie firms are the business environment dimensions included in our analysis. We use firm-level data to evaluate how those four dimensions mediate the impact of firms' entry and exit on resource allocation efficiency and productivity growth at the sector level. Additionally, we assess how the business environment affects firms' growth and firms' productivity growth.

Although the circumstances where the entrepreneur develops their business are of utmost importance, the characteristics of the entrepreneur are also an essential determinant of the firms' performance (e.g., Bloom et al., 2007 and 2013). Queiró (2018) shows that firms founded by more educated entrepreneurs are larger at entry and show higher growth throughout their lifetime. In this paper, we evaluate how education, measured by years of schooling at the time of the firm's birth, impacts its growth and productivity performance.

Micro and small-sized firms are pervasive in the Portuguese economy. As noted by Hurst and Pugsley (2012), few small businesses have little desire to innovate and grow. Micro and small-sized firms show deficient productivity levels, and most do not show any productivity growth. Therefore, a high share of micro and small-sized firms, namely if they are lifestyle businesses, thwarts productivity growth. A business environment that favours resource allocation towards micro and small-sized firms may cause low aggregate productivity growth (e.g., Garicano et al., 2016). This paper shows that firm size matters for productivity dynamics and presents evidence of the significant productivity gap between frontier firms and the rest of the economy.

Several explanations have been proposed to explain the productivity growth slowdown in developed countries. Robert Gordon (2017) argues that recent innovations have a lower potential to increase productivity; that is, there are diminishing returns from new technologies. Jones (2009) and Bloom et al. (2020) suggest that innovation has become more challenging or that there are diminishing returns to innovation investment. Decker et al. (2017 and 2020) emphasise the decline in business dynamism, which might have hampered the reallocation of resources to the most productive firms. In the same vein, Philippon (2019) argues that declining competition and rising barriers to entry may have 'allowed incumbents to rest on their laurels'.

Andrews et al. (2015) suggest that the productivity growth slowdown in developed countries was caused by the slowdown in innovation and technology diffusion from frontier firms to the rest of the economy. These authors show that global frontier firms have registered a robust increase in productivity. They are typically larger, more profitable, younger, own more patents and are also more likely to be part of a multinational group. According to Andrews et al. (2015), the cause of productivity growth slowdown is the increasing divergence between global frontier firms and the rest. This suggests that enhancing productivity policies through the promotion of innovation, technological adoption and the creation of an environment that fosters the reallocation of resources towards the most productive firms may be effective. This conclusion led Andrews et al. (2015) to explore differences in productivity between the national frontier and global frontier firms and identify policies that may accelerate the productivity catching up of laggard firms to the national productivity frontier.

In Europe, only a small percentage of SMEs scale up and grow (e.g., EBI, 2019). Conditions and barriers to SME performance vary with the business environment, product and labour markets institutions, with infrastructures, with the availability and access to knowledge, skills, technology and finance, and with the participation in global value chains (e.g., OECD, 2020). Since the adoption of the euro, structural reforms aiming to improve the efficiency of product, labour and financial markets have been at the centre of the discussion of economic policies on the growth of the Portuguese economy.

Monteiro et al. (2017) analyse the impact of product market reforms during the economic and financial assistance programme (2011–2014) and conclude that they contributed to enhancing resource efficiency and productivity gains. Labour market rigidity has been an important issue in the debate about the stagnation of the Portuguese economy in the 21st century (e.g., Blanchard, 2007; IMF, 2008). In this paper, we use a novel labour market flexibility index, built at the sector level and using firm-level information, to investigate whether labour market rigidity has been hampering firms' growth. The misallocation of resources toward non-tradable sectors has been one of the culprits of the productivity slowdown in the Portuguese economy (e.g., Reis, 2013). Therefore, we also investigate the role of openness to trade in the impact of firms' entry and exit on the efficiency of resource allocation and productivity growth. Finally, financially distressed firms, also known as zombie firms, have represented a significant share of the Portuguese economy in 2008–2014 — see, for example, Gouveia and

Osterhold (2018) —, and have been associated with market distortions that hamper productivity growth.

Although the circumstances in which entrepreneurs develop their businesses are crucial to fulfilling their ambitions, their idiosyncrasies are also relevant for their firm's performance. Bloom et al. (2013) emphasise the importance of management for firm performance, and they also conclude that better management practices are positively associated with higher levels of education and human capital. In this paper, we investigate the importance of the entrepreneurs' characteristics, measured by the education of the founder of the firm, on firms' growth and productivity growth.

The paper has the following structure. Section 2 presents data on firm size classes in the Portuguese economy and the European Union and shows productivity gaps between national frontier and European frontier firms. Section 3 identifies and describes the main features of frontier SMEs and their dynamics in 2006–2018. Section 4 describes and assesses the impact of the business environment on the efficiency of resource allocation and productivity growth at the sector level. Section 5 investigates the determinants of the firms' paths from birth to frontier. Section 6 estimates the determinants of firms' growth and evolution on the productivity distribution. Section 7 concludes and proposes policies to foster firms' productivity growth.

4.2. Firm size and productivity

Micro and small-sized firms are pervasive in the Portuguese economy. The high share of micro and small-sized firms has been associated with low productivity growth. However, this feature of the Portuguese economy is shared by most of the European Union countries (EU-27) — see table 1. Data in Table 1 show that large-sized firms only account for 0.6 % and 0.2 % of the total firms in PT and the EU-27, respectively. However, micro and small-sized firms account for 54.0 % and 49.0 % of the total employees, and 38 % and 35.8 % of the value-added in Portugal and the EU-27, respectively.

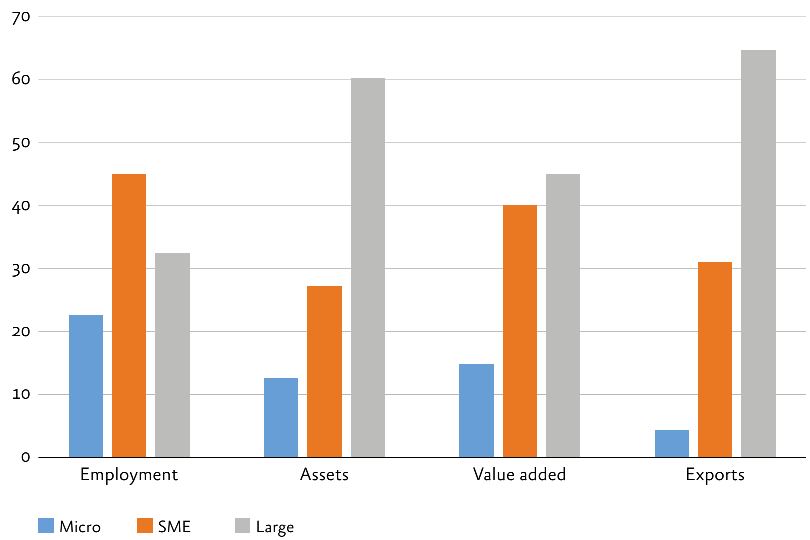
Table 1 Share by firm size class, Portugal and the EU-27, 2018

	Micro and small		Medium		Large	
	Portugal	EU	Portugal	EU	Portugal	EU
Firms	97 %	98.9 %	2.0 %	0.9 %	0.6 %	0.2 %
Employees	54 %	49.0 %	16.2 %	16.0 %	29.6 %	35.0 %
Value-added	38 %	35.8 %	18.5 %	17.0 %	44.0 %	47.2 %

Source: own calculations with firm-level data from the SCIE (Statistics Portugal) and Eurostat (2021)

Figure 1 presents the shares of employment, assets, value-added and exports for micro, SMEs and large-sized firms in the Portuguese economy in 2018. Micro-sized firms accounted for 80 % of the total number of firms, 23 % of employment, 13 % of assets, 15 % of value-added and 4 % of exports.[63] SMEs accounted for 45 % of employment, 27 % of assets, 40 % of value-added and 31 % of exports; and large-sized firms accounted; and large-sized firms accounted for 32 % of employment, 60 % of assets, 45 % of value-added and 65 % of exports.

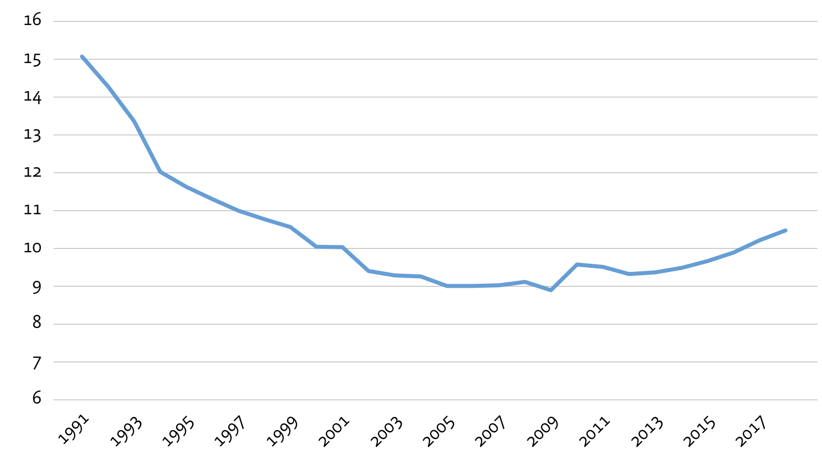
Figure 1 **Share in total employment, assets, value-added and exports by firm size (in %), 2018**



Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

Hurst and Pugsley (2012), using data for the US, conclude that «few small businesses intend to bring a new idea to market [...] [and] most small businesses have little desire to grow big or to innovate in any observable way». Hurst and Pugsley (2012) emphasise the incentive to be one's own boss in the creation of new firms. A surge in these types of firms should hinder productivity growth. Garicano et al. (2016) argue that labour laws in France that favoured the allocation of resources towards micro and small firms — firms with less than 50 employees — were one of the causes of low productivity growth. Braguinsky et al. (2011), analysing the relationship between firm size and productivity in the Portuguese economy, have also argued that labour market institutions could have hindered the growth of more productive firms. The authors showed that firm size in Portugal has decreased since the mid-1980s and argue that the «Portugal's shrinking firms» phenomenon is associated with low productivity growth. Guimarães and Silva (2021) confirm the long downward trend in average firm size since 1985, with a sharper decrease from 15 to 8 employees in 2013 and a slight increase from 8 to 10 employees after 2013 — see figure 2.

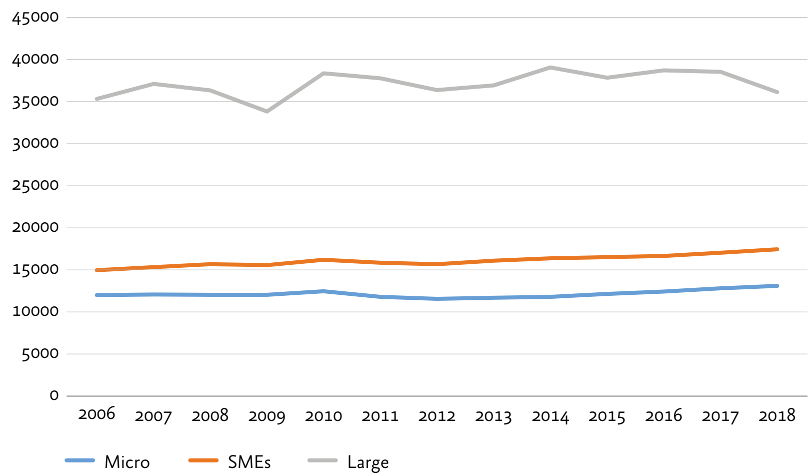
Figure 2 **Average firm size in the Portuguese economy, 1991–2018 (by number of employees)**



Source: own computations with QPs database

Figure 3 presents the average labour productivity in the manufacturing sector, showing that it increases significantly with firm size. In 2018, in the manufacturing sector, the labour productivity of large-sized firms was 2.1 and 2.8 times higher than that of SMEs and micro-sized firms, respectively.

Figure 3 **Labour productivity in the manufacturing sector, 2006–2018 (in €, 2011 prices)**



Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

The next section provides a granular analysis of productivity and firm size classes by focusing on the most productive firms, i.e., the group of frontier firms.

4.3. Large-sized firms, frontier SMEs and the rest

The definition of frontier firms is not clear-cut — see, for example, Andrews et al. (2015). In this paper, we define frontier firms as the top 10 % most productive firms, measured by labour productivity in the manufacturing sector.

We start by comparing the productivity of frontier and non-frontier firms in Portugal and other European countries — see Table 2.[64] Table 2 shows that the productivity gap between Portuguese frontier firms and other European counterparts is smaller (60 % for all firm size classes and 54 % for SMEs) than the gap between Portuguese and other European non-frontier firms (48 % of EU, when we consider all firm sizes and SMEs).

Table 2 **Labour productivity in Portugal and in European countries: frontier versus non-frontier firms (thousand €), 2018**

	Average labour productivity	
	All sizes	SMEs
Frontier: PT	115	72
Frontier: EU	193	134
Non-frontier: PT	22	21
Non-frontier: EU	46	44

Source: own computations using data from Orbis

In spite of the large productivity gap between Portuguese and European firms, the labour productivity of frontier firms in sectors such as *Transport Equipment, Textile...* and *Rubber and Plastics* is much closer to the one observed in the group of EU countries considered in this analysis. For example, in 2018, the labour productivity of Portuguese frontier firms in the Transport Equipment sector was 118 thousand €, whereas in France, Finland and Spain it was 120, 122 and 135 thousand €, respectively.

Increasing productivity growth in the Portuguese economy requires that national frontier firms become closer to the performance of European and global frontier firms. On the other hand, it is crucial to create the necessary conditions for non-frontier firms to catch up with frontier firms in terms of productivity.

In this section, we focus on SMEs in the Portuguese manufacturing sector. Table 3 shows data from 2018 on a set of operational and financial characteristics for the following groups of firms: frontier SMEs, non-frontier SMEs, and large-sized firms.[65]

Applying our definition of frontier firms, in 2018, there were 1,371 frontier SMEs in the manufacturing sector, accounting for 8.5 % of the total employment, 15.8 % of the total value-added and 12.6 % of the total exports. The average labour productivity of frontier SMEs was 3.7 times the labour productivity of non-frontier SMEs and was slightly lower than the labour productivity of large firms. Frontier SMEs are larger, export 4.7 times more, have a higher share of managers and workers with a college degree, and are much more profitable than non-frontier SMEs. Additionally, 15.8 % of frontier SMEs are foreign-owned.

Table 3 SMEs and large-sized firms in the manufacturing sector, 2018

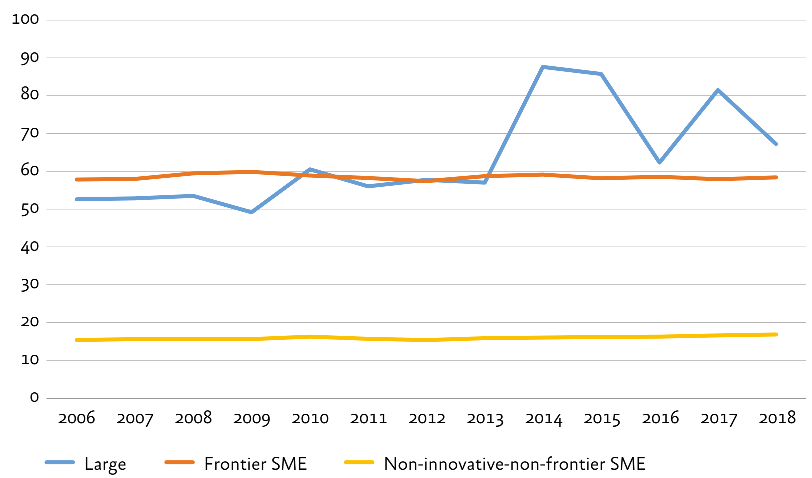
	Non-Frontier SME	Frontier SME	Large
Average age of the firm	22	25	37
Average productivity (unweighted) (th €)	17	63	67
Average employment	32	40	429
Average assets (th €)	1,857	7,506	77,408
Average turnover (th €)	1,910	7,964	92,713
Average exports (th €)	683	3,201	52,637
Share of firms with graduated workers	7.3 %	20.5 %	17.7 %
Share of firms with graduated managers	32.9 %	63.0 %	96.1 %
Average hourly wage (€)	5	8	9
Average price of exports (€)	85	446	295
Profitability (EBITDA/total assets)	0 %	12 %	7 %
Leverage	77 %	49 %	53 %
Foreign-owned (>50 %)	3 %	15 %	42 %
Number of firms	10029	1371	424
Share in total employment	49.4 %	8.5 %	27.8 %
Share in total VA	31.4 %	15.8 %	43.7 %
Share in total exports	19.6 %	12.6 %	64.0 %

Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

Figure 4 shows the evolution of average labour productivity in the manufacturing sector as defined above, in 2011–2018, for frontier SMEs, non-frontier SMEs and large-sized firms.[66] Data shows that, after 2013, large-sized firms have the highest average labour productivity. However, in 2006–2010, the average labour productivity of frontier SMEs firms was higher or similar to that of large-sized firms, and in 2018 the difference between the two groups was only 15 %.

The labour productivity of frontier firms throughout the same period was more than three times higher than the labour productivity of non-frontier SMEs.

Figure 4 **Average labour productivity in the manufacturing sector, 2006–2018 (in €, 2011 prices)**



Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

The data presented in figure 4 does not capture the dynamics of firms' growth. For example, the group of frontier SMEs in each year corresponds to a different set of firms because firms change their state over time, namely their position in the productivity distribution and their size class. Therefore, to capture firms' dynamics over time, we compute transition matrices across each firm size class and the status of frontier SMEs from 2006 to 2018, from 2007 to 2018, and so on. In table 4, we present the results for the transitions from 2006 to 2018, from 2010 to 2018, from 2014 to 2018 and from 2017 to 2018. Table 4 shows the percentage of firms that changed from the condition of micro, non-frontier SME, frontier SME and large-sized to the state of frontier SME or large-sized firm in 2018.

The data in table 4 show that, in 2018, 22.7 % (308) of the firms classified as frontier SMEs were already in the top 10 % SMEs in 2006. That percentage was 34 % in 2010, 51.7 % in 2014 and 69.7 % in 2017. Table 4 also shows that 3.6 %, 3.4 %, 2.0 % and 0.4 % of the frontier SMEs in 2006, 2010, 2014 and 2017, respectively, changed their status to large-sized firms.

Table 4 **Transition matrix across size and frontier classes from 2006, 2010, 2014 and 2017 to 2018**

	2006		2010		2014		2017	
	F – SME	Large	F – SME	Large	F – SME	Large	F – SME	Large
Micro	0.5 %	0.0 %	0.7 %	0.0 %	0.6 %	0.0 %	0.3 %	0.0 %
SME — non-frontier	2.3 %	0.5 %	3.1 %	0.6 %	3.2 %	0.7 %	2.5 %	0.3 %
SME — frontier	22.7 %	3.6 %	34.0 %	3.4 %	51.7 %	2.0 %	69.7 %	0.4 %
Large	2.1 %	63.7 %	2.0 %	78.1 %	0.8 %	87.2 %	1.7 %	93.9 %

Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

Table 5 compares the characteristics of frontier SMEs in 2010 that remained in that state in 2018 (406 firms) with frontier SMEs in 2010 that became large-sized firms in 2018 (41 firms). Table 5 shows that the frontier SMEs in 2010 that became large by 2018 were older, almost four times larger on average, had higher average labour productivity and higher profitability than the firms that remained frontier SMEs. Additionally, 41 % of the frontier SMEs that became large by 2018 were foreign-owned.

Data in table 5 also show that the group of frontier SME that became large-sized grew much faster in terms of employment (114 % vs 31 %), assets (81 % vs 21 %), turnover (90 % vs 34 %) and exports (123 % vs 81 %). Hourly wages are higher and grew faster for firms in the group that became large-sized (27 % vs 14 %).

Additionally, it should be noted that, between 2010 and 2018, the percentage of foreign-owned firms increased for both groups: from 11 % to 16 % for frontier SMEs and from 41 % to 46 % for large firms. The acquisition of national firms by foreign capital may reflect the shortage of capital on the one hand and the attractiveness of those businesses on the other hand.

Table 5 **Frontier SMEs and Large firms: changes from 2010 to 2018**

	2010		2018	
	Remained Frontier SMEs	Became Large firms	Frontier SMEs	Large firms
Average age of the firm	22	28	30	36
Average productivity (unweighted) (th €)	60	64	63	57
Average employment	36	124	47	265
Average assets (th €)	7,644	22,801	9,228	41,228
Average turnover (th €)	7,181	24,859	9,597	47,281
Average exports (th €)	1,987	12,684	3,593	28,266
Share of firms with graduated workers	15 %	16 %	20 %	19 %
Share of firms with graduated managers	58 %	90 %	70 %	90 %
Average hourly wage (€)	7.55	7,82	8,64	9,90
Average price of exports (€)	17	9	32	12
Profitability (EBITDA/total assets)	9 %	12 %	10 %	8 %
Leverage	55 %	60 %	44 %	54 %
Foreign-owned (>50 %)	11 %	41 %	16 %	46 %
Number of firms	406	41	406	41

Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

4.4. Business environment, misallocation of resources and productivity growth

In this section, we estimate a set of models at the sector level to evaluate the impact of the business environment on the efficiency of resource allocation and productivity growth. We look at four dimensions of the business environment: product market competition, labour market rigidity and openness to trade and credit markets.

The seminal paper by Hshie and Klenow (2009) shows that productivity dispersion can be interpreted as the presence of frictions or resource misallocation. Within-sector productivity dispersion reflects the coexistence of low and high productivity firms. An efficient allocation of resources implies the growth of the most productive firms and the exit of the less productive firms. Thus, an efficient allocation of resources would tend to equalise the marginal value product of inputs or revenue productivity.

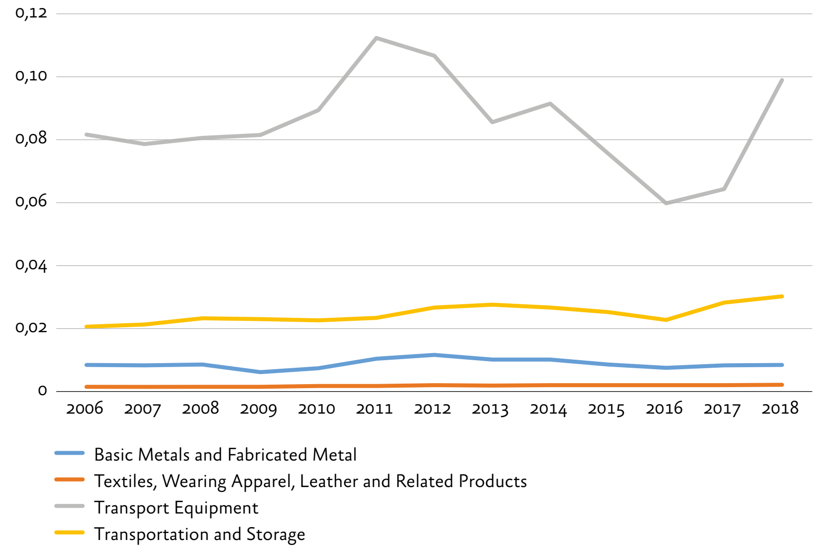
Within-sector dispersion in labour productivity across firms may be due to idiosyncratic productivity shocks or to market frictions and distortions in product, labour or financial markets — see, for example, Syverson (2011). In an analysis of the US economy, Decker et al. (2017 and 2020) argue that a surge in market frictions may have hindered the reallocation of resources to the most productive firms, reducing business dynamism, with high productivity firms less likely to grow and low productivity firms less likely to exit the market.

In spite of the economic expansion of the Portuguese economy in 2014–2019, productivity growth remained sluggish. Since the adoption of the euro in 1999 and the recession that followed in 2002/2003, structural reforms have been at the centre of the discussion of economic policies on growth and convergence. Structural reforms may enhance productivity growth by contributing to a more efficient allocation of resources (e.g., Acemoglu and Robinson, 2012). The Economic and Financial Assistance Programme (2011–2014), following the bailout of the Portuguese economy in 2011, included a set of structural policies that, among other goals, aimed at increasing the competition of the product market and the flexibility of the labour market (e.g., Eichenbaum et al., 2016). On the other hand, the European Semester — the fiscal framework of the euro area launched in 2011 to coordinate the fiscal policies of the EU Member States — aims at implementing structural reforms to increase employment and foster economic growth (e.g., European Commission, 2020).

Monteiro et al. (2017) assess the impact of the product market reforms implemented during the Economic and Financial Adjustment Programme on productivity growth. The liberalisation of gas and electricity markets, the creation of a transport regulator, the reduction of ports operating costs and the revision of the competition law were among some of the implemented product market reforms— see Jalles, Martins and Brinca (2021, FFMS) and Cruz and Januário (2021, FFMS) for a detailed analysis of these reforms. Monteiro et al. (2017) conclude that product market deregulation enhanced the efficiency of resource allocation and resulted in productivity gains.

In our analysis, product market competition is gauged by the Herfindahl–Hirschman Index (HHI) computed for each sector-year and calculated as the sum of the market shares' squares of each firm within the industry. Figure 5 shows the evolution of HHI for four of the most important sectors in terms of weight in the economy and total exports. It shows that market competition varies significantly across sectors and that it has changed significantly between 2006 and 2018.

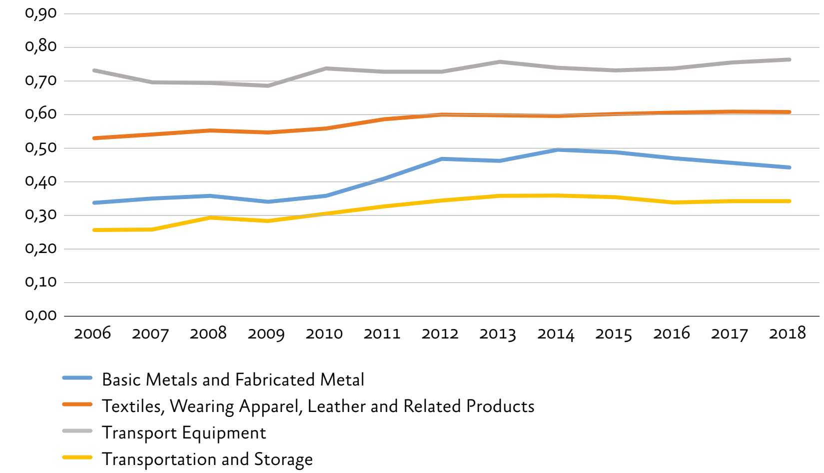
Figure 5 Herfindahl–Hirschman Index



Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

The strong growth of exports was an important structural change of the Portuguese economy in the last decade. Exports are an opportunity to diversify markets and are associated with more innovative and productive firms. Openness to trade, measured by the exports to sales ratio at the sector level, has increased in most sectors in 2006–2018 and varies significantly across sectors — see figure 6.

Figure 6 Openness to trade

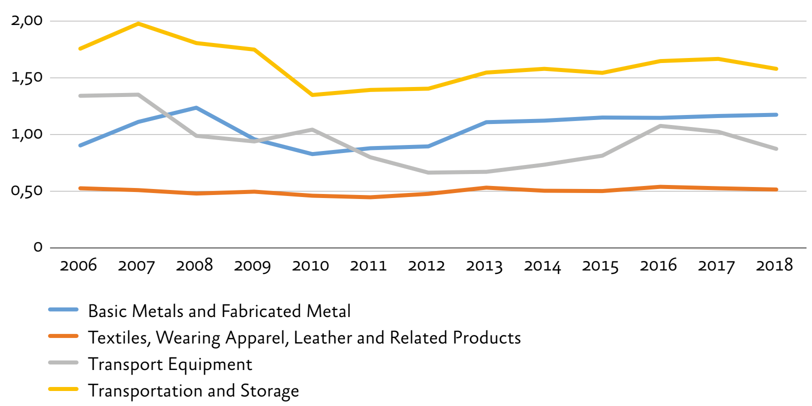


Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

Labour market rigidity has been an important issue in the debate on the causes of low productivity growth in the Portuguese economy (e.g., Blanchard, 2007; IMF, 2008). Blanchard and Portugal (2017) emphasise the importance of enhancing micro flexibility in the Portuguese labour market to foster the reallocation of workers to high-growth sectors. The Economic and Financial Assistance Programme (2011–2014) included several measures aiming at increasing labour market flexibility, among others, the reduction of the level and duration of unemployment benefits; the reduction of severance payments; the increase in the flexibility of working time arrangements; the reduction of vacations and holidays and the limitation of automatic extensions of collective agreements. Most of these reforms contributed to a more flexible, although still very segmented, labour market — see Varejão, Cerejeira, Portela and Vasconcelos (2021, FFMS).

In this paper, we use a novel index of labour market flexibility built on firm-level information, considering the following variables: the shares of workers not covered by collective agreements; the share of workers without permanent contracts; the number of extra hours over normal hours worked; irregular payments (such as bonuses) over the base wage and the Kaitz index. This measure of labour market flexibility allows the classification of sectors according to their degree of labour market flexibility, where high Flex sectors show labour market flexibility above the median and low Flex sectors show labour market flexibility below the median. Figure 7 presents data for the Flex index for four sectors. The data show that labour market flexibility varies significantly across sectors. For the sectors considered in figure 7, *Textile, wearing apparel, leather and related products* is the sector with the most rigid labour market, and *Transportation and storage* is the sector with the highest labour market flexibility.

Figure 7 **Labour market flexibility index**



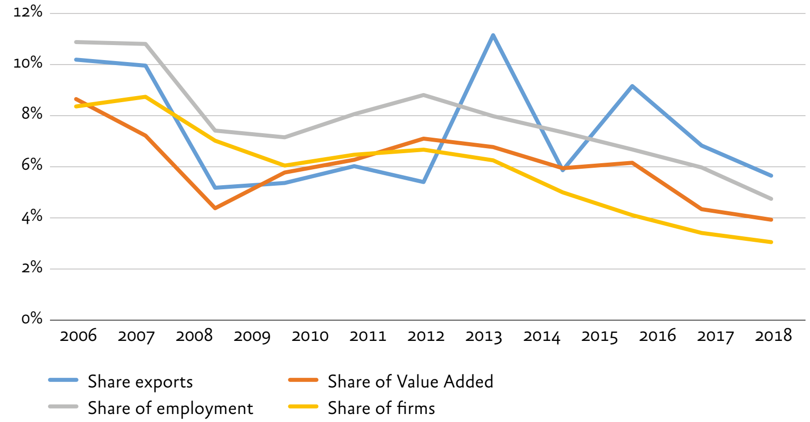
Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

Efficient financial markets and credit availability are crucial for firms' investment, for the adoption of new technologies and, therefore, for productivity growth. Financially distressed firms, also known as zombie firms, have been associated with high leverage and lower economic performance (e.g., Caballero et al., 2008). Several factors may contribute to persistent high shares of financially distressed firms, namely, banks' evergreen lending to inefficient firms (e.g., Caballero et al., 2008; Acharya et al., 2019); credit misallocation due to underdeveloped financial markets (e.g., Reis, 2013; Gopinath et al., 2017; Azevedo et al., 2018) and inefficient insolvency regimes (e.g., Andrews et al., 2017). Financially distressed firms divert resources from the most efficient firms, distort market competition and, therefore, hamper productivity growth.

Financially distressed firms were pervasive in the Portuguese economy during the financial, banking and debt crises (2008–2014). In that period, financially distressed firms accounted for a high share of total firms, total value-added, employment and total exports — see, for example, Gouveia and Osterhold (2018). The impact of the COVID-19 crisis has raised concerns that the share of zombie firms in the Portuguese economy may increase significantly.

Figure 8 presents the weight of financially distressed firms in the Portuguese economy in 2006–2018. Following the OECD approach — see, for example, McGowan et al. (2017) and Gouveia et al. (2018) — we define as financially distressed the firms that report an Interest Coverage Ratio (ICR), given by the ratio of EBITD to interest expenses, lower than one over three consecutive years.

Figure 8 **Share of financially distressed firms in the whole economy (in %)**

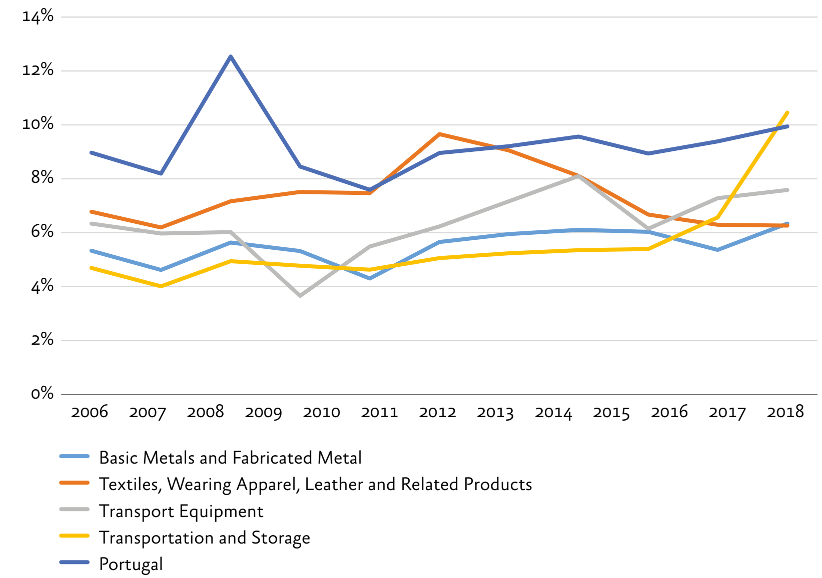


Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

Decker et al. (2017, 2020) emphasise the role of the business environment, which reflects institutional and political features, on low productivity growth. According to the authors, an institutional environment that promotes business dynamism, i.e., accelerates the reallocation of resources between incumbents and innovators, is essential for productivity growth. Reforms that favour firm entry, the growth of more productive firms and the exit of the less productive ones are expected to improve the allocation of resources and foster productivity growth (e.g., Foster et al., 2001; Restuccia and Rogerson, 2008). Conversely, when the business climate deteriorates, i.e., when market distortions deter more productive firms from growing and less productive firms from exiting the economy, we should observe a rise in productivity dispersion and a decline in productivity (Foster et al., 2019). Philippon (2019) provides a nice discussion about the importance of free entry as a mechanism to foster business dynamism.

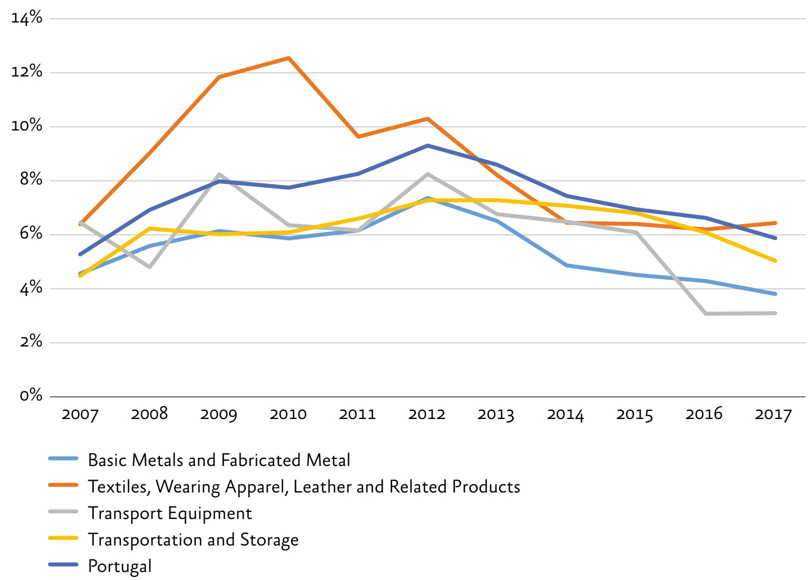
Figures 9 and 10 show, respectively, the entry and exit rates of four sectors for the whole economy in 2006–2018. Figure 9 shows that, for the whole economy, the entry rate increased from 8 % in 2012 to 10 % in 2018. However, entry rates varied significantly for the sectors included in figure 9, from 10 % in Transportation and storage to 6 % in *Textiles*... and *Basic metals*....

Figure 9 **Entry rate per sector for the whole economy (in %)**



Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

Figure 10 Exit rate per sector for the whole economy (in %)



Source: own calculations with firm-level data from the SCIE (Statistics Portugal)

We estimate a model at the sector level to evaluate the role of the business environment, namely the efficiency of the product, labour and financial markets, in enhancing an optimal reallocation of resources towards more productive firms to the detriment of firms with poorer economic performance. Following the approach of Foster et al. (2019), we estimate the following model to evaluate how the entry and exit of firms affects the efficiency of resource allocation within sectors and how it contributes to productivity growth:

$$y_{st} = \lambda_s + \eta_t + \sum_{k=1}^{r} [\beta_k \overline{M}_{st} F_{s,t-k} + \delta_k \underline{M}_{st} F_{s,t-k}] + \varepsilon_{st}$$

where y_{st} stands either for within sector/year productivity dispersion, measured by the coefficient of variation, or within sector productivity growth. $\overline{M}_{st}$ and $\underline{M}_{st}$ are dummy variables that classify sectors as being high or low, respectively, gauged by the degree of flexibility (FLEX), market concentration (HHI), openness (Open) and financial distress (FDF). Sectors are classified as being high or low in each of these indicators according to their position relative to the median value. F_{st} stands for the rate of *entry* or *exit* flow of firms in sector s and in year t. λ_{st} stands for sectors' fixed effect and η_t stands for time effects. ε_{st} is a white noise error term. Finally, r indicates the number of lags used in each model. With the exception of the productivity dispersion equation and the exit of firms, where $r = 1$, we consider that the dynamics of the transmission of the effects resulting from the entry and exit of firms on productivity dispersion and productivity growth takes two lags and, in these cases, we define $r = 2$.

We use sector/year level longitudinal data for four-digit industry classification for 2006–2018. As some sectors are extremely small, in our econometric analysis, we only consider sectors that have a significant weight in the economy. The threshold is defined according to the share of value-added of each sector in the economy. Specifically, we have computed quintiles in yearly value-added and excluded the first two quintiles of sectors, resulting in the loss of 223 sectors and 21,706 firms. This corresponds to 20.2 % of the total firms and 12.7 % of the aggregate value-added. As a robustness check, we have also estimated the different models with an alternative sample where we dropped the first quintile of sectors. The results are in line with the ones obtained from our main sample.

Tables 5 and 6 present the results for the entry and exit of firms, respectively. The estimates presented in table 5, columns (1) and (2), suggest that the entry of firms in sectors characterised by high labour market flexibility has a significant negative impact on productivity dispersion, at the 1% level, and a significant positive effect on productivity growth, at the 10 % level. These results suggest that in sectors with higher labour market flexibility, the entry of firms contributes to a more efficient allocation of resources and, therefore, to productivity growth. Conversely, entry does not seem to improve resource allocation and productivity growth in sectors with a rigid labour market.

Our econometric results in table 5 also suggest that the entry of new firms into the market improves the allocation of resources and contributes to productivity growth in sectors characterised by higher market competition. However, in sectors with a higher market concentration, our estimates suggest that entry does not improve resource allocation, nor does it contribute to productivity growth — see columns (3) and (4). These results suggest that product market distortions may hinder an efficient allocation of resources and productivity growth.

In sectors with a low degree of openness to trade, the entry of new firms seems to improve the allocation of resources and productivity growth. On the other hand, the allocation of resources in sectors with a high degree of openness is not affected by the entry of new firms — see columns (5) and (6). These estimates suggest that the entry of new firms may foster the efficiency of resource allocation in sectors less exposed to international competition.

Finally, our estimates suggest that the entry of firms in sectors with a higher share of financially distressed firms does not impact the efficiency of resource allocation and productivity growth, whereas sectors with a lower share seem to benefit from the entry of new firms — see columns (7) and (8). These results suggest that financially distressed firms may be a source of distortion that hampers the entry and growth of new firms.

Table 6 Regression analysis by Sector/Year — Entry

	Flex		*HHI*		*Open*		*FDF*	
	Dispersion	Growth	Dispersion	Growth	Dispersion	Growth	Dispersion	Growth
$High_{t-1}$	-0.00269***	0.00046*	0.00091	0.00123	−0.00067	0.00246	−0.00815	0.00333
	(0.00095)	(0.00024)	(0.00624)	(0.00177)	(0.00523)	(0.00252)	(0.00693)	(0.00207)
$High_{t-2}$	−0.00160**	−0.00012	0.00253	−0.00003	−0.00387	−0.00094	0.00307	−0.00131
	(0.00071)	(0.00008)	(0.00619)	(0.00084)	(0.00285)	(0.00105)	(0.00695)	(0.00115)
Low_{t-1}	0.00237	0.00113	−0.00316***	0.00043***	−0.00278***	0.00039***	−0.00267**	0.00045***
	(0.00616)	(0.00127)	(0.00033)	(0.00012)	(0.00094)	(0.00010)	(0.00112)	(0.00016)
Low_{t-2}	−0.01140	0.00033	−0.00221***	−0.00012**	−0.00169**	−0.00007	−0.00196***	−0.00003
	(0.01016)	(0.00062)	(0.00028)	(0.00005)	(0.00066)	(0.00012)	(0.00065)	(0.00012)

Source: own computations using data from QP and SCIE.
Notes: standard errors in parentheses clustered at the sector level. Significance levels: *, 10 %; **, 5 %; ***, 1 %. The sample underlying the estimations has 1260 observations corresponding to 140 sectors. *Dispersion* stands for the coefficient of productivity variation.

Table 6 presents the econometric results for the impact of firm exit on the efficiency of resource allocation and productivity growth. We do not find significant impacts of firm exit on productivity dispersion. This is valid irrespective of the degree of labour market flexibility, product market concentration, openness to trade or incidence of financially distressed firms. These results may suggest that exit mechanisms have not been very efficient; that is, they do not seem to induce less efficient firms to leave the market, therefore reducing the efficiency of resource allocation. In this vein, Gouveia and Osterhold (2018) investigate the role of credit misallocation, namely in a significant share of non-viable firms (zombie firms), in the low productivity growth of the Portuguese economy and conclude that a reduction in exit and restructuring barriers may favour aggregate productivity.

Table 7 Regression analysis by Sector/Year — Exit

	Flex		*HHI*		*Open*		*FDF*	
	Dispersion	Growth	Dispersion	Growth	Dispersion	Growth	Dispersion	Growth
$High_{t-1}$	0.01216	0.00283**	0.01168	0.00208	0.00226	0.00207	0.01348	0.00348**
	(0.01262)	(0.00132)	(0.01005)	(0.00140)	(0.00580)	(0.00168)	(0.01086)	(0.00142)
$High_{t-2}$		−0.00328**		−0.00269*		−0.00155		−0.00215
		(0.00155)		(0.00139)		(0.00160)		(0.00143)
Low_{t-1}	0.00688	0.00145	0.00302	0.00434***	0.01877	0.00286*	0.00728	−0.00304**
	(0.00608)	(0.00196)	(0.01060)	(0.00145)	(0.01451)	(0.00165)	(0.00925)	(0.00137)
Low_{t-2}		−0.00119		−0.00231*		−0.00375**		−0.00304**
		(0.00124)		(0.00136)		(0.00161)		(0.00137)

Source: own computations using data from QP and SCIE.
Notes: standard errors in parentheses clustered at the sector level. Significance levels: *, 10 %; **, 5 %; ***, 1 %. The sample underlying the estimations has 1540 observations for odd columns and 1400 for even columns, corresponding to 140 sectors.

4.5. From birth to the productivity frontier: entrepreneurs and their circumstances

In this section, we show that both entrepreneurs' characteristics and the circumstances in which they develop their business are relevant for the evolution of the firm in terms of productivity distribution. The characteristics of an entrepreneur are gauged by the founder's level of education, which is measured by years of schooling, at the time of the firm's foundation. Queiró (2018) concluded that firms founded by more educated entrepreneurs tend to be larger at entry and also exhibit higher growth. Nicholas Bloom, John Van Reenen and their co-authors conclude that better management practices are positively associated with higher levels of education and that firms with better management practices tend to be larger, more efficient, grow faster and have higher survival rates (e.g., Bloom and Van Reenen, 2007; Bloom et al., 2013). Alexandre et al. (2020), using firm-level data for the Portuguese economy, conclude that the formal education of management teams reduces the probability of micro and small-sized firms becoming financially distressed and increases the probability of their subsequent recovery.

Concerning the circumstances of the entrepreneur, we consider two dimensions within the business context: the degree of product market concentration, measured by the Herfindal-Hirshman Index (HHI), and the degree of labour market flexibility, measured by the labour market flexibility index described above.

Table 8 presents the descriptive statistics of the variables used in our model, which is estimated at the two-digit sector level.

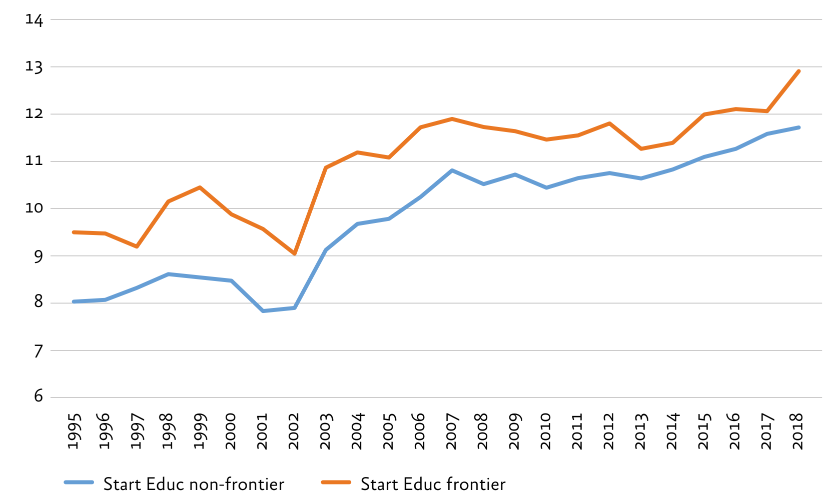
Table 8 **Descriptive statistics**

	p10	p25	Mean	p50	p75	p90
			2006			
Frontier	0	0	0.084	0	0	0
Start Educ	4	6	9.254	9	12	16
Start HHI	0.002	0.003	0.008	0.005	0.009	0.013
Start Flex	0.638	0.694	0.867	0.784	0.979	1.122
			2018			
Frontier	0	0	0.094	0	0	0
Start Educ	6	9	10.585	12	12	16
Start HHI	0.002	0.003	0.015	0.006	0.014	0.020
Start Flex	0.617	0.671	0.835	0.779	0.950	1.067

Source: own computations using data from QP and SCIE.

In our econometric analysis, we consider a sample of firms created since 1995, for which we have information about the founders' education. Figure 11 presents the average years of schooling of the founders of non-frontier firms and the founders of firms that become frontier (i.e., that belonged to the top 10 % most productive in the economy at some point). The positive trend in both lines reflects the significant improvement in Portuguese education in the last decades (e.g., Almeida et al., 2017). Between 1995 and 2018, the average schooling of managers increased by four years. Figure 11 shows that the founders of firms that become frontier at some point have, on average, one more year of schooling than founders of non-frontier firms.

Figure 11 **Founders' education: frontier and non-frontier firms**



Source: own calculations with firm-level data from QPs

We estimate a *probit* model to evaluate the impact of founders' education and the business environment on the probability of a firm becoming part of the top 10 % most productive in its sector. The probit model has the following form:

$$P(Frontier_{it} = 1 | \boldsymbol{X}_{ist}, \boldsymbol{\beta}) = \frac{\exp(\boldsymbol{\beta X}_{ist})}{1 + \exp(\boldsymbol{\beta X}_{ist})}$$

The dependent variable is the probability of the firm *i* being a frontier firm in sector *s* in year *t*.

$\boldsymbol{X}_{ist}$ is a vector with the explanatory variables: $StartEduc_{ist}$ stands for the average years of schooling of the management team at the time of the firm's birth; $Start\ HHI_{i,s,t}$ stands for the degree of market concentration in sector s, measured by the HHI; and $Start\ Flex_{i,s,t}$ stands for the degree of labour market flexibility in sector *s*, measured by the Flex index.

The results of the estimations, presented in table 9, show that the higher the education of the founders' management team at the year of the firm's foundation, the higher the probability of a firm becoming a frontier firm. This result shows that managers' education has a positive correlation with firm and productivity growth, corroborating the evidence presented in Queiró (2018).

Our estimations also show that firms entering sectors with higher market concentration, that is, with a higher HHI, have a lower probability of becoming part of the group of frontier firms. Finally, the results of the estimations also show that firms entering sectors with a more flexible labour market have a higher probability of becoming part of the 10 % most productive firms.

The estimates suggest that both the entrepreneur and their circumstances are relevant for the firm to become part of the group of frontier firms.

Table 9 Regression analysis, probit model: frontier firms

	Coefficients	Marginal Effects
Start Educ	0.0401***	0.0066***
	(0.0006)	(0.0001)
Start HHI	-0.1597**	-0.0262**
	(0.0747)	(0.0122)
Start Flex	0.2624***	0.0430***
	(0.0085)	(0.0014)

Source: own computations using data from QP and SCIE.
Notes: robust standard errors in parentheses; significance levels: * 10 %, ** 5 %, *** 1 %. The number of observations is 652,209, while the number of firms is 134,129. All regressions include time dummies as well as cohort dummies. The model is estimated by probit. The dependent variable is the probability that a given firm is in the top decile of productivity in a given industry and year. Explanatory variables represent the values of managers and owner's average education in the year of birth of the firm, and sector indices for product market concentration and labour market flexibility, respectively. The time span of the data is 1995–2018. Marginal effects are computed at the averages of the explanatory variables. Standard errors for the marginal effects are computed using the delta method.

4.6. Firms' growth: management and economic context

In this section, we evaluate the impact of managers' education, labour market flexibility, product market competition and credit market efficiency on firms' growth and productivity growth. Firms' growth depends on a set of factors that can be classified as internal and external — see Marchese et al. (2019). Internal factors depend on the decisions of the owners and management teams that affect the performance of the firm: human resource management and training, management practices (investment in ICT and digitalisation), the participation in business networks (global value chains, for example), investment in R&D and the capacity to innovate in products and processes.

However, the effectiveness of management and investment decisions on firms' growth and firms' productivity growth depends on external factors, that is, on the business environment. The existence of efficient transport infrastructure and broadband is crucial for participation in global value chains. The availability of skills is essential for the efficacy of ICT investments and digitalisation (see, for example, Schivardi and Schmitz, 2020).

As discussed above, an efficient product market, which allows for the entry and growth of the most efficient firms and the exit of the least efficient firms, is vital for firms' growth and productivity growth (e.g., Philippon, 2019). In addition, the labour market should provide incentives for firms to invest in the training of their workforce and to allow its adjustment to new market conditions and technologies (e.g., Blanchard and Portugal, 2017). Efficient financial markets and availability of credit are crucial for firms' investment and, therefore, for the adoption of new technologies and productivity growth (e.g., Gopinath et al., 2017). These are the three dimensions of the business environment considered in our analysis.

Table 10 presents the descriptive statistics of the variables used in the econometric estimation.

Table 10 Descriptive statistics

	p10	p25	mean	p50	p75	p90
			2007			
Var. Employment	-2	0	0.351	0	1	3
Var. Turnover	-1	0	0.671	0	1	3
Var. Productivity	-4	-1	0.639	0	2	6
Man Educ	4	6	9.379	9	12	16
Flex	0.664	0.773	0.948	0.906	1.128	1.164
HHI	0.003	0.003	0.009	0.005	0.006	0.013
ShZombies	8.177	10.230	13.963	16.255	16.255	19.063
Firm age	2	3	6.321	5	8	13
			2018			
Var. Employment	-2	0	0.286	0	0	3
Var. Turnover	-1	-1	0.275	0	1	2
Va. Productivity	-4	-1	0.220	0	2	5
Man Educ	6	9	10.882	12	13.333	16
Flex	0.671	0.716	0.841	0.810	0.945	1.053
HHI	0.001	0.003	0.018	0.007	0.018	0.020
ShZombies	1.778	2.343	3.790	4.271	4.558	5.551
Firm age	1	3	8.567	6	13	19

Source: own computations using data from QP and SCIE.

We estimate the following model:

$$\Delta y_{i,s,t} = \alpha y_{i,s,t-1} + \sum_{k=1}^{3} \beta_k^1 \, ManEduc_{i,t-k} + \sum_{k=1}^{3} \beta_k^2 \, Flex_{s,t-k} + \sum_{k=1}^{3} \beta_k^3 \, HHI_{s,t-k} + + \sum_{k=1}^{3} \beta_k^4 ShZombies_{s,t-k} + \mu_i + \gamma_t + \varepsilon_{i,s,t}$$

Where $y_{i,s,t}$ stands for firm *i*, in sector *s*, at time *t*, turnover, employment or labour productivity. These dependent variables are transformed into intervals of 5 % percentiles. Δ represents the firms' transition across the intervals of 5 % percentiles between $t-1$ and *t*. The explanatory variables include firm *i* managers' education, *ManEduc*, measured as the average years of schooling of the management team; the index of labour market flexibility computed at the sector/year level, *Flex*; the index of product market competition computed at the sector/year level, *HHI*; the share of zombie firms in sector/year, *ShZombies*; μ represents firms' fixed effect; γ represents time dummies; and ε is the error term.

The results of the estimation are presented in table 11. The results show that the managers' average education, *ManEduc*, has a positive and statistically significant effect on firms' upward transition over the sector's turnover, employment and productivity distributions. This result is in line with Queiró (2018).

Our results also show that firms in sectors with a higher labour market flexibility, that is, with a higher *Flex*, present a faster upward transition in the turnover, employment and productivity distributions. These results suggest that labour market flexibility may favour firms' growth and firms' productivity performance.

Table 11 Regression analysis

	Turnover	Employment	Productivity
ManEduc (t-1)	0.0106***	0.0101**	0.0204***
	(0.0036)	(0.0044)	(0.0068)
ManEduc (t-2)	0.0075*	0.0024	-0.0032
	(0.0041)	(0.0049)	(0.0078)
ManEduc (t-3)	0.0040	0.0017	0.0134*
	(0.0038)	(0.0046)	(0.0075)
Flex (t-1)	0.0698	0.0085	0.0961
	(0.0576)	(0.0675)	(0.1152)
Flex (t-2)	0.1326***	0.1549***	0.1636*
	(0.0486)	(0.0542)	(0.0915)
Flex (t-3)	0.1148**	0.0858	0.0450
	(0.0459)	(0.0545)	(0.0871)
HHI (t-1)	-0.3729	-0.2383	-0.3727
	(0.2690)	(0.2946)	(0.4799)
HHI (t-2)	-0.7845***	-0.7245**	-1.0880**
	(0.2504)	(0.2958)	(0.4553)
HHI (t-3)	-0.0212	0.1049	0.6332
	(0.2401)	(0.2864)	(0.4468)
ShZombies (t-1)	0.0103	0.0134**	0.0127
	(0.0064)	(0.0059)	(0.0095)
ShZombies (t-2)	-0.0031	-0.0185**	-0.0026
	(0.0093)	(0.0077)	(0.0129)
ShZombies (t-3)	-0.0301***	-0.0220***	-0.0233**
	(0.0060)	(0.0057)	(0.0096)

Source: own computations using data from QP and SCIE.
Notes: robust standard errors in parentheses; significance levels: * 10 %, ** 5 %, *** 1 %. The number of observations is 311,825, while the number of firms is 70,174. The dependent variable, Δy_ (i, s, t), is the change in the 5 % percentile distribution of the variable of interest in each column: Employment, Turnover and Productivity, respectively. All regressions include y_ (i, s, t-1), time dummies and a polynomial on the firms' age. The model is estimated by fixed effects. The time span of the data is 2006–2018.

The results for the measure of product market competition, *HHI*, show that firms in sectors with a higher product market concentration face barriers to progressing in turnover, employment and productivity distribution.

Finally, our econometric results also show that sectors with a higher share of zombie firms have a detrimental effect on firms' progress in turnover, employment and productivity distribution. These results seem to corroborate previous research on the misallocation effects of zombie lending (see, for example, Caballero et al., 2008; Schivardi et al., 2017).

4.7. Concluding remarks

Low productivity growth in the Portuguese economy since the 21st century may share some of the causes of productivity slowdown in developed countries. However, the significant gap between national frontier firms and European frontier firms suggests that Portugal has not escaped its middle-income country's condition. Therefore, accelerating the diffusion of innovation through a closer link between European and national frontier firms may foster the catch up in productivity by the Portuguese economy. However, it is also necessary to close the gap in productivity growth between frontier firms and other firms by stimulating innovation diffusion and promoting a business environment that favours SMEs' growth (e.g., Andrews et al., 2015).

In fact, estimates in this paper suggest that policies that promote a more favourable business environment may contribute to a more efficient resource allocation and productivity growth. Namely, enhancing product market competition, i.e., reducing barriers to entry and exit in the product market to allow good firms to grow and bad firms to exit, may favour a better allocation of resources and productivity growth. On the other hand, reducing labour market rigidity seems to contribute to firms' growth, increasing the firms' probability of becoming part of the frontier group. Finally, our results suggest that better bankruptcy legislation, aiming at accelerating the exit or recovery of zombie firms, may improve resource allocation and productivity growth.

Although the business environment seems to be crucial for an efficient allocation of resources and for firms' growth, the estimates in this paper also show that the education of the management team has a significant impact on firms' growth and on the probability of the firm joining the group of top productivity performers. These results corroborate the findings of Queiró (2018). The estimates also suggest that good management practices may be a powerful tool to innovate and implement new management processes (e.g., Bloom et al., 2013).

References

Acemoglu, D., and J. A. Robinson, *Why Nations Fail: The Origins of Power, Prosperity and Poverty*, (1st). 1st ed, Crown, New York, 2012.

Acharya, V. V., Eisert, T., Eufinger, C., and Hirsch, C., «Whatever it takes: The real effects of unconventional monetary policy», The Review of Financial Studies, Vol. 32, No. 9, 2019, pp. 3366–3411.

Alexandre, F., M. Portela and S. Cruz, «Financial Distress and the Role of Management in Micro and Small-Sized Firms», IZA DP No. 13738, IZA Institute of Labour, Bonn, 2020.

Almeida, A., H. Figueiredo, J. Cerejeira, M. Portela, C. Sá and P. Teixeira, «Returns to postgraduate education in Portugal: Holding on to a higher ground?», IZA Discussion Paper No. 10676, 2017.

Andrews, D., McGowan, M. A., and Millot, V., «Confronting the zombies: Policies for productivity revival», OECD Economic Policy Papers No. 2017–21, 2017.

Andrews, D. and Petroulakis, F., «Breaking the shackles: zombie firms, weak banks and depressed restructuring in Europe», ECB Working Paper No. 2240–2019, 2019.

Andrews, D., Criscuolo, C., & Gal, P. N., «The best versus the rest: the global productivity slowdown, divergence across firms and the role of public policy», OECD Productivity working papers, No. 05. OECD, Paris, November 2016.

Andrews, D., Criscuolo, C., & Gal, P. N., «Frontier firms, technology diffusion and public policy: Micro evidence from OECD countries», OECD Productivity working papers, No. 02, November 2015.

Azevedo, N., Mateus, M., Pina, A., et al., «Bank credit allocation and productivity: Stylised facts for Portugal», Banco de Portugal Working Paper No. 2018–25, 2018.

Blanchard, O., «Adjustment within the euro. The difficult case of Portugal», *Portuguese Economic Journal*, Vol. 6, No. 1, 2007, pp. 1–21.

Blanchard, O. and P. Portugal, «Boom, slump, sudden stops, recovery, and policy options. Portugal and the Euro», *Portuguese Economic Journal*, Vol. 16, 2017, pp. 149–168.

Bloom, N., Eifert, B., Mahajan, A., McKenzie, D., and Roberts, J., «Does management matter? Evidence from India», *The Quarterly Journal of Economics*, Vol. 128, No. 1, 2013, pp. 1–51.

Bloom, N. and Van Reenen, J., «Measuring and explaining management practices across firms and countries», *The Quarterly Journal of Economics*, Vol. 122, No. 4,2007, pp. 1351–1408.

Bloom, N., C. Jones, J. Van Reenen and Webb, «Are ideas getting harder to find?», *American Economic Review*, Vol. 110, No. 4, 2020, pp. 1104–44.

Braguinsky, S., L. G. Branstetter and A. Regateiro, «The incredible shrinking Portuguese firm», NBER Working Paper 17265, National Bureau of Economic Research, Massachusetts, Cambridge, 2011.

CDCEP, «Datação dos Ciclos Económicos Portugueses», Comité de Datação dos Ciclos Económicos Portugueses, Francisco Manuel dos Santos Foundation, available here.

Cruz, C. O. and J. Januário, *Infrastructure and territory: In the Next Ten Years of Public Policy*, Franscisco Manuel dos Santos Foundation, Lisbon, 2021.

Decker, R., J. Haltiwanger, R. S. Jarmin, and J. Miranda, «Declining Dynamism, Allocative Efficiency, and the Productivity Slowdown», *American Economic Review*, Vol. 107, No. 5, 2021, pp.322–26.

Decker, R., J. Haltiwanger, R. S. Jarmin, and J. Miranda, «Changing Business Dynamism and Productivity: Shocks versus Responsiveness», *American Economic Review*, Vol. 110, No. 12, 2020, pp. 3952–3990.

Dias, D. A., C. R. Marques, and C. Richmond, «Misallocation and productivity in the lead up to the Eurozone crisis», *Journal of Macroeconomics*, Vol. 49, 2016, pp. 46–70.

Eichenbaum, M., S. Rebelo and C. Resende, *The Portuguese Crisis and the IMF*, International Monetary Fund, Washington D.C, 2016.

European Commission, «Country Report Portugal 2020», 2020.

EBI, «Investment Report 2019/2020 – accelerating Europe's transformation», European Investment Bank, 2019.

Foster, L., J. Haltiwanger, and CJ Krizan, «Aggregate Productivity Growth: Lessons from Microeconomic Evidence», in *New Developments in Productivity Analysis* (eds. Edward Dean, Michael Harper and Charles Hulten), University of Chicago Press, 2001.

Garicano, L., Lelarge, C., & Van Reenen, J., «Firm size distortions and the productivity distribution: Evidence from France», *American Economic Review*, Vol. 106, No. 11, 2016, pp. 3439–79.

Gopinath, G., Kalemli-Özcan, Ş., Karabarbounis, L., & Villegas-Sanchez, C., «Capital allocation and productivity in South Europe», *The Quarterly Journal of Economics*, Vol. 132, No. 4, 2017, pp. 1915–1967.

Gordon, R., *The Rise and Fall of American Growth – The U.S. Standard of Living Since the Civil War*, Princeton University Press, 2017.

Gouveia, A. and C. Osterhold, «Fear the walking dead: zombie firms, spillovers and exit policies», OECD Productivity Working Paper 13, 2017.

Guimarães, P. and M. Silva, «On the evolution of the average firm size in Portugal», Economic Bulletin, Banco de Portugal, March 2021.

Hurst, E. and B. Pugsley, «What do small businesses do?», *Brookings Papers on Economic Activity*, Vol. 43, No. 2, 2012, pp. 73–142.

Hsieh, C. T. and P. Klenow, «Misallocation and manufacturing TFP in China and India», *Quarterly Journal of Economics*, Vol. 124, No. 4, 2009, pp. 1403–1448.

IMF, «Portugal: 2008 Article IV Consultation: Staff Report», International Monetary Fund, Washington, 2008.

Jalles, J. T., J. O. Martins and P. Brinca, *Business Environment: Competition, Markets and Taxation*, Franscisco Manuel dos Santos Foundation, Lisbon, 2021.

Jones, Charles, «The burden of knowledge and the 'Dead of the Renaissance Man': is innovation getting harder?», *Review of Economic Studies*, Vol. 76, 2009, pp. 283–317.

Monteiro, G., Gouveia, A.F. and Santos, S., «Product markets' deregulation: a more productive, more efficient and more resilient economy?», OECD Economics Department Working Papers, no. 9, Paris, 2017.

Philippon, T., *The Great Reversal – How America Gave Up on Free Markets*. The Belknap Press of Harvard University Press, 2019.

Marchese, M., E. Giuliani, J. C. Salazar-Elena, I. Stone, «Enhancing SME Productivity –Policy highlights on the role of managerial skills, workforce skills and business linkages», OECD, Paris, 2019.

Mcgowan, M. A., Andrews, D., and Millot, V., «Insolvency regimes, zombie firms and capital reallocation», OECD Economics Department Working Paper No. 1399, 2017.

OECD, «Broad-based Innovation Policy for All Regions and Cities», OECD Publishing, Paris, 2020, available here.

Queiró, F., «Entrepreneurial Human Capital and Firm Dynamics», GEE Paper Number 116, December 2018.

Reis, R., «The Portuguese slump and the crash and the Euro crisis», *Brookings Papers on Economic Activity*, Vol. 44, No. 1, 2013, pp. 143–210.

Restuccia, D., and Rogerson, R., «Policy distortions and aggregate productivity with heterogeneous establishments», *Review of Economic Dynamics*, Vol. 11, No. 4, 2008, pp. 707–720.

Schivardi, F., & Schmitz, T., «The IT revolution and southern Europe's two lost decades», *Journal of the European Economic Association*, Vol. 18, No. 5, 2020, pp. 2441–2486.

Schivardi, F., Sette, E., and Tabellini, G., «Credit misallocation during the European financial crisis», Bank of Italy Temi di Discussione Working Paper No. 1139, 2017.

Syverson, C., «What Determines Productivity?», *Journal of Economic Literature*, Vol. 49, No. 2, 2011, pp. 326–365.

Varejão, J., J. Vasconcelos, J. Cerejeira and M. Portela, *Building the new paradigm: Skills and Labour Markets*, Franscisco Manuel dos Santos Foundation, Lisbon, 2021.

Appendix

Table A1 Market concentration, openness, labour market flexibility and labour productivity

Sector	HHI		Openness		Flex		Productivity	
	2006	2018	2006	2018	2006	2018	2006	2018
Agriculture, Hunting, Forestry and Fishing	0.02	0.00	0.19	0.12	0.74	1.03	17	15
Arts, Entertainment, Recreation and Other Service Activities	0.02	0.01	0.02	0.05	0.86	0.82	11	12
Basic Metals and Fabricated Metal	0.01	0.01	0.34	0.44	0.90	1.17	18	21
Chemicals and Chemical Products	0.03	0.03	0.31	0.52	1.50	1.03	37	33
Coke, Refined Petroleum and Nuclear Fuel	0.11	0.80	0.11	0.27	1.85	1.64	25	41
Construction	0.00	0.00	0.06	0.16	1.16	1.11	22	19
Education	0.00	0.01	0.01	0.03	0.56	0.59	10	12
Electrical and Optical Equipment	0.07	0.07	0.35	0.49	1.41	1.27	21	25
Electricity, Gas and Water Supply	0.20	0.08	0.02	0.12	2.31	1.08	252	408
Food, Beverages and Tobacco	0.01	0.01	0.13	0.23	1.03	0.94	15	17
Health and Social Work	0.01	0.01	0.00	0.01	0.71	0.58	28	25
Hotels and Restaurants	0.00	0.00	0.02	0.03	0.67	0.69	11	12
Machinery, n.e.c.	0.01	0.02	0.41	0.56	1.11	0.96	22	27
Manufacturing, n.e.c; Recycling	0.01	0.01	0.26	0.39	0.79	0.99	16	20
Mining and Quarrying	0.11	0.11	0.40	0.56	1.57	1.20	27	20
Other Non-Metallic Minerals	0.01	0.02	0.24	0.41	0.98	0.80	18	20
Post and Telecommunications	0.06	0.05	0.07	0.22	1.22	1.16	25	27
Pulp, Paper, Paper Products, Printing and Publishing	0.05	0.05	0.40	0.23	0.91	0.99	20	24
Real Estate Activities	0.01	0.00	0.02	0.02	0.62	0.63	39	39
Renting of M&Eq and Other Business Activities	0.00	0.00	0.07	0.17	1.31	1.03	22	25
Rubber and Plastics	0.03	0.05	0.43	0.62	1.61	0.85	24	26
Textiles, Wearing Apparel, Leather and Related Products	0.00	0.00	0.53	0.61	0.53	0.52	12	14
Transport Equipment	0.08	0.10	0.73	0.76	1.34	0.87	21	25
Transportation and Storage	0.02	0.03	0.26	0.34	1.75	1.58	20	28
Wholesale and Retail Trade; Repair of Motor Vehicles	0.00	0.00	0.05	0.08	0.76	0.70	17	20
Wood and Products of Wood and Cork	0.02	0.02	0.39	0.45	0.59	0.70	16	19

Table A2 **Sectors' shares in total employment, value-added and exports**

Sector	Share of employment		Share of value added		Share of exports	
	2006	2018	2006	2018	2006	2018
Agriculture, Hunting, Forestry and Fishing	0 %	2 %	0 %	1 %	0 %	1 %
Arts, Entertainment, Recreation and Other Service Activities	1 %	2 %	1 %	2 %	0 %	0 %
Basic Metals and Fabricated Metal	3 %	3 %	3 %	3 %	7 %	6 %
Chemicals and Chemical Products	1 %	1 %	2 %	1 %	4 %	3 %
Coke, Refined Petroleum and Nuclear Fuel	0 %	0 %	0 %	1 %	0 %	3 %
Construction	14 %	9 %	12 %	7 %	5 %	4 %
Education	1 %	1 %	1 %	1 %	0 %	0 %
Electrical and Optical Equipment	1 %	1 %	2 %	1 %	5 %	4 %
Electricity, Gas and Water Supply	1 %	1 %	5 %	5 %	1 %	4 %
Food, Beverages and Tobacco	4 %	4 %	4 %	4 %	4 %	5 %
Health and Social Work	3 %	3 %	3 %	3 %	0 %	0 %
Hotels and Restaurants	7 %	9 %	4 %	6 %	0 %	0 %
Machinery, n.e.c	1 %	1 %	1 %	1 %	2 %	2 %
Manufacturing, n.e.c; Recycling	2 %	2 %	2 %	2 %	2 %	3 %
Mining and Quarrying	0 %	0 %	1 %	1 %	1 %	1 %
Other Non-Metallic Minerals	2 %	1 %	2 %	2 %	3 %	2 %
Post and Telecommunications	2 %	3 %	8 %	7 %	2 %	4 %
Pulp, Paper, Paper Products, Printing and Publishing	1 %	1 %	2 %	2 %	3 %	2 %
Real Estate Activities	1 %	1 %	2 %	1 %	0 %	0 %
Renting of M&Eq and Other Business Activities	13 %	16 %	9 %	12 %	3 %	5 %
Rubber and Plastics	1 %	1 %	1 %	2 %	3 %	4 %
Textiles, Wearing Apparel, Leather and Related Products	8 %	6 %	4 %	4 %	13 %	9 %
Transport Equipment	2 %	2 %	2 %	2 %	12 %	12 %
Transportation and Storage	5 %	6 %	8 %	9 %	10 %	10 %
Wholesale and Retail Trade; Repair of Motor Vehicles	22 %	21 %	21 %	20 %	13 %	13 %
Wood and Products of Wood and Cork	1 %	1 %	1 %	1 %	4 %	2 %

Table A3 Employees and managers' education

Sector	Share of graduated workers		Share of firms with graduated managers	
	2006	2018	2006	2018
Agriculture, Hunting, Forestry and Fishing	22 %	24 %	11 %	11 %
Arts, Entertainment, Recreation and Other Service Activities	13 %	25 %	8 %	19 %
Basic Metals and Fabricated Metal	9 %	15 %	4 %	7 %
Chemicals and Chemical Products	44 %	57 %	17 %	29 %
Coke, Refined Petroleum and Nuclear Fuel	30 %	51 %	17 %	27 %
Construction	10 %	13 %	8 %	10 %
Education	47 %	61 %	35 %	48 %
Electrical and Optical Equipment	35 %	42 %	13 %	24 %
Electricity, Gas and Water Supply	43 %	46 %	20 %	22 %
Food, Beverages and Tobacco	13 %	22 %	4 %	9 %
Health and Social Work	73 %	82 %	30 %	43 %
Hotels and Restaurants	7 %	15 %	3 %	7 %
Machinery, n.e.c	21 %	33 %	8 %	16 %
Manufacturing, n.e.c; Recycling	11 %	20 %	5 %	12 %
Mining and Quarrying	15 %	24 %	4 %	9 %
Other Non-Metallic Minerals	15 %	20 %	4 %	7 %
Post and Telecommunications	53 %	65 %	42 %	57 %
Pulp, Paper, Paper Products, Printing and Publishing	15 %	22 %	6 %	12 %
Real Estate Activities	27 %	39 %	20 %	29 %
Renting of M&Eq and Other Business Activities	48 %	60 %	36 %	47 %
Rubber and Plastics	30 %	37 %	8 %	12 %
Textiles, Wearing Apparel, Leather and Related Products	9 %	14 %	2 %	4 %
Transport Equipment	28 %	39 %	6 %	13 %
Transportation and Storage	6 %	12 %	2 %	6 %
Wholesale and Retail Trade; Repair of Motor Vehicles	14 %	21 %	8 %	14 %
Wood and Products of Wood and Cork	8 %	13 %	3 %	6 %

Table A4 **Percentage variation 2006–2018**

Sector	Employment	Value added	Exports
Agriculture, Hunting, Forestry and Fishing	975 %	844 %	691 %
Arts, Entertainment, Recreation and Other Service Activities	60 %	65 %	312 %
Basic Metals and Fabricated Metal	4 %	14 %	49 %
Chemicals and Chemical Products	3 %	-9 %	51 %
Coke, Refined Petroleum and Nuclear Fuel	116 %	895 %	4940 %
Construction	-32 %	-36 %	36 %
Education	42 %	66 %	187 %
Electrical and Optical Equipment	7 %	-12 %	30 %
Electricity, Gas and Water Supply	50 %	8 %	1175 %
Food, Beverages and Tobacco	10 %	8 %	99 %
Health and Social Work	34 %	23 %	459 %
Hotels and Restaurants	40 %	65 %	89 %
Machinery, n.e.c	5 %	26 %	64 %
Manufacturing, n.e.c; Recycling	10 %	29 %	83 %
Mining and Quarrying	-30 %	-40 %	5 %
Other Non-Metallic Minerals	-29 %	-21 %	25 %
Post and Telecommunications	66 %	-1 %	174 %
Pulp, Paper, Paper Products, Printing and Publishing	-20 %	4 %	0 %
Real Estate Activities	9 %	5 %	-52 %
Renting of M&Eq and Other Business Activities	38 %	51 %	243 %
Rubber and Plastics	16 %	48 %	104 %
Textiles, Wearing Apparel, Leather and Related Products	-16 %	4 %	20 %
Transport Equipment	17 %	36 %	71 %
Transportation and Storage	12 %	23 %	75 %
Wholesale and Retail Trade; Repair of Motor Vehicles	5 %	6 %	80 %
Wood and Products of Wood and Cork	-26 %	-14 %	-1 %

Table A5 **Variable's description**

Variable	Description	Source
Frontier	One if the firm is in the top decile of productivity in a given sector and year	SCIE
Firms' founders	Owners or employees classified in code 1 of the profession at one digit	QP
Start Educ	Average years of education of the founders at the year of the firm's birth	QP
Start HHI	Herfindahl–Hirschman Index computed at the sector and year level using sales data	QP
Start Flex	Flexibility index computed at the sector and year level using information on the share of workers not covered by a collective agreement, the share of overtime hours on total hours, the Kaitz index and the wage cushion	QP
Cohort	Categorical variable computed from firm's birth year (BY): 1, [1995,2001]; 2, [2002,2007]; 3, [2008,2013]; 4, [2014,2018]	QP

Paper 5
Infrastructure and territory: in the next ten years of public policy

Carlos Oliveira Cruz, Instituto Superior Técnico
João Fragoso Januário, Instituto Superior Técnico

5.1. Introduction

Historically, many governments have used infrastructure spending as a short-term strategy to unlock economic growth and social development (Aschauer, 1989; Munnell, 1991). But different types of infrastructure have had different impacts and generated different perceptions on the potential economic benefit of infrastructure spending. Social infrastructures, such as hospitals, schools or water-supply networks, provide the underlying infrastructural layer that supports basic human needs and frequently generate public consensus about government spending (Familoni, 2006).

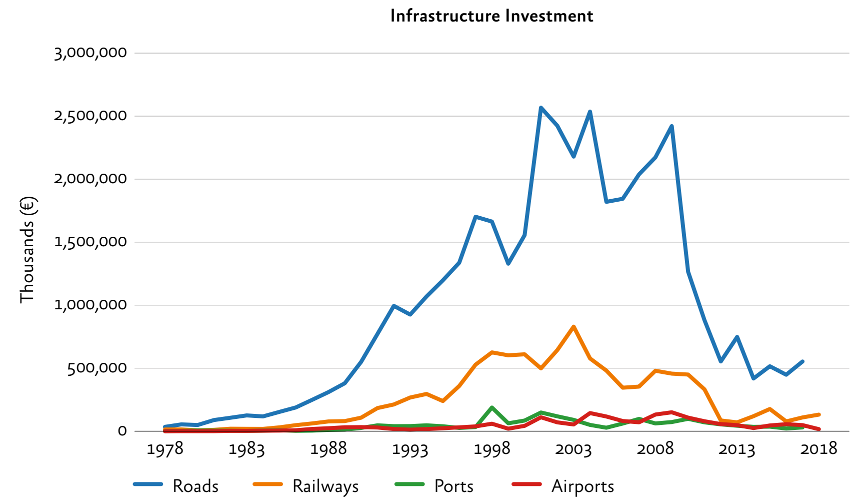
Transport and communication infrastructure represent different forms of infrastructure. Transport infrastructure provides access to services and facilitates economic trade and the delivery of production inputs (e.g., labour and materials). This type of infrastructure requires significant public investment, and the optimal level of expenditure is far from consensual. Whilst there is considerable debate on the pros and cons of using infrastructure spending to leverage growth, some authors argue that infrastructure stock is not the best predictor for economic growth in the case of Europe — where most countries are above the minimum threshold required for infrastructure to facilitate economic activity, (see, for instance, Crescenzi and Rodríguez-Pose, 2012) and, instead, advocate for investment in innovation and human capital.

Nevertheless, the political goal of fostering economic growth and productivity while simultaneously improving territorial cohesion has prompted many governments to expand and build large transport infrastructure networks: essentially road networks and railways. This was the case in Portugal, particularly between 1990 and 2010, targeting a specific type of infrastructure: motorways. Choosing motorways as a preferred transport investment is not unique to Portugal, and has been well documented in the literature, given the overall public impact of these projects when compared, for example, to ports or other lower-profile projects (e.g., secondary roads or railway accesses to ports). Rodriguez-Pose et al. (2018) have referred to this phenomenon as the *thirst for prestige transport infrastructure*.

Portugal has experienced significant investment in infrastructure since the 1990s, when the country had a significant deficit in basic infrastructure (figure 1). In the late 1980s and, mainly, during the 1990s, there was political consensus on the need to invest in infrastructure. Several large-scale projects were executed, such as the flagship project Vasco da Gama Bridge (at the time the longest concrete bridge in Europe and the first public-private partnership carried out in Portugal), the light rail transit (LRT) system in the city of Porto (at the time the largest greenfield LRT under construction), and the Expo'98 with all its associated projects (e.g., the Lisbon-Oriente station and the red line of the Lisbon Metro network). During this period, economic growth rates averaged between 2 and 4 %, with a prospering construction sector and low unemployment rates, which certainly played a role in the economic growth.

During the same period, the motorisation rate also grew significantly. In 1990, Portugal (PT) had a motorisation rate of 185.2 vehicles per 1000 inhabitants (the EU-wide average was 341.3); in 2010, PT had an average rate of 443.8, against 482.2 in the EU; and in 2018, an average rate of 513.7, against 530.1 in the EU. The combination of a growing motorisation rate and the search for a *prestige infrastructure* (as presented by Rodríguez-Pose et al., 2018) led politicians to prioritise the investment in roads, particularly motorways.

Figure 1 Evolution of public investment (per transport mode: roads, airports, ports, railways)



Source: Marvão Pereira; Current Prices

From 1990 to 2010, the density of the Portuguese motorway network increased from 3.4 to 28.4 km per 1000 km², while the average EU density increased from 9.7 to 15 km per 1000 km² (Cruz, 2018). Conversely, the density of the Portuguese rail network decreased by political decision, since railway lines were closed, mostly those with lower levels of demand, to reduce the overall costs of the railway system. For this reason, the development in urban transit was limited when compared to similar European countries.

Two instruments were critical to this wave of infrastructure construction: EU funds and public-private partnerships (PPP). Between 1985 and 2015, the EU structural funds provided the much-needed financial leverage for countries to upgrade their infrastructure (Medeiros, 2014; Kelly et al., 2015). Portugal received between three and five billion euros per year between 1989 and 2020 (Pires, 2017). In order to close the financing gap and bypass budgetary deficit limits, the Portuguese government structured most of the investment in the road system under PPP agreements, which also made it possible to accelerate the delivery of infrastructure (Cruz and Sarmento, 2018). However, this investment led to a future heavy financial burden (approx. 0.7 % of the GDP), increased by optimistic traffic forecasts (to be discussed in section 5).

The main goal of this policy paper is to base the discussion on transport policy performance on historical data — from a perspective of facilitating trade and movements and lowering logistical costs —, and help define the medium-term priorities for improving the effectiveness and efficiency of the transport system. This paper does not intend to analyse the optimal infrastructure spending, nor the magnitude or potential effects of fiscal multipliers or transport spending elasticities. Our aim is to target the improvement of the investment performance in transport infrastructure by adopting a more microeconomic perspective that identifies potential bottlenecks (physical or logical), as well as strategic investment and policy priorities. The discussion around infrastructure development is usually centred on the investment volume. This is a narrow perspective, and we aim to push the discussion forward. Our approach will focus on the accessibility levels (at the municipal scale) provided by the growing infrastructure development. Ultimately, the economic impact should derive from the (improved) service delivered by the new infrastructure. The study will not adopt an *a priori* judgement of policy options. Our goal is to identify potential competitive advantages and infrastructure-related bottlenecks and barriers to the internationalisation and competitiveness of Portuguese enterprises from a medium-term perspective.

The analysis will follow a top-down approach, beginning with the connectivity to international markets and supply chains and evolving towards the local impact of the transport system (at the municipal level), and is based on a mix of publicly available aggregated data and more detailed transport data provided by us, the authors[67].

The paper is organised around five main research questions, addressed in sections 2 to 5:

- section 2: Is Portugal internationally well connected?
- section 3: Does Portugal have the *right* infrastructure?
- section 4: Has infrastructure investment improved cohesion and promoted economic growth?
- section 5: Does Portugal have a proper institutional setting to develop the *right* infrastructure?

Throughout the chapters, there will be a concern with establishing policy orientations for infrastructure development for the next ten years. These recommendations will be organised and summarised in the final section (section 6): "The next ten years of infrastructure policy".

5.2. Is Portugal internationally well connected?

5.2.1. Air and maritime connectivity

Numerous empirical studies provide evidence of the relationship between exports (gross exports and value-added exports) and the quality of infrastructure and logistics (e.g., Bensassi et al., 2015;

Botasso et al., 2018). Physical international connections are guaranteed by all four main transport modes: air, maritime, road and railway. The first two modes — air and maritime — depend on nodal infrastructure — airports and ports — which provide the air/sea interface with land transport and, therefore, are or should be connected with the overall road and railway infrastructure to ensure capillarity and connection with the hinterland.

Connectivity to international markets is a crucial aspect. As argued by Gerefii et al. (2006), the governance of value chains and the organisation of logistics networks require rapid, reliable and resilient distribution networks. For a small country like Portugal, the ability to have physical (and digital) connectivity to global value chains is crucial, considering its physical distance from the economic and populational epicentre of Europe and from other world economic hubs. Here, maritime and air transport connectivity play a pivotal role. To the authors' knowledge, there is little evidence (scientific or otherwise) on the analysis of 'Portugal's connectivity to international markets.

Port and airport infrastructure provide the necessary handling of cargo, legal and administrative functions to ensure that logistics operators (one-stop-shop integrators and/or mode-specific integrators) can operate and establish their supply networks. The level of the services offered by these types of infrastructure should be measured in terms of network connectivity — i.e., connections to other markets. This is different from the road and railway infrastructure assessment, where the network density is the critical factor. The ability to establish continental logistics networks depends on the capacity of having roads and railways in which to operate.

These international networks provided by air and maritime transport are crucial. An analysis of 'Portugal's ten largest export companies[68] shows that they are very much focused on the automotive industry, which heavily depends on ports[69]. Indeed, more than half of the Portuguese exports use maritime transport.

A recent study (Park, 2020) argues that countries can gain significant comparative advantages from the quality of their transport infrastructure and logistics. The author argues that the *emergence and proliferation* of Global Value Chains (GVCs) changed the organisation of the production and distribution of goods, highlighting the importance of efficient and effective transport systems.

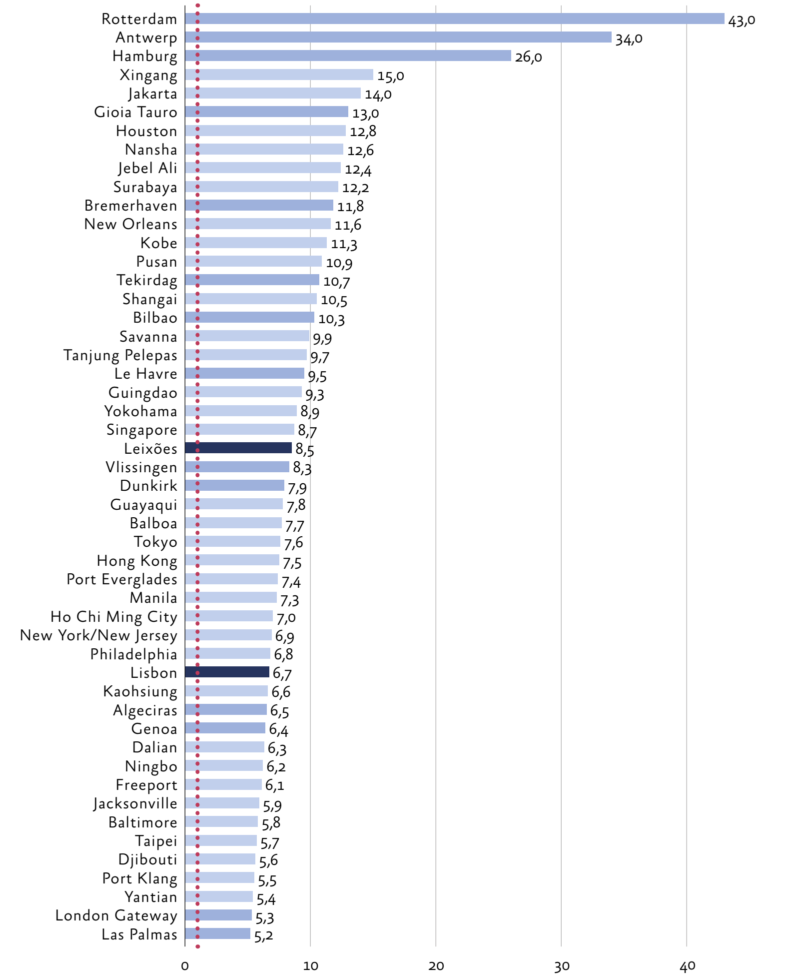
Portugal has five main ports — Leixões, Aveiro, Lisbon, Setúbal and Sines — which are managed according to a landlord port model, where a 100 % publicly owned entity manages the port area (the landlord) and several private terminal operators, who are responsible for cargo handling and operate under concession agreements (typically 20 to 30-year agreements). Normally, the connectivity of a port with other ports is measured using the *node betweenness* variable, which shows the relative importance of the port as a connection point between other ports, and registers the number of times a certain port is on the shortest path between two other ports (UNCTAD, 2020). The advantage of direct connections is that they show how interconnected the port is within the main maritime flows.

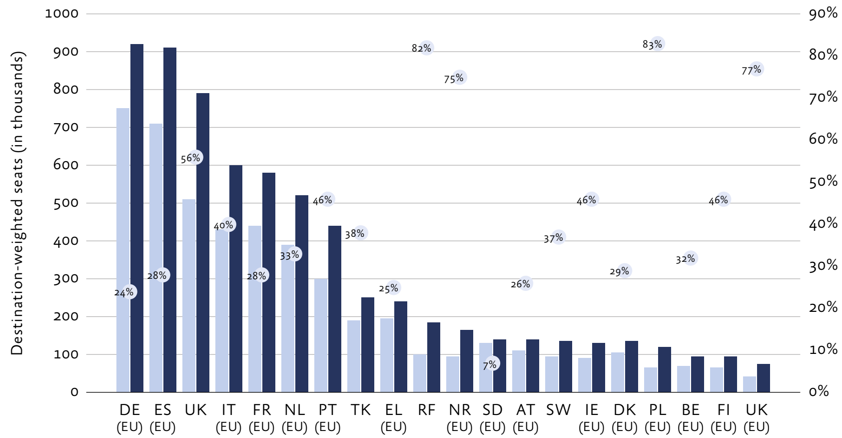
In terms of port betweenness, the ports of Leixões and Lisbon come in 24th and 36th place amongst the most important ports in the world. One can expect a higher betweenness value for ports located in larger economies. After adjusting for GDP, Leixões and Lisbon move up to the 7th and 10th positions worldwide and 2nd and 3rd positions in Europe, respectively. Relative to the size of the country's economy, Portugal has significant port connectivity. These figures are not surprising considering that Portugal is located in the intersection of the main international maritime corridors (e.g., South America — Europe; Mediterranean routes; North America — Mediterranean, figure 2a). Although Sines does not rank high in terms of betweenness, it is the largest Portuguese port (15th in Europe in number of TEUs, with over 1.7 million) and was the fastest-growing port in Europe (291.5 %) between 2011 and 2018.

The same pattern can be observed in the air transport market. Air transport plays a crucial role in a geographically peripheral country such as Portugal, as it is the main gateway for tourism and international connections. Many studies have analysed the correlation between air transport and economic activity. The most common indicator for measuring air connectivity is the number of destinations and the number of seats offered for each destination. Using data from 2019, provided by the International Air Transport Association (IATA), Portugal is the 10th most connected country in Europe and the 6th when accounting only for EU countries (figure 2b). As mentioned above, given that air transport is frequently used as a proxy for economic activity, when one standardises air transport connectivity per GDP, Portugal ranks 4th behind three island nations (Iceland, Cyprus and Malta), which, for obvious reasons, heavily depend on air travel. Mainland Portugal has three main airports, Lisbon, Porto and Faro, which handled approximately 31, 13 and 9 million passengers, respectively, in 2019. These airports were privatised to Vinci in 2012, under a 50-year concession agreement (for more information, see Cruz and Sarmento, 2017).

Figure 2 Maritime and air transport connectivity

a) Port betweenness in 2020 (average represents the entire sample: + 300 ports)





Source: IATA, 2020

5.2.2. Logistics performance

The overall good connectivity in terms of international shipments is visible in the logistics index (World Bank LPI database, 2018), where Portugal ranks 7th. The logistics index weights six critical factors for effective logistics, namely: customs, infrastructure, international shipments, logistics competence, tracking and tracing and timeliness. Among these, Portugal ranks the worst in customs, a government function (see table 1).

In 2007, Portugal ranked 28th. Despite an overall improvement in the Logistics Index, from 28th to 23rd, between 2007 and 2019, there are two criteria where Portugal systematically underperformed: customs and infrastructure. Customs are a critical government function, operated by several specific government bodies (in this case, the Portuguese tax and customs authority, the *Autoridade Tributária e Aduaneira,* and the border security authority, the *Serviço de Estrangeiros e Fronteiras*), which cover all functions related with the administrative, legal and fiscal control of cargo for exports and imports. As with many other public bodies, there is a public perception of understaffing and excessively bureaucratic processes, with little automation and digitalisation, with things very much based on *papers and stamps*. As is the case of most value chains, a system's capacity is determined by its weakest link. The efforts towards improving port efficiency, both on the *sea side*[70] and on the *land side*, which typically require large investments, can be jeopardised. Anecdotal evidence of the type of bottlenecks that exist in customs services is the fact that, for example, in Sines (the largest container Port in Portugal), the customs have a rigid 5-day working week, with no night shifts. In contrast, the container terminals and the rail and road operators work under a 24/7 clock system. Regardless of the increase in the capacity and operational efficiency of the loading and unloading of cargo, there is an administrative bottleneck in the customs services. This bottleneck has been extensively documented, discussed by stakeholders, and acknowledged by the Port Authority in its Strategic Master Plan (Universidade Católica Portuguesa and Administração do Porto de Sines, 2020). However, the problems remain and affect all major ports.

With regard to the second bottleneck — infrastructure — both the public and the private sector have direct responsibility for investments in different subsystems. As mentioned above, the port system operates under a *landlord* model. The public sector is responsible for the investment on the *sea side*, i.e., navigation systems and canals, and accessibility by land (road and rail). The private sector is responsible for building and upgrading the terminals within the port area.

The investments must follow an approved investment plan, and large investments are still subject to the supervision and approval of the Port Authority (the landlord). Therefore, the government plays a fundamental role in direct investments in port accessibilities. Indirectly, the state has to monitor if the private sector is fulfilling its investment commitments and streamline the approval process.

Table 1 International Logistics Performance Index

Country	LPI Rank	LPI Score	Customs	Customs	Infrastructure	Infrastructure	International shipments	International shipments	Logistics competence	Logistics competence	Tracking & tracing	Tracking & tracing	Timeliness	Timeliness
Germany [EU]	1	4.20	1	4.09	1	4.37	4	3.86	1	4.31	2	4.24	3	4.39
Sweden [EU]	2	4.05	2	4.05	3	4.24	2	3.92	10	3.98	17	3.88	7	4.28
Belgium [EU]	3	4.04	14	3.66	14	3.98	1	3.99	2	4.13	9	4.05	1	4.41
Austria [EU]	4	4.03	12	3.71	5	4.18	3	3.88	6	4.08	7	4.09	12	4.25
Japan	5	4.03	3	3.99	2	4.25	14	3.59	4	4.09	10	4.05	10	4.25
Netherlands [EU]	6	4.02	5	3.92	4	4.21	11	3.68	5	4.09	11	4.02	11	4.25
Singapore	7	4.00	6	3.89	6	4.06	15	3.58	3	4.10	8	4.08	6	4.32
Denmark [EU]	8	3.99	4	3.92	17	3.96	19	3.53	9	4.01	3	4.18	2	4.41
United Kingdom	9	3.99	11	3.77	8	4.03	13	3.67	7	4.05	4	4.11	5	4.33
Finland [EU]	10	3.97	8	3.82	11	4.00	16	3.56	15	3.89	1	4.32	8	4.28
United Arab Em.	11	3.96	15	3.63	10	4.02	5	3.85	13	3.92	13	3.96	4	4.38
Hong Kong	12	3.92	9	3.81	15	3.97	8	3.77	12	3.93	15	3.92	15	4.14
Switzerland	13	3.90	16	3.63	9	4.02	20	3.51	11	3.97	5	4.10	13	4.24
United States	14	3.89	10	3.78	7	4.05	23	3.51	16	3.87	6	4.09	19	4.08
New Zealand	15	3.88	13	3.71	13	3.99	27	3.43	8	4.02	16	3.92	9	4.26
France [EU]	16	3.84	19	3.59	12	4.00	17	3.55	17	3.84	12	4.00	14	4.15
Spain [EU]	17	3.83	17	3.62	19	3.84	6	3.83	18	3.80	19	3.83	20	4.06
Australia	18	3.75	7	3.87	16	3.97	40	3.25	21	3.71	20	3.82	21	3.98
Italy [EU]	19	3.74	23	3.47	18	3.85	21	3.51	24	3.66	18	3.85	17	4.13
Canada	20	3.73	18	3.60	21	3.75	30	3.38	14	3.90	21	3.81	22	3.96
Norway	21	3.70	21	3.52	24	3.69	26	3.43	23	3.69	14	3.94	24	3.94
Czech Republic [EU]	22	3.68	30	3.29	26	3.46	10	3.75	20	3.72	24	3.70	16	4.13
Portugal	**23**	**3.64**	**35**	**3.17**	**32**	**3.25**	**7**	**3.83**	**22**	**3.71**	**23**	**3.72**	**18**	**4.13**

Source: World Bank LPI database[71]

5.2.3. Main findings

Relative to the size of its economy, Portugal compares well in terms of air and maritime connectivity. These transport systems are critical for two of the most important exports industrial sectors: tourism (highly dependent on air transport) and the automotive industry (highly dependent on maritime transport). These connections are established in a context of competitive markets (both the air and maritime transport markets are highly competitive) and provide a fundamental logistics layer for 'Portugal's exports and economic activity. Thus, it is important to ensure that potential bottlenecks are resolved, particularly those pertaining to customs effectiveness and efficiency.

Another bottleneck identified in the logistics index is related to infrastructure. In effect, both systems (ports and airports) suffer from capacity problems.

The airport systems suffer from severe capacity problems (pre-pandemic period), particularly Lisbon's airport. The construction of a new airport in Lisbon has been discussed since the 1970s, and over the last two decades, there have been several alternative decisions regarding its location[72]. Following the privatisation of ANA in 2012, the concessionaire proposed the use of an existing military base in the south bank of the Tagus River (Montijo) while maintaining the existing airport (operating in a dual-airport model), which would reduce the volume of investment in the new airport. However, in 2021, following opposition from municipalities in the south bank, the government reopened the discussion of the airport location, comparing two alternatives: Montijo and Alcochete.

The same capacity constraints are visible in Ports. As discussed in section 2.2., logistical infrastructure is underperforming in Portugal. The government has planned several investments to increase the capacity of the existing ports, such as a new container Terminal in Sines (Vasco da Gama terminal). However, these plans have been delayed and are now temporarily suspended due to the pandemic (as of April 2021).

Nevertheless, we should expect a significant amount of investment in the port and airport sectors in the next decade (with the construction of the second airport in Lisbon and expansions in the airports of Porto and Faro). The difference between airports and ports when compared, for example, with railways, is that they operate under concession agreements and, therefore, investment in these sectors should be mostly (if not entirely) leveraged by the private sector.

5.3. Does Portugal have the *right* infrastructure?

The investments made over the last three decades have created an infrastructure stock that provides the basis for the structuring and operation of logistics networks and the movement of people. In the case of air and maritime transport, described in the preceding section (section 2), the connectivity and the accessibility are primarily dependent on the organisation of the networks (air and maritime transport connections ensured by privately held companies), while the nodal infrastructure (ports and airports) provide an interface with land transport. In the case of land transport — via road and railways — the connectivity and accessibility derive directly from the extension and the density of the network. The longer the network, the higher the levels of accessibility. While, from a macro perspective, the analyses tend to focus on the overall value of investment capital in infrastructure, the different mix of networks (road vs railways) leads to different options in terms of logistics chains and individual choices of mobility and travel. This chapter aims to analyse the infrastructure mix in a critical light and understand whether the existing stock will contribute to addressing the system's main infrastructure challenges, namely, tackling climate change, promoting economic trade and decreasing context costs.

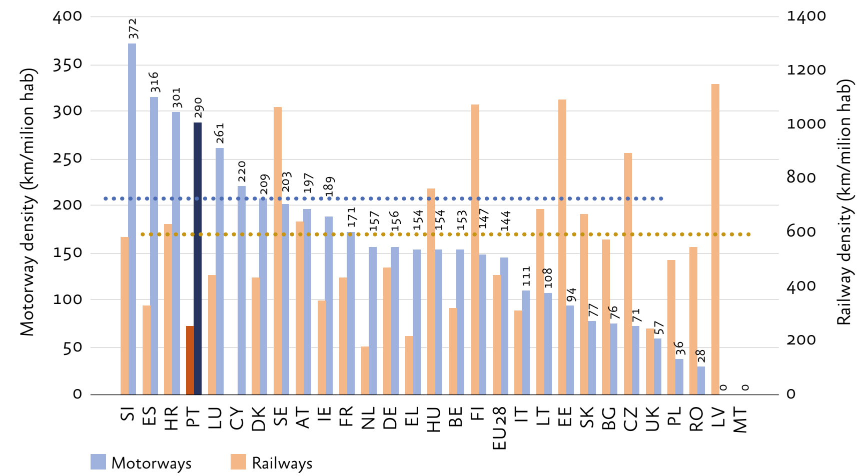
5.3.1. Roads and railway infrastructure

The infrastructure investment described above brought about the rapid physical development of the Portuguese road network. From the early 1990s to 2011, the road network increased six times, recording the fastest growth in the EU. Figure 3a presents the density of motorway and railway networks in EU countries in 2018 (in km per million inhabitants). Portugal ranks fourth in terms of motorway network density, behind Slovenia, Spain and Hungary. The national density of approximately 290 km of motorway (MW) per million inhabitants is more than twice the EU-28 average (144 km MW per million inhabitants).

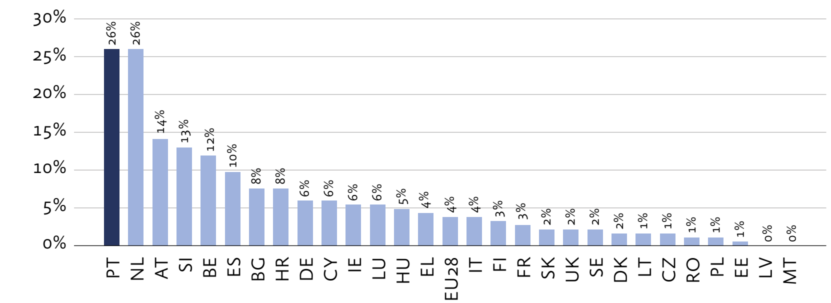
On the other hand, Portugal had a rail density of 248 km per million inhabitants, compared with the EU average of 526.8 km per million inhabitants. Only two countries have more motorway than railway density — Portugal and Cyprus. On average, EU countries have railway networks 4.9 times denser than motorway networks. Even when comparing the density of motorways with other roads, the Portuguese system is disproportional, with 26 % of its main road system being motorways, compared to the EU average of 7 % (figure 3b). Although the density of secondary roads is lower, the capacity of the Portuguese motorway system is far higher than its potential utilisation. However, the number of *passenger.km*[73] per km of motorway is significantly lower than the EU-28 average. In Portugal, there were around 27.400 *passenger.km*/km of motorway in 2018, compared to an average of 63.800 in the EU-28 (figure 3c). Countries such as the United Kingdom, Poland and Romania present much higher figures:170.000, 156.000 and 146.000, respectively. Only Spain and Cyprus have lower numbers than Portugal, with 21.500 and 23.000 *passenger.km*/km of motorway, respectively.

Figure 3 Benchmark of road and rail networks

a. Motorway and network density (km of motorway/million inhabitants) in 2018

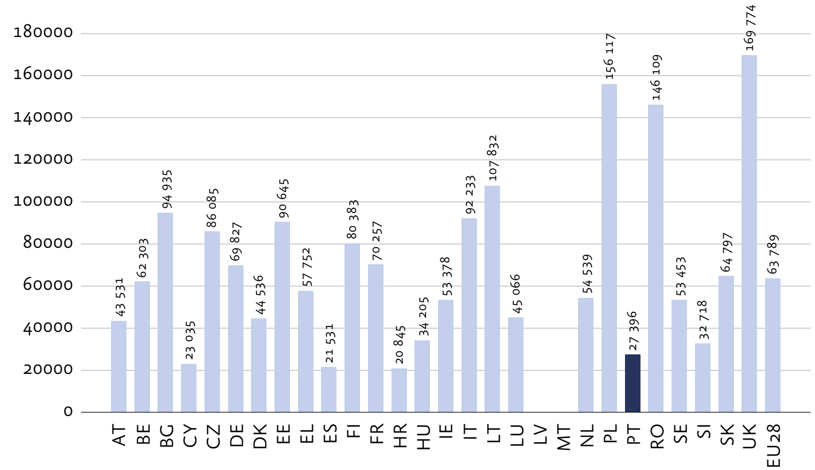


b. Percentage of motorways in the road system in 2018

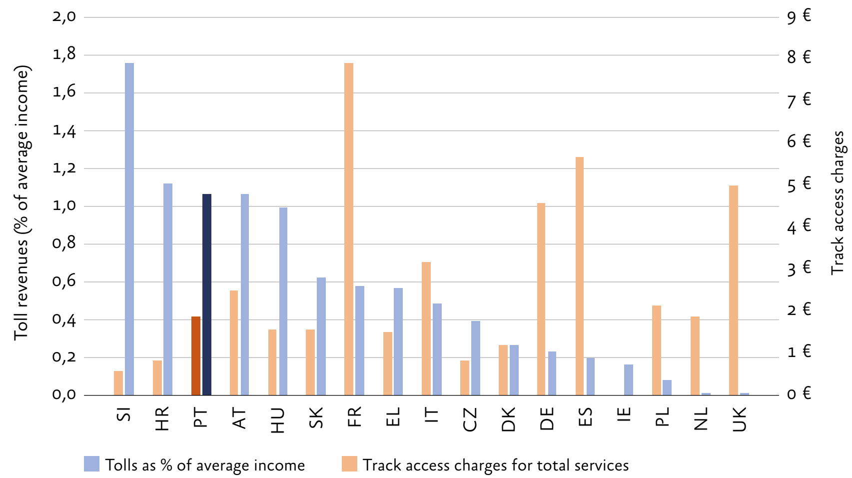


Source: European Union Road Federation
Note: figure 3b) left axis: toll revenue per inhabitant in relation to average income; right axis: railway track access charges
Note: Countries: AT — Austria; BE — Belgium, de – Germany; DK — Denmark; EL — Greece; ES — Spain; FI — Finland; FR — France; IE — Ireland; IT — Italy; LU — Luxembourg; NL — Netherlands; PT — Portugal; SE — Sweden; UK — United Kingdom; BG — Bulgaria; CY — Cyprus; CZ — Czech Republic; EE — Estonia; HR — Croatia; HU — Hungary; LT — Lithuania; LV — Latvia; MT — Malta; PL — Poland; RO — Romania; SI — Slovenia; SK — Slovakia

c. Average levels of utilisation of motorways in EU countries, in 2017;
Passenger.km in private cars per km of motorway



d. Toll revenues in 2018



The utilisation costs differ significantly between railway and motorway systems. In the railway system, Portugal has an average access charge of 1.83 euros/km, compared to the EU average of 2.65 euros/km (figure 3b; right *yy* axis). However, the density of the Portuguese railway network is also only half of the EU average density.

For the motorway system, the opposite is the case. In 2018, Portugal generated a toll revenue of 1.114 billion euros, which amounts to approx. 108 euros per year, per inhabitant. This is approx. 1 % of the average income, against the average of 0.35 % in the analysed sample of European countries. Only Slovenia and Croatia report higher values than Portugal. However, it should be noted that in many countries, there is a payment of *tolls* in the form of *stickers/vignettes* for goods vehicles that cross those countries, which also ends up affecting companies not located in such countries (a share of the toll revenue arises from crossings and not from local origin/destination traffic).

Portugal has the largest share of toll revenues per inhabitant as a percentage of the average annual net wage of the countries in the Mediterranean region. In addition to the tolls, private concessionaires have also benefited from direct government payments totalling 1.129 billion euros arising from availability schemes and compensations due to, among others, renegotiations. Between governments and user payments, the motorway system has collected almost 2.243 billion euros, representing a total cost of approx. 850.000 euros per year, per km of motorway. The overall cost is higher because there are other revenue sources, particularly from fuel taxes, which are allocated to the state-owned infrastructure management authority, the *Infraestruturas de Portugal*. Unfortunately, this information is not available for all countries, so it is not possible to present a benchmark figure.

The network growth also created an additional cost concerning the maintenance of the motorway system. Typically, maintenance can account for an annual average cost of around 80.000 to 90.000 euros/km. This represents an annual cost of over 250 million euros.

Besides the fact that the average cost of utilisation is higher than usual, there is also an unreasonable structural economic burden on those who are paying for the system. From an economic perspective, the optimal toll price level should be related to the level of traffic congestion.
A motorway in free flow, i.e., one that is not congested, is a semi-public asset: the *consumption* of a unit (flow) does not limit the consumption by other users but is subject to a price (the amount of the toll). However, congestion conditions give rise to rivalry in consumption. For each additional vehicle on the road, one (or more) vehicles are prevented from driving under normal conditions. The motorway behaves similarly to a private asset, as there is rivalry and exclusion in consumption. Therefore, in the case of private assets, the laws of supply and demand should apply. This means that if the system was replaced by a free flow regime, the toll price should rise in order to exclude all those whose marginal utility is lower than the toll price (for more information, see Button, 2010). Strictly speaking, in this case, the formulation of the toll price should include the marginal costs imposed on the remaining users or the negative externalities generated.

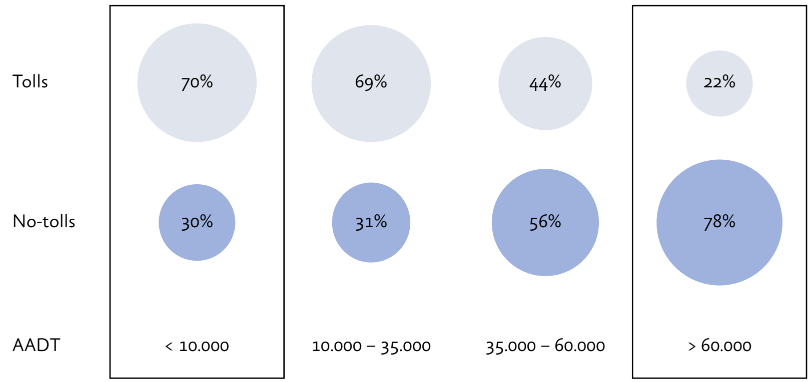
The toll pricing principle in Portugal, however, is quite the opposite. Figure 4 presents the percentage of motorway length per volume of traffic[74] and the existence (or not) of tolls. With an average traffic above 60,000 vehicles per day, it is very likely that the road sections in question exhibit congestion during some periods of the day, typically, the peak hours. The road sections with such volume of traffic are essentially located in the two main metropolitan areas (Lisbon and Porto) and on the main arterial motorways (e.g., bridges connecting the south and north riverbanks in both metropolitan areas). Among them, only 22 % have tolls.

Furthermore, 70 % of the road sections with the lowest traffic level, defined below as having an average traffic of 10,000 vehicles per day[75], have tolls. There is a cross-subsidisation from users in underutilised roads, which are below the optimal level of traffic, to those in congested roads, which are well above the Pareto optimality in terms of traffic volume. The obvious economic incoherence of this distribution also raises equity issues. As mentioned above, all congested road sections are located in the main metropolitan areas, which offer available alternatives such as public transport (railways, metros and buses). The same does not necessarily apply to most non-coastal regions, where the motorways are the backbone of the mobility service, and there are no reasonable mobility alternatives provided (in terms of cost and service availability).

Several political and equity considerations can arise in light of these observations. There is a clear inequity between the rural population in inland Portugal, and in the population of large urban areas, with the former subsidising the road systems of the latter. Additionally, as a typical result of larger concentrations and densities, urban areas concentrate most of the public transport supply (e.g., buses, metros, railway services), which is critical for the provision of mass transit solutions. However, public transport is highly subsidised, which creates an additional layer of inequity.

Although it is not the purpose of this paper, it is important to mention that the social tensions arising from these types of inequities between rural and urban regions can have strong political implications, with discontent shown in the ballot box, giving rise to the growth of populist and anti-system parties, as well as social unrest (as shown by the recent case of the *gilet jaunes* in France)

Figure 4 Comparison of motorway sections with and without tolls, by level of traffic, measured as annual average daily traffic (AADT) — 2017.



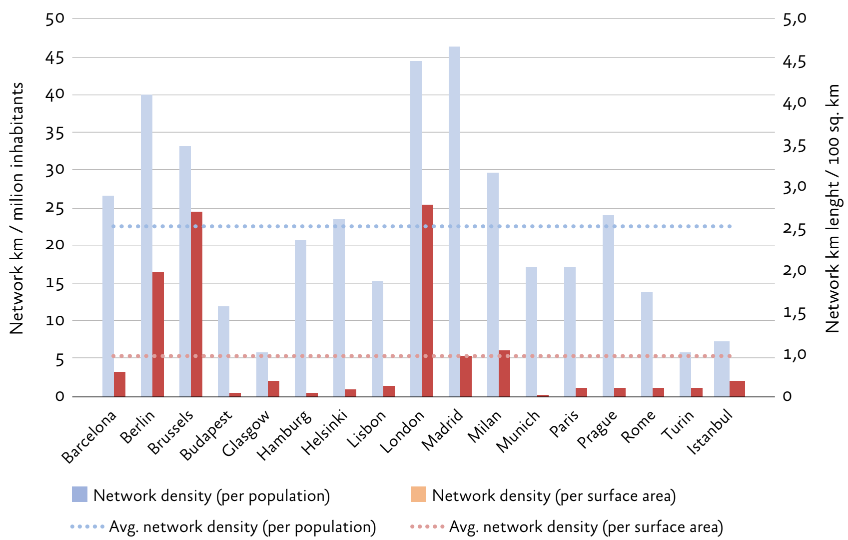
Source: adapted from Cruz, 2018

5.3.2. Urban transit infrastructure

Urban transit infrastructure plays a central role in the promotion of more sustainable transport solutions. As mentioned above, Portugal's transport sector is responsible for one-quarter of the total CO_2 emissions. Any significant reduction will have to involve the management of mobility in metropolitan areas, which account for the largest travel share. The investment in the expansion of urban transit systems, particularly metro systems, has been modest compared to the investment in the road sector. The density of the metro network in the main cities (Lisbon and Porto) has seen limited development when compared to similar European cities. Lisbon and Porto have 1.48 km and 3.28 km per 1000 km^2, respectively, against an average of 5.15 km per 1000 km^2 in the EU (figure 5). In terms of economic growth, social development and increased motorisation rates, the political response in Portugal was *all-in* for road-based mobility. The change in mobility patterns has led to a change in the modal split, increasing the share of individual transport (IT) and reducing the share of collective transport. The trend in most large European conurbations, and the basic recommendations for good urban governance, tend precisely towards the opposite direction. Despite the public investment to improve the public transport system, the system is not yet able to leverage the change in the urban mobility paradigm and offer a real alternative to the use of IT.

This is particularly alarming given the extraordinary growth of private car utilisation in Portugal, mostly in large metropolitan areas. In 2001, in Lisbon, the modal share of private transport (individual vehicles) was 39 %, and the modal share of public transport was 34 %. In 2017, the share of private transport rose even further to 58.9 %, and the share of public transport decreased to 15.8 %. The overwhelming majority of the Lisbon Metropolitan Area Municipalities have private transport shares above 50 %.

Figure 5 **Density of metro systems**



Source: INE

5.3.3. NGA networks

Next Generation Access (NGA) networks[76] are essential for the integrated development of the European Union as recognised by the Digital Single Market Strategy (DSM) 2014 –2019. As stated in the DSM, EU Member States should ensure that consumers can access services and communicate effectively, no matter where they are in Europe. Hence, good quality access to the Internet can also be vital to foster the development of the business environment.

According to ANACOM data, coverage by NGA networks was below 1 % of the territory in 35.32 % of all Portuguese civil parishes (figure 6a). Accordingly, despite the efforts, in recent years, to increase the national coverage, there is still room for improvement. According to EC data, THE overall NGA coverage of the Portuguese territory (83 %) is slightly below the EU-28 average (85,8 %). Despite being a frontrunner of NGA network adoption in the early 2010s, the growth rate stagnated after 2013, leaving Portugal below the European average. Since 2016, the country has made an effort to converge with its European counterparts[77] (see figure 6b).

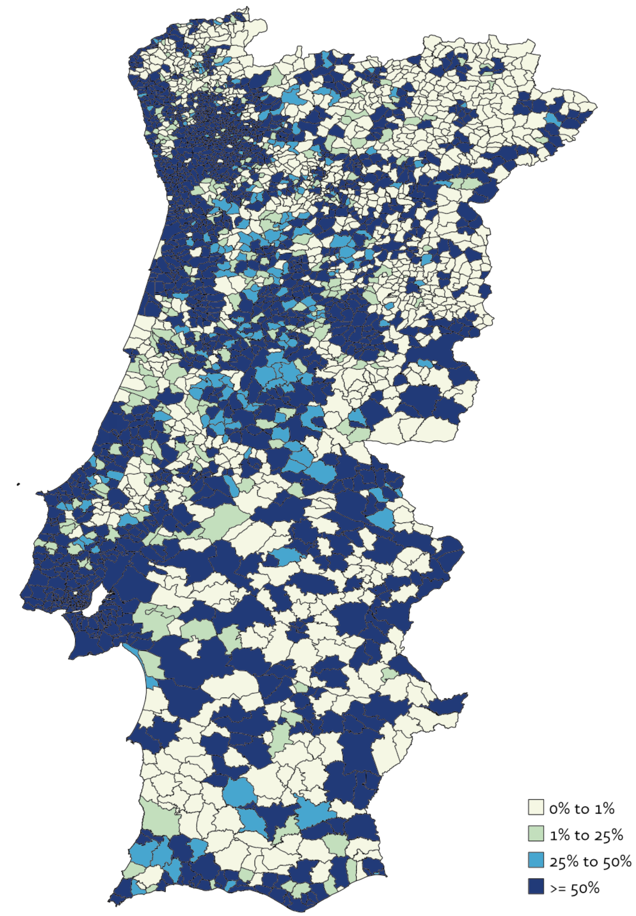
By the end of 2020[78], 72 % of the Portuguese households had access to a broadband Internet connection (FTTH[79] and HFC[80]), showing a positive trend when compared to the 22.6 % registered in the last quarter of 2011. The regions with the highest penetration rates were the Lisbon Metropolitan Area, Azores and Madeira. Nevertheless, the remaining regions have recently registered an increased adoption of broadband connections, moving in the direction of more robust national cohesion.

Using the EC analysis on broadband prices, Portugal shows an average price for fixed broadband connections 12.7 % higher than the EU average and a 23.6 % higher price for mobile broadband. Only two fixed broadband products are cheaper in Portugal (products with > 200 Mbps and 100/100 Mbps speeds, figure 6c). As far as mobile broadband products are concerned, all of them are more expensive in Portugal (figure 6d).

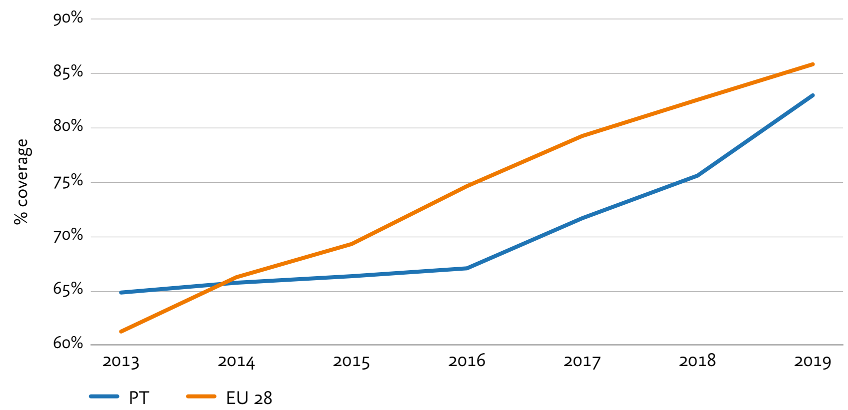
These prices represent additional costs, and have a negative effect on the overall efficiency and competitiveness of the Portuguese economy. Additionally, this fact is also particularly relevant for the growth of inequality in the Portuguese territory. Typically, the regions with lower fixed broadband coverage also have lower urban densities, productivity and income. Telecom operators tend to invest less in those regions, given the lower expected economic return on the invested capital. The alternative — mobile broadband — comes at a significantly higher cost, creating an additional burden. This inequality in access to affordable broadband telecommunications became particularly visible in the context of the COVID-19 pandemic lockdown, with the transition towards fully online education, remote working and a greater reliance on e-shopping.

Figure 6 **Analysis of NGA network coverage and prices in Portugal**

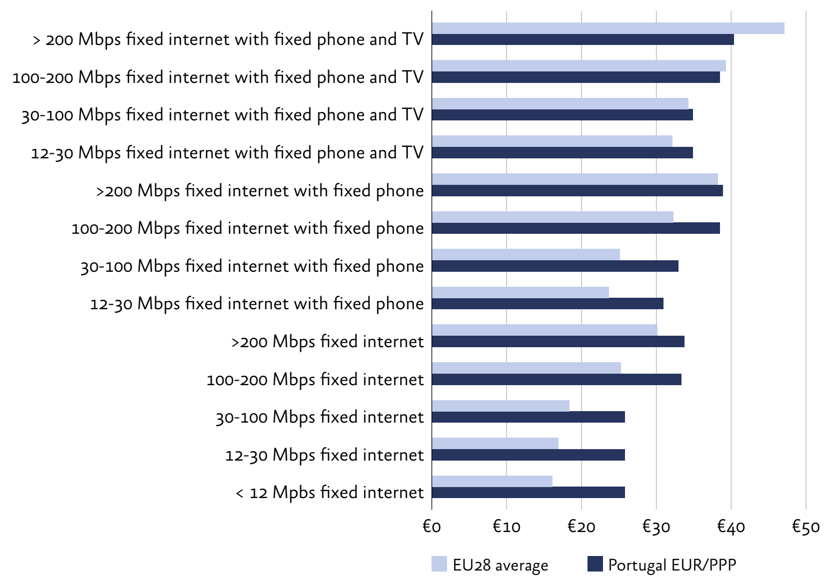
a. National NGA network coverage



b. Overall NGA coverage (%)

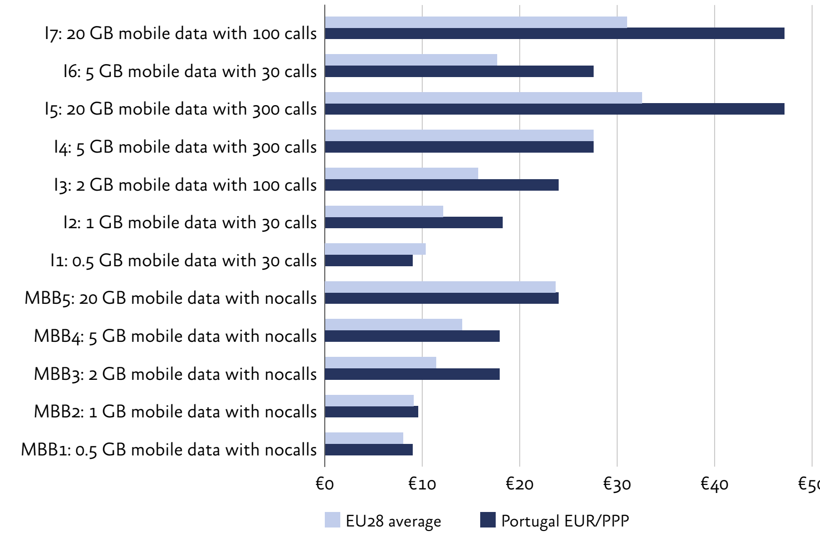


c. Usage baskets for fixed broadband: Least expensive offers



Source: European Commission

d. Prices for mobile broadband usage baskets: Least expensive offers



Sources: European Commission, 2020; ANACOM database; 'authors' analysis

5.3.4. Main findings

As shown in the previous sections, although Portugal has made significant investments in transport infrastructure, the existing stock is not adequate to improve the environmental performance of the transport sector, reduce CO_2 emissions and contribute to achieving the goals of the Paris Agreement. Portugal needs to invest and increase the density of its urban metro networks and railway system. Moreover, the road sector, particularly with regard to its excess capacity, does not have an economically efficient pricing policy. The large majority of the network in a situation of excess is overpricing users, whereas the road sections experiencing significant congestion, in the largest metropolitan areas are toll-free, despite the higher availability of public transport alternatives.

The unbalanced transport infrastructure is exacerbating the asymmetries between coastal and inland areas, and, particularly, between the metropolitan areas and the rest of the country. Metropolitan areas, despite their higher concentration of public transport and better Internet access, concentrate most non-tolled road sections. Non-metropolitan areas, and, particularly, inland areas, face additional Internet access costs and are directly subsidising transportation in metropolitan areas.

Furthermore, to ensure a more environmentally balanced modal shift, it will be necessary to increase the urban transit networks in metropolitan areas, which are currently contributing to territorial asymmetry and creating social and political discontent.

In order to advance towards a sustainable transport system and mitigate the social inequalities the current system is creating, it will be necessary to move from a concession-based toll mechanism (where tolls are designed to finance the infrastructure) towards a network-based toll mechanism that is aligned with the pricing of externalities and capable of stimulating sustainable transport behaviours. The existing concessions are a rigid barrier to this change, as far as the pricing paradigm is concerned. However, we have identified two opportunities: 1) many concessions have moved from actual tolls to availability payments, i.e., the government pays the concessionaires a fixed fee based on the availability of the infrastructure and, therefore, has the flexibility to change tolls; 2) in the coming ten years the first concessions, launched in the 1990s, will come to an end, and the assets in question will be returned to the government, opening up opportunities for changes in the pricing structures.

It is also important to develop an integrated analysis of transport and NGA accessibility. As became clear during the COVID-19 pandemic, NGA accessibility can be an important replacement for physical transportation. Under the cohesion umbrella, it would be relevant to overlap both physical transport and NGA accessibility to identify the municipalities where social and economic exclusion may be arising due to low levels of accessibility. These inequalities tend to aggravate in inland and low-density areas, already affected by a decreased offer of several other public services (such as schools, health services and post offices). Ultimately, these inequalities may lead to the growth of far-right political parties, as seen in the more impoverished and traditionally left-winged region of Alentejo in the 2021 Presidential Election.

5.4. Has infrastructure investment improved cohesion and promoted economic growth?

5.4.1. Accessibility and development

Governments have justified most transport infrastructure investments with the goal of unlocking economic growth and improving cohesion, as discussed by the European Commission (1999). Were these goals attained? Is there evidence, in the Portuguese case, that increased accessibility has fostered economic development? Pereira (2017) found that investments in national and municipal roads, railways and motorways have shown positive productivity effects at the NUTS II level, although investment in education, ports and airports presented higher long term output marginal products. Other studies at the NUTS

III level show that the results are not consistent across the country (Januário et al., 2021).

In this section, we seek to provide an overview — at the level of the Portuguese municipalities and based on descriptive analysis — of whether there is evidence of a relationship between accessibility (in particular, changes in accessibility) and growth. Given the massive investment in the road sector and the extraordinary increase in the levels of regional and municipal accessibility, one would expect to find evidence of such a relationship. For the purpose of this research, accessibility was measured from an infrastructure perspective, in terms of geographic accessibility, for two distinct transport modes: roads and railways. The indicator was calculated considering the weighted average travel time from one municipality to all the other municipalities (or regions, depending on the 'indicator's geographic unit). The travel time was weighted by population[81].

Since 1991, there has been a massive improvement in road accessibility throughout the country. In relative terms, road accessibility has improved the most in peripheral areas (interior, north and south), given that these regions and municipalities did not have a motorway network in 1991. By contrast, in terms of rail accessibility, a large portion of the territory lost its connection to the network or, at least, experienced a significant decrease in overall railway accessibility (The Appendix provides a geographic view of the accessibility levels). Remarkably, the connection between the 'country's two largest cities (Lisbon and Porto) by rail has not been significantly improved. The railway travel time between 1986 and 2019 was reduced by 2 %, while the road travel time was reduced by 31 %.

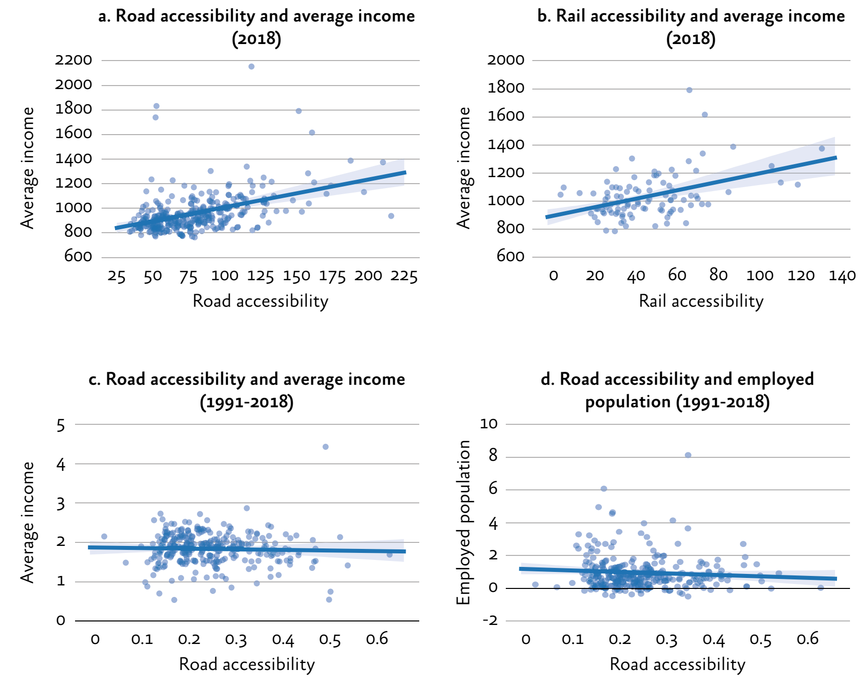
5.4.2. Correlation with population and average income

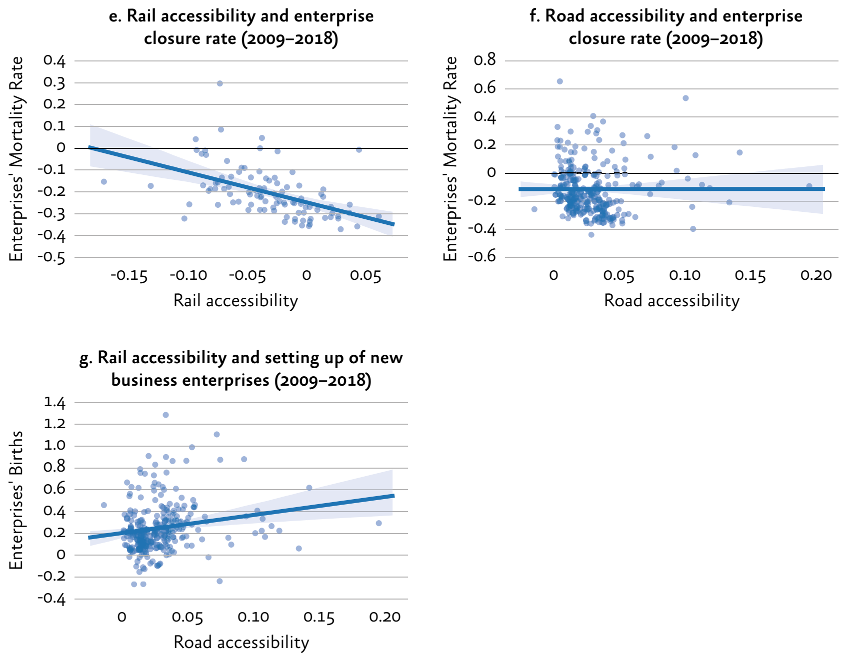
There is an obvious spatial bias in Portugal. The more populated areas, also with higher average incomes and productivity, are mostly located in coastal areas, where there is better road accessibility. A high correlation between accessibility and income (figure 7a) is, therefore, to be expected. While there is a greater dispersion of values, one can also see a positive correlation between rail accessibility and average income (figure 7b). Again, the same spatial bias applies. But when we analyse the changes in accessibility (road and rail) between 1991 and 2018, it becomes harder to find evidence for such a relationship. In the case of road accessibility (figure 7c), we observed a slight negative correlation with the average income percentage change and with employment (figure 7d).

We also looked at the effect on the setting up (*birth*) and closure (*mortality*) of business enterprises. There is evidence of a negative correlation between rail accessibility and the percentage changes in the rate of enterprise closure. To a large extent, this correlation can be attributed to the negative values of both variables (figure 7e). This relationship could also be a sign of spatial bias caused by the distribution of the railway infrastructure. The highest increases in enterprise closure rates and the highest declines in railway accessibility during this period were observed in some of the 'country's innermost regions. Figure 7f shows no correlation between the percentage change in road accessibility and the enterprise closure rate. However, there is a positive correlation between the percentage change in the number of enterprise openings and positive changes in road accessibility between 1991 and 2018 (figure 8b). This positive correlation counters the negative correlation observed between road accessibility and the number of people employed, suggesting a potential increase in the predominance of small and medium-sized enterprises.

As far as Internet access is concerned, figure 7a shows a slight positive correlation between Internet access and the change in the number of enterprise openings between 2012 and 2018. It is also noteworthy that some municipalities with an increase in Internet access of over 200 % and located outside the Lisbon and Porto metropolitan areas have also seen significant growth in the setting up of new business enterprises. The average income also positively correlates with Internet access, accounting for the percentage change in income between 2012 and 2018 (figure 7b). Municipalities with more considerable improvements in Internet access have also shown higher increases in average income. We also found a slightly negative correlation between Internet access and the percentage change in a 1-year survival rate of business enterprises (figure 7c).

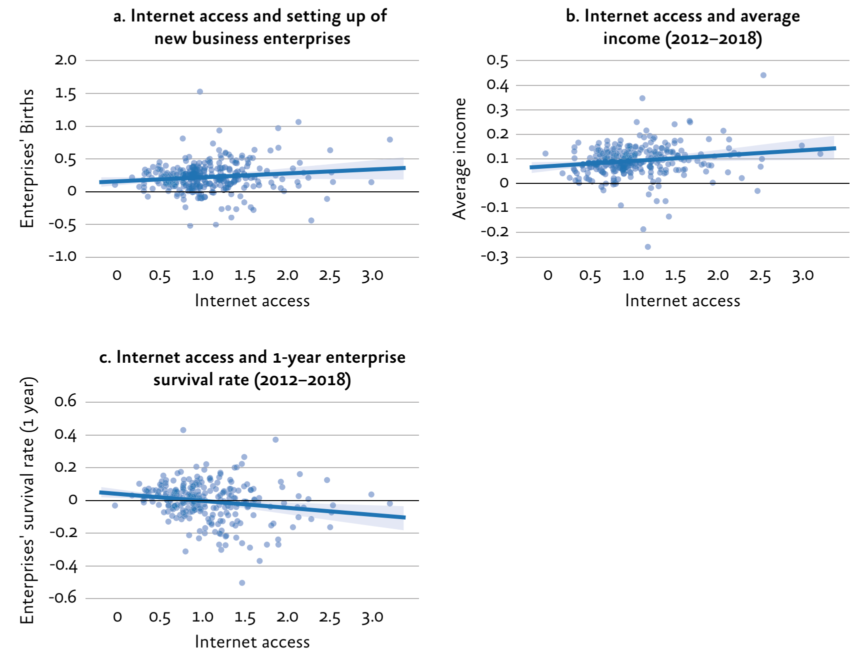
Figure 7 Road and rail accessibility and selected socio-economic variables





Source: Author's analysis

Figure 8 Internet access (2012-2018)

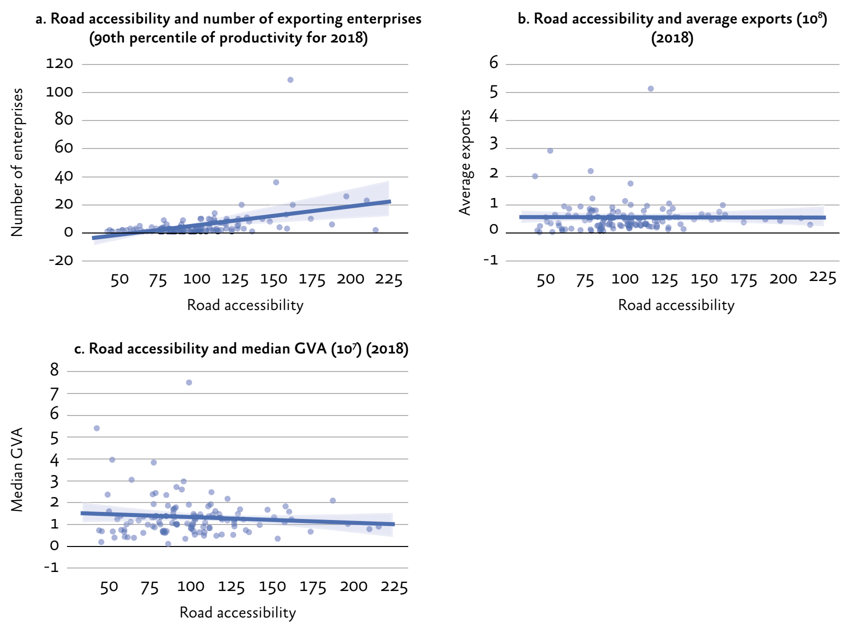


Source: Author's analysis

5.4.3. Correlation with exports and SMEs

In order to understand the impact of the transport and communication infrastructure on the overall exporting capacity, we also analysed the data of the 90 % most productive companies (in terms of exports), as well as data for SMEs[82]. There is evidence of a positive correlation between exporting businesses and road accessibility (figure 9a), but we found no correlation between road accessibility and the value of average exports (figure 9b). Although road accessibility might be an essential factor for the location of exporting businesses, the value of those exports may not depend on their proximity to the road infrastructure. In 2018, the leading share of exports in the Portuguese economy came from the secondary sector[83]. Four locations have registered more than 200 million euros in exports during 2018, namely, Palmela (513 M€), Sines (291 M€), Mangualde (219M€) and Bragança (209M€). The first two locations are home to two of the largest industrial businesses nationwide: Volkswagen Autoeuropa and the Galp refinery, respectively. Figure 9c shows no significant correlation between road accessibility and the median Gross Value Added (GVA).

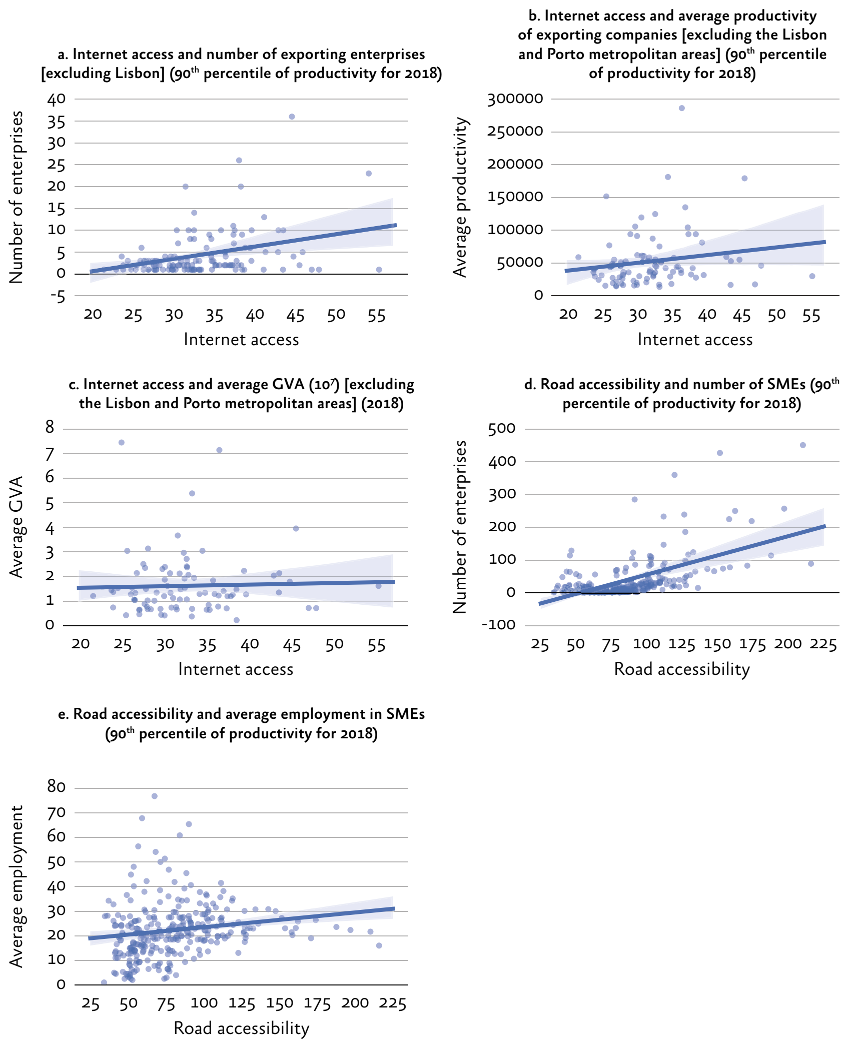
Figure 9 Road accessibility and exports



Source: Author's analysis

Again, figure 10a shows a positive correlation between Internet access and the number of exporting enterprises. Lisbon appears as an outlier, with 109 companies set up in 2018 and with the highest value of Internet connections per 100 inhabitants (at 58.35). When one excludes Lisbon from the sample, the correlation between the two variables becomes more evident. Internet access also positively correlates with average productivity (figure 10b) and average GVA (figure 10c). This finding could suggest that, on average, locations with higher road accessibility also experience higher levels of productivity (figure 10d) and GVA (figure 10e). A correlation between Internet access and average exports is not evident, which is consistent with the fact that most exports are made by the secondary sector.

Figure 10 Internet access, exports and SMEs (2018)



Source: Author's analysis

There is a positive correlation between the number of SMEs and road accessibility. Most locations with more than 100 enterprises created in 2018 are in the Lisbon or Porto metropolitan areas. After removing the two major metropolitan areas, one still finds a positive, although weaker, correlation between road accessibility and the number of SMEs.

5.4.4. Regression analysis

To assess the effects of infrastructure investment on economic growth at the municipal level, we developed a fixed-effects model with the following specification:

Where:

$$\Delta \ln y_{i,t} = \alpha \ln y_{i,t-1} + \beta \Delta Infr_{i,t} + \gamma W_{ij}\, \Delta Infr_{i,t} + \eta\, X_{i,t} + \tau_t + \varepsilon_{i,t}$$

- $\Delta \ln y_{i,t} = \ln y_{i,t-1} - \ln y_{i,t-1}$ is the annual change of the natural logarithm of GVA in municipality i (the dependent variable);
- $y_{i,t-1}$ is the annual lagged level of GVA in municipality i;
- $\Delta Infr_{i,t}$ is the annual growth in transport accessibility;
- W_{ij} is a row-standardised spatial contiguity matrix (queen criterion) representing the geographical relationship between municipality i and other municipalities j;
- $W_{ij}\, \Delta Infr_{i,t}$ is the spatially weighted increase in transport accessibility in neighbouring municipalities;
- $X_{i,t}$ is a vector of control variables (educational level, firm structure, average income in municipality i);
- α, β, γ and η are the regression coefficients to be estimated;
- τ_t are year dummies;
- $\varepsilon_{i,t}$ is the error term

Due to data availability, the regression covered a period of ten years, between 2009 and 2019, as there is minimal data available, at the municipality level, on GVA or average income before 2009. To understand the differences between municipalities within the large metropolitan areas (Lisbon and Porto) and the rest of the country, we have built two sets of models: one accounting for all available municipalities, and the other using only municipalities outside the referred metropolitan areas (MA). The results were the following:

Table 2 Regression Results

Dep. Variable: Change of log GVA	Entire Country	Outside Main MA
Lagged GVA	-0.3211***	-0.3401***
	(0.0157)	(0.0169)
Change in Road Accessibility	0.0002	0.0021
	(0.0067)	(0.0084)
Spatially Weighted Road Accessibility	-0.0260***	-0.0363***
	(0.0077)	(0.0098)
Average Income of Employees	0.0007***	0.0008***
	(0.0001)	(0.0001)
Percentage of Small and Micro Companies (< 10 employees)	0.0156***	0.0112*
	(0.0064)	(0.0068)
Region Dummies	Yes	Yes
Year Dummies	Yes	Yes
Observations	2769	2419
R^2	0.2135	0.2225
Municipalities	277	242

Notes: Standard errors in parentheses; ***P < 0.01, **P < 0.05, *P < 0.1.

It is important to note that the period under analysis corresponds to a decade of overall decrease in infrastructure investment (see figure 1).

In both models, the values of annually lagged GVA, spatially weighted road accessibility, average income of employees and percentage of companies with less than ten employees have shown statistical significance. The change in road accessibility in each municipality did not prove statistically significant to our model, confirming the lack of correlation observed in the previous section (section 4.3). The lagged GVA appears in both models with a negative sign, suggesting that the most significant changes in GVA occurred in municipalities with lower values. Although with a positive sign, the change in road accessibility in each municipality shows no statistical significance at 10 %, suggesting that further investment in road infrastructure will not increase the GVA. The spatially weighted road accessibility accounts for the changes in road accessibility for the neighbouring municipalities. This variable has shown a negative sign. Increasing road accessibility in any given region is not necessarily positive for its neighbours. A possible explanation can be found in the literature — the creation of productivity corridors along infrastructures with potential negative spill-overs over neighbouring regions (Holl, 2004). It is noteworthy that the higher value of the coefficient in the model corresponds to municipalities outside the two largest metropolitan areas, which may suggest that the effect of these productivity corridors is more substantial in the most inland regions. Further research would be necessary to confirm this hypothesis. In both models, we also see a positive sign and statistical significance in employees' average income, suggesting that municipalities with higher salaries are also the most productive ones. One should consider the business types operating in each municipality, given that the type of business (industry or service) is also closely related to the average income of its employees. Thus, attracting the most productive companies to a municipality should also increase its employees' average income and overall productivity (as given by the GVA value). The percentage of small and micro companies also shows a positive sign in both regression models. However, one should keep in mind that the services industry, where a great portion[84] of the population is employed, accounts for a large percentage[85] of the GVA nationwide, with companies in this sector employing significantly fewer employees[86] than the secondary sector of the economy. Therefore, a higher percentage of micro and small companies can represent a higher predominance of firms in the tertiary sector.

We also developed a similar model controlling for railway accessibility but did not find any statistically significant impact on GVA. Nonetheless, we should mention that the availability of data regarding railway accessibility was significantly shorter than data on roads.

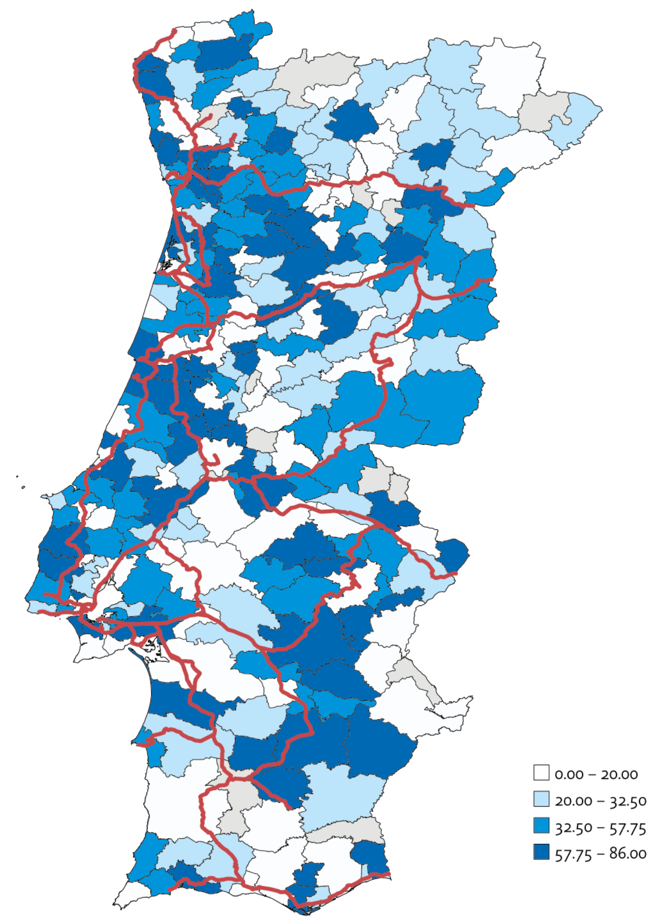
We must also note that this regression analysis has the obvious limitation of considering a relatively short period of time (2009–2019) due to data limitations at the municipal level.

5.4.5. Main findings

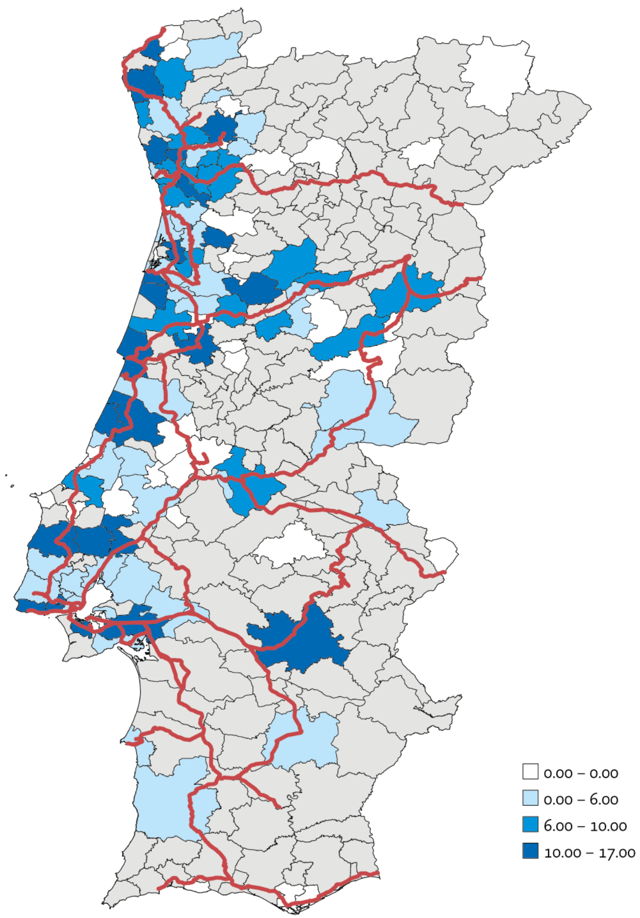
The metropolitan areas of Lisbon and Porto present higher levels of accessibility. This comes as no surprise, as, according to the literature, metropolitan areas can benefit from agglomeration effects produced by efficient transport networks (Melo et al., 2016). The most interior regions of the country were also the most affected by the decline in the railway infrastructure. As is the case of road infrastructure, railway infrastructure is also predominantly located near the coastline and major urban centres (figure 11a). Consequently, firms, particularly in the primary and secondary sectors, prioritise their location based on the proximity to transport infrastructure and the reduction in logistic costs (figure 11b).

Figure 11 Road and railway networks, SMEs and exports (2018)

a. Number of SMEs in the 90th percentile of productivity (2018) and railway infrastructure



b. Number of exporting enterprises in the 90th percentile of productivity (2018) and railway infrastructure



Coastal urban areas have a significant share of the economic activity, especially in the services sector. Accordingly, higher income levels in these areas were also to be expected (European Commission, 2018; Auziņa-Emsiņa & Ozoliņa, 2019). Our analysis has not clearly shown evidence of a correlation between substantial improvement in road accessibility and substantial growth development or a decrease in regional asymmetries. There is no clear correlation between the percentage of change in road and railway infrastructure investment and the average income and employed population between 1991 and 2018. However, we found a positive correlation between improved road accessibility and the setting up of new business enterprises, suggesting an increase in the predominance of small and medium enterprises. This observation is consistent with the predominance of micro-sized enterprises[87] (96.1 %[88], in 2018) in the Portuguese economy, which is above the European average of 93 %[89].

There is a positive correlation between the variation in the number of new enterprises and Internet access between 2012 and 2018. We also found a positive correlation between Internet access and the average income, suggesting that the enhancement of the communication infrastructure may promote entrepreneurship and lead to an increase in the average income. Some of the municipalities with an increase in Internet access of over 200 % over this period, and located outside the metropolitan areas of Lisbon and Porto, have also seen significant increases in the number of new enterprises. While focusing on exporting enterprises, we found a positive correlation between the accessibility to road infrastructure and the number of companies in the 90th percentile of productivity, resulting from the aforementioned spatial bias. We did not find a correlation between road accessibility and the average GVA, nor between GVA and Internet access. However, there is a positive correlation between Internet access and the number of exporting companies in the 90^{th} percentile of productivity, even after excluding the metropolitan areas of Lisbon and Porto.

Based on the regression results, we also found that employees' average income and road accessibility are two of the most impactful factors at the municipality level. However, increasing road accessibility did not prove statistically significant to increasing the GVA and could also have negative spill-over effects for neighbouring municipalities due to the creation of productivity corridors (as discussed by Holl, 2004). Hence, investment in new road infrastructure should be thoroughly assessed case by case. Regarding railway accessibility, the results show no statistically significant impact on the increase of GVA. However, the much smaller sample size for railway infrastructure could be limiting our results, and, therefore, we would recommend further studies to confirm these findings.

5.5. Does Portugal have a proper institutional setting to develop the *right* infrastructure?

Maximising the economic and social impact of infrastructure expenditure, particularly in the case of transportation, requires an ability to plan, deliver and manage these projects effectively. Some studies have linked infrastructure spending and economic returns to political and institutional factors (e.g., Esfahani and Ramirez, 2003), supporting the thesis that higher institutional quality is more likely to improve infrastructure quality. More recently, Crescenzi et al. (2016) addressed the links between institutions, infrastructure spending and economic growth in European regions. They claim that the quality of government is crucial for maximising infrastructural impact. As argued by Rodríguez-Pose et al. (2018): «Poor institutional systems may lead to: (a) political economy factors inflating investment in transport; (b) a widespread system of corruption and collusion, and; (c) significant cost overruns and delays».

Does Portugal have the right institutional setting to select, procure and deliver infrastructure projects? In order to answer this question, and using the Rodríguez-Pose et al. (2018) structure for potential evidence of a flawed institutional system, we have analysed 'Portugal's past performance in project evaluation and planning, policy options (in)stability and respective implementation and execution.

5.5.1. Project evaluation and planning

Flyvbjerg et al. (2002, 2004) associate many project failures to the *planning fallacy*, i.e., a strategic misrepresentation of costs and benefits, and optimistic forecasts in terms of ability and implementation timing. Whilst some authors may argue that many cost overruns arise from the need to adapt a project to changing circumstances (e.g., Love and Ahiaga-Dagbui, 2018), the reality is that there is frequently a disconnect between the planning stage and the project implementation and operation phase. The problem of inadequate demand for forecasting is even more relevant when PPP are used, as is the case in Portugal. Low demand decreases the economic impact of the project and, on top of this, can represent an added cost for the concessionaire, which would normally be borne by the government.

The literature has provided several reasons why optimistic forecasts are so probable. As summarised by Cruz and Sarmento (2020), some of them include: (1) opportunistic behaviour and optimism bias; (2) inadequacy of forecasting models and data; (3) overall uncertainty; (4) changes in demographics and land-use patterns; (5) project causes, such as quality or construction delays, among others; (6) competition and demand, and; (7) the economic cycle.

There is abundant evidence of significant optimism bias in the structuring of the Portuguese road network. Based on the network density presented in section 3, which is significantly above the European average, one would expect that real traffic should be lower than forecast. In an analysis of the Portuguese motorways, Marques (2019) found an average traffic deviation[90] of –22 %. The literature has identified a well-known phenomenon — the ramp-up effect — where, as the projects evolve, real traffic closes the gap to the initial forecast. In Portugal, the opposite has been the case, mostly due to the fact that the government changed from shadow to real tolls, further decreasing real traffic in road concessions.

Table 3 Traffic forecast deviations in Portuguese road concessions

		Year 1 (n=13)		Year 5 (n=11)		Year 10 (n=8)	
Nuts II	**Concession**	**Forecast deviation**	**Average deviation**	**Forecast deviation**	**Average deviation**	**Forecast deviation**	**Average deviation**
Algarve	Algarve	13 %	13 %	10 %	10 %	-58 %	-58 %
Central region	Beira Interior	-10 %		-22 %		-64 %	
	Beiras Litoral e Alta	28 %		32 %		-23 %	
	Costa da Prata	-31 %	4 %	-31%	-2 %	-65 %	-50 %
	Litoral Oeste	-25 %		n.a.		n.a.	
	Pinhal Interior	58 %		15 %		n.a.	
Lisbon region	BaixoTejo	19 %	-1%	n.a.	-33 %	n.a.	-32 %
	Grande Lisboa	-21 %		-33 %		-32 %	
Northern region	Douro Interior	n.a.		-26 %		n.a.	
	Grande Porto	-42 %		-33 %		-62 %	
	Interior Norte	-26 %	-28%	-18 %	17 %	-59 %	-52 %
	Norte	-62 %		-56 %		-66 %	
	Norte Litoral	19 %		10 %		-20 %	
	Transmontana	-27 %		n.a.		n.a.	

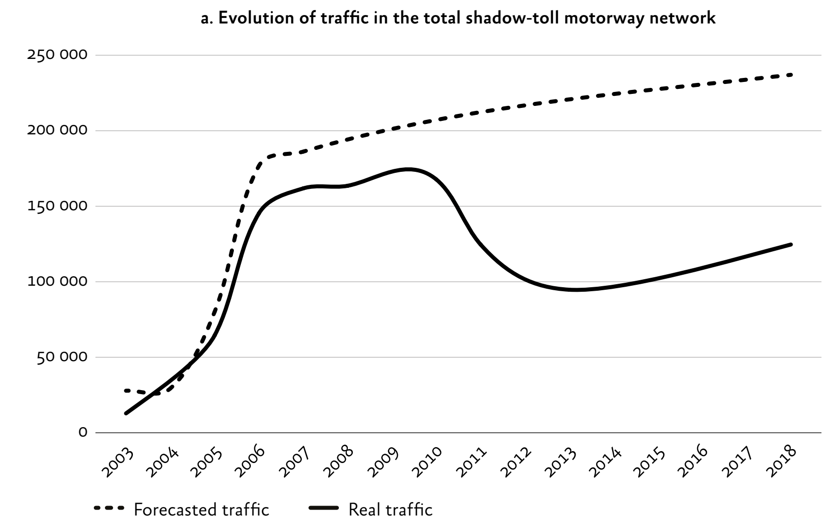
Notes: (1) n.a. — not available. (2) The deviations were calculated using the initial forecasts. The forecasts were updated over time, but the initial forecast provides the basis for the initial cost-benefit analysis and structuring of the project in question. The forecasts provided different levels of traffic, from 13.8 AADT per 1000 inhabitants to 73.9 AADT (Marques, 2019). Year 1, 5, and 10 represent the year of concession.

5.5.2. (In)stability of road management policies

In Portugal, there has been an additional factor that provided a significant change in the expected traffic and a consequent economic (not just financial) impact — policy changes. In 2010, when tackling the financial and economic crisis, the government decided to introduce actual tolls in the existing shadow toll concessions. These motorways were initially designed as *toll-free* for users, with a shadow toll being paid by the government to the concessionaire in regions where economic and social development was considered below average. In turn, these infrastructures would, hopefully, provide an economic boost. It is important to mention that many of these motorways were built over existing secondary roads. Therefore, although there was a manifest increase in capacity, there was also a replacement effect. After the government introduced tolls in 2010, there was a significant drop in demand to approximately half the initial forecast levels (on the shadow toll motorways, figure 12a). In most concessions, the traffic was already below the forecast levels (e.g., *Interior Norte*, as shown in figure 12b), but a few others were experiencing traffic levels above the forecasts (e.g., *Norte Litoral*, as shown in figure 12c).

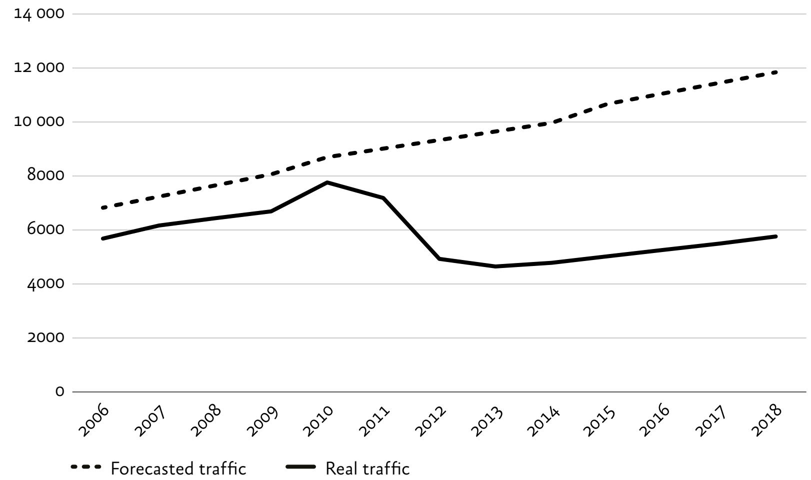
The combined payments of motorway users and taxpayers (in the form of an availability payment to the concessionaire) represented an increase of 40 % in the overall financial costs of these infrastructures when compared to the previous shadow toll system. Part of this increase is due to the cost of implementing an electronic toll collection system (also operated by concessionaires, see Fernandes et al., 2018). Moreover, there were additional economic costs resulting from the transfer of traffic from motorways (lower congestion, lower travel times, lower road accident levels) to the secondary network.

Figure 12 **Traffic in ex-SCUT[91] road concession**

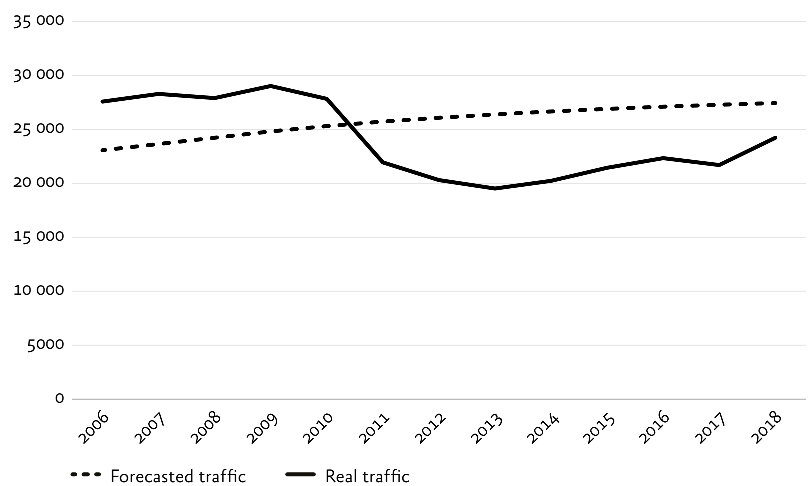


Note: the unit is the AADT

b. Traffic in the Interior Norte concession (Unit: AADT)



c. Traffic in the Norte Litoral concession (Unit: AADT)



Source: adapted from Marques (2019)

5.5.3. Implementation and execution

A frequent criticism of public spending in infrastructure is the inability to control cost and time overruns. These represent an additional cost for taxpayers and erode the economic benefit of a project. Catalão et al. (2019) analysed a dataset of 1091 transport projects in Portugal, identifying an average cost overrun of 10.3 %, with an average overrun of 300.000 euros for an average project value of 2.9 million euros, and a maximum value of 308 million euros. These projects were carried out under traditional procurement conditions. The largest projects, i.e., those above 1 billion euros, and for which there is no available data, were typically executed under PPP arrangements. Catalão et al. used an exogenous model to identify whether, over the course of more than 30 years, institutional, legal and political factors were at play in explaining the magnitude of the overruns. Indicators developed by the World Bank to measure government quality, such as the rule of law, corruption and government efficiency, were applied. As expected, the authors found that better government quality reduces the size of cost overruns.

These findings were consistent with subsequent studies covering other sectors (e.g., housing and environment) (Catalão et al., 2020). In terms of time deviation, the same authors found an average time deviation of 42.6 % (Catalão et al., 2021). Again, there is evidence of a correlation between government quality (and institutional and legal robustness) and a decrease in time deviations.

As already mentioned, the larger projects were carried out under PPP arrangements. Whereas there is no available data on potential cost and time deviations, there is available data on renegotiations of PPP contracts. With regard to PPP renegotiations, which occur when the purpose of the initial contract is no longer to establish the framework for the project management and development, some studies identify an increasing probability of renegotiation as the institutional quality decreases (for more information, see Cruz and Sarmento, 2021; Sarmento and Renneboog, 2020).

These studies, which are country-specific and cover more than 30 years, also identified the main determinants of such cost deviations. The size of the project was not statistically significant to explain the probability and the extent of the cost deviations.

5.6. The next ten years of infrastructure policy

Over the coming ten years, Portugal will experience a new wave of infrastructure investment, amounting to over 20 billion euros, with a significant contribution from the European Next Generation Recovery Fund. Two essential goals of this investment are similar to those set out in the 1990s — unlocking growth and increasing cohesion —, but there is an added one — improving the environmental performance of the system. However, a country like Portugal, which already has a relevant, albeit *road-centred* stock of infrastructure, should carefully select infrastructure investments that will address shortcomings of past infrastructure policy and focus on collective environmental, social and economic sustainability and resilience.

Based on Portugal's investment experience over three decades, and relating to today's infrastructure mix and its relative performance, we have drawn up several recommendation policies that could potentially increase the impact of such a wave of investment.

Improving performance is not all about large sunk investments

Improving performance in transport and logistics is typically associated with large sunk investments in multimillion euro projects. As we have shown, there are improvements to the system that leverage performance and efficiency (e.g., the case of customs in ports) and give rise to a more rational and equitable distribution of costs (e.g., road tolls). It is difficult to understand that administrative bottlenecks, which are part of a 'government's responsibility and influence, can affect the competitiveness of international connections, both in seaports and in airports. The road sector, often seen as a rigid oversized infrastructure, offers an opportunity to design, test and roll out innovative solutions for managing road capacity. Portugal has been a pioneer in the development and export of contactless road payment solutions (the case of *Via Verde*), and has the technological expertise to redesign road tolling principles towards a congestion-based principle in order to decrease the profound inequalities in the existing pricing. More than an opportunity, it is a necessity in the medium term.

Improving the environmental performance of the transport system will require investment in rail-based modes

Portugal has made a strong financial commitment to infrastructure development but also created an unbalanced infrastructure mix that is highly centred on the motorway system and lags behind in terms of railway and urban transit systems. The high capacity of the road system will not replace the need for investing in railways and urban transit to help achieve a more sustainable modal shift, particularly in large urban areas.

The question regarding rail infrastructure is whether to focus on the most populous areas or to recover existing rail infrastructure in the form of deactivated lines (or new lines) in low-density areas in the quest for regional convergence. The lack of irrefutable evidence about the impact of changes in accessibility and growth should raise some concern over the use of large infrastructure as a development tool. Furthermore, the travel times in the main economic corridor (Setúbal-Lisbon-Porto-Braga) have not improved significantly over the last three decades, and the main railway line connecting Lisbon to Porto is one of the few suffering from congestion problems. There appear to be advantages in considering rail infrastructure investment in the coastal areas, both by increasing the metropolitan network density in the two main metropolitan areas (to close the density gap to the European average) and by connecting them. Improvements in the rail networks should also target the logistical infrastructure bottlenecks in order to increase the share of freight rail transport. This would require improving the connections to ports (particularly Sines) and to Spain, where greater coordination should decrease the physical, administrative and operational frictions.

Improving government and institutional quality

The problems of optimism bias and cost overruns justify the need for an improvement in the institutional capacity and in the governance models for infrastructure development. There is a certain bias in 'today's project delivery models. The publicly held companies responsible for planning and delivering the projects have full control over the projects' lifecycle. However, there is no control mechanism to avoid excessively optimistic forecasts for these projects. There is an urgent need for a proper technical planning unit that can provide an independent view over the project selection and structuring within the public administration system. The UK Infrastructure and Projects Authority is a good example. This is particularly relevant for Portugal in the specific context of the coming decade. It will be necessary to implement EU funds at an unprecedented level, and, at the same time, there is a decreasing marginal utility to infrastructure investment, making it crucial to critically evaluate and select projects.

A more robust governmental and institutional capacity will facilitate policy evaluation and avoid public decision-making with long-term negative consequences. Not only will it increase sounder decisions on infrastructure development, but it will also lead to a more balanced and sustainable infrastructure system that is able to tackle climate change and promote social cohesion and economic development.

The coming ten years of infrastructure policy should abandon the macro perspective that *more is better*, and focus on identifying and executing projects with clear and tangible benefits, thus improving the 'system's performance in terms of connecting firms, consumers and workers. The potential benefits of infrastructure development go hand in hand with the ability to solve specific and identifiable transport and logistics bottlenecks. The typical decision-making tools, such as cost-benefit analysis, need to include the measurement of potential benefits in terms of increasing resilience, improving the performance of the logistics system and improving the environmental performance, adopting a holistic consideration of the 'project's contribution to the infrastructure system as a whole.

Acknowledgements

The authors are grateful to FFMS and to the Project Coordinator Fernando Alexandre for the opportunity to join this ambitious and impactful project. The authors would also like to acknowledge the feedback provided by the Project's Steering Committee. A special recognition is due to Andrés Rodriguez-Pose for several suggestions/comments on draft versions of the paper. Any errors that might remain are the authors' own responsibility.

References

Aschauer, D. A., «Is public expenditure productive?», *Journal of monetary economics*, Vol.23, No.2, pp. 177–200, 1989.

Auziņa-Emsiņa, A. & Ozoliņa, V., «Modelling impact of urban-rural income convergence in the EU», *Research for Rural Development*, Vol. 2, pp. 2010–2016, 2019.

Bensassi, S., Márquez-Ramos, L., Martínez-Zarzoso, I., Suárez-Burguet, C., «Relationship between logistics infrastructure and trade: evidence from Spanish regional exports», *Transport. Res. Pol. Pract.,* Vol. 72, pp. 4761, 2015.

Bottasso, A., Conti, M., Costacurta de Sa Porto, P., Ferrari, C, Tei, A., «Port infrastructures and trade: empirical evidence from Brazil», *Transport. Res. Pol. Pract.*, Vol.107, pp. 126–139, 2018.

Bruzelius, N.A., «Microeconomic theory and generalised cost», *Transportation*, Vol.10, No.3, 1981, pp. 233–245, doi:10.1007/BF00148460.

Button, K., *Transport economics*, Edward Elgar Publishing, 2010

Cardos, M., & García-Sabater, J. P., «Designing a consumer products retail chain inventory replenishment policy with the consideration of transportation costs», *International Journal of Production Economics*, Vol.104, No.2, 2006, pp. 525–535.

Catalão, F. P., Cruz, C. O., & Sarmento, J. M., «The determinants of cost deviations and overruns in transport projects, an endogenous models approach», *Transport Policy*, Vol.74, 2019, pp. 224–238.

Catalão, F. P., Cruz, C. O., & Sarmento, J. M., «Public management and cost overruns in public projects», *International Public Management Journal*, 2020, pp. 1–27.

Catalão, F. P., Cruz, C. O., & Sarmento, J. M., «The Determinants of Time Overruns in Portuguese Public Projects», *Journal of Infrastructure Systems*, Vol. 27, No. 2, 2021, 05021002.

Crescenzi, R., & Rodríguez-Pose, A., «Infrastructure and regional growth in the European Union», *Papers in regional science*, Vol. 91, No. 3, 2012, pp. 487–513.

Crescenzi, R., Di Cataldo, M., & Rodríguez-Pose, A., «Government quality and the economic returns of transport infrastructure investment in European regions», *Journal of Regional Science*, Vol. 56, 2016, pp. 555–582.

Cruz, C.O., *Management of the national road network: financing, pricing, efficiency and equity*. Porto Chamber of Commerce, 2018, ISBN: 987.972-96580-6-8. (Originally in Portuguese)

Cruz, C.O., Costa, Á., Sarmento, J.M., Sousa, V., Januário, J., *Transport systems in Portugal: Analysis of efficiency and regional impact*, Fundação Francisco Manuel dos Santos, 2021, Final Report.

Cruz, C. O., & Marques, R. C., «Exogenous determinants for renegotiating public infrastructure concessions: evidence from Portugal», *Journal of construction engineering and management*, Vol.139, No. 9, 2013, pp. 1082–1090.

CRUZ, C. O., & Sarmento, J. M., «Airport privatization with public finances under stress: An analysis of government and investor's motivations», *Journal of Air Transport Management*, Vol.62, 2017, pp. 197–203.

CRUZ, C. O., & Sarmento, J. M., «The price of project finance loans for highways», R*esearch in Transportation Economics*, Vol.70,2018, pp. 161–172.

CRUZ, C. O., & Sarmento, J. M., «Traffic forecast inaccuracy in transportation: a literature review of roads and railways projects», *Transportation*, Vol. 47, No. 4, 2020, pp. 1571–1606.

CRUZ, C.O., Sarmento, J.M., *The renegotiations of public-private partnerships in Transportation: Theory and Practice*, Springer Nature, 2021.

ESFAHANI, H. S., & Ramírez, M. T., «Institutions, infrastructure, and economic growth», *Journal of Development Economics*, Vol.70, 2003, pp. 443–477.

EUROPEAN Commission, *Cohesion and Transport*, COM (1998) 806 final, Brussels, 1999

EUROPEAN Commission, *a Digital Single Market Strategy for Europe*, Brussels, 2015

EUROPEAN Commission, *2018 SBA Fact Sheet*, Brussels: European Commission, 2018.

EUROPEAN Commission, «Statistics on rural areas in the EU», 2018, link

EUROPEAN Commission, *Mobile and Fixed Broadband Prices in 2019*. 2020 Report.

EUROPEAN Court of Auditors, *Public private partnerships in the EU: Widespread shortcomings and limited benefits*, 2018, Special Report No. 09.

FAMILONI, K. A., «The role of economic and social infrastructure in economic development: A global view», *Journal of Economic Perspectives,* Vol. 6, No. 4, 2006, pp. 11–32.

FERNANDES, C., Oliveira Cruz, C., & Moura, F., «Ex post evaluation of PPP government-led renegotiations: Impacts on the financing of road infrastructure», *The Engineering Economist*, Vol. 64, No. 2, 2019, pp. 116–141.

FLYVBJERG, B., M. K. Skamris Holm, and S. L. Buhl., «Underestimating Costs in Public Works: Error or Lie?», *Journal of the American Planning Association* Vol. 68, No. 3, 2002, pp. 279–95.

FLYVBJERG, B., M. K. Skamris Holm, and S. L. Buhl., «What Causes Cost Overrun in Transport Infrastructure Projects?», *Transport Reviews* Vol. 24, No. 1, 2004, pp. 3–18.

GEREFFI, G., Humphrey, J., & Sturgeon, T., «The governance of global value chains», *Review of international political economy*, Vol. 12, No. 1, 2005, pp. 78–104.

GEURS, K.T., van Wee, B., «Accessibility evaluation of land-use and transport strategies: Review and research directions», *Journal of Transport Geography*, Vol. 12, No. 2, 2004, pp. 127–140.

GRAHAM, D. J., «Agglomeration, productivity and transport investment», *Journal of transport economics and policy (JTEP)*, Vol. 41, No. 3, 2007, pp. 317–343

HANSEN, W.G., «How Accessibility Shapes Land Use», *Journal of the American Planning Association*, Vol. 25, No. 2, 1959, pp. 73–76.

Hoffmann, J, & Hoffmann, J., «Ports in the global liner shipping network: Understanding their position, connectivity, and changes over time». *Transportation and Trade Newsletter*, UNCTAD, Article No. 57, 2020

IATA, «Air Connectivity: Measuring the connections that drive economic growth», Technical Report, 2020, (available here).

Januário, J., Costa, Á., Cruz, C.O., Sarmento, J., Sousa, V., *Empirical evidence on the effects of regional accessibility on economic productivity,* Working paper, 2021.

Kelly, C., Laird, J., Costantini, S., Richards, P., Carbajo, J., & Nellthorp, J., «Ex post appraisal: What lessons can be learnt from EU cohesion funded transport projects?», *Transport Policy*, Vol. 37, 2015, pp. 83–91.

López, E., Gutiérrez, J., & Gómez, G., «Measuring regional cohesion effects of large-scale transport infrastructure investments: an accessibility approach», *European Planning Studies*, Vol. 16, No. 2, 2008, pp. 277–301.

Love, P. E. D., and D. D. Ahiaga-Dagbui., «De-Bunking' Fake News' in a Post-Truth Era: The Plausible Untruths of Cost Underestimation in Transport Infrastructure Projects», *Transportation Research Part A: Policy and Practice,* Vol.113, 2018, pp. 357–68.

Marques, R., *Optimism bias in road concessions*, MSc Thesis Civil Engineering, Instituto Superior Técnico (Supervisor: Carlos Oliveira Cruz), 2019.

Melo, P. C., Graham, D. J. & Brage-Ardao, R., «The productivity of transport infrastructure investment: A meta-analysis of empirical evidence», *Regional Science and Urban Economics*, Vol. 43, No. 5, 2013, pp. 695–706.

Melo, P. C., Graham, D. J., Levinson, D. & Aarabi, S., «Agglomeration, accessibility and productivity: Evidence for large metropolitan areas in the US», *Urban Studies*, 2016, pp. 1–17.

Morrison, J.M., Dumple, P.L., Wigan, M.R., «Accessibility indicators for transport planning», *Transportation Research Part A*, Vol.13A, No.2, 1979, pp. 91–109.

Munnell, A. H., «Policy watch: infrastructure investment and economic growth», *Journal of economic perspectives,* Vol. 6, No. 4, 1992, pp. 189–198.

Park, S., «Quality of transport infrastructure and logistics and source of comparative advantage», *Transport Policy*, Vol. 99, 2020, pp. 54–62.

Pereira, A. M. & Pereira, R. M., *Infrastructures Investment in Portugal*, Fundação Francisco Manuel dos Santos, Lisboa, 2015.

Pereira, A.M., & Andraz, J.M., «Public Investment in Transportation Infrastructures and Industry Performance in Portugal», *Journal of Economic Development*, Vol. 32, No. 1, 2007, pp. 1–20.

Pires, L.M., «30 Anos de fundos estruturais (1986-2015)», *Relações Internacionais*, Vol. 53, 2017, pp. 19–38.

Rodríguez-Pose, A., Crescenzi, R., & Di Cataldo, M., «Institutions and the thirst for 'prestige' transport infrastructure, in *Knowledge and institutions*, Springer, Cham, 2018, pp. 227–246

Sarmento, J. M., & Renneboog, L., «Renegotiating public-private partnerships», *Journal of Multinational Financial Management*, Vol. 100661, 2020.

Wiengarten, F., Pagell, M., Ahmed, M. U., & Gimenez, C., «Do a country's logistical capabilities moderate the external integration performance relationship?», *Journal of Operations Management*, Vol. 32, No. 1–2, pp. 51–63, 2014.

Appendix

Figures A1, A2 and A3 exhibit the road accessibility in 1991 and 2018, and the variation (in percentage) between the two periods.
Figures A4, A5 and A6 replicate the analysis for railway accessibility.

Figure A1 Road accessibility (1991)

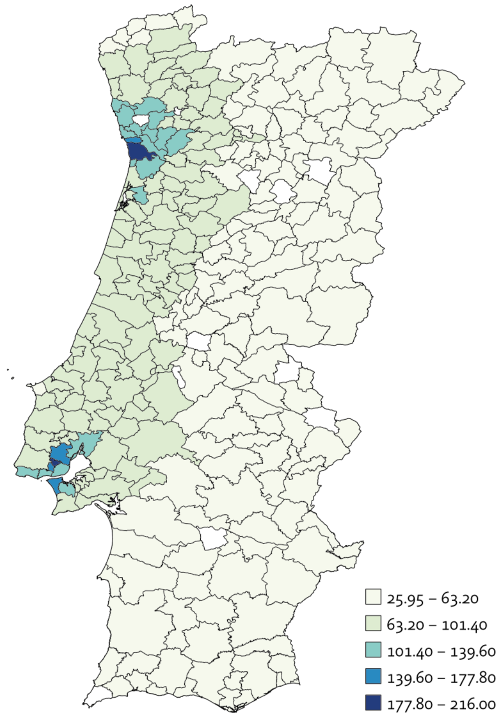


Figure A2 Road accessibility (2018)

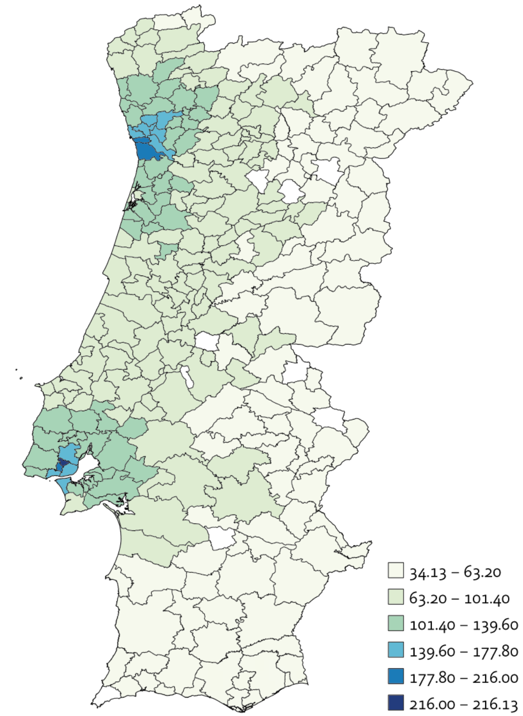


Figure A.3 Road accessibility variation 1991–2018

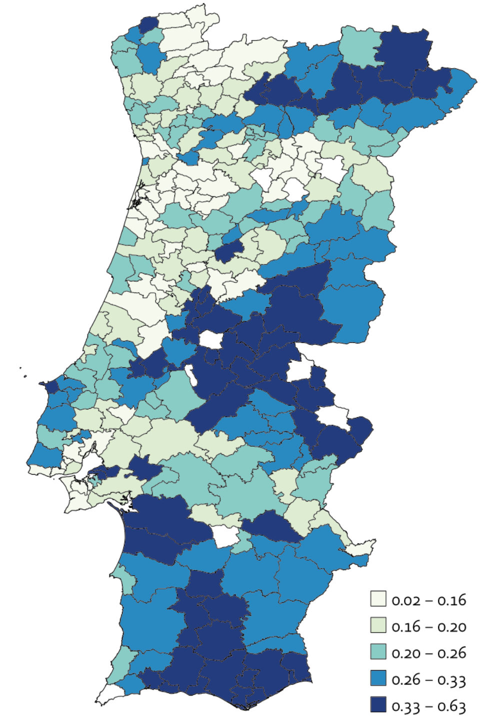


Figure A4 Rail accessibility (1991)

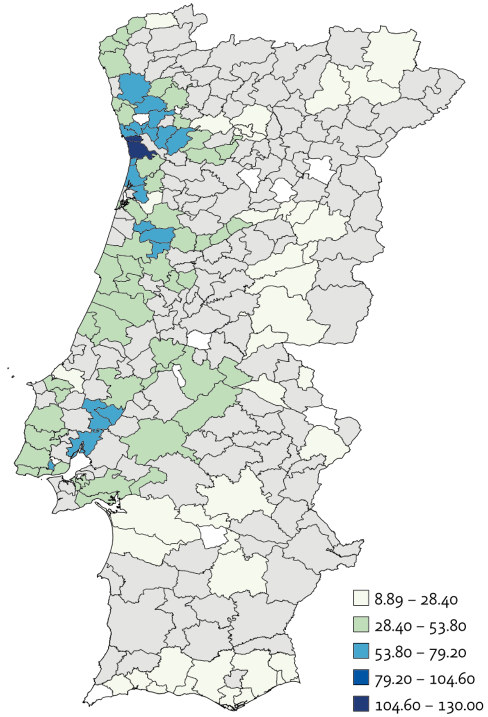


Figure A5 Rail accessibility (2018)

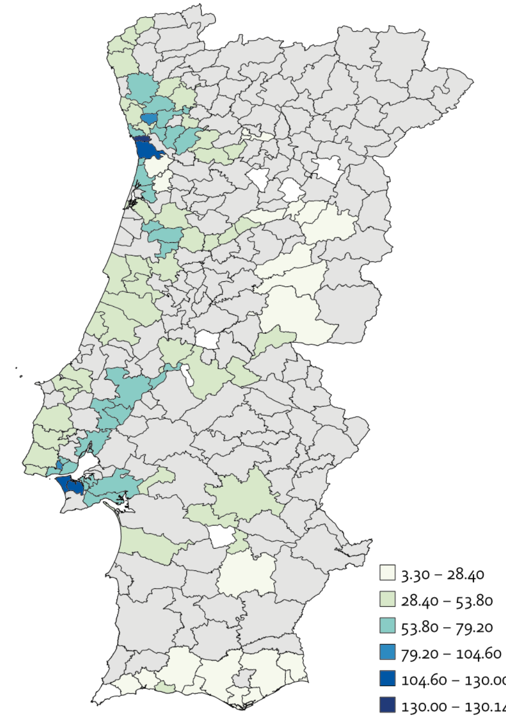
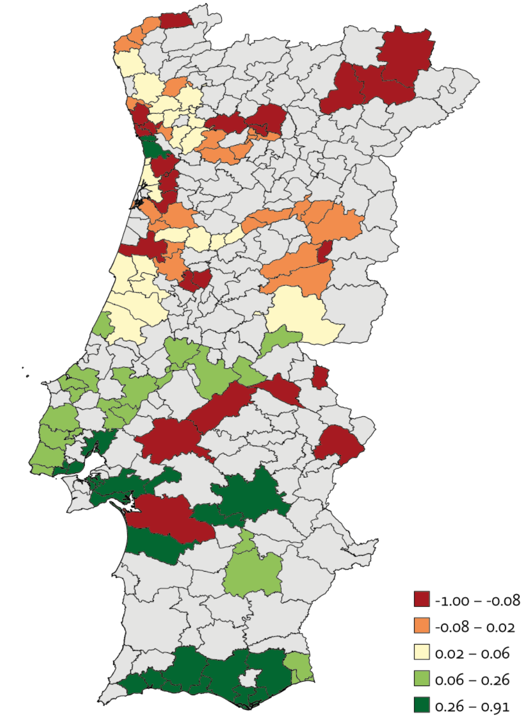


Figure A6 Rail accessibility variation 199-2018



Paper 6
Foreign direct investment and global value chains in Portugal[92]

Luís A. V. Catão, ISEG, UECE/REM, CEPR
Pedro de Faria, University of Groningen
António Martins, ISEG, UECE/REM
Miguel Portela, University of Minho and IZA

6.1. Introduction

Rapid and sustained export growth is known to be instrumental to overall economic development and the wealth of nations (IMF-WB-WTO, 2017). This is due to the positive demand effects of export expansion on production and employment, as well as the positive supply side effects of external competition and scale on the productivity of firms and the attraction of foreign direct investment (FDI) and technology. These positive effects, in turn, help release financing constraints to firm growth (Manova, 2018). In addition, in countries with high ratios of net foreign debt to GDP, like Portugal, faster export growth tends to lower sovereign risk by reducing the ratio of net foreign liabilities (NFLs) to exports — a classic indicator of external solvency — and tilting NFL composition toward more stable forms of foreign financing like, for example, FDI (Catão and Milesi-Ferretti, 2014).

The Portuguese economy was closed to foreign trade for much of the past century (relative to its size).[93] Following its accession to the European Union (EU) in 1986, it has embarked on a remarkable process of opening up to trade and foreign capital. This trend gained traction from around the mid-1990s, in the wake of the Treaties of Maastricht and Amsterdam, which fostered European Economic and Monetary integration by abolishing physical barriers to the movement of goods, capital and people across EU member countries.

In this connection, FDI and participation in the so-called global value chains (GVC) have been key drivers of economic integration within the EU as well as globally. In particular, increasing GVC participation — by allowing production in one country to add value from two or more countries before reaching the final user[94] and, thereby, fostering specialisation — has broadened the reallocation potential of production factors and FDI to wherever production is more economically carried out, thus aiding value added (GDP) growth through export dynamism. *Mutatis mutandis*, international evidence also corroborates the inverse causality: countries and policies that help attract FDI also tend to improve GVC participation and its positive effects on productivity and export growth (World Bank, 2020).

Against this background, this paper addresses the overarching policy question of how export dynamism and economic growth are best promoted in Portugal and what are the roles of FDI and GVC participation in this connection.

We address this question in three steps. First, we provide an up-to-date description of trends in FDI and GVC participation and their relationships with export growth at the aggregate and sectoral levels in Portugal. Whenever relevant and appropriate, we compare national trends with trends in other European Union countries. Second, we use firm, sectoral and regional data to measure the contribution of foreign investment and participation in export markets to employment, productivity and wages. Third, we relate traditional measures of comparative advantage in Portugal to sectoral trends in GVC participation in Portugal relative to the rest of the world. Finally, in line with the above-mentioned empirical results, we ask what targets are seemingly realistic for increasing FDI in Portugal and the participation of Portuguese firms in GVCs. In this connection, we look in particular at roles of variables under policy control (such as education, connectivity and managerial capacity) in attracting more FDI and speeding up the integration of the Portuguese economy in global and European production networks so as to accelerate the growth of Portugal's GDP in the coming decades.

6.2. Macro facts on trade openness, FDI and GVC participation

Between 1995 and 2018, trade openness in Portugal increased faster than in most other EU partners. Moreover, in the past decade, this openness was more based on the export-side than on the import-side of trade, in a remarkable reversal of the country's historical proclivity toward running significant trade deficits (figure 1). However, by 2018, the ratio of gross exports of goods and services to GDP has remained lower than in many EU partners, and strikingly low as a share of net foreign liabilities (NFL), only second to Greece in the EU (figures 2 and 3). Also, when compared to other EU peers, there has been faster export growth as of the mid-2000s, underpinned by services, whose exports nearly doubled as a share of GDP to around 15 % (before the 2020 COVID-19 crisis).

Importantly, a growing share of NFLs has been accounted for by larger FDI inflows, bringing Portugal's gross FDI stock to GDP ratio to the upper half of the EU cross-country distribution (figure 4). In addition to this higher share of *good cholesterol* in NFL (Catão and Milesi-Ferretti, 2014, and Catão, 2017), aggregate data point to a (mostly) positive correlation between growing FDI/GDP shares and the share of GVC participation in exports, and the overall growth of exports (figure 5).[95]

Figure 1 Portugal's Trade Balance (% of GDP)

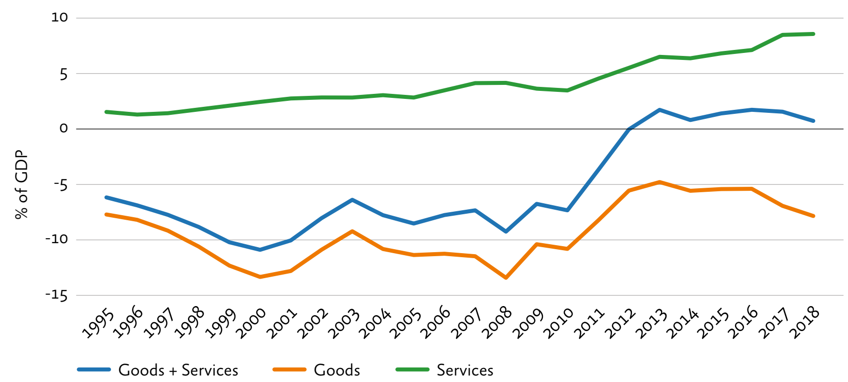


Figure 2 Gross Exports to GDP among EU countries

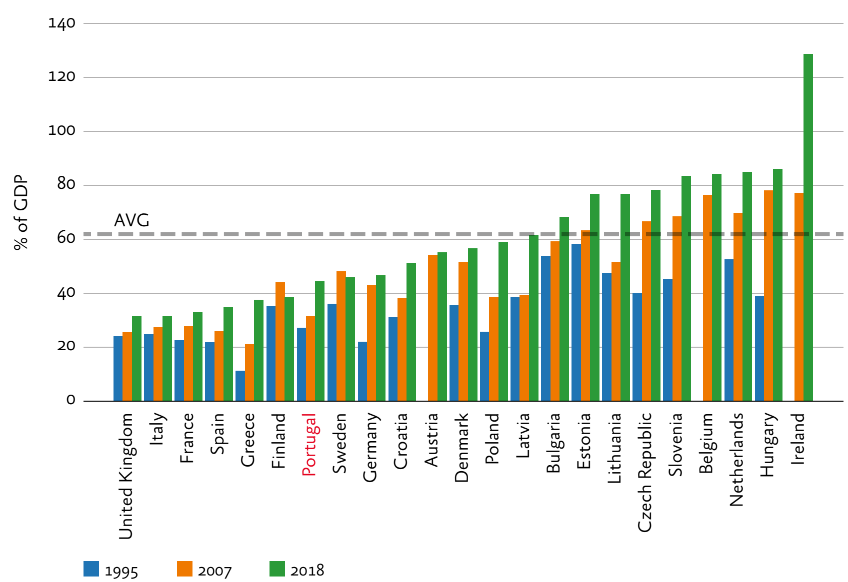


Figure 3 Ratio of Net Foreign Liabilities to the Exports of Goods and Services among EU countries

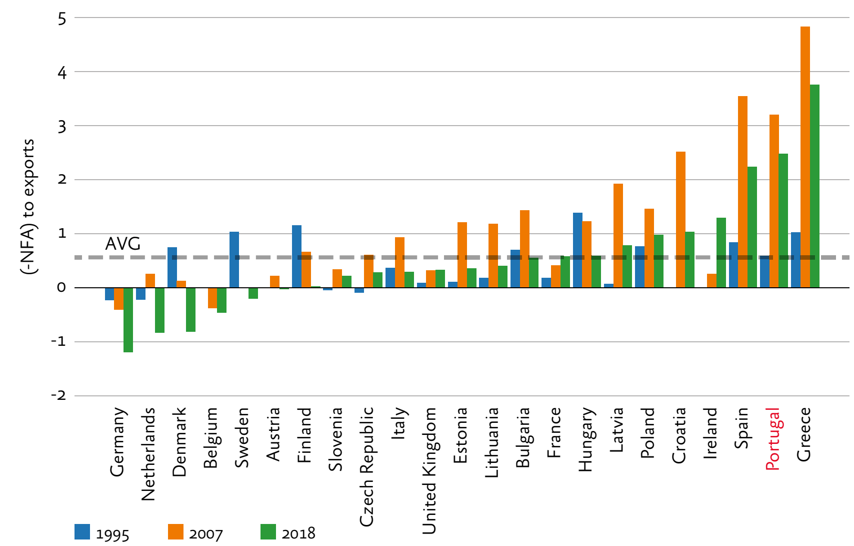
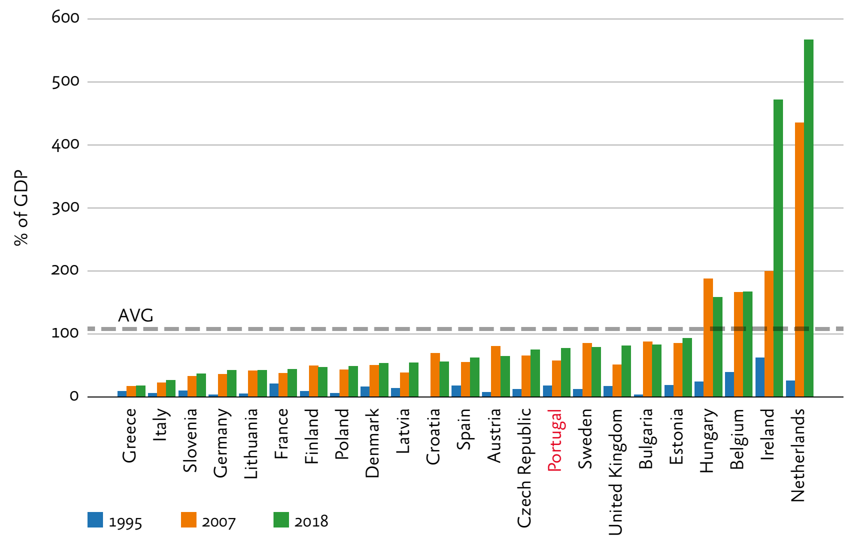


Figure 4 Gross FDI Liability Stock to GDP in the EU



In light of the above, as in other cases, there is evidence that FDI inflows in Portugal have moved in tandem with the participation of Portuguese firms in GVCs, with a potential two-way causality. Both the theoretical and the empirical cross-country literature provide a clear rationale for this association: since the network production links associated with GVC require a closer relational link between firms and sectors — to ensure a close match between the supply and demand of inputs, and large investments by suppliers (up or down the production stream), which are made more difficult by distance and by incomplete contracts between firms from different countries — lead firms might find it optimal to rely on integrated suppliers and assemblers in foreign countries, thereby investing in countries that supply to those chains via FDI (Antrás, 2020; World Bank, 2020). After joining the EU, Portugal has become institutionally more friendly to foreign investment and more open to growing FDI inflows associated with GVC participation. This should be expected to continue as the country *learns* to exploit the advantages in supplying goods and/or services within GVC trade — a key policy issue that we will discuss further below.

6.3. Sectoral effects of FDI and GVC participation in Portugal

Since firms and sectors, rather than countries, are the pivotal players in the process of GVC participation and export dynamics (see World Bank 2020 for a discussion), it is instructive to go beyond the aggregate correlations of section 2.[96]

The first step on a sectoral evaluation of the effects of GVC participation and export dynamism is to ask whether sectors with higher GVC participation display faster export growths. A look at figure 6 points to a positive answer: on average, sectors with higher GVC participation in gross export have displayed higher export growths, albeit the correlation is subject to considerable variance.[97]

Yet, higher participation of the firms in any given sector in a GVC does not necessarily guarantee higher value-added growth. This is because a higher share of the sector's output passing by two or more countries — which is the linchpin of the standard GVC participation metric — is consistent with a more extensive use of imported inputs with foreign value-added. Thus, it is important to look at the association between GVC participation and the growth in the value added to gross exports (VAX) and the respective sector's gross output (GVA). Figure 7 also points to a positive association on average, albeit subject to considerable dispersion too. This finding is important because GVC participation may also raise demand for domestic production that does not translate immediately into exports of that sector but may boost competitiveness and exports of other sectors, present and future. In addition, value-added (or GDP at a macro level) is a broader measure of welfare than export value-added alone. Finally, growing GVC participation has also been positively correlated with the growth of FDI inflows of a sector (figure 8).

6.4. Firm-level effects of foreign ownership and GVC participation in Portugal

The broad macro and sector-wide pictures provided in the previous sections raise important analytical and policy-related questions that arguably require a more granular view to arriving at more precise answers. For instance, how have greater FDI and GVC participation in Portugal reshaped the economy's specialisation, as well as its corporate and labour market landscapes? How have they affected export/output ratios, productivity, employment, and wages at the firm and sector levels? Are these trends consistent with the country's comparative advantages and desirable welfare-wise going forward? To which extent can policy influence these outcomes and, if so, how?

To make progress in answering these questions, a brief conceptual/historical detour seems useful. By allowing the stages of production of a good or service to be performed in different country-sector combinations, GVCs allow a finer international division of labour, i.e., a kind of novel hyper-specialisation in the international division labour. Extrapolating from the classic argument that traditional trade augments productivity by facilitating specialisation, the spread of GVCs should therefore be associated with even greater income gains than those yielded by traditional trade, i.e., trade whereby exports are produced using only or mostly domestic inputs and factors of production.

Figure 5 FDI, Global Value Chain and Export Shares in Portugal

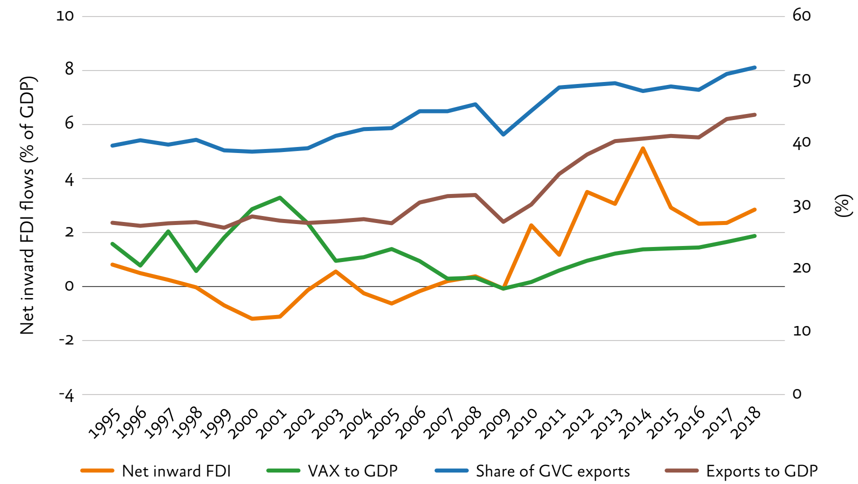


Figure 6 Growth of Gross Exports and share of GVC in Exports by Sector in Portugal

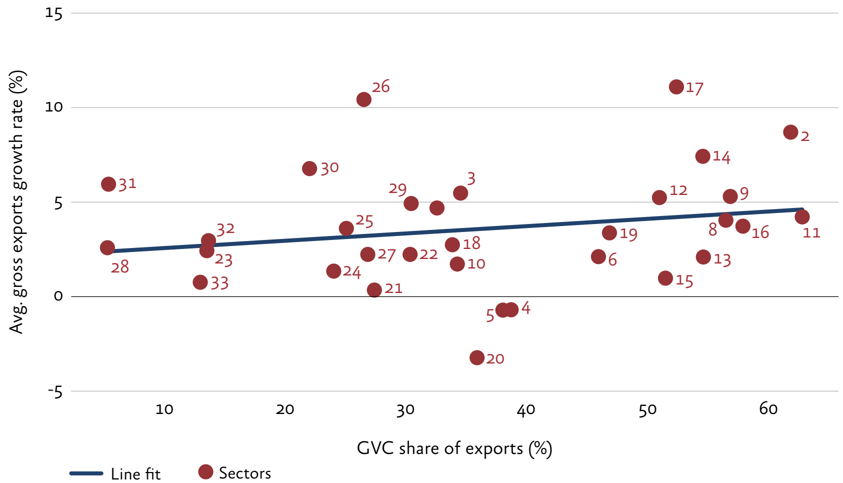


Figure 7 GVC participation and Gross Value Added Growth by Sector in Portugal

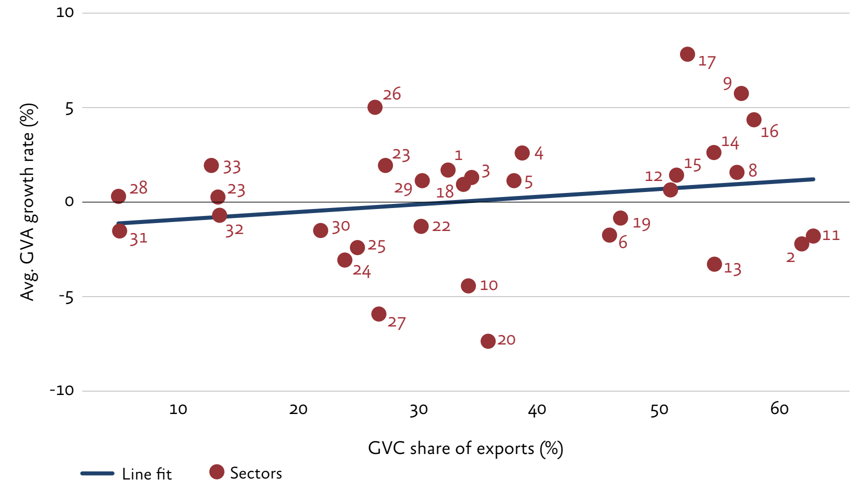
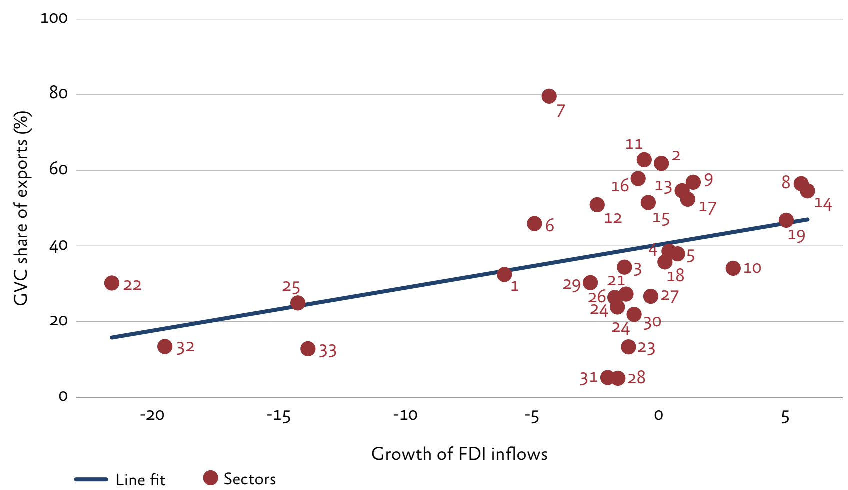


Figure 8 **GVC participation and FDI inflows by Sectors in Portugal**



The spread of GVCs took off from around the mid-1990s, with global manufacturing networks becoming increasingly interdependent. At around the same time, manufacturing firms began to rely more extensively on a wide range of customisation services to market their products. As pointed out in Antrás (2020), «GVCs allow countries to benefit from the comparative advantage of other countries, not only at the sectoral level but also at the stage level within sectors». By broadening the range of international suppliers and strategic partnerships to customise and market products, and by creating a wide network that can stretch from acquiring unprocessed raw materials to delivering finished goods to end users, GVCs tend to lower input costs, increase scale and facilitate technology and knowledge transfer, thereby raising firm-level productivity.[98] The gains of trade grounded on traditional country-based production models are thus magnified. Because of their potential to integrate production processes and marketing across borders, it is only natural that large multinational enterprises (MNE) have been a centrepiece of GVC diffusion. Therefore, a key actor in GVC diffusion is the so-called *lead firm*, which usually earns market powers through technological research and product design, undertaking big investments in brand development. In turn, these investments allow the lead firm to select alternative vendors and capture the lion's share of the value created within GVCs[99]. Well-known examples include high-tech giants like Apple, Cisco and Dell.

These considerations not only highlight the beneficial effects of Portugal's expanding involvement in GVCs, but also invoke the important question of how this is best done so that the country explores its comparative advantages and maximises value added more effectively within GVCs. Within this context, the debate between manufacturing and service-industry specialisation is visibly important: since the operation of GVCs has been increasingly involving more services inputs, GVC involvement is also dictated by productivity and costs in the local service sector — including a broad range of relationships that support businesses, such as IT, marketing, and distribution support. This clearly touches upon the long-standing and politically-sensitive debate on the inevitability, or desirability, of de-industrialisation, entailing a relative decline in the participation of traditional labour-intensive industries in GDP accompanied by the concomitant rise of a modern and more productive service sector. The other debate is focused on the *made in* vs *created in* question, i.e., *fostering local-based innovation* vs *importing technology and specialising in more downstream activities* such as manufacturing and marketing to the final user, at home or abroad.

A sensible first stab at answering this complex set of questions is to better understand the Portuguese experience so far regarding the effects of GVC involvement, the participation of firms in export markets and the role of foreign ownership in the evolution of employment, productivity and wages at the firm level.

6.4.1. Dataset considerations

For a sensible empirical analysis of the relationships mentioned above, it is important to be aware of the strengths and limitations of the existing datasets. One of the strengths is the availability of country-wide firm-level data on more than 200,000 private non-financial firms (excluding self-employed entities) over 13 years (2006–2018). These data provide information, among other observables, on firm size, ownership (foreign vs national), age, employment, wages, labour force education, managerial indicators and degree of participation in foreign markets. By generating 44.3 billion euros of gross value added in 2018, this firm-level dataset accounts for about a quarter of Portugal's GDP. For further information on the construction of this dataset, see Alexandre and Portela (2021).

A salient limitation of this dataset is that it does not unveil input-output relations among resident firms, nor the underlying contractual relationships between lead firms and suppliers participating in GVCs. These relationships are crucial to identify some of the channels through which GVC participation affects domestic value added. Yet, the data does allow us to gauge the effects of greater direct participation in export markets and the role of foreign ownership on the firms' performance, which are crucial to understand some of the major effects of FDI and GVC participation on the economy. Moreover, and importantly, by aggregating data on firms at the sector level (using, e.g., the TiVA sectoral classification), we can make inferences on the contribution of GVC participation to firm performance, as discussed below.

6.4.2. Firm-level stylised facts

Table 1 provides key summary statistics for our sample of non-financial private firms. The second to fourth columns highlight the differences between firms according to their degree of participation in foreign markets (as measured by the share of exports in total sales). The following columns break down the sample into two groups: (1) between domestically and foreign-owned firms, defining the latter as those with more than 50 % foreign ownership and; (2) between sectors with above-average GVC participation (*High GVC*) and sectors with below-average GVC participation (*Low GVC*). In all columns, the number in parenthesis shows the standard deviation of the variable immediately above.

Table 1 Descriptive Stats by Export type, Domestic vs Foreign-Owned Firms and High vs Low GVC participation

	All	exp <= 10%	10%< exp < 50%	exp >= 50%	Domestic	Foreign	High GVC	Low GVC
# Firms	200699	183594	8388	8717	195666	5033	17902	182797
% of Total	100 %	91.5 %	4.2 %	4.3 %	97.5 %	2.5 %	8.9 %	91.1 %
Sales Volume (in thousands of €)	1561	1132	6079	6264	1125	18500	4465	1277
	(29400)	(20100)	(92200)	(56400)	(23000)	(117000)	(75600)	(19700)
GVA (in thousands of €)	221	178	645	718	197	1155	452	198
	(536)	(441)	(968)	(1071)	(475)	(1334)	(819)	(494)
Avg. Employees	13	11	32	44	11	88	27	12
	(129)	(127)	(99)	(184)	(108)	(450)	(95)	(132)
Productivity	19372	18445	27732	30843	18767	42891	20045	19306
	(19652)	(18844)	(23004)	(26221)	(18610)	(37000)	(17973)	(19808)
Avg. Salary / Hour	5.6	5.4	7.2	8.1	5.5	11.6	5.5	5.6
	(4.3)	(4.0)	(4.6)	(8.0)	(4.0)	(8.6)	(3.7)	(4.3)
Salary / Productivity	0.9	0.8	1.5	1.9	0.8	4.5	1.4	0.9
	(33.9)	(35.2)	(6.1)	(19.0)	(33.6)	(43.2)	(14.6)	(35.2)
Exports / Sales	0.06	0.02	0.32	0.85	0.06	0.31	0.16	0.05
	(0.21)	(0.10)	(0.16)	(0.15)	(0.19)	(0.40)	(0.30)	(0.19)
Share of Foreign firms	0.03	0.02	0.07	0.14	0.00	1.00	0.04	0.02
	(0.16)	(0.13)	(0.26)	(0.35)	0.0	0.0	(0.19)	(0.15)
Firm Age	16.0	15.8	19.0	16.1	15.9	17.5	18.6	15.7
	(13.6)	(13.5)	(14.6)	(14.7)	(13.6)	(15.5)	(14.4)	(13.5)
Employees' Avg. years of schooling	10.3	10.2	10.6	10.8	10.2	12.4	8.8	10.4
	(3.0)	(3.0)	(2.9)	(3.0)	(3.0)	(2.6)	(2.3)	(3.0)
% with experienced Manager in Foreign firms	0.05	0.05	0.11	0.12	0.05	0.29	0.05	0.05
	(0.22)	(0.21)	(0.31)	(0.33)	(0.21)	(0.45)	(0.22)	(0.22)
% with experienced Manager in Exporter firms	0.09	0.07	0.25	0.29	0.09	0.25	0.16	0.08
	(0.29)	(0.26)	(0.44)	(0.46)	(0.28)	(0.43)	(0.36)	(0.28)

Nine stylised facts emerge from the previous table:

Fact 1 — As in other countries, Portugal's participation in export markets is limited to a small sub-set of firms (**less than 7 %**, even after excluding self-employed entities).

Fact 2 — Firms that export more than 10 % of their sales are about six times **larger**, 1/3 **more productive** and pay **wages/hour rates** 40 % to 50 % **higher** than the ones that export less than 10 %.

Fact 3 — Firms that export more than 10 % of their sales have a **higher share of foreign ownership** (7–14 % vs 2 % of all firms).

Fact 4 — Firms that export more than 10 % of their sales have (unconditionally) about twice as high a chance of having **a manager with previous foreign firm experience**, and a nearly four-fold higher proportion (25–29 % vs 7 %) of **managers with experience in firms that export a non-trivial share of their output**. Expectedly, foreign firms are also much more typically managed by individuals with previous foreign firm experience (25 % vs 5 %).

Fact 5 — The level of educational attainment of the average employee is **low** throughout the distinct groups of firms (below university levels or 16 years of schooling), being only **marginally higher** for firms that export more than 10 % of their sales and significantly higher (two extra years of schooling) among foreign firms.

Fact 6 — The size differences between domestic and foreign firms are considerable, with foreign firms being, on average, **18 times** bigger than their domestic counterparts (measured by sales), and generating **five times** more value added and **eight times** more employment. In addition, foreign companies tend to export, on average, **30 % of their sales compared to 6 %** of the average domestic firm. Since foreign firms have higher participation in high GVC sectors (4 % vs 2 %), the average firm in high GVC sectors is also bigger.

Fact 7 — Foreign-owned firms have **much higher productivity** and pay **higher salaries** in absolute terms and in relation to their productivity, and they display less dispersion across firms in terms of these indicators.

Fact 8 — Combining the above facts, we conclude that **being both a high exporter and a foreign-owned firm** is generally associated with **higher firm size, higher wages and higher productivity**.

Fact 9 — Firms that operate in **high GVC sectors** tend to be **bigger** (27 vs 12 employees), be **older** (18.6 vs 15.7 years), have **higher foreign ownership** (4 % vs 2 %), **higher participation in export markets** (16 % vs 5 %), and higher **labour productivity** while paying **comparable wage rates**.

These facts clearly indicate that two of the most common traits of being a GVC participant —i.e., being, at least, partly foreign-owned and extensively engaged into export markets — are typically associated with higher productivity and employee remuneration. Since firms that operate in high GVC sectors export more (as % of sales), and have higher foreign ownership participation, as shown in the last two columns of table 1, these features tend to be most pronounced in sectors with higher GVC participation. However, and importantly, higher exporters and foreign firms, as well as firms operating in high GVC sectors, generate less domestic value added by unit of sale (on average). This may be the case because these firms are often two-way traders (Amador, Cabral and Ringstad, 2018), which means they also import more for every unit of sale. However, this lower ratio of GVA/sales does not imply that their contribution to GDP growth is lower. In fact, the evidence suggests otherwise since these firms sell more and are more productive. Finally, and importantly, firms operating in sectors with high GVC participation are also operating in sectors that invest more in research and development (R&D) as a share of value added (Galindo-Rueda, F., & Verger, F., 2016). To the extent that higher R&D spending translates into higher growth prospects, this adds another positive edge to the relationship between GVC participation and growth performance.

The upshot is that, even without available data allowing us to trace GVC participation at the firm level, our aggregation and breakdown of firm-level data, as presented in table 1, highly suggests that GVC participation improves firm growth and remuneration. We further reinforce this evidence through regression analysis exercises, which seek to go beyond the descriptive associations in table 1, and postulate some causality running from foreign exposure (through export and foreign ownership) and economic performance.

6.4.3. Measuring causal effects of export-market participation and foreign ownership on firm and sector level performance

As noted in the previous section, we will now use firm and sector level data to gauge econometrically the impact of foreign ownership and exposure to export markets on the performance of non-financial, non-self-employed private firms. We do this by using panel data spanning the period 2006 –2018 for the universe of firms with available data. Some relevant descriptive statistics of our firm panel were already presented in table 1 and discussed in the previous subsection (200,699 firms in total). Performance is measured by a set of five observables: i) productivity; ii) average salary/hour; iii) wage to productivity ratio; iv) exports as a share of sales; and v) total exports. As in table 1, we define foreign ownership as a binary indicator so that for any firm with a foreign investor's shareholding above 50 %, that indicator takes the value of 1. Foreign market participation is measured as a dummy variable that equals 1 when the company exports more than 5 % of sales in two consecutive years. We also control for variables that previous studies found important, including the firm's age, workers' educational attainment and management experience (Bastos e al, 2018; Guadalupe et al., 2012).

We proceed at two levels of aggregation. The first level concerns the individual firm, and we use a fixed effect (FE) specification to investigate the impact of a set of independent variables on the performance variables listed above, and a probit model to gauge the probability of the firm becoming an exporter. For this level of aggregation, we have 200,699 firms × 13 years of observation. The second level of aggregation concerns the sector-region pair, for which we have 1078 observations (16 or 17 sectors depending on the region × 5 regions × 13 years). The first-aggregation level regressions effectively gauge the direct effects of foreign exposure on those five observables (through ownership, commerce and human capital flows). We also explore the spillover effects of foreign exposure that go beyond the individual firm, both on the sector and on the region where the firm operates. The aggregation of the sector-region pair aims to capture the broader and wider economic effects.

The FE results reported in table 2 show the positive effect of becoming a foreign-owned firm on the set of five observable variables (Model $_{\text{Productivity}}$: $\beta_{\text{Foreign owned}} = 0.0594$, $p < 0.01$; Model $_{\text{Wages}}$: $\beta_{\text{Foreign owned}} = 0.0194$, $p < 0.01$; Model $_{\text{Wages/Productivity}}$: $\beta_{\text{Foreign owned}} = 0.0185$, $p < 0.01$; Model $_{\text{Exports/Sales}}$: $\beta_{\text{Foreign owned}} = 0.0068$, $p < 0.01$ and Model $_{\text{Exports}}$: $\beta_{\text{Foreign owned}} = 0.2156$, $p < 0.01$). In addition, the results show that higher educational attainment and a manager with previous experience in exporting or foreign firms are favourable factors. These findings are aligned with those of Bastos et al. (2018), as well as with the international business literature indicating that foreign MNEs perform better, on average, than domestic firms, since they have access to more resources and capabilities (Michel and Shaked, 1986) and that there is a correlation between performance and exporting (Wagner, 2007).

We have also quantitatively examined the likelihood of a firm becoming an export using linear and probit regression models. The various regression results are not shown to conserve space but mostly confirm the expectation that foreign ownership increases the probability of becoming an exporter. Previous managerial experience in exporting firms also increases the probability of a firm becoming an exporter. The most surprising finding is the ambiguous effect — depending on the regression specification — of hiring managers with working experience on a foreign firm on the probability of becoming an exporter. While the FE regression shows a marginally significant positive effect of this variable on the probability of a firm becoming an exporter, the regressions without FEs show a negative effect. These mixed findings might be explained by the difficulties of certain firms in translating the knowledge brought by employees with previous experience in foreign firms into productivity gains (Dokko et al., 2009). Differences in management practices between foreign and domestic firms might hamper the ability of domestic firms to incorporate the knowledge and skills acquired by employees with experience in foreign firms (Sofka et al., 2014; Distel et al., 2019). When analysing these findings, in light of the results from table 2, we can conclude that human capital with foreign firm experience plays a clear role in increasing the export performance of already exporting firms, but we also conclude that it is more difficult for firms to rely on this kind of human capital to become an exporter. Table 3 presents the results of the sector-region level of aggregation, seeking to tease out the effects of foreign ownership on economic performance. We measure foreign ownership in two alternative ways — one as the % share of sales, and the other as the % share of employment — and report the measurement based on the % of sales. The variable that accounts for the effects of FDI (*weight of foreign firms in the region/industry*) shows no positive sector-region wide effects on productivity. Since the effects of foreign ownership are positive in the firm-level regressions reported in table 2, this may suggest a negative spillover effect of foreign ownership on the productivity of other firms. However, in all other variables, including wages and export participation, the effect of an increase on the weight of foreign firms in the region/industry has a general positive impact on the sector-region pair. Again, the surprising results regarding productivity might be explained by the difficulty of local firms in translating the knowledge and skills acquired by employees who previously worked in foreign firms into productivity gains. Specific knowledge is difficult to adapt to different contexts. Firms might have more ease in capturing knowledge that can help them internationalise their activities (exports) and attract better employees (higher salaries) than in adopting new ways of organising their activities that lead to productivity improvements.

Table 2 Regression analysis: FE

	Ln Productivity	Ln Average Wage	Ln Wages/ Productivity	Ln Exports/ Sales	Ln Exports
Micro	0.0040	-0.0223***	-0.1682***	-0.0078***	-0.6130***
	(0.003)	(0.001)	(0.001)	(0.000)	(0.014)
Medium	0.0366***	0.0079***	0.2615***	0.0127***	0.7336***
	(0.006)	(0.002)	(0.005)	(0.001)	(0.037)
Large	0.0455***	-0.0053	0.6607***	0.0218***	1.4899***
	(0.015)	(0.006)	(0.019)	(0.003)	(0.107)
Foreign owned	0.0594***	0.0194***	0.0185**	0.0068***	0.2156***
	(0.011)	(0.004)	(0.008)	(0.003)	(0.070)
Exporter	0.1001***	0.0194***	0.0049***		
	(0.003)	(0.001)	(0.001)		
Firm age	0.0227***	0.0038***	-0.0022***	0.0001	0.0359***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.004)
Firm age sq.	-0.0002***	-0.0000***	0.0000***	-0.0000*	-0.0004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (Avg.)	0.0039***	0.0080***	-0.0029***	-0.0001	0.0031
	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)
Education (s.d.)	-0.0091***	0.0025***	0.0089***	0.0004***	0.0421***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)
Share Sales (Reg&Ind)	-0.0010***	-0.0006***	-0.0002***	0.0001***	0.0011
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Manager F. Owned Exp	0.0049	0.0170***	0.0652***	0.0022**	0.1866***
	(0.006)	(0.002)	(0.004)	(0.001)	(0.035)
Manager Export Exp	0.0210***	0.0152***	0.0658***	0.0147***	0.5341***
	(0.005)	(0.002)	(0.003)	(0.001)	(0.030)
R-sq-within	.02	.13	.056	.0068	.017
R-sq-between	.023	.16	.34	.088	.15
Rho	.74	.78	.71	.79	.69
corr(u_i, Xb)	-.16	.18	.47	.24	.27

Notes: robust standard errors in parenthesis (clustered at the firm level).
Ln indicates that the variables are measured in logarithms of the raw data for the respective variable.
Significance levels: *, 10 %; **, 5 %; ***, 1 %.
All regressions include time, region and sector dummies.
Firms: 385189
Observations: 2230211

Table 3 Sector-Region OLS Regression — Foreign Firm share measured as % of sales

	Ln Productivity	Ln Average Wage	Ln Wages/ Productivity	Ln Exports/ Sales	Ln Exports
A: Agriculture, Forestry and Fishing	-0.3953*	0.2556*	-1.5342	0.0402	-1.7865
	(0.164)	(0.100)	(0.909)	(0.027)	(1.049)
B: Mining and Quarrying	-0.1683	0.6341**	-2.9491**	0.1544	-2.2230
	(0.192)	(0.188)	(0.742)	(0.108)	(1.106)
C: Manufacturing	-0.2493*	0.2417	0.0320	0.2063***	1.0875
	(0.115)	(0.115)	(0.700)	(0.038)	(0.809)
D: Electricity, Gas, Steam, Air Supply	1.5469**	0.1909	-6.4424***	-0.0218	-7.0788***
	(0.457)	(0.105)	(0.510)	(0.060)	(1.032)
E: Water; Sewerage, Waste Management, Remediation Activities	0.2257	0.3828***	-2.0063*	0.0098	-2.8310**
	(0.154)	(0.071)	(0.891)	(0.016)	(0.922)
F: Construction	-0.3061**	0.3632***	0.8530	0.0304	0.3078
	(0.080)	(0.078)	(0.762)	(0.029)	(1.058)
H: Transportation, Storage	-0.2448	0.6329***	-0.2745	0.0980	-0.0155
	(0.233)	(0.129)	(1.037)	(0.053)	(1.273)
I: Accommodation and Food Service	-0.6112**	0.0310	0.2672	-0.0471	-2.6693
	(0.167)	(0.071)	(0.785)	(0.023)	(1.345)
J: Information and Communication	0.5678	-0.2970	-3.6740***	0.2012***	-4.0302***
	(0.428)	(0.140)	(0.567)	(0.043)	(0.718)
L: Real Estate Activities	0.5250	-0.3308**	-3.5217***	0.0162	-4.9178***
	(0.274)	(0.109)	(0.621)	(0.014)	(0.642)
M: Professional, Scientific and Technical Activities	0.6073	-0.6208**	-2.9985**	0.1362*	-3.9319**
	(0.416)	(0.147)	(0.864)	(0.050)	(1.038)
N: Administrative and Support Service	-0.4681*	-0.2128**	-0.4090	0.0397	-2.0137***
	(0.214)	(0.048)	(0.692)	(0.022)	(0.428)

	Ln Productivity	Ln Average Wage	Ln Wages/ Productivity	Ln Exports/ Sales	Ln Exports
P: Education	0.0244	-0.4841**	-3.4607**	0.0527	-8.0007***
	(0.343)	(0.171)	(0.819)	(0.028)	(0.847)
Q: Human Health and Social Work Activities	0.3494	-0.5601***	-2.8253***	0.0244	-6.4067***
	(0.208)	(0.108)	(0.418)	(0.031)	(0.722)
R: Arts, Entertainment and Recreation	0.1721	0.1396	-2.7412***	0.0304	-4.7419***
	(0.332)	(0.239)	(0.410)	(0.014)	(0.296)
S: Other Service Activities	-0.4882***	-0.0891	-1.9906**	-0.0241**	-5.7606***
	(0.067)	(0.051)	(0.463)	(0.007)	(0.848)
Sales Share of Foreign Firms	-0.0014	0.0060**	0.0315*	0.0021*	0.0499*
	(0.002)	(0.002)	(0.013)	(0.001)	(0.020)
R2	.59	.72	.59	.61	.61

Notes: robust standard errors in parenthesis (clustered at the firm level)
Ln stands for the natural logarithm of the variable
Significance levels: *, 10 %; **, 5 %; ***, 1 %.
All regressions include time, region and sector dummies
Other Controls: Firm Age, Firme Age squared, Average Employee education
Observations: 1078

6.5. Static vs Dynamic Comparative Advantages, FDI reallocation and GVC participation in Portugal

The sectoral composition of the Portuguese GDP has been traditionally heavily skewed toward services (notably tourism/accommodation and food, financial and business services, and public administration) and toward activities that are typically non-traded internationally, like retail commerce, construction, real estate and, more recently, financial services. Traditional manufacturing has been dominated by textiles and leather, food and beverage products, paper and paper products, and wood and cork products (figure 9). Among the primary sectors, fishing and winemaking are also staple activities in Portugal, so the weight of agriculture, forestry and fishing in GDP is higher than in many other OECD countries. These sectors have higher shares in Portugal's total exports than their respective world shares — a metric of ex-post or *static* comparative advantage proposed by Balassa (1989) and often called the Balassa index (figure 10). Both traditional Pearson's and the non-parametric Spearman's correlations indicate a positive association between the Balassa index and the sectoral value added participation underlying such a traditional pattern of specialisation.

By comparison, sectors whose exports are heavily reliant on GVC participation have low participation in GDP. This can be seen in figure 9, where these sectors are marked in red, very much falling on the left of the sectoral share distribution. With the notable exception of three sectors (motor vehicles, metal, and plastic and rubber products), high GVC sectors also fall on the left of figure 10, indicating that Portugal is underrepresented in those sectors when compared with other countries worldwide.

It should also be noted that sectors with high participation of resident firms in GVC — notably, computer, electronic and optical products, electrical equipment, metal products, chemical and pharmaceutical products, rubber and plastic products, and motor vehicles — also have high global participation in GVC (World Bank, 2020). This means that GVC participation in Portugal broadly follows its sectoral distribution pattern in the rest of the world.

Figure 9 Portugal: Sectoral Shares in GDP

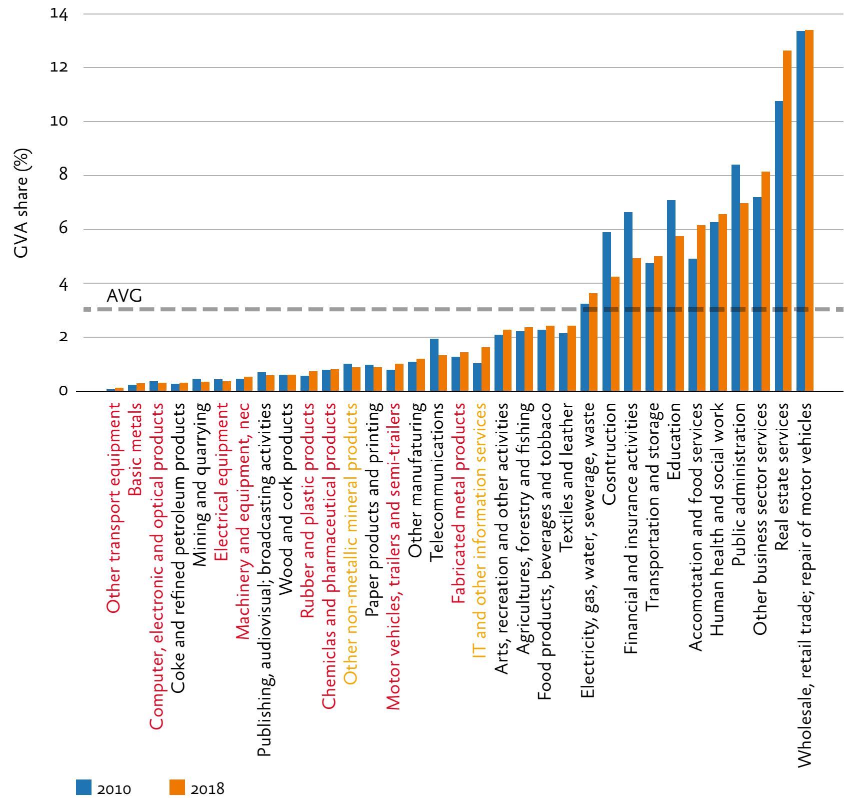
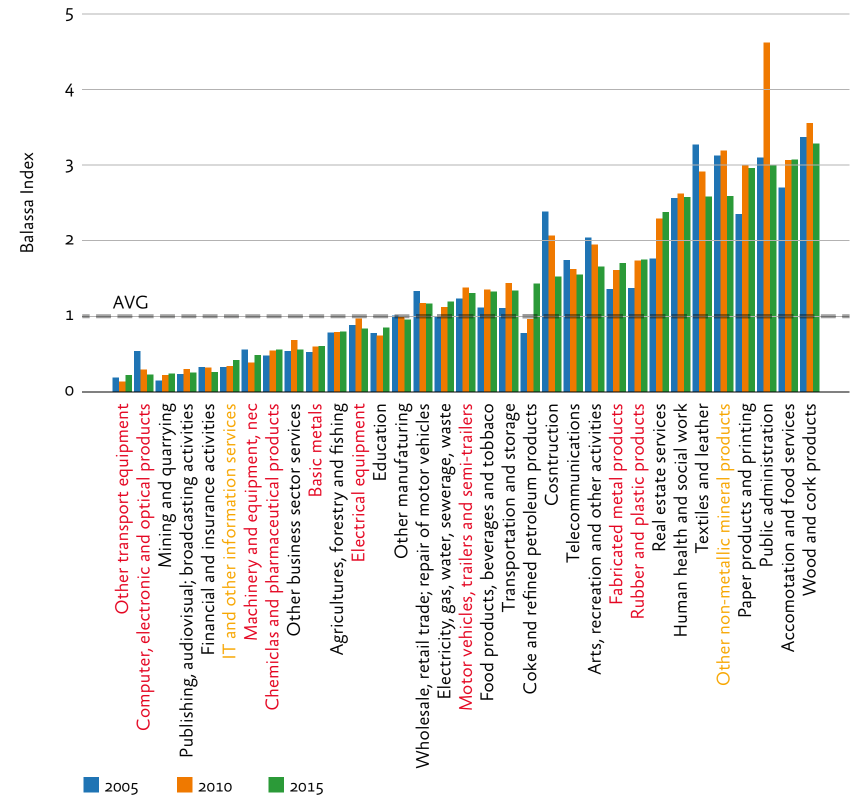


Figure 10 Balassa's Comparative Advantage Index



Furthermore, because the weight of most GVC intensive sectors in GDP is rising — albeit at low levels in some cases, since the country's traditional, ex-post comparative advantages do not fall within such sectors —, as measured by the Balassa index, for instance, GVCs have been spearheading changes in the country's specialisation that differ from its historical or *static* pattern of comparative advantages.[100]

However, a look at figures 9 through 11 suggests that these structural changes have not been particularly fast in many sectors. In figure 9, the increases in GVA shares in sectors below the average (dotted line) have been modest between 2010 and 2018, whereas figure 11 shows that GVC participation shares have been relatively *sticky* between 2005 and 2015 (according to the last information on GVC participation shares available). In other words, sectors with high (low) GVC participation in 2005 remained similarly high (low) in 2015. However, one sector that has become sharply important in the Portuguese economy was not among those with historical-comparative advantage— namely, *other business services*. The participation of this sector in GDP rose by nearly three percentage points between 2010 and 2018 (figure 9). This is a sector where back-office tasks associated with GVC participation may typically lie. The fact that it remains low among Portuguese exports relative to the rest of the world (figure 10) suggests that there is still considerable scope for fast growth through GVC participation in this sector.

How do these changes relate to the sectoral composition of FDI in Portugal? Figure 12 indicates that the FDI stock has tended to concentrate in traditional sectors with high value added, like retail and wholesale trade (sector 21), real estate (sector 28), utilities (sector 19), transportation and storage (sector 22), construction (sector 20) and accommodation and food services (sector 23). In particular, greater inflows of FDI toward the financial sector (together with real estate) have been a key feature of Portuguese economic growth over the recent decades (Alexandre et al., 2017). By contrast, GVC intensive sectors have attracted a much smaller share of FDI into the country, but this share has been rising since 2008. Again, this can be seen through simple correlation statistics, which show that the stock and inflow of FDI are positively correlated with gross value added (GVA) and negatively correlated with GVC participation, but the growth of FDI inflows is positively correlated with GVC participation. This is consistent with the underlying change toward sectoral reallocation in the direction of new GVC-intensive sectors. In addition, the weight of past FDI allocation and the continued attractiveness of sectors like construction, real estate, and financial services continue to positively drive FDI inflows.

Figure 11 **GVC participation shares by sector**

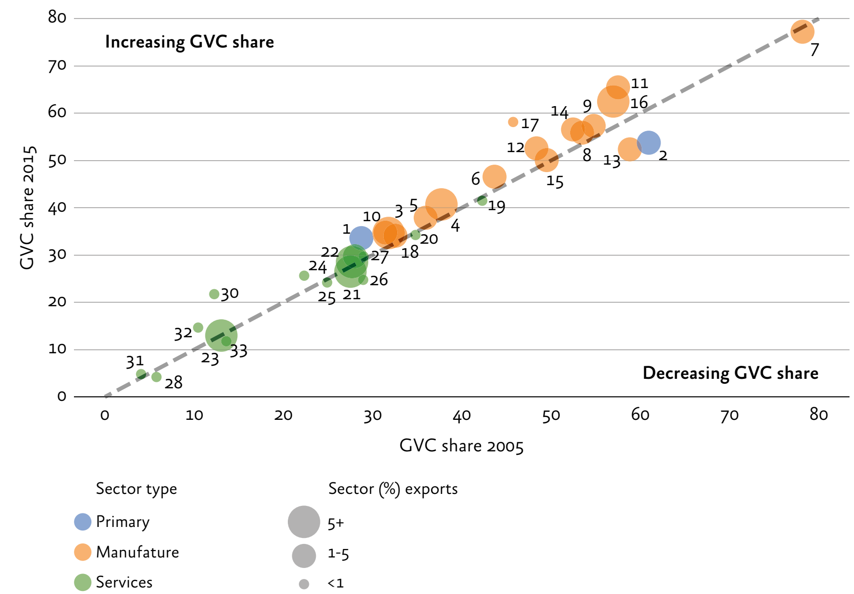


Figure 12 Sectoral Distribution of FDI

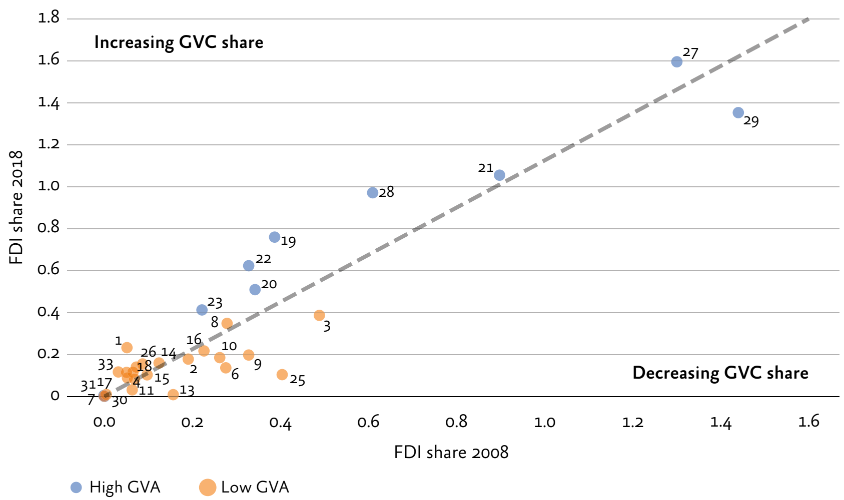
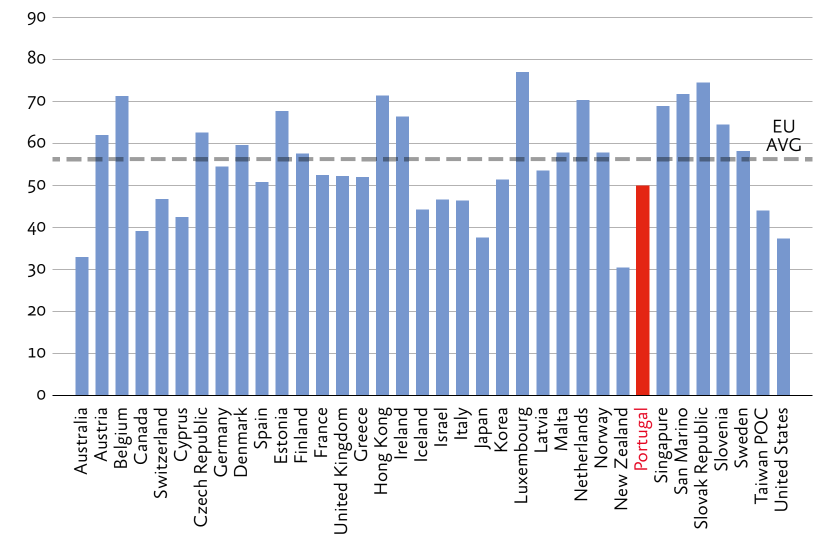


Figure 13 GVC Participation (as % of exports) in Advanced Countries, 2015



6.6. Policy Implications

The rise of GVC exports and the weight of GVC-intensive exports in GDP has been an important feature of Portuguese economic growth over the past two decades. This trend is clearly in line with the development elsewhere in the EU and worldwide, and the trust of the theoretical and empirical literature on the topic points to its broad macro and micro-economic desirability. However, as shown above, sectors with above-average GVC participation in the country — which, as also shown above, are also the sectors with higher global GVC participation— remain small in terms of gross value added relative to GDP. They also remain a small proportion of Portugal's overall exports relative to their international counterparts, as shown by the Balassa index. Portugal's overall share of exports related to GVC trade also remains below the EU average, as per the latest observation point available (figure 13), a finding that is echoed by a recent study of the European Commission (2020) on FDI and GVC participation in Europe at the sector level, which places Portugal in the low participation group together with Croatia, Cyprus, Greece, Italy, Spain and Latvia.[101]

However, as noted above, GVC participation has been increasing and appears to have been instrumental in increasing Portuguese exports — both in gross and value-added terms —, even though other traditional/lower GVC sectors (like tourism-related activities) have shown considerable export dynamism in recent years and became a high value-added activity. Combined with the econometric results of section 4 — on the overall positive effect of export-market participation and foreign ownership on economic performance at the firm level —, these various pieces of evidence make a clear case for raising the level of GVC participation in Portugal and doing so at a faster pace. Given the positive connection between FDI and GVC participation, which shows up in Portuguese data and has also been widely documented for various other countries, FDI-friendly policies clearly have a role to play in this connection.

Turning to what policy can do to enhance GVC participation and increase its impact on the Portuguese economy, a variety of studies have identified factors associated with FDI and GVC attraction that are under the control of policy and, hence, could be used as levers for this purpose. They include: i) improved connectivity (physical and Internet-based); ii) greater efficiency of the domestic legal system and, in particular, of contract enforcement; iii) greater educational attainment of the labour force or human capital in general; iv) lower unit labour costs (i.e., wage rate relative to productivity) and; v) increased ability of local firms to benefit from the knowledge and skills brought by foreign firms. While there has been considerable heterogeneity in the quantitative estimates of the ultimate effects of these variables on the GVC participation at the country level, the direction of the effect is clearly positive. Since these goals are also desirable for other reasons, it is plain that goals i) to v) are commendable policy goals.

It is also important to understand what may be under the broad umbrella of goals in i) to iii). In goals i) and ii), for instance, one could think that information flows about regional capabilities and regulations to the foreign investor are important. If so, there should be efficiently-operated and suitably decentralised agencies to convey relevant information to the foreign investor and help guide their decision to allocate FDI into the most attractive region/sector pair. Within this context, there is room for policy to incentivise the creation of research centres of excellence — which in today's world may include new research on the adoption of green technologies — helping connect small and medium enterprises to GVC leading firms. One example in this connection, cited in World Bank (2020), is The Penang Skills Development Centre in Malaysia, which is said to have played an important role in supporting Malaysia's upgrading to electronics and engineering GVCs. Within the context of greater connectivity, it seems relevant to distinguish between sub-indicators, for instance, extending the use of the Internet to schools, and not only to the broader population. A lower tax wedge on labour, better training programmes and education, together with the effects of better managerial practices and a properly designed social safety net, allow a country to increase its productivity and lower its unit labour costs without necessarily lowering the take-home wage and increasing inequality (see Catão and Obstfeld, 2019 and various chapters therein).

The considerations above point in the direction of specific macro and micro policy goals, potentially achievable by the end of this decade, which include:

Macro Goals:

- raise the ratio of gross exports of goods and services to GDP to no less than the EU average (currently, about 60 %, see figure 1);
- raise the ratio of GVC participation in gross export to no less than 60 %, i.e., again closer to the EU average (see figure 13);
- raise the gross FDI liability stock above 100 % of GDP;
- lower the ratio of NFL to exports below 160 per cent.

Micro/Structural Goals:

- raise Internet connectivity — measured by Internet use per capita and/or Internet use in schools — from current levels to no less than the EU average;
- raise the quality of physical infrastructure, in particular port infrastructure, to no less than the EU average (for instance, as measured by the World Economic Forum index ranging from 1 to 7);
- raise the share of skilled labour in total force to no less than the EU average (using the OECD or other metrics);
- raise the average years of school of the average employee in private non-financial firms from 10.3 years (in 2018, see table 2) to no less than 12-13 years;
- raise the share of managers with experience in foreign firms among private non-financial firms from 5 % (in 2018, see table 1) to 10 % or more;
- raise the share of managers with experience in exporting firms among private non-financial firms from 9 % (in 2018, see table 1) to no less than 15 %–20 %.

It is important to bear in mind that some of the targets mentioned above are relative to other countries, which means that the goalposts are moving — and likely in the direction of more GVC engagement by many countries within the EU — and, therefore, can be effectively quite ambitious. It is also important that the macro and micro/structural goals mentioned above are complemented, and perhaps aided, by other important objectives of the government's current medium-term economic plan, which is expected to guide the sectoral allocation of EU funds and other public resources[102] — including employment goals, measures to improve technological capabilities in the public and private sectors, particularly regarding green technologies, and measures to promote greater social equity.

In a nutshell, the overarching goal of policies should be clear: namely, promote a more extensive and efficient insertion of Portugal in the production network at both the EU and global levels, through a higher and quality-oriented participation of Portuguese firms in GVCs and FDI friendly policies, particularly in sectors where Portugal remains underrepresented in the respective export-share participation, so as to maximise the potential of value added growth in the country for the rest of this decade and beyond. The recent disruptions in GVC linkages associated with the COVID-19 crisis and rising concerns on the desirability of increasing intra-regional linkages in strategic sectors offer

Portugal a timely opportunity to signal its attractiveness as a location for GVC-related foreign investment. In line with the foregoing discussion, this can be done by showing a clear government resolve to achieve the macro/structural goals highlighted above, therefore increasing the relative attractiveness of the country as a locus for FDI and, consequently, incentivising domestic firms, particularly smaller ones, to start or broaden their participation in GVCs.

References

Alexandre, F., Bação, P., Carreira, C., Cerejeira, J., Loureiro, G., Martins, A. and Portela, M., *Investimento empresarial e o crescimento da economia portuguesa,* ed. Fundação Calouste Gulbenkian, Lisboa, 2017.

Alexandre, F., Costa, H. and Portela, M., *Growing innovative SMEs: the entrepreneur and his/her circumstances*, mimeo, 2021.

Amador, J., Cabral, S. and Ringstad, B., «International trade in services: firm-level evidence for Portugal», *Portuguese Economic Journal*, Vol. 18 No. 3, 2019, pp. 127–163.

Antràs, P., «Conceptual aspects of global value chains», *World Bank Economic Review,* Vol. 34, No. 3, 2020, pp. 551–574.

Antràs, P., *De-Globalisation? Global Value Chains in the Post-*COVID*-19 Age*, NBER Working Paper 28115, National Bureau of Economic Research, 2020.

Balassa, B., *"Revealed" comparative advantage revisited*, Comparative Advantage, Trade Policy and Economic Development, New York University Press, New York, 1989, pp. 63–79.

Bastos, P., Dias, D. A., & Timoshenko, O. A., «Learning, prices and firm dynamics», *Canadian Journal of Economics/Revue canadienne d'économique*, Vol. 51 No. 4, 2018, pp. 1257–1311.

Bastos, P., Monteiro, N. P., & Straume, O. R., «Foreign acquisition and internal organization», *Journal of International Economics*, Vol. 114, 2018, pp. 143–163.

Catão, Luís A.V. and Gian Maria Milesi-Ferretti, «External Liabilities and Crisis Risk», *Journal of International Economics,* Vol. 94 No. 1, 2014, pp. 18–32

Catão, Luís A.V., *"Reforms and External Balances in Peripheral Europe" in Economic Crisis and Structural Reforms in Southern Europe: Policy Lessons*, edited by D. Katsikas and P. Manasse, Routledge, London, 2017.

Catão, Luís A.V. and Maurice Obstfeld (eds), *Meeting Globalization's Challenges: Policies to Make Trade Work for All,* Princeton University Press, 2019.

Distel, A. P., Sofka, W., de Faria, P., Preto, M. T., & Ribeiro, A. S., «Dynamic capabilities for hire–How former host-country entrepreneurs as MNC subsidiary managers affect performance», *Journal of International Business Studies,* 2019, pp. 1–32.

Dokko, G., Wilk, S. L., & Rothbard, N. P., «Unpacking prior experience: How career history affects job performance», *Organization Science*, Vol. 20 No. 1, 2009, pp. 51–68.

European Commission, «Foreign Direct Investment, Global Value Chains and Regional Development in Europe», 2020, link.

Galindo-Rueda, F., & Verger, F., *OECD taxonomy of economic activities based on R&D intensity*, OECD Working Paper 2016/04, 2016.

Goldberg, Pinelopi K. and Nina Pavcnik, «Distributional Effects of Globalization in DEVELOPING Countries», *Journal of Economic Literature*, Vol. 45, No. 1, 2007, pp. 39–82.

Guadalupe, M., Kuzmina, O., & Thomas, C., «Innovation and foreign ownership», *American Economic Review*, Vol. 102 No. 7, 2012, pp. 3594–3627.

IMF-WB-WTO, *Making Trade an Engine of Growth for All: The Case for Trade and for Policies to Facilitate Adjustment*, International Monetary Fund, Washington DC, 2017.

INE, Statistics Portugal, *Comércio Internacional (CI)*, Instituto Nacional de Estatística, Lisboa, 2018.

INE, Statistics Portugal, *Quadros de Pessoal (QP)*, Instituto Nacional de Estatística, Lisboa, 2018.

INE, Statistics Portugal, *Sistema de Contas Integradas das Empresas (SCIE)*, Instituto Nacional de Estatística, Lisboa, 2018.

Jones, L., Demirkaya, M., & Bethmann, E., «Global value chain analysis: concepts and approaches», *Journal of International Commerce and Economics*, April 2019.

Manova, Kalina, «Global value chains and multinational activity with financial frictions» in Amador, João and Filipo di Mauro (eds) *The Age of Global Value Chains*, a VoxEU.org (eBook), CEPR Press, 2018.

Michel, A., & Shaked, I., «Multinational corporations vs. domestic corporations: Financial performance and characteristics», *Journal of international business studies*, Vol. 17 No. 3, 1986, pp. 89–100.

Miroudot, S., *Services and manufacturing in global value chains: is the distinction obsolete?*, ADBI Working Paper 927, 2019.

OECD, «FDI Qualities Assessment of Ireland», 2020, link

Sofka, W., Preto, M. T., & De Faria, P., «MNC subsidiary closures: What is the value of employees' human capital in new jobs?», *Journal of International Business Studies*, Vol. 45, No. 6, 2014, pp. 723–750.

Wagner, J., «Exports and productivity: A survey of the evidence from firm -level data», *World Economy*, Vol. 30, No. 1, 2007, pp. 60–82.

World Bank, *Trading for Development in the Age of Global Value Chains*, Global Development Report, Washington DC, 2020.

Paper 7
Contributions for a National Ocean Strategy

Maria Antonieta Cunha e Sá, Nova School of Business and Economics
Til Dietrich, Nova School of Business and Economics
Flora Marchioro, Nova School of Business and Economics
Renato Rosa, Nova School of Business and Economics
Catarina Frazão Santos, NovaSBE, Marine and Environmental Sciences Centre
Carina Vieira da Silva, NovaSBE, Marine and Environmental Sciences Centre

7.1. Introduction

Currently, Portugal has approximately 1.7 million km² of maritime territory under national jurisdiction, which is roughly 18 times its land size. If Portugal's submission to the United Nations for the extension of the outer limit of its continental shelf beyond 200 nautical miles is approved, the territory will span for almost 4 million km². This is equivalent to 40 times Portugal's land area (Portuguese Government, 2013), approximately 1 % of the Earth's water surface, 4 % of the Atlantic Ocean or the land size of the European Union (EU) (DGPM, 2014). Naturally, activities related to the ocean are representative of the Portuguese economy and cultural heritage. Accordingly, the Portuguese government was among the first in Europe to develop a national ocean strategy, starting this process in 2004.[103] Since then, several initiatives were undertaken at the national level to promote ocean's sustainable management.

The coming years are likely to be characterised by the recovery from the economic downturn due to the COVID-19 pandemic. This entails challenges, but also opportunities for rebuilding a more resilient economy. In Portugal, this will necessarily involve fostering sustainable blue growth by taking advantage of the country's geostrategic and geopolitical position, while preserving blue natural capital.

Given the importance of the ocean and Blue Economy[104] (BE) for Portugal and the key role that the ocean plays in the EU transition path to carbon neutrality in 2050, it is crucial to advance scientific knowledge in order to improve public policy decision-making for social good. This policy paper contributes to this endeavour by looking into the future and by taking lessons from past policies, assessing knowledge gaps, and setting out proposals (recommendations) to design and implement cost-effective maritime policies in the near future.

The remainder of this policy paper is structured as follows. Section 2 reviews Portuguese marine policies over the last two decades, analysing the past performance of the Portuguese Blue Economy (BE) and related sectors, examining the environmental status of the ocean, and discussing Marine Spatial Planning (MSP) in Portugal. Based on the findings from section 2 and a literature survey on the topic, section 3 identifies knowledge gaps and provides recommendations for a sustainable maritime policy framework. Finally, section 4 offers some concluding remarks.

7.2. Portuguese blue growth: two decades of marine policies (2000–2020)

Since the beginning of the 21st century, the interest in ocean-related activities has increased worldwide. Several international initiatives were launched to foster governance, sustainable management of the ocean, and blue growth in that context. Portugal has not only followed that trend but has also positioned itself amongst the nations leading the international agenda on this topic. Portugal has thus also been at the forefront of the definition of national ocean policies. Particularly relevant for this paper are the first two National Ocean Strategies (NOS), which, having recognised the potential role the ocean may have for the country, defined a set of policy objectives and initiatives targeting the blue economy. Below, we briefly present the objectives and main lines of action put forward by both strategies.

While their architectural policy design differs, both the NOS 2006–2016 and the NOS 2013–2020 (Portuguese Government, 2006, 2013) concur regarding set objectives (see table 1). The NOS 2006–2016 does not explicitly include goals related to the ocean's value on strengthening Portugal's national identity and its potential role in increasing Portugal's relevance in international fora. However, these are still explicitly conveyed in the document. Both strategies are also aligned in terms of the principles guiding their implementation. Namely, they advocate a precautionary principle approach, and an integrated maritime policy grounded on ecosystem-based management. Finally, both strategies propose a set of actions to foster the development of ocean-related activities. In this context, NOS 2013–2020 explicitly addresses all blue economy sectors and puts forward a total of over 100 specific measures to foster sustainable maritime activities. NOS 2006–2016 is more concise, as it singles out tourism and ports as established activities with potential for growth, identifies six new areas where Portugal may be internationally competitive (renewable energies, aquaculture, underwater robotics, instruments and sensors for the study of the ocean, biotechnology and genetic resources), and proposes 40 policy measures.

Table 1 National Ocean Strategies' Objectives

NOS 2006–2016	
Create the conditions and mechanisms that may enable the various agents to develop, in a balanced and articulated manner, the multiple activities linked to the sea, promote the marine environment's quality, economic growth, and create new jobs and opportunities.	The realisation of these activities must be based on adequate scientific knowledge, an adjusted spatial planning, the constant defence of marine biodiversity, and the preservation of this valuable resource, which is the sea.
NOS 2013–2020	
Reaffirm the national maritime identity in a modern, proactive and entrepreneurial framework. Bring to realisation the economic, geostrategic and geopolitical potential of the national maritime territory, turning the Mar-Portugal into an asset with permanent economic, social and environmental benefits. Create conditions to attract investment, both national and international, in all Sea economy sectors, promoting growth, employment, social cohesion and territorial integrity, and, until 2020, promote an increase of the sea economy contribution for the GDP of about 50 %.	Strengthen national scientific and technological capacity, stimulate the development of new areas of action that promote the knowledge of the Ocean and effectively, efficiently and sustainably enhance its resources, uses and activities as well as the ecosystem's services. Make Portugal, on a worldwide level, a leading maritime nation and an undisputed partner of the Integrated Maritime Policy and of the EU maritime strategy, in particular for the Atlantic area.

Whilst comparing the policy structure of both strategies is no simple task, they essentially intervene in four domains:

1. the role of the ocean in reinforcing Portugal's national identity;
2. sustainable Blue Economy Growth;
3. knowledge-based Integrated Maritime Policy;
4. the Ocean and Portugal's relevance in international fora.

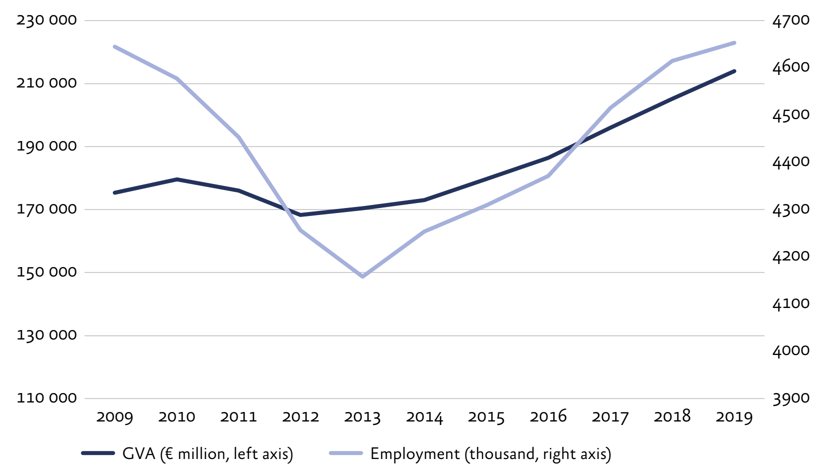
To date, and to the best of our knowledge, no study has critically analysed the results of past policies. While a formal evaluation of the NOS is not feasible, in this paper we discuss the evolution of key aggregates related to the second and third domains identified above. The success of policies aiming to foster Sustainable Blue Economy Growth is evaluated through the analysis of blue economy's past performance. To assess the existence of a knowledge-based Integrated Maritime Policy, we look at the environmental status of marine and coastal ecosystems, and the development of Marine Spatial Planning (MSP) in Portugal.

7.2.1. Overview of the Portuguese Blue Economy (BE) in the past decade

In this section, the performance of the Portuguese BE is examined. First, the context of data availability for marine indicators is briefly described, and general information is provided. Second, the overall performance of the BE is examined after describing some general trends for the Portuguese economy.

Activities related to the ocean are and have been an essential part of the Portuguese economy. As such, this section characterises the BE in the past decade, providing a benchmark for evaluating public policy interventions in the following section, if found. Yet, since most economic databases are not compiled to provide information on the BE, it is difficult to trace the development of most activities related to the sea, with the exception of fisheries. The only aggregate databases for Portugal are the European Union Blue Indicators (EU BI) and the Ocean Satellite Accounts (OSA) (INE, 2020a). Since 2009, the EU BI provide the longest and most consistent time series (OSA has a break in the time series), and it serves as the main data source to assess the BE at an aggregate level and the relative contribution of the different sectors. Where applicable, EU BI are complemented with OSA data, fishing statistics and Port data from Instituto Nacional de Estatísticas (INE) (INE, 2020b). Even though the EU BI and OSA cover the whole BE, they are only comparable up to a limited extent[105]. The economic performance of the specific sectors is evaluated mainly on the basis of gross value added (GVA) and employment to ensure comparability. However, for some sub-sectors this information is unavailable, and other aggregates are used to track that sub-sector's development over time and understand the underlying patterns.

Figure 1 National economy GVA and employment

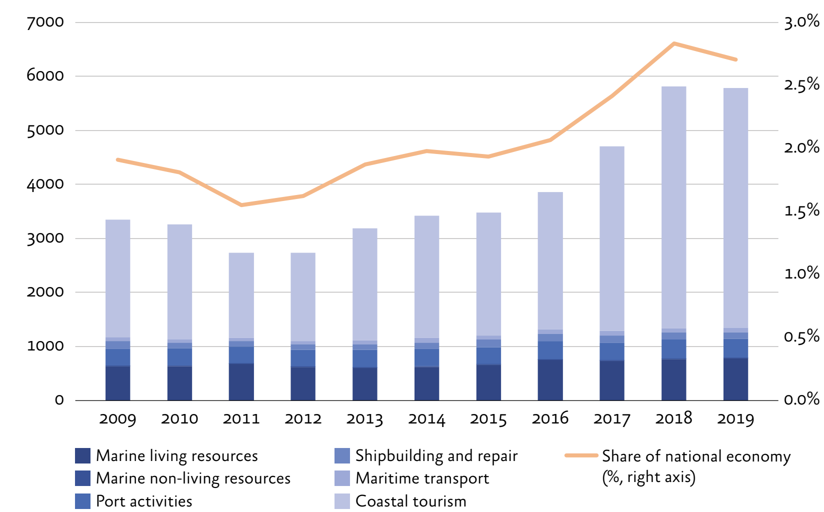


Source: EU Blue Indicator

To put the evolution of the Portuguese BE into perspective, we first present an overview of the performance of the Portuguese economy. First, we briefly assess the GVA and employment trends in the Portuguese economy[106]. Figure 1 shows that both GVA and employment experienced a dip during the European sovereign debt crisis. After 2012/2013, the situation started to improve and, as of 2015, growth rates rose sharply, with employment growing by 8 % between 2015 and 2019, reaching pre-crisis levels, and GVA increasing by 19.1 % over the same period.

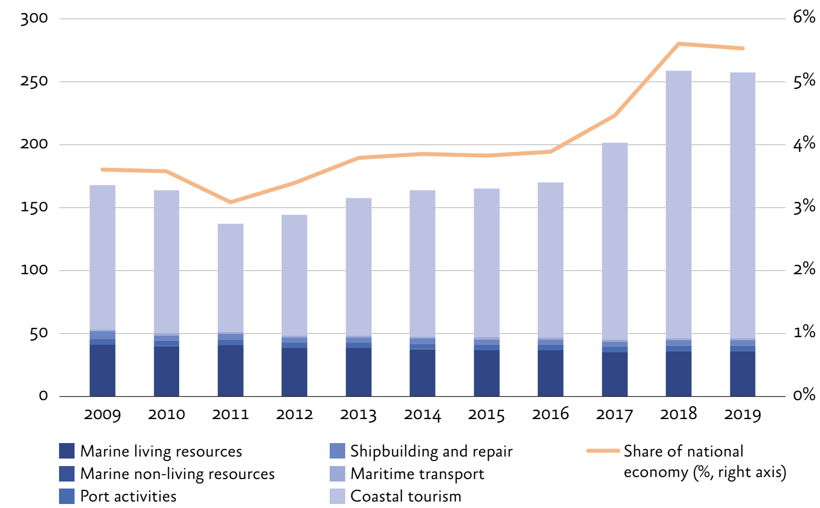
This general expansion of the Portuguese economy after exiting the bailout and reducing austerity measures in 2014 has to be taken into account when assessing the development of the BE. In 2019, the BE generated a GVA of €5.80 billion, which is 2.71 % of the national economy (figure 2). This represents an increase of about 72.9 % in comparison to 2009.

Figure 2 GVA of the Portuguese Blue Economy, million EUR (left axis)



Source: EU's Blue Indicators

Figure 3 Employment in the Portuguese Blue Economy, in thousands (left axis)



Source: EU's Blue Indicators

Figure 2 shows the trend in nominal GVA by sector and its contribution to the national economy, showing that the expansion started in 2013, after the sovereign debt crisis, and has accelerated after 2015. Before that period, BE GVA had decreased by roughly 1.5 %. Furthermore, the importance of the BE increased as it grew more than the national economy.

Figure 3 shows that employment followed a similar trend. In 2019, the BE employed 257,291 workers, which represents an increase of approximately 53 % compared to 2009. Again, recovery started in 2012, and a large share of this expansion is related to the post-2015 period as growth in the previous six years was at roughly 4 %. The proportion of national employment closely matched this development as it increased by about 53 %, from 3.6 % in 2009 to 5.5 % in 2018. Between 2009 and 2015, the proportion of national employment only rose by approximately 6 %. Despite the growth of the BE, average wages declined by roughly 3 %. Figures 2 and 3 show that the expansion of the BE seems to be largely driven by the coastal tourism sector.

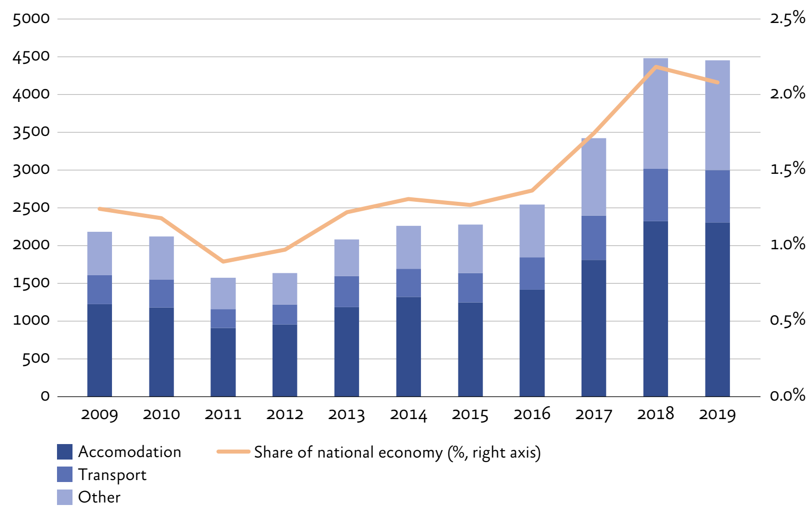
7.2.1.1. Performance of the Portuguese Blue Economy Sectors

In this section, we provide an overview of the economic performance of the Portuguese Blue Economy sectors.

a. Coastal tourism

Coastal tourism is, by far, the largest sector of the Portuguese BE and has a prominent position in the national economy. Figure 4 shows the evolution of its GVA between 2009 and 2019 (€4.45 billion, equivalent to 2.1 % of the national economy and 76.8 % of the BE). The sector grew 104 % during the analysed period. While the sector started recovering in 2013, a large proportion of this increase can be attributed to the post-2015 period, as GVA almost doubled. However, growth was slightly negative in 2019. Figure 5 reveals that employment in the sector followed a similar trend. In 2019, the sector directly employed 210,814 workers, covering 4.5 % of the national employment and representing 81.9 % of the Portuguese BE employment in Portugal, which increased by 84.8 %between 2009 and 2019. This expansion started in 2013, accelerated after 2015, growing by 75.6 % in three years, and slightly dropped in 2019. However, despite the strong employment growth, the average employee wage decreased by 7.1 %, indicating that employment growth was driven by relatively unskilled labour. Furthermore, tourists' *other expenditures* show the strongest growth in the period under analysis, representing a larger share of the current coastal tourism sector (figure 4). Those expenditures include, for example, cultural and recreational goods, and food and beverage services.

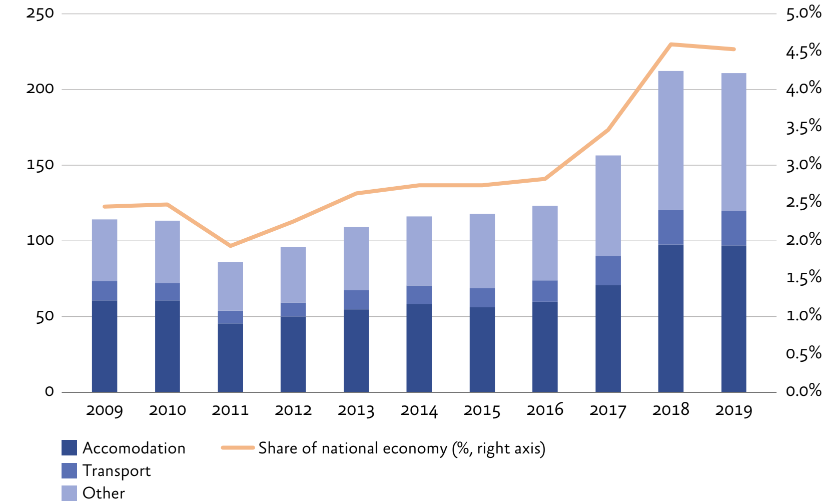
Figure 4 **GVA of coastal tourism, million EUR (left axis)**



Source: EU's Blue Indicators

When analysing the evolution of coastal tourism, it is interesting to consider tourism in general. A comparison with the Tourism Satellite Account reveals that coastal tourism developed in line with total tourism, which also experienced a boom after 2015.

Figure 5 **Employment in coastal tourism, thousands (left axis)**



Source: EU's Blue Indicators

b. Fishing industry

Historically, the fishing industry has played a key role in the economies of coastal nations such as Portugal. In 2019, its GVA was at €774.5 million, representing 0.36 % of the national economy. In comparison to 2009, it has increased by 21 %. The three main sub-sectors considered within the fishing industry are capture fisheries, aquaculture and the transforming industry. Figure 6 shows that the sector developed roughly in line with the national economy, as its share in total GVA is stable, around approximately 0.37 %, showing a declining trend in the past years. In 2016, the industry experienced an expansion, mainly driven by the aquaculture sub-sector, which almost doubled its GVA. The production of this sub-sector increased by 75.8 % between 2004 and 2018, according to the fishing statistics. Much of aquaculture's growth can be attributed to molluscs as the quantity produced rose by 149.8 %, and the value of production more than tripled between 2004 and 2018 (INE, 2020b).

However, it is the processing industry that shows the highest value of production for the entire period. Its importance is similar over time, with a slight increase after 2012. According to data from fishing statistics, the processing industry contributes about 70 % to the fishing industry's output value, and its production and value of production increased by 43.7 % and 68.6 %, respectively, between 2005 and 2018. Despite the sector's steady growth, the composition of the transforming industry changed during the past two decades. Most notably, frozen products became the largest contributor to the total value of production (55 % of which dominated by mackerel). In contrast, the shares of salted and dried products declined steadily. The share of canned products in total value rose, which, combined with only a slight increase in production, implies that price increases were an important factor in this expansion.

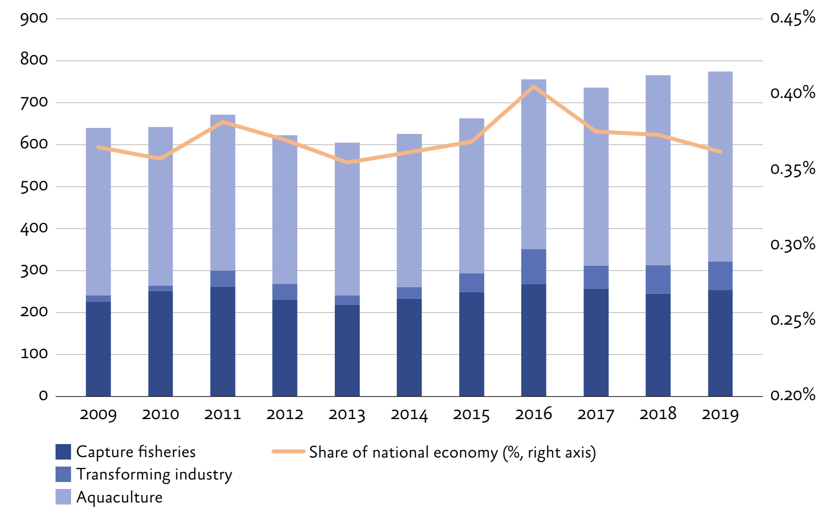
The second largest sub-sector, capture fisheries, experienced a considerable decline in importance as its share in the overall fishing industry decreased from 31.1 % to 23.6 %. The increase in the absolute value of unloaded fish by 19.6 %, in nominal terms, is also driven by rising fish prices since the quantity produced dropped by 9.2 %, according to fishing statistics.

Fishing industry employment constantly declined in the past decade (figure 7). In 2019, the sector employed 35,820 workers, representing a decrease of 13.1 % compared to 2009. Overall, the share of the fishing industry in national employment plummeted to an absolute low value of 0.77 %. Here, the downturn seems to be driven by the capture fisheries sub-sector, where employment decreased by 18.6 %. The average wage increased by 28 % between 2009 and 2019, indicating that low-cost labour was losing importance.

Portugal has one of the highest fish consumptions per capita in Europe. In 2018, the Portuguese average was at 60.9 kg per capita, more than twice the European average (EUMOFA, 2020). Since the Portuguese fishing industry cannot supply the internal demand, the trade balance is negative and has been worsening throughout the years. The deficit increased from –€718 million to –€1,102 million between 2006 and 2019 (EUMOFA, 2020).

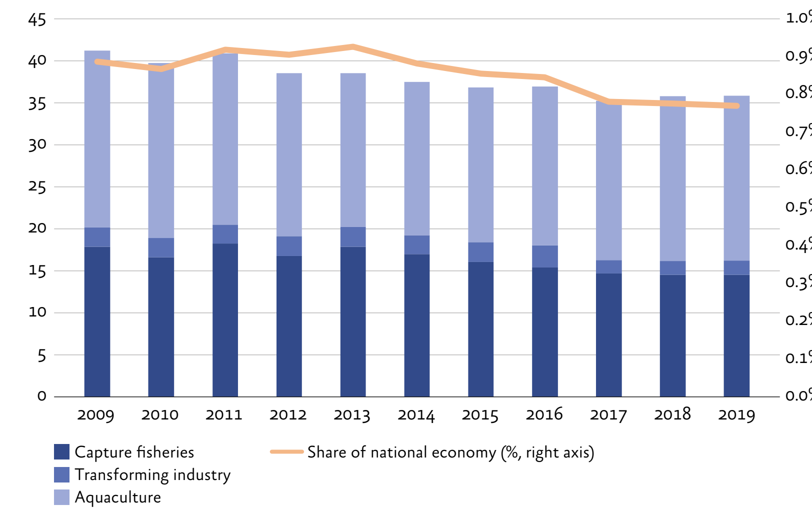
In conclusion, the fishing industry was not able to keep pace with the growing Portuguese economy after 2015. However, this was driven by capture fisheries and masks the fact that the fish processing and aquaculture industries grew stronger than the average economy.

Figure 6 GVA of the fishing industry, million EUR (left axis)



Source: EU's Blue Indicators

Figure 7 Employment of the fishing industry, thousands (left axis)



Source: EU's Blue Indicators

c. Ports, marine transport and shipbuilding & repair

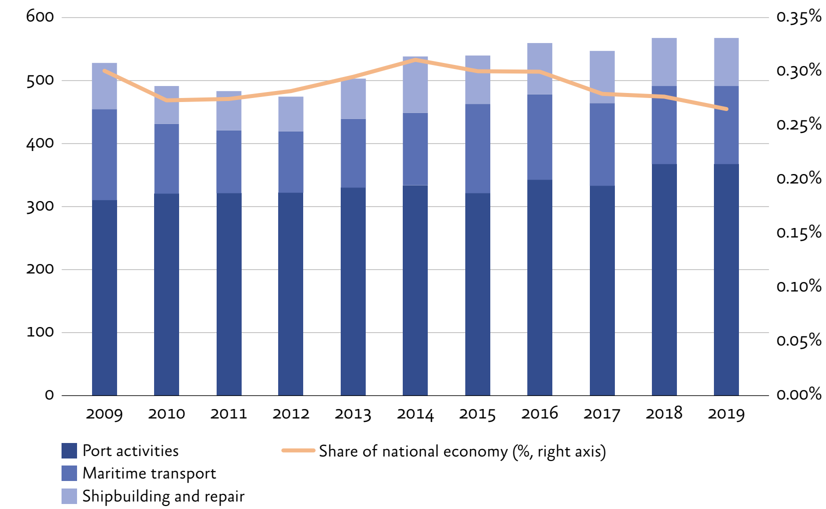
Port activities and the maritime transport and shipbuilding & repair sectors take up a relatively small proportion of the BE, with a declining aggregate weight throughout the past decade. In 2019, they generated a GVA of €567.7 million, thereby contributing 0.27 % to the national GVA (figure 8). While this implies a GVA growth of roughly 7.5 % compared to 2009, the sectors' share in the national economy stagnated around 0.29 %. These industries experienced a downturn in 2010–2012, during the sovereign debt crisis, and have been declining since 2016. In 2019, they employed 10,535 workers, which represents 0.23 % of the national employment. Figure 9 shows that employment in the sector dropped sharply from 2009 to 2010, remaining almost constant afterwards.[107]

A quick look at the developments of the underlying sectors reveals that the main contributor to this decline was the shipbuilding sector, as both the port activities and the maritime transport sector experienced growth.

The observed growth in port activities was mainly due to cargo handling, which increased strongly between 2004 and 2019, with the weight of loaded goods almost doubling and the weight of unloaded goods rising by roughly 17 % (INE, 2020). This development can be mainly attributed to the port of Sines, which increased more than six-fold the weight of both loaded and unloaded containers between 2004 and 2019.

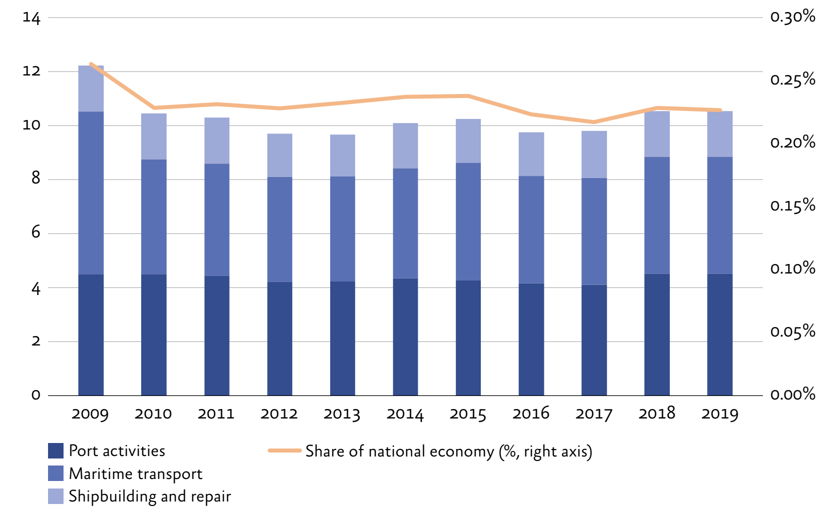
Unsurprisingly, the maritime transport sector underwent a similar development. The deadweight tonnage (DWT — expressing the total loading capacity of a ship) of all commercial vessels handled at Portuguese ports almost doubled over the same period, from 245 million to 474 million tonnes (INE, 2020). This increase was mainly due to the ports of Sines and Lisbon. In the case of Sines, the development came mostly from freight transport related to the above-mentioned cargo handling. For the port of Lisbon, it can be argued that passenger transport greatly contributed to this increase, as cargo handling cannot explain the growth in DWT. Unfortunately, a disaggregation of passenger movement per port was not feasible, but aggregate data reveal that, in 2019, 1.86 million passengers embarked or disembarked at Portuguese ports, effectively tripling since 2004.

Figure 8 **GVA of the ports, marine transport and shipbuilding & repair sector, million EUR (left axis)**



Source: EU's Blue Indicators

Figure 9 **Employment of the ports, marine transport and shipbuilding & repair sector, million EUR (left axis)**



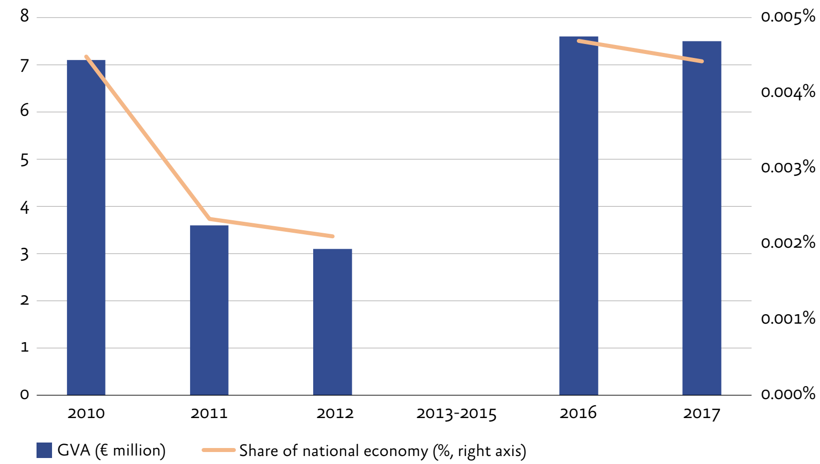
Source: EU's Blue Indicators

In contrast, the shipbuilding and repair sector declined during the past two decades. GVA was roughly equivalent in 2004 and 2019 as the sector's descent was compensated by the strong growth of sports and recreational shipbuilding activities (INE, 2020). The sector's share in national GVA declined from 0.08 % to 0.06 %. FTE (full-time equivalent) employment in 2019 was at 3,637, implying a decrease of 37.8 % compared to 2004. This was also reflected in the share of national employment, which almost halved from 0.12 % to 0.07 % between 2004 and 2019. However, employment in the sports and recreational shipbuilding sector has been growing strongly in the past years.

d. Blue biotechnology

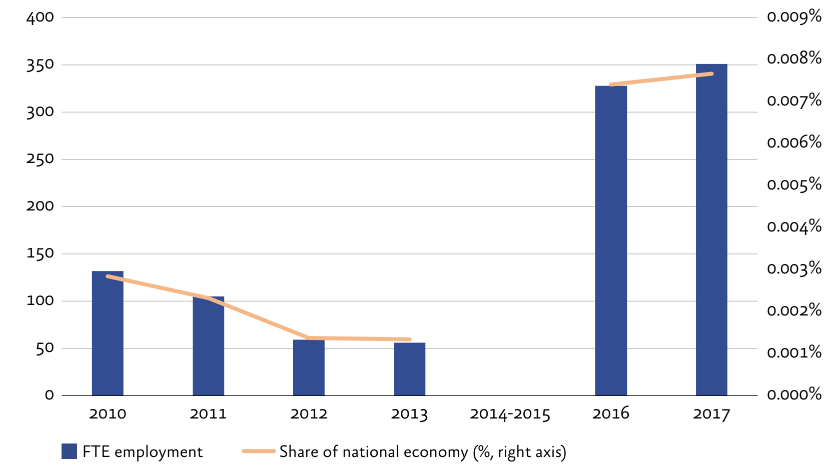
Blue biotechnology includes the use of marine natural resources for biotechnology applications (e.g., in the production of food or feed, health and pharmaceutical products, cosmetics, nutraceuticals, biomaterials and biofuels), or the use of biotechnology to improve sustainability and performance Between 2012 and 2017, the number of kind-of-activity units[108]. In the sector *new uses and resources of the ocean,* as defined by the OSA, more than quadrupled (INE & DPGM, 2016). Strictly speaking, this group of activities also includes renewable energies and earth observation, but they only represent a residual part of the sector and have not seen substantial growth. Therefore, it is reasonable to attribute a large share of this OSA sector's development to blue biotechnology. Based on this assumption, GVA only increased by 5.6 % from 2010 to 2017 (figure 10), which can mainly be attributed to high intermediate consumption expenses as the production value tripled from €9.2 to €27.6 million in the same period. This GVA development suggests that the sector merely returned to its pre-crisis levels. However, FTE employment increased by 165 % and its share in national employment more than doubled (figure 11), suggesting that the sector was expanding.[109] The largest part of this expansion occurred after 2013.

Figure 10 **GVA of new uses and resources of the Ocean, million EUR (left axis)**



Source: INE/DGPM Ocean Satellite Account (OSA)

Figure 11 **FTE employment in new uses and resources of the Ocean (left axis)**



Source: INE/DGPM Ocean Satellite Account (OSA)

e. Blue energy

Offshore wind energy plays a key role in the EU's strategy for transitioning to a climate-neutral energy sector. To date, the majority of offshore wind farms are located in the northern European seas. This is mainly because the Atlantic Ocean is deeper and harsher in the south, entailing technical challenges, especially for the foundation of fixed wind turbines. Therefore, there have been no commercially viable projects so far in that region of the Atlantic. However, Portugal is a central player in the development of floating platforms. In 2011, the experimental project DEMOWFLOAT, aimed at testing a floating wind turbine, was set up using funds from the EU (*Wavec — Offshore Renewables — DEMOWFLOAT*, n.d.). In July 2020, the first floating wind farm in continental Europe, WindFloat Atlantic, went fully operational with a capacity of 25 MW (Richard, 2020).

Two less established forms of generating renewable energy offshore are wave and tidal energy. In 2008, the world's first commercial wave farm was opened north of Porto. However, only two months later, it was stopped due to technical problems and has not been restarted since then (MI News Network, 2019). International wave energy companies are using Portugal's waters to test and manufacture their systems. One such system, installed close to Peniche, is in its commissioning phase, and an R&D and manufacturing base has been set up near Viana do Castelo (Djunisic & Djunisic, 2019; Recharge, 2020).

f. Seabed mining

Since Portugal's claim for extension of its continental shelf at the United Nations, seabed mining, and especially deep-sea mining (DSM), have gained much attention, mainly because this extension would give Portugal exclusive mining rights for mineral resources. However, the topic is subject to considerable political debate due to its adverse effects on the maritime environment. In 2018, the European Parliament adopted a resolution urging the Member States to stop subsidising and issuing permits for deep-sea mining explorations (European Parliament, 2018). Until 2018, Portugal had registered 24 occurrences of critical raw mineral aggregates (European Commission, 2020). Since 2019, the International Seabed Authority (ISA) has issued three of its seven contracts of exploration of polymetallic sulphide deposits with Portugal (e.g., copper, zinc, lead), in the Northern Mid-Atlantic ridge, near the Azores archipelago (ISA, 2019). To date, there are no deep-sea mining activities in Portugal or elsewhere in the world.

Sand extraction in Portugal is regulated by Law No. 49/2006, which states that extraction from the coastal area is to be limited to maintenance, protection and shoreline nourishment purposes. Its commercial use is, therefore, not allowed so far.

7.2.2. Environmental Status of Marine and Coastal Ecosystems

As mentioned before, the regular monitoring of the NOS' achievements and impacts is key to assess the efficiency and effectiveness of its implementation. Within this context, the use of quantifiable indicators is of particular relevance. The SEAMInd Project was implemented in 2014 to provide an integrated decision support tool to assess the Blue Economy and the success of the NOS. The project aims to identify a relevant set of indicators to measure maritime policy results based on a sustainable development approach and make them observable and publicly available in an integrated and user-friendly digital platform. SEAMInd indicators are organised according to the NOS 2013–2020 framework and its strategic development domains.

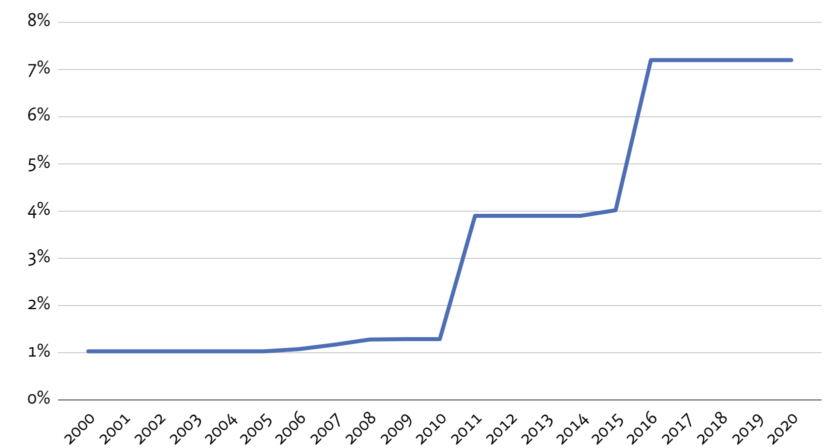
SEAMInd has already identified a set of relevant indicators that can provide updated and timely quantitative information to monitor the results and impact of the NOS. However, seven years after the implementation of SEAMInd, the technological platform that integrates all indicators and allows for public scrutiny of the NOS is not yet available. Moreover, while there are already available indicators to assess blue growth (OSA & SEAMInd), there are still insufficient indicators to monitor the environmental status of marine and coastal ecosystems, preventing the development of an integrated system that supports decision-making on Portuguese ocean management.

In order to characterise the environmental status of marine and coastal ecosystems over the past two decades, this section focuses on the strategic development domain of the OAIS (Ocean, Atmosphere and Integrated System). While SEAMInd identified 31 indicators to monitor (1) biodiversity management and conservation and (2) good environmental status, only seven indicators have available metadata, according to the DGPM (2020b). However, we were unable to find easily available information on those seven indicators. Therefore, below, we provide an overview of the observed changes in the OAIS domain in the last two decades based on three easily accessible SEAMInd indicators.

7.2.2.1. Proportion of Marine Protected Areas (MPA) in Relation to the Portuguese Maritime Area (SEAMInd #III.2)

Regarding the preservation of relevant ecosystems (SEAMInd #III.2), there has been an increase in the proportion of marine protected areas (MPA) in relation to the Portuguese maritime area in the last decades (figure 12) (UNEP-WCMC & IUCN, 2021). The first Portuguese MPA was designated almost 50 years ago, in 1971, in the Madeira region (Selvagens islands). Only one decade later, Portugal established its first MPA in the continental exclusive economic zone (EEZ), (the Natural Reserve of Berlengas), and in the Azores (Protected Landscape of Monte da Guia, Faial). Since then, and especially over the past decade, a significant number of MPAs have been established under Portuguese jurisdiction. Traditionally, Portuguese MPAs focused on coastal areas, expanding into the open ocean only more recently (namely, beyond Territorial Waters) (Horta and Costa, 2017). Despite the growing trend, these MPAs only represent 7.2 % of the entire marine space under Portuguese jurisdiction (including the continental shelf beyond 200 nm). When compared to European values, Portuguese numbers fall short (Agnesi et al., 2020) and are below the 10 % Aichi Target 11 for 2020 under the Convention on Biological Diversity and further away from the 30 % target established for 2030 (DGPM, 2020a).

Figure 12 **Evolution of the coverage of Marine Protected Areas (MPAs) in relation to the Portuguese maritime area over the last two decades**



Source: UNEP-WCMC & IUCN, 2021

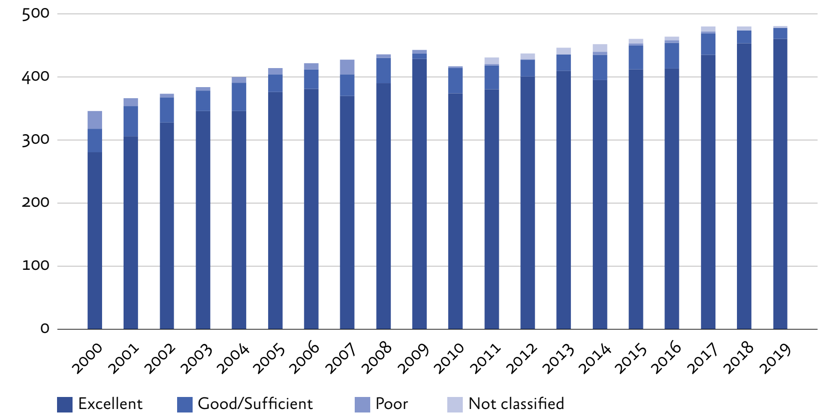
Moreover, there is great concern about the effectiveness of the existing MPAs, since most of the area covered by MPAs in Portugal is only moderately protected (the least regulated MPA class), allowing for a variety of human activities with potential impacts on marine species and ecosystems (Horta and Costa, 2017). Indeed, MPAs that do not have strict regulations and do not confer a high level of protection within their limits are no more than *paper parks* — as is the case of the Natura 2000 sites (Horta and Costa, 2017). To overcome this problem and support the existence of efficient, effective and equitable MPAs, the various stages of MPA implementation (i.e., design, regulation, management and supervision) must be ensured. Potential ways forward include overcoming limitations related to the lack of own funding; more efficient supervision by integrating local users; sharing experiences between managers and relevant stakeholders; and allocating clear responsibilities to achieve MPA objectives (Horta and Costa, 2017).

7.2.2.2. Coastal Bathing Waters (SEAMInd III.15)

Coastal bathing waters are situated on the sea or transitional water coastline, and their quality is classified according to two microbiological parameters (*Escherichia coli* and *Intestinal enterococci*) defined in the Bathing Water Directive. The number of coastal bathing waters mandatorily subjected to water quality control has grown considerably over the last two decades, from 346 in 2000 to 481 in 2019.

The quality trend for the 1990–2019 period is shown in figure 13 (EEA, n.d.). At the beginning of the 21st century, 8.1 % of coastal bathing waters did not comply with the minimum quality standards of the Directive, while 91.9 % were classified as *sufficient* or better. The Portuguese authorities have taken measures to improve the overall quality of the water, resulting in the gradual improvement of the water quality as observed in the decreasing percentage of non-compliant bathing waters to 0.7 % in 2010 and 0 % in 2019, and in the increasing compliance rate. An increase in coastal bathing waters classified as *excellent* can also be observed, from 81.2 % in 2000 to 95.6 % in 2019.

Figure 13 **Trends in coastal bathing water quality**



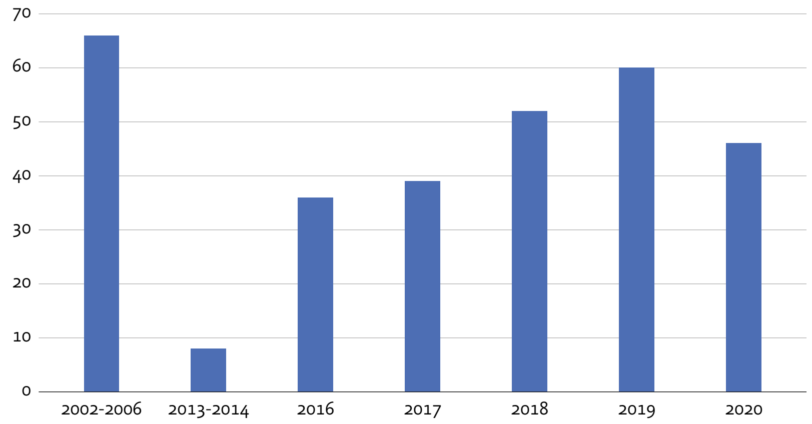
Source: EEA

7.2.2.3. Beach Litter (SEAMInd III.19)

Marine litter is any solid and persistent material that has been manufactured or used by man and deliberately or accidentally discarded in the marine and coastal environment. Marine litter is composed of materials such as plastics, wood, metals, glass, rubber, clothing, paper, etc.

At the end of the 1990s, the OSPAR (Convention for the Protection of the Marine Environment of the North-East Atlantic) commissioned a pilot project for monitoring marine litter on beaches, which was implemented between 2000 and 2006. After an interruption period, Portugal resumed the beach litter monitoring programme in 2013, following OSPAR's guidelines (figure 14). The programme implemented by the Portuguese Environment Agency included two more beaches than the pilot project in 2013 and six beaches from the Azores five years later, in 2018.

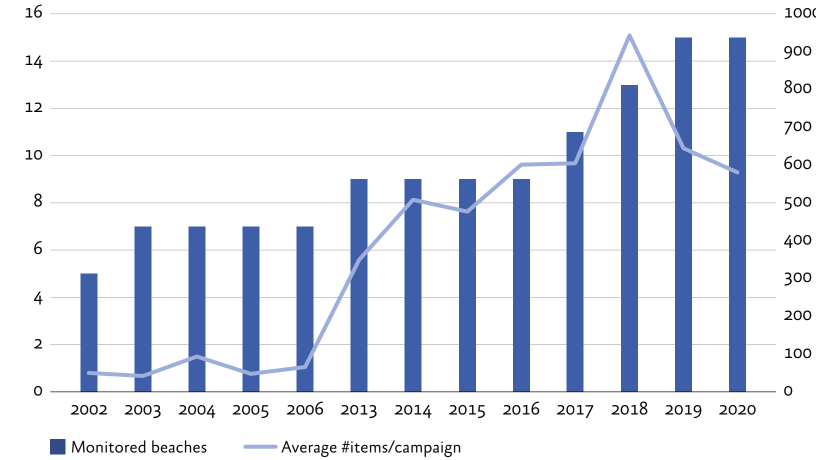
Figure 14 Samplings campaigns



Source: OSPAR

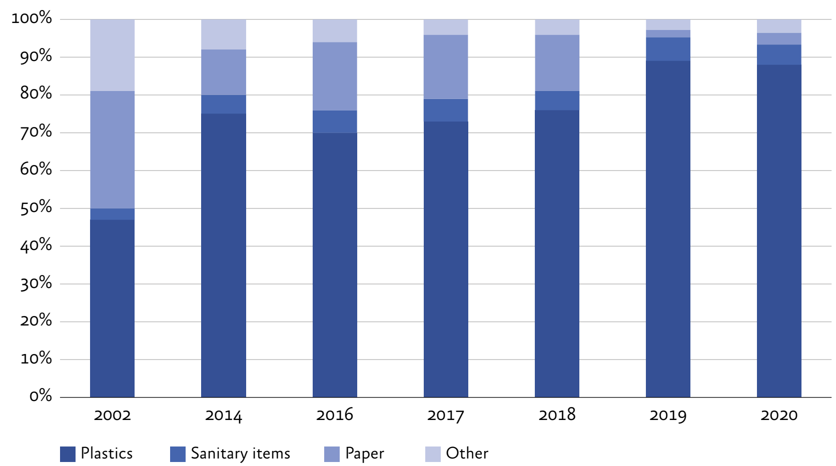
The annual results show an increase in the average number of items identified per campaign on the monitored beaches (figure 15) (APA, 2016–2020). Despite the positive decrease in the last two years (2019 and 2020), Portugal is still one of the OSPAR members with the highest mean total abundance of beach litter items, according to the OSPAR dashboard (OSPAR, 2018). Regarding the composition of beach litter, plastic is the most worrying category with an increasing predominance (figure 16), not only because it is a highly resistant material but also due to its growing worldwide production for new applications and the replacement of conventional materials.

Figure 15 Average number of items identified per campaign



Source: OSPAR

Figure 16 Item's predominance (in percentage)



Source: OSPAR

7.2.3. Ocean governance: marine spatial planning in Portugal

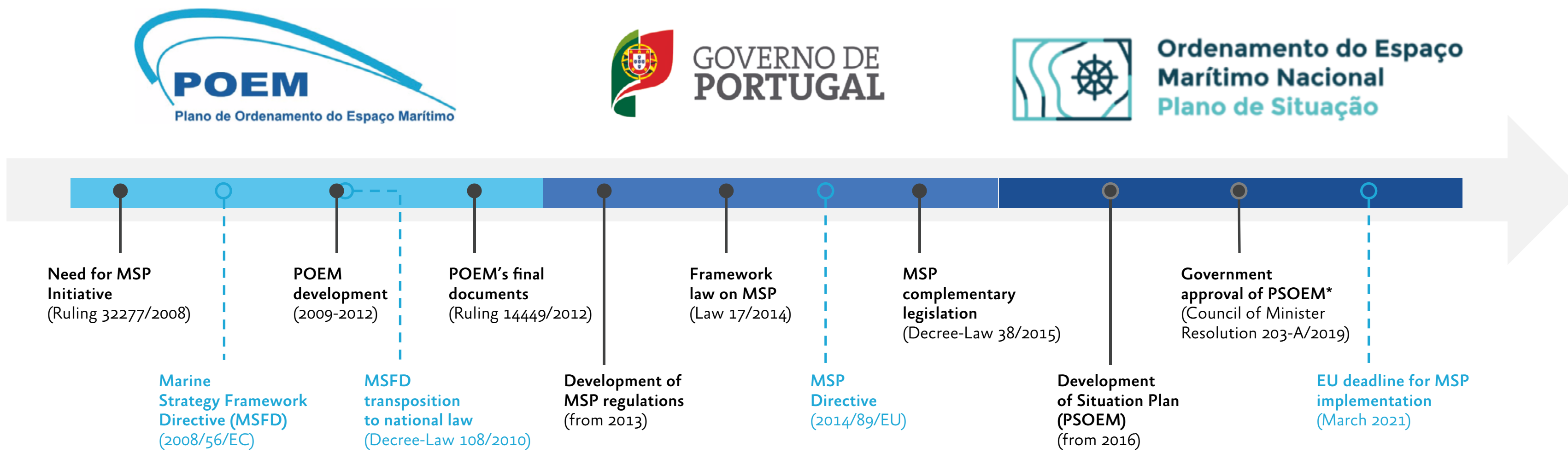
From the EU Green Paper (European Commission, 2006) to the recent EU Maritime Spatial Planning Directive (European Commission, 2014), Marine Spatial Planning (MSP) processes based on the principle of ecosystem-based management (EBM) have been recognised as a necessary tool to ensure sustainable maritime development (Ehler, 2020). Within this context, Portugal is no exception. Contrary to other EU Member States whose maritime spaces were under significant anthropogenic pressure and MSP processes arose as an answer to existing needs (e.g., Belgium, Netherlands) (Ehler and Douvere, 2009), Portugal did not make an intense utilisation of its marine space (Santos et al., 2015). In fact, most existing activities were limited to the territorial sea (12 nm from the baseline), and the *traditional* ones such as fishing, maritime transportation and tourism were the most predominant (Santos et al., 2015). The Portuguese MSP started with a combination of three aspects: (1) the *national goal* for the sea, established in the NOS 2006–2016 and the Strategic Commission for the Oceans Report, and closely related to a *prospective vision* for ocean use (Portuguese Government, 2006; Strategic Commission for the Oceans, 2004); (ii) the need to comply with European guidelines (e.g., EU Integrated Maritime Policy, EU MSP Roadmap) and; (iii) the broader recognition of MSP importance and pertinence at the international level (European Commission 2007, 2008a, 2008b; Santos, 2016).

The timeline for the Portuguese MSP initiative is depicted in figure 17. Starting in 2008, the Portuguese MSP included three main phases: (i) the *maritime spatial plan* (POEM); (ii) the development of specific national legislation on MSP and; (iii) the Situation Plan (PSOEM) (figure 17).

Specific MSP regulations developed between 2013–2015 envisioned two types of national MSP instruments, both legally binding on public and private entities: The PSOEM, which lays down the baseline for national MSP by identifying the distribution of uses and resources within the Portuguese maritime space and; Allocation Plans (focused on identifying and allocating areas to new uses, not yet included in the PSOEM) (Santos, 2016; Decree-Law No. 38/2015, 2015). The PSOEM encompasses all marine waters under Portuguese jurisdiction, from territorial waters to the exclusive economic zone (EEZ) and the extended continental shelf (including beyond the 200 nm limit according to the proposal submitted to the United Nations). In late 2019, the PSOEM was finally approved by the government (Resolution of the Council of Ministers No. 203-A/2019) for the subdivision of continental Portugal, Madeira and the continental shelf beyond 200 nm, while the Azores subdivision is still under development. According to the EU MSP Directive, all Member States' plans shall be established at the latest by the end of March 2021 (European Commission, 2014). Thus, the PSOEM will have to be fully in place and adopted before long.

A preliminary analysis of the Portuguese MSP initiative (from POEM and MSP regulations) indicates that its underlying principle is *soft sustainability* (Qiu and Jones, 2013) because although it recognises the relevance of the EBM, environmental concerns seem to come second to economic goals (Santos et al., 2014, 2015; Santos, 2016). Provided that EBM must be implemented (according to the EU Marine Strategy Framework Directive) and a *good environmental status* (GES) of the marine environment must always be ensured (European Commission, 2008), finding ways to address the challenges of sustainable ocean planning is truly fundamental (Santos et al., 2018).

Figure 17 Timeline of the Portuguese Marine Spatial Planning initiative (related European initiatives marked in blue)



Source: Authors' contribution

7.2.4. The impact of past policies

While the previous sections do not constitute a formal evaluation of past ocean-related policies, they reveal relevant information concerning 1) the performance of the Portuguese BE, 2) the country's capacity to evaluate the status of its marine and coastal ecosystems, and thereby securing a healthy Ocean Economy and 3) the implementation of a key IMP policy instrument in Portugal.

By analysing the performance of BE in the past decade, we can observe a growing trend since 2013, after the European sovereign debt crisis. Coastal tourism is the most relevant sector of the Portuguese BE and is the main contributor to national tourism (e.g., most overnight stays occur in coastal areas), playing an important role in the national economy. Less pronounced growth is observed in the aquaculture sub-sector, mainly due to an increase in mollusc farming. Port activities and maritime transport have also experienced some growth, which can be mostly attributed to recent investments in the ports of Sines and Lisbon, significantly increasing the loading capacity in Sines and the passengers' transport in Lisbon. While a decline can be observed in the shipbuilding sector, sports and recreational shipbuilding have experienced a significant expansion since 2015. Finally, currently available data do not provide evidence of growth for emerging sectors (blue biotechnology, blue energy, and seabed mining). Therefore, the analysis presented in section 2.1 essentially reveals that while few established sectors have also contributed to blue growth in Portugal, the latter is still mostly driven by an increase in coastal tourism. Notwithstanding the goals put forward by previous NOS, growth in emerging areas has yet to materialise. Regarding the environmental status of marine and coastal ecosystems, although some improvements can be observed, namely in monitoring efforts, there is still a major gap in the indicators available to monitor these ecosystems. Up to date, there is no integrated system to evaluate the GES in the marine environment or to assess the efficiency and effectiveness of the NOS. Moreover, Portuguese MSP follows a *soft sustainability* principle, prioritising economic goals. Thus, without an adequate assessment of the environmental status of the marine and coastal ecosystems, EBM will not be achieved, preventing the development of knowledge-based Integrated Maritime Policy, a key policy goal of the NOS 2013–2020 to foster sustainable blue growth.

7.3. Portugal and the ocean: looking into the future

The final goal of this section is to provide a set of recommendations for the design of a Portuguese Ocean Strategy. To this end, we first provide an overview of the research, produced between 2000 and early 2021, for the different sectors composing the BE. By analysing the research produced we aim to 1) identify current knowledge gaps and 2) understand how they may constitute obstacles to the future development of the different sectors. Finally, building upon the analysis provided in section 2 and the literature review results, we propose adjustments to the public policy setup.

7.3.1. Research overview

Box 1: main research gaps in coastal tourism

- Assess the environmental consequences of massive tourism on Marine and Coastal Ecosystem Services (MCES);
- Assess and valuate Marine and Coastal Ecosystem Services to support the coastal regulatory framework;
- Build social capital at the local level: engaging stakeholders through public participatory methods;
- Diversify local supply by systematically collecting microdata;
- Explore substitutabilities/complementarities at the local level: coordinating strategies across regions.

In this section, we present the results of a literature survey on research produced between 2000 and early 2021 on the state, development and prospects of six sectors of the Portuguese Blue Economy (fisheries and aquaculture, seabed mining, blue energy, maritime transport, marine coastal tourism, and blue biotechnology).[110] The BE comprises a very heterogeneous set of activities and expertise. As a result, a thorough literature review on this subject requires a multidisciplinary team covering various fields of knowledge. While efforts for completeness were undertaken, the analysis that follows may be biased towards the knowledge of the authors of this paper.

a. Coastal tourism

The literature review on tourism research found papers on the economic, environmental and social impacts of tourism. Among the papers on marine recreational activities, some address nature tourism (e.g., bird, whale, and dolphin watching), while others focus on sea-sports activities (e.g., surfing and scuba-diving). Although coastal tourism research did not follow a clear trend in the past years, research on tourism impacts and solutions to coastal erosion grew after 2018. Since 2012, nature and sport coastal tourism have also received more attention from academia. Therefore, we may conclude that the increasing interest in this topic in recent years can be associated with the growing trend that tourism, and coastal tourism, in particular, have experienced in Portugal since 2011/12.

Most of the research on the consequences of tourism focus on the effects of mass coastal tourism on marine and coastal ecosystems and the quality of the corresponding provided services. In particular, these studies investigated the contribution of coastal tourism to the decline in the availability of water resources and consequent loss of biodiversity, landscape degradation and coastal erosion. In particular, coastal erosion, due to unregulated development pressures exacerbated by climate change, has great detrimental effects on touristic inflows and property value (Andrade et al., 2007; Vaz et al., 2013; Medeiros and Cabral, 2013; Marinho et al., 2019 and Nunes et al., 2020). Some studies mention the need to fill knowledge gaps, regarding, for example, the assessment of the net benefits of artificial beach nourishment (Antunes do Carmo, 2019 and Marinho et al., 2019). Given that beaches provide recreational and regulating services (Kovačić et al. 2020), regulatory frameworks to support coastal policy design should be based on a more integrated approach, such as the Marine and Coastal Ecosystem Services Assessment and Valuation (Fernandez et al. 2016). In this context, spatial modeling and the access to remote sensing data on a regular basis are key elements to monitor fragile ecosystems and manage them in an integrated and sustainable way (e.g., Coastal Zone Management Plans) (Vaz et al., 2013). Finally, to ensure the success of those initiatives, it is crucial to engage local communities (Dominiques et al., 2019). The use of participatory public techniques involving the different stakeholders is very important to help solve conflicts and contributes to building social capital at the local level. While this is relevant for areas that already experienced touristic pressure, it is perhaps more critical for the Alentejo and central region, where investment returns are possibly higher, to fill the above-identified gaps (Andraz et al., 2015). In fact, tourism demand seems to reveal a stronger preference for the quality of the natural environment (Vaz et al., 2009).

An important trend in coastal tourism management concerns the diversification of touristic supply in highly touristic regions to overcome seasonality (Andraz et al., 2015; Albuquerque et al., 2009 and Samora-Arvela et al., 2020). This has also been highlighted in both NOS, which identified the need to increase recreational and nautical sports tourism. Although the number of studies specifically addressing this topic is still scarce, there has been an increasing number of successful investments in nautical tourism. In fact, a diversification of touristic activities has been pursued in the last years in order to accommodate heterogeneous visitors' preferences, thereby creating new demand. In this context, local municipalities play an important role as they have privileged access to information that should be used to benefit local populations. The regular analysis of consumers' preferences requires a systematic microdata collection in order to adjust supply to demand (e.g., bird watching, trekking, whale watching, sea caves visits, biking, recreational fishing, nautical sports, surfing, diving, sailing, among others), (e.g., Antunes do Carmo, 2019; Frank et al., 2015; Rangel et al., 2013; Costa et al., 2018 and Istomina et al., 2015). The engagement with different stakeholders (municipalities, local associations, and businesses) whose activities would take advantage of this knowledge should also be considered, as they may contribute at different levels, including with financial support. An illustrative example is provided by the successful strategy followed by the municipality of Nazaré in 2010 (Cunha-e-Sá et al., 2018).

Since Portugal is small and has a heterogeneous touristic offer, the coordination of such strategies at the regional level could positively contribute to smooth out seasonality by exploring the complementarities/substitutabilities across different regions (Agapito et al., 2012 and Vaz et al., 2009).

b. Fishing industry

Box 2: main research gaps in the fishing industry

- Optimise maintenance and surveillance services;
- Study how environmental factors and climate change may affect fish populations;
- Invest in research on fishing technologies that reduce negative impacts on seabed structure and by-catch of non-commercial species;
- Identify favourable locations for inshore and offshore aquaculture;
- Foster research on integrated multi-trophic aquaculture;
- Diversify the Portuguese aquaculture sector to increase its adaptive capacity to climate change;
- Increase knowledge on pathology control, nutritional parameters optimization and environmental footprint of harvested species;
- Develop reliable predictive models for waves, current and temperature, as well as remote control and monitoring systems (e.g., GIS).

The literature survey on the fisheries and aquaculture sector in Portugal reveals that most studies focus on the biology and ecology of fish species, followed by studies on fishing technology, techniques and gears. Compared to the previous research topics, the number of studies on aquaculture is relatively lower, however, it has increased during the last decade.

Capture fisheries

Literature on this field has identified a continuous reduction in fish landings by the Portuguese fleet since its peak in the 1960s (Leitão et al., 2014). While several reasons concur to explain this trend, most studies identify the reduction in fishing capacity as the main driver leading to the reduction in fish landings (Leitão et al., 2014; Guyader et al., 2007 and Khalilian et al., 2010). In fact, environmental factors affecting fish populations seemed to have played a minor role in the reduction of total catches (Bueno-Pardo et al., 2020). More recently, though, evidence shows this state of affairs may have changed. Stock concerns are often coupled with water temperature rise (Torralba, 2015), upwelling intensity (Cabrero 2018), harmful algae blooms (ICES, 2013) and ocean acidification (Stewards-Sinclair et al., 2020). In this context, perhaps the most illustrative case is the one related to the recent crisis in the sardine fishery. Also, the status of several commercially relevant fishery resources remains unassessed, preventing the definition of informed fishery policies.

The impacts of fishery activities on the environment have also been the subject of various studies. Trawling, in particular, has been shown to have a negative impact on the seabed (Ramalho et al., 2017) and to collect high amounts of accessory species through bycatch (regulated under the EU Landing Obligation that entered in force in 2015). Also, the methods used by multispecies fishery that characterise the Portuguese industry do not allow for the control of the harvested species, and hence to target the optimal TAC (total allowable catch) levels (Leitão, 2015). High risks of bycatch and discard are still present in the industry, even after the introduction of the discard ban under the EU Common Fishery Policy in 2015.

Aquaculture

As outlined in The Strategic Plan for the Portuguese Aquaculture 2014–2020, challenges in aquaculture production involve simplifying and lengthening licencing schemes, as well as improving the identification of the most suitable areas for aquaculture (usually located near estuaries and rivers). On top of that, the overall water temperature profile and the wave intensity on the continental west coast do not provide the required conditions for the production of most currently farmed species. When considering the development of open ocean aquaculture in Portugal, the main obstacles are related to the high exposure of the national coast to waves and strong ocean currents. Therefore, the success of this activity is still dependent on technological development (Encarnação, 2016). As such, the sector requires further investments in reliable predictive models for waves, current and temperature, as well as remote control and monitoring systems (e.g., GIS), (Encarnação, 2019).

Optimal locations for aquaculture have been the subject of various studies. Teixeira et al. (2018) identified areas with low potential for conflict with other sectors (e.g., salt production in *salterns*), concluding that ponds previously occupied by inactive farms and flooded salterns/

salterns filled with land are the locations that best compromise between optimal environmental conditions, available infrastructure and conflict minimisation. Sousa et al. (2020) point to the use of previously-reclaimed wetland areas (e.g., in Ria Formosa) as possible locations for aquaculture sites that, if adequately integrated into the existing environment, could reduce the need to convert new wetlands into anthropic environments and, thus, ensure natural conservation. On top of resource conflicts between the two fish production systems, Ramos et al. (2015) and Ramos et al. (2017) highlight the social limitations (e.g., fishery-dependent communities might feel their jobs are threatened) of coupling offshore aquaculture with coastal fishing, especially from small-scale fisheries.

In terms of possible threats for the sector, Stewart-Sinclair et al. (2020) study the potential impacts of human-induced climate change and ocean acidification on molluscan aquaculture. Between 2020 and 2100, the Portuguese aquaculture sector will be highly affected by climate change due to the high economic value mollusc aquaculture plays in the country's economy. Considering that the adaptive capacity of Portugal is low (i.e., Portugal is highly reliant on certain mollusc species), diversifying the sector through the production of new species will be essential to maintain the profitability and sustainability of the industry. Although some species might be resilient to the direct impacts of climate change on sea temperature and ocean acidification (e.g., blue mussel), their production might still be affected by indirect impacts (e.g., disease, algal blooms, invasive species). Finally, Salas-Leiton et al. (2020) present a summary of the main policy objectives of the Portuguese regulation in aquaculture and identify the need to «increase the knowledge regarding genetic selection of breeders, pathology control, nutritional and feeding parameters optimisation, and improvement of environmental footprint» as a critical goal for present and future policies. Recent publications on this issue (Machado et al., 2018; Olaya-Restrepo et al., 2018; Santos et al., 2020 and Sousa Araujo et al., 2020) also highlight the need to consider future climate change impacts when introducing aquaculture species.

c. Ports and marine transport

Box 3: main research gaps in ports and marine transport

- Measure port performance, efficiency and eco-efficiency by developing a dashboard of standardised indicators;
- Estimate companies' economic performance;
- Improve the governance of PAs;
- Collect real time data at the local level to monitor the natural environmental condition on a regular basis;
- Design evidence-based public policies to control for GHGs emissions and navigation risk;
- Collect microdata at the local level to elicit households' preferences with respect to quality changes in Marine and Coastal Ecosystem Services (MCES) on a regular basis;
- Conclude contracts for PA (Port Authority) partnership that avoid the opportunistic behaviour of concessionaires, improve port efficiency and minimise post-negotiation negative effects (environmental, economic, social);
- Promote the connectivity among PAs and research centres to design and implement projects to reduce the CO_2 emissions and promote the use of electric propulsion and less pollutant fuels.

The literature survey on research produced on the maritime transport sector in Portugal identified several studies on the topic. After

2009, these studies seem to have mostly focused on the management and efficiency of Portuguese ports. Among them, some provided information on the most used shipping routes in Portuguese waters, while after 2017, a few others focused on the environmental impact of marine transport emissions. These results are aligned with the increasing interest of the Portuguese Government in the sector in recent years, as evidenced by the Ports Strategy delivered in 2016, highlighting the relevance of the geostrategic location of Portugal between Europe, America, and Africa. This vision was recovered in the most recent version of the National Recovery and Resilience Plan (RRP). The concern about the environmental impacts of maritime transport has increased significantly following the touristic boom in Portugal and the need to combat climate change. The fact that important national ports are located in the vicinity of important urban areas and pristine natural environments, such as Lisbon, Leixões, and Sines, respectively, can be associated with the recent research interest in the environmental impacts of marine transport.

In this context, the main concerns are port efficiency, GHGs emissions and navigation risk. In the

case of port efficiency, the governance framework plays an important role. Caldeirinha et al. (2017) analyse the Portuguese port governance from 2005 to 2015. Recently, a liberalisation trend has been observed, raising issues concerning the concession of port terminals, management of contracts, control of activities and development of labour's liberalisation policies. The authors suggest the development of a stronger private cooperation among Portuguese Port Authorities (PA), as well as mergers and acquisition to develop economies of scale. Cruz and Marques (2012) discuss the problem of risk-sharing in contractual regulation of PA partnerships and draw specific contracts aimed at increasing incentives to avoid the opportunistic behaviour of the concessionaires, also improving port efficiency and minimising post-negotiation negative effects. Examples are (i) variable term contracts with Key Performance Indicators (KPIs) thresholds, (ii) vertical unbundling, separating operation from infrastructure development and management, and (iii) mandatory public tender obligations for all construction works.

The status of the Portuguese ports network has been the main subject of research regarding port performance and efficiency. Out of the nine commercial ports in mainland Portugal, Sines, Lisbon, and Leixões represent more than 90 % of total container traffic and have both import and export traffic (Gil-Ropero et al., 2018). In line with the trend of reinforcing bigger hubs, while all Portuguese ports received investments from the Competitiveness Strategy Horizon 2016–2026, the three ports mentioned above received the largest amounts. Some studies have concluded that various Portuguese ports are not operating at their most productive scale (e.g., Gil-Ropero et al., 2018 and Carvalho et al., 2010). This supports the idea that until ports are operating at their respective production possibility frontiers and/or demand in container traffic increases, there is no need for further investment in the port infrastructure. Instead, it is more critical to improve strategic planning and management. Cruz and Ferreira (2016) conclude that seaport authorities should not compete on the volume of their expenditures in order to increase cargo infrastructure. They also suggest port-specific recommendations on the management of fixed assets, labour and ships handled.

Finally, trends in sea-level rise due to climate change are highlighted when assessing overall future port efficiency. In particular, Christodoulou et al. (2018) conclude that Portuguese ports will be safe from an extreme sea-level increase (e.g., 4.5m).

As mentioned before, the impacts of marine transport on the environment are, in general, of major concern. Portugal is no exception, as its north-western coast is subject to very heavy traffic, and the most important ports, namely Sines and Lisbon, are located in the vicinity of highly vulnerable pristine environments (e.g., Natural Parks and Reserves) and important urban areas. Besides providing valuable provisioning, regulating and other cultural services, pristine environments have a high social value since recreational touristic activities are a very important source of revenue for the country. Urban areas are also very important sources of tourism revenues, however, the health condition of the local population is at risk due to emissions of local pollutants. Since all those benefits depend on the good condition of natural ecosystems, their preservation is of utmost importance.

The negative externalities associated with maritime transportation are mainly related to navigation risk and GHGs emissions (Nunes et al., 2017). In the former case, the risk associated with environmental damage has to do with eventual accidents with hydrocarbon, hazardous and/or noxious substances (HC/HNS). These risks are typically addressed by setting liability rules that encourage the internalisation of the socially desirable precaution levels in undertaking the risky activity. In the case of GHGs emissions, the challenges involve not only using more environmental-friendly fuels in all types of vessels (tankers, containers, cruises and boats in general) but also finding cleaner solutions, such as complementary electric propulsion, and green hydrogen, or renewable fuels of non-biological origin (RFNBO), taking advantage of the growing contribution of renewable sources to the energy mix (Kanellos et al., 201 and Nguyen et al., 2020). This will be especially important as it reduces emissions when boats enter ports in coastal urbanised areas, such as Lisbon, Porto and Funchal (in Madeira). Moreover, regulatory interventions should also be considered, such as the creation of a NO_x control area or the inclusion of the sector in the EU Emission Trading Scheme (ETS) market. All these potential solutions will involve location-specific benefits and costs that have to be assessed for policy purposes. Such assessment requires not only a good knowledge of the natural condition of the different marine and coastal ecosystems, including threats and pressures but also of the impact that potential quality changes on their condition may have on the welfare of local, regional, national and international populations. Hence, in order to support research to better inform policy-making, it is essential to collect real-time data on a regular basis to monitor the natural environmental condition and microdata to elicit households' preferences with respect to quality changes. Given the geostrategic position of Portugal, the vast coastal area where the largest urban centres and ports are located and the importance of marine and coastal touristic activities, all these initiatives will provide important information on the full opportunity costs of intervening along the coastline under different circumstances (e.g., the case of oil spills). Since this is a topical issue, more studies on the subject have been recently produced.

d. Blue biotechnology

Box 4: main research gaps in blue biotechnology

- Create a national database on the availability, economic value, location and sustainability of blue biotechnology resources across the country;
- Improve the cooperation of research centres to access bioresources, biobanks, pilot-scale units, manufacturing facilities and national partners;
- Advance scientific knowledge on how blue biotechnology can support the restoration of marine ecosystems (e.g., seagrass forests, eelgrass meadows) and increase environmental benefits (e.g., carbon storage, reducing eutrophication);
- Advance scientific knowledge on how genomics and biotechnologies can be used to increase the performance of aquaculture species (e.g., faster growth, less diseases, improved nutritional values);
- Identify the biotechnology markets where the country can develop strategic comparative advantages.

In this context, most studies relate to microalgae, seaweeds and marine plants (mainly red and brown seaweeds), while others focus on animal products (fish, shellfish and marine invertebrates), marine bacteria and fungi. Overall, since 2015, we observed a strong growth in research on this topic when compared to other BE sectors. Since 2018, marine bacteria, such as actinobacteria, have gained more attention, while new animal products and marine fungi still represent a small proportion of the research.

Most of the research conducted in this field focuses on microalgae and seaweeds. Portugal has a historical tradition in algae production. Microalgae and seaweeds have an extensive range of possible applications. Pereira et al. (2020) and Rodrigues et al. (2015) discuss the use of seaweed in Portugal as a food resource. Other studies focus on the possible use of red, green or brown algae for antifungal (Pinteus et al., 2015; Pereira and Silva, 2020), antimicrobial and antiviral (Mendes et al., 2013; Girão et al., 2019; Pereira and Silva, 2020) or antitumor treatment (Alles et al., 2018; Silva et al., 2018; Girão et al., 2019 and Cotas et al., 2020). Other studies focus on the use of seaweed for nutraceutical products as an antioxidant (Silva et al., 2018 and Cotas et al., 2020) or a low-fatty acids source of protein (e.g., Santos et al., 2016). Finally, Pereira et al. (2020), Rodriguez et al. (2015), Cabo et al. (2019) and Pardilhó et al. (2020) discuss the use of algae as sources for fertilisers, agar-agar, protective straying products and natural pigments.

However, the development of this activity faces intense competition from Asian markets (Van den Burg et al., 2019). Other concerns are present when sustainability is at stake. Borges et al. (2019) study the potential biomass renewal of an algae population *at its distributional limits* in the North of Portugal and conclude that the yearly renewal of the species (around 0.94 % of the standing stock) is too low to sustainably manage the harvest. In this context, it may be feasible to consider the use of integrated multi-trophic aquaculture systems (IMTAs) to produce fish and algae (Azevedo et al., 2015; Silva et al., 2019 and Moreira et al., 2020), as there are different locations that may not impact the biological quality of the resources found in the wild. Finally, the restoration of seagrass forests and eelgrass meadows is highly valued in the context of climate change (Vieira et al., 2020). Besides providing an important regulating service, sequestering carbon and reducing eutrophication and algal bloom (Van den Burg et al., 2019), they can also be used to produce bio gasoline and biodiesel (Cooke et al., 2013) and batteries to store electricity (although this second purpose is still under-studied) (Azevedo et al., 2019). While the production of microalgae and seaweeds is promising, species-specific research is still needed to assess what and where to harvest, and what to cultivate in aquaculture.

Literature on other blue biotechnology-related resources is still scarce. However, empirical evidence suggests that different resource endowments are spread over the territory, from the North (e.g., Mendes et al. 2013, Ribeiro et al. 2020), to the Centre (e.g., Pinteus et al., 2015; Alves et al., 2018; Cotas et al., 2020) and the far-South (e.g., algae production in Faro; Cooke et al., 2013, or Raja et al., 2015).

Different studies have highlighted several bottlenecks that prevent the development of this activity in the country. While some are related to regulations, policies and lack of investment/financing, most barriers seem to be technological (Vieira et al., 2020 and van den Burge et al., 2019). The Blue Bioeconomy Roadmap for Portugal (2019) considers that cooperation is the main obstacle (e.g., access to bioresources, biobanks, pilot-scale units, manufacturing facilities and national partners), followed by complex funding mechanisms. In general, this points out to the characteristics of the Portuguese corporate network, which mostly consists of small firms, often indebted and lacking capital. Therefore, the establishment of international partnerships seems to be an important step to overcome those obstacles.

e. Blue energy

Box 5: main research gaps in blue energy

- Estimate the potential social economic value of wind and wave energy deployment and assess their relative competitive advantage regarding the contribution of Portugal to the 2050 EU carbon neutrality goal;
- Estimate the uncompensated net benefits of wind and wave energy deployment;
- Select the optimal location for wind and wave energy deployment based on an MSP framework;
- Encourage the installation of new projects in pilot areas.

Wave energy is the subject of most of the identified studies, followed by wind energy and a few papers on the potential of tidal energy in the country. While wave energy has been researched since 2004, offshore wind and, especially, tidal energy have gained more attention since 2011 and 2018, respectively. The analysed studies include research on wave and wind modeling, technology innovation in energy conversion and platform engineering, infrastructure costs, expected energy efficiency and the economic feasibility of the projects.

Overall, the literature surveyed confirms the existence of potential ideal conditions to explore wave and wind energy in Portuguese waters. In addition, several papers have analysed possible locations for wave farms (e.g., Rosa-Santos et al., 2019; Silva et al., 2018; Castro-Santos et al., 2018; Mendes et al., 2012; Cruz et al., 2007) and wind farms, in particular, in deep offshore areas (e.g., Pacheco et al., 2017; Couto et al., 2019 and Vieira et al., 2019). Finally, there does not seem to be a consensus on the capacity of Portugal to become internationally competitive in this sector.

Based on our review, in general, we conclude that the produced research is insufficient to assess the potential economic value of deploying offshore wind and wave energy sources in Portugal. The potential economic value of these energy sources depends on factors as diverse as the characteristics of the natural endowment and its dynamics over time and across space (e.g., climate change; Santos et al. (2018); Ribeiro et al. 2020); the technology available and how it fits into natural conditions (Diaz and Guedes Soares, 2020; Vieira et al., 2019) as well as its impact on costs (Pacheco et al., 2017); the underlying share of renewable energy in the national energy mix; the access to the grid inland (Vieira et al., 2019), how it interconnects at regional and transboundary levels, and the external effects associated to its deployment; and the regulatory framework (Salvador et al., 2019; Pacheco et al., 2017).

Furthermore, the deployment of these renewable energy sources generates positive as well as negative externalities. On the positive side, among other benefits, they contribute to reducing GHGs (CO_2 and local pollutants) emissions, they may serve as artificial reefs (e.g., wind turbines), and they can provide coastal protection (Palha et al. 2009, Rusu et al. 2016, Lopes de Almeida 2017, and Silva et al. 2018). On the negative side, they are responsible for environmental disamenities (e.g., noise, aesthetics) and conflict with highly socially valued alternative uses of those areas, such as fishing, recreational activities, and habitat protection (e.g., birds migration corridors, marine protected areas). Therefore, for public policy purposes, it is essential to estimate those uncompensated benefits and costs, without which the full (social) opportunity cost of the allocated resources will not be assessed.

This last point highlights the importance of adopting an integrative approach upon which the sustainability of the underlying ecosystems should be grounded (Ecosystem-Based Management, EBM). The protection of the marine environment requires the definition of sustainable management strategies where preservation and use have to be balanced. In this context, the regulatory framework plays an important role. Yet, two main drawbacks (Pacheco et al. 2017) were identified: (i) the lack of transparency of the most common incentives granted (feed-in-tariffs), and (ii) the inadequacy of the MSP framework to reflect the required balance between the economic, social and environmental dimensions (Salvador et al. 2019, and section 2.3). Concerning the second drawback, the success of the MSP strategy is conditional on moving away from *soft sustainability* versions, where environmental concerns take second place (Salvador et al., 2019 and section 2.3).

To achieve EU carbon neutrality by 2050, there is a need for research, both from a private and a social perspective that sheds light on the underlying forces driving investments in renewable energy. However, only a general equilibrium approach can fully respond to this challenge. Namely, an approach that assesses how the relative competitiveness dynamics between the different energy sources respond to the challenges of decarbonisation of the Portuguese economy in the transition to the EU 2050 carbon neutrality goal. Achieving that goal depends on the adopted public policies at national, regional and EU levels (e.g., the evolution of the carbon price in ETS market), as well as how they contribute to technological innovation and to overcome both potential bottlenecks (e.g., in labour markets) and the unintended consequences of such policies (e.g., distributive effects). This will be key to inform future sustainable public policy decisions.

f. Seabed mining

Box 6: main research gaps in seabed mining

- Improve knowledge on the seabed morphology, geochemistry and biology, and geology of the Mid-Atlantic Ridge;
- Assess the natural endowments of critical raw materials in deep seabed under national jurisdiction and develop geographical mapping;
- Develop guidelines to set a comprehensive environmental multi-stage risk analysis of the impact of seabed mining on natural capital and its alternative uses accounting for the full economic costs;
- Establish the required incentives to promote international cooperation in prospecting and exploration under a strict regulatory framework;

In this sector, an analysis of the literature identified several papers on the status, mapping and morphology of the Portuguese seabed (especially near the Mid-Atlantic Ridge amidst the Azores islands), as well as on the impacts of the activity on benthic flora and fauna, and the risks of destabilising deep-sea ecosystems. While studies on the existence of seabed mineral resources have not grown significantly over the years, studies on the environmental consequences of potential mining activities have increased since 2011. Research in this topic clearly signals the specificity of the seabed mining sector. Though it is important to assess the resources endowments, given the potential damages that mining activities can produce in such pristine environments, it is also crucial to carefully study its environmental consequences.

Research on seabed mining in Portuguese waters is still nascent but has increased in the past decade. The studies can be grouped into two broad categories, revealing the main concerns and challenges raised by this activity. The first category focuses on mapping and on the status of the Portuguese seabed, contributing to identify the occurrence/potential occurrence of seabed resources. The main obstacles in this category are related to the high costs of conducting research and the lack of available skilled labour (Carver et al. 2020, Levin et al. 2020), not only in Portugal but globally, especially in the early phases of prospecting and exploration. Portuguese participation in large European projects is, thus, fundamental to finance research in this field. The MINDeSEA project, which registered the occurrence of 24 critical raw mineral aggregates in Portugal, provides a good example. Other crucial initiatives in this context, which have drastically increased knowledge of the Portuguese deep seabed, are linked to the oceanographic campaigns promoted by the Task Group for the Extension of the Continental Shelf (EMEPC). Currently, a group of Portuguese scientists from Azores were granted European funds (Horizon 2020) to explore a region of the deep sea in Azores that was never explored before, the *Dorsal Médio-Atlântica*. The ongoing mission is entitled *iMAR: Avaliação Integrada da Distribuição dos Ecossistemas Marinhos Vulneráveis ao longo da Dorsal Médio-Atlântica na região dos Açores* and aims to identify highly vulnerable areas as well as more sensitive marine ecosystems and collect scientific information to support decision making.

The second strand of literature focuses on the environmental impacts of the activity (for a detailed description, see the MIDAS Consortium report — *Managing Impacts of Deep-seA reSource exploitation*, WWF's *Into Deep 2020* and the *Fauna & Flora International (FFI)* 2020 reports). The most important reported impacts are the following:

- mortality of flora and fauna, and biodiversity loss on the mined substrates (in line with Van Dover et al., 2017; Niner et al., 2018; Simon-Lledó et al., 2019; Christiansen et al., 2020);

- habitat loss, fragmentation and modification due to changes in mineral and sediment composition, geomorphology and chemical regimes (Vanreusel et al. 2016, Waye-Barker et al. 2015);
- formation of near-seabed sediment plumes through the activity of crawlers (e.g., Cooper et al. 2011, Uścinowicz et al. 2014);
- potential release of substances into the water column (e.g., Simpson and Spadaro 2016);
- light and noise pollution (e.g., Roberts et al. 2015).

The European Parliament (January 2018) and the European Commission (June 2020) joined calls for a moratorium on deep-sea mining. In July 2020, the National 2021–2030 Sea Strategy confirmed the alignment of Portugal with that position. Similarly, the National 2021–2030 Sea Strategy confirmed the EU position and considered scientific and technological research & innovation in pilot projects as a key initial step to minimise the potential drawbacks of the activity (Portuguese Government, 2020).

A very concerning issue regards the recovery capacity of the seabed after exploration. The MIDAS report concludes that, for most seabed areas, recovery to baseline is likely to occur, if at all, only in the long term, with very few exceptions. In this context, a European pilot mining test in the EEZ of the Azores — the Blue Atlantis project — may also contribute to increasing knowledge on the impacts of this activity. To the best of our knowledge, however, technical or policy outcomes have not yet been presented. The large uncertainty due to the high costs of conducting experimental research in this field, and the consequent inadequate provision of baseline data, suggest a poor environmental risk assessment.

Finally, DSM also presents challenges concerning the regulatory framework (Warner 2020), political economy, geopolitics and human resources (Carver et al. 2020, Levin et al. 2020). In summary, sustainable seabed mining still has a long way to go before it can be undertaken safely. More research is crucial to improve knowledge on the consequences of this activity on ecosystems. Without it, it is not possible to establish a reliable regulatory framework to prevent exploratory activities (Christiansen et al., 2020).

7.3.2. Setting a framework for maritime policy

A new Portuguese Ocean Strategy was presented in September 2020. Its final version should be soon released after a public consultation period. To date, however, an evaluation of the NOS 2013–2020 is still not available.

The evaluation programme is a crucial step in any public policy decision-making process. Policy evaluation requires a clear framework of analysis. Such framework should clearly state the reference year or benchmark, the timeframe, the targets to be achieved, and how they can be assessed — ranking them according to the priorities set in different policy options (which typically reflect different underlying instruments or a mix of instruments) —, the criteria supporting those targets and a detailed description of the monitoring process. In fact, the lack of a well-defined monitoring process threatens the credibility of the whole evaluation programme.

The NOS 2013–2020 defined a complex and extremely ambitious policy implementation plan — the *Mar-Portugal Plan* —, with 17 Programmatic Areas corresponding to 21 different objectives and over

100 actions. Each Programmatic Area also includes a dedicated action programme, whose main goal is to identify the projects that would ensure the execution of concrete actions. Within the *Mar-Portugal Plan,* we identified more than 150 projects establishing specific objectives, implementation timelines, funding sources and coordination entities. The most recent document on the progress of those projects dates from 2015, providing qualitative information on their corresponding implementation stages. Unfortunately, there are no current publicly available data allowing for a full evaluation of the implementation status of those projects. More importantly, though, the high complexity of the *Mar-Portugal Plan* is a major obstacle to ensure the regular monitoring and evaluation of these projects. The lack of a national policy evaluation system and the delays regarding the implementation of some emblematic projects suggest the need for a more focused approach in order to establish priorities for early action.

The definition of such priorities should be set according to the public policy goals, relying on the capacity of the established research and on the availability of funding. The knowledge gaps and obstacles preventing the development of sectors in the Blue Economy identified above are, to a large extent, reflected in the objectives and actions defined in previous national ocean strategies, namely in the NOS 2013–2020. However, and despite the increase of national scientific production in the Ocean area during the last 20 years, most research gaps remain unanswered. This lack of knowledge constitutes a significant obstacle to setting the ocean policy agenda. In particular, without an adequate assessment of the current environmental status of coastal and marine ecosystems, and the identification of current and future threats, there is no available information to credibly set the necessary measures for the effective implementation of an IMP — a major policy objective of the NOS 2013–2020. Also, as discussed in section 2, growth in the Blue Economy has been marginal. While the obstacles to developing sectors in the BE are well-known, there is a general lack of economic studies to inform public decision-making about how investments can contribute to social welfare, and to growth of the Portuguese BE. In this context, this policy paper suggests a set of recommendations to improve the Portuguese Ocean Policy framework. Establishing the conditions that will allow the country to address the gaps identified above is a first and crucial step to support public policy decision-making in this field.

Currently, Portugal can take advantage of a considerable capacity in marine-related research. According to the report *Conhecimento do Mar*, published in 2017 by the Directorate-General for Maritime Policy (DGPM) of the Ministry of the Sea, Portugal has two state laboratories focused on Ocean research and two other laboratories pursuing research actions directly related to this topic. According to the last evaluation round undertaken by the Foundation for Science and Technology (FCT) — the Portuguese public agency supporting science, technology, and innovation in Portugal — five Research and Development units dedicated to the thematic area of *Ocean Sciences and Technologies* were ranked as excellent.

While the report *Conhecimento do Mar* provides a detailed picture of the marine-related National Scientific and Technological System, a well-grounded analysis of its ability to answer the research gaps and obstacles identified above is lacking. Therefore, it is crucial to develop a Research Strategy specifically designed for marine-related topics that aims to increase Portugal's research capacity in areas that are relevant for the NOS, for other national commitments and for sectoral plans. In this context, the Irish *National Marine Research & Innovation Strategy 2017–2021* may constitute a useful benchmark (Irish Government, 2017). This strategy is based on three different levels of analysis, namely by:

1. identifying national and international policy drivers for each area;
2. performing a Research Maturity Capability Assessment of the National Scientific and Technological System;
3. identifying the funding requirements that allow a given marine-related area to increase its research maturity level.

The Research Maturity Capability Assessment is based on a model that takes three dimensions into account: Human Capacity, Infrastructure, and Networks & Relationships. The assessment selects five maturity levels for each dimension. Using this model, it is possible to identify the national research maturity of the different research areas considered relevant to state policies. However, the analysis does not prioritise different research areas. Instead, it acknowledges the complementarities that may exist between them to provide national authorities with a valuable instrument to identify the areas where support may effectively assist the implementation of a knowledge-based IMP. Particularly interesting is the information provided in that document, identifying the financing requirements to increase the level of research maturity in the five maturity stages. Such information is vital to support policymakers' decisions and help allocating public funds to build policy-oriented national research capacity in a more cost-effective way.

Delivering an integrated maritime policy requires a substantial effort to foster coordination among public entities. Since resources are scarce, developing such a Marine Research Strategy could be a powerful instrument to increase the coordination between different research institutions and state agencies, and to help prioritise research areas and research efforts to support public policy in a more cost-effective way, while also contributing to BE growth. Following this model and signalling the research institutions that can answer the scientific challenges at different maturity levels would also contribute to the development of a more integrated research strategy in the field, with clear positive spillovers at the national level. On the other hand, the Strategy would also pinpoint the areas where national research is less competitive and, therefore, where international cooperation can be more relevant. However, this does not prevent the state from dedicating the available funds to developing a new research project. Nonetheless, in that case, the state also becomes accountable for the consequences of such a decision, namely, the corresponding opportunity cost, which is reflected in the lack of resources for all the other projects. Again, the advantage of this model is to apply an *allocation rule* to research funding well-grounded on clear criteria, and therefore more credible and transparent, making it easier to monitor and evaluate the corresponding outcomes.

Based on the analysis undertaken in section 3, which does not replace the development of such a model in any circumstance, we identified two main areas where research in Portugal is clearly lagging behind, compromising developments in the field. First, the development of an ecosystem-based approach focusing on key marine and coastal ecosystems is required. Second, the potential socio-economic value of fostering development in the different sectors in a small open economy has to be estimated, under different scenarios, as externalities cannot be ignored. As mentioned above, as resources are scarce, it is crucial to understand the net benefits forgone by any selected choice. Importantly, to increase the welfare of local populations, sustainable resource management requires a broader perspective encompassing economic, social, environmental and institutional goals. As the distributive effects of the different policies cannot be ignored, the participation of local populations, by engaging them in the decision-making process, is crucial for their success.

The development of a Marine Research Strategy, as explained above, is an illustrative example of potential initiatives that can be implemented to overcome the existing knowledge gaps in a more cost-effective way while taking full advantage of the current national research excellence in the field. This target-oriented scientific research will promote a more sustainable management of ocean resources, and will help pick up BE growth in a cost-effective way

7.4. Concluding remarks

Blue Economy policies have, to a large extent, initiated in the early 21st century. Portugal is often referenced for its leading role in fostering public policies targeting blue growth, both at the national and international level. However, to the best of our knowledge, there are no studies evaluating those policies and identifying the lessons learned to inform future ocean-related public initiatives. In this context, and conditional on the available information, this paper aims to contribute by analysing the performance of the Portuguese BE, assessing the environmental status of the Ocean, and critically discussing the development of an MSP in Portugal. We also performed a literature survey on marine-related research to identify relevant knowledge gaps and obstacles that might hinder the development of a sustainable Ocean Economy. Our analysis reveals that while Portugal made improvements in maritime economic growth and its ability to adopt an integrated maritime policy, the country has fallen short of the goals set in previous policies. Since no policy evaluation has been publicly released by the national authorities in charge, it is difficult to understand why previous goals were not achieved, making it harder to look into the future by learning from the past.

The world's oceans face an increasing number of pressures, putting the services that support human well-being at risk. At the same time, however, sustainably managing ocean resources may constitute a valuable opportunity to help solving some of the major challenges faced by contemporary societies. Balancing the use and guaranteeing a healthy ocean is, therefore, of utmost importance. Portugal's marine and coastal resources endowment, as well as its geostrategic and geopolitical position, suggest a promising potential for sustainable growth in this area. To date, however, this potential has not yet been materialised. In fact, unlike other European countries that have experienced relevant growth in ocean-related activities — such as fixed offshore wind platforms (e.g., United Kingdom, Denmark, Belgium) or aquaculture (e.g., Norway, Spain, United Kingdom, France), given current knowledge and available technology — the characteristics of the Portuguese coast considerably limit the development of such ocean-related established sectors.

On the other hand, the country's marine and coastal endowment offer promising opportunities in emerging areas, such as seabed mining or blue biotechnology. However, harnessing sustainable growth opportunities in those sectors is still strongly dependent on R&D development and on the country's ability to ensure that such growth will not degrade its blue natural capital. In this context, the definition of an informed ocean policy is critical to unleashing the potential of a solid national blue economy.

Based on section 3.1, this paper identified two major obstacles preventing the design of a more effective ocean strategy, namely (i) the lack of an ecosystem-based approach focusing on key marine and coastal ecosystems and (ii) the absence of systematic assessment of the full opportunity costs of investment in the different BE sectors in the context of an EU small open economy transitioning to carbon neutrality by 2050. Since the ultimate goal is to develop a sustainable marine resource management programme to increase the welfare of local populations, a broader perspective encompassing economic, social, environmental and institutional goals is required. Since the distributive effects of the different policies cannot be ignored, the participation of local populations, by engaging them in the decision-making process, is crucial for their success. That is, the policy's success also depends on how credibly and transparently it is perceived by the public opinion.

Taking advantage of a considerable capacity in marine-related research, we suggest that developing a marine research and innovation strategy is crucial for establishing the necessary conditions to support public policy decision-making. In particular, that strategy should result in an allocation rule to assess the national research maturity of the different research areas considered relevant to the public policies. The research funding allocation should be based on well-grounded and clear criteria, increasing credibility and transparency, and facilitating monitoring and outcome evaluation. Finally, the country should allocate public funds based on such information, thus contributing to the development of cost-effective and policy-oriented national research capacity and, subsequently, to the to BE growth, taking into account the relative competitiveness of the Portuguese economy.

Acknowledgements

The authors gratefully acknowledge the Subdirector General for Maritime Policy, Eng. Conceição Santos and Professor António Nogueira Leite, and Dr. Rui Azevedo, President and Secretary General of Fórum Oceano, respectively, for their most valuable comments.

References

Agapito, D., Mendes, J., & do Valle, P. O., «The rural village as an open door to nature-based tourism in Portugal: The Aldeia da Pedralva case», *Tourism: An International Interdisciplinary Journal*, Vol. 60, No. 3, 2012, pp. 325–338.

Agnesi, S., Annunziatellis, A., Chaniotis, P., Mo, G., Korpinen, S., Snoj, L., Tunesi, L., Reker, J., «Spatial Analysis of Marine Protected Area Networks in Europe's Seas III», ETC/ICM Technical Report 3, European Topic Centre on Inland, Coastal and Marine waters, 2020, 40 pp.

Albuquerque, H., Martins, F., & Costa, C., «Achieving forms of sustainable and competitive tourism in coastal areas. The case of Baixo Vouga», *Journal of Coastal Research*, Vol. 56, pp. 1110–1114.

Alves, C., Pinteus, S., Rodrigues, A., Horta, A., & Pedrosa, R., «Algae from Portuguese coast presented high cytotoxicity and antiproliferative effects on an in vitro model of human colorectal cancer», *Pharmacognosy Research*, Vol. 10, No. 1, 2018, pp. 24.

Antunes do Carmo, José Simão., «The Changing Paradigm of Coastal Management: The Portuguese Case», Sc*ience of The Total Environment*, Vol. 695,133807, 2019.

Andrade, H., Alcoforado, M. J., & Oliveira, S., «Methodologies to assess the effects of climate on tourism: weather type and individual perception», Development in tourism climatology, Commission on Climate and Recreation, International Society of Biometeorology, Freiburg, 2007, pp. 74–79.

Andraz, J. M., Norte, N. M., & Gonçalves, H. S., «Effects of tourism on regional asymmetries: Empirical evidence for Portugal», *Tourism Management*, Vol. 50, 2015, pp. 257–267.

Araujo, S. G., Cotas, J., Morais, T., Leandro, A., García-Poza, S., Gonçalves, A. A. M., & Pereira, L., «Calliblepharis Jubata Cultivation Potential — A Comparative Study between Controlled and Semi-Controlled Aquaculture», *Applied Sciences*, Vol. 10, No. 21, 7553, 2020, link.

APA — Agência Portuguesa do Ambiente, «Relatórios do Programa de Monitorização do Lixo Marinho em praias», 2016-2020, link

Azevedo, G., Domingues, B., Abreu, H., Sousa-Pinto, I., Feio, G., & Hilliou, L., «Impact of cultivation of Mastocarpus stellatus in IMTA on the seaweeds chemistry and hybrid carrageenan properties», *Carbohydrate Polymers*, Vol. 116, 2015, pp. 140–148.

Azevedo, I. C., Duarte, P. M., Marinho, G. S., Neumann, F., & Sousa-Pinto, I., «Growth of Saccharina latissima (Laminariales, Phaeophyceae) cultivated offshore under exposed conditions», *Phycologia*, Vol. 58, No. 5, 2019, pp. 504–515.

Bueno-Pardo, J., Pierce, G. J., Cabecinha, E., Grilo, C., Assis, J., Valavanis, V., [...] & Queiroga, H., «Trends and drivers of marine fish landings in Portugal since its entrance in the European Union», *ICES Journal of Marine Science*, Vol. 77, No. 3, 2020, pp. 988–1001.

Blue Indicators Online Dashboard, [Dataset], 2021, link.

Borges, D., Araujo, R., Azevedo, I., & Pinto, I. S., «Sustainable management of economically valuable seaweed stocks at the limits of their range of distribution: Ascophyllum nodosum (Phaeophyceae) and its southernmost population in Europe», *Journal of Applied Phycology*, Vol. 32, No. 2, 2020, pp. 1365–1375.

Cabo, S., Morais, M. C., Aires, A., Carvalho, R., Pascual-Seva, N., Silva, A. P., & Gonçalves, B., «Kaolin and seaweed-based extracts can be used as middle and long-term strategy to mitigate negative effects of climate change in physiological performance of hazelnut tree», *Journal of Agronomy and Crop Science*, Vol. 206, No. 1, 2020, pp. 28–42.

Cabrero, Águeda, Gonzalo González-Nuevo, Jesús Gago, and Jose Manuel Cabanas., «Study of Sardine (Sardina Pilchardus) Regime Shifts in the Iberian Atlantic Shelf Waters», *Fisheries Oceanography* Vol. 28, No. 3, 2019, pp. 305–16, link.

Caldeirinha, V., Felício, J. A., & da Cunha, S. F., «Government policies and Portuguese port governance in the period from 2005 to 2015», *Research in Transportation Business & Management*, Vol. 22, 2017, pp. 11–20.

Carvalho, P., Marques, R. C., Fonseca, Á., & Simões, P., «Governance and comparative performance of Iberian Peninsula seaports. An application of non-parametric techniques», *International Journal of Transport Economics/ Rivista internazionale di economia dei trasporti*, Vol. 37, No. 1, 2010, pp. 31–51.

Carver, R., Childs, J., Steinberg, P., Mabon, L., Matsuda, H., Squire, R., [...] & Esteban, M., «A critical social perspective on deep sea mining: Lessons from the emergent industry in Japan», *Ocean & Coastal Management*, Vol. 193, 105242, 2020.

Castro-Santos, L., Silva, D., Bento, A. R., Salvação, N., & Guedes Soares, C., «Economic feasibility of wave energy farms in Portugal», *Energies*, Vol. 11, No. 11, 2018, pp. 3149.

CEO — Comissão Estratégica dos Oceanos, «Relatório da Comissão Estratégica dos Oceanos. Parte II — Análise e Propostas», Comissão Estratégica dos Oceanos, Lisbon, 2004.

Christiansen, B., Denda, A., & Christiansen, S., «Potential effects of deep seabed mining on pelagic and benthopelagic biota», *Marine Policy*, Vol. 114, 103442, 2020.

Christodoulou, A., Christidis, P., & Demirel, H., «Sea-level rise in ports: a wider focus on impacts», *Maritime Economics & Logistics*, Vol. 21, No. 4, 2019, pp. 482–496.

Cooke, P., Porter, J., Pinto, H., Cruz, A. R., & Zhang, F., «Notes from the Iberian algae belt», *European Planning Studies*, Vol. 19, No. 1, 2011, pp. 159–173.

Cooper, K. M., Curtis, M., Hussin, W. W., Froján, C. B., Defew, E. C., Nye, V., & Paterson, D. M., «Implications of dredging induced changes in sediment particle size composition for the structure and function of marine benthic macrofaunal communities», *Marine Pollution Bulletin*, Vol. 62, No. 10, 2011, pp. 2087–2094.

Costa, A., Pintassilgo, P., Matias, A., Pinto, P., & Guimarães, M. H., «Birdwatcher profile in the Ria Formosa Natural Park», *Tourism & Management Studies*, Vol. 14, No. 1, 2018, pp. 69–78.

Cotas, J., Marques, V., Afonso, M. B., Rodrigues, C. M., & Pereira, L., «Antitumour potential of Gigartina pistillata carrageenans against colorectal cancer stem cell-enriched tumourspheres», *Marine Drugs*, Vol. 18, No. 1, 2020, pp. 50.

Couto, A., Silva, J., Costa, P., Santos, D., Simões, T., & Estanqueiro, A., «Towards a high-resolution offshore wind Atlas-The Portuguese Case», *Journal of Physics: Conference Series*, IOP Publishing, Vol. 1356, No. 1, October 2019, pp. 012029.

Cruz, M. R. P. d., & Ferreira, J. J. M. d., «Evaluating Iberian seaport competitiveness using an alternative DEA approach», *European Transport Research Review*, Vol. 8, No. 1, 2016, pp. 1–9.

Cruz, C. O., & Marques, R. C., «Risk-sharing in seaport terminal concessions», *Transport Reviews*, Vol. 32, No. 4, 2012, pp. 455–471.

Cruz, J. M., & Sarmento, A. J., «Sea state characterisation of the test site of an offshore wave energy plant», *Ocean Engineering,* Vol. 34, No. 5-6, 2007, pp. 763–775.

Cunha-e-Sá, M. A., Freitas, R., Nunes, L. C., & Otrachshenko, V., «On nature's shoulders: Riding the big waves in Nazaré», *Tourism Economics*, Vol. 24, No. 4, 2018, pp. 369–385.

Decree-Law No. 38/2015, Diário da República, 1.ª Série, 50; March 2015, pp. 1523-49.

DGPM — Direção-Geral de Politíca do Mar, «National Ocean Strategy 2013-2020», DGPM, 2014, link.

DGPM — Direção-Geral de Politíca do Mar, «National Ocean Strategy 2021-2030», Public Consultation Document, DGPM, 2020a, 57 pp, link.

DGPM —Direção-Geral de Politíca do Mar, «SEAMInd — Indicadores e Monitorização de suporte à Estratégia Nacional para o Mar. Volume III Monitorização dos Objetivos para as Áreas Programáticas Oceano, Atmosfera e Sistema Integrado», Vers. 1, DGPM, Lisbon, 2020.

Diaz, H., & Guedes Soares, C., «An integrated GIS approach for site selection of floating offshore wind farms in the Atlantic Continental European coastline», *Renewable and Sustainable Energy Reviews*, Vol. 134, 110328, 2020.

Djunisic, A. S., & Djunisic, S., «AW-Energy close to commissioning WaveRoller device in Portugal», *Renewablesnow.Com*, 2019, link.

Douvere, F., & Ehler, C. N., «New perspectives on sea use management: initial findings from European experience with marine spatial planning», *Journal of Environmental Management*, Vol. 90, No. 1, 2009, pp. 77–88.

EEA, «Bathing water results for 2010, 2016 and 2019 — Portugal», European Environment Agency, n.d., link.

Ehler, C. N., «Two decades of progress in Marine Spatial Planning», *Marine Policy*, No. 104134, 2020.

Ehler, C., & Douvere, F., «Visions for a Sea change: Report of the First International Workshop on Marine Spatial Planning», Intergovernmental Oceanographic Commission and the Man and the Biosphere Programme, UNESCO Headquarters, Paris, France, 8–10 November 2006.

Encarnação, P., «Aquaculture in Portugal: Challenges and Opportunities», Jerónimo Martins, 2016, link.

Encarnação, P., «Challenges and Opportunities for Offshore Aquaculture in Portugal. Seaculture, 2019, link.

EUMOFA — European Market Observatory for Fisheries and Aquaculture Products, «The EU Fish Market — 2020 Edition», Publication Office of the European Union, Luxembourg, 2020.

European Commission, «Green Paper —Towards a future Maritime Policy for the Union: a European vision for the oceans and seas», COM, 2006, pp. 275.

European Commission, «An Integrated Maritime Policy for the European Union»,Communication from the Commission, 575 Final, Brussels, 2007, pp. 16.

European Commission, «Roadmap for maritime spatial planning: achieving common principles in the EU», Communication from the Commission, 791 Final, Brussels 2008a, pp. 11.

European Commission, Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008, establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union, L164; 2008b. p. 19–40.

European Commission, «Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014, establishing a framework for maritime spatial planning», Official Journal of the European Union, L257, 2014, pp. 135-145.

European Commission, «The EU Blue Economy Report — 2020», Publications Office of the European Union, Luxembourg, 2020.

European Parliament, «International ocean governance: an agenda for the future of our oceans in the context of the 2030 Sustainable Development Goals», Committee for the Environment, Public Health and Food Safety, Strasbourg, 2018.

ISA — International Seabed Authority, «Evora workshop progresses discussions on the development of REMP for the Northern Mid-Atlantic Ridge», International Seabed Authority, 2 December 2019, link.

Ferreira, J. G., C. Saurel, J. D. Lencart and Silva, J. P. Nunes, and F. Vazquez, «Modelling of Interactions between Inshore and Offshore Aquaculture», *Aquaculture*, Vol. 426, April 2014, pp. 154–64, link.

Frank, F., Pintassilgo, P., & Pinto, P., «Environmental awareness of surf tourists: A case study in the Algarve», *Journal of Spatial and Organizational Dynamics*, Vol. 3, No. 2, 2015, pp. 102–113.

Gil-Ropero, A., Cerban, M., & Turias, I. J., «Efficiency evolution of largest iberian peninsula container ports: An application of Malmquist Productivity index», Project: SMARTPORT Action Plan Towards the Smart Port Concept in the Mediterranean Area, pp. 53–81.

Guyader, O., Berthou, P., & Daurès, F., «Decommissioning schemes and capacity adjustment: a preliminary analysis of the French experience», in *Fisheries buybacks*, Blackwell Publishing, 2007, pp. 81-104.

Recharge, Snieckus, D., «Industrial wave power off Portugal "by 2023" as flagship array hub unveiled», Article, *Recharge*, 7 July 2020, link.

ICES, «Report of the Working Group on Harmful Algae Bloom Dynamics (WGHABD)», ICES CM, Belfast, UK., 9–12 April 2013, 67 pp, link.

INE — Instituto Nacional de Estatística and DGPM (Directorate-General for Maritime Policy), «Satellite Account for the Sea — 2010-2013 — Methodological Report», INE and DGPM, Portugal, 2016.

INE — Instituto Nacional de Estatística, «Ocean Satellite Account», [Dataset], INE, Portugal, 2020a, link.

INE — Instituto Nacional de Estatística, «Estatísticas da Pesca — 2019», INE, Portugal, 2020b, link.

Irish Government, «National Marine Research & Innovation Strategy 2017-2021», Ireland, 2017.

Istomina, E. A., & Luzhkova, N. M., «Birdwatching tourism infrastructure planning in the Ria Formosa natural park (Portugal)», *Geography and Natural Resources*, Vol. 37, No. 4, 2016, pp. 371–378.

Kanellos, F. D., Anvari-Moghaddam, A., & Guerrero, J. M., «A cost-effective and emission-aware power management system for ships with integrated full electric propulsion», *Electric Power Systems Research,* Vol. 150, 2017, pp. 63–75.

Kovačić, M., Silveira, L., & Kerčević, S., «Comparative analysis of managing beaches as a recreational resource in Croatia and Portugal», *Pomorstvo*, Vol. 34, No. 2, 2020, pp. 405–416.

Khalilian, S., Froese, R., Proelss, A., & Requate, T., «Designed for failure: a critique of the Common Fisheries Policy of the European Union», *Marine Policy*, Vol. 34, No. 6, 2010, pp. 1178–1182.

Leitão, F., Baptista, V., Zeller, D., & Erzini, K., «Reconstructed catches and trends for mainland Portugal fisheries between 1938 and 2009: implications for sustainability, domestic fish supply and imports», *Fisheries Research*, Vol. 155, 2014, pp. 33–50.

Leitão, F., «Landing Profiles of Portuguese Fisheries: Assessing the State of Stocks», Fisheries *Management and Ecology*, Vol. 22, No. 2, 2015, pp. 152–63, link.

Levin, L. A., Amon, D. J., & Lily, H., «Challenges to the sustainability of deep-seabed mining», *Nature Sustainability*, Vol. 3, No. 10, 2020, pp. 784–794.

Lopes de Almeida, J., «REEFS: An artificial reef for wave energy harnessing and shore protection — A new concept towards multipurpose sustainable solutions», *Renewable Energy*, Vol. 114, 2017, pp. 817–829.

Machado, D., Baptista, T., Joaquim, S., Anjos, C., Mendes, S., Matias, A. M., & Matias, D., «Reproductive Cycle of the European Clam Ruditapes Decussatus from Obidos Lagoon, Leiria, Portugal», *Invertebrate Reproduction & Development,* Vol. 62, No. 4, 2018, pp. 179–90, link.

Marinho, B., Coelho, C., Hanson, H., & Tussupova, K., «Coastal management in Portugal: Practices for reflection and learning», *Ocean & Coastal Management*, Vol. 181, 104874, 2019.

Medeiros, R., & Cabral, P., «Dynamic modeling of urban areas for supporting integrated coastal zone management in the South Coast of São Miguel Island, Azores (Portugal)», *Journal of Coastal Conservation*, Vol. 17, No. 4, 2013, pp. 805–811.

Mendes, R. P. G., Calado, M. R. A., & Mariano, S. J. P. S., «Wave energy potential in Portugal — Assessment based on probabilistic description of ocean waves parameters», *Renewable energy*, Vol. 47, 2012, pp. 1–8.

Mendes, M., Pereira, R., Pinto, I. S., Carvalho, A. P., & Gomes, A. M., «Antimicrobial activity and lipid profile of seaweed extracts from the North Portuguese Coast», *International Food Research Journal*, Vol. 20, No. 6, 2013, pp. 3337–3345.

MI News Network, «The Aguçadoura Wave Farm — The World's First Wave Farm», Article, Marine Insight, 11 December 2019, link.

Moreira, A. S., da Costa, E., Melo, T., Sulpice, R., Cardoso, S. M., Pitarma, B., [...] & Domingues, M. R., «Seasonal plasticity of the polar lipidome of Ulva rigida cultivated in a sustainable integrated multi-trophic aquaculture», *Algal Research*, Vol. 49, 101958, 2020.

Nguyen, H. P., Hoang, A. T., Nizetic, S., Nguyen, X. P., Le, A. T., Luong, C. N., [...] & Pham, V. V., «The electric propulsion system as a green solution for management strategy of CO2 emission in ocean shipping: A comprehensive review», *International Transactions on Electrical Energy Systems*, No. e12580, 2020.

Niner, H. J., Ardron, J. A., Escobar, E. G., Gianni, M., Jaeckel, A., Jones, D. O., [...] & Gjerde, K. M., «Corrigendum: Deep-Sea Mining with no Net Loss of Biodiversity—An Impossible Aim», *Frontiers in Marine Science*, Vol. 5, 195, 2018.

Nunes, L. J., Raposo, M. A., & Gomes, C. J. P., «The Impact of Tourism Activity on Coastal Biodiversity: A Case Study at Praia da Cova Redonda (Algarve—Portugal)», *Environments*, Vol. 7, No. 10, 2020, pp. 88.

Nunes, R. A. O., Alvim-Ferraz, M. C. M., Martins, F. G., & Sousa, S. I. V., «Assessment of shipping emissions on four ports of Portugal», *Environmental Pollution*, Vol. 231, 2017, pp.1370–1379.

Olaya-Restrepo, J., Erzini, K., and Gonzalez-Wanguemert, M., «Estimation of Growth Parameters for the Exploited Sea Cucumber Holothuria Arguinensis from South Portugal», *Fishery Bulletin*, Vol. 116, No. 1, 2018, pp. 1–8, link.

Ospar, «Mean Total Abundance of Beach Litter Items — 2018», OSPAR, 2018, link.

Pacheco, A., Gorbeña, E., Sequeira, C., & Jerez, S., «An evaluation of offshore wind power production by floatable systems: A case study from SW Portugal», *Energy,* Vol. 131, 2017, pp. 239–250.

Palha, A., Mendes, L., Fortes, C. J., Brito-Melo, A., & Sarmento, A., «The impact of wave energy farms in the shoreline wave climate: Portuguese pilot zone case study using Pelamis energy wave devices», *Renewable Energy*, Vol. 35, No. 1, 2010, pp. 62–77.

Pardilhó, S. L., Machado, S., Bessada, S. M. F., Almeida, M. F., Oliveira, M. B., & Dias, J. M., «Marine Macroalgae Waste from Northern Portugal: A Potential Source of Natural Pigments?», *Waste and Biomass Valorization*, Vol. 12, 2020, pp. 1–11.

Pereira, L., Morrison, L., Shukla, P. S., & Critchley, A. T., «A concise review of the brown macroalga Ascophyllum nodosum (Linnaeus) le Jolis», *Journal of Applied Phycology*, Vol. 32, 2020, pp. 1–24.

Pereira, L., & Silva, P., «A concise review of the red macroalgae Chondracanthus teedei (Mertens ex Roth) Kützing and Chondracanthus teedei var. lusitanicus (JE De Mesquita Rodrigues) Bárbara & Cremades», *Journal of Applied Phycology*, Vol. 33, No. 1, 2021, pp. 111–131.

Pinteus, S., Alves, C., Monteiro, H., Araújo, E., Horta, A., & Pedrosa, R., «Asparagopsis armata and Sphaerococcus coronopifolius as a natural source of antimicrobial compounds», *World Journal of Microbiology and Biotechnology*, Vol. 31, No. 3, 2015, pp. 445–451.

Portuguese Government, «National Ocean Strategy 2006-2016», [in Portuguese], Ministério da Defesa Nacional, Estrutura de Missão para os Assuntos do Mar, Portugal, 2006, pp. 33.

Portuguese Government, «National Ocean Strategy 2013-2020», Direcção-Geral de Política do Mar, Portugal, 2013. pp. 74.

Portuguese Government, «Plano de Situação do Ordenamento do Espaço Marítimo Nacional», in *Volume I: Enquadramento, Estrutura e Dinâmica*, República Portuguesa, Portugal, 2018, pp. 109.

Portuguese Government, «Consulta Pública sobre a Estratégia Nacional para o Mar 2021-2030», Portuguese Government, 2020.

QIU, W., & Jones, P. J., «The emerging policy landscape for marine spatial planning in Europe», *Marine Policy*, Vol. 39, 2013, pp. 182–190.

Raja, R., Hemaiswarya, S., Arunkumar, K., & Carvalho, I. S., «Antioxidant activity and lipid profile of three seaweeds of Faro, Portugal», *Brazilian Journal of Botany*, Vol. 39, No. 1, 2016, pp. 9–17.

Ramalho, S. P., Lins, L., Bueno-Pardo, J., Cordova, and. A., Amisi, J. M., Lampadariou, N., [...] & Cunha, M. R., «Deep-sea mega-epibenthic assemblages from the SW Portuguese Margin (NE Atlantic) subjected to bottom-trawling fisheries», *Frontiers in Marine Science*, Vol. 4, 2017, pp. 350

Ramos, J., Lino P. G., Caetano M., Pereira F., Gaspar M., and Neves dos Santos, M., «Perceived Impact of Offshore Aquaculture Area on Small-Scale Fisheries: A Fuzzy Logic Model Approach», *Fisheries Research*, Vol. 170, October 2015, pp. 217–27, link.

Ramos, J., Caetano, M., Himes-Cornell, A., & Neves dos Santos, M., «Stakeholders' Conceptualization of Offshore Aquaculture and Small-Scale Fisheries Interactions Using a Bayesian Approach», *Ocean & Coastal Management,* Vol. 138, March 2017, pp. 70–82, link.

Rangel, M. O., Pita, C. B., Gonçalves, J. M. S., Oliveira, F., Costa, C., & Erzini, K., «Developing self-guided scuba dive routes in the Algarve (Portugal) and analysing visitors' perceptions», *Marine Policy*, Vol. 45, 2014, pp. 194–203.

Ribeiro, A. S., deCastro, M., Rusu, L., Bernardino, M., Dias, J. M., & Gomez-Gesteira, M., «Evaluating the Future Efficiency of Wave Energy Converters along the NW Coast of the Iberian Peninsula», *Energies*, Vol. 13, No. 14, 3563, 2020.

Ribeiro, I., Girão, M., Alexandrino, D. A., Ribeiro, T., Santos, C., Pereira, F., [...] & Carvalho, M. F., «Diversity and Bioactive Potential of Actinobacteria Isolated from a Coastal Marine Sediment in Northern Portugal», *Microorganisms*, Vol. 8, No. 11, 1691, 2020.

Richard, C., «WindFloat Atlantic fully operational», *Windpower Monthly*, July 27 2020, link.

Roberts, L., Cheesman, S., Breithaupt, T., & Elliott, M., «Sensitivity of the mussel Mytilus edulis to substrate-borne vibration in relation to anthropogenically generated noise», *Marine Ecology Progress Series,* Vol. 538, 2015, pp. 185–195.

Rodrigues, D., Freitas, A. C., Pereira, L., Rocha-Santos, T. A., Vasconcelos, M. W., Roriz, M., [...] & Duarte, A. C., «Chemical composition of red, brown and green macroalgae from Buarcos bay in Central West Coast of Portugal», *Food chemistry*, Vol. 183, 2015, pp. 197–207.

Rosa-Santos, P., Taveira-Pinto, F., Rodríguez, C. A., Ramos, V., & López, M., «The CECO wave energy converter: Recent developments», *Renewable Energy*, Vol. 139, 2019, pp. 368–384.

Rusu, E., Silva, D., & Soares, C. G., «Evaluation of the shoreline dynamics in a coastal sector of the Portuguese nearshore», C. G. Soares and T. A. Santos (eds.), *Maritime Technology and Engineering 3*, Vols. 1–2, Crc Press-Balkema, Leiden, 2016.

Santos, C. F., Domingos, T., Ferreira, M. A., Orbach, M., & Andrade, F., «How sustainable is sustainable marine spatial planning? Part II —The Portuguese experience», *Marine Policy*, Vol. 49, 2014, pp. 48–58.

Santos, C. F., Orbach, M., Calado, H., & Andrade, F., «Challenges in implementing sustainable marine spatial planning: the new Portuguese legal framework case», *Marine Policy*, Vol. 61, 2015, pp. 196–206.

Santos, S. A., Oliveira, C. S., Trindade, S. S., Abreu, M. H., Rocha, S. S., & Silvestre, A. J., «Bioprospecting for lipophilic-like components of five Phaeophyta macroalgae from the Portuguese coast», *Journal of Applied Phycology*, Vol. 28, No. 5, 2016, pp. 3151–3158.

Santos, C. F., «Marine spatial planning in Portugal: an ocean policy analysis», Doctoral Dissertation, University of Lisbon, 2016.

Santos, C. F., Agardy, T., Andrade, F., Crowder, L. B., Ehler, C. N., & Orbach, M. K., «Major challenges in developing marine spatial planning», *Marine Policy*, 13 September 2018.

Santos, F., Gómez-Gesteira, M., DeCastro, M., Añel, J. A., Carvalho, D., Costoya, X., & Dias, J. M., «On the accuracy of CORDEX RCMs to project future winds over the Iberian Peninsula and surrounding ocean», *Applied Energy*, Vol. 228, 2018, pp. 289–300.

Santos, P, M., Albano, P., Raposo, A., Ferreira, S. M. F., Costa, J. L., & Pombo, A., «The Effect of Temperature on Somatic and Gonadal Development of the Sea Urchin Paracentrotus Lividus (Lamarck, 1816)», *Aquaculture*, Vol. 528, 735487, November 2020, link.

Salas-Leiton, E., Vieira, L. R., & Guilhermino, L., «Sustainable Fishing and Aquaculture Activities in the Atlantic Coast of the Portuguese North Region: Multi-Stakeholder Views as a Tool for Maritime Spatial Planning», *Sustainability* Vol. 13, No. 2, 2021, pp. 663, link.

Salvador, S., Gimeno, L., & Larruga, F. J. S., «The influence of maritime spatial planning on the development of marine renewable energies in Portugal and Spain: Legal challenges and opportunities», *Energy Policy*, Vol. 128, 2019, pp. 316–328.

Samora-Arvela, A., Ferreira, J., Vaz, E., & Panagopoulos, T., «Modeling nature-based and cultural recreation preferences in Mediterranean regions as opportunities for smart tourism and diversification», *Sustainability*, Vol. 12, No. 1, 2020, pp. 433.

Silva, D., Martinho, P., & Soares, C. G., «Wave energy distribution along the Portuguese continental coast based on a thirty three years hindcast», *Renewable Energy*, Vol. 127, 2018, pp. 1064–1075.

Silva, J. P., Alves, C., Pinteus, S., Silva, J., Valado, A., Pedrosa, R., & Pereira, L., «Antioxidant and antitumor potential of wild and IMTA-cultivated Osmundea pinnatifida», *Journal of Oceanology and Limnology*, Vol. 37, No. 3, 2019, pp. 825–835.

Silva, L. D., Bahcevandziev, K., & Pereira, L., «Production of bio-fertilizer from Ascophyllum nodosum and Sargassum muticum (Phaeophyceae)», *Journal of Oceanology and Limnology,* Vol. 37, No. 3, 2019, pp. 918–927.

Simon-Lledó, E., Bett, B. J., Huvenne, V. A., Köser, K., Schoening, T., Greinert, J., & Jones, D. O., «Biological effects 26 years after simulated deep-sea mining», *Scientific Reports*, Vol. 9, No. 1, 2019, pp. 1–13.

Simpson, S. L., & Spadaro, D. A., «Bioavailability and chronic toxicity of metal sulfide minerals to benthic marine invertebrates: implications for deep sea exploration, mining and tailings disposal», *Environmental Science & Technology*, Vol. 50, No. 7, 2016, pp. 4061–4070.

Sousa, C. A. M., M. E. Cunha, and L. Ribeiro., «Tracking 130 Years of Coastal Wetland Reclamation in Ria Formosa, Portugal: Opportunities for Conservation and Aquaculture», *Land Use Policy*, Vol. 94, 104544, May 2020, link.

Stewart-Sinclair, P. J., Last, K. S., Payne, B. L., & Wilding, T. A., «A global assessment of the vulnerability of shellfish aquaculture to climate change and ocean acidification», *Ecology and Evolution,* Vol. 10, No. 7, 2020, pp. 3518–3534.

Strategic Commission for the Oceans, «The Ocean, a National Goal for the 21st Century», [in Portuguese], Comissão Estratégica dos Oceanos, Portugal, 2004, pp. 57+329.

Teixeira, Z., C. Marques, J. S. Mota, and A. C. Garcia, «Identification of Potential Aquaculture Sites in Solar Saltscapes via the Analytic Hierarchy Process», *Ecological Indicators,* Vol. 93, 2018, pp. 231–42, link.

Torralba, J., and M. Besada., «A Stochastic Model for the Iberoatlantic Sardine Fishery. Global Warming and Economic Effects», *Ocean & Coastal Management*, Vol. 114, September 2015, pp. 175–84, link.

UNEP-WCMC and IUCN, «Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM)», UNEP-WCMC and IUCN, Cambridge, UK., March 2021, link.

Warner, R., «International environmental law principles relevant to exploitation activity in the Area», *Marine Policy*, Vol. 114, 103503, 2020.

Wavec — Offshore Renewables — DEMOWFLOAT, «Wavec — Offshore Renewables», n.d, [online], link.

Waye-Barker, G. A., McIlwaine, P., Lozach, S., & Cooper, K. M., «The effects of marine sand and gravel extraction on the sediment composition and macrofaunal community of a commercial dredging site (15 years post-dredging)», *Marine Pollution Bulletin*, Vol. 99, No. 1-2, 2015, pp. 207–215.

World Bank; United Nations Department of Economic and Social Affairs, *The potential of the blue economy: increasing long-term benefits of the sustainable use of marine resources for small island developing states and coastal least developed countries*, World Bank, Washington, DC. © World Bank, 2017, link License: CC BY 3.0 IGO.

Van Den Burg, S. W. K., Dagevos, H., & Helmes, R. J. K., «Towards sustainable European seaweed value chains: a triple P perspective», *ICES Journal of Marine Science*, Vol. 78, No. 1, 2019, pp. 443–450.

Van Dover, C. L., Ardron, J. A., Escobar, E., Gianni, M., Gjerde, K. M., Jaeckel, A., [...] & Weaver, P. P. E., «Biodiversity loss from deep-sea mining», *Nature Geoscience*, Vol. 10, No. 7, 2017, pp. 464–465.

Vanreusel, A., Hilario, A., Ribeiro, P. A., Menot, L., & Arbizu, P. M., «Threatened by mining, polymetallic nodules are required to preserve abyssal epifauna», *Scientific Reports*, Vol. 6, No. 1, 2016, pp. 1–6.

Vasconcelos, V., Moreira-Silva, J. & Moreira, S., *Blue Bioeconomy Roadmap for Portugal*, BLUEandGREEN, CIIMAR, Matosinhos, Portugal, 2019, 68pp.

Vaz, B., Williams, A. T., Silva, C. P. D., & Phillips, M., «The importance of user's perception for beach management», *Journal of Coastal Research*, Vol. 56, pp. 1164–1168.

Vaz, E. N., Walczynska, A., & Nijkamp, P., «Regional challenges in tourist wetland systems: an integrated approach to the Ria Formosa in the Algarve, Portugal», *Regional Environmental Change*, Vol. 13, No. 1, 2013, pp. 33–42.

Vieira, M., Henriques, E., Amaral, M., Arantes-Oliveira, N., & Reis, L., «Path discussion for offshore wind in Portugal up to 2030», *Marine Policy*, Vol. 100, 2019, pp. 122–131.

Vieira, H., Leal, M. C., & Calado, R., «Fifty shades of blue: How blue biotechnology is shaping the bioeconomy», *Trends in biotechnology*, Vol. 38, No. 9, 2020, pp. 940–943.

WWF, Horta e Costa, B., «MPA X-ray — Diagnóstico das Áreas Marinhas Protegidas Portuguesas», 2nd edition, WWF Portugal, Portugal, 2017, 80pp.

Notes

1. This work was supported by Fundação Francisco Manuel dos Santos (FFMS). The authors would like to thank the comments received by Fernando Alexandre, Thomas Philippon and Andrès Rodriques -Pose, and also other members of the project´s steering committee. The opinions expressed herein are those of the authors and do not necessarily express those of their employers. Any remaining errors are the authors´ sole responsibility.

2. For a recent paper relating productivity and the COVID-19 shock using industry-level data in Canada see Blit (2020).

3. The usual Balassa-Samuelson condition gives an indication on the sustainable rate of increase of these relative prices based on the differential of productivity between the tradable and the non-tradable sector.

4. The real exchange rate (in logs) is usually defined as $q = e + p — p^*$ where e is the nominal exchange rate, p is the domestic price and p^* is the foreign price. This equation can be decomposed into $q = [e + p_T — p_T^*] + a.[(p_N — p_T) — (p_N^* — p_T^*)$, where p_T and p_N are the price of tradables and non-tradables, respectively, and a is the share of non-tradable sectors in GDP (assume the same for p^*). If the law of one price is verified in the tradable sector, then $e + p_T — p_T^*=0$ (this requires a homogeneity assumption for tradable goods, which is roughly verified in the case of Portugal). With a constant share of non-tradables a and a given foreign price differential between tradables and non-tradables, we have $\Delta(p_N/p_T) \approx \Delta q$.

5. This effect cannot not be fully captured by the usual Real Effective Exchange Rates (REER), which are biased by the large trade shares within the Eurozone. Portugal is not in competition with domestic producers in EU markets, since most of its direct competitors in EU markets are outside the Eurozone.

6. This was quite a novelty compared with the typical IMF adjustment programmes.

7. $RCA_i = (X_i/\Sigma X_j — M_i/\Sigma M_j).100$, for a given product i. Note that the traditional Balassa specialisation index only takes into account the export side of trade flows, so it can capture comparative advantages in a situation of perfect specialisation. When trade is characterised by large intra-industry flows and Global Value Chains, it is crucial to take into account both exports and imports. Moreover, revealed comparative advantages need to observed in the hypothetical situation of an overall balanced trade. Accordingly, by construction, the sum of RCAs for all products, is always equal to zero (for a discussion see Oliveira Martins and Price, 2004). It goes without saying that the relative position of each sector will not change if the RCA indicator is normalised by GDP or another macro variable.

8. In the past, workers' remittances were a substantial source of external revenues, but their importance has steadily declined over time.

9. It is important to note that tourism can transform a significant share of the service economy into tradable activities and, *de facto*, increase the size of the domestic market.

10. See Furceri et al. (2020) for more details. Data come from an updated version of the data used in Dabla Norris et al. (2015). The capacity utilisation adjustment is applied by extending the approach followed by Basu et al. (2006) for the US to 18 advanced economies (including the US) for the 1970–2014 period. The estimate of the economy-wide TFP change was carried out using industry-level data from KLEMS, subsequently decomposed into its *within* and *between* components. The use of sector-level data is important to capture the underlying change in productivity since measured TFP fluctuations are typically driven, in part, by highly procyclical unobserved capacity utilisation.

11. OECD Labour productivity Statistics, OECD.Stat 2021.

12. Data for Portugal ends in 2006 due to sectoral data availability in EUKLEMS, as Furceri et al. (2020) applied a consistent methodology to 18 advanced economies.

13. This included the purchase of medical resources, employment support programmes, subsidies to small and medium enterprises, and tax breaks (due to the cancellation of some taxes and social security contributions).

14. According to Cechetti et al. (2011), countries whose private corporate sector exceeds 90 % of GDP tend to have a lower growth performance. In another study, Park et al. (2018) looked at the increase of debt by households and non-financial firms, and reported results similar to Mian and Sufi (2015): an increase in corporate debt is never expansionary, and is associated with a negative impact on GDP after three years, with the effect being particularly negative and strong on investment.

15. Note that we view these as a selection of main structural aspects which should be thought of as a policy package given their positive externalities and complementarities. It is, therefore, difficult (and subjective) to rank or prioritise one over another as this is also dependent on the phase of the business cycle and on political economy considerations.

16. These objectives can strengthen aggregate demand by raising consumer and business confidence. They can promote medium-term economic prospects and living standards, by raising productivity and employment, and enhance the resilience of the economy to shocks (IMF, 2016, 2019a). They can also affect inequality by changing the distribution of jobs and wages, and the allocation of income between labour and capital.

17. In fact, in the last year, vocal stakeholders have been advocating for the relaxation of policies or the reversal of past reforms, in some cases resorting to strikes. This is strategically undesirable.

18. The database was compiled through a systematic reading and coding of policy actions documented in various sources, including national laws and regulations, as well as IMF staff reports. This was done for 90 advanced and emerging markets and developing economies during 1973–2014.

< 19. The indicator of domestic finance captures credit and interest -rate controls, entry barriers, supervision and the degree of privatisation in the domestic financial system.

< 20. With respect to external finance, the composite indicators of capital and current account openness capture *de jure* regulations governing international transactions, and move approximately in tandem.

< 21. The trade indicator is based on tariff rates data at the product level.

< 22. Concerning product market reforms, the composite index is based on dimensions of regulations in the telecommunication and electricity sectors, and includes major reforms, such as privatisations of state-owned companies or measures affecting the level of market competition.

< 23. The labour market liberalisation indicator represents a measure of employment protection legislation.

< 24. For a finer and more detailed analysis of structural reform gaps see figure A1 in the Appendix, using alternative data sources.

< 25. This is due to a burdensome registration and licencing regime. Regulations on sales' promotions are also restrictive.

< 26. Note, however, that, on a positive note, a strategy for increasing the competitiveness of the port network has been developed and published in 2019.

< 27. Indicators measure the degree to which policies promote or inhibit competition in areas of the product market where competition is viable. The economy-wide product market regulation indicators measure the regulatory barriers to firm entry and competition in a broad range of key policy areas, ranging from licencing and public procurement, to the governance of state-owned enterprises, price controls, evaluation of new and existing regulations and foreign trade.

< 28. Major historical reforms correspond to those associated with a change in the relevant indicator above two standard deviations of the distribution (of annual changes in the relevant indicator across the whole sample). The magnitudes of historical reforms are not comparable across different policy areas.

< 29. Refer to the Appendix for technical details.

< 30. Germany has two different taxes on profits: a corporation tax and a *trade tax*. These two taxes are applied to two slightly different profits: the *trade tax* is applied to an adjusted profit in which some financing costs are added back to taxable income. In 2020, the combination of these two taxes amounted to 29.9 %.

< 31. This is in line with IMF´s latest *Article IV recommendation* (2019b), in particular the fact that from a structural perspective, issues of expenditure composition need attention. This report was written before the pandemic crisis but some pre-2020 spending cuts, particularly in capital, were advised not to be durable, requiring adjustments within the expenditure envelope, together with a re-examination of the wage and the pension bills. In the context of the new COVID-19 EU´s 750-billion-euro recovery fund, this general recommendation becomes even more important to support potential growth and should be accompanied by a public investment management assessment associated with a strengthening of governance (IMF, 2018).

< 32. A simple way to measure fragmentation is to compute the number of municipalities per 10,000 inhabitants, within a given metropolitan area.

< 33. In this respect, the COVID-19 crisis seems to have accelerated these economic decentralisation trends.

< 34. Actually, the correlation without Ireland is equal to 0.41.

< 35. Noteworthy, while fiscal decentralisation may be influenced by the type of political systems (federal vs. unitary countries), unitary countries such as Denmark or Sweden are among the most decentralised in the OECD. Using other decentralisation criteria, Portugal also displays a low level of decentralisation level (see OECD, 2020).

< 36. The contributions to the growth of employment and GVA are straightforward. The contributions to labour productivity cannot be calculated directly, as productivity is a ratio between output and employment. Thus, the contribution was calculated as the difference between national labour productivity growth as calculated with and without the indicated region.

< 37. This regional pattern can be related to the discussion above on the effect of relative prices. See Alexandre et al. (2011) who showed that «real exchange rates have mainly sizable effects open low-technology sectors, which adjust mainly through job destruction.

< 38. D'Costa et al. (2018) show that structural reforms of product and labour markets sustain the productivity catching-up of lagging regions, since the distance to frontier increases the penalties associated with structural rigidities.

< 39. Portugal was one of the top reformers between 2012 and 2013 (OECD, 2014).

< 40. FCT's Assessment of Research Units – 1999, (fct.pt), 2019.

< 41. Technologies can be transferred through patent trade. However, when technologies are developed by a given pool of skills and linked with the production needs, the cost of transferring the production with the new cutting-edge technology becomes higher when compared with the benefit of producing (and continue to upgrade the technology) locally. Thus, both human capital and technological development are acting here as sources of long-run growth, avoiding the so-called negative erosion effect from technological development into human capital accumulation.

< 42. In 2019, 78.6 % of the HEI professors were over 40 years old and 46.5 % over 50 (DGEEC, 2020). Jones (2010) and Feyrer (2008) analysed the age profile of inventors/innovators and showed that young

and middle-aged workers are those who contribute the most to the pace of the innovation process.

< 43. Contracts between the Government and Universities/Public Institutes – RTP Archives (in Portuguese).

< 44. Which succeeded the Excellence Initiative already in place since 2005.

< 45. Excellence Strategy — BMBF.

< 46. The programme's webpage is available here

< 47. The programme's webpage is available here

< 48. Hird, M.D. and Pfotenhauer, S.M (2017) "How complex international partnerships shape domestic research clusters: Difference-in-difference network formation and research re-orientation in the MIT Portugal Programme". Research Policy, 46, pp. 557-572.

< 49. Available here.

< 50. Higher positions are obtained by the University of Lisbon for Marine and Ocean Engineering (6th worldwide) and Remote Sensing (38th worldwide). In the Food Science and Technology field the University of Porto appears in the 15th position worldwide and the Polytechnic Institute of Bragança in the 30th position. In some technological subfields the Catholic University of Lisbon (Food Science and Technology), the Algarve University (Environmental Science and Engineering), the Trás-os-Montes University (Food Science and Technology) and the Beira Interior University (Computer Science and Engineering) are listed but in lower ranks.

< 51. Available here.

< 52. Figure 6 highlights ordinal differences in positions of universities within countries. We consider the initial position of each interval, for universities classified within intervals, and the actual ordinal position when they have one. The sum of the five best universities is the sum of the ordinal position of those universities. Numbers within bars indicate the exact position or the highest value of the interval.

< 53. A good example is the Big Data course taught to students of Economics and other Social Sciences by Professor Raj Chetty (Big Data to Solve Economic and Social Problems | Opportunity Insights). This course does not require previous tertiary education and is given using practical examples.

< 54. For more information on the partnership, see crossmappingthe-future.com

< 55. Letter of Intent, Memorandum of Economic and Financial Policies and Technical Memorandum of Understanding (2011). Henceforth, we will refer to this agreement as *The MoU agreement*.

< 56. OECD, Recent Trends on Employment Protection Regulation, in Employment Outlook 2020, available online here.

< 57. Source: *Flash Eurobarometer 459: Investment in the EU Member States* (2020), available online here. Respondents are asked to rank the obstacles to investment from major to moderate, minor or none at all. The rank positions we report correspond to the result obtained by adding the percentage of responses indicating a major or moderate intensity for each possible obstacle.

< 58. For more information on the programme, see link.

< 59. In *Livro Verde sobre o Futuro do Trabalho 2021*, pp. 92-94.

< 60. All data obtained from INE-Statistics Portugal, Survey of Adult Education and Training, 2017.

< 61. See Acemoglu and Autor (2011).

< 62. For a definition of the performance indicators, see table A.1. in the Appendix.

< 63. Micro-sized firms (<10 workers and <10M€ of sales or total asset); SMEs (9 workers < SME < 250 workers and < 50M€ turnover or total assets); Large firms (>249 workers or >50 M€ sales or total assets). This definition follows the EU recommendation 2003/361, Eurostat

< 64. We consider a group of countries from the Orbis database that report data for at least 25 % of their firm population, namely, Portugal, Spain, Italy, Slovakia, Sweden, France, Slovenia, Finland, the Czech Republic, Belgium and Luxemburg.

< 65. The Manufacturing sector includes the following sectors: Basic Metals; Chemicals and Pharmaceutical; Products; Coke and Refined Petroleum Products; Computer, Electronic and Optical Products; Electrical Equipment; Fabricated Metal Products; Food Products, Beverages and Tobacco; Machinery and Equipment, n.e.c.; Motor Vehicles, Trailers and Semi-Trailers; Other Manufacturing; Repair and Installation of Machinery and Equipment; Other Non-Metallic Mineral Products; Other Transport Equipment; Paper Products and Printing; Rubber and Plastic Products; Textiles, Wearing Apparel, Leather and Related Products; Wood and Products of Wood and Cork.

< 66. Both for SMEs and large firms, only firms with more than two employees were considered to remove outliers.

< 67. The policy paper also uses data and results from previous research, properly identified and referenced.

< 68. The leading export companies in 2020, according to the National Institute of Statistics: 1) Volkswagen Autoeuropa (Automotive), 2) Petrogal (Gas and Oil), 3) The Navigator Company (Paper Pulp), 4) Bosch Car Multimedia (Automotive), 5) Continental Mabor (Automotive), 6) Faurécia (Automotive), 7) PSA Automobiles (Automotive), 8) Visteon Electronics (Automotive), 9) Aptivport Services (Automotive), 10) Eberspacher Exhaust Technology Portugal (Automotive).

< 69. Modal share of freight exports in 2018: Maritime (54.60 %); Road (39.10 %); Air (3.40 %); Railways (0.40 %), Others (2.50 %).

< 70. Sea side or land side refer to the various systems on sea (canals, navigation systems, etc.) or on land (terminals, road and railway accessibilities, etc.).

< 71. The International Logistics Performance Index is a composite index, calculated and made available by the World Bank to allow

benchmarking amongst countries in terms of the *challenges and opportunities* they face in their performance on trade logistics. Available here.

< 72. Since 2006, the government has been announcing locations for a new greenfield airport, first in Ota (2006), then in Alcochete (2008), and then it proposed a brownfield project in Montijo (2012). Several other locations were considered before 2006.

< 73. *Passenger.km* is a commonly used indicator of utilisation, obtained by the sum of the product of all passengers by the average length of the travel.

< 74. Measured in annual average daily traffic (AADT).

< 75. For traffic volumes below this threshold, a motorway with separate lanes (2x2) is an oversized solution.

< 76. NGA networks are advanced networks that are able to offer a very high-speed communication service through optical elements, or equivalent technology.

< 77. Source: European Commission

< 78. Source: ANACOM

< 79. FTTH: Fibre-to-the-Home

< 80. HFC: Hybrid Fibre Coax

< 81. This indicator was calculated for the 1986 –2019 period as part of a research project funded by the Francisco Manuel dos Santos Foundation (FFMS): *Transport Systems in Portugal: Analysis of Efficiency and Regional Impact*.

< 82. Data provided by Miguel Portela (UMinho), to whom the authors are grateful.

< 83. As per the data provided by Pordata here.

< 84. As per the data provided by Pordata here.

< 85. As per the data provided by Pordata here.

< 86. As per the data provided by Pordata here.

< 87. A micro company is defined as a company that employs less than ten people and whose annual turnover or annual balance sheet does not exceed 2 million euros (source: INE)

< 88. As per the data provided by Pordata here.

< 89. As per the data provided by Statista here.

< 90. Traffic deviation is calculated as follows: (Real Traffic — Forecast Traffic)/Forecast Traffic.

< 91. SCUT was the former name of the current Portuguese electronic toll system

< 92. This paper was prepared for the project *From made in to created in: a new paradigm for the Portuguese economy*, sponsored by the Francisco Manuel dos Santos Foundation. The authors are grateful to Fernando Alexandre, Gonçalo Matias and other participants of this project, including its steering committee members, for their helpful comments. The usual caveats apply.

< 93. As noted in Antrás (2020), a stark prediction of the standard gravity model of trade is that smaller economies tend to display higher trade openness (measured as total export of goods and services to GDP or total exports plus imports to GDP).

< 94. As defined by a leading expert (Antrás, 2020), GVCs are defined as «… a series of stages involved in producing a product or service that is sold to consumers, with each stage adding value, and with at least two stages being produced in different countries. A firm participates in a GVC if it produces at least one stage in a GVC». A classic example is the iPhone, which was designed by Apple in the U.S., contains parts from countries like Germany, Japan and South Korea, and is assembled in China.

< 95. As standard in the literature, the GVC exports of a country (or sector) can be broadly defined as the value of production crossing more than one national border. That comprises the value added of foreign inputs embodied in the country's gross exports (in this case Portugal's), plus the domestic value added component of exports (Portugal's) that is re-exported by other countries. The first component is associated with the so-called *backward participation*, and the second with the so-called *forward participation* in a GVC. We measure the extent of GVC participation as the ratio of GVC exports to total (gross) exports. Using such measure, around one half of the world trade appears to be associated with GVC participation.

< 96. This does not mean that aggregate inferences on the macro implications of greater GVC participation should be neglected. The connection between export dynamism, GVC participation and FDI, and their benefits on lowering debt ratios and sovereign risk, have already been alluded to in the introduction. In terms of other macroeconomic implications, the fact that firms participating in GVCs account for much of the country's exports and are two-way traders (both importing and exporting goods and/or services), suggests that large real exchange rate depreciations may not be as effective as in the past in improving the trade balance. This is so because, after a depreciation, higher gross exports tend to be accompanied by higher import growth in the intermediate products that are required to boost exports.

< 97. The sector breakdown follows that of the OECD Trade in Value Added (TiVA) database, with the following sector codes: 1 — Agriculture, Forestry and Fishing. 2 — Mining and Quarrying. 3 — Food Products, Beverages and Tobacco. 4 — Textiles, Wearing Apparel, Leather and Related Products. 5 — Wood and Products of Wood and Cork. 6 — Paper Products and Printing. 7 — Coke and Refined Petroleum. 8 — Chemicals and Pharmaceutical Products. 9 — Rubber and Plastics. 10 — Other non-metallic mineral products. 11 — Basic Metals. 12 — Fabricated Metal Products. 13 — Computer, Electronic and Optical Products. 14 — Electrical Equipment. 15 — Machinery Equipment, Nec. 16 — Motor Vehicles, Trailers and semi-trailers. 17 — Other Transport Equipment. 18 — Other Manufacturing; Repair and Installation of Machinery Equipment. 19 — Electricity, Gas, Water Supply, Sewerage, Waste and Remediation Services. 20

— Construction. 21 — Wholesale and Retail Trade; Repair of Motor Vehicles. 22 — Transportation and Storage. 23 — Accommodation and Food Services; 24 — Publishing, Audiovisual and Broadcasting Activities. 25 — Telecommunications. 26 — IT and Other Information Services. 27 — Financial and Insurance Activities. 28 — Real Estate Activities. 29 — Other Business Sector Activities. 30 — Public Admin. and Defence; Compulsory Social Security. 31 — Education. 32 — Human Health and Social Work. 33 — Arts, Entertainment, Recreation and Other Service Activities.

< 98. According to Jones et al (2019), such technology/knowledge diffusion can be accomplished through three mechanisms. The first one is a *diffusion effect*, whereby MNEs can assist local firms through knowledge and technology sharing. The second one is *the availability and quality effect*, where GVC participation increases the availability and quality of the inputs. The third one is *the demonstration effect*, where technology and knowledge spillovers happen by firms imitating or reverse engineering GVC products. See World Bank, 2020 (Chapter 3) on the evidence on technological and knowledge transfer.

< 99. The flip-side of it is that wage inequality effects are also likely to be stronger (Goldberg and Pavcnic, 2007, Antrás, 2020). As with standard trade, the effects on intra-country poverty are much less clear-cut; and, at least on a global basis, trade expansion including through GVCs has contributed to (absolute) poverty reduction as well as to some decline in inter-country inequality (Catão and Obstfeld, 2019).

< 100. When the Balassa index = 1, it means that the respective sector participation in Portugal's exports equals that of the participation of the same sector in world exports.

< 101. European Commission (2020, p. 5)

< 102. See the government's white paper on the *Plano de Recuperação e Resiliência (Recovery and Resilience Plan)*.

< 103. Report by the *Comissão Estratégica dos Oceanos* (Strategic Ocean Committee), (CEO, 2004).

< 104. There is not only one definition of BE. While the European Commission, for example, states that the BE encompasses all sectoral and cross-sectoral economic activities based on or related to the oceans, seas and coasts (European Commission, 2020), the World Bank, establishes a clear link with the sustainable use of maritime resources, explicitly excluding policies that lack this component (World Bank and DESA, 2017). This policy paper adopts an integrated definition, covering the sectors defined by the European Commission, while emphasising the need for a sustainable management of marine natural resources.

< 105. There are three main reasons for this: (i) the sectoral composition as well as the extent of the inclusion of indirect economic impact differs between the two sources, (ii) the OSA measures GVA at basic prices, while the EU BIs measure is presented at factor costs, and (iii) employment in the OSA is provided in full-time equivalent units, while in the EU BIs report it is given by the total number of individuals employed.

< 106. To improve comparability, we use data from EU BI, which might not always be in line with National Accounts for the reasons described in footnote 3. Also, all values are in nominal terms.

< 107. This sharp decline coincided with the financial crisis that occurred at Estaleiros de Viana do Castelo, located in the North of Portugal.

< 108. A kind-of-activity unit is (part of) an organisation that only engages in one type of productive activity or where a large share of total GVA is generated by a specific activity.

< 109. Due to a break in the data from OSA between 2013 and 2016 a more precise analysis could not be made.

< 110. The survey was conducted in February and March 2021 in the publicly accessible repositories *Web of Science*, *Google Scholar* and *ScienceDirect*.

Index of figures

Paper 2

National Scientific and Technological System (NSTS)

Paper 3

Building the new paradigm: skills and labour markets

Paper 4

Growing to the frontier: entrepreneurs and their circumstances

Index of tables

Part I
From *made in* to *created in*: a new paradigm for the Portuguese economy

Parte II
Policy papers

Paper 1
Business environment: competition, markets and taxation

Paper 2
National Scientific and Technological System (NSTS)

Paper 3
Building the new paradigm: skills and labour markets

Autors

ALEXANDRE, Fernando

Holder of a PhD in Economics from the University of London, Birkbeck College. Associate professor with habilitation at the University of Minho, vice-president of the Economic and Social Council and consultant to the Francisco Manuel dos Santos Foundation. Served as pro-rector, president of the School of Economics and Management and director of the economics department at the University of Minho. He was chairman of the Board of Directors at SBS Startup Braga, SA, and deputy secretary of state to the Minister of Internal Affairs during the XIX Constitutional Government. Author and coordinator of seven books on the Portuguese economy and articles published in international scientific journals, such as *World Economy*, *Open Economies Review*, *Regional Studies*, *CESifo Economic Studies*, *Journal of Technology Transfer*, *Economics Letters* or *Higher Education*. He has worked as a consultant for public and private entities, including the European Commission, the Portuguese Government, the Francisco Manuel dos Santos Foundation, the Calouste Gulbenkian Foundation, the Portuguese Court of Auditors, the Confederation of Portuguese Business (CIP), the Portuguese Association of Insurers or the Commercial Association of Porto. He is also a member of the commentary panel on RTP3's programme *360°*, and collaborates with the media on a regular basis.

JALLES, João Tovar

João Tovar Jalles holds a PhD in Economics from the University of Cambridge and is an Assistant Professor of Economics at the University of Lisbon. Before that, he was a Senior Economist at the Portuguese Public Finance Council. João also held Economist positions at the IMF, the OECD and the ECB. Academically, he taught at Sciences Po, Paris, the University of Aberdeen and the University of Cambridge, UK, and the Nova University, Lisbon. His main research areas include fiscal policy, forecasting performance, structural reforms, macro-financial linkages and energy economics. He has written extensively, having published more than 100 academic papers in refereed journals.

MARTINS, Joaquim Oliveira

Joaquim Oliveira Martins holds a PhD in Economics from the University of Paris-I, Panthéon-Sorbonne. He is a Fellow at the Academy of Social Sciences (FAcSS), UK, a counsellor at the Center for Prospective Studies and International Information (CEPII), Paris, and a lecturer at the University of Paris Dauphine-PSL. Previously, he was Deputy-Director of the OECD's *Centre for Entrepreneurship, SMEs, Regions and Cities*. Joaquim Martins has authored several academic articles and OECD's publications on trade and competition, productivity and growth, environment, structural policy complementarities and regional policies.

BRINCA, Pedro

Pedro Brinca is an Assistant Professor at the Nova School of Business and Economics (Nova SBE), and an Associate Researcher II at the University of Oslo. Previously, he was a lecturer at the Stockholm University and a Jean Monet Fellow at the Robert Schuman Centre for Advanced Studies of the European University Institute. He has published research on two main streams, namely, the identification of theories with quantitative relevance for explaining business cycles, and the interplay between micro and macro heterogeneity in topics such as fiscal policy, structural transformation and technological change.

SEQUEIRA, Tiago Neves

Tiago Sequeira holds a PhD in Economics from the Nova School of Business and Economics. He is a Full Professor at the University of Coimbra and a full member of the Centre for Business and Economics Research (CeBER). Tiago has been developing theoretical and empirical studies on economic growth and has published more than 70 works in several international journals, including the *Research Policy*, the *Journal of Economic Behavior and Organization*, the *Scandinavian Journal of Economics*, the *Oxford Economic Papers*, and the *Ecological Economics*. He has held several university-management positions as member of the University Senate, member of Scientific Councils, Course Director and Coordinator, Head of University Departments and Centres, and Vice Dean, and he is also coordinator and jury of research and innovation projects funded by private and public foundations. Tiago Sequeira was one of the economists invited by the Portuguese President of the Republic to the 2013 meeting *Economia Portuguesa no Pós-Troika* (the Post-Troika Portuguese Economy), and one of the economists invited by the Prime Minister of Portugal to analyse the impact of the COVID-19 pandemic in the Portuguese economy and the subsequent economic crisis.

MONTELIUS, Lars

Lars Montelius is the Director-General of the International Iberian Nanotechnology Laboratory (INL) since September 1, 2014. He teaches Nanotechnology at the Lund University, Sweden, and is the founder of several Swedish companies working with nanotechnology. Lars Montelius is also the President of the International Union for Vacuum Science, Technique and Applications (*IUVSTA*), with over 150,000 members from 32 countries. He is a member of the EC Executive High-Level Group (HLG), at DG NMPB, and Board member and Working Group Chair of two European Technology Platforms (ETPs), namely the *NANOFutures* (the European initiative for sustainable development by Nanotechnologies) and the *EuMa*t (the ETP for Advanced Engineering Materials and Technologies). Between 2003 and 2009, Lars Montelius was Dean of the Physics Department of the Faculties of Science and Engineering of the Lund University. Between 2009 and 2011, he was the Director of the Öresund University and Öresund Science Region (ÖSR) initiative, a cross-border cooperation between 11 universities and three regional authorities from two countries in the Öresund Region. Lars Montelius was also Chair of the Swedish Technical Standardisation Committee on Nanotechnology from 2007 to 2014, and has authored more than 300 international indexed publications.

FERRÃO, Paulo

Paulo Ferrão was born in Lisbon in 1962. He graduated in Mechanical Engineering (1985) at the Higher Technological Institute (IST) of the Technical University of Lisbon — where he received the award of best student of the year in his field — and in Strategic Management in the Context of Innovation (1988) at the University Institute of Lisbon (ISCTE). He holds a Master's Degree in Heat Transfer and Conversion (1998), a PhD (1993) and a Habilitation (2004) from the IST. Paulo Ferrão was President of the Foundation for Science and Technology (FCT) and the National Director of the *MIT-Portugal* programme — the largest national Science and Technology partnership in Engineering Systems, and a key focus area for Sustainable Energy Systems. He is a Full Professor at the Instituto Superior Técnico (IST), Lisbon, co-founder of the cross-disciplinary research venue *IN+ Centre for Innovation, Technology and Policy Research* and was the coordinator for Sustainable Technologies and Environmental Systems at the associated laboratory of the Institute for Systems and Robotics (ISR). Paulo Ferrão has published more than 70 articles in scientific journals and book chapters, and has presented more than 80 articles in conferences and seminars. He also co-organised over 12 international conferences and led over 30 scientific projects on Energy Efficiency and Industrial Ecology.

VAREJÃO, José

José Varejão holds a PhD in Economics (2001) from the University of Porto with a specialisation in Labour Economics. Currently, he is an Associate Professor of Economics at the Faculty of Economics of the University of Porto, a researcher at the Centre for Economics and Finance of the University of Porto (CEF.UP), and a research associate at the Institute of Labour Economics (IZA), Germany. He collaborated and provided consultancy to several institutions, and was responsible for the assessment study on the Active Labour Market Policies (ALMPs) laid down in the Memorandum of Understanding between Portugal and the European Union. José Varejão has published articles in journals such as the *Journal of Labor Economics*, the *Journal of Population Economics* and the *Labour Economics*. He is the Director of the Faculty of Economics of the University of Porto since 2015.

PORTELA, Miguel

Miguel Portela holds a PhD in Economics from the Tinbergen Institute/University of Amsterdam (2007). He is currently an Associate Professor, with Habilitation, at the University of Minho, and the Director of its Doctoral Programme in Economics. He is an affiliated researcher at the Centre for Research in Economics and Management (NIPE), at the Centre for Research in Higher Education Policies (CIPES) and at the Institute of Labour Economics (IZA), Germany, and he maintains an ongoing collaboration with the Bank of Portugal. His research interests lie in the areas of labour economics, economics of education and applied econometrics. Miguel has authored several papers, books and book chapters, and has been published in renowned journals such as the *Econometrica*, the *Scandinavian Journal of Economics*, the *Regional Studies* and the *Studies in Higher Education*. His work has been cited, among others, in the *Brookings Papers on Economic Activity* (BPEA), the *Review of Economics and Statistics*, the *Journal of Business and Economic Statistics*, the *Industrial and Labor Relations Review* and the *Labour Economics*. He maintains ongoing research collaborations with different countries, and he leads and integrates research teams working on financed projects. Miguel Portela has written policy-oriented reports on Minimum Wage, Education and Employment for the Portuguese labour market and has vast consultancy experience, both for private and public institutions.

VASCONCELOS, Joana

Joana Vasconcelos is an Associate Professor at the Católica Lisbon School of Law, where she also graduated and earned her Master's and PhD degrees. Currently, she teaches Labour Law and Labour Procedural Law in Undergraduate and Masters' programmes of the Católica Lisbon School of Law. She was a consultant for the Presidency of the Legal Centre of the Portuguese Council of Ministers and was part of the team that wrote the Preliminary Draft of the Labour Code. She is regularly invited by Portuguese Law Faculties and similar institutions to teach Labour Law and Labour Procedural Law in Post-Graduate and Advanced Legal Studies programmes, and is also a regular speaker on these subjects in colloquia, congresses and conferences. Joana Vasconcelos collaborates as a consultant with the *Miranda & Associados* law firm and is the author of several books and articles on Labour Law and Labour Procedural Law.

CEREJEIRA, João

João Cerejeira holds a PhD in Economics from the European University Institute (Florence). He is currently an Assistant Professor at the Department of Economics of the University of Minho, a member of the Centre for Research in Economics and Management (NIPE) and a research affiliate at the Centre for Research in Higher Education Policies (CIPES). His main areas of research include labour economics and the assessment of public programmes and policies. His advising experience includes policy-oriented reports on economic impacts associated with climate changes, the impact of large-scale cultural events, and the assessment of labour market policies for organisations such as the Portuguese Government and the International Labour Organisation (ILO), as well as other private companies and non-profit organisations. He has published several articles on these themes in international journals and book chapters.

COSTA, Hélder

Hélder Costa holds a Graduation, a Masters' degree and a PhD in Economics from the University of Minho (Uminho), and is an FCT Research Fellow. From 2016 to 2017, he was consultant for the Dean's Office of the University of Minho. His research work is mainly focused on Labour Economics, and he has published an article in the *Regional Studies* journal and co-authored a book on the Portuguese economy.

CRUZ, Carlos Oliveira

Carlos Oliveira Cruz is an Assistant Professor, with Habilitation, at the Department of Civil Engineering, Architecture and Geo-Resources (DECivil) of the Técnico Institute (University of Lisbon), and a researcher at the Civil Engineering Research and Innovation for Sustainability (CERIS). He is also Associate Editor of the *Journal of Management in Engineering* and Assistant Editor of the journal *Competition and Regulation in Network Industries*. Before that, he provided consultancy on transport systems and infrastructures' planning and management to private and public entities such as the OECD, the EBRD, and international investment funds. Carlos Oliveira Cruz was also a Visiting Scholar at the J. F. Kennedy School of Government (Harvard University), where he developed research work on management models for infrastructures, an advisor to the State Department of Transport and the manager of a consulting and engineering services company in the field of transportation.

JANUÁRIO, João

João Fragoso Januário holds a Master's degree in Civil Engineering from the Instituto Superior Técnico (University of Lisbon), a Post-Graduation in Enterprise Data Science and Analytics from the Nova Information Management School (Nova University, Lisbon), and is currently completing his PhD in Civil Engineering at the Instituto Superior Técnico. João is a researcher at the Civil Engineering Research and Innovation for Sustainability (CERIS), and the Co-Founder of the artificial intelligence and data analysis company *Alfredo Real Estate Analytics*. Previously, he has worked in the investment banking sector.

CATÃO, Luís

Luís A. V. Catão holds a BSc in Electrical Engineering, a BA in Economics from the Federal University of Rio de Janeiro (with honours), and an MPhil and PhD in Economics from the University of Cambridge. He is an Associate Professor (currently on leave) at the Lisbon School of Economics & Management (ISEG), a Research Fellow at the Centre for Economic Policy Research (CEPR), and an Affiliated Researcher at the Research Unit on Complexity and Economics (UECE) and the Research in Economics and Mathematics (REM), both from the ISEG. Previously, he was a senior economist in the research department of the International Monetary Fund (IMF). His research has been published in leading academic journals and cited in public presentations by leading policymakers, newspapers and magazines, including The *Economist*, the *Dow Jones News*, the *Financial Times*, the *Washington Post*, the *Herald Tribune*, the *Wall Street Journal*, *Time Magazine,* the *Valor Econômico* and the newspaper *O Expresso*. Luís Catão is co-editor, with Maurice Obstfeld, of the journal *Meeting Globalisation's Challenges*, published by the Princeton University Press in 2019.

de FARIA, Pedro

Pedro de Faria is an Assistant Professor at the Department of Innovation Management & Strategy (IMS) of the Faculty of Business and Economics (University of Groningen, Netherlands). His research work is directed towards innovation management and business strategy, with a particular focus on how companies manage their knowledge acquisition activities and cooperate with their partners.

MARTINS, António

António Martins holds MA in Finances from the Nova School of Business and Economics (Nova SBE). Currently, he is a PhD student in Economics at the Lisbon School of Economics & Management (ISEG) and a Teaching Assistant at the Nova SBE.

DIETRICH, Til

Til recently graduated from Nova School of Business and Economics (Nova SBE) with a MSc in Economics. Previously, he studied Economics and Business Economics at Maastricht University, spending a semester in Chile. Between his studies, he gained working experience in the international development of green bond markets at the German Corporation for International Cooperation (GIZ) and in the financing of renewable energy projects at Triodos Bank. Currently, Til works as a research assistant for Nova SBE's Environmental Economics Knowledge Center and freelances as a data analyst. He is passionate about environmental issues, with a strong concern for social equity in the transition towards a more sustainable society. Til loves outdoor sports, cooking and diving into the philosophy of human behavior.

MARCHIORO, Flora

Flora Marchioro is a PhD Candidate in Economics at the University of Lugano (Switzerland), and a former master student in economics at Nova School of Business and Economics (Portugal), with a specialization in public policies. She graduated from Nova SBE in January 2021 with a full-mark thesis on the impact of fiscal incentives on the adoption of electric vehicles in Europe. Besides public economics, her interests range from environmental and resource economics to energy markets. Before joining her PhD program, she worked in the consulting sector as data and market research analyst, and collaborated with the Nova SBE Environmental Economics Knowledge Center.

ROSA, Renato

Renato Rosa graduated and obtained his PhD in Economics from the Nova School of Business and Economics (Nova SBE), is Principal Researcher at the Nova SBE, and the co-scientific Director of the Nova Environmental Economics Knowledge Center. From 2008 to 2011, he worked at Fondazione Eni Enrico Mattei, where he developed research in the integration of forestry, agriculture and land use topics into numerical macroeconomic models. In 2018, he was awarded a Scientific Employment Stimulus grant, as Principal Researcher, and in 2012, a research starting grant in the *FCT Investigator Programme*. His research interests focus on renewable resources and ecosystem services, with an emphasis on multidisciplinary bio-economic modelling. His research has been published in top field journals, and he has been invited to speak in various universities, seminars and workshops. Renato Rosa's joint work with fish and forestry scientists has recently resulted in two bioeconomic models for Portuguese forests and one bioeconomic model for the Ibero-Atlantic Sardine stock. Renato has taught at the Nova SBE, the University of Aveiro and the Ca'Foscari University of Venice.

CUNHA E SÁ, Maria Antonieta

Maria A. Cunha e Sá holds a PhD in Economics from the University of Illinois at Urbana-Champaign, USA, and is an Associate Professor of Economics at the Nova School of Business and Economics (Nova SBE). Her fields of interest are Environmental and Natural Resource Economics, with an emphasis on the economic valuation of environmental goods and natural resources modelling. She has vast experience in project coordination and has published in several international scientific journals, such as the *Journal of Environmental Economics and Management*, the *American Journal of Agricultural Economics*, the *Land Economics*, the *Environment & Resource Economics*, the *Journal of Economic Dynamics and Control*, the *Energy Economics*, and the *Ecological Economics*. Maria serves as a referee to several journals in these fields and is member of the Editorial Board of the *Environment and Development Economics,* since 2008, and the *Economia Agraria y Recursos Naturales (EARN)* since 2014. She was Vice-President of the European Association of Environmental and Resource Economists (EAERE), and President-elected of the Spanish-Portuguese Association of Natural and Environmental Resources Economics (AERNA) from 2008 to 2012. She is the co-scientific Director of the Nova Environmental Economics Knowledge Centre since the Unit was launched in November 2017. She represents Portugal in the EAERE, and the Nova SBE in the Academic Council of the platform Nova4TheGlobe (Nova University, Lisbon).

SILVA, Ana Carina

Ana Carina Vieira da Silva is an environmental biologist with a PhD in Climate Change and Sustainable Development Policies, and a specialisation in Environmental Sciences. As a Junior Researcher at the Nova School of Business and Economics (Nova SBE), Carina follows a transdisciplinary approach trying to bridge the gap between Natural Sciences and Economics, aiming to improve biodiversity conservation and environmental management in general. Her interests focus on the full economic costs and benefits of the different uses of ecosystems, and her research is centred on the use and non-use values of marine and coastal ecosystem services and their estimation, using revealed and stated preference valuation techniques to inform decision making.

SANTOS, Catarina Frazão

Catarina Frazão Santos holds a PhD in Marine Sciences from the University of Lisbon (co-directed by the Duke University) and a Graduation in Marine Biology. Currently, she is an Invited Researcher at the Nova School of Business and Economics (Nova SBE), and an Invited Auxiliary Researcher and Lecturer at the Faculty of Sciences and the Marine and Environmental Sciences Centre (MARE) of the University of Lisbon. Catarina's research focuses on sustainable marine spatial planning and ocean policy. More recently, she has been investigating pathways and solutions to sustainable ocean planning under global climate change. She is the global coordinator of the FCT-funded project OCEANPLAN, and is strongly engaged in international collaborations and networks (e.g., as an invited expert supporting the Research Executive Agency (REA) of the European Commission, or as a member of the EU COST Action *Ocean Governance for Sustainability*). Catarina is the leading author of scientific articles in top field journals. Since early in her scientific path, she was awarded grants by the FLAD-IMAR (Luso-American Development Foundation and Portuguese Institute of Marine Research), the FCT (Portuguese national funding agency for science, research and technology) and the ICES (International Council for the Exploration of the Sea) to develop her work.

Steering comitee

AUTOR, David

Is Ford Professor in the MIT Department of Economics, codirector of the NBER Labor Studies Program, and coleader of both the MIT Work of the Future Task Force and the JPAL Work of the Future experimental initiative. His scholarship explores the labor-market impacts of technological change and globalization on job polarization, skill demands, earnings levels and inequality, and electoral outcomes.

Autor has received numerous awards for both his scholarship — the National Science Foundation CAREER Award, an Alfred P. Sloan Foundation Fellowship, the Sherwin Rosen Prize for outstanding contributions to the field of Labor Economics, and the Andrew Carnegie Fellowship in 2019 — and for his teaching, including the MIT MacVicar Faculty Fellowship. Most recently, Autor received the Heinz 25th Special Recognition Award from the Heinz Family Foundation for his work "transforming our understanding of how globalization and technological change are impacting jobs and earning prospects for American workers".

In 2017, Autor was recognized by Bloomberg as one of the 50 people who defined global business. In a 2019 article, the Economist magazine labeled him as "The academic voice of the American worker." Later that same year, and with (at least) equal justification, he was christened "Twerpy MIT Economist" by John Oliver of *Last Week Tonight* in a segment on automation and employment.

OLIVEIRA, Arlindo

Was born in Angola and lived in Mozambique, Portugal, Switzerland, and California. He obtained his BSc and MSc degrees from Instituto Superior Técnico (IST) and his PhD degree from the University of California at Berkeley. He is a distinguished professor of IST, president of the INESC group, member of the board of Caixa Geral de Depósitos, researcher at INESC-ID, and member of the National Council for Science, Technology and Innovation and of the Advisory Board of the Science and Technology Options Assessment (STOA) Panel of the European Parliament. He authored three books, translated into different languages, and hundreds of scientific and newspaper articles. He has been on the boards of several companies and institutions and is a past president of IST, of the Portuguese Association for Artificial Intelligence, and of INESC-ID. He was the head of the Portuguese Node of the European Network for Biological Data (ELIXIR) and a researcher at CERN, INESC, Cadence Research Laboratories and Electronics Research Labs of UC Berkeley. He is a member of the Portuguese Academy of Engineering and a senior member of IEEE. He received several prizes and distinctions, including the Technical University of Lisbon / Santander prize for excellence in research, in 2009.

MATIAS, Gonçalo

Director of Studies and member of the Foundation's Executive Committee and Board of Directors, Gonçalo Saraiva Matias is a professor at the School of Law of the Portuguese Catholic University, from which he received his BA, MA and PhD. He is the director of the Católica Global School of Law, has conducted research as a Fulbright Visiting Scholar at the Georgetown University Law Center, and mostly works in the fields of Regulatory, Administrative, Constitutional and International Law. He was a visiting professor at Washington University in St. Louis. He was an Advisor for Legal and Constitutional Affairs at the Portuguese President's Civil House between 2008 and 2014, and has been a consultant of the Civil House since 2014. He was also Director of the Migration Observatory, Under-Secretary of State and Secretary of State for the Administrative Modernization of the 20th Constitutional Government.

PHILIPPON, Thomas

Is the Max L. Heine Professor of Finance at New York University, Stern School of Business. Philippon was named one of the "top 25 economists under 45" by the IMF in 2014. He has won the 2013 Bernácer Prize for Best European Economist under 40, the 2010 Michael Brennan & BlackRock Award, the 2009 Prize for Best Young French Economist, and the 2008 Brattle Prize for the best paper in Corporate Finance. Philippon has studied various topics in macroeconomics and finance: systemic risk and financial crisis, the dynamics of corporate investment and household debt, financial innovation and financial regulation, Eurozone crisis. His recent book "The Great Reversal" (Harvard Press, 2019) focuses on the increasing market power of large firms. He currently serves as an academic advisor to the Financial Stability Board and to the Hong Kong Institute for Monetary and Financial Research. He was previously an advisor to the New York Federal Reserve Bank, a board member of the French prudential regulatory authority from 2014 to 2019, and the senior economic advisor to the French finance minister in 2012-2013. Philippon graduated from Ecole Polytechnique, received a PhD in Economics from MIT and joined New York University in 2003.

REBELO, Sérgio

Sergio Rebelo is the MUFG Professor of International Finance at the Kellogg School of Management, where he has served as Chair of the Finance Department. Professor Rebelo has published widely in macroeconomics and international finance. His research focuses on the causes of business cycles, the impact of economic policy on economic growth, and the sources of exchange rate fluctuations. He has won numerous teaching awards at the Kellogg School of Management, including the Executive Masters Program Outstanding Professor Award and the Professor of the Year Award. Professor Rebelo has served as a consultant to the World Bank, the International Monetary Fund, the European Commision, the Board of Governors of the Federal Reserve System, the European Central Bank, the McKinsey Global Institute, the Global Markets Institute at Goldman Sachs, and other organizations. He received his Ph.D. in Economics from the University of Rochester.

REIS, Ricardo

Is a Professor of Economics at the London School of Economics, and holder of the A.W. Phillips Chair. Among other distinctions, he received the Yrjo Jahnsson Prize, awarded by the European Economic Association to the best European economists under 45, in 2021; the Germán Bernácer Prize, which distinguishes European economists under 40 in the fields of macroeconomics and finance, in 2016; and the Prize in Monetary Economics and Finance from the Banque de France and the Toulouse School of Economics, which distinguishes European researchers in the fields of monetary economics, finance and banking supervision, in 2017. Besides being an academic consultant at the Bank of England, the Riksbank and the Federal Reserve Bank of Richmond, he directs the Economic and Social Research Council's Centre for Macroeconomics in the UK, and works as an advisor for multiple organisations. He also writes about macroeconomics in various publications, and maintains a weekly column in the *Expresso*. His main areas of research include inflation expectations, unconventional monetary policies, central bank balance sheets, disagreement and inattention, business cycle models and inequality, automatic stabilizers, sovereign bond-backed securities and the role of capital misallocation in the European crisis.

RODRÍGUEZ-POSE, Andrés
Is the Princesa de Asturias Chair and a Professor of Economic Geography at the London School of Economics. He is the Director of the Cañada Blanch Centre LSE. He is a former Head of the Department of Geography and Environment between 2006 and 2009. He is a past-President of the Regional Science Association International (RSAI) (2015-2017) and served as Vice-President of the RSAI in 2014. He was also Vice-President (2012-2013) and Secretary (2001-2005) of the European Regional Science Association. He was awarded the 2018 ERSA Prize in Regional Science, arguably the highest prize in regional science, and has been a holder of a European Research Council (ERC) Advanced Grant and of a prestigious Royal Society-Wolfson Research Merit Award. In 2019 he received Doctorates Honoris Causa from Utrecht University (the Netherlands) and Jönköping University (Sweden). He is an editor of Economic Geography, editor-in-chief of Journal of Geographical Systems and sits on the editorial board of 33 other scholarly journals, including many of the leading international journals in economic geography, human geography, regional science, and management. Between 1999 and 2016 he was an editor of Environment and Planning C, acting as joint chief-editor from 2008 onwards.

SCHÜTTE, Georg
Since 1 January 2020 Dr. Georg Schütte has been Secretary General of the Volkswagen Foundation. Prior to this, he served as State Secretary in the German Federal Ministry of Education and Research for ten years and, among others, led the negotiations between the Federal Government and the German Länder on the future financing of the German research system. Dr. Schütte was born in Rheine, Germany, in 1962 and holds a doctoral degree in media and communication research from the Technical University of Dortmund, Germany, as well as a Masters Degree of the City University of New York, USA. He conducted research at Harvard University and at the University of Siegen. Before he entered government service, Georg Schütte was Secretary General of the Alexander von Humboldt Foundation. He has worked in research and foundation management for more than 25 years.

Published studies

Economics

O Cadastro e a Propriedade Rústica em Portugal
Coordination of Rodrigo Sarmento de Beires; 2013.

Custos e Preços na Saúde: Passado, presente e futuro
Coordination of Carlos Costa; 2013.

25 anos de Portugal Europeu: A economia, a sociedade e os fundos estruturais
Coordination of Augusto Mateus; 2013.

Que economia queremos?
Coordination of João Ferrão; 2014.

A Economia do Futuro: A visão de cidadãos, empresários e autarcas
Coordination of João Ferrão; 2014.

Três Décadas de Portugal Europeu: Balanço e perspectivas
Coordination of Augusto Mateus; 2015.

Empresas Privadas e Municípios: Dinâmicas e desempenhos
Coordination of José Tavares; 2016.

Investimento em Infra-Estruturas em Portugal
Coordination of Alfredo Marvão Pereira; 2016.

Benefícios do Ensino Superior
Coordination of Hugo Figueiredo e Miguel Portela; 2017.

Diversificação e Crescimento da Economia Portuguesa
Coordination of Leonor Sopas; 2018.

Dinâmica Empresarial e Desigualdade
Coordination of Rui Baptista; 2018.

Encerramento de Multinacionais: O capital que fica
Coordination of Pedro de Faria; 2018.

GDP-linked bonds in the Portuguese Economy
Coordination of Gonçalo Pina, 2020.

Features of Portuguese International Trade: a Firm-level Perspective
Coordination of João Amador; 2020.

Financial Constraints and Business Dynamics: Lessons from the 2008--2013 Recession
Coordination of Carlos Carreira, Paulino Teixeira, Ernesto Nieto--Carrillo e João Eira; 2021.

Transport systems in Portugal Analysis of efficiency and regional impact
Carlos Oliveira Cruz, Álvaro Costa, Joaquim Miranda Sarmento, Vítor Faria e Sousa e João Fragoso Januário, 2021.

From made in to created in: A new paradigm for the portuguese economy
Coordination of Fernando Alexandre.; 2021.

Institutions

Droga e Propinas: Avaliações de impacto legislativo
Coordination of Ricardo Gonçalves; 2012.

Justiça Económica em Portugal: A citação do réu no processo civil
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: Factos e números
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: Gestão processual e oralidade
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: Meios de resolução alternativa de litígios
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: Novo modelo processual
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: O sistema judiciário
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: Produção de prova
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: Recuperação do IVA
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Justiça Económica em Portugal: Síntese e propostas
Coordination of Mariana França Gouveia, Nuno Garoupa, Pedro Magalhães; 2012.

Segredo de Justiça
Coordination of Fernando Gascón Inchausti; 2013.

Feitura das Leis: Portugal e a Europa
Coordination of João Caupers, Marta Tavares de Almeida e Pierre Guibentif; 2014.

Portugal nas Decisões Europeias
Coordination of Alexander Trechsel, Richard Rose; 2014.

Valores, Qualidade Institucional e Desenvolvimento em Portugal
Coordination of Alejandro Portes e M. Margarida Marques; 2015.

O Ministério Público na Europa
Coordination of José Martín Pastor, Pedro Garcia Marques e Luís Eloy Azevedo; 2015.

Juízes na Europa: Formação, selecção, promoção e avaliação
Coordination of Carlos Gómez Ligüerre; 2015.

Limitação de Mandatos: O impacto nas finanças locais e na participação eleitoral
Coordination of Francisco Veiga e Linda Veiga; 2017.

O Estado por Dentro: Uma etnografia do poder e da administração pública em Portugal
Coordination of Daniel Seabra Lopes; 2017.

O Impacto Económico dos Fundos Europeus: A experiência dos municípios portugueses
Coordination of José Tavares; 2017.

Orçamento, Economia e Democracia: Uma proposta de arquitetura institucional
Coordination of Abel M. Mateus; 2018.

Instituições e Qualidade da Democracia: Cultura política na Europa do Sul
Coordination of Tiago Fernandes; 2019.

Os Tribunais e a Crise Económica e Financeira: Uma análise ao processo decisório em contexto de crise económico-financeira
Patrícia André, Teresa Violante e Maria Inês Gameiro; 2019.

Society

Como se aprende a ler?
Coordination of Isabel Leite; 2010.

Fazer contas ensina a pensar?
Coordination of António Bivar; 2010.

Desigualdade Económica em Portugal
Coordination of Carlos Farinha Rodrigues; 2012.

Projecções 2030 e o Futuro
Coordination of Maria Filomena Mendes e Maria João Valente Rosa; 2012.

Envelhecimento Activo em Portugal: Trabalho, reforma, lazer e redes sociais
Coordination of Manuel Villaverde Cabral; 2013.

Escolas para o Século XXI: Liberdade e autonomia na educação
Coordination of Alexandre Homem Cristo; 2013.

Informação e Saúde
Coordination of Rita Espanha; 2013.

Literatura e Ensino do Português
Coordination of José Cardoso Bernardes e Rui Afonso Mateus; 2013.

Processos de Envelhecimento em Portugal: Usos do tempo, redes sociais e condições de vida
Coordination of Manuel Villaverde Cabral; 2013.

Que ciência se aprende na escola?
Coordination of Margarida Afonso; 2013.

Inquérito à Fecundidade 2013
INE e FFMS; 2014.

A Ciência na Educação Pré-Escolar
Coordination of Maria Lúcia Santos, Maria Filomena Gaspar, Sofia Saraiva Santos; 2014.

Dinâmicas Demográficas e Envelhecimento da População Portuguesa (1950–2011): Evolução e perspectivas
Coordination of Mário Leston Bandeira; 2014.

Ensino da Leitura no 1.º Ciclo do Ensino Básico: Crenças, conhecimentos e formação dos professores
Coordination of João A. Lopes; 2014.

Ciência e Tecnologia em Portugal: Métricas e impacto (1995–2012)
Coordination of Armando Vieira e Carlos Fiolhais; 2014.

Mortalidade Infantil em Portugal: Evolução dos indicadores e factores associados de 1988 a 2008
Coordination of Xavier Barreto e José Pedro Correia; 2014.

Os Tempos na Escola: Estudo comparativo da carga horária em Portugal e noutros países
Coordination of Maria Isabel Festas; 2014.

Cultura Científica em Portugal
Coordination of António Granado e José Vítor Malheiros; 2015.

O Multimédia no Ensino das Ciências
Coordination of João Paiva; 2015.

O Quinto Compromisso: Desenvolvimento de um sistema de garantia de desempenho educativo em Portugal
Coordination of Margaret E. Raymond; 2015.

Desigualdade do Rendimento e Pobreza em Portugal: As consequências sociais do programa de ajustamento
Coordination of Carlos Farinha Rodrigues; 2016.

Determinantes da Fecundidade em Portugal
Coordination of Maria Filomena Mendes; 2016.

Será a repetição de ano benéfica para os alunos?
Coordination of Luís Catela Nunes; 2016.

Justiça entre Gerações: Perspectivas interdisciplinares
Coordination of Jorge Pereira da Silva e Gonçalo Almeida Ribeiro; 2017.

Migrações e Sustentabilidade Demográfica: Perspectivas de evolução da sociedade e economia portuguesas
Coordination of João Peixoto; 2017.

Mobilidade Social em Portugal
Coordination of Teresa Bago d'Uva; 2017.

Porque melhoraram os resultados do PISA em Portugal? Estudo longitudinal e comparado (2000–2015)
Coordination of Anália Torres; 2018.

Igualdade de Género ao Longo da Vida: Portugal no contexto europeu
Coordination of Anália Torres; 2018.

As mulheres em Portugal, Hoje: Quem são, o que pensam e como se sentem
Coordination of Laura Sagnier e Alex Morell; 2019.

Financial and Social Sustainability of the Portuguese Pension System
Coordination of Amílcar Moreira; 2019.

Identidades Religiosas e Dinâmica Social na Área Metropolitana de Lisboa
Coordination of Alfredo Teixeira; 2019.

A evolução da ciência em Portugal (1987-2016)
Elizabeth Vieira, João Mesquita, Jorge Silva, Raquel Vasconcelos, Joana Torres, Sylwia Bugla, Fernando Silva, Ester Serrão e Nuno Ferrand; 2019.

A pobreza em Portugal: Trajetos e quotidianos
Coordination of Fernando Diogo, 2021.

FUNDAÇÃO
FRANCISCO MANUEL DOS SANTOS