EU competitiveness: recent trends, drivers, and links to economic policy

A Synthesis Report

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Abstract

This report informs the debate on Europe’s economic competitiveness and how it can be sustained under the pressures of globalisation. It presents a series of research findings from different areas of analytical work carried out at the ‘Growth and Innovation’ Directorate of the Joint Research Centre. The focus is on current challenges, with topics ranging from global value chains analysis to competition policy, and from the possible reasons for the recent EU productivity stagnation to the economic damage implied by FDI restrictions. The common denominator of all contributions is their aim to inform discussions on competitiveness and their relevance for EU economic policy.

Authors

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1 Introduction

Europe’s economic competitiveness and how it can be sustained under the pressures of globalisation has been a key concern of the EU Commission during the last years, as reflected, e.g. in the series of communications on industrial strategy that have been published (European Commission 2012, 2014, 2017) and the Reflection paper on harnessing globalisation (European Commission 2017a). The EU Council in March 2019 concluded that

[.] fair competition should be ensured within the Single Market and globally, both to protect consumers and to foster economic growth and competitiveness, in line with the long-term strategic interests of the Union. We will continue to update our European competition framework to new technological and global market developments. ¹

The present report informs this debate with a series of research findings from different areas of analytical work carried out at the ‘Growth and Innovation’ Directorate of the Joint Research Centre. The covered topics address current challenges and range from global value chains analysis to competition policy, and from the possible reasons for the recent EU productivity stagnation to the economic damage implied by FDI restrictions.

The common denominator of these contributions is their relevance for EU economic policy and that they have to say something on competitiveness. The latter is an elastic and multidimensional concept, without a commonly accepted ‘rigorous’ definition in economics. Instead, it has been operationalized and applied mostly in a pragmatic manner, in function of the considered research questions and the scale of analysis (e.g. firm level or country level).² This report follows that same line.

Four challenges Europe’s economy is facing

But what are the challenges Europe’s economy is facing? Four things could be mentioned: First, the EU’s manufacturing industries have lost considerable weight in global manufacturing value chains, not only because of the general shift of the global economy’s centre-of-mass towards Asia and other fast-growing regions, but also due to the relocation of entire industries (e.g. assembly) or other upstream services for electronics) to other world regions. Chapter 2 revisits the recent evolution of EU competitiveness overall and for manufacturing industries in particular, while Chapter 7 takes a closer look at the characteristics and potential contribution of the service industries.

Second, as a priority of the von der Leyen Commission, EU industry is facing simultaneously the digital transformation and the transition towards a net zero emission and circular economy. Developing technologies, products and solutions towards this aim while having access to finance, resources and human capital equipped with the right skills constitute a major challenge and implies as a prerequisite a vibrant innovation and entrepreneur ecosystem. In fact, increased global competitive pressures also challenge the EU as leading innovator in the world, which in turn is crucial for future industrial competitiveness. Innovation will be a central driver for EU policies. Chapter 3 looks into the driving forces of innovation in the EU.

Third, the transition towards a net zero emission and circular economy can only be achieved with the full contribution of private enterprises, their know-how and innovation potential. This requires competitive markets with fair access and level playing field, both in the EU and third countries, both for EU and non-EU companies. Chapters 5 and 6 discuss the relevance of competition policy and show how restrictive regulation can impede Foreign Direct Investment.

Fourth and last, increasing productivity is instrumental for the EU industry’s sustained competitiveness and growth. In view of this, the sluggish growth of labour productivity currently observed in many European industries constitutes a key EU policy concern, threatening to undermine our living standards in the long run. In this respect, the impact of structural change and intangible investment has been shown to play a significant role in low productivity growth, as discussed in Chapter 4.

Overview of chapters

Chapter 2 offers a detailed picture on how EU competitiveness is evolving and in which sectors concern might be warranted. It turns out that the EU has persistently lost weight in global manufacturing value chains, in particular vis-à-vis China. However, at the sectoral the picture is quite heterogeneous, which calls for caution against overly dramatic and generalist outlooks. However, competitiveness concerns appear to be

² See, e.g., “Measuring Competitiveness” by Peneder and Rammer (2018) on the conceptual dimension, or the competitiveness study of the EU refining sector by Marschinski et al. (2020).
warranted for electronics, a key sector for productivity and innovation, in which the EU’s global share has fallen even more than in total manufacturing. The need for differentiated and even optimistic view is corroborated by an analysis of the EU’s global competitiveness from the perspective of Economic Complexity science, which sees the EU ahead of the US and Japan in terms of its production capabilities and growth prospects. The EU as a whole has been increasing its competitiveness in the past 5–7 years and is leading by far the worldwide ranking of countries. As of 2018, the EU shows the highest levels of Fitness in most sectors. When breaking down overall Economic Fitness into specific values for 26 industrial sectors (NAICS classification), it is found that in the past decade the EU has consistently held top positions in the Fitness ranking of all the considered sectors, except for a few and mostly low complexity areas like fishing, apparel and furniture.

Chapter 3 looks at competitiveness from the angle of innovation, showing that in this area there is still a gap with respect to the US and Japan. China is strongly developing ICT technologies and growing its automotive sector, where the EU is traditionally strong. On the other side, EU companies show comparative advantages in most green technologies, except for ICT applications for energy. In a survey of the EU’s most innovative companies, Artificial Intelligence (AI) and Big Data are most often mentioned as highly relevant for future competitiveness, being among the top three technologies in six out of eight industrial sectors. These technologies seem to have the most diverse application possibilities. Other ICT-related technologies are considered much less important for future competitiveness. The relevance of other technologies, such as Industry 4.0 (I4.0) and Robotics, is much less widespread. Surprisingly ICT services and ICT hardware technologies are not mentioned among the most relevant technologies for future competitiveness, in any of the sectors.

Chapter 4 investigates another pillar of competitiveness, namely productivity, and first looks into how it is affected by structural change: it quantifies which part of the EU labour productivity slowdown is due to structural change, at the sectoral level, during the period 1970-2017, in order to distil a number of findings on which sectors have contributed over-proportionally to this secular stagnation. On the one hand, both the agricultural and manufacturing sector have shown a higher labour productivity growth during this period than the average economy, and hence their significant weight reduction by 75% and 36%, approximately, has, all else equal, contributed to the slow down economy-wide productivity growth. On the other hand, some service sectors with below average productivity growth rates like accommodation and Food service activities (I), regulated professions (M-N), and non-market services (O-U) have significantly increased their economic weight. Second, the chapter also addresses the role of intangible capital and investment, which recently has come to be appreciated as an important driver of labour productivity growth. The relationship between intangible investment and productivity growth is heterogeneous in terms of asset type and sector. National accounts intangibles are important for the industry, while non-national accounts intangibles are important for the service sector. Furthermore, it turns out that more intangible-intensive industries were more resilient during the financial crisis.

Chapter 5 reviews the impact of competition policy and competitive markets on economic efficiency, and in particular on how it provides an increased incentive for firms to innovate. In fact, more competition can lead to an increase in innovation either through the appropriability effect that encourages new or incumbent firms to innovate in order to catch post-innovation rents, or through the ‘escape competition’ effect that induces incumbents to innovate in order to preserve their pre-innovation rents, when faced with the possibility that their rivals may innovate. However, the exact link between competition policy and innovation is still debated and inconclusive. Moreover, analysing the impact of competition policy interventions on innovation is particularly relevant in this period of slow productivity growth in Europe. Thus, this chapter provides a comprehensive survey of studies that examine how competition policy interventions affect growth via innovation channels.

The chapter’s conclusions emphasize that in order to better understand the role of competition authorities in fostering growth, more empirical and methodological investigations are still needed, which can further help policy makers in characterizing the “position” of sectors or firms under scrutiny and better inform their policy interventions. Data and methodological challenges are still ubiquitous in estimating the relationships between competition and innovation. Undoubtedly, increased data availability allowed solving many methodological problems since the seminal paper of Schumpeter (1942), and proxies used to gauge the competition and innovation have also been refined. Nonetheless, the empirical results are still lacking robustness.

1 Jungmittag and Pesole (2019) present related JRC research on the productivity effects of industrial robots.
Chapter 6 investigates how the free flow of investment, essential for allocative efficiency and hence competitiveness, can be obstructed by restrictive policy barriers. In particular, it carries out an econometric analysis of how such policies affect cross-border Mergers & Acquisition (M&A) flows into the EU. In this, two specific questions are addressed. First, whether the presence of a screening mechanism is indeed a deterrent to foreign investment. And second, what are other types of restrictions to market access and operation of foreign companies that affect the amount of M&A flows? The results show that different restrictive measures affect cross-border investment unevenly across sectors. Hence, policies aiming to drive up inward M&A flows should tailor regulatory restrictions to the targeted sectors in order to avoid discouraging investments in other sectors. In particular, manufacturing and non-financial services result to be negatively affected by restrictive measures, such as restrictions on foreign personnel being employed in key positions, or restrictions on the establishment of branches, land acquisition or profit and capital repatriations. Thus, a targeted policy reform may foster FDI flows and, in turn, could influence industrial competitiveness and overall economic growth. On the other side, the presence of a formal screening procedure does not per se does not negatively affect cross-border investment. However, when looking only at cross-border investments from tax havens, screening mechanisms do exert a negative effect on M&A investments. The latter point reinforces the idea that the presence of a higher level of transparency and accountability may discourage profit shifting or even illegal activities.

Finally, Chapter 7 focuses on global value chains and on how service inputs contribute to their upgrading and increased competitiveness. It is shown that, as countries develop, domestic services embodied in merchandise exports tend to increase their share in the total value added generated domestically by those exports. These so-called Mode 5 exports are highly relevant for the EU, where their contribution continues to grow despite being already high. In the considered period of 2000 to 2014, their contribution has increased at the expense of fabrication activities, which can signal functional upgrading. This results in the EU being specialized in supporting business functions, which are characterized by a high nominal productivity compared with the average job in the EU. This suggests that the EU is competing by specializing in skill and knowledge-intensive tasks (services in nature) in Global Value Chains. However, it is also observed that generally the productivity of fabrication is very high in advanced countries (including the EU), and very low in emerging economies. This suggests that actually very different tasks might be included under the heading of “fabrication”.

A related JRC study that analyses the impact of restrictive regulation on Greenfield FDI is Jungmittag and Marschinski (2020).
2 Recent trends in EU competitiveness

2.1 EU competitiveness in global manufacturing value chains

The EU’s falling share in global manufacturing has fuelled concerns about an overall loss of competitiveness, in particular vis-à-vis China. In this contribution we show that sectoral idiosyncrasies are strong and advise against a ‘one size fits all’ policy. To this end we use the World Input Output Table (WIOD) and decompose the value added of manufacturing value chains and study the drivers of the EU’s relative decline. It turns out that competitiveness concerns appear to be most warranted for electronics, a key sector for productivity and innovation, in which the EU’s global share has fallen even more than in total manufacturing, without evidence that EU specialization in other segments to this value chain could significantly mitigate the trend.

The seminal work of Timmer et al. (2013) introduced the concept of Global Value Chain (GVC) income and measured the value added generated throughout the value chain of manufacturing final products, using the 2013 release of the World Input-Output Database (WIOD). Here, we present results from a novel decomposition analysis that extends the time coverage of Timmer et al. by using the 2016 release of WIOD, and, more importantly, quantifies the contributions of the different drivers to the observed decline of the EU’s share in manufacturing GVC income.

Participation losses on top of EU’s weak demand momentum

The EU accounted in year 2000 for 30% of worldwide value added in manufacturing value chains – over 60% together with the US and Japan – and well above China’s 5% (Figure 2.1). The picture in 2014 was rather different, with China showing the largest individual country share (20%) and the the EU’s contribution reduced by almost a third to 22%. This positive trend for China (and other emerging economies like India) and the corresponding negative evolution for developed countries was already in place before the Great Recession and does not seem to level afterwards. As a result, the EU-US-Japan bloc represented in 2014 less than a half of worldwide value added in manufacturing value chains.

Figure 2.1. Country shares of value added for manufacturing value chains

Note: In real terms using chain-linked volumes, reference year 2010
Source: Own elaboration based on WIOD

Following the methodology explained in Marschinski and Martínez-Turégano (2019, 2020), we decompose these changes in the country shares of GVC income into a complete set of contributions grouped into two broad categories, demand effects and participation effects. The latter capture changes in the distribution across sectors and countries of the value added generated by one unit of final demand of a given product. They can, thus, be associated with competitiveness.

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5 Written by David Martínez Turégano and Robert Marschinski
6 Timmer et al. (2016). Data and methodology available at http://www.wiod.org/release16. We use the input-output tables in previous year prices released in 2019 and present the results in real terms using chain-linked volumes, reference year 2010. Some minor adjustments have been made to the original dataset, mainly to correct methodological breaks stemming from the use of different national account systems over the sample period.
In Table 2.1, we observe that the largest part of the redistribution in global value added for manufacturing value chains is due to demand effects – close to 75% in the case of the EU. And, in particular, due to changes in the geographical composition of worldwide final demand (country demand effects), to the benefit of China and other emerging economies like India. The EU’s global share also diminished due to sectoral demand effects, i.e. an overall structural shift in the composition of final demand away from manufacturing goods, which was reinforced by the lasting impact of the crises. In contrast, positive contributions from this effect are observed in China driven by income effects and fast-growing investment.

**Table 2.1. Percentage points contribution to the 2000–14 change of country shares in value added for manufacturing value chains**

<table>
<thead>
<tr>
<th>Manufacturing value chains</th>
<th>Total change</th>
<th>Demand effects</th>
<th>Participation effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Country</td>
<td>Sectoral</td>
</tr>
<tr>
<td>European Union</td>
<td>-8.4</td>
<td>-4.3</td>
<td>-1.8</td>
</tr>
<tr>
<td>United States</td>
<td>-4.8</td>
<td>-2.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Japan</td>
<td>-3.7</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>China</td>
<td>15.0</td>
<td>5.7</td>
<td>1.9</td>
</tr>
<tr>
<td>India</td>
<td>1.9</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Rest-of-World</td>
<td>0.1</td>
<td>1.2</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Note: In real terms using chain-linked volumes, reference year 2010

Source: Own elaboration based on WIOD

In addition to negative demand effects, we find that participation losses also significantly contributed to the decline of the EU’s share in global manufacturing value chains, again to the benefit of new competitors, China in particular. Country participation effects, i.e. impacts due to changes in the location of suppliers at all stages of the value chain, are negative across most sectors in developed countries. In the EU, this might not be unexpected for the global textile value chain in face of competition by low-wage emerging economies. However, the similarly observed negative trend for electronics calls for closer attention as it could eventually harm EU innovation capacities and erode productivity growth.

**EU concerns on electronics spread along the whole value chain**

The overall share of electronics in worldwide demand – both as a final and intermediate product – has steadily increased over time, as a result of income and technological developments shifting consumer and producer preferences. EU electronics’ manufacturers have benefited from this trend, but at the same time they have been subject to increasing competition from non-EU economies, which has limited the positive impact of the sector’s favourable evolution. In fact, the global redistribution of value added for the electronics value chain is similar but even stronger than that observed for total manufacturing final demand (Figure 2.2). This is particularly true for the increase of China’s share – from 5% to more than 25% –, as well as for the decline of the EU, which lost more than 10 percentage points in worldwide value added and showed a relatively worse performance than the US over the sample period.

**Figure 2.2. Country shares of value added for electronics value chain**

Note: In real terms using chain-linked volumes, reference year 2010
For this purpose, in Table 2.2 we disaggregate the country participation effects in electronics value chains by different sectors of value added generation, including activity groups for manufacturing and services based on technological content. First, we observe that the total country participation effects in electronics value chains are notably more negative than those for the aggregate of manufacturing shown in Table 2.1. Second, the redistribution of value added triggered by the relocation of electronics supply has gone beyond the manufacturing activity itself and reached the associated upstream stages, including business services with high technological content. The EU’s situation is very similar to the one of the US and Japan, and mirrors the significant increase of China.

Table 2.2. Percentage points contribution of participation effects to the 2000–14 change of country shares in value added for electronics value chains

<table>
<thead>
<tr>
<th>Electronics value chains</th>
<th>Country participation effects</th>
<th>Manufacturing value added</th>
<th>Non-manufacturing value added</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High-tech Electronics</td>
<td>Low-tech Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High-tech Business services</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low-tech Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other activities</td>
</tr>
<tr>
<td>European Union</td>
<td>-8.1</td>
<td>-4.2</td>
<td>-0.3</td>
</tr>
<tr>
<td>United States</td>
<td>-7.9</td>
<td>-5.1</td>
<td>-0.5</td>
</tr>
<tr>
<td>Japan</td>
<td>-5.7</td>
<td>-2.8</td>
<td>-0.3</td>
</tr>
<tr>
<td>China</td>
<td>20.1</td>
<td>7.8</td>
<td>2.0</td>
</tr>
<tr>
<td>India</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Rest-of-World</td>
<td>1.5</td>
<td>0.7</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Note: In real terms using chain-linked volumes, reference year 2010
Source: Own elaboration based on WIOD

2.2 EU competitiveness from the perspective of Economic Complexity

Economic Complexity is a framework building on earlier evolutionary and institutional literature (Hirschman, 1958; Cimoli and Dosi, 1995; Teece, et al., 1994) to capture the complexity of economic systems. It describes the economy as an evolutionary process of globally interconnected ecosystems. The main recent advance vis-à-vis the earlier literature is the use of newly developed approaches from network and complex dynamical systems science (Hausmann and Klinger, 2006; Hidalgo and Hausmann, 2009; Tacchella et al., 2012). The Economic Complexity framework shifts the focus of economic analysis from aggregate quantities (What is the GDP of the country? How many patents are published?) to their underlying components (In which industrial sectors do countries specialize? Which patents are published?), with the aim to provide complementary information to more conventional macroeconomic analysis. It offers the potential of describing quantitatively several policy relevant issues that otherwise would only be treated qualitatively, or by case studies.

The Economic Fitness of a country is a measure of the complexity of the country’s productive structure (Hidalgo and Hausmann, 2009; Tacchella et al., 2012). Complex economies are characterized by their diversification and their ability to compete globally with complex (i.e. non-ubiquitous) industrial products. In fact, the Economic Fitness of a country is computed as the sum over all products for which the country shows a revealed comparative advantage (diversification), where each product is weighted by its complexity (a measure of its sophistication). It turns out that the Fitness of a country represents an effective indicator of competitiveness. It is based on an intensive measure of diversification and therefore carries complementary information with respect to more standard quantifications of economic output, such as the GDP of a country. The Economic Fitness can be computed also at the sector level in a straightforward generalisation.

The interplay between Fitness and real GDP per capita at purchasing power parity (GDPpccpp) gives rise to rich dynamics (Cristelli et al., 2015). A quantitative analysis of the microscopic features of the country trajectories in the GDP-Fitness plane allows for a rigorous and statistically robust description of macroeconomic dynamics. With techniques inspired by the physics of dynamical systems, it is possible to forecast medium term (5-years) GDP growth up to 25% more precisely than the forecasts of the International Monetary Fund (Tacchella et al., 2018).

7 We follow the OECD taxonomy of economic activities based on technological intensity, updated by Galindo-Rueda and Verger (2016). High-tech business services are broadly defined and include NACE sections ‘J – Information and Communication’ and ‘M – Professional, Scientific and Technical activities’.
8 Written by Andrea Tacchella and Robert Marschinski
In addition, the Economic Complexity framework makes use of the concept of relatedness to forecast the competitiveness of countries at the product level. Relatedness is a quantification of how much two economic activities are related in terms of the endowments and capabilities typically needed for their development. Since it is easier to move between related activities than towards unrelated ones, empirical approaches to quantify relatedness are currently used to inform policies and industrial strategies in governments, international organizations and firms.

Here we employ a Machine Learning approach able to infer a highly effective representation of the ‘relatedness space’. The output of this methodology is the Product Progression Probability (PPP), which represents the probability that a country will become (or remain) a globally competitive exporter of a given product within a five years horizon.

**Analysed by Economic Complexity, the EU as a whole has been increasing its competitiveness in the past 5-7 years and is leading by far the worldwide ranking of countries.** As of 2018, the EU as a whole is the most diversified economy in the world in terms of the number of products for which it shows a revealed comparative advantage (2650 products), followed by China (2376 products), and the US (1776 products). Japan ranks 16th (1348 products). However, Economic Complexity has demonstrated that what matters for competitiveness is not only the total number of such products, but also their average complexity. Considering this weighted sum – the Economic Fitness – confirms the EU’s position as global leader (LogFitness 2.89), with an even greater relative advantage over the US (1.93) due to the higher average complexity of the EU’s product mix. Japan also shows a concentration on a mix of high-complexity products and, despite being less diversified than the US, shows a slightly higher Fitness value (LogFitness 1.95).

Pre-COVID growth estimates (Figure 2.3), in terms of GDP Per Capita at Purchasing Power Parity, project compound annual growth rates for 2018-2023 of 1.01% for the EU (as opposed to 0.84% during 2007 to 2018), 0.78% for the US (0.83% during 2007 to 2018), and 0.66% for Japan (0.62% during 2007 to 2018). The relative uncertainty of the forecast is relatively small for the EU, whereas for the US and even more so Japan it is somewhat higher.

**Figure 2.3. Fitness-GDPpc trajectories and forecasted growth distributions for EU, US, and China in terms of GDP Per Capita at Purchasing Power Parity (Pre-COVID estimates).**

The EU shows the highest levels of Fitness in most sectors. It is possible to break down each region’s Economic Fitness into the specific values it shows for each of a standard set of 26 industrial sectors (NAICS classification), ordered clockwise in decreasing complexity (Figure 2.4). It can be observed that in the past decade the EU has consistently held top positions in the Fitness ranking of all the considered sectors, except for a few and mostly low complexity areas like fishing, apparel and furniture. A comparison between 2007...
and 2018 shows only minor variations, e.g. a slight worsening in furniture and printing, against a slight improvement in fishing.

**Figure 2.4. Sector Fitness rankings (further out represents higher Fitness)**

![Sector Fitness rankings](image)

Source: own computations of JRC.B5

Japan’s chart on the other side is strikingly different, and in fact represents the most extreme case of a country specialized on high complexity industries. Mining and printing show a slight retraction between 2007-2018, further adding to the low competitiveness in low-complexity sectors.

The United States are overall more similar to the EU, with a high level of sectoral Fitness in most industries, and in particular in those of higher complexity. They show however a lower Economic Fitness than the EU in several low and medium complex areas, and a higher Economic Fitness only in fishing. The relatively strongest gains in competitiveness over 2007 to 2018 are recorded in textiles, and losses in animal production.

Next, the **Product Progression Probability** (PPP) estimates the probability that a country will be a competitive exporter (i.e. showing revealed comparative advantage or RCA) of a given product after 5 years. The estimation takes into account the current RCA of the product and, most importantly, the levels of RCA of all related products, which is a proxy for the availability of related capabilities of the country. In the final analysis shown in Figure 2.5, the Product Progression Probability of EU, Japan, and USA is broken down to the product level, for an ad-hoc selected list of products related to renewable energy technology and Industry 4.0. The values represent the expected probability that the economy will be a competitive exporter of the product by year 2023.

In these illustrative examples, the main emerging insight is that none of the three considered economies manages to be competitive across the full spectrum of products considered here, thus highlighting the interdependence and complementarity of the productive systems. Europe shows very high values for wind energy products and electric motors, but lower values than the competitors in photovoltaics and Industry 4.0 products, except for industrial robots. In batteries the EU will very likely be a competitive exporter of nickel-cadmium batteries, but not of lithium-ion cells. Japan is very strong in photovoltaics and some Industry 4.0 products, for which both US and EU show low values. And the US shows a pattern overall similar to the EU, but weaker, except in electronic processors.

As a conclusion of this analysis from the perspective of Economic Complexity, it can be confirmed that the EU is the leading economy in the world in terms of this approach’s lead indicator of competitiveness, namely Economic Fitness, ahead of both the US and Japan. Its competitiveness has been increasing since 2015, the year that marked the end of the recession after the financial crisis. At the level of individual manufacturing sectors, the EU also shows consistently high sectoral Fitness values, across the whole board of low-, medium- and high-complexity industries. However, these high values at sectoral levels do not avoid that the EU has a low competitiveness for some specific products, including some with relevance for its envisaged green transition. Finally, this section also served to highlight the potential of the Economic Complexity approach, which could also be applied to other products, e.g. medical or pharmaceutical, or other countries, e.g. China.
Figure 2.5. Product Progression Probability at the product level on selected products.

Source: own computations of JRC.B5
3 What characterizes the EU’s most competitive firms?²

3.1 Some stylized facts, basic empirical findings

Investments in research and innovation from industry are essential to implement the twin Green and Digital transitions that lie at the core of the EU recovery plan and the EU agenda for the next seven years. The JRC, in collaboration with the Directorate General for Research and Innovation, monitors and analyses the companies that most invest in R&I around the world. Every year since 2004, the JRC publishes the ranking of the top 2500 companies with the largest R&I, analysing the main dynamics across industrial sectors and world regions and countries. Located in more than 40 countries around the world, these companies concentrate a very large portion (circa 90%) of the total industrial R&I invested in the world.

Each of these companies invested over €30 million in R&I (for a total of €823.4 billion), and is not only direct innovator and employer, but seed to innovation ecosystems and door to global networks. EU industrial transformation cannot go outside global competitiveness. However, there is still a gap with respect to the US and Japan, and China is strongly developing ICT technologies and growing its automotive sector, where the EU is traditionally strong (Figure 3.1).

Figure 3.1: Scoreboard companies’ specialisation in main world regions. Region, number of companies, and in parenthesis below the total R&I investment.

Source: The 2019 EU Industrial R&I Investment Scoreboard (Hernández et al. (2020))

A patent analysis shows that the top R&I investors own 50% of patents filed in the EPO and USPTO offices from 2012 to 2015. The share of green patents in the total is 9%, of which 53% belong to the Scoreboard companies. Companies from regulatory driven sectors, energy and transport, hold the highest shares of green patents, but the ICT sector follows just behind (see Figure 3.2). Most green patents owned by the Scoreboard companies (about 80%) are in companies headquartered in Japan (30.9%), the US (26.8%), Germany (11.8%)

and South Korea (10.5%). EU companies show comparative advantages in most green technologies, except for ICT applications for energy. Toyota had most green patents, but Bosch, Volkswagen, Airbus and Rolls-Royce are EU-firms in the top 25 global companies by number of green patents.

**Figure 3.2: Distribution of patents filed by the top R&D investors**

![Distribution of patents filed by the top R&D investors](image)

- **Top left:** Patents filed by Scoreboard (SB) and non-Scoreboard (Non-SB) companies and share of green patents (according to CPC classification).
- **Top right:** Green patents filed by Scoreboard and non-Scoreboard companies.
- **Bottom left:** Scoreboard companies' green patents by technological classes (CCS = carbon capture and storage; CCAT = Climate Change Adaptation Technologies).
- **Bottom right:** Scoreboard companies' green patents by country.

Source: The 2019 EU Industrial R&D Investment Scoreboard (Hernández et al. 2020)

### 3.2 Factors that promote or impede competitiveness

The "2019 EU Survey on Industrial R&D Investment Trends" addressed the subsample of 1000 EU companies of the Scoreboard revealing interesting insight about competitiveness issues from the actor perspective of such large MNEs. The 131 EU companies participating in that Survey expect R&D investment to increase by 4.6% per annum in 2019 and 2020. This is slightly below the 5.4% that was expected last year, but still high from a historic perspective. The survey does however not include the impact of the COVID-19 crisis. Companies in the 'Health Industries' and 'ICT producers' sectors expect their R&D to increase the most.

**Sustainable technologies are considered among the most relevant to remain competitive in the future.** This year’s survey asked the participants about the technologies that they deem relevant to remain competitive in the future. As can be seen in Figure 3.3, out of the technologies proposed, Big Data,  

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10 Filed in the EPO and USPTO offices from 2012 to 2015.  
11 Cooperative patent classification (CPC), jointly managed by the EPO and USPTO offices.
sustainable technologies and Artificial Intelligence (AI) are considered (highly) relevant by the highest proportion of participants.

**Figure 3.3**: Proportion of firms identifying different technologies as (highly) relevant to future competitiveness

![Graph showing the proportion of firms identifying different technologies as (highly) relevant to future competitiveness](image

Table with data showing the proportion of firms identifying different technologies as (highly) relevant to future competitiveness.

Source: Potters and Grassano (2019).

**Big Data and AI can be broadly applied in most sectors.** Looking at the sector level, AI and Big Data are also the most widely considered as highly relevant to future competitiveness, being among the top three technologies in six out of eight sectors. These technologies seem to have the most diverse application possibilities. This can also be seen in the joint study by the JRC and OECD into patents in the field of AI, which shows that AI is both widely used but also developed in sectors that traditionally have low ICT intensity (Dernis et al. 2019).

**Other ICT-related technologies are considered much less important for future competitiveness.** The relevance of other technologies, such as Industry 4.0 (I4.0) and robotics, is much less widespread. ICT services and ICT hardware technologies are not mentioned among the most relevant technologies for future competitiveness, in any of the sectors.

**Sustainable technologies are important both for sectors that provide these technologies and for sectors that use these technologies**\(^\text{12}\). Sustainable technologies are among the top three technologies in chemicals, automobiles, industrials and others (mainly low R&D intensity sectors consisting of companies in food, utilities and finance). Sustainability in the automobiles sector has received widespread attention due to public debate in recent years, and investments in sustainability are above average. For the upstream chemicals sector, the production of sustainable chemical technologies can be an important source of competitive advantage when these can be applied in a variety of sectors, including e.g. materials (plastics), agriculture (sustainable fertilisation) and energy (direct power conversions)\(^\text{13}\). For the industrials sector, it is somewhat surprising to find that this sector reports the lowest intensity of environmental sustainability.

We asked participants to estimate how many main competitors they have in their main market. **Figure 3.4** indicates that the majority of firms have fewer than 11 competitors.

When splitting the sample between companies that expect to increase their R&D investments and those that expect to decrease them, we see no clear relation between competition and R&D expectations.

We also asked participants about the strength of competition in their main markets, differentiating between price competition, technological competition (technology pace), and innovation competition (pace of introducing new products or services). These different types of competition are rated very similar in strength, with 70–75% of participants indicating that competition is (very) strong, price competition was mentioned most often as the strongest (75%), and technological competition as the least strong (70%).

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\(^{12}\) greening of and greening by sectors

\(^{13}\) See: Future technology for prosperity: Horizon Scanning by Europe’s technology leaders, August 2019 report.
Figure 3.4: Proportion of main competitors and R&D expectations

However, sectoral patterns can be distinguished. Table 3.1 indicates which sectors find each type of competition the strongest. Price competition is the strongest in the Automobiles and ICT services sectors. Health industries seem to experience the highest competitive pressure to introduce new (patentable) innovations on the market, and experience much less price competition once the products are on the market.

Table 3.1: Types of competition experienced by sector

<table>
<thead>
<tr>
<th>Price competition</th>
<th>Technological competition</th>
<th>Innovation competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobiles &amp; other transport</td>
<td>ICT services</td>
<td>Health industries</td>
</tr>
<tr>
<td>ICT services</td>
<td>Industrials</td>
<td>ICT producers</td>
</tr>
</tbody>
</table>

Source: Potters and Grassano (2019).

As in earlier editions of the survey, the quality and availability of researchers are the two most important factors for R&D location (see Figure 3.5). Low labour costs for researchers was – as in previous surveys – rated as the least important factor for R&D location.

Figure 3.5: Proportion of firms rating a factor as (highly) attractive in locating R&D

Note: The figure refers to 120 out of the 131 companies in the sample. Source: Potters and Grassano (2019).
However, as seen in the past two years, the importance of location factors is strongly related to the R&D strategy of the company. When dividing up the sample of firms into three groups – firms with R&D in only one country, in two to five countries, or in six or more countries – some interesting differences emerge, as shown in Figure 3.6.

Proximity to technology poles is a more important factor for companies located in many countries. These companies source their knowledge in various parts of the world and want to be connected to the main innovation ecosystems and global innovation networks (GINs).

**Figure 3.6: Proportion of firms rating a factor as (highly) attractive in location – comparison by R&D strategy**

![Proportion of firms rating a factor as (highly) attractive in location – comparison by R&D strategy](image)

Note: The figure refers to 115 out of the 131 companies in the sample. Source: Potters and Grassano (2019).

Access to markets, R&D cooperation opportunities and technology poles are the factors that differ most between different R&D strategies. Participating companies with R&D activities in more than five countries are the most active in sourcing their knowledge from technology poles and find it more important to be close to their markets. It is interesting to see the high importance attached by participating firms with R&D activities in only one country to access to markets and R&D cooperation opportunities. It seems that these firms are looking for R&D expansion, but have strong requisites on whether to do this. It might be an important lesson for upcoming surveys to learn whether or not firms are considering expansion, or even a condensing of R&D activities in fewer sites.

Location factors that are considered equally important by all participants are a reliable legal framework and access to specialised R&D knowledge.

**Production location**

We see that this year – as opposed to last year – production and R&D activities are similarly dispersed over countries. 11% of the respondents indicated that production activities are concentrated in one country, just as for R&D activities. We do not have data on the total number of production locations, but we can deduce from the data that 83% of the respondents have production activities in three or more countries.
countries, similar to R&D activities (81%). In last year’s survey, R&D activities were less dispersed than production activities. Since we have analysed this dispersion only for the past two years, it will be important to see whether this is an ongoing trend.

**Production activities are more dispersed around the globe than R&D activities.** Almost 60% of the companies have their main production location at the company’s headquarters (75% within their top three production locations), compared with almost 80% and 85% respectively for R&D activities. This implies that the location of R&D activities is much more influenced by the historical creation of the firm, and that these R&D activities are more difficult to move around the globe. From earlier research, we know that basic R&D activities are more likely to be located at the headquarters, while more development activities are co-located with other production locations. Therefore, locating R&D activities outside the headquarters country means complementing or expanding the home-base knowledge rather than eroding knowledge creation.¹⁴

**The top production locations are similar to the top R&D locations,** although the UK surpasses France as a production location, as shown in Figure 3.7. The difference between China and the US is less pronounced for production activities. India is mentioned much less as a top production location than an R&D location, while Brazil is mentioned much more often.

**Figure 3.7: Number of mentions as a top three production location**

![Diagram showing number of mentions as top three production location](image)

*Note: The figure refers to 115 out of the 131 companies in the sample.*

*Source: Potters and Grassano (2019).*

**Access to markets is the most important factor in locating production, even more pronounced than in earlier surveys,** as shown in Figure 3.8. In fact, the top three most important factors coincide with last year’s survey, as do the bottom three. Low employment protection is the least important factor in

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¹⁴ See the Summary Report of the 8th IRIMA Workshop on ‘Corporate R&D and Innovation Value Chains: Implications for EU Territorial Policy’ by M. Dosso, P. Gkotsis, L. Potters and A. Tübke for an overview of state-of-the-art research on this topic.
locating production activities – also more pronounced than in earlier surveys. These factors seem to be stable, well-defined business strategy best practices that do not change from year to year.

For ICT producers, access to markets seems to be the least important factor, with only 43% of the firms indicating this as an important factor for locating production, much less than other sectors (where at least 75% of firms indicate this as an important factor). Their products seem to be widely marketable, and the best production locations depend on other factors, such as availability and quality of personnel and specialised production infrastructure and knowledge.

The strong link between companies in the Automobiles sector and their suppliers is confirmed, with the highest proportion of firms (80%) indicating that proximity to suppliers is an important factor for locating production. Furthermore, firms in this sector value the availability of good labour, while at the same time being the sector that most highly rates low labour costs as a factor in locating production.

Figure 3.8: Proportion of respondents rating a factor as (highly) attractive in locating production

<table>
<thead>
<tr>
<th>Factor</th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80%</td>
</tr>
<tr>
<td>Quality of personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>Macroeconomic and political stability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>Proximity to other activities of your company</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>Access to production infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>High availability of personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>Access to specialised production knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>Red tape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40%</td>
</tr>
<tr>
<td>Regulation of your product markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40%</td>
</tr>
<tr>
<td>Proximity to suppliers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40%</td>
</tr>
<tr>
<td>Low labour costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Access to public support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Low employment protection of production personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0%</td>
</tr>
</tbody>
</table>

Note: The figure refers to 112 out of the 131 companies in the sample. Source: Potters and Grassano (2019).

Access to public support for production is much more important to companies that decide to produce in China or India. In Figure 3.9, we again look at production location factors, but this time differentiating by geographical R&D strategy: EU-only firms, or firms with a focus on the US, or on China or India. The factors are shown in order of differences between R&D strategies. One of the least important overall location factors – Access to public support – is much more important as a location factor for companies producing in China or India, where these firms probably benefit from a wide range of public support. EU firms decide to move production activities outside of the EU (to the US, China or India), when these countries offer access to specialised production knowledge.
Although China has shown impressive growth as a host of R&D activities for EU firms over the years that the EU R&D Survey has been run, it is still mentioned far more often as a production location (see Figure 3.10). This is in stark contrast to the US, Spain and India, which are mentioned more often as a location to perform R&D than for production activities.
Figure 3.10: Popular R&D and production locations

![Chart showing popular R&D and production locations]

Note: The figure refers to 112 out of the 131 companies in the sample. Source: Potters and Grassano (2019).

As in previous editions of the survey, companies were asked to rate the significance of some potential drivers of the decision whether to change future R&D investment. For each of the drivers included in the survey, Figure 3.11 shows the percentage of companies that considering it very (4) or highly (5) relevant.

Figure 3.11: Share of participants rating different drivers for changing R&D investments as (highly) relevant

![Bar chart showing percentage of companies rating different drivers]

Note: The figure refers to 124 out of the 131 companies in the sample. Source: Potters and Grassano (2019).

Demand change, improving productivity and the chance to exploit technological opportunities are the three main factors driving future changes in R&D investment. This coincides with last year’s
survey and is a clear indication that R&D investments are driven by profits and technological potential to increase future productivity and sales (through technology push).
4 Potential factors behind the observed productivity stagnation in the EU

In this chapter, the role of two different factors that can influence overall productivity are investigated: structural change and intangibles. More specifically, the first part analyses the effect that structural transformation has had on the long-term labour productivity performance of a number of EU economies. The second part takes a closer look at investment in intangible assets, which are generally considered to be an important driver of productivity and productivity growth in the modern economy (see e.g. Haskel and Westlake, 2017).

4.1 Role of structural change in productivity growth

The aim of this section is twofold. First, to quantify the part of the labour productivity decline that is due to structural change, at the sectoral level during the period 1970-2017. Second, to shed light on the factors behind the observed heterogeneous impact of structural change across different EU Member States. An emphasis is placed on analysing developments in the service sector, specifically by comparing those subsectors within services which exhibit opposite dynamics.

4.1.1 Introduction

We use the latest releases of both the STAN and EU KLEMS datasets to explore two main questions. First, we demonstrate the process of secular stagnation that is afflicting most EU-15 economies by examining average labour productivity growth rates over relatively long periods of time in the last forty-five years. Second, we investigate the quantitative impact of structural change on long-term labour productivity growth for the Member States for which available data exist. To do this, we make a comparison of average labour productivity growth over the 1970-2017 period computed by fixing the nominal value added weights of different industries to the values that prevailed in different years in the past. We then compare the resulting growth rates with the growth rate that actually materialised. This counterfactual exercise illustrates the long-term labour productivity growth rates that could have been attained once the effect of structural change is factored out.

Secular stagnation is oftentimes referred to a situation of negligible or no economic growth in a market-based economy. The same concept has also been applied to refer to a slow but steady process of increasingly lower growth in output per capita over time.

The graph in Figure 4.1 confirms that EU-15 countries are no exception to this dismal process in terms of labour productivity performance. It plots the (smoothed) labour productivity growth rates for the total economy, and the agricultural, manufacturing and service sector.

It follows from this graph that trend growth in labour productivity has diminished over time across all sectors. This fall is most pronounced in the agricultural sector, and less so in the service sector. This means that the productivity slowdown also features an element which is intrinsic to each of these industries. Nevertheless, it is worth noting that the labour productivity growth rates of the service sector lie below the growth rates of the other sectors in every year. This confirms the view of the service sector as an especially productivity-stagnant sector. In the next section we argue and show that the widespread process of within-industry labour productivity stagnation, of differing degrees across sectors, is reinforced by the process of structural change. This section attempts at quantifying the effect of the latter, taken the other drivers as given.

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15 Written by Miguel Sanchez Martinez, Peter Bauer, and Aurélien Gentry.
16 Unless explicitly otherwise noted, labour productivity in this chapter refers to real gross value added per hour worked, both at the economy-wide and industry levels. For a discussion on the choice of gross value added over gross output see Nordhaus (2008).
17 For more information on these two datasets, please see: http://www.oecd.org/industry/ind/stanstructuralanalysisdatabase.htm; http://www.euklems.net/
18 The counterfactual question this exercise addresses is: what would have a verage annual labour productivity growth in the 1970-2017 period been in a given country if the economic weight of all sectors had been fixed at their 1970 values compared to the actually realized rate?
19 Original mentioning of the secular stagnation concept was made in Hansen (1939). The concept has in more recent years been popularised by Pr. Larry Summers in its speech at the IMF Economic Forum of November 2013.
20 As argued in the next subsection, we do not claim in this chapter that structural change alone is the main driver of the observed productivity slowdown, but rather, that it is a non-negligible determinant.
4.1.2 The impact of structural change on labour productivity growth

Having established the existence of secular stagnation for most EU-15 economies, we proceed to analyse the role played by structural change as a driving force underlying such a long-term phenomenon. In order to calculate the bearing that economic structural change (and specifically the secular shift of economic weight from manufacturing and agriculture to the tertiary sector) has had on long-term average labour productivity growth, two main sets of analyses are presented. First, the results of counterfactual computations of the average growth rate are shown for different sectoral weights taken from different base years in the 1970-2017 period. These are compared to the actually observed labour productivity growth rate during the same period to quantify the extent of the problem. Second, we document the change in the weight of the manufacturing and service sectors, measured in terms of both value added and employment, both for the EU-15 and for individual countries for which we have long enough data to identify non-negligible changes. Third, we provide a discussion on productivity performance for different service subsectors across the countries analysed. These sectors are selected on the basis of their performance relative to the average service subsector. There is a great deal of heterogeneity in productivity performance among service industries that needs to be duly captured to avoid treating the tertiary sector as a single block. Doing this would run the risk of missing the special characteristics and widely dissimilar technological potential of the different subindustries within services.

It is important to note the existing cross-country heterogeneity in terms of the importance of the effect of structural change on labour productivity growth. Countries such as Germany and Denmark are not affected by the negative impact of structural change to the same extent as countries such as Italy or Spain. However, the effect is still non-negligible, especially considering the long time span and the fact that labour productivity is generally perceived as the ultimate determinant of citizens’ well-being. This difference in impact owes to both smaller changes over time in the sectoral composition of the former two economies (cross-industry effect) as well as to better performance in labour productivity growth in every sector (within effect).

To illustrate the amount of country dispersion in the latter two components, the following chart in Figure 4.2 displays both the average labour productivity growth rate and the percentage change in the nominal value added weight of the overall service sector in the period 1970-2017 for all the economies analysed.

Figure 4.2 reveals that labour productivity in the service sector in countries such as Denmark, Germany, Austria and the Netherlands has grown at a higher average rate in the period analysed than the EU-15 average, while the economic weight of this sector in nominal terms has not increased as markedly as in other countries. At the other end, countries such as Italy and Spain have experienced the opposite: slower labour productivity growth and a larger increase in the size of the service sector.
Figure 4.2. Average labour productivity growth rate and nominal gross value added for the service sector as a whole, percentages, 1970-2017.

Note: The real estate sector is excluded from the computations. Data for the UK are only available until the year 2016. EL, IE and PT are excluded due to poor sectoral coverage in the distant past. EL, IE and PT are excluded due to poor sectoral coverage in the distant past. Source: Author calculations on STAN and EU KLEMS, 2019.

The numbers in Table 4.1 show for twelve EU-15 economies and some relatively newer EU Member States the counterfactual average labour productivity growth rates in the period 1970-2017 calculated as the weighted sum of 1-digit sectoral average productivity growth rates, where the weights are in terms of the nominal value added shares prevailing in either 1970 or 2017. This exercise illustrates the effects that the different sectoral compositions prevailing in the two end years yield on average long-run labour productivity.

Table 4.1. Average labour productivity growth rate (1970-2017, %).

<table>
<thead>
<tr>
<th>EU-15 countries</th>
<th>Base year of industry weights</th>
<th>EU-13 countries</th>
<th>Base year of industry weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>2.63</td>
<td>2.03</td>
<td>BG*</td>
</tr>
<tr>
<td>DK</td>
<td>2.60</td>
<td>2.32</td>
<td>CZ*</td>
</tr>
<tr>
<td>DE</td>
<td>2.21</td>
<td>1.95</td>
<td>EE*</td>
</tr>
<tr>
<td>IE*</td>
<td>3.96</td>
<td>5.51</td>
<td>CY*</td>
</tr>
<tr>
<td>EL*</td>
<td>0.58</td>
<td>0.63</td>
<td>LV*</td>
</tr>
<tr>
<td>ES</td>
<td>1.93</td>
<td>1.13</td>
<td>LT*</td>
</tr>
<tr>
<td>FR</td>
<td>2.28</td>
<td>1.65</td>
<td>PL**</td>
</tr>
<tr>
<td>IT</td>
<td>1.33</td>
<td>0.73</td>
<td>RO*</td>
</tr>
<tr>
<td>LU</td>
<td>2.33</td>
<td>3.62</td>
<td>SI*</td>
</tr>
<tr>
<td>NL</td>
<td>2.14</td>
<td>1.80</td>
<td>SK*</td>
</tr>
<tr>
<td>AT</td>
<td>2.40</td>
<td>1.92</td>
<td></td>
</tr>
<tr>
<td>PT*</td>
<td>1.05</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>2.76</td>
<td>2.20</td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>1.97</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>2.00</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td><strong>EU-15</strong></td>
<td><strong>2.08</strong></td>
<td><strong>1.65</strong></td>
<td></td>
</tr>
</tbody>
</table>

Note: Average labour productivity growth rates are computed based on nominal value added weights taken from the base year indicated. * denotes weights from 1995 instead of 1970. ** denotes weights from 2000 instead of 1970. The real estate sector is excluded from these calculations. Data for the UK span until the year 2016. HR, HU and MT are excluded due to a too short time coverage.

Source: Author calculations on STAN and EU KLEMS, 2019.
Table 4.1 shows that the structural change process by which relatively more productivity-stagnant industries gain greater relative economic weight over time has had a more perverse effect in the EU-15 countries than in the newer Member States, especially if we leave out outliers such as Ireland and Luxembourg. For the EU-13 countries, there is no evidence yet of a significantly negative effect from structural change at play: the average productivity growth rate resulting from fixing the economic structure prevailing in 2017 is in general higher than the one computed using weights further back in the past (e.g., CY, CZ, LV, PL). Even though there might be several reasons for such a dissimilar sign of the effect of structural change across countries, such as greater weights of manufacturing industries and shorter time series data, one of the main drivers is the fact that EU-13 Member States are mostly transition economies. This makes them more capable of reaping productivity gains across all economic sectors, as they find themselves in the midst of a catching-up process with the most advanced countries in the EU. Economies belonging to the EU-15, on the other hand, have exhausted most of the productivity gains associated with earlier development processes, irrespective of the type of industry, whereas the weights of stagnant industries are typically much larger than in the EU-13.

4.1.2.1 The rise of services

The following charts in Figures 4.3 and 4.4 show the change in the weight of the manufacturing and service sectors, measured in terms of both value added and employment, both for the EU-15 and for individual countries for which we have long enough data to identify non-negligible changes.

Figure 4.3. Weight of the manufacturing sector in 1970 and 2017, measured as a share of both economy-wide value added and employment (%).

The general pattern observed in these graphs is clear: the weight of the manufacturing sector has diminished over time, in favour of the service sector, in all the economies analysed. This holds true for economic weights interpreted both in terms of nominal value added and employment shares. Another important observation is that the falls in manufacturing employment shares between 1970 and 2017 are generally proportionally higher than in value added. In the EU-15, for example, the difference in the change in employment (-14 percentage points) and value added (-10 percentage points) shares between these two years is equal to -4 percentage points. This presumably indicates that the relative loss of labour input in the manufacturing sector has not led to a proportional decline in output, likely due to relatively faster technological progress. This is also in line with the predictions that technological progress in the progressive sectors of the economy translates into lower labour input needs and increasing output in real terms.

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21 As mentioned before, the evolution of productivity growth in these two countries is driven by very country-specific factors.

22 In countries such as the UK this gap rises to 8 percentage points.
Figure 4.4. Weight of the service sector in 1970 and 2017, measured as a share of both economy-wide value added and employment (%).

As expected, the inverse phenomenon is observed in the service sector; employment shares increased proportionally more than nominal value added shares. This is exemplified by a difference between the changes in employment (29 percentage points) and value added (19 percentage points) shares in the period 1970-2017 for the EU-15 of 10 percentage points.23 This lends support to the view that the service sector tends to hoard more labour input.24

The service sector comprises a set of industries which exhibit large discrepancies in terms of their labour productivity performance. It is thus worth investigating which subsectors within services are most responsible for weighing on labour productivity growth and which other sectors, on the contrary, display relatively better productivity performance, even compared to the more progressive primary and secondary sectors.

The information and communication service (ICT) subsector shows the highest average growth rate in the period analysed.25 In fact, at 4.46 per cent, this rate exceeds that of both the manufacturing (3.11 per cent) and the agricultural sectors (4.13 per cent). However, the gain over time of the ICT sector in terms of both nominal value added and employment shares is almost negligible. This in turn implies that despite the large increase recorded in labour productivity, the ICT sector has contributed very little to economy-wide productivity growth.

On the other hand, the professional service sector is one of the worst performers in terms of labour productivity growth, whereas it has significantly increased its nominal value added weight. This means that this sector is a significant negative contributor to overall labour productivity growth. There is however room to raise productivity in this sector through the expansion of important technologies such as digitalisation and automation.26

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23 This gap reached 11 percentage points in Spain, Finland, France, Italy. The exception is Luxembourg, whose service sector’s value added increased by 24 percentage points more than its employment share.
24 Part of these flows of workers into the tertiary sector originates from the manufacturing sector, so long as the assumption of a sufficiently high degree of substitutability of labour across sectors holds.
25 Studies on the causes behind the above-average productivity performance of the ICT sector stress its being one of the most R&D intensive sectors (see, e.g., Duch-Brown et al. (2016) for the case of the Spanish ICT sector).
26 It is important to remark that current technological advancements have the potential of boosting productivity even further, both in knowledge-intensive sectors such as ICT and less knowledge-intensive sectors that tend to absorb more labour input, such as the professional labour services sector.
The community, social and personal services subsector, which comprises important public services such as health and education, also bears a negative impact onto aggregate labour productivity growth. With a nominal value added share of 18 per cent in 1970, it was already the largest service subsector. It expanded its weight further to 22 per cent of total nominal value added in 2017. This sector has represented an important drag since the beginning of the period, both through poor intrinsic productivity growth and through a relatively large increase in its economic weight.

4.1.2.2 In-depth analysis for the EU-15

This subsection provides a breakdown of the main sectors responsible for the negative impact of structural change documented in the preceding sections.

The following table shows that excluding services from the computation of the counterfactual average labour productivity growth rates in the 1970-2017 period leads to an increase in the resulting rates for both base years, to 2.83% and 2.68%, with 1970 and 2017 value added weights, respectively. This is noticeably higher than the 2.08% and 1.65% rates obtained when services are included.

Table 4.2. Average labour productivity growth in the 1970–2017 period with different nominal value added weights including and excluding service, EU-15 (%).

<table>
<thead>
<tr>
<th>Base year</th>
<th>All industries</th>
<th>Excluding services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>2.08</td>
<td>2.83</td>
</tr>
<tr>
<td>1975</td>
<td>1.99</td>
<td>2.84</td>
</tr>
<tr>
<td>1980</td>
<td>1.93</td>
<td>2.80</td>
</tr>
<tr>
<td>1985</td>
<td>1.91</td>
<td>2.84</td>
</tr>
<tr>
<td>1990</td>
<td>1.85</td>
<td>2.77</td>
</tr>
<tr>
<td>1995</td>
<td>1.77</td>
<td>2.73</td>
</tr>
<tr>
<td>2000</td>
<td>1.75</td>
<td>2.72</td>
</tr>
<tr>
<td>2005</td>
<td>1.69</td>
<td>2.64</td>
</tr>
<tr>
<td>2010</td>
<td>1.64</td>
<td>2.65</td>
</tr>
<tr>
<td>2017</td>
<td>1.65</td>
<td>2.68</td>
</tr>
<tr>
<td>Actual</td>
<td>1.82</td>
<td>2.73</td>
</tr>
</tbody>
</table>

Note: The real estate sector is excluded from these computations. Source: EU KLEMS, 2019.

It can be seen from Table 4.2 that average annual real labour productivity growth in the 1970–2017 period in the EU-15 would have been about 0.26 percentage points higher (about 14 per cent higher) compared to the actually realized growth rate if the economic structure prevailing in 1970 had remained the same over time. In other words, the long-run shifts in the sectoral composition of output have had a detrimental effect on economy-wide labour productivity development.

It is also important to note that the gap between the two counterfactual growth rates when not including services compared to including them significantly narrows down. The observations of both much higher growth rates and a shrinking difference between counterfactual growth rates when excluding services imply that it is mainly the structural shift towards the tertiary sector that drives the differences observed in average labour productivity growth when using past and current economic weights. This is hence indicative of the major drag that the servicification of the EU-15 economies represents for labour productivity growth.

27 This difference, which might seem small at face value, is non-negligible, given that labour productivity is generally perceived as the most important determinant of long-run welfare. At a value of around 10760 Euro per hour in 1970 (in 2010 constant terms), had the growth rate reached 2.08 per annum during the 47-year period considered, output per hour would have been about 3200 euros higher at the end of the period compared to the amount obtained at the actual annual growth rate of 1.82 per cent. All else equal, this difference in income per capita would likely have allowed lifting from poverty an additional number of citizens in the order of the tens of thousands.
To investigate which sectors have played a larger role in the long-run slowdown in productivity growth, the following table shows the nominal value added shares of each sector at the 1-digit level and their respective average labour productivity growth rates:

Table 4.3. EU-15: Change in value added shares and average labour productivity growth in each one-digit sector, 1970-2017 (%).

<table>
<thead>
<tr>
<th>Sector</th>
<th>VA share 1970</th>
<th>VA share 2017</th>
<th>Average LP growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Agriculture, forestry and fishing</td>
<td>6.9</td>
<td>1.7</td>
<td>4.13</td>
</tr>
<tr>
<td>B: Mining and quarrying</td>
<td>1.6</td>
<td>0.5</td>
<td>3.06</td>
</tr>
<tr>
<td>C: Total manufacturing</td>
<td>28.1</td>
<td>18.1</td>
<td>3.10</td>
</tr>
<tr>
<td>D-E: Electricity, gas and water supply</td>
<td>2.7</td>
<td>3.0</td>
<td>2.94</td>
</tr>
<tr>
<td>F: Construction</td>
<td>8.7</td>
<td>6.0</td>
<td>0.85</td>
</tr>
<tr>
<td>G: Wholesale and retail trade; repair of motor vehicles and motorcycles</td>
<td>13.5</td>
<td>12.4</td>
<td>1.92</td>
</tr>
<tr>
<td>H: Transportation and storage</td>
<td>5.8</td>
<td>5.4</td>
<td>2.26</td>
</tr>
<tr>
<td>I: Accommodation and food service activities</td>
<td>2.0</td>
<td>3.4</td>
<td>-0.25</td>
</tr>
<tr>
<td>J: Information and communication</td>
<td>3.7</td>
<td>5.7</td>
<td>4.46</td>
</tr>
<tr>
<td>K: Financial and insurance activities</td>
<td>3.8</td>
<td>5.6</td>
<td>1.46</td>
</tr>
<tr>
<td>M-N: professional, scientific, technical, administrative and support service activities</td>
<td>4.3</td>
<td>12.9</td>
<td>0.42</td>
</tr>
<tr>
<td>O-U: Community, social, and personal services</td>
<td>18.8</td>
<td>25.4</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Note: VA refers to value added and LP to labour productivity. The sum of shares may not equal to 100% due to rounding. The real estate sector is excluded from these computations.

Source: EU KLEMS, 2019.

From Table 4.3 some trends concerning the drivers, at the 1-digit sectoral level, of the negative impact of structural change on productivity growth can be identified. First, both the agricultural and manufacturing sectors have seen their relative economic weights substantially shrink from 1970 to 2017, by approximately 75% and 36%, respectively. Since, at 4.13 and 3.1 per cent, these sectors have performed better in terms of labour productivity growth during this period relative to the average sector, the reduction in their shares has, all else equal, contributed to slowing down economy-wide productivity growth. Second, certain service sectors have negatively affected the growth rate of labour productivity growth, chiefly the accommodation and food service activities (I), regulated professions (M-N), and non-market services (O-U). These service subsectors have significantly increased their economic weight, while they have performed relatively poorly in terms of productivity growth.

4.2 Role of intangibles in productivity growth

4.2.1 Intangible assets within and outside national accounting

Investment in intangible assets is generally considered to be an important driver of productivity and productivity growth in the modern economy (see e.g. Haskel and Westlake, 2017). Although intangibles can have a somewhat broad definition, by now there seems to be a consensus on a working definition for intangible assets, at least at the macro level. They are classified into three groups: computerised information, innovative property and economic competencies (for details, see e.g. Corrado et al., 2018). Some intangible assets are already included in national accounts (NA intangibles), namely software, database, R&D, mineral exploration and artistic originals. Others are not included (non-NA intangibles): design and economic competencies which are in turn comprised of brand, organisational capital and training.

Recent studies on multi-country data (Corrado et al., 2018; Thum-Thysen et al., 2017) confirm that at the aggregate economy level, higher investment into intangible capital is associated with higher productivity
growth and with faster convergence to the frontier (the US). This type of investment also explains a significant part of the variation in total factor productivity (TFP) across countries. The important role of intangibles in production is also underpinned by some evidences on their complementarity with other assets (Thum-Thysen et al., 2017 and 2019).

In the first part of the analysis, we exploit the industry-level dimension of the INTAN-Invest database to estimate the importance of intangible investment for labour productivity. An industry level investigation of the relationship between labour productivity growth and investment sheds light especially on the sectoral (e.g. services vs industry) differences in the impact of intangible investment. In addition, the possible heterogeneity in the impact and the different roles played by different types of intangible assets are explored. The analysis is based on the estimation of a production function, augmented with intangible assets as an input, to investigate the role of intangibles in productivity growth (for methodological details, see Bauer et al. 2020, Chapter 6).

The main messages stemming from this analysis are that, one, non-NA intangibles (mainly economic competencies) are important for productivity growth especially in services, and, two, NA intangibles (software and R&D) seem to be more important for industry.

Furthermore, we see that there is large heterogeneity in terms of intangible investment and capital use across countries. For example, Figure 4.5 shows this heterogeneity in terms of investment rate (as a share of capital stock). Thus, after estimating the role of intangible assets in production, we assess country-specific performance (productivity) based on our production function estimates. For that purpose countries are ranked according to the size of the contribution of the growth in intangible capital to productivity growth.

**Figure 4.5. Investment-to-capital ratio in 2015.**

According to the ranking, the worst performing countries are Greece, Italy, Germany, Spain and Portugal, while the best countries are the UK, the US, the Netherlands, Sweden and France.

The second part of the analysis is focusing on industrial performance during the period of the global financial crisis. We assess the question how intangible investment could have helped to weather shocks during that period using another database, the latest vintage of EU KLEMS (2019). Our analysis shows that, when inherent differences between industries and between countries are controlled (fixed effects), more tangible intensive industries suffered more in terms of the loss in real value added during 2008-2009, while overall intangible intensity, in general, and training intensity, in particular, were associated with higher growth. Likewise, in the long run (2014-2017), R&D intensive industries grew faster. During the first phase of the crisis (2008-2009), employment growth was positively correlated with overall intangible intensity and R&D intensity. Finally, both labour productivity and TFP growth in R&D and overall intangible intensive industries is significantly higher compared to less intensive industries after the crisis (2014-2017).

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28 For the details about the database, see Corrado et al., (2016).
29 For a discussion of this vintage of EU KLEMS, see Stehrer et al. (2019).
Consistently with the above results, R&D investment intensity is robustly associated with economic resilience, with the latter measured based on different metrics. For example, the recovery of R&D-intensive industries in terms of both labour productivity and TFP growth was stronger.

4.2.2 Results of the production function estimation

We estimated a Cobb-Douglas production function via the fixed effect estimator and system GMM. The main result in all specifications (see Table 4.4) is that non-NA intangibles (design and economic competencies) are important for services but not important for the industry. NA intangibles (software and R&D) are more important for industry than for services. For example, for the baseline estimation (columns 8 and 9), coefficients are 0.006 and 0.131 for NA and non-NA intangibles in services, respectively, while in industry, they are 0.053 (NA intangibles) and −0.009 (non-NA intangibles). The coefficient of NA intangibles in services and non-NA intangibles in industry are not significant at standard levels of significance. If we interpret these results in the context of the original production function, it means that a (ceteris paribus) 10% increase in NA intangible capital will result in an increase of productivity by 0.06% in services, a negligible impact, and by 0.53% in industry, a low, but economically significant number. A 10% increase in non-NA intangible capital will increase productivity by 1.31% in services, a considerable impact. In industry, we regard the impact of non-NA intangible capital as zero, because the coefficient is statistically insignificant and negative.

Table 4.4. Estimated coefficients of the production function (dependent variable: Δlog(value added))

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed effect</th>
<th>System GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Serv</td>
</tr>
<tr>
<td>Δlog(ICT capital)</td>
<td>0.0142**</td>
<td>0.0329***</td>
</tr>
<tr>
<td></td>
<td>(0.00577)</td>
<td>(0.00927)</td>
</tr>
<tr>
<td>Δlog(machinery capital)</td>
<td>−0.00620</td>
<td>−0.0172</td>
</tr>
<tr>
<td></td>
<td>(0.0189)</td>
<td>(0.0194)</td>
</tr>
<tr>
<td>Δlog(NA intangible capital)</td>
<td>0.0263**</td>
<td>0.0167</td>
</tr>
<tr>
<td></td>
<td>(0.0131)</td>
<td>(0.0138)</td>
</tr>
<tr>
<td>Δlog(non-NA intangible capital)</td>
<td>0.160***</td>
<td>0.201***</td>
</tr>
<tr>
<td></td>
<td>(0.0278)</td>
<td>(0.0292)</td>
</tr>
<tr>
<td>Δlog(labour services)</td>
<td>0.363***</td>
<td>0.265***</td>
</tr>
<tr>
<td></td>
<td>(0.0261)</td>
<td>(0.0300)</td>
</tr>
<tr>
<td>Country FE</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Sector FE</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Country-sector FE</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Year</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Observations</td>
<td>2,040</td>
<td>1,416</td>
</tr>
<tr>
<td>Number of country sectors</td>
<td>108</td>
<td>75</td>
</tr>
</tbody>
</table>

Note: ‘Serv’ and ‘Ind’ indicate the services and the industry sub-sample, respectively. We do not report the coefficient of the lagged dependent variable in case of the system GMM estimation. It was not significant and very small for the whole sample and for the industry, while significant but very small for services.

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

For tangible capital, ICT capital is statistically significant only in services, while in industry only Machinery is significant. In any case, from the estimated coefficients it seems that the importance of tangible capital in production is relatively low; this is in-line with the results of Niebel et al. (2017). Summing up the coefficients of the production function, it is far less than one, suggesting that the constant returns to scale property of the production function is not satisfied.\(^{51}\)

\(^{50}\) We find the same results when we apply a simple approach where we regress average productivity growth over a longer period on investment intensity as a robustness check.

\(^{51}\) A decreasing returns to scale property of the aggregate production function is in contrast with standard macroeconomic theory. Despite that, empirically, it is not an unusual finding when production functions are estimated at an aggregated level, see e.g. Niebel et al. (2017), or Adarov and Steher (2019). Possible
All of our estimates suggest a much larger impact of non-NA intangibles than of NA intangibles on aggregate productivity. This is due to the fact that the service sector has a larger share in the economy, and NA intangibles are comparatively less relevant in the service sector. Furthermore, the impact of NA intangibles in industry is not as high as the impact of non-NA intangibles in services.

4.2.3 Ranking of countries according to the contribution from intangible investment

We rank countries by the contribution of intangible capital growth to productivity growth. This is computed as the estimated coefficients of both types of intangible capital multiplied by the respective actual values of the growth of capital. We want to emphasize that we use the same estimated coefficients for each country, thus differences are not stemming from different factor elasticities as we assume homogeneity across countries. Still, the heterogeneity of the contributions across countries stems from different sources. First, it comes from the different growth rates of intangible capital across countries. Second, it comes from the different distributions of intangible investments between assets and sectors. Finally, it comes from the different economic structure of countries, i.e. the different sector weights.

According to the aggregate productivity contribution of intangible capital growth (Figure 4.6), the worst performing countries are Greece, Italy, Germany, Spain and Portugal, while the best countries are the UK, the US, the Netherlands, Sweden and France.

4.2.4 Results on the role of intangibles in industrial performance during the financial crisis

We analyse the role of tangible and intangible assets during the global financial crisis in output growth (measured by real value added), growth in labour (measured by the number of persons employed and hours worked) and productivity growth using the EU KLEMS (2019) database. We estimate the impact on both labour productivity growth (measured by real value added per hours worked) and total factor productivity (TFP) growth. We capture the importance of intangibles in an industry by using investment intensity of that industry, i.e. a ratio of investment-to-value added.

As developments in industries during the crisis could depend on industry characteristics other than investment intensities (e.g. demand dropped more for high income-elasticity goods), we need to control for inherent explanations include omitted variables (e.g. infrastructure as an input variable) and measurement error (especially in capital inputs).

It means that the interpretation of the contribution is the difference in productivity growth compared to the counterfactual of zero growth of intangible capital.

Low level of investment rate of certain assets in certain countries could be explained by low rate of return on these assets in those countries. Without country-heterogeneity in the production function, we cannot check this hypothesis.
industry differences. To this end, we estimated country-industry panel regressions of EU15 countries and the US. We controlled for industry and country fixed effects which means that any average differences between industries or countries were eliminated in terms of both the explanatory variables (investment intensities) and the dependent variables (output, labour and productivity growth). We also controlled for tangible intensity wherever we estimated the effect of intangible intensity as these intensities are (weakly) correlated. When we report the result for tangibles, the aggregate intangible intensity was included as a control.

Our analysis shows that industries which are more tangible intensive suffered more in terms of the loss in real value added during 2008-2009, while overall intangible intensity, in general, and training intensity, in particular, were associated with higher growth. Likewise, from 2014 to 2017, R&D intensive industries grew faster. During the first phase of the crisis (2008-2009), employment growth was positively correlated with overall intangible intensity and R&D intensity. Finally, both labour productivity (Figure 4.7) and TFP growth in R&D and overall intangible intensive industries is significantly higher after the crisis (2014-2017) compared to less intensive industries.

Figure 4.7. Effect on real value added growth and labour productivity growth of an increase of pre-crisis investment intensity equivalent to jumping from the bottom 25% to the top 25% of the intensity distribution (controlled for country and industry effects in a panel setting).

Note: Striped area denotes non-significant coefficient in the panel estimation.
Source: JRC calculations based on EU KLEMS 2019

4.2.5 Intangibles have a strong impact on productivity and contribute to economic resilience during crises

The main findings of this study are that intangible investment is an important driver of labour productivity growth. The relationship between intangible investment and productivity growth is heterogeneous in terms of asset type and sector. National accounts intangibles are important for the industry, while non-national accounts intangibles are important for the service sector. Furthermore, we find that more intangible intensive industries were more resilient during the financial crisis. For example, both labour productivity and TFP growth in R&D and overall intangible intensive industries is significantly higher after the crisis (2014-2017) compared to less intensive industries.

From a policy perspective, improving productivity by increasing intangible investment requires the knowledge of the drivers and potential obstacles to intangible investment. There is existing evidence in the literature that drivers of intangible investment are different from the ones affecting tangible investment. Corrado et al. (2018) applies a pooled cross-country regression to show that intangible investment relative to tangible investment is correlated with employment regulation (negatively), government funded R&D (positively) and relative prices (negatively). Thum-Thysen et al. (2017 and 2019) use the accelerator model (with a country fixed-effect extension) on country-level data to show that the intangible investment rate is much more affected by human capital and employment regulation than tangible investment, and less sensitive to the aggregate demand and to the long-term interest rate. Further research should focus on shedding light on the causal drivers of intangible investment.
5 Can competition policy strengthen EU competitiveness? The impact of competition policy on dynamic efficiency

The primary objective of competition authorities is to ensure competitive markets. As it is well known, competition policy enforcement exerts two types of effect: i) a direct effect, which derives from the elimination of cartels or by prohibitions of mergers; ii) and an indirect effect, which refers to the deterrence effect obtained thanks to the competition policy activity, which discourages firms to engage in illegal economic behaviour. Those effects are associated with mark-up reductions and a more competitive environment (Ilzkovitz and Dierx, 2020).

However, to fully understand the impact of competition policy on macroeconomic performance, policymakers should not only consider the direct or indirect effects of competition policy enforcement. In an ex-post evaluation policy exercise, one should also consider that competition policy affects the macroeconomic performance through three channels: allocative, productive and dynamic efficiency channels. Allocative efficiency occurs when there is a reallocation of scarce resources between firms (the so-called ‘between effect’). Productive efficiency occurs when there is an improvement in the utilization of the production factors by firms (the so-called ‘within effect’). Dynamic efficiency refers to a situation where firms have an incentive to improve existing products and introduce new technologies, which move forward the technology frontier. As all those channels result in higher productivity growth due to a more competitive market structure, all policies that lead to markets operating more competitively, such as competition authorities interventions, will result in faster economic growth.

Among all the three channels, innovation is well-recognized to be a main driver of long-run growth. Recently, some questions have been raised on which actions should be taken to strengthen the competitiveness of European firms, especially in relation to the recent phenomenon of digitalization and the emergence of the superstar firms, whose interpretation is subject to two opposite explanations. On the one hand, some economists argue that they are the results of the ‘winner takes most/all’ competition, i.e. most efficient and innovative producers are rewarded with a higher market share (Van Reenen, 2018 and Bighelli et al. 2020). Additionally, some degree of market power seems necessary to incentivize firms to innovate and introduce new products. On the other hand, some economists are concerned that the rise in concentration is disconnected from technological advances at top firms (De Loecker et al. 2020). Dominant firms may use its market power to eliminate the threat of potential competitors or acquire rivals (Federico et al. 2020).

The recent trends in the market structure seem to intensify the traditional trade-off between static and dynamic efficiency. While in competitive markets firms price at cost achieving static efficiency, competition may actually be the source of dynamic inefficiency since it reduces the incentives to innovate by preventing innovators from recovering the fixed costs of their investment in new technologies. Therefore, some criticisms have been raised on the motivations behind competition policy decisions, which do not seem to sufficiently take into account the impact of innovation on productivity and some questions have been raised on which role competition authorities may play in order to incentivize growth (Schilling, 2015).

From the literature, we know that lower mark-ups may be associated with higher efficiency only if static efficiency gains more than offset the increased fixed costs of research and innovation. Recent studies show that the relation between competition and productivity takes an inverted U-shape (Boone, 2001 and Aghion et al., 2005) as a result of the interaction between an "escape competition" and a "discouragement" effects. When regulation is high, more competition through lower mark-ups promotes innovation, as firms are encouraged to innovate to escape competition. As competition becomes stronger and average profits decrease, though, the benefits of catching-up disappear. Beyond a certain threshold, the latter effect prevails so that further deregulation is associated with lower productivity.

This chapter discusses how competition policy interventions may stimulate aggregate productivity, boosting the long-term economic growth by innovation. Section 5.1 overviews the theoretical foundation in favour of a

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34 Written by Roberta Cardani, Beatrice Pataracchia and Marco Ratto.
35 The term “dynamic efficiency” refers to the efficiencies that arise in the long run with innovation. On the contrary, the term “static efficiency” builds on the two above-mentioned concepts: productive and allocative efficiency. It refers to the extent by which total surplus is maximized in the short run, using the current technology and its inputs combination.
36 Superstar firms are firms that have substantially a greater share of sales than their peers have but a low labour share and are pulling away from those peers over time (winner-take-all strategy). This is the case of Amazon, Facebook or Google. Superstar firms enjoy some market power but also triggers some incentives to invest and innovate.
positive link between competition policy, innovation and TFP growth, while in Section 5.2 we focus on empirical studies who analyse the role played by competition policy and market competition in promoting productivity via innovation channel, as a main driver of economic growth. Finally, Section 5.3 concludes.

5.1 The economic logic

There is a broad consensus among economists on the fact that improving the degree of competition in the markets can drive an increase in productivity (see Syverson, 2011, Nicodème et al., 2007, and Competition and Markets Authority, 2015, to survey the literature).

Competition authority interventions directly generate a decrease in mark-up by improving the conditions of competition in the markets. The lower mark-up is translated then into lower prices for the consumers. However, competition policy interventions have also an indirect impact on productivity growth by means of static and dynamic efficiency, summed up in Figure 5.1. 37

Figure 5.1 Impact of competition policy on TFP growth

An increase in market competition may force firms to achieve in each period the highest level of efficiency in production (allocative efficiency) and in the utilization of resources (productive efficiency), given the available technologies. This is the static efficiency, i.e. increasing competition ensures that the more productive firms increase their market share at the expense of the less productive. The low-productivity firms may then exit the market, to be replaced by higher productivity firms. In addition, increasing market contestability forces firms to optimise the use of resources, reducing various forms of X-inefficiency (like, for example, managerial or worker slack and bureaucratic inertia), and subsequently enhancing productivity in the market.

While static efficiency induces firms to move closer to the technological frontier, dynamic efficiency produces a movement of the frontier itself, resulting from investments in product and/or process innovations (Nicodème and Sauner-Leroy, 2007).

Innovations may affect efficiency levels in the (near) future and stimulate the level of dynamic efficiency of the market (see, e.g. Baumol, 2003). Competition policies also potentially affect dynamic efficiency. The degree of market competition may drive firms to innovate and differentiate products in order to gain market shares. In this sense, innovation enhances productivity through technological improvements of production processes or the creation of new products.

However, the link between market competition and productivity is a debated issue in the profession. Literature on market competition, innovation and growth emphasises the importance of economic profits in providing incentives for firms to innovate or to increase efficiency but it is inconclusive on the direction of these effects. In particular, three forces may act. On one hand, industrial organization and early endogenous growth models argue that competition may be detrimental for innovations (Schumpeterian discouragement effect), as it may reduce the rewards to innovate or entry into a market and thus discourage innovation activities, as in Romer

37 Note that we are not discussing here the possible interrelation among the three channels. For example, entries of new firms may have a negative effect on mark-up but a positive effect on innovation. Correspondingly, innovation can increase the competition in a market.
(1990) and Aghion and Howitt (1992). Their results are driven by the assumption that innovation activities are run by incumbents with the existing technology, whose pre-innovation rent is null and the payoff of innovation is equal to the post-innovation rent.

On the other hand, when the decision to innovate mainly depends on the difference between the post-innovation and pre-innovation rent, the monopolist has less incentive to innovate, because he would only replace his existing rent bearing the cost of innovation, whereas competitive firms would take over the market while before they would just cover their production costs. This is the so-called Arrow (1962) replacement effect.

Finally, other studies rooted in the distance-to-frontier theoretical tradition show that potential or actual competition can induce an incumbent leader to react to the competition threat and innovate in order to maintain its leadership (escape competition effect), as in Aghion et al. (2004).

Recently, new endogenous growth models have attempted to include all these drivers in a single model (e.g. Aghion et al., 2005, 2006 and 2009). They predict that the link between competition and innovation may be positive or negative depending on i) the initial level of market competition and ii) on the industry/firm’s initial distance from the technological frontier. In particular, this strand of the literature distinguishes between two types of industries: i) “neck-and-neck” industries, where firms are very close technologically; and ii) “unlevelled” industries, who are unequal. In neck-and-neck industries, the “escape-competition” effect dominates and greater competition increases innovation incentives, since innovation induces firms to obtain higher profits. Conversely, in unlevelled industries the Schumpeterian effect is expected to dominate and greater competition may reduce innovation incentives, since the laggard firm’s ex post reward to catching up with the technological leader falls as competition intensifies.

5.2 Empirical evidence on the dynamic efficiency channel

There is a rich empirical evidence linking a higher degree of innovation to productive growth. However, there have been rather mixed results assessing the impact of competition policy and market competition on innovation. This section reviews the empirical literature that deals with the link between market competition, competition policy and innovation.

5.2.1 The effect of innovation on productivity

Many studies have investigated the impact of innovation on productivity growth. Overall, most empirical studies and methodologies provide a strong evidence of a positive and significant impact of R&D on productivity (see Hall, 2011). In other words, innovation can both increase firms’ efficiency and improve the products they offer; hence it rises demand and reduces costs of production. However, the impact seems to depend on how innovation is measured: the impact of product innovation on productivity is significant and positive, but the impact of process innovation is more ambiguous. Hall (2011) argues that this is due to the difficulty to measure the real quantity effect of process innovation.

Griffith et al. (2006) investigate how innovation feeds into productivity of firms in France, Germany, Spain, and the UK, using data from the internationally harmonized Community Innovation Survey. They find that process innovation is only associated with higher labour productivity in France; while product innovation is associated with higher productivity in France, Spain, and the UK, but not in Germany. Griffith et al (2004) show that R&D stimulates growth directly through innovation and indirectly through technology transfer for a few OECD countries.

5.2.2 The effect of competition policy on innovation

The relationship between competition policy interventions and innovation is complex and empirical works shows not always statistically significant results. The main contributions analyse the extent of product market reforms and relates them to firm distance from the frontiers, different stage of the innovation activities and degree of competition in the upstream sectors.

Arnold et al. (2008) analyse the regulation-productivity link at the firm-level and suggest that burdensome regulation has been particularly harmful to the ability of the economy to allocate resources to the most efficient firms and for productivity growth in firms operating close to the technological frontier. Such

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regulation may have negative effects also on allocative efficiency because they have a disproportionately strong effect on firms characterised by an above-average productivity growth.

Using a semi-endogenous quality-ladder model, Ledezma (2013) shows that, if the status of leadership relies on technological advantages strategically acquired by leaders in the process of innovation, policy interventions may in some cases dissipate the rents. At the same time, this may also induce firms to innovate in order to leapfrog the incumbent in a Schumpeterian fashion. The same conclusion has been reached by Blind (2012).

Conversely, Castellacci (2011) finds that, in Norway, more concentrated industries have both a greater likelihood to invest in innovation and larger R&D outlays than less concentrated ones. Therefore, he argues that the Schumpeterian effect is associated with the ex-post effects of innovation (i.e. innovation choice and intensity of R&D). Interestingly, the positive effect of market concentration on R&D investment grows with the proximity to the frontier. On the other hand, in the case of oligopolistic industries, the impact of efforts on firm performance should be higher in competitive sectors (escape competition effect in late innovation stages).

Bourlès et al. (2013) have reached a similar conclusion, analysing the influence of upstream competition on productivity outcomes in downstream markets for OECD countries. They argue that weak competition in the intermediate input sectors of the economy becomes an impediment for downstream firms to implement their innovative strategies in their own markets, especially when they compete neck-and-neck with their rivals and seek to escape competition. This is because, downstream firms may have to negotiate with (and can be held up by) suppliers due to their bargaining power. Those markets are characterized by a large proportion of firms having a wide technological gap to fill and therefore the increase in competition can be strong enough to deter any innovation activities.

Mixed results are obtained also by Amable et al. (2016), who find that, using the Product Market regulation (PMR) indicators, competition has been found to have a positive influence on leaders' innovation and a negative one on followers'.

Less recently, Griffith et al. (2010) confirm that the introduction of the Single Market Programme in Europe in the early 1990s spurred innovation and stimulated productivity. They also estimate that the Single Market Programme increased R&D intensity by 1.2% in the UK metal products industry, leading to an increase of 0.7 percentage points in TFP growth. Within an industry, the effect of increasing competition on innovation appears to be larger in countries that are closer to the global technological frontier.

Nicoletti and Scarpetta (2003) use multifactor productivity (MFP) growth at the industry level and find that product market regulation lowers MFP growth in OECD countries. According to their results, deregulation delays in European economies entailed a cost in terms of MFP growth. They also find that if European countries formed their regulatory policy according to that of the most liberal OECD ones, MFP growth would raise over 10 years by up to 1.1 percentage points.

Using firm-level database for some European Countries, Arnold et al. (2011) examine the effect of product market regulation on firm-level productivity growth. They find that product market regulations, that reduce the competitive pressures, tend to lessen firm productivity. The negative effect is particularly strong on firms characterized by an above-average productivity growth and may depend on the propensity to use certain types of technologies.

Kolch et al. (2004) identify a positive impact of antitrust regulation on R&D intensity in the former G7 countries. On the contrary, using panel data for 21 OECD countries Blind (2012) shows that competition enhancing regulation has no significant positive impact on innovation: assuring high level of competitiveness might increase the incentive to innovate, but if the competition intensity is too high, the relationship might turn into a negative one in the long run, because the resources for future innovation activity may be not available.

Recently, Cette et al. (2016) analyse the consequences on productivity of anti-competitive regulations in product markets through their impact on production prices. They conclude that rents weaken incentives to improve efficiency and to innovate in downstream industries, when upstream industries have market power and can charge the downstream sectors with high prices for intermediate inputs. This implies that market concentration generates a negative impact on productivity.
5.2.3 The effect of market structure on innovation

The key element behind the inconclusive results found in the empirical literature assessing the impact of competition policy on innovation, seems to be related to the link between competition and innovation. As discussed next, empirical evidence supports either a positive or a negative or an inverted-U-shape relationship.

On the one hand, some economists demonstrate that competition may be detrimental for innovations. This results dates back to Schumpeter (1942), who argues that monopolistic firms can fund R&D expenditure more easily as the market structure allows them to capture all the gains from their innovations. Consequently, the monopolist can achieve higher rates of innovation and thus growth.

Empirical papers have found evidence of a negative impact of competition on innovation. Seminal work of Hamberg (1964), who find that R&D activity increases with the firm size and industry-concentration. Mansfield (1983) surveys the major product and process innovations in the chemical, drug, petroleum, and steel industries to shed some light on the effects of technological change in the market structure. He concludes that highly concentrated industries seem to devote a relatively low percentage of their R&D to basic research, and there is an inverse (but not significant) relationship between an industry's concentration ratio and the percentage of its R&D that is long-term or aimed at entirely new products and processes.

Kraft (1989) focuses on metal-working industry in West Germany in order to eliminate inter-industry differences. He concludes that competition impedes innovation, when market concentration is measured both in terms of number of potential competitors or competitors present in the market and in terms of capital intensity as a proxy of barriers to entry.

Using French survey data with information on sales from innovative products, Crepon et al. (1998) assess both the innovation impacts of R&D and the productivity impact of innovation and R&D. They find that the probability of engaging in R&D activity and the R&D effort (measured as R&D capital intensity) increases with a firm's size, its market shares and diversification. Nonetheless, firm productivity is correlated positively with higher innovation activity.

More recently, Genakos et al. (2018) focus on the telecommunication sectors and estimate the effects of competition on investment. They found that concentration has raised investment especially in more recent years, which may reflect the strong investment needs with the rollout of the 4GLTE networks.

This view can also be related to the literature on endogenous growth. In Aghion and Howitt (1992), an increase in product market competition between intermediate producers reduces expected future profits from innovations and therefore the rate of technical change ("rent dissipation effect"). In addition, more intense competition will lower the expected durability of innovations ("creative destruction") and hence the incentive to innovate. Aghion et al. (2001), however, argue that an extension of the basic framework could allow for a positive relationship between market competition and growth. They consider an oligopolistic intermediate sector where innovation enables a firm to break away from intense competition for a certain period. The closer a firm is to the technological frontier, the stronger is the incentive to innovate in order to escape competition. In such a framework, an increase in competition involves an innovation trade-off: it reduces monopoly rents, but enhances the incentive to innovate in order to escape competition.

On the other hand, empirical studies have resulted in a positive linear relationship between innovation and competition. Some economists claim that the cost-reducing improvements in productivity obtained via R&D may generate larger increases in profits even in the presence of a competitive environment competition, as opposed to Schumpeter's view. Studies of Arrow (1962), Scherer (1980) and Porter (1990) show that competition stimulates incumbents to innovate otherwise the firm is forced to leave the market and the potential entrant will win the race. Nickell (1996) finds positive correlations between competition and innovative investments, thereby sharing Arrow's view.

Geroski (1990) shows that highly concentrated industries or those in the process of becoming more concentrated are less innovative than more competitive environments. Blundell et al. (1999) use a panel of 340 UK firms over the period 1972 to 1982 and find that less competitive industries have fewer aggregate innovations. Interestingly, the high market share firms are those who tend to innovate more, but also those who commercialize more innovations, although this generates more competition in the industry. The reason for this lies in the fact that firms with high market shares who innovate get a higher valuation on the stock market than those who do not. Carlin et al. (2004) find a positive relationship between competition and innovation (or productivity). In particular, the presence of some market power together with competitive pressure from foreign suppliers, strongly enhances performance. The presence of competitors has both a
direct effect on the performance, and an indirect effect, by improving the efficiency with which the rents from market power in product markets are utilised to undertake innovation.

Other empirical studies show that competition might have a non-linear effect on innovation. Strong competition may decrease the probability to extract sufficient rents from investments in innovation. In such cases, competitors are either close behind, catching up or imitating innovation. Consequently, excessive competition may postpone or foreclose innovation. Conversely, if a market consists of a monopoly, there would be lower competitive pressure and therefore lower incentive to innovate.

Some economists are in favour of an inverted-U-shape relationship between competition and innovation. Scherer (1967) develops this research by allowing for additional non-linealities, and in a cross-sectional analysis of Fortune 500 firms discovers a significant inverted-U shape, with higher competition initially increasing and then decreasing the rate of innovation. Aghion et al. (2005 and 2009) also comes up with an inverted-U-shape relation between competition and innovation: both a positive and negative effect of competition on innovation may arise depending on the initial level of competition. The reason is due to two divergent effects on the incentive to innovate. On the one hand, lower cost directly reduces the cost of adding a new product and encourages firms to innovate in order to outperform the opponents. On the other hand, as the number of firms expand they become more likely to compete neck-and-neck through lower prices, which reduces both their profits and the incentive to innovate. Consequently, when the initial level of competition is low, the latter effect supporting innovation dominates. When the initial level of competition is high, the negative sign prevails.

Several subsequent empirical works have tested this non-linear relationship between competition and innovation, also finding mixed evidence. Some scholars show that this relationship holds (such as Scherer 1967, Lee, 2009, and Polder and Veldhuizen, 2012) and others that it does not (such as Poldahl and Tingvall, 2006, and Santos, 2010).

In particular, Polder and Veldhuizen, (2012) investigate the relationship between competition and innovation in the Netherlands at the sectoral level between 1999 and 2006 and find that there exists a U-shaped relationship, whose slope sign change point depends on the spread of the technology within the considered industry. Grünwald (2009) uses a panel of 1800 Swedish firms to examine the link between competition and innovation. The study finds that higher levels of competition are associated with faster R&D, but only for firms that are not technological laggards.

Poldahl and Tingvall (2006) use Swedish firm level data for the manufacturing sector and find evidence for an inverted U shape when measuring competition by the Herfindahl index, while when using the price cost margin indicator, they find a negative relationship.

Lee (2009) shows that a firm’s R&D response to competitive market pressure depends primarily on its level of technological competence: firms with high levels of technological competence tend to exhibit a higher level of R&D efforts to intensify competitive market pressure, while firms with low levels of technological competence exhibit a lower level of R&D efforts.

Finally, Artés (2009) finds that the relation between R&D and market structure is weak after controlling (i) for how easy it is for the firms to appropriate the results of their R&D efforts or (ii) for technological opportunities and heterogeneity across Spanish industries. Monopoly power (mark-up or market share) is associated with a higher probability of firms becoming R&D doer. Using the concentration ratio, an inverted U-shape relationship emerges. However, after controlling for industry and market characteristics and for appropriability, the relation between R&D intensity and market structure disappears. Using the same dataset, Santos (2010) finds that competition (measured by the number of competitors or market shares), has negative effects on product innovation and no effects on process innovation.

The original results by Aghion et al. (2005) have been recently challenged by Correa (2012), who finds a structural break in the data sample used by Aghion et al. (2005). Taking this structural break into consideration, the inverted-U empirical relationship between innovation and competition found by Aghion et al. (2005) cannot be reproduced. Depending on what time period the data is taken from, different relationships are found to exist. Correa finds a positive innovation–competition relationship during the period of 1973–1982, and no relationship in the period of 1983–1994. Askenazy et al. (2013) show that the quadratic relationship between competition and R&D holds for large firms, while the standard linear relation is there for smaller firms.

Hashmi (2013) also re-examines the U-shaped relationship between competition and innovation as in Aghion et al. (2005) by using data from publicly traded manufacturing firms in US and UK. He finds that U.S. data
validates a negative and statistically significant linear relationship, while UK data confirms an inverted-U-shaped relationship between competition and innovation. He explains the different results by the theoretical assumption that UK manufacturing industries are technologically more neck-and-neck than their counterparts in the US.

5.3 Conclusions

The primary objective of competition authorities is to ensure competitive markets. It has been proven that competition yields greater efficiency, boosts productivity and fosters investment. This is the result of three channels. Competition leads firms to a more efficient use of resources, so firms are incentivised to provide their products at lower prices (allocative channel). Competition also impacts on market structure as the more inefficient firms will be forced to exit the market, while the more efficient firms will enter the market or will enhance their market share (efficiency channel). Additionally, more competition can lead to an increase in innovation either through the appropriability effect that encourages new or incumbent firms to innovate in order to catch post-innovation rents, or through the “escape competition” effect that induces incumbents to innovate in order to preserve their pre-innovation rents, when faced with the possibility that their rivals may innovate. Thus, competition incentivises firms to innovative (dynamic channel).

Among these three channels, innovation is well-recognized to be the main driver of productivity growth. In this chapter we provided a survey of studies that examine how competition policy interventions affect growth via innovation channels.

Analysing the impact of competition policy interventions on innovation is particularly relevant in this period of slow productivity growth in Europe. Competition policy may contribute to strengthen the incentives for firms to innovate. Because of its focus on static efficiency, competition authority has been criticized to not sufficiently consider the dynamic efficiency.

Theoretical literature shows that pro-competitive policies (with the effect of limiting firms’ market power and lowering firm-level price mark-ups) have the potential to increase firm-level productivity. However, the link between competition policy and innovation is still debated and inconclusive. From the literature, we know that there is a tension between static and dynamic efficiency: lower mark-ups may be associated with higher efficiency but only if the static efficiency gains more than offset the larger fixed costs of research and innovation. Recent studies show that the relationship between competition and productivity takes an inverted U-shape as a result of the interaction between the “escape competition” and the “discouragement” effects. When regulation is high, more competition through lower mark-ups promotes innovation, as firms are encouraged to innovate to escape competition. As competition becomes stronger and average profits decrease, although, the benefits of catching-up disappear. Beyond a certain threshold, the latter effect dominates the former so that further deregulation is associated with lower productivity.

Therefore, anti-competitive regulations can have different aggregate effects on productivity in different countries and industries depending on specific technologies and market factor structure, such as the average position of firms relative to global frontier production technologies and relative to the U-shape.

To better understand the role of competition authorities in fostering growth, more empirical and methodological investigations are still needed, that can further help policy makers in characterizing the “position” of sectors or firms under scrutiny and better inform their policy interventions. Data and methodological issues are still encountered in estimating the relationships between competition and innovation. Undoubtedly, increased data availability allowed solving many methodological problems since the seminal paper of Schumpeter (1942) and proxies used to gauge the competition and innovation have also been refined. Nonetheless, the empirical results are still lacking robustness at least for three reasons.

First, econometric studies deliver different results according to the different data and measures of innovations. In particular, some drawbacks should be considered regarding the different measures of innovation, as explained in OECD/Eurostat (2019) and Mohren and Hall (2013): innovation counts are not always comparable across industry sectors and firm-size groups as small firms tend not to patent their innovations; the propensity to innovate varies across industries and firms; quantitative data are more likely to produce meaningful and robust results than qualitative ones based on surveys.

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30 An example of ex-post evaluation of competition policy intervention that takes into account the indirect link between market competition and productivity is Cai et al., 2020.
Secondly, panel datasets are more insightful than cross-sectional datasets, as the former would allow to correct for unobserved heterogeneity and to examine the dynamic aspects of the relationship (Mohnen and Hall, 2013).

Third, existing empirical studies on competition policy interventions and innovation have to deal with endogeneity and simultaneity. The degree of competition is influenced by the rate of competition policy interventions, and vice versa. Finding exogenous variation in the degree of competition in the field in order to identify a causal effect of competition on innovation is therefore difficult. Even if some attempts have been made, some doubts remain with respect to the identification of such an effect. Moreover, the relationship between competition policy and innovation is affected by several factors that are not directly observed in the data, such as firms’ rate of time preference, marginal costs or the technological gap between firms within an industry at any point in time. The lack of these data implies that field studies may not be fully capable to disentangle how such relationship is influenced by these factors.
6 Are restrictive policies harmful for cross-border investments and competitiveness? ⁴⁰

6.1 Context

Foreign direct investment (FDI) are able to foster productivity and competitiveness of the receiving countries, thanks to positive spillovers from multinationals to domestic firms. For instance, Smarzynska Javorcik (2004) highlights that there are positive productivity spillovers from FDI taking place through contacts between foreign affiliates and their local suppliers in upstream sectors. Economic theories consider FDI as an asset for host countries as foreign takeovers are likely to bring along superior technology, easing technology diffusion, and increase productivity by shifting production toward more sophisticated technologies or goods (Hale and Xu, 2016). The empirical literature on FDI actually points to a positive link between FDI and GDP growth (Iamsiraroj and Doucouliagos, 2015). This seems to be related to the degree of absorptive capacity of the host country. In particular, the largest impact of FDI on growth is observed for open economies with an educated workforce and developed financial markets (Bodman and Le, 2013). The effects on employment are less clear and span from a decrease in short terms due to the introduction of labour saving technologies (Hijzen et al., 2013) to an increase in the longer term. This is obtained by forcing a change in workforce composition towards more skilled workforce (Dinga and Mnich, 2010).

Considering inward FDI positions from non-EU investors into the EU28, as shown in Figure 6.1, the United States is the first investor with 2,400 billion Euro in 2017 (about 40% of all inward FDI), before Switzerland, Canada and Japan. China (including also Hong Kong) is the 5th investor in Europe, with 3.5% all of FDI positions. Offshores⁴¹ stand out as extremely important in channelling investments into Europe. Considering the important role of FDI in the EU, it seems important to study policies, such as restrictive measures, potentially able to affect FDI flows and, in turn, could influence industrial competitiveness and overall economic growth (Bermejo and Werner, 2018). In this chapter we discuss the relationship between restrictive measures and cross-border investment in the European Union.⁴²

**Figure 6.1.** Non-EU investments in Europe, Inward FDI positions in the EU28 (year 2017, by partner country).

![FDI Investments Chart](chart.png)

Source: JRC-ECFIN FinFlows data.

In Europe, as of December 2019, only 15 out of 28 Member States have FDI review mechanisms in place, differing widely in scope (e.g., review of intra- or extra-EU FDI, differing screening thresholds, breadth of sector coverage), process (e.g., pre-authorization vs. ex post screening of FDI), review timetables and enforcement. On 5 March 2019, the European Parliament and the Council of the European Union formally

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⁴⁰ Written by Wildmer Gregori and Michela Nardo.
⁴¹ Offshores include Bermuda, Bahamas, Cayman, Gibraltar, Guernsey, Jersey, and UK-Caribbean.
⁴² This chapter is based on the study done by Gregori and Nardo (2020).
adopted a new regulation on FDI screening. The regulation, fully operational from October 2020, introduces a coordination mechanism whereby the European Commission may issue non-binding opinions on FDI reviews performed in EU Member States when they affect security and public order.

Our goal is to address the following questions: to what extent the presence of a formal screening procedure, and more generally the existence of regulatory barriers, are indeed a deterrent to foreign investments? To address this question, we focus on M&A flows estimating an augmented gravity model to link cross-border investments between 2011 and 2018 in 23 European countries and FDI restrictions, as measured by the OECD FDI Regulatory restrictiveness index, as further detailed in the following subsection.

6.2 Empirical model and dataset

The empirical trade literature has extensively used the gravity model since the seminal paper of Tinbergen (1962) and the theoretical foundations provided by Anderson and Van Wincoop (2003). Gravity equations identify as basic determinants of bilateral transactions the size of trading partners and their distance. These explanatory variables well fit trade volumes explaining a large share of the variance in bilateral flows. More recently, the gravity equation approach has paved the way to analyse FDI determinants (see, among others, Di Giovanni; 2005, Bénassy-Quéré et al., 2007; Hijzen et al., 2008, Head and Ries, 2008; De Sousa and Lochard, 2011). We contribute to this literature by estimating an augmented gravity model, to capture the links between cross-border M&A flows and target country’s regulatory measures. Our key explanatory variable is the OECD restrictiveness index, and the baseline equation, estimated using the Poisson Pseudo Maximum Likelihood (PPML) estimator, is as follows:

\[ M\&A_{ijkt} = \exp[\beta_0 + \beta_1 \ln(RI_{ijkt-1}) + \beta_2 \ln(\text{Distance}_{ijt}) + \beta_3 \ln(GDP_{ijt-1}) + \beta_4 \ln(GDP_{jt-1}) + \gamma_{\text{Bilateral}_{ijt-1}} + \omega_{\text{Government}_{ijt-1}} + \nu_{EU} + \delta_t + \varphi_k + \epsilon_{ijkt}], \]

where \( M\&A_{ijkt} \) represents the flow of cross-border M&A (in thousands of Euros) from country \( i \) to country \( j \) in subsector \( k \) at time \( t \), with \( j=1,...,23 \) identifying the target EU Member States and \( i=1,...,92 \) the investor (origin) country. Therefore, the dependent variable shows for each sector for each country pair the amount of investment done in a specific year. Following Mistura and Roulet (2019), all explanatory variables are lagged by one year to reduce potential endogeneity issues. \( RI_{ijkt-1} \) is the OECD FDI restrictiveness index for target country \( j \) in sector \( k \) at time \( t-1 \). We include standard gravity variables, specifically the distance between each country in pair \( ij \), the GDP of both the origin country and the destination country, respectively \( i \) and \( j \). The model is enlarged and includes further control variables, grouped into two vectors, \textit{Bilateral}_\textit{ij} and \textit{Government}_\textit{i}. The former embodies time-invariant characteristics between country \( i \) and country \( j \), specifically: contiguity, common language, colonial links, common legal origin, time difference and the agreement of both countries to be part of a regional trade agreement. The vector \textit{Government}_\textit{i} instead features time-variant characteristics of the destination countries, specifically regulatory quality, trade openness and tax indicator. Additionally, we include a dummy equal to one when the investor is located in EU, denoted \( \nu_{EU} \). This is done to capture the effect of the common EU market and the widespread integration of production chains that could within EU countries. \( \delta_t \) denotes year fixed effects and captures global shocks. \( \varphi_k \)

\[ \text{See the EU Regulation 2019/452 (https://eur-lex.europa.eu/eli/reg/2019/452/), the EC Working document on FDI in the EU (https://trade.ec.europa.eu/doclib/docs/2019/march/tradoc_157724.pdf) and a related data source called "The Foreign Ownership dataset - FOWN" (Gregori et al., 2019).} \]

\[ \text{Greenfields account for a non-negligible share of total FDI (Canton and Solera, 2016). However, they are excluded from this study as they are not covered by national screening procedures in the majority of EU countries (https://trade.ec.europa.eu/doclib/docs/2019/june/tradoc_157946.pdf). The current EU regulation, instead, includes greenfields among the investment to screen on grounds of security and public order and the EU countries are currently adapting their national legislations. There is an additional reason to keep separate M&As from greenfields. The latter usually take several years to materialise (with the consequent dilution across time of the investment) and typically involve agreements with local authorities that often co-finance these type of projects (e.g. supplying some type of facilities such as transportation, lands, tax-rebates). This is rarely the case for M&As.} \]

\[ \text{The OECD FDI restrictive index (RI) enters in the equation in a logarithm form. To avoid that observations with an RI equal to zero drop out from the sample, we transform the RI as follows: } \text{RI}=1+\text{RI}^{\text{OECD}}. \]
is the sector fixed effects, to control for persistent differences among sectors. Finally, $e_{ij,t}$ is the zero-mean error. To account for potential heteroscedasticity, standard errors are clustered by country-pair.

The dataset used has a mixed origin. Cross-border M&A data are from Bureau van Dijk Zephyr database, a Moody’s analytics product. Zephyr is widely used in the literature (Reiter, 2013, Clo’ et al., 2017; Del Bo et al., 2017, among others) and provides information on M&A, portfolio investments and Joint Ventures deals worldwide starting from 1997 with a daily update. Information come from a wide range of sources, including financial journals, reports, company press releases, and company websites. We focus only on completed cross-border deals where the target company is in EU28, excluding rumoured or uncompleted deals to increase the quality of our dataset. For each deal, we include information on the origin of the investor and target (destination) country of the cross-border investment, year of the agreement, sector of the target company and deal value in nominal terms. The starting point of our analysis is linked to the availability of FDI regulatory restrictiveness index (RI), used as explanatory variables and published annually by the OECD since 2010. RI measures the statutory restrictions on foreign investors or investments for OECD countries. Four types of measures are identified and measured by the index: (1) limits on foreign equity, to account for limits on foreign participation, holdings and ownership; (2) restrictions on foreign personnel being employed in key positions, to account for measures such as time-bound or economic limits on the employment of foreign personnel as managers and requirements related to the nationality of board of directors’ members; (3) other restrictions, related to restrictions on the establishment of branches, acquisitions of land for business purposes, profit or capital repatriation, but also reciprocity clauses in specific sectors; and (4) existence of screening and prior approval, to account for screening mechanism applied only to foreign investors. The RI ranges from 0 to 1, and it is calculated as linear aggregation of four sub-indicators corresponding to the four typologies of restrictions considered. RI is also available at the sectoral and subsectoral levels.

### 6.3 The role of restrictive policies

Specification (1) in Table 6.1 has as explanatory variable the global RI, which includes all type of restrictions, and stepwise all control variables. Results show that restrictions have a sizable negative effect on the amount of cross-border M&A. Ceteris paribus, a drop of 1% in the restrictiveness index is likely to increase M&A flows by 1.60% on average. This confirms that regulatory barriers to foreign investment are indeed an obstacle and additional gains in terms of M&A flows could be obtained by decreasing or eliminating them. This result is stronger than the findings of Mistura and Roulet (2019). They actually obtain that 10% decrease in the index is likely to imply 3% increase in M&A in their model with 60 countries and over the period 2001-2016. Besides the difference in the time frame and sample size, our analysis is based on flow data which are, by nature, more volatile than stocks to variations of investment barriers.

The breakdown of the global index into components to account for the different typology of restrictions provides further interesting insights. Equity restrictions and key foreign personnel have significantly negative effect on M&A flows. A 1% decrease of each sub-index generates a variation in cross-border investment of 1.39% and 10.63% respectively. The variable other restrictions (i.e. restrictions on the establishment of branches, acquisitions of land for business purposes, profit or capital repatriation and reciprocity clauses in specific sectors) is the sub-index with the highest effect in investment flows, both in terms of magnitude and statistical significance. A decrease by 1% is likely to imply a surge of 23.22% in cross border investments. Furthermore, we find that specific regulatory measures adopted have higher and differentiated impact on cross-border flows, depending on the regulatory measure implemented, as discussed further below.

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45 The baseline model does not include origin country fixed effects, due to convergence issues encountered while estimating the model (Silva & Tenreyro, 2011). Nevertheless, to mitigate potential omitted variable issues, we implement a series of robustness checks. For instance, we include a tax indicator for the origin country. As for the destination country’s indicator, the origin country’s tax indicator is constructed for each origin country and year as the difference between the origin country’s tax rate (source: KPMG database) and the average tax rate of all the origin countries in the dataset. Results (available upon request) suggest that the origin tax indicator does not affect M&A flows.

46 To compute the M&A flow's variation for specification (4) in Tab. 2, we solve the following equation: $\% \Delta \text{M&A} = \text{exp}(\Delta RI \times (-1.59)) - 1 \times 100$. In our case, $\Delta RI$ is equal to 0.01, which is the imputed % variation of the “RI – global”.

47 The analysis of the sub-indexes may present a trade-off, especially when they are correlated among each other. On the other hand, when all sub-indexes are included at the same time, it may be possible to clearly assign the influence to the individual sub-indexes (omitted variable bias vs multicollinearity). Considering that we are interested in assigning the influence for each sub-indexes, we follow the first approach.
Surprisingly, the sign of the screening approval is not negative as one may expect (Mistura and Roulet, 2019). The sign is positive in the baseline specification, but turns out to be not significant when further analyses are implemented. Altogether, our results suggest that the presence of a formal screening procedure does not negatively affect M&A flows. The difference between our findings and those of Mistura and Roulet (2019) could be due to the differences in scope and coverage of the screening, narrower in EU countries. Furthermore, as noticed by Mistura and Thomsen (2017), countries having formal screening processes in place tend, on average, to have more restrictions in other areas as well (hence the lack of significance of the screening variable). In fact, in some countries (e.g. France), the screening mechanism may include, as conditions for the authorization, restrictions in the percentage of equity holding. This suggests that the presence of a screening mechanism per se is not an obstacle to foreign investments. Besides, usually M&A are asset specific, thus less sensitive to the presence of screening processes (Nocke and Yeaple, 2007). Additionally, the OECD index excludes pure national security approvals, nor does it take into account the difference in applications across countries. Unfortunately data on deals subject to screening with the corresponding decisions are not available (usually they are confidential data). Therefore, the analysis on the link between screening processes and foreign investment that would require data on both authorised and blocked deals cannot be implemented.

Table 6.1. RIs’ effects and M&A, baseline estimation (PPML, period 2011-2018)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI - global</td>
<td>-1.59***</td>
<td></td>
<td></td>
<td></td>
<td>4.20**</td>
</tr>
<tr>
<td></td>
<td>(0.56)</td>
<td>(0.56)</td>
<td>(0.56)</td>
<td>(1.75)</td>
<td>(1.75)</td>
</tr>
<tr>
<td>RI - equity restrictions</td>
<td>-1.38**</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.54)</td>
<td>(0.54)</td>
<td>(0.54)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RI - key foreign personnel</td>
<td>-10.10**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.70)</td>
<td>(4.70)</td>
<td>(4.70)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RI - other restrictions</td>
<td>-20.88***</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(4.11)</td>
<td>(4.11)</td>
<td>(4.11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RI - screening approval</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.20**</td>
</tr>
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<td>(1.75)</td>
</tr>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Year fixed effects</td>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Sector fixed effects</td>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Pseudo-R²</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Notes: This table shows the baseline results from implementing the PPML model. The dependent variable is the value of bilateral M&A in thousand EUR. All explanatory variables are lagged by 1 year. Controls refer to Bilateral indicators, Government indicators and EU dummy. Robust standard errors are shown in parentheses. Robust standard errors clustered by country pair are shown in parenthesis. The symbols *, **, and *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

We use our dataset to dig into sector-specific responsiveness of cross-border investments to regulatory restrictions and divide the sample in the three according to the target destination of M&A: primary, secondary and tertiary sector. As expected, the primary sector is hardly reactive to restrictions. Manufacturing is instead negatively affected by equity restrictions and by other restrictions (i.e. restrictions on the establishment of branches, acquisitions of land for business purposes, profit or capital repatriation and reciprocity clauses in specific sectors), the latter being much more relevant in deterring FDI than the former. Restriction on repatriation of profits and establishment of branches also deter investments in the service sectors while the rest of restrictions play little role. In order to account for the specificities of the financial sector (highly regulated per se), in the tertiary sector we differentiate between deals with target in the financial sector and all the other deals (Table 6.2). Regulatory restrictiveness does not affect financial services while the effect on non-financial services is mainly driven by the variable other restrictions.

See the robustness checks implemented in the full paper: Gregori and Nardo (2020).
### Table 6.2. RIs’ effects and M&A, financial vs non-financial services (PPML, period 2011–2018)

<table>
<thead>
<tr>
<th></th>
<th>Financial services</th>
<th>Non-financial services</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI - equity restrictions</td>
<td>-</td>
<td>-0.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.22)</td>
</tr>
<tr>
<td>RI - key foreign personnel</td>
<td>20.81</td>
<td>-11.74**</td>
</tr>
<tr>
<td></td>
<td>(26.01)</td>
<td>(5.43)</td>
</tr>
<tr>
<td>RI - other restrictions</td>
<td>-11.03*</td>
<td>-18.75***</td>
</tr>
<tr>
<td></td>
<td>(6.11)</td>
<td>(7.14)</td>
</tr>
<tr>
<td>RI - screening approval</td>
<td>-</td>
<td>1.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.16)</td>
</tr>
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<td>Controls</td>
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<td>yes</td>
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<tr>
<td>Year fixed effects</td>
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<td>yes</td>
</tr>
<tr>
<td>Subsector fixed effects</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Observations</td>
<td>50,784</td>
<td>118,496</td>
</tr>
<tr>
<td>Pseudo-$R^2$</td>
<td>0.03</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: This table shows the baseline results from implementing the PPML model. The dependent variable is the value of bilateral M&A in thousand Euro. All explanatory variables are lagged by 1 year. Robust standard errors are shown in parentheses. Controls refer to bilateral indicators, Government indicators and EU dummy. Robust standard errors clustered by country pair are shown in parenthesis. The symbols *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

We also analyse the role of tax havens (TH). Inward investments from TH may be affected differently by restrictive measures compared to non-havens, possibly because the use of these jurisdictions may be linked to different incentives. In the recent years, the attention on the role low tax jurisdictions has been raised by a series of scandals (Offshore leaks, Luxleaks, Swisseaks and Panama Papers). For instance, Jansky and Palansky (2019) observe that foreign direct investment from tax havens may be linked to profit shifting activities (see, among others, Fatica and Gregori, 2020; Dowd et al., 2017). Next to that, tax and financial havens may be exploited to take advantage of a less stringent regulatory environment than in advanced economies, including when it comes to rules on transparency and banking secrecy (Balakina et al., 2017). As suggested by results reported in Table 6.3, on average TH are associated with a higher level of cross-border investments. In fact, the TH dummy is always positive and statistically significant in all columns. In relation to RI, “other restrictions” (i.e. restrictions on the establishment of branches, acquisitions of land for business purposes, profit or capital repatriation and reciprocity clauses in specific sectors) is negatively related with cross-border investment (specification 4), in particular when we consider tax havens, suggesting a higher responsiveness of investment from these locales to these restrictions. Differently from our baseline results (see Table 6.1, specification 5), Table 6.3, specification 5 shows that the presence of screening approval mechanisms is negatively related to investments from TH. This result reinforces the idea that TH may be exploited because there are peculiar incentives, such as profit shifting activities, and the presence of a higher level of transparency may discourage cross-border investments from TH in case of illegal activities.

#### 6.4 Final remarks

Restrictive policies play an important role in affecting cross-border M&A flows into the EU. Two research questions motivated our analysis. Is the presence of a screening mechanism indeed a deterrent to foreign investment? Are other types of restrictions to the market access and operation of foreign companies important for determining the amount of M&A flows? We show that, on average, regulatory restrictions have a negative effect on cross-border investments. Our results show that different restrictive measures affect cross-border investment unevenly. The presence of a formal screening procedure per se does not negatively affect cross-border investment. However, when we focus on cross-border investments from tax havens, screening mechanisms decrease M&A investments from these locales.

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50 To define a country as tax haven, we refer to the list of non-cooperative tax jurisdictions and high-risk third country adopted by the European Union (see https://www.europarl.europa.eu/cmsdata/147412/7%20-%20EPRS-Briefing-621872-Listing-tax-havens-by-the-EU-FINAL.PDF).
**Table 6.3.** RI’s effects and M&A, the role of tax havens (PPML, period 2011-2018)

<table>
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<tr>
<th>RI - global</th>
<th>(1)</th>
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<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$RI_{jt-1}$</td>
<td>-1.51***</td>
<td>(0.56)</td>
<td>-2.25</td>
<td>(2.99)</td>
<td>-1.34**</td>
</tr>
<tr>
<td>$RI_{jt-1}$</td>
<td>-10.80**</td>
<td>(4.87)</td>
<td>-1.23</td>
<td>(2.31)</td>
<td>12.36</td>
</tr>
<tr>
<td>$RI_{jt-1}$ * TH</td>
<td>-2.25</td>
<td>(2.99)</td>
<td>-1.23</td>
<td>(2.31)</td>
<td>12.36</td>
</tr>
<tr>
<td>$RI_{jt-1}$</td>
<td>-20.23***</td>
<td>(4.19)</td>
<td>-40.04*</td>
<td>(20.90)</td>
<td>-14.89***</td>
</tr>
<tr>
<td>$RI_{jt-1}$ * TH</td>
<td>4.43**</td>
<td>(1.74)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| TH | 1.97*** | (0.43) | 1.95*** | (0.42) | 1.93*** | (0.41) | 2.00*** | (0.42) | 1.95*** | (0.41) |

| Controls | yes | yes | yes | yes | yes |
| Year fixed effects | yes | yes | yes | yes | yes |
| Sector fixed effects | yes | yes | yes | yes | yes |
| Pseudo-R$^2$ | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |

**Notes:** This table shows the role of tax havens (TH) from implementing the PPML model. TH is a dummy variable equal 1 if a country is listed as tax haven, 0 otherwise. The dependent variable is the value of bilateral M&A in thousand Euro. All explanatory variables are lagged by 1 year. Robust standard errors clustered by country pair are shown in parenthesis. The symbols *, ** and *** indicate statistical significance at the 10 %, 5 % and 1 % levels, respectively.

The take-away messages for the policy agenda are therefore two. The first comes from the sector specific analysis: regulatory restrictions influence cross-border investments unevenly, depending on the target sector. Policies addressed to drive up inward M&A flows should tailor regulatory restrictions to the targeted sectors in order to avoid discouraging investments in other sectors. In particular, manufacturing and non-financial services results negatively affected by restrictive measures, such as restrictions on foreign personnel being employed in key positions, or restriction on the establishment of branches, land acquisition or profit and capital repatriations. Thus, a targeted policy may foster FDI flows and, in turn, could influence industrial competitiveness and overall economic growth.

The second take-away is more general. The existence of a formal screening procedure per se does not affect M&A flows on average. However, our findings apply to EU countries, characterised by a rather narrow screening scope, linked to (although not yet fully matching) security and public order. Screening processes on broader economic grounds, such as those based on national interest (e.g. Australia), may provide different results. Our findings also show that screening procedures are detrimental for investments coming from tax haven countries. This evidence reinforces the idea that the presence of a higher level of transparency and accountability may discourage profit shifting or even illegal activities.
7 Strengthening competitiveness by upgrading Global Value Chains – The role of services

In the last two decades, we have seen an increase in economic integration globally thanks to technological progress in communications, cheaper transport and logistics, and trade liberalisation (Los, Timmer, and De Vries, 2015). New indicators, such as the OECD/WTO Trade in Value Added (TIVA)52 show that this process went hand in hand with a rising use of services by manufacturing companies. This other phenomenon is called ‘servicification’53 and is evident also when observing international trade. The services’ share of value added incorporated in exports increased in most countries from 1995 to 2009 (Miroudot and Cadestin, 2017; OECD, WTO, and World Bank Group, 2014; Baldwin, Forslid, and Ito, 2015).

There is an extensive literature on the consequences of servicification for international competitiveness, economic performance and development (for example, Gandoy, Díaz-Mora, and González-Dáaz, 2018).54 In this chapter, we focus on the domestic services’ contribution to merchandise exports (which has been labelled Mode 5 exports55 to determine if it shows a trend towards concentration in support business functions, as would correspond with a functional upgrading. This type of upgrading56 enables the acquisition of sustainable competitive advantage, since it consists in moving away from activities where competition is about costs and concentrate on those where entry barriers enable benefits to be obtained for longer (Pietrobelli and Rabello, 2005). Functional upgrading means shifting towards the most sophisticated and skill-intensive business functions or creating the knowledge behind the product (as explained by Kummritz, Taglioni, and Winkler, 2017). These more sophisticated business functions are usually identified with support business services, which are those that do not directly generate revenues but enable the principal activity57 (Pérez et al., 2019; Timmer, Miroudot, and de Vries, 2018; de Vries et al., 2019).

We compare the EU as a whole with other world economies, and also observe the situation of the different EU Member States58. To obtain the value added embodied in Mode 5 exports we use Trade-SCAN 1.1, a tool developed by the Joint Research Centre of the European Commission for the decomposition of the factor content of exports. The model underlying this software is a Multiregional Input-Output (MRIO) model that uses data from the 2016 Release of WIOD (Timmer et al. 2016; Timmer et al. 2015).59 The methodology for the decomposition of gross exports implemented in Trade-SCAN follows that proposed by Arto, Dietzenbacher, and Rueda-Cantuche (2019).

Then we need to split the results by business function. To do this we establish a correspondence with business functions based on Sturgeon (2019). Table 7.5 details the correspondence between CPA codes, industry codes in Trade-SCAN and business functions.

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51 Written by José Manuel Rueda Cantuche, Maria Victoria Roman, and Antonio F. Amores.
52 This indicator was proposed by the OECD and the World Trade Organization (WTO). For a more detailed explanation of the TIVA project see Ahmad et al. (2017) and the website: https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm.
53 This phenomenon is also called ‘servicising’, ‘manu serviço economy’ or ‘servitisation’. For a literature review about this topic see Park, Nayyar, and Low (2013) or Bombińska (2019).
55 These services are not covered by any of the four modalities of trade contemplated in the General Agreement on Trade in Services (GATS). This produces the circumstance that a service that is exempt from paying duties when provided separately would have to pay when incorporated in a product that is exported.
56 This is one of the modalities of upgrading in the typology introduced by Humphrey and Schmitz (2002). Upgrading is conceived as a movement towards more value-intensive activities, towards the use of enhanced technology, knowledge and skills, and towards greater benefits (security, profits, capacities, value added) from the participation in GVCs (Gereffi, 2005; Gereffi and Fernandez-Stark, 2019; Kummritz, Taglioni, and Winkler, 2017). As Tian, Dietzenbacher, and Jong-A-Pin (2019) show in their literature review about industrial upgrading, this is a multidimensional phenomenon that needs to be measured with different indicators. For an extensive literature review on upgrading consult Park, Nayyar, and Low (2013). For a critical review of the upgrading literature and its core concepts see Gereffi (2019).
57 Timmer, Miroudot and de Vries (2018) understand the business functions as the tasks performed by one specific occupational type of workers, grouping them into four categories (i.e. fabrication, R&D, marketing and management) that differ in their demand of factor inputs and propensity to be relocated.
58 For the analysis at EU Member State level we consider the total exports of each country (both intra- and extra-EU exports). Note that this study is elaborated before the Brexit and, therefore, UK is included in the EU.
59 The WIOD database is available in here: http://www.wiod.org/database/wiots16.
We present results distinguishing the following business functions: (i) R&D, engineering and related technical services (R&D+); (ii) fabrication activities; (iii) transportation, logistics and storage (TLS); (iv) marketing and sales activities (MKT+). Then, following the OECD (2016), we group the rest of the industries, including management and administration, information technology and other services, in the category ‘horizontal’ (including those recommended for exclusion, to account for the total domestic effect), as these functions support the activity of the firm all the way from the conception to the delivery of products.

Most results are presented as shares of each business function over the total domestic value added in merchandise exports. But, following Timmer, Miroudot, and de Vries (2018), we also calculate specialisation indexes. Along with value added embodied in Mode 5 exports, we study the labour/capital share of Mode 5 exports, the nominal labour productivity and capital availability of Mode 5 jobs.

The main results are summarized below:

— In 2014, Mode 5 exports account for almost one third of value added associated with EU merchandise exports to the world. This means that the Mode 5 contribution is especially relevant in the EU, when compared with other advanced economies, such as the USA or Japan. This is in line with previous analysis (Cernat and Kutlina-Dimitrova 2014). China and India account for a notable increase in the role of Mode 5 exports, having reached the level of the USA and Japan (27%).

— In the EU, the 2008 crisis affected Mode 5 exports. However, the recovery of horizontal activities and TLS+ activities was quick (see Figure 7.8). In 2014, both business functions reached values 20% above 2008 levels. MKT+ just recovered in 2014 the pre-crisis levels. In the case of R&D+, the recovery was still incomplete in 2014, with its value added embodied in merchandise exports blocked below 2005 levels.

— Within Mode 5 services, those corresponding to horizontal and MKT+ activities stand out as the most relevant, not only in the EU, but also in most of the other countries (above 9% of domestic value added

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This is the closest antecedent of our study as far as we know. The authors estimate the Mode 5 content of merchandise exports, considering a very similar set of services and exporting industries (with the exception of construction, which we include in the manufacturing industry and not in the services industry). Nevertheless, they use a different database, something that might explain the differences found. The most relevant one concerns Switzerland’s Mode 5 share, which is 10 pp larger than in our results. Other outcomes are quite similar, notably, the figure of EU Mode 5 exports (around EUR 300 billion) and the EU Mode 5 share (34%) in 2009.
embodied in merchandise exports each, on average). The EU stands out amongst advanced countries because of its atypical low share of fabrication tasks as source of domestic value added embodied in merchandise exports (68% in contrast with the average of advanced countries: 77%).

Figure 7.8. Value added embodied in primary and manufactures exports, by business function (in million euro)

Notes: Horizontal: management and administration, information technology and other services; R&D+: R&D, engineering and related technical services; TLS: transportation, logistics and storage; MKT+: marketing and sales activities.
Source: Own elaboration.

The EU is also different from other advanced economies due to the trend towards the substitution of fabrication by support (mainly, horizontal) activities as sources of domestic value added in merchandise exports (1 pp from 2000 to 2014). This trend, which can be interpreted as a sign of upgrading, is not observed in other advanced countries (see Figure 7.9). The fabrication share increased, for example, in Taiwan (6 pp), Canada (2.8 pp) and USA (1 pp). Contrary, this trend is actually present, and more pronounced than for the EU, in emerging countries such as China (6 pp), India (4 pp), Turkey (3 pp) or Mexico (2 pp). In general, emerging countries have experienced upgrading (with an average decrease in the fabrication share of 1.5 pp) in contrast with advanced ones (where fabrication increased its share in 0.5 pp). This supports the convergence theory and coincides with previous results of Tian, Dietzenbacher and Jong-A-Pin (2019). Also observed in previous studies is the generalized absence of change in the share of R&D+ during the study period, both in advanced and emerging countries (OECD 2016).

According to our results, the EU is specialized in support business functions (see Table 7.6). The EU-15 region stands out in horizontal activities and the EU-13 in MKT+. In both groups of countries, support functions associated to Mode 5 exports have a higher nominal labour productivity than the average job (75 versus 72 thousand EUR in EU-15, and 31 versus 28 thousand EUR in EU-13).

In the EU, horizontal activities compared to other business functions stand out by their large labour share (67%), and MKT+ is characterised by a low labour share (53%) and a high nominal productivity (62 thousand EUR) and capital availability (29 thousand EUR). These characteristics are typical of advanced economies (see Figure 7.10).

Another characteristic of advanced countries (and of the EU-15 region) is that fabrication activities associated to merchandise exports tend to have amongst the largest values for nominal labour productivity and capital availability (135 and 87 thousand EUR, respectively in average for advanced countries). The contrary happens in emerging economies (and in the EU-13 region, like shown in Figure 7.11). This might be related to the different type of tasks undertaken under the label of fabrication stages in different countries. Wang et al. (2017) show that the same manufacturing industry occupies a very different position within global value chains depending on the country where it is located. In the electronics industry, for example, fabrication tasks undertaken in Taiwan are further upstream in the value chain than fabrication tasks taking place in the USA.

Advanced economies include, together with the EU28, Australia, Canada, Switzerland, Japan, South Korea, Norway, Taiwan and USA.
Summarizing, we have seen that, as countries develop, domestic services embodied in merchandise exports tend to increase their contribution to the value added generated domestically by those exports. These Mode 5 exports are significantly relevant for the EU, where their contribution continues to grow despite being already high. In the studied period, their contribution has increased at the expense of fabrication activities, something that can signal functional upgrading (and that is more common in emerging countries). This results in the EU being specialized in supporting business functions, which are characterized by a high nominal productivity compared with the average job in the EU. This suggests that the EU is trying to compete by specializing in skill and knowledge-intensive tasks (services in nature) in Global Value Chains. However, we have observed that generally the productivity of fabrication is very high in advanced countries (including the EU), and very low in emerging economies. This suggests that we are covering very different types of tasks under the same term ‘fabrication’. This is a limitation of the present analysis that might be overcome in future exercises by incorporating data on occupations.

**Figure 7.9.** Change in the share of value added embodied in primary and manufacturing exports, by country and business function (2000 – 2014, in percentage points)

<table>
<thead>
<tr>
<th>Country</th>
<th>-15</th>
<th>-10</th>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>Advanced</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Emerging</td>
<td></td>
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<tr>
<td>Total</td>
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<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

Notes: Advanced includes most advanced economies: the European Union (28 Member States), Australia, Canada, Switzerland, Japan, South Korea, Norway, Taiwan and the United States; Emerging includes the rest of countries; Horizontal: management and administration, information technology and other services; R&D+: R&D, engineering and related technical services; TLS: transportation, logistics and storage; MKT+: marketing and sales activities.

Source: Own elaboration.
**Table 7.6. Specialisation indexes by country and business function (2014)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Horizontal</th>
<th>R&amp;D+</th>
<th>Fabrication</th>
<th>TLS</th>
<th>MKT+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1.57</td>
<td>0.11</td>
<td>0.98</td>
<td>1.07</td>
<td>0.66</td>
</tr>
<tr>
<td>Brazil</td>
<td>1.05</td>
<td>0.99</td>
<td>0.95</td>
<td>1.39</td>
<td>1.19</td>
</tr>
<tr>
<td>Canada</td>
<td>0.97</td>
<td>1.31</td>
<td>1.03</td>
<td>0.86</td>
<td>0.80</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.98</td>
<td>0.39</td>
<td>1.04</td>
<td>0.67</td>
<td>0.90</td>
</tr>
<tr>
<td>China</td>
<td>1.06</td>
<td>0.91</td>
<td>0.97</td>
<td>1.13</td>
<td>1.13</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.50</td>
<td>0.20</td>
<td>1.11</td>
<td>0.52</td>
<td>0.95</td>
</tr>
<tr>
<td>India</td>
<td>0.97</td>
<td>0.33</td>
<td>0.93</td>
<td>1.37</td>
<td>1.62</td>
</tr>
<tr>
<td>Japan</td>
<td>0.93</td>
<td>3.01</td>
<td>0.96</td>
<td>1.02</td>
<td>1.07</td>
</tr>
<tr>
<td>Korea</td>
<td>0.84</td>
<td>1.49</td>
<td>1.03</td>
<td>0.97</td>
<td>0.89</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.90</td>
<td>0.62</td>
<td>1.03</td>
<td>0.54</td>
<td>1.08</td>
</tr>
<tr>
<td>Norway</td>
<td>0.59</td>
<td>0.36</td>
<td>1.14</td>
<td>0.51</td>
<td>0.63</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>0.62</td>
<td>0.64</td>
<td>1.10</td>
<td>0.81</td>
<td>0.76</td>
</tr>
<tr>
<td>Russia</td>
<td>0.84</td>
<td>0.00</td>
<td>1.02</td>
<td>0.97</td>
<td>1.23</td>
</tr>
<tr>
<td>Turkey</td>
<td>0.59</td>
<td>1.91</td>
<td>0.90</td>
<td>2.69</td>
<td>1.51</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.46</td>
<td>0.17</td>
<td>1.15</td>
<td>0.25</td>
<td>0.79</td>
</tr>
<tr>
<td>United States</td>
<td>1.41</td>
<td>1.04</td>
<td>0.97</td>
<td>0.72</td>
<td>0.90</td>
</tr>
<tr>
<td>EU-28</td>
<td>1.40</td>
<td>1.34</td>
<td>0.90</td>
<td>1.29</td>
<td>1.17</td>
</tr>
<tr>
<td>Advanced</td>
<td>1.02</td>
<td>1.03</td>
<td>1.02</td>
<td>0.82</td>
<td>0.87</td>
</tr>
<tr>
<td>Emerging</td>
<td>0.82</td>
<td>0.70</td>
<td>1.00</td>
<td>1.18</td>
<td>1.19</td>
</tr>
</tbody>
</table>

Notes: EU-28: European Union (28 Member States); Advanced includes most advanced economies (i.e. EU28, AUS, CAN, CHE, JPN, KOR, NOR, TWN and USA); Emerging includes the rest of countries; Horizontal: management and administration, information technology and other services; R&D+: R&D, engineering and related technical services; TLS: transportation, logistics and storage; MKT+: marketing and sales activities.

Source: Own elaboration.
Figure 7.10. Nominal labour productivity in primary and manufacturing exports, by country and business function, by country (2014, in thousand euro per job)

Notes: Advanced includes most advanced economies: the European Union (28 Member States), Australia, Canada, Switzerland, Japan, South Korea, Norway, Taiwan and the United States; Emerging includes the rest of countries; Horizontal: management and administration, information technology and other services; R&D+: R&D, engineering and related technical services; TLS: transportation, logistics and storage; MKT+: marketing and sales activities.

Source: Own elaboration.
Figure 7.11. Nominal labour productivity in primary and manufacturing exports, by country and business function, by EU Member State (2014, in thousand euro per job)

Notes: EU-15 is formed by the following countries: Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Sweden. The remaining countries are grouped under EU-13. Horizontal: management and administration, IT and other services; R&D+: R&D, engineering and related technical services; TLS: transportation, logistics and storage; MKT+: marketing and sales activities.

Source: Own elaboration.
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