Productivity and Business Dynamics through the lens of COVID-19: the shock, risks and opportunities

By Chiara Criscuolo[1]

Abstract

Relying, wherever possible, on timely data, the paper provides evidence on four channels through which the COVID-19 crisis has affected productivity and business dynamics across euro area countries: (i) cross-sectoral reallocation, (ii) creative destruction and within sector reallocation, (iii) adoption of digital technologies and (iv) teleworking. The results highlight that sectoral reallocation is sizeable and towards high-productivity sectors. The process of creative destruction and of within-sector job reallocation have slowed down but have not been distortive. Entry has recovered more quickly than in the Global Financial Crisis. Firms have also accelerated the ongoing digital transformation process and have adopted remote working. However, not all firms went “digital and remote” to the same extent. Firms that were already more digital before the crisis adopted more and more advanced technologies with implications for productivity dispersion and business dynamics in the aftermath of the crisis.

1 Introduction

The COVID-19 crisis has led to what can be considered the most dramatic global recession since World War II. It created an economic shock that has impacted both demand and supply, and curtailed large areas of activity intermittently over months, as measures on the part of both governments and individual actors were implemented to limit the spread of the virus. The pandemic has also caused a significant increase in uncertainty for an extended period of time, with important consequences for corporate investment and durable goods consumption. With new

[1] OECD. This document, as well as any data and any map included herein, are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area. The opinions expressed and arguments employed herein are those of the author and do not necessarily reflect the official views of the OECD or of the governments of its member countries. For their invaluable inputs, I am indebted to colleagues and co-authors from the OECD Productivity, Innovation and Entrepreneurship Division: Sara Calligaris, Flavio Calvino, Márcio Carvalho, Antoine Dechezlepretre, Isabelle Desnoyers-James, Milenko Fadic, Andrea Greppi, Peter Horvát, Francesco Manaresi, Gianpiero Mattera, and Rudy Verlhac and from the Global Forum on Productivity and the Economics Department: Dan Andrews, Filippo Cavassini, Peter N. Gal, Francesco Losma, and Natja Mosiashvili. I am grateful to John Van Reenen, Fergal Shortall and anonymous referee for useful comments and suggestions. Responsibility for any errors in the article remains my own. E-mail: Chiara.criscuolo@oecd.org.

variants of the virus still causing new infections in many countries, the end is still not in sight in many parts of the globe, keeping the fate of the recovery path highly uncertain.

The pandemic has affected virtually every firm, in every sector and country in the world. The impacts have been both direct, from the pandemic itself, and indirect, from factors such as the repercussions of economic recession; decrease in travel; changes in consumption behaviour and production modes; impaired movement of individuals; and disruptions to Global Value Chains (GVCs). Some sectors have been more affected than others depending on their ability of working and selling remotely and on how social distancing measures affected their operations. They either were left almost unaffected, had an opportunity to grow, if considered "essential" or if they were providing new services, or halted almost completely, if they relied on face-to-face interactions and the physical presence of customers and a public.

The aim of this paper is to provide new cross-country evidence on euro area (EA) countries to inform policy in the aftermath of the COVID-19 crisis. The focus will be on the channels through which the COVID-19 crisis has affected productivity and business dynamics in the short- and potentially in the long term, zooming in on four main mechanisms: cross-sectoral reallocation, the process of creative destruction and within sector reallocation, the adoption of digital technologies and remote modes of working.

We complement the new cross-country evidence with results from the extant literature to provide additional insights on specific issues. Indeed, one of the biggest challenges faced when preparing the paper has been the availability of timely granular data that covered the ongoing COVID-19 crisis, with a clear trade-off between completeness of the data, cross-country comparability and timeliness of the information. Often, choices had to be made, and the evidence presented in the paper is the result of these compromises.

For many of the changes described in the paper, it is too early to say whether they will outlast the crisis or not. We're still probably in the cyclical phase of this crisis characterised by high degree of uncertainty, (e.g. on the role of new variants and the efficacy of vaccines against them) and it's not yet clear what the longer-term effects will be. Some changes might be temporary, because of ongoing restrictions or depressed demand, and we don't yet have a sense of whether the landscape has changed permanently or not, as some of the restrictions are still in place.

Cross-sectoral reallocation for example may be, to a certain extent, the result of low-productivity sectors being effectively "closed", with the relevant labour at home rather than working in other sectors. The resulting increase in measured productivity during the pandemic could be just a temporary batting-average effect and some of the effects of the cross-sectoral reallocation in the medium-to-long run might be contained if the re-opening is managed properly in short-term.

On the other hand, some of the reallocation might be more permanent. For example, the growth of online retail vs brick and mortar shops seems to have come with a

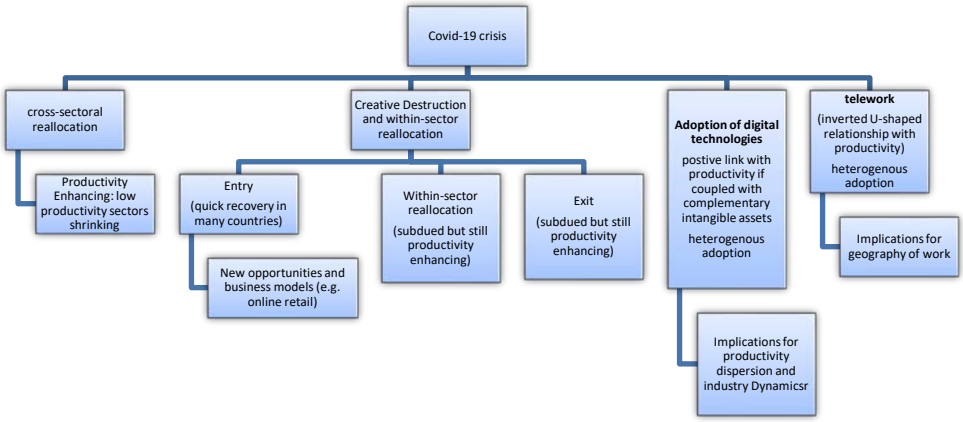
growth in entry of new businesses and some changes in household consumption. The horizon of other shifts might also be heterogeneous. It seems likely that increased teleworking, may be a permanent change, with knock-on effects on the location of economic activity in some industries, while there may be no permanent changes in household behaviour in term of travel or consumption as a result of the pandemic itself, once the restrictions are fully lifted.

To what extent any of these changes will continue beyond the cycle and will affect productivity in the medium to long run is an open question. This blurry boundary between what is cyclical and what is structural makes it tricky to have a sense of long term prospect with some certainty and additional scarring effects, such as those on human capital due to schools closures for extended periods during the pandemic will also weigh in.

The paper will try to draw longer-term policy conclusions on the basis of what we have seen so far and where available, of expectations of managers and workers from survey evidence. Figure 1 provides an overview of the different ways in which the COVID-19 pandemic may have affected productivity and business dynamics that are considered in this paper.

Figure 1

How the COVID-19 pandemic affects productivity and business dynamics



Across nearly all sectors, the crisis brought a large drop in revenues throughout 2020 for many firms who still had to respect payment commitments to suppliers and workers. This caused a liquidity shortfall which may have resulted in a liquidity crisis and the potential default of businesses, including those that were profitable before the onset of the crisis, and consequent job losses had it not been for the sizeable fiscal intervention by governments through different support measures. These measures include for instance direct financing of wage bills via job retention (e.g. short-term work and wage subsidy) schemes, support to laid-off workers (e.g. extension of the coverage and increase in the replacement rate of unemployment

benefits), tax deferrals, debt moratoria and extensions.[2] In some euro area countries (e.g. Finland, France, Greece, Italy, Lithuania, Slovak Republic and Spain),[3] these measures were also accompanied by changes in dismissal regulations, such as layoff bans. A major part of support policies ensured that companies maintained access to credit, via loans provided or guaranteed by the government[4] and/or through the relaxation of macroprudential buffers.[5] This significant effort in preventing a drop in credit supply to firms has likely contributed to support productivity, as there is significant evidence that negative credit shocks reduce firm investments in productivity-enhancing activities (Manaresi and Pierri 2019, Duval, Hong, and Timmer 2020, Lenzu, Rivers, and Tielens 2020). The support measures went hand-in-hand with large-scale monetary policy measures by central banks, which have also facilitated the expansive use of fiscal policy during the crisis.

The evidence presented suggests that labour productivity in the EA business sector increased in the first few months following the tight social distancing measures implemented in many EA countries to limit the spread of the virus. This increase reflects a short-term response to the crisis whereby hours worked dropped much faster than output. Indeed, thanks to the large support measures put in place to ensure the protection of job relationships and business survival, the drop in output was not accompanied by a similarly sized drop in employment. However, hours worked dropped and even more than output, with a consequent increase in labour productivity measured as output per hour worked. During the second half of 2020, hours worked recovered in line with output to result in a small drop in labour productivity.

During 2020, average sectoral labour productivity, measured as real value added per hour worked, saw in fact a 1.5% increase, while aggregate output in real terms declined by 6.3% across the EA. The aggregate figure is the result of heterogeneous productivity performance and reallocation across sectors. Low-productivity services that require face-to-face contact with customers, such as hotels, restaurants and entertainment, were the most affected, and experienced drops in terms of value added and hours worked, especially during the first half of the year, because of the social distancing regulations. Most other sectors often being affected indirectly, e.g. through a drop in demand in downstream sectors and by consumers or through disruptions in the value chain (e.g. food; aeronautics; etc.) saw a smaller decrease in both output and hours worked. Information and Communication even saw an increase in value added. The relative shrinking of the lower productivity sectors in terms of labour input and their subsequent decreased weight in the economy,

---

2 For example, Demmou et al. (2021) suggest that, without any policy intervention, up to 38% of firms would face liquidity shortfalls after 10 months since the implementation of confinement measures.

3 See https://www.oecd.org/social/Covid-19-Employment-and-Social-Policy-Responses-by-Country.xlsx

4 Similar schemes have also been implemented at the supranational level, for example the European Investment Bank managed the Pan-European Guarantee Fund. See Falagiarda, Prapiestis and Rancoita (2020) for a more detailed analysis of uptake of these schemes across euro area countries.

5 See, for example, https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200312~45417d8643.en.html

contributed to higher aggregate labour productivity. At the same time the large drop in their value added contributed to the decline in real output.

However, it is still too early to be sure that this productivity-enhancing between-sectors reallocation effect is going to be long lasting, as it will depend on changes in consumer behaviour, government support and regulatory measures. The implications for growth in the recovery in turn will depend on the costs and frictions characterising the reallocation of resources across sectors in different countries. The higher the frictions and costs, the more difficult the reallocation and slower the growth.

The reallocation observed during the crisis is the result of mobility of resources across existing businesses, and of creative destruction with firms entering and exiting the market. This process of creative destruction is a key driver of aggregate productivity growth, so understanding to what extent COVID has affected the magnitude and nature of this process is particularly important.

Cross-country evidence shows that contrary to the 2008 Global Financial Crisis (GFC), business entry in several EA countries has held up during the COVID-19 crisis and in some sectors, e.g. online retail[6], have seen a significant increase. Indeed, the COVID-19 crisis has provided new opportunities for start-ups and innovation. Venture capital has flown to investments in sectors related to remote working, automation, e-payments and health but also in areas related to the green transition. If start-ups can grow and develop in a level playing field, with the necessary financing sources and regulatory environment, current trends of declining business dynamism and rising concentration might also be halted. However, if successful start-ups cannot enter or grow because of regulatory barriers or lack of financial resources, or become targets of M&As by large players, then pre-COVID trends in concentration will likely continue in the recovery period, with consequences for productivity growth, inequality and innovation, as will be discussed in Section 5 of the paper.

Exit has declined during the COVID-19 crisis relative to 2019 suggesting a slowing down of the creative destruction process. If lower exit levels reflect productive firms remaining afloat and productive jobs matching being protected from the shock, then lower exit might be beneficial for aggregate productivity growth (Guerrieri et al., 2020). However, if lower levels of exit allow non-productive firms to remain in business a slowing down the cleansing process of reallocation, they will contribute negatively to aggregate productivity growth. Evidence from single country studies suggests that, although subdued, exit during the COVID-19 crisis has not been distortive, as less productive firms were more likely to exit during the crisis. Similarly, reallocation of resources amongst incumbents has been positively related to size and productivity.

These changes point to a potentially positive outlook for productivity growth after the crisis. The speed of the recovery will also depend on the extent to which policy will allow for a swift reallocation of resources across sectors and on whether the process

---

[6] See for example for the Netherlands (Fareed and Overvest, 2021) and for US (US Census, 2021).

of exit, which has been largely put to a halt by governments, gradually returns to levels that are more “normal”.

The COVID-19 crisis has also spurred significant changes within firms. Indeed, the crisis has shifted the modus operandi of firms and individuals, and potentially altered behaviour and preferences in the long run. In particular, through the required sudden and far-reaching changes “imposed” on businesses to continue operating, the COVID-19 crisis has been a catalyst for an unexpected acceleration in the adoption of digital technologies and of telework practices. This is likely to have long run consequences on firms’ productivity growth but also on productivity distribution and market power, and, through the latter, indirectly on economic growth, inequality and innovation.

On the one hand, the sudden and fast adoption of digital technologies, teleworking and e-selling might allow firm-level productivity to increase across the board. This, in turn, would improve aggregate productivity. Firms lagging behind, such as SMEs might experience rapid productivity improvements thanks to the increased adoption, and might be able to close the gap with firms at the frontier of the productivity distribution. In this scenario, aggregate productivity would increase and productivity dispersion would decrease thanks to the faster catch-up of “laggard” firms. Wage inequality, which is closely related to productivity dispersion, might also decrease.[7]

However, if the adoption of digital technologies is heterogeneous across firms, and if both, the adoption and the productivity returns to it, depend on firms having complementary intangible assets, such as good management, the COVID-19 crisis might lead to an exacerbation of ongoing trends of productivity divergence and (wage) inequality. Already before the crisis, SMEs, liquidity constrained and lagging firms were adopting less or more basic digital technologies than firms that were larger, liquidity unconstrained and more productive, which were adopting faster, more and more advanced digital technologies. If adoption of digital technologies during the COVID-19 crisis follow a similar pattern, existing productivity gaps might endure, and might be further magnified at the aggregate level, since the cross-sectoral changes, induced by the COVID-19 crisis, have tilted resources towards digital services where productivity divergence was already more pronounced.

Some early evidence, presented in Section 4, suggests indeed that, while the adoption of digital technologies and remote work has become widespread, they are asymmetric across firms. Larger, more productive and more digital intensive firms have been leading ahead. Thus, there might be a risk for an even larger digital divide in the post-pandemic era and policies that ensure a more inclusive digital

---

[7] Criscuolo et al. (2020) use new harmonised cross-country linked employer-employee dataset for 14 OECD countries to and find that, on average across countries, about half of the changes in overall wage inequality can be explained by changes in the dispersion of average wages between firms. Two thirds of these changes in between-firm wage inequality are accounted for by changes in productivity-related premia that firms pay their workers above common market wages. The remaining third can be attributed to changes in workforce composition, including the sorting of high-skilled workers into high-paying firms. These results are in line with previous cross-country evidence showing a strong correlation between productivity dispersion and wage inequality (Berlingieri, Blanchenay and Criscuolo, 2017) and with evidence from single country studies (for references, see Criscuolo et al., 2020).

transformation, from the provision to lagging firms of digital skills and complementary intangible assets to the wide availability of digital infrastructure will become very important.

Indeed, the risk that the pandemic accelerates trends not only of productivity dispersion but also of rising concentration and market power more generally, is topical. The evidence for now is scant, mainly due to the lack of available data but also because of methodological and measurement challenges. Evidence reported in the paper suggest that concentration may indeed increase especially in digital intensive sectors, given the larger number of sizeable M&A deals by the largest players in these sectors. Concentration might also increase if the wave of business exits and bankruptcies, that have been frozen during the crisis mainly thank to the massive support provided by government, finally materialise. Maintaining a level playing field for businesses during and after the pandemic, especially in sectors that have already high levels of concentration, should therefore remain a priority for governments.

These results have important implications for policy, which will be discussed in Section 7. The main message is that while some of the changes observed during the crisis have the potential to increase potential output, structural policies will play an important role for minimising adjustment costs of reallocation and thus minimising the risk for unemployment, inflationary pressures and rising inequalities. Support measures will have to be gradually lifted and adapted to the evolving economic conditions to avoid stifling the reallocation process. Policies that foster digital diffusion, such as skills and worker mobility will be particularly important, given the nature of the reallocation and the increased digitalisation of firms especially if combined with policies that improve digital infrastructure. Policies that foster creative destruction, ensuring smooth entry and exit, and support experimentation, as well as those that ensure a level playing field, such as competition policy and enforcement, will be important components of the toolkit that would ensure a resilient and inclusive recovery.

The paper is organised as follows. Section 2 provides an overview of the heterogeneous impact of the crisis on output, investment, employment and hours worked, as well as its heterogeneity across sectors and its implications for aggregate productivity, remaining however agnostic on whether these changes are cyclical or structural. Section 3 focuses on the process of creative destruction, providing new evidence on trends of entry, exit and bankruptcy during the COVID-19 crisis. This section also discusses productivity implications of the reallocation observed across and within-sectors during the crisis, focusing on the potential distortive role of government support given the generosity of many such measures.

Section 4 focuses on two significant changes observed during the pandemic within firms: the sudden and widespread adoption of digital technologies during the crisis and the use of remote working arrangements to overcome social distancing measures. Implications for organisations, productivity and its distribution and inequality across workers, firms and regions are likely to outlast the crisis. The section provides new evidence on telework adoption within countries and highlights

differences in adoption within sectors across firms of different size and in different locations, as well as the role of digital infrastructure.

Section 5 looks at market power before and during the COVID-19 crisis, by looking at markups and concentration trends over time and across sectors, as well as at the M&A dynamics during the COVID-19 pandemic. It links these trends to structural factors, such as the digital transformation and the rising importance of intangible assets in production.

Section 7 concludes by providing an overview of policy implications.

2 The heterogeneous impact of the crisis

2.1 The asymmetric response of employment and hours worked

The COVID-19 crisis was significant in its impact on demand and supply across countries. Sizeable was also the policy response of many developed economies. Estimations suggest that the announced support measures across euro zone countries amounted up to 4 to 11% of GDP (French National Productivity Board, 2021). A support measure widely used by governments has been job retention schemes that help maintain employment by firms and supported companies' cash flow and was accompanied in many countries by regulations banning layoffs. These measures allowed avoiding mass-layoffs and safeguarding job relationships. It also allowed steering clear of a liquidity crisis despite the sudden drop in sales. Moreover, the safeguard of job matches likely contributed to a swift recovery of activities.

Indeed, as shown in Figure 2, business sector[8] output declined substantially in the second quarter of 2020, as a response to the restrictions in place to contain the COVID-19 pandemic and to the drop in demand. Despite the gravity of the crisis, in euro area (EA) countries, total employment, expressed as persons employed, saw an average contraction compared to the second quarter of 2019 that is a fifth of the output drop (3.8% relative to 17.9% contraction). This is likely thanks to government supported job retention schemes. Thus, GDP per person employed dropped significantly.

The adjustment took place on hours worked rather than employment. Hours per person employed saw a much larger drop, by more than 20% in the EA, reflecting temporary closures or curtailed operations by firms, as well as demand constraints and potential effects of increased uncertainty. This allowed productive job matches to be maintained and employment to recover smoothly in the last two quarters of 2020. This seems indeed very different from what happened in the 2008 GFC when hours

[8] Figure 1 considers non-agriculture business sector excluding real estate (ISIC Rev. 4 Divisions 05 to 66 and 69 to 82).

worked and employment as well as investment took a much long time to recover (See Figure 3).[9]

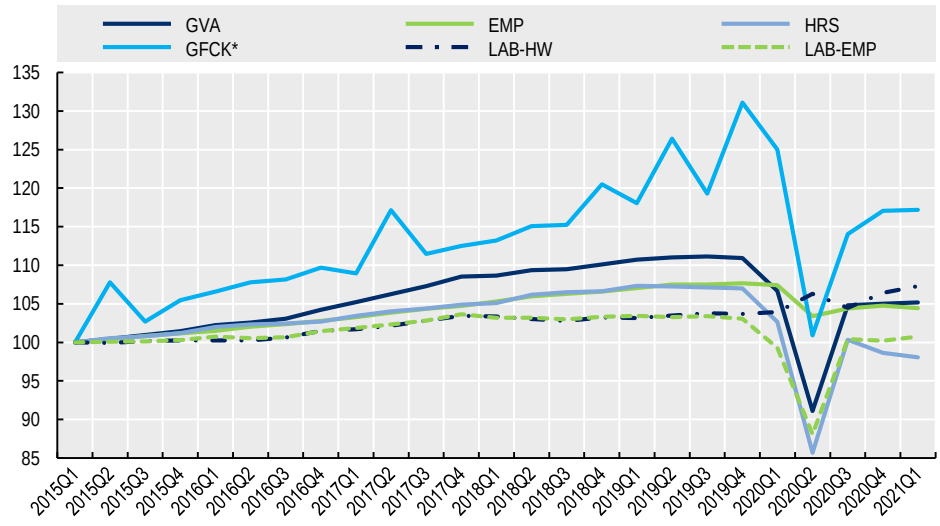
For most euro area countries, labour productivity, measured as value added per hours worked, increased between 2019 and 2020. Over the course of 2020, hours worked adjusted much faster than output resulting in an inverted V shape productivity trend in 2020.

Figure 2 also highlights that investment dropped significantly in 2020 and remained at lower level relative to the pre-crisis period. Low investments may have long term effects, e.g. on potential output. Thus, in the Appendix we distinguish between investment in tangible and intangible assets (Figure A 1 and Figure A 2). As it had been the case in the Global Financial Crisis, investment in intangible assets show stronger resilience to the shock.

Figure 2

Real Gross value added, number of employees hours worked, Gross fixed formation and labour productivity in Non-agriculture business sector excluding real estate

2015-21, euro area



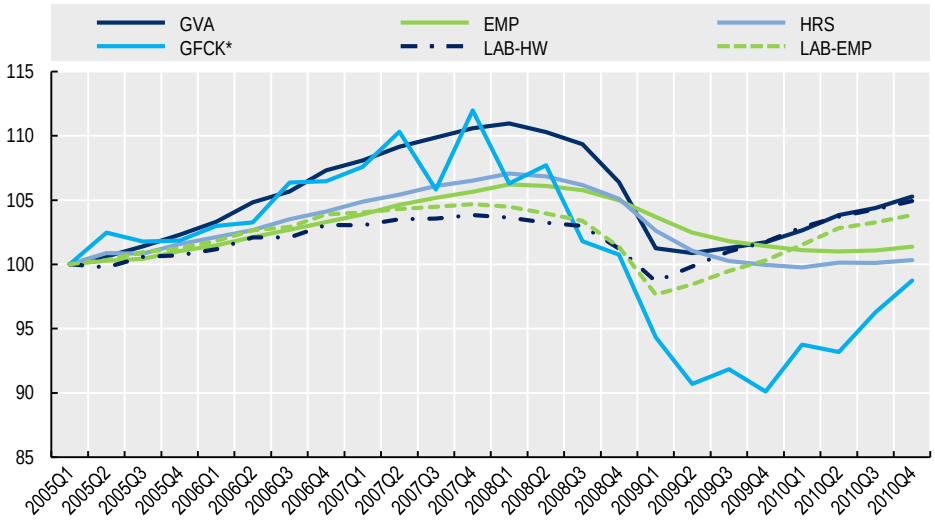
Source: Calculations based on Eurostat's National Accounts database.
Note1: Non-agriculture business sector excluding real estate (ISIC Rev. 4 divisions 05 to 66 and 69 to 82) corresponds to the total economy excluding agriculture, real estate, public and other services.
Note2: GVA in the chart corresponds to real value added, EMP to total employment in persons, HRS to hours worked, LAB-HW labour productivity with hours worked in denominator, LAB-EMP- labour productivity with employment in denominator and GFCK* gross fixed capital formation for all industries, as this is variable is not available by industry in quarterly estimates.

[9] Trends for the UK and the US in both the current COVID-19 crisis and the 2008 Great Financial Crisis are shown in Figure A 3 and Figure A 4 in the Appendix, respectively.

Figure 3

Real Gross value added, number of employees hours worked, Gross fixed formation and labour productivity in Non-agriculture business sector excluding real estate

2005-10, euro area



Source: Calculations based on Eurostat's National Accounts database.
Note1: Non-agriculture business sector excluding real estate (ISIC Rev. 4 divisions 05 to 66 and 69 to 82) corresponds to the total economy excluding agriculture, real estate, public and other services.
Note2: GVA in the chart corresponds to real value added, EMP to total employment in persons, HRS to hours worked, LAB-HW labour productivity with hours worked in denominator, LAB-EMP- labour productivity with employment in denominator and GFCK* gross fixed capital formation for all industries, as this is variable is not available by industry in quarterly estimates.

2.2 Heterogeneous impact of the crisis across sectors

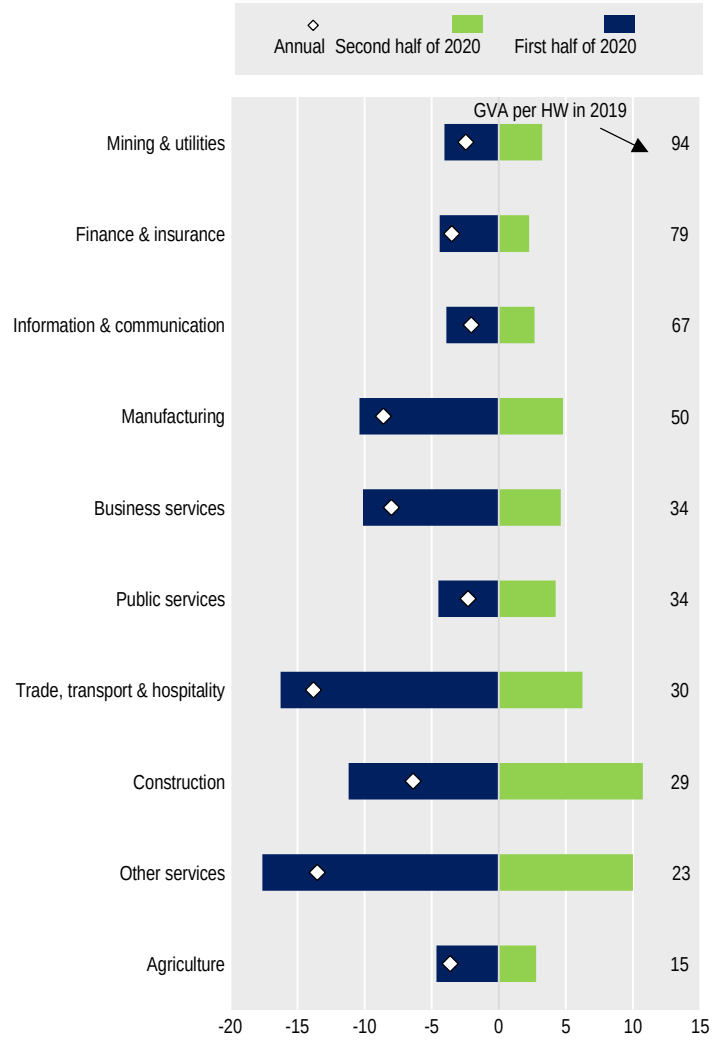
While the effects of the pandemic have been felt globally, they have been far from uniform across sectors. Indeed, the pandemic and the stringent measures, taken by governments and private actors, limiting mobility and interactions have affected some sectors more than others. In particular air travel, tourism, brick and mortar retail, and entertainment, have seen their revenues plunge. Indeed, when looking at EU countries, the majority of job losses are attributed to the sectors belonging to wholesale, retail, transport, hotels and restaurants. Of these, retail (e.g. of food) and transport services, considered as "essential services", were probably less affected than hotels and restaurants, whose operations were hit hardest by the restrictions introduced to limit the virus's spread. Most of these sectors involve significant social contact in consumption (e.g. travel, hospitality, arts and entertainment, personal services, and airlines) or strongly depend on these sectors (e.g. transport)

Other industries, such as telecommunication services, online retail, and essential industries were less negatively affected by the recession. These are also the industries with relatively higher productivity as shown in Figure 4.

Figure 4

Low productivity sectors cut hours relatively more, 2019-20, euro area

Change in hours worked relative to previous half year by major sectors of economic activity



Source: Calculations based on Eurostat's National Accounts database.
Note: euro area corresponds to weighted average of 19 EA member countries. Variables in 2015 prices.

The inter-industry reallocation process observed during the COVID-19 pandemic with low productivity sectors disproportionally affected and high productivity sectors, such as Information and communication services, showing stronger resilience, contributes positively to productivity growth. Relatively less productive sectors also observed significantly higher drop in Value added, as shown in Figure A 6.

The first half of 2020 saw an increase in labour productivity across most industries, with the exception of Manufacturing; Entertainment; Mining and utilities; likely reflecting the stronger adjustment in hours worked relative to the drop in output, in response of the tight lockdown measures during the first wave of the epidemic. During the second half of 2020, most sectors saw a decrease in productivity, with the exception of manufacturing and mining and utilities. The only sector that shows a major decrease in productivity throughout 2020 is the arts and entertainment, which sees a cumulative drop in labour productivity of 3%, more than 15 folds of the other sectors. By the end of the year, the increase in aggregate productivity is also the result of reallocation from low-productivity sectors to high-productivity.[10]

When comparing which sectors have been most affected by the COVID-19 crisis with those mostly hit during the 2008 GFC strong differences are evident: for example, the sectors that saw the largest drop in 2008-2009 were manufacturing and construction. These two sectors were not strongly affected by the COVID-19 pandemic, with construction growing in the first half of 2020 and manufacturing rebounding quickly in the second half of the year achieving a positive annual growth in 2020.

Bloom et al. (2020a) estimate inter–industry reallocation to have contributed 8.5% to labour productivity growth in the UK in the second quarter of 2020, with the effect declining over the course of 2020 to account for less than 1% of labour productivity in the first quarter of 2021. This suggests that the importance of inter-sectoral reallocation for aggregate productivity growth will have less weight in the medium and long run. In addition, as noted by Bloom et al. (2020c), if the cross-sectoral reallocation results from the shrinking of low productivity sectors without the corresponding growth in high productivity sectors, the crisis may result in lower economic output with negative implications for aggregate growth and welfare.

The next section will provide more details on the Schumpeterian process of creative destruction. Because of data limitations, we will look at the extensive margins of entry and exit using timely data and refer to existing evidence from single countries that investigates whether the process of creative destruction observed during the crisis is productivity enhancing or whether exit indiscriminately hit productive and non-productive firms.

---

[10] In sum, in the first semester of 2020, the stronger drop in hours worked relative to value added has shaped the aggregate trends in labour productivity. This effect was, however, short lived and bounced back in almost all sectors by the end of the 2020 resulting in mitigated changes in labour productivity relative to 2019 at the sectoral level (Figure A 7).

3 Process of creative destruction during the COVID-19 pandemic

As discussed in Section 2, reallocation is key for productivity growth. The process of Schumpeterian creative destruction through business entry and exit is central to reallocation and for ensuring growth and innovation (see for example Acemoglu et al., 2018).[11]

Whether the restructuring following a recession is productivity enhancing and can be considered a silver lining is still an open question, both from a theoretical and an empirical standpoint. While a crisis might result in a cleansing of low productivity firms and thus an increase in productivity growth (e.g., Caballero and Hammour, 1996; Osotimehin and Pappadà, 2017; Foster, Grim, and Haltiwanger, 2016) recessions can be sullying (Caballero and Hammour, 2005; Kehrig, 2015) depending on their nature and the potential increased role of distortions during downturns.

Indeed, Foster, Grim, and Haltiwanger (2016) find that reallocation following the GFC was not as cleansing as in previous recessions and Bartelsman, Lopez-Garcia and Presidente (2019), for nine European countries, find that the link between reallocation and productivity broke during the GFC and attribute this to the trade collapse observed during the GFC. Additional evidence finds that the lack of entry following the 2008 GFC amplified the effects of the financial crisis and caused a missing generation of firms (Messer, Siemer and Gourio, 2016) with negative implications for job creation, productivity growth and innovation.

The question therefore arises on the magnitude and productivity-enhancing nature of the reallocation linked to the COVID-19 crisis. Given data limitations, we are able to provide cross-country evidence on the extensive margins of reallocation, business entry and exit, and not on the intensive margin and cannot explore the cleansing nature of the crisis. Thus, we rely on single country level studies to provide evidence on this issue, e.g. in the euro area: France (Cros, Epaulard and Martin, 2021); Portugal (Kozeniauskas, Moreira and Santos, 2020); Italy (Lamorgese, et al., 2021) and the Netherlands (Fareed and Overvest, 2021). Evidence is also available for the UK (Bloom, et al., 2020a and Andrews, Charlton and Moore, 2021) and the US (Barrero et al., 2021; Wang et al., 2020; Bartik et al., 2020).

3.1 Entry, Exit and Bankruptcy during the crisis

The drop in demand, the increased uncertainty but also the strict social distancing measures and governments' support instruments have significantly affected both entry and exit during the COVID-19 pandemic with an ex-ante ambiguous effect on aggregate productivity.

---

[11] See Foster, Haltiwanger and Krizan (2006) for evidence on the US; Bartelsman, Haltiwanger and Scarpetta (2013) for cross-country evidence and Disney, Haskel and Heden (2003) for evidence on the UK.

Firm entry, including of high productivity and innovative start-ups, might have dropped because of the demand shock, the lack of liquidity and increased uncertainty especially in the sectors most affected by the crisis. However, entry might have increased as crises also generate new opportunities for new ventures and new business models. Moreover, even if entry has declined, because of selection at entry, firms that start during the crisis might be on average more productive.

The fate of firms' exits and bankruptcies during the crisis might be twofold. On the one hand, crises may increase the probability of exit at the bottom end of the productivity distribution, thus tightening the process of market selection and therefore result in improved aggregate productivity. On the other hand, the liquidity shock arising from the exogenous social distancing constraints during the COVID-19 pandemic may have forced even productive firms to exit especially in the most affected sectors and in countries where support measures may have not provided prompt and sufficient support to households to sustain demand and to firms to contain liquidity constraints. In countries where governments put in place fiscal support measures, exit, including of low productivity firms, may be subdued as a result of such measures and regulations that delay bankruptcies (see also Caballero and Hammour, 1996). In either case the exit process would be less productivity enhancing during the crisis. In the first case because of the break in the link between productivity and exit and in the second case because support would prevent the cleansing effect of exit and the reallocation of resources from low- to high-productivity firms. This is more likely to be the case if the most productive firms rely less on government support.

Figure 5 shows the change in the number of monthly (quarterly) entry and cumulative entry in 2021 and 2020, relative to 2019 levels in the same month (or quarter) across eight euro area (Belgium; Finland; France; Germany; Italy; Netherlands; Portugal and Spain); UK and US.

In most countries, entry at the beginning of 2021 has recovered or exceeded 2019 levels for the same period (with the noticeable exception of Portugal). Some countries have even experienced a surge in entry compared to 2019.

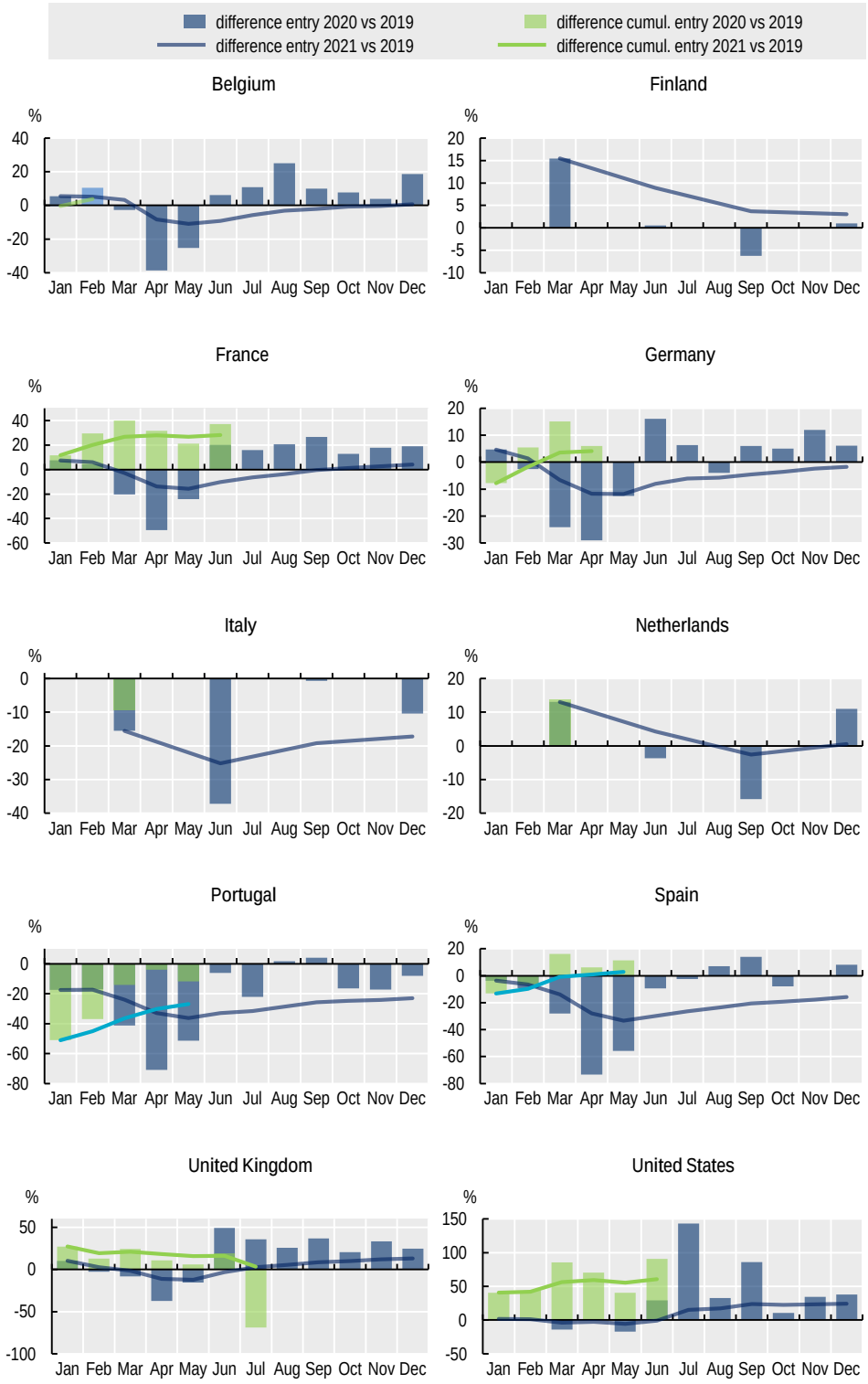
This is reassuring as the fall in firm entry during crises may amplify the drop in output and reduce the speed of recovery (Clementi and Palazzo, 2016) and potentially leave long-lasting scars to the economy (Sedláček, 2020; Messer, Siemer and Gourio, 2016). The data reported in Figure 5 shows that entry declined substantially in the first months of the COVID-19 pandemic, when the global economy was hit by a sudden and deep economic contraction (OECD, 2020). At its trough (which for most countries corresponded to April 2020), the number of entrants per month was between 20 and 60% lower than the corresponding figure in 2019. The recovery in entry evident for most countries from June 2020 was characterised by a high degree of cross-country heterogeneity: the United Kingdom and the United States experienced a V-type recovery. Other countries (including Italy, Portugal and Spain), continue to struggle with a U-type recovery with the total number of entrants in 2020, and to some extent in 2021, remaining significantly below the 2019 level. Other countries for which data are available (Belgium, France and Germany) fared in

between these two groups in 2020, with some signs of acceleration of business registrations in 2021 in France.

The overall drop in business registrations observed so far in some euro area countries (especially in Southern Europe: Italy, Spain and Portugal) may exacerbate secular trends of declining dynamism that have been observed across many OECD countries over the last two decades (Calvino, Criscuolo and Verlhac, 2020) and have persistent negative consequences for employment and productivity growth during the recovery.

Figure 5

Change in entry, 2021 and 2020 vs 2019

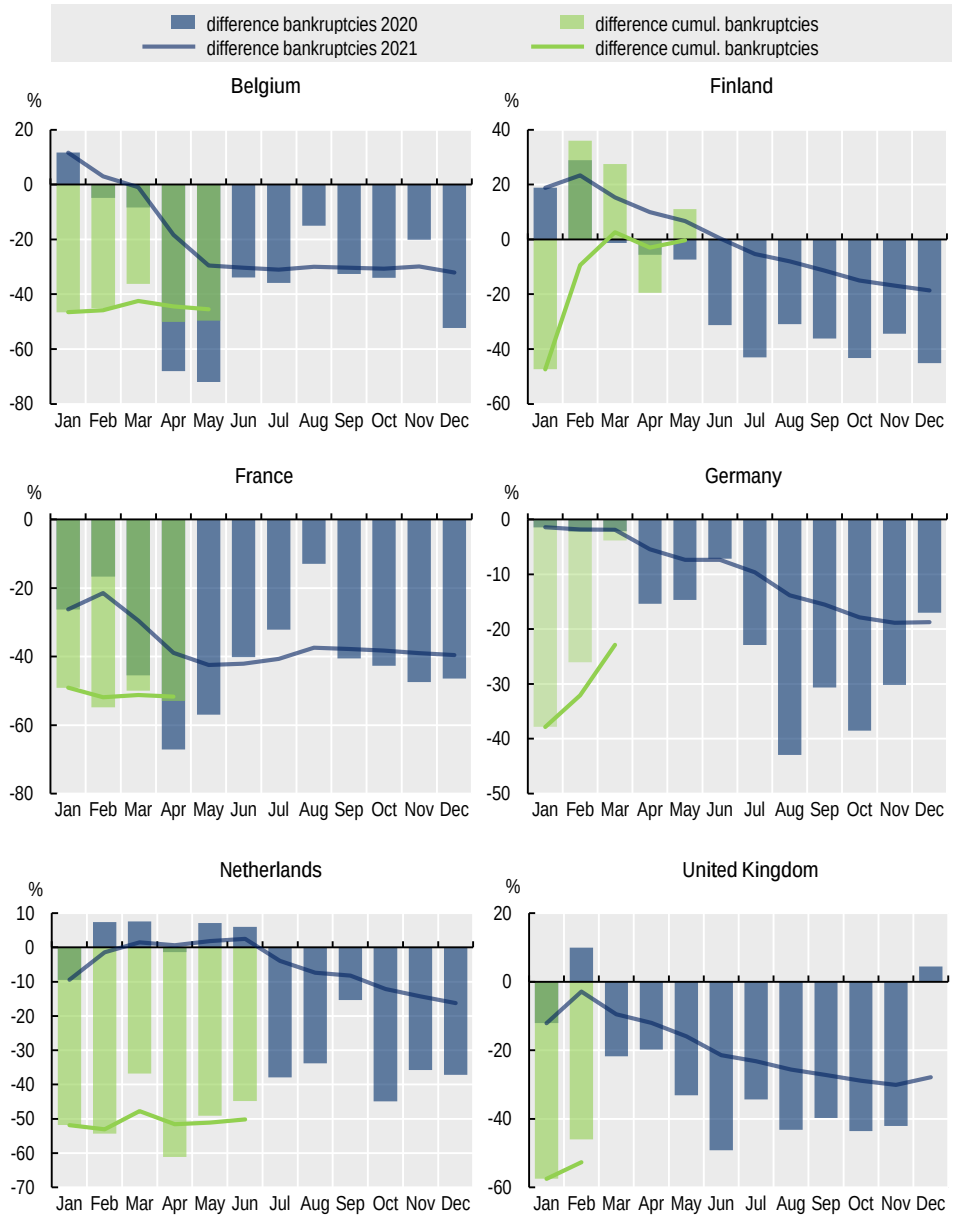


Note: Bars represent the percentage difference in entry in 2021 (2020) relative to the same month (quarter) of 2019. Lines represent the percentage difference in cumulative business openings from January to each month considered in 2021 (2020) and cumulative bankruptcies over the same period in 2019.

Figure 6 shows the change in the number of monthly bankruptcies and cumulative bankruptcies in 2021 and 2020, relative to 2019 levels in the same month (or quarter). According to the latest available data, total cumulated bankruptcies in 2020 and 2021, since January of each year, were down relative to the corresponding period of 2019. Both regulatory interventions on insolvency procedures and financial support to firms' liquidity may have played an important role in reducing bankruptcies, the former particularly in the early stages of the pandemic, when most countries were implementing such regulations.

Figure 6

Change in bankruptcies, 2021 and 2020 vs 2019



Note: Bars represent the percentage difference in bankruptcies in 2021 (2020) relative to the same month (quarter) of 2019. Lines represent the percentage difference in the cumulative number of bankruptcies from January to each month considered in 2021 (2020) and cumulative bankruptcies over the same period in 2019.

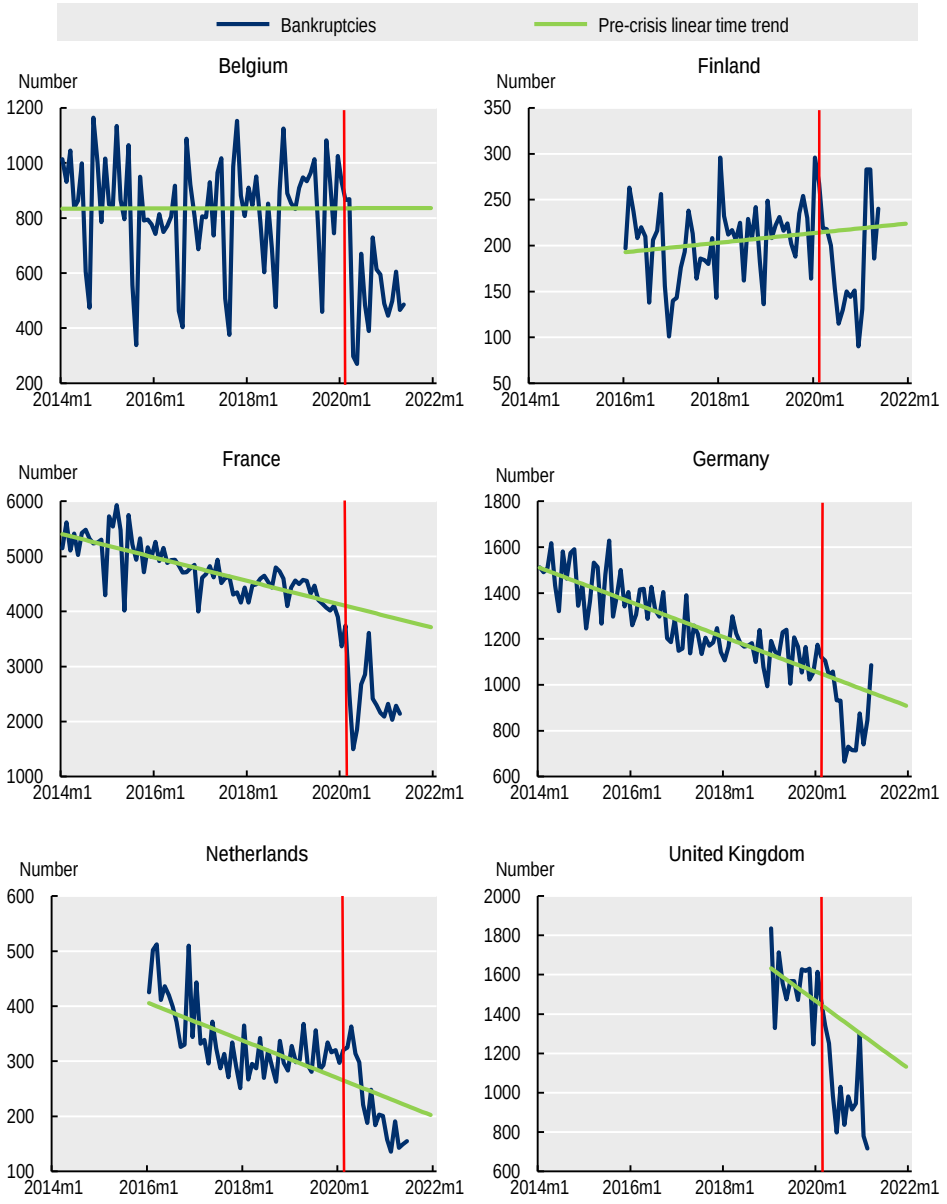
Figure 7 shows the number of bankruptcies together with a linear time trend estimated for the period 2014-2019. Although some countries display downward trends in bankruptcies also prior to the crisis, most countries have experienced a significant decline in bankruptcies relative to the trend.

While the slowdown in bankruptcies may have supported viable firms and reduced firing and hiring costs and limit the loss of potential output, the longer support policies are in place the higher the risk that they may actually negatively affect aggregate productivity growth by slowing down the productivity enhancing reallocation process across firms and sectors. If the persistent decline in bankruptcies is a reflection of unproductive firms, the so-called zombie firms, being kept in business, capital and labour might not be reallocated to new business opportunities and to more productive firms.

In addition, if the financial support provided through subsidised credit and loan guarantees translates into more firms being in a vulnerable financial position, a new wave of bankruptcies might have just been postponed until the emergency support measures are lifted. This may pose significant systemic risks.

Figure 7

Number of bankruptcies and linear time trend



Note: The figure plots the number of bankruptcies and a country specific linear time trend estimated over the pre-crisis period (2014-19, depending on data availability). The red line indicates February 2020.

Business dynamics during the COVID-19 crisis seem very different from the dynamics observed during the global financial crisis of 2008, presented in Box 1. In particular, entry has picked up much more quickly in some of the euro area countries relative to 2008. While during the GFC, exits went up rapidly across the euro area, exits and bankruptcies were “frozen” during the pandemic and at the end of 2020 were still at lower levels relative to the same quarter in 2019. This is possibly the result of both fiscal and regulatory support measures.

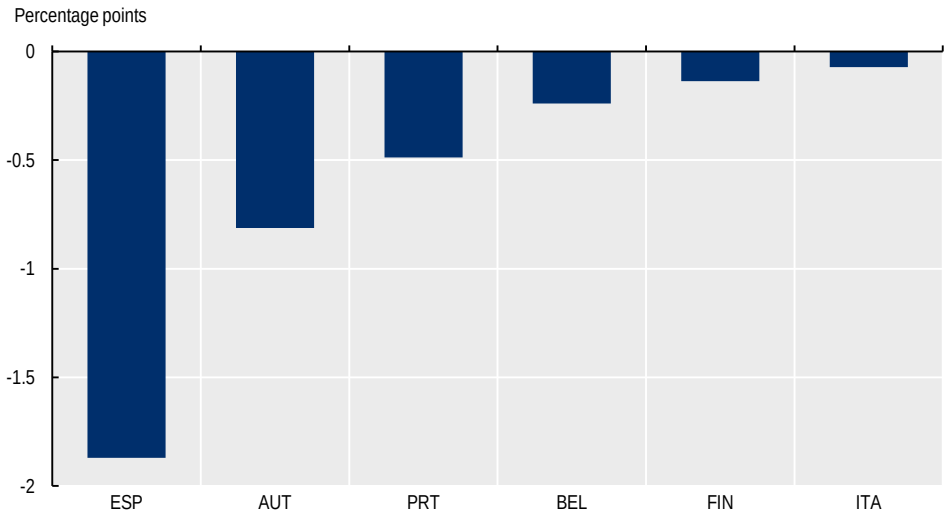
BOX 1: Entry and Exit during the 2008 crisis

Firm entry, and to some extent firm exit, may exhibit cyclical patterns over the business cycle (see for instance Tian, 2018), reflected also in lower entry and higher exit during recession periods.

Using data for manufacturing and non-financial market services for selected EA countries from the DynEmp v3 database, Figure 8 shows changes in average entry rates during the GFC relative to the pre-crisis period across countries. It reveals that countries have generally experienced significant declines in entry rates during the financial crisis.

Figure 8

Change in entry rates during the 2008-09 crisis

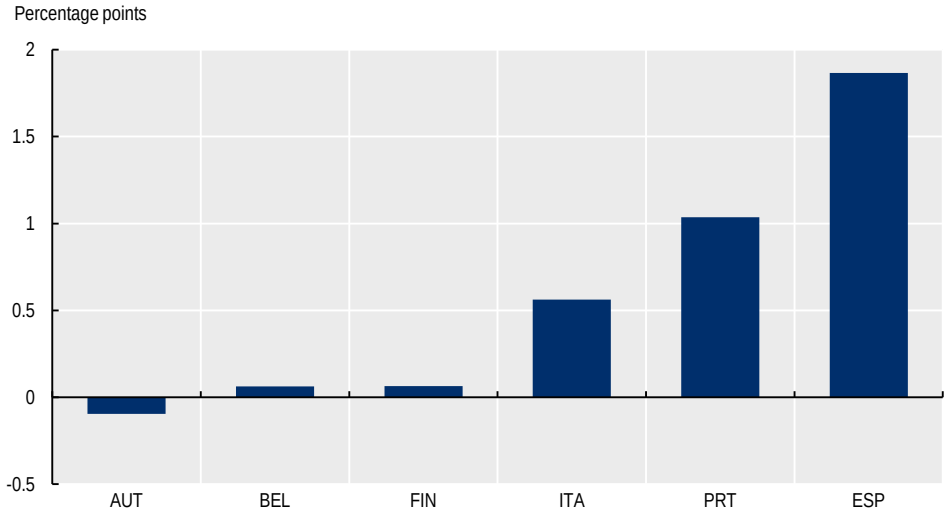


Note: The figure plots the difference, in percentage points, between average entry rates in 2008-09 and average entry rates over the 2005-07 period. Data cover manufacturing and non-financial market services and focus on employer units (i.e. excluding firms with one or less person engaged). Owing to methodological differences, figures may deviate from officially published national statistics.
Source: OECD DynEmp v3 database.

Figure 9 shows instead changes in exit rates during the GFC relative to the pre-crisis period, across countries, and suggests that most countries have also experienced a rise in exit rates during the financial crisis. In addition to large drops in demand affecting firms' incentives and revenues, the GFC was also characterised by tightening financial condition affecting firm's access to funding. This may have further amplified the cyclical changes in business dynamics, with possible long-lasting consequences for output, productivity and employment (Clementi and Palazzo, 2016; Gourio, Messer and Siemer, 2016; Sedláček, 2020).

Figure 9

Change in exit rates during the 2008-09 crisis



Note: The figure plots the difference, in percentage points, between average exit rates in 2008-09 and average exit rates over the 2005-07 period. Data cover manufacturing and non-financial market services and focus on employer units (i.e. excluding firms with one or less person engaged). Owing to methodological differences, figures may deviate from officially published national statistics.
Source: OECD DynEmp v3 database.

3.2 Employment effects of changes in entry

Young firms play a crucial role for job creation and output growth, and the ability of entry rates to recover swiftly from the COVID-19 shock may have significant implications in the medium term for the aggregate economy, and in particular for employment.

To show this, we simulate the employment effects of the average change in the number of entering firms across countries, using data from the OECD DynEmp3 database. Methodological details of the simulation are given in Box 2.

Focusing on the change in the total number of entrants in 2020 relative to 2019 (see Figure 5) we can distinguish three groups of countries:

- Countries that have experienced a missing generation of new firms in 2020, with an average decline in annual entry of 18.7%. This group includes Italy, Portugal and Spain. In these countries, the fall in monthly entry in early 2020 has been followed by a slower recovery, resulting in a significantly lower cumulative number of entrants by the end of the year compared to 2019.
- Countries that have experienced a stronger recovery in monthly entry after the initial fall, resulting in comparable or slightly higher levels of entry by the end of 2020. In this group of countries, including Belgium, Finland, France, Germany and the Netherlands, annual entry was on average 1.3% percent higher in 2020 than in 2019 (ranging from -1.7% to 4%).
- Countries that have experienced a significant rise in entry in 2020, with a cumulative number of business creation largely exceeding 2019 levels, by 18.6% on average. This includes the United Kingdom and the Unites States.

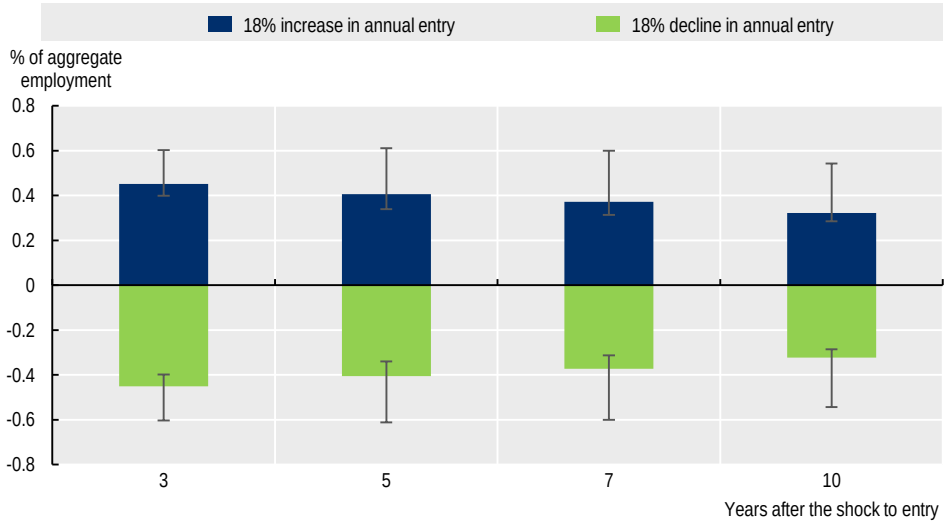
The simulation therefore estimates the effect of a 18% decline in entry (scenario of a missing generation of new firms), and a 18% increase in entry (rise in dynamism), assuming that other margins (i.e. post-entry growth, average size at entry, and survival rates) remain unchanged.[12]

Figure 10 shows that the decline in entry experienced by the first group of countries may lead to a decline in aggregate employment between 0.4% and 0.6% after 3 years and between 0.3% and 0.5% after 10 years. Symmetrically, the significant rise in dynamism observed in the third group of countries could lead to significant and persistent employment gains, between 0.4% and 0.6% after 3 years, and between 0.3% and 0.5% after 10 years.

Entry has remained low at the beginning of 2021 compared to 2019 in Italy and Portugal, reinforcing the potential losses associated with the start-up deficit. On the contrary, other countries, such as France and the United States, and to a some extent the UK, have seen high levels of entry in early 2021 compared to 2019, which could further increase the employment gains during the recovery and beyond.

Figure 10

Employment effects of changes in entry



Note: The figure shows the employment losses or gains associated with a 15% decline, a 3% increase and a 20% increase in the number of entrants, relative to aggregate employment in the initial year, on average across countries and cohorts of entrants in 1995, 1998, 2001, 2004, 2007, 2010, and 2012. The bands represent low and high values of the effects of the shocks, representing respectively the 25th and 75th percentiles. The simulation is based on the decomposition proposed by Calvino, Criscuolo and Menon (2015), focusing on A38 industries in manufacturing and non-financial market services. Countries included are Austria, Belgium, Finland, Italy, the Netherlands, Portugal, and Spain.
Source: based on the OECD DynEmp v3 database.

[12] These margins may be affected by the COVID-19 shock, though the direction of this effect is not ex-ante clear. The literature has found that financial recessions generate tighter selection at entry: firms that enter are fewer but better (Ates and Saffie, 2021) and adopt more profitable production technologies (Gonzales-Torres, Manaresi and Scoccianti, 2020). Conversely, for non-financial recessions, evidence show that selection at entry is less relevant and low demand at entry persistently reduces growth throughout the new firm's life-cycle (Moreira, 2017). The effect of the COVID-19 shock on startup selection will ultimately depend on the relative weights of supply and demand channels.

BOX 2: Methodological details of the simulation

The simulation starts from a decomposition of the net job contribution of surviving entrants to aggregate employment presented by Calvino, Criscuolo and Menon (2015).

The contribution is captured through the normalized net job variation by surviving (Surv) entrants (Ent) in country c, at time t:

$$NJV_{c,t}^{Ent} = \frac{EMP_{c,t}^{Surv\ Ent}(t+j)}{EMP_{ct}(t)}$$

The numerator of normalized net job creation, $EMP_{c,t}^{Surv\ Entrant}(t+j)$, identifies employment at time t+j of units entering at time t and that survive between time t and t + j. Parentheses indicate that employment is reported at time t + j. The denominator $Emp_{ct}(t)$ identifies employment at time t of all active units at time t (including incumbents and new firms).

Calvino, Criscuolo and Menon (2015) find that the net job creation of surviving entrants represent between 1 and 8% of aggregate employment depending on countries. This normalized net job variation by surviving entrants can further be decomposed as follows:

$$\frac{EMP_{ct}^{Surv\ Ent}(t+j)}{EMP_{ct}(t)} = \frac{EMP_{ct}^{Surv\ Ent}(t+j)}{EMP_{ct}^{Surv\ Ent}(t)} \times \frac{EMP_{ct}^{Surv\ Ent}(t)}{NrUnits_{ct}^{Surv\ Ent}(t)} \times \frac{NrUnits_{ct}^{Surv\ Ent}(t+j)}{NrUnits_{ct}^{Ent}(t)} \times \frac{NrUnits_{ct}^{Ent}(t)}{EMP_{ct}(t)}$$

where $NrUnits_{ct}^{Surv\ Ent}(t)$ identifies the number of entrants in country c surviving between time t and t + j and $NrUnits_{ct}^{Ent}(t)$ identifies the total number of entrants in country c, at time t.

The first term on the right hand side corresponds to average post-entry growth rate of surviving entrants:

$$PEG_{ct}^{Surv\ Entr}(t+j) = \frac{EMP_{ct}^{Surv\ Ent}(t+j)}{EMP_{ct}^{Surv\ Ent}(t)}$$

The second term corresponds to the average size at entry of surviving entrants:

$$Avg\_Sz_{ct} = \frac{EMP_{ct}^{Surv\ Ent}(t)}{NrUnits_{ct}^{Surv\ Ent}(t)}$$

The third term corresponds to the survival share of entrants, between t and t+j:

$$Surv\_rate_{ct}(t+j) = \frac{NrUnits_{ct}^{Surv\ Ent}(t+j)}{NrUnits_{ct}^{Ent}(t)}$$

The fourth term corresponds to the start-up rate (total number of entering units over total employment):

$$Start\_rate_{ct}\frac{NrUnits_{ct}^{Ent}(t)}{EMP_{ct}(t)}$$

To simulate the employment effects of a change in the number of entrants, $NrUnits_{ct}^{Ent}(t)$, we compute the aforementioned quantities using the DynEmp database and a counterfactual when the number of entrants $NrUnits_{ct}^{Ent}(t)$ changes, i.e. when $NrUnits_{ct}^{Ent}(t)^{\boldsymbol{Shock}} = NrUnits_{ct}^{Ent}(t) \times (1 + \boldsymbol{shock}/100)$ where shock takes the values of the percentage change in entry in 2020 relative to 2019 for different groups of countries (all other quantities are unchanged).

The employment losses or gains associated with a given shock to the number of entering firms are then measured in percentage of aggregate employment, as follows:

$$NJV_{c,t}^{Ent\boldsymbol{shock}} - NJV_{c,t}^{Ent} = \frac{EMP_{c,t}^{Surv\ Ent}(t+j)^{\boldsymbol{shock}} - EMP_{c,t}^{Surv\ Ent}(t+j)}{EMP_{ct}(t)}.100$$

This potential employment effect is computed for different cohorts of entrants, i.e., for t = 1998, 2001, 2004, 2007, 2010, 2012 for different time horizons j = 3, 5, 7, 10, 14 and for the following countries c: Austria, Belgium, Brazil, Canada, Costa Rica, Finland, Hungary, Italy, Japan, Korea, The Netherlands, Norway, Portugal, Spain, Sweden and Turkey.

For each value of the shock, we report the median, 25th and 75th percentiles of the distribution of $NJV_{c,t}^{Ent\boldsymbol{shock}} - NJV_{c,t}^{Ent}$.

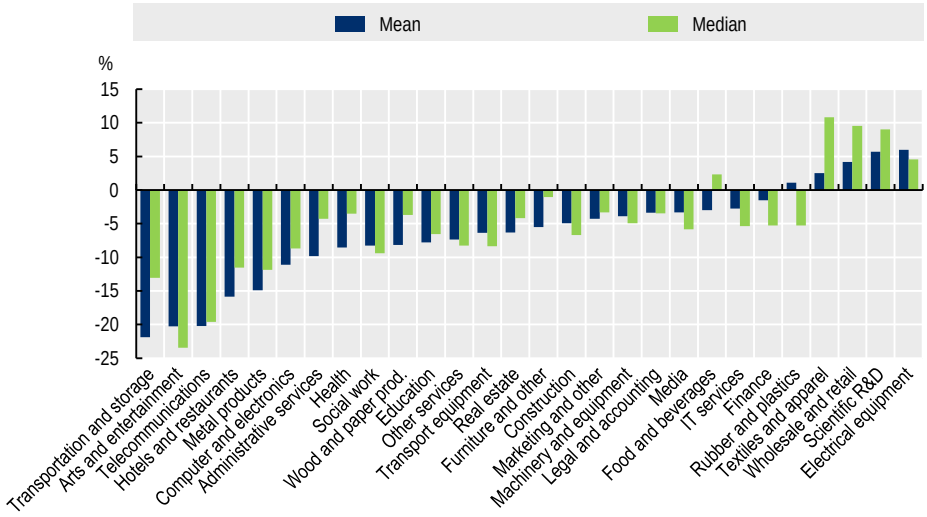
3.3 Sectoral heterogeneity in changes in entry rates during the Crisis

Up until now, we have looked at entry in the business sector, but there is significant heterogeneity across countries regarding the relative effect of the crisis across sectors on business dynamics. For 5 euro area countries (Belgium, Finland, Italy, the Netherlands, and Portugal), data on entry at the sectoral level (28 SNA A38 sectors that altogether represent on average 96% of total entry in non-missing sectors, in 2020)[13] are available allowing a deeper overview and analysis of the changes observed during the COVID-19 crisis.

[13] In Italy 35% of observations are not classified in any NACE Section and are excluded from the analysis, reducing the coverage to 55% of total entry

Figure 11

Average and median change in entry by A38 sectors, 2020 vs 2019



Note: The figure plots the average and median percentage change in entry in 2020 relative to 2019, across countries, by SNA A38 sectors. Countries included are Belgium, Finland, Italy, the Netherlands, and Portugal.

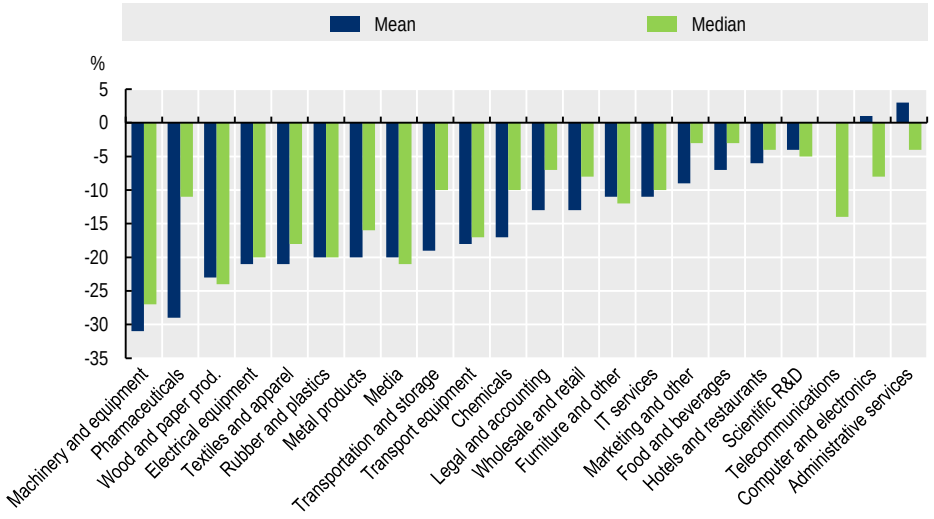
Figure 11 reveals the heterogeneous impact of the crisis on entry across sectors.

On average across countries, “Electrical equipment”; “Scientific R&D”; “Wholesale and retail trade” and “Textile and apparel” stand out as the most resilient sectors, as they have experienced an increase in the total number of entry in 2020 relative to 2019 between 2.5% and 6% on average. Interestingly, evidence from the US (United States Census, 2021) and the Netherlands (Fareed and Overvest, 2021) show that the surge in entries in the retail sector come mainly from new online retail shops rather than new brick and mortar stores. This evidence, together with the National Accounts data discussed in Section 2, shows how the retail sector, which was hit hard by the crisis, was also where new firms have been an important driver of technological change to cope with the pandemic shock. This echoes existing evidence showing that new firms sustained innovation and intangible accumulation during the past recession (Gonzales-Torres, Manaresi, Scoccianti 2020), and drove structural change in the long-term (Dent, Karahan, Pugsley, Sahin 2016).

Conversely, “Transportation and storage”, “Arts and entertainment”; “Telecommunications”, “Hotels and restaurants” and “Metal Products” have been hit harder by the crisis, with an average decline in entry of about 20% and all five countries experiencing a negative change in entry in 2020.

Figure 12

Change in entry during the 2008-09 crisis, by SNA A38 sectors



Note: The figure reports the percentage change in the average number of entering units in 2008-09 relative to the average number of entering units in 2006-07 (excluding firms with one person engaged or less). Countries included are Austria, Belgium, Canada, Finland, France, Hungary, Italy, Norway, Portugal, Spain and Sweden.
Source: OECD DynEmp v3 database.

Figure 12 compares industry patterns in entry during the pandemic with those observed during the 2008 GFC. The comparison highlights the generally stronger negative response of entry during the GFC and marked differences in sectoral heterogeneity, with manufacturing sectors being much more strongly affected during the GFC and services sectors being relatively more affected during the pandemic.

3.3.1 Entry was more resilient in sectors that rely less on face-to-face interactions

Relying on the disaggregated quarterly data on entry available at the SNA A38 industry level[14] for 2019 and 2020, we investigate the (univariate) correlation between the change in entry in 2020 and sectoral characteristics.[15] In particular, the analysis considers characteristics that capture the intensity of face-to-face interactions; potential to telework; as well as the digital intensity of different sectors.[16]

We investigate the univariate correlation between year-on-year change in entry and sectoral characteristics by exploiting cross-sectoral variation within a country-quarter,

[14] The following SNA A38 sectors are excluded from the analysis: Agriculture; Mining; Coke and refined petroleum; Chemicals; Pharmaceuticals; Electricity and gas; Water and sewerage; Public administration; Households; Extraterritorial Organizations.

[15] Data for Belgium, Finland, Italy, and the Netherlands cover business formation including legal and natural persons, while data for Portugal covers only the formation of legal persons (and equivalent)

[16] The share of employment in occupations involving regular face-to-face contact with customers is based on Koren and Petö (2020). The potential to telework is a task-based indicator of telework potential from Espinoza and Reznikova (2020). Digital intensity refers to ICT task intensity, based on Calvino et al., 2018, and Grundke et al., 2017, and to the average ICT skill level based on Cammeraat, Samek and Squicciarini (2021). See additional details in Table B 1 in the Appendix.

using quarterly data for 2020.[17] The results presented in **Table** 1 focus on univariate correlations.

Table 1

Change in entry in 2020 and sectoral characteristics, by quarter

	(1)	(2)	(3)	(4)
	Customer Contact	ICT task content	ICT skill	Telework potential
$\beta^{Q1}(\mathbf{Q1}.\mathbf{X}_s)$	0.039	-0.143	-10.278*	-0.220*
	(0.102)	(0.129)	(6.236)	(0.115)
$\beta^{Q2}(\mathbf{Q1}.\mathbf{X}_s)$	-0.383*	0.679***	19.499**	0.334**
	(0.203)	(0.235)	(9.338)	(0.165)
$\beta^{Q3}(\mathbf{Q1}.\mathbf{X}_s)$	-0.000	0.047	8.952	0.157
	(0.098)	(0.160)	(10.274)	(0.216)
$\beta^{Q4}(\mathbf{Q1}.\mathbf{X}_s)$	-0.559*	0.193	3.230	-0.063
	(0.326)	(0.257)	(10.5)	(0.219)
R2	0.175	0.168	0.162	0.162
Observations	520	520	520	520
Nb Countries	5	5	5	5
Nb A38	25	25	25	25

Note: This table reports the coefficients from a regression of year-on-year percentage change in entry on sectoral characteristics interacted with quarter dummies, and including country-period fixed effects. The regression is based on quarterly data for Belgium, Finland, Italy, the Netherlands and Portugal. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Results reported in Column 1 of Table 1 suggest that the declines (increases) in entry in the second quarter of 2020 (with respect to 2019 Q2) and in the fourth quarter of 2020 (with respect to 2019) were more (less) pronounced in sectors with a higher share of employment involving regular face-to-face contact with customers.

Estimated coefficients reported in Column 2 show that the decline in entry in 2020 Q2 was on average less pronounced in sectors with higher ICT task intensity of jobs. In unreported multivariate regression analysis, both ICT task intensity and the share of employment in occupations involving regular face-to-face contact with customers remain jointly significant (in 2020Q2).

[17] We estimate the following model: $\Delta^4 E_{csq} = \boldsymbol{\beta}^q . X_s . 1_{\{quarter=q\}} + \theta_{cq} + \varepsilon_{csq}$

Where $\Delta^4 E_{csq} = ({E_{csq}}^{2020} / {E_{csq}}^{2019} - 1) \times 100$ is the percentage change in entry in 2020 relative to the same quarter *q* of 2019 in a given country *c* and sector *s*. X_s are (country invariant) sectoral characteristics, interacted with quarter dummies $1_{\{quarter=q\}}$ equal to 1 for quarter *q* and 0 otherwise. θ_{cq} are country-quarter fixed effects. This model allows estimating differentiated correlations between the change in entry and sectoral characteristics over the four quarters of 2020. The model includes country-quarter fixed effects controlling for the aggregate impact of the crisis on business formation in each quarter of the year in each country. Standard errors are robust to heteroscedasticity (clustered standard errors at the country-sector level yield consistent results).

Columns 3 and 4 show similar results hold when looking at ICT skills and at the industry's telework potential, respectively.

To summarise, the analysis shows that the change in entry in 2020 Q2 (relative to 2019 Q2) and in 2020 Q4 (relative to 2020Q4) is negatively correlated with the share of employment in occupations involving regular face-to-face contact with customers. The change in entry in 2020 Q2 (relative to 2019 Q2) is positively correlated with ICT task intensity in the sector, as well as the average ICT skills of workers in the sector, and the telework potential of the sector.

Indeed, one of the silver linings to the pandemic might be the opening up of new opportunities because of the needs associated with social distancing, and its impact on every aspect of daily life, from remote work, education and health services and online shopping and entertainment, as well as innovation in drugs, medical equipment and services. This is confirmed from information on venture capital deals[18] in the EA. While Across EA countries the number of deals decreased in 2020 with the exception of Belgium and Estonia, there was an increase in total value of VC deals in 2020 in many EA countries (in particular Estonia, Finland, Ireland, Italy, Austria, Netherlands, and France). Some of the activities that saw an increase in VC financing where indeed related to messaging and communication; online dating; teleconferencing; health; robotics; but also home living; administrative services and online media and entertainment.[19]

3.4 Is reallocation during the COVID-19 crisis productivity enhancing?

In section 2, we presented evidence that inter-industry reallocation during the COVID-19 pandemic has shrunk low-productivity sectors and thus contributed positively to aggregate productivity growth. At the beginning of this section, we have discussed the importance of reallocation for productivity growth. Evidence on within-industry reallocation across countries during COVID is not yet available. However, evidence from single country studies provides interesting insights.

In particular, existing studies provide evidence on the two mechanisms that may have weakened the cleansing effect of exit. First, whether the negative correlation between exit and productivity has been weakened or broken and second, whether support measures - by helping all firms equally or in some cases less productive firms more than high productivity ones - have made exit less productivity-enhancing than in normal times.

[18] This analysis is based on a database on Venture Capital deal based on information from the CrunchBase and Dealroom databases.

[19] Results available upon requests.

In the euro area, analysis for France (Cros, Epaulard and Martin, 2021);[20] show that even if depressed, the exit process during the crisis has been productivity enhancing and that government support absorbed some of the sectoral nature of the crisis without distorting the reallocation process. The 2021 report of the "Coeuré Committee"[21] shows that despite the generosity of the French support measures, amounting to almost 10% of French GDP, few firms have made use of the full suite of measures to which they were entitled to and that Zombie firms haven't been disproportionately supported. Rather, support was channelled ex post to firms most impacted by the crisis. Indeed, simulations analysis (Bénassy-Quéré et al., 2021) suggests that the measures may have halved the number of newly insolvent firms, especially in the hospitality sector. These results suggest a tentatively positive evaluation of the French support measures. Evidence for the Netherlands shows that exit during COVID was much more common amongst smaller businesses (Fareed and Overvest, 2021) and thus closely related to size that can be considered a rough proxy for productivity. OECD (2021) confirms that across the OECD smaller firms shrank more than larger ones. Looking at the intensive margin, results also suggest that reallocation has been productivity enhancing: across the EURO area: the ECB Survey on the Access to Finance of Enterprises (SAFE) finds that revenue and employment growth recovered much faster across larger firms, while SMEs and micro firms experienced a strong and persistent contraction in turnover and employment. In Italy, Lamorgese et al. (2021) show that better managed firms, defined as those making larger use of structured management practices, saw a smaller decline in sales, probably reflecting a better ability to adapt to the new remote working environment. Evidence for Portugal (Kozeniauskas, Moreira and Santos, 2020) also suggests that higher-productivity firms have been more successful at maintaining employment, but the cleansing effect of exit during the was mitigated by a subdued rise in exit among low-productivity firm, likely reflecting the higher likelihood of low productivity firms to benefit from government support.

For the UK, evidence confirms that the reallocation process has not been distorted during the crisis with the reallocation between industries (low-productivity sectors where affected more) and within-industries (the least productive firms within these industries were affected more) resulting in the productivity-enhancing nature of inter- and intra-industry reallocation. Using a different data source, Andrews et al. (2021) also confirm that job reallocation continued to be positively linked to productivity during COVID. In addition, recent analysis (Anayi et al., 2021) points to an increase

[20] Cros, Epaulard and Martin (2021) analyse data on bankruptcies of small employing firms in France and find that although subdued the cleansing process of exit is not distorted with low productivity and high debt being key predictors of bankruptcy before and during the pandemic. They also find that the role of government support has been to dampen the COVID shock protecting sectors that had been most affected by the crisis without impacting on the cleansing effect of exit. Andrews et al. (2021) also focus mainly on small firms

[21] The Committee on the Monitoring and Evaluation of Financial Support Measures for Companies Confronted with the Covid-19 Epidemic presided by Benoît Cœuré focused on 4 measures: job retention, the Solidarity Fund for smaller companies, state-guaranteed loans, and deferral of social security contributions.

in reallocation [22] relative to the past 15 years, with the within-industry reallocation component accounting for about two thirds of the total.

For the US, a similar increase in reallocation was also found, with both excess jobs and excess sales reallocation rates increasing during the COVID crisis (Anayi et al., 2021; Barrero et al., 2021 and Bartik et al., 2020). On bankruptcies the evidence is more mixed, with bankruptcies for non-home-owners consumers and small businesses dropping significantly despite increased unemployment levels (Chapter 7 filings were at levels 20% below 2019 levels and Chapter 13 filings were up to 65% below 2019 levels in August 2020). On the other hand, Chapter 11 filings by large corporations have increased to reach nearly 200% relative to 2019 (Wang et al., 2020).[23]

4 Adoption of digital technologies and telework during the COVID-19 crisis

The pandemic brought with it the need for social distancing, working remotely, and producing and providing goods and services at a distance. It has clearly accelerated existing trends towards digitalisation, which holds potential for significant productivity improvements but also risk increasing inequalities if the benefits are not equally distributed across workers, firms and regions within countries.

During the crisis, many firms invested in technological and organisational innovations and automation, which is also in line with existing theories suggesting that crises are a good time for restructuring. There are at least two potential explanations for this. Lower opportunity costs in periods of low demand will lead to the introduction of productivity improving innovations (e.g., Aghion and Saint Paul, 1998; Barlevy, 2004; Nickell, Nicolitsas and Patterson, 2001). In addition, increased perceived risk of failure makes efficiency, rather than growth, the priority (Gibbons and Roberts, 2012). For the US, Hershbein and Kahn (2018) and Jaimovich and Siu (2020) confirm the faster pace of (skill-biased) restructuring during previous crises.

Relative to previous crises, the social distancing restrictions peculiar to the COVID-19 crisis have forced many firms to reorganise much more quickly and much more heavily. This involved a rapid adjustment to remote working and to online

---

[22] In the UK, sales reallocation increases more than employment reallocation reflecting the dampening role of furlough schemes on the latter, in the US this difference does not arise reflecting heterogeneity in the two countries' support measures.

[23] Evidence from Australia and New Zealand (Andrews, Hambur and Bahar, 2021 and Andrews, Charlton and Moore, 2021) confirm that job reallocation remain productivity enhancing during the pandemic. Although a comparison between Australia and New Zealand points to the importance of support measures generosity and duration to avoid slowing down this process. For Japan, Hong, Kikuchi and Saito (2020) find that the cleansing effect of exit remain stable during the Covid-19 crisis, even though exits have been muted.

delivery of their goods and service, which in turn provided an additional unique incentive to digitalise, and to some extent automate, their operations.[24]

The increased digitalisation and automation - and for some firms faster adoption of artificial intelligence - is likely to lead to an initial drop in output, as reorganizations take time and require heavy adjustments to the operation of businesses, but will ultimately result in an increase in firm productivity (Kopytov, Roussanov and Taschereau-Dumouchel, 2018; Brynjolfsson, Rock and Syverson, 2021).

However, the already more productive and better managed firms can more easily adopt the latest digital technologies and more quickly reap their productivity benefits, since they master the required complementary intangible assets such as proprietary software, organisational capital and intellectual property. To the extent that this is the case, the adoption of digital technologies might result in increased divergence amongst the “best” firms and the “rest”.

Indeed, digital technologies such as software and other intangible assets (e.g. management; branding) are characterised by such features such as scalability, sunkenness, synergies, non-rivalry and non-excludability (Haskel and Westlake, 2018). These might reinforce the productivity advantage of the best firms in the sector, especially when intangible assets, such as software, are proprietary (Bessen, 2020). Scalability allows firms to replicate innovations and business models across different locations and allows larger firms to benefit relatively more from digital technologies (see also Brynjolfsson and Hitt, 1998). Intangible assets are also characterised by large sunk costs of development and lack of secondary markets where intangible assets can be resold. In turn, intangibles are characterised by high fixed costs and low marginal costs, which again favours disproportionately the larger, more established players on the market. Moreover, thanks to the synergies between intangibles and with other tangible assets, the best firms have greater efficiencies in digital intensive sectors.

All these features translate in larger, more intangible and digital intensive firms enjoying a larger productivity advantage relative to the rest of the firms, as discussed below, but also larger markups and larger shares of the industry output as discussed in section 5.

In so far as the COVID-19 crisis has been accompanied by an acceleration in the shift to a more digital and intangible economy, this crisis might perpetuate, if not step up, the trend in productivity divergence evident since the early 2000 across the economy (Andrews, Criscuolo and Gal, 2016). As shown in Figure 13, a divergence between firms at the frontier (the “best”) and all others below (the “rest”) - both globally and within the euro area - is evident, even when focusing only on the post-GFC period. This divergence is larger and increasingly more so in digital intensive

[24] Chernoff and Warman (2020) characterize the correlations between automation potential and COVID-19 transmission risk; while Caselli, Fracasso and Traverso (2020) confirm that robotisation has facilitated social distancing and lowered the risk of contagion in Italy.

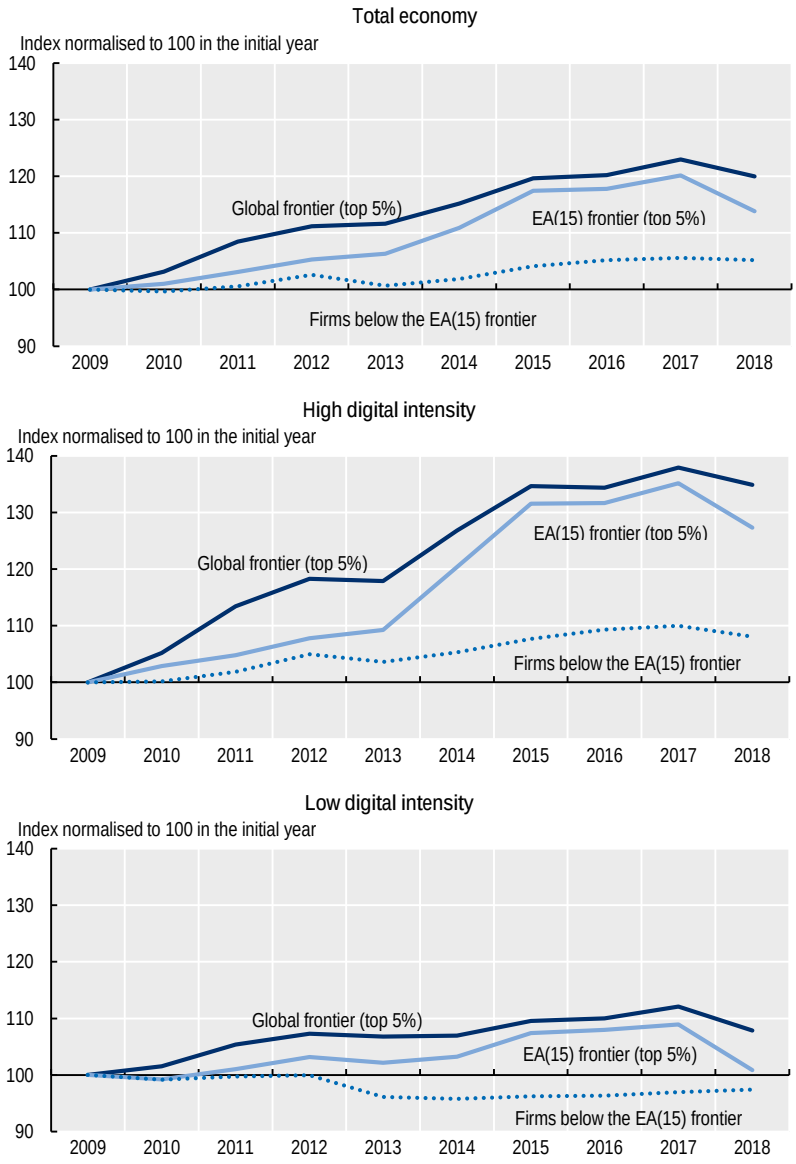
sectors, defined following the taxonomy developed in Calvino et al. (2018).[25] In line with the discussion above, firms at the global and euro area frontier are more likely to be a multinational corporation, have more intangible assets, such as patents and trademarks, and conduct higher level of R&D. Thus, they are better placed to take advantage of digital technologies by leveraging the benefits accruing from these complementary tangible and intangible investments, in particular in combination with their larger (global) size.

Interestingly, when focusing on the "rest" in digital intensive sectors of the economy, we see an improvement in the average productivity of these firms in the last ten years, in contrast to the decline that we observe in the other sectors. If COVID-19 has supported the diffusion of digital technologies to the rest both in digital intensive and in less digital intensive sectors, then the average productivity of firms below the frontier might increase across the board, with ultimately positive implications for aggregate productivity. However, this hinges on the capacity of the firms below the frontier to successfully combine digital technologies with the required complementary assets ranging from skills and other types of capital mentioned above.

[25] This digital intensity taxonomy combines several indicators capturing different technological components of digital intensity (tangible and intangible ICT investment, purchases of intermediate ICT goods and services, robots), the human capital it requires to embed technology in production (ICT specialists intensity and ICT task intensity), and the way digital technologies change the interface of firms with the output market (online sales).

Figure 13

Productivity divergence especially in digital intensive services



Source: Calculations based on ORBIS updating methodology from Andrews, Criscuolo and Gal., 2016 and using the Calvino et al., 2018 taxonomy.

There is further evidence from different data sources pointing to the complementary role of digital and intangible intensity for increasing the productivity gaps between firms. In particular, Corrado, et al. (2021) relying on within-countries micro-aggregated data covering 10 euro area countries[26] find that productivity divergence at the bottom, i.e. between the median firms and the bottom decile of the productivity distribution, in digital intensive sectors is more pronounced in country-sectors that

[26] Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands and Portugal.

are more intangible-intensive.[27] In addition, results in Berlingieri et al. (2020) find that laggard firms catch-up to the productivity frontier at a lower speed in more digital intensive and more knowledge intensive industries. These findings suggest that an increase in the intangible and digital intensity of the business sector might be particularly challenging for smaller, less productive firms and hamper their productivity catch-up to the frontier.

The next section will collect existing evidence on trends in digital adoption during the crisis, drawing on the limited evidence available in the literature from different studies.

Section 4.2 will then address in detail the rise of telework, a phenomenon that epitomises the sudden changes linked to the use of digital technologies during the COVID-19 crisis, relying on timely data sources including a new data collection effort by the Global Forum on Productivity.

Although it is too early to gauge evidence on the productivity implications of digital adoption and telework during the COVID-19 crisis, the aim of the next two sections is to highlight a significant heterogeneity in the extent and the level of sophistication of digital technology adoption across businesses. This tendency might preserve, if not reinforce, existing trends in productivity divergence as well as concentration and markup distributions, as discussed in Section 5.

4.1 Adoption of digital technologies

While anecdotal evidence on the role of the COVID-19 crisis as a catalyser for digital adoption abounds, evidence from large surveys remains rather limited. Indeed data from National Statistical Offices across European countries covering the use of ICT technologies during 2020 will only become available in December of this year (Eurostat).

However, efforts to document the digital transformation in the EU and the US, the UK and emerging economies have been made by the European Investment Bank (2021a); the CEP at the London School of Economics (Riom and Valero 2020; Bloom et al. 2020a) McKinsey Global Institute (2021), and the World Bank (DeStefano and Timmis, forthcoming; World Bank, 2021). The use of online digital platforms – both by firms and households – has been also found to increase across many segments of the economy, with the rise of mobile payments and online deliveries (OECD, 2021).

The different data sources point to a significant acceleration of digital adoption across firms and countries. However, they also point to significant heterogeneity in the adoption of digital technologies across firms, with larger firms or firms that were

already digital before the COVID-19 crisis leading ahead in the adoption of digital technologies during COVID.

Results of the EIB survey show that across both the US and the EU larger firms are more likely to invest in multiple digital technologies.[28] The results also confirm that digital firms are more likely to invest in other intangible assets, training and innovation and show higher productivity level and propensity to export, grow faster and pay higher wages.

In the European Union 48% of small and 59% of large digital firms, i.e. firms for which at least one advanced digital technology is implemented in parts of the business, expect digital technologies to gain importance in the coming years, compared with only 32% and 46% of small and large non-digital firms. This, in turn, can potentially lead to an increased gap between digital and non-digital firms in the recovery phase. Similar figures also hold for the United States.

Similarly, the CEP-CBI survey reports that more than 60% of survey respondents have adopted digital technologies (e.g., Enterprise Resource Planning; Customer Relationship management systems; Remote working technologies; Cloud computing; Mobile technology; Automated machinery and AI applications) during the crisis and 38% adopted new digital capabilities (e.g., E-commerce, Advanced analytics and Cyber security). 90 to 95% state that COVID-19 prompted or accelerated the adoption of these technologies and practices. These firms were also more likely to invest in other intangible assets. In line with evidence for EU and US firms, UK medium to large firms showed somewhat higher probability of adopting digital technologies, capabilities and management practices. Also, firms that had previously adopted digital technologies were 30 percent more likely to do so. 90% of UK firms that have adopted digital technologies during COVID expect that they will continue adopting beyond the crisis, pointing to a persistent effect on digital adoption.

The World Bank (2021), using results of an event study by De Stefano and Timmis (2021), focuses on firms in 9 countries, including 4 in the EU (the Czech Republic, Hungary, Poland, the Slovak Republic; and also Brazil, China, India, Mexico and Thailand). The study shows a significant acceleration of adoption of digital technologies, such as e-commerce, online payments, data analytics and advanced data analytics.[29] Interestingly, the World Bank study corroborated that during the crisis firms that are larger, multinational, more productive and digital, i.e. with advanced software and cloud in place before the crisis, adopt more advanced digital technologies, (e.g., advanced data analytics), while adoption of more basic digital

---

[28] Firms were surveyed about the use of different digital technologies in different sectors. In Manufacturing, technologies considered are (a) 3D printing, (b) robotics (c) internet of things (IoT), and (d) big data/artificial intelligence. In construction (a) 3D printing; (b) drones; (c) IoT; (d) virtual reality. In services: (a) virtual reality; (b) platforms (c) IoT (d) big data/artificial intelligence. In infrastructure (a) 3D printing; (b) platforms; (c) IoT (d) big data/artificial intelligence.

[29] Data analytics includes both advanced functions, such as A/B testing, and more basic functions, such as visitor count tracking, feedback forms, and error tracking. A/B testing reflects an advanced data analytic technology, where firms randomly show visitors different versions of their website, and track visitor behaviour (such as purchases) in response, in order to optimize their website design.)

technologies, such as e-commerce, was more widespread amongst smaller domestic firms.

Taken together, the evidence across different countries seems to point to a clear acceleration in the adoption of digital technologies linked to the peculiarities of the COVID crisis. This has played a critical role for strengthening the resilience of businesses and economies to the crisis. Evidence from the US (Pierri and Timmer, 2020) suggests that adoption of digital technologies is linked to a smaller impact of the pandemic on unemployment and the labour market; evidence for Australia, the US and the UK (Andrews, Charlton and Moore, 2021) also seems to suggest that tech savvy firm were more resilient to the crisis.

In addition, according to the responses to the EIB and CEP-CBI surveys, firms expect the adoption of digital technologies and practices to outlast the crisis and to have implications for productivity, profitability and employment. The widespread adoption of even basic digital technologies might represent an important stepping-stone especially for smaller, less productive firms to accelerate their catch-up process.

However, the same evidence also highlights that any pre-existing digital divide across firms, along the size, productivity and the digital use dimensions, plays an important role in explaining the extent, the intensity and the sophistication of digital technology adoption during the pandemic.[30] In addition, productivity divergence seems to be larger in sectors providing ICT services (e.g. computer programming, software engineering and data processing) where the increasing potential of digital technologies to create global winner-takes-most dynamics (Brynjolfsson and McAfee, 2011) might have helped frontier firms to increase their performance disproportionally more than laggards. Thus, any existing digital divide will likely persist beyond COVID or even be exacerbated, in the absence of any policy intervention. Firms at the frontier are likely to have not only adopted more and more sophisticated technologies but also been able to benefit more from them in terms of profitability and productivity, thanks to their complementary intangible assets and management capabilities and their larger scale. This has implications for the persistence of productivity growth and dispersion, wage inequality as well as market power as we discuss in Section 5.

4.2 Adoption of telework practices

One of the biggest changes observed by workers and businesses during the COVID-19 pandemic has been the widespread and often sudden reliance on telework (working from home – WFH – or remote work)[31] as firms were faced with

[30] This is in line with evidence from the pre-COVID-19 era (see for example Calvino et al., *forthcoming*, for recent evidence on Italy).

[31] Note that in the paper we use the three terms interchangeably: telework; remote work of working from home.

the need to maintain social distances and respect lockdown measures without having to put their activities to a complete halt.

Being able to rely on what Eberly, Haskel and Mizen (2021) called “potential capital”, represented by residential homes and workers’ internet connections, has ensured that a large share of the economy could continue operating despite strict lockdown measures and therefore provided an invaluable source of resilience. Eberly, Haskel and Mizen (2021), estimate that across Japan, the UK, Germany, Spain, France, Italy and the US “potential capital” mobilised through telework contributed roughly 10 percent of GDP on average.

At the same time, for many firms and workers, tapping into the potential capital of home offices meant having to unexpectedly and suddenly adopt new work and management practices, investing in new digital technologies, tools and capabilities. Taken together, these changes represented a unique opportunity to break the stigma of telework and to learn to work in a digital environment. This shift has helped to find more efficient ways of working with digital technologies. This, in turn, could raise the relative productivity of working with such tools – including working from a distance (Davis, Ghent and Gregory, 2021).

Although the direction and magnitude of the net and long term effects of the surge in remote and hybrid work across countries, sectors, firms and workers remain still unclear, it holds the potential of significantly changing the nature of work, organisations, and cities, with implications for productivity, employment and wages, among other key economic variables.

We will present some recent evidence on these issues. Results on the effect on productivity are still mixed, possibly reflecting the role of other factors, internal and external to the firm, including management, skills, communications infrastructure and an appropriate working environment at home (Bloom, Mizen and Taneja, 2021; Morikawa, 2021 Bloom et al., 2014; Institut Sapiens, 2021).

In addition, recent estimates might reflect short-term effects and might not capture the full longer-term impact. As discussed in OECD (2020) and modelled in a general equilibrium setting in Behrens, Kichko and Thisse (2021) the relationship between telework and productivity is non-monotonic. At lower levels, increased telework is linked with higher productivity because of costs saving for firms, e.g. in term of office space, and higher worker efficiency and satisfaction, due to lower time spent on commuting, better concentration at home, etc. However, at higher levels of telework, productivity can decline as fewer face-to-face interactions in the workplace can lower workers’ satisfaction and increase one’s sense of solitude; at the firm level this implies fewer opportunities for informal information sharing and learning on the job, impaired communication and coordination, limited managerial oversight and reduced knowledge flows. Moreover, new, innovative ideas and opportunities for collaboration often come out from ad-hoc, informal discussions at the coffee corner, sometimes between members from different teams. In the long run, the lack of such opportunities can have a negative impact on the innovative capacity of the firm.

At a more aggregate level, high level of telework can also translate in lower benefit to workers and firms from agglomeration economies of being located in dense cities and in turn can lower the knowledge spillovers and benefits from agglomeration economies (Behrens, Kichko and Thisse, 2021).

There is therefore an optimal level of telework at intermediate levels of intensity. These have been found to lie between 1 and 3 days of telework a week (Behrens, Kichko and Thisse, 2021; Bloom, Mizen and Taneja, 2021 and OECD, 2021).

Several surveys have collected evidence on telework practices during COVID.[32] Some of these surveys also include questions on expectations about the use of telework practices after COVID e.g., (OECD, 2021; Bloom et al., 2020c and Riom and Valero, 2020). The European Labour Force survey (EU LFS) also contain information on telework and (microaggregated) information for 2020 has become recently available. We will provide some evidence relying on information from Eurofound and preliminary analysis that relies on information on telework from the EU LFS and from the OECD GFP survey.

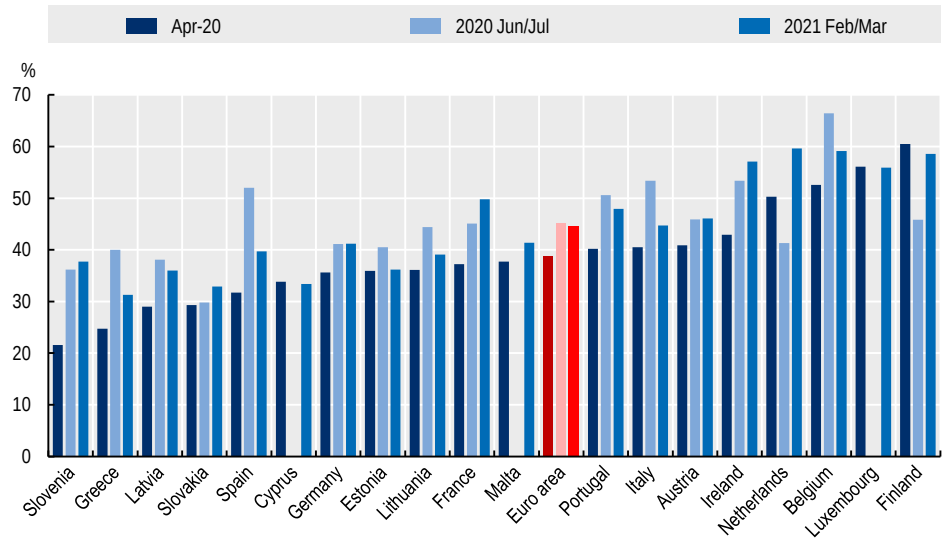
A clear pattern emerges across countries that wherever possible, given the job tasks, there was a significant and sudden switch from office to home work during COVID-19, making teleworking the customary mode of working for many employees and firms. Eurofound estimates suggest that in Europe the switch meant going from about 1 in 20 workers in 2019 regularly working remotely to more than 1 in 3 working exclusively from home during the first lockdown measures in Europe, corresponding to almost all teleworkable jobs being done from home (see Sostero et al., 2020), with significant differences across countries and sectors. Cross-country differences are significant, ranging in the euro area from 21.6% in Slovenia to 60.5 % in Finland and with cross-country differences reflective of trends in the use of telework pre-pandemic and broadly consistent during the course of the pandemic.

[32] For the EU: Eurofound 2020, 2021, OECD, 2021; Morikawa, 2021; Ozimek, 2020; Taneja, Mizen and Bloom, 2021; OECD, 2021 for the US: Brynjolfsson et al., 2020; Barrero, Bloom and Davis, 2021; Bartik et al., 2020; for the UK: the Decision Maker Panel (Bloom et al. 2020), the CEP-CBI survey (Riom and Valero, 2020).

Figure 14

Telework uptake during the COVID crisis was heterogeneous across countries

Share of workers teleworking over the COVID-19 crisis



Notes
Source: Authors calculations based on Eurofound.

Although some of the cross-country differences may reflect heterogeneity in industry and occupational structure, most of the differences remain even conditional on them (Sostero et al., 2020)

Interestingly, while the pandemic may have removed most of the cultural and social norms that may have hindered the adoption of telework pre-pandemic, the ability to telework remains strongly correlated with both high-quality communications infrastructure for firms (Figure 15) and households (Figure 16), and the digital skills of the workforce (Figure 17). This confirms evidence of similar correlations pre-pandemic (OECD, 2021) and makes skills and ICT infrastructure two key priorities to continue benefitting from telework after the crisis. Results from different surveys also point to the fact that teleworking is also correlated with the level of education of the workforce as well as whether they live in urban areas.

Figure 15

Telework uptake related to firm communication infrastructure

Telework uptake during the COVID pandemic (April 2020) and firm infrastructure for fast broadband speed

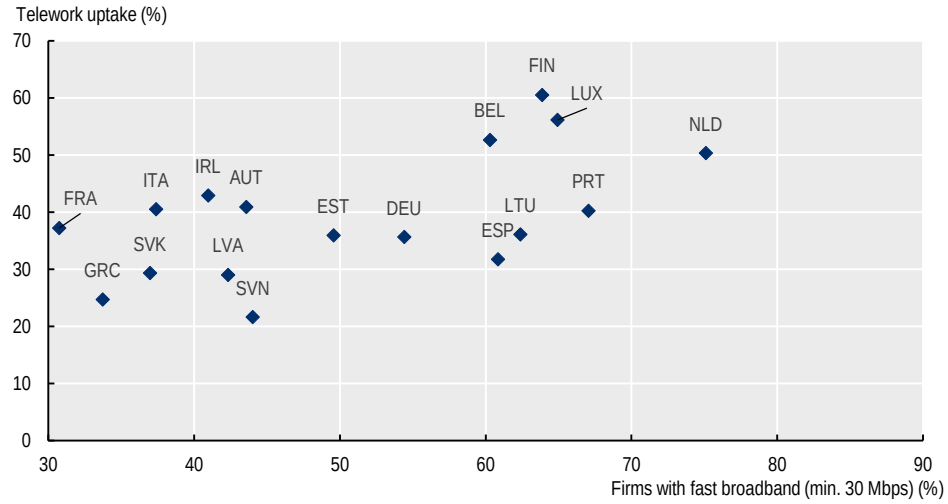
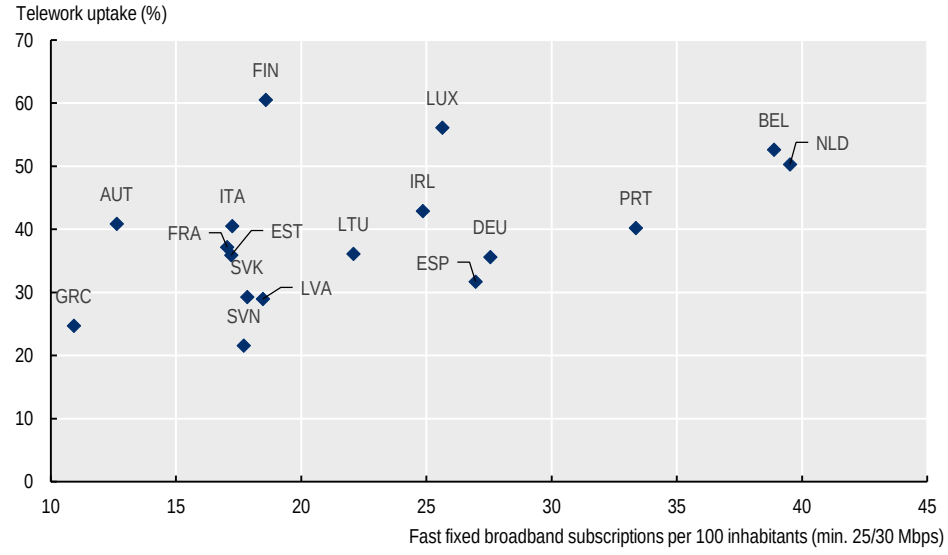


Figure 16

Telework uptake related to home communication infrastructure

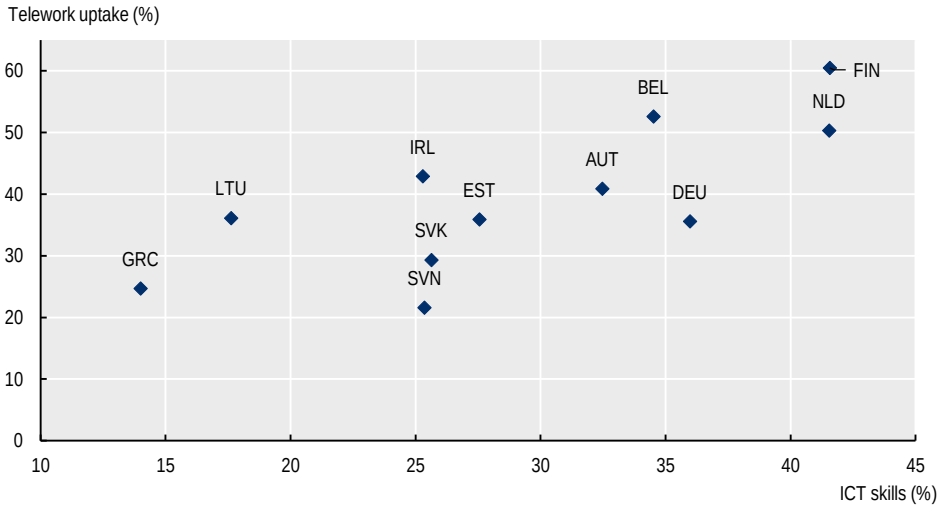
Telework uptake during the COVID pandemic (April 2020) and home infrastructure for fast broadband speed



Note: Firms with at least 30 Mbps advertised download speed broadband connection, data for 2019. Fast fixed broadband subscriptions per 100 inhabitants (minimum 25/30 Mbps), based on December 2019 speed tiers. Australia: Data reported for December 2018 and onwards is being collected by a new entity using a different methodology. Figures reported from December 2018 comprise a series break and are incomparable with previous data for any broadband measures Australia reports to the OECD. Speed tier data are only for services purchased over the National Broadband Network (NBN), which comprise the majority of fixed broadband services in operation. There is no public data available for the speed of non-NBN services. Mexico and Switzerland: Data are preliminary. New Zealand: Speed tiers are for 2018 instead of 2019.
Sources: Author's calculation based on Eurofound (2020) for telework uptake; OECD (2021[1]), "ICT Access and Use by Businesses", OECD Telecommunications and Internet Statistics (database), https://doi.org/10.1787/9d2cb97b-en for broadband infrastructure and speed.

Figure 17

Telework uptake and ICT skills



Note: The ICT skills indicator corresponds to the "proficiency in digital environments". Percentage of adults with high scores in PIAAC's problem solving in technology-rich environments. Problem solving in technology-rich environments is defined as using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks; it measures both problem-solving and basic computer literacy skills (i.e. the capacity to use ICT tools and applications).. Sources: Author's calculation based on Eurofound (2020); OECD (2019[2]), *Skills Matter: Additional Results from the Survey of Adult Skills*, https://doi.org/10.1787/1f029d8f-en for ICT skills.

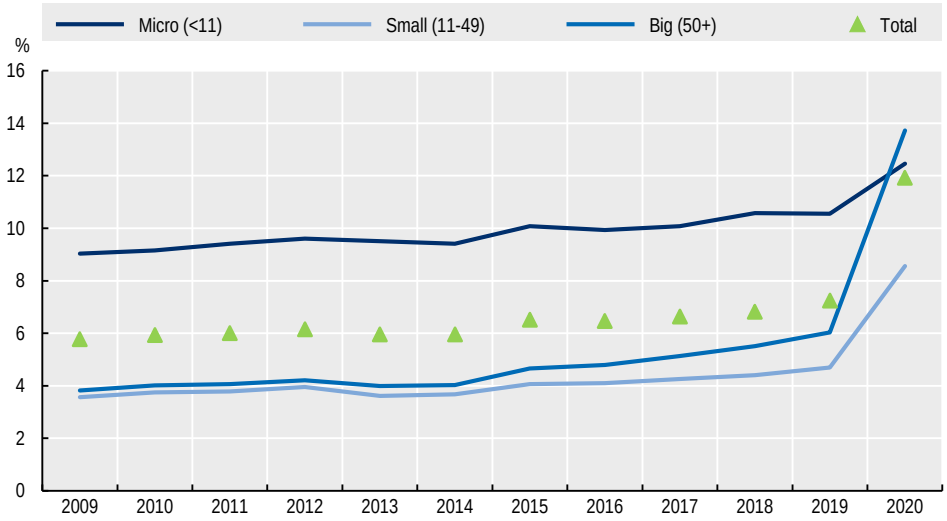
Data for the US point to a telework uptake of similar magnitude as in Europe with results from the Survey by QuestionPro on behalf of Stanford University reporting that about 62 percent of those working in May were doing so from their home (Barrero et al., 2021). Similarly, Brynjolfsson et al. (2020) and Bick, Blandin, and Mertens (2020) find very close figures (56% and 49%, respectively). In the UK, the ONS also reports a massive shift to the use of telework practices during COVID (ONS, 2020).

Differences exist not only across countries and sectors but also within them. To show this, we rely on granular information on telework use – by firm size, sector and region – from the European Labour Force survey.[33] The evidence reported in Figure 18 and Figure 19 suggests that while there was a general increase in working from home, the uptake was much stronger amongst larger businesses (with more than 50 employees) and in more densely populated areas (i.e. cities), rather than in towns and rural areas.

[33] The analysis focuses on non-agriculture private business sector firms with at least one employee.

Figure 18

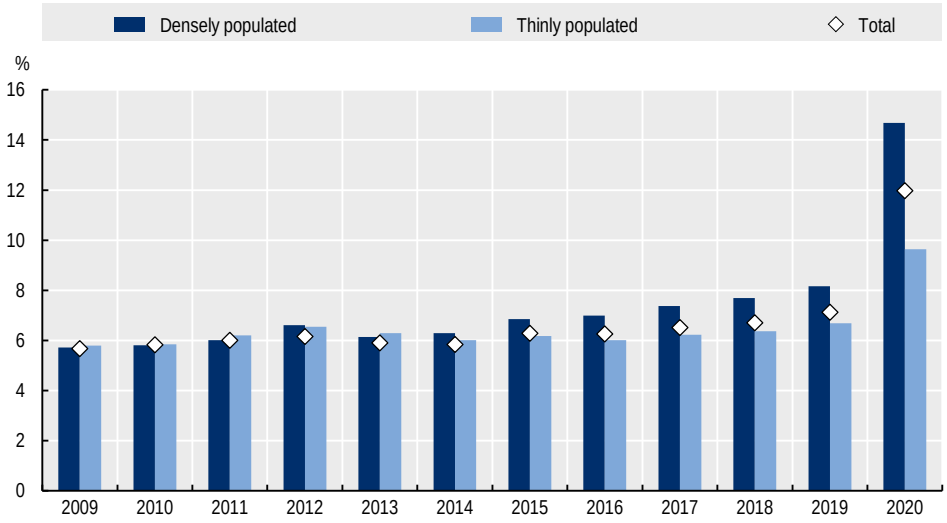
Share of workers usually working from home across firms of different size



Source: Calculations based on EU-LFS.

Figure 19

Share of workers usually working from home in urban (densely populated) and rural (thinly populated) areas



Source: Calculations based on EU-LFS.

We also conduct an econometric analysis that tries to gauge potential reasons for differences in adoption of telework in 2020 across firms, controlling for unobserved time invariant factors at the country, sector, size-class and region level.

In particular, we focus on the changes observed in 2020 and on factors that may explain differences in the uptake of telework in the last two years. The results are

reported in Table 2 and suggest that the share of workers switching to telework was stronger in 2020 than in 2019, and the switch tends to happen more in areas where there is a larger share of households with broadband connection (either fixed or mobile). Even within these areas, broadband connection facilitated switching to telework relatively more for workers in larger firms and those living in cities. These results are robust to including the share of manufacturing activity in the area.[34]

Table 2

Telework uptake during COVID-19 – Broadband, size and population density

	(1)	(2)	(3)	(4)
	Home work	Home work	Home work	Home work
Broadband	0.0239	-0.116	0.531***	0.391*
	(0.0610)	(0.101)	(0.184)	(0.209)
Size class 11-19 * broadband		-0.0533		-0.0565
		(0.129)		(0.130)
Size class 20-49 * broadband		0.272*		0.254
		(0.159)		(0.162)
Size class 50 or more * broadband		0.325**		0.313**
		(0.133)		(0.132)
Intermediate areas * broadband			-0.400**	-0.395**
			(0.197)	(0.197)
Thinly populated * broadband			-0.652***	-0.640***
			(0.190)	(0.191)
2020 dummy	0.0430***	0.0430***	0.0429***	0.0429***
	(0.00222)	(0.00223)	(0.00223)	(0.00223)
Observations	10,039	10,039	10,039	10,039
Number of ids	5,406	5,406	5,406	5,406
Adjusted R-squared	0.109	0.111	0.113	0.115

Notes: within-regression (country- area-industry-size class panel) regressions of home work on: year fixed effects and broadband (column 1); year fixed effects and broadband interacted with size class (column 2); year fixed effects and broadband interacted with population density class (column 3); year fixed effects and broadband interacted with both size and population density class (column 4). Baseline categories: size class: 1-10; population density class: densely populated; robust standard errors in parentheses. Broadband is defined as a share of households by country, population density class and year with access to the internet through broadband connection either mobile or fixed.

The large rise in telework during COVID and the relationship between adoption of telework and size are confirmed by additional regression analysis. This additional check uses results for selected euro area countries from a survey designed to describe the implications of the switch to telework during COVID for productivity and expected use of telework after COVID conducted by the Global Forum on Productivity (GFP) (OECD, 2021). The GFP survey on telework and productivity reached out to workers and managers from several thousands of companies in 25 countries. It shows that the increase ranges from 20% in manufacturing (from 15 to 35%) to 40%, doubling from less than 40% to almost 80% in knowledge intensive services such as ICT, finance and other professional services.

In addition to firm size, the GFP survey shows that the use of regular telework before and during the pandemic (and its expected persistence after COVID) appear to be

[34] Results available upon request.

strongly related with firms having experience with telework practices before (and/or during the pandemic) (OECD 2021).

The survey results highlight that both managers and to a larger extent workers would like to continue teleworking regularly, at an optimal level of 2 or 3 days per week with coordination of on-site presence as critical for firm performance and therefore suggest that hybrid modes of working might persist beyond the crisis. This is in line with findings from a larger scale survey conducted in the UK by Bloom, Mizen and Taneja (2021). Results from another large scale survey for the US (Barrero et al., 2021) predicts teleworking on 22.2% of working days – equivalent to slightly more than a day per week, which also represents a significant increase relative to pre-pandemic levels.

Against this background, savings in commuting time are estimated to explain half of the estimated productivity increase in the US following COVID, mainly thanks to saved commuting time and higher worker efficiency[35] (Barrero et al, 2021). However, these estimates might only capture the positive short term effect of telework on productivity and not the long term relationship that might arise once the economy has fully adjusted to telework (Behrens, Kichko and Thisse, 2021).

The observed trends and the expected persistent use of regular telework may have clear implications for the future of work and organisations, but also of auxiliary business services and real estate in cities, of productivity and innovation.

For the US, Barrero et al. (2021) project that telework will result in a drop in spending of at least 5-10 in cities such as San Francisco or New York relative to pre-COVID-19 levels. This reflect the fact that professionals in well-payed white collars occupations will likely continue to benefit from telework, commute fewer days a week into the office and thus spend less in shops, restaurants, amenities and services near their offices in the city. Althoff et al. (2021) and Ramani and Bloom (2021) find that workers, especially in high income skill service jobs, either moved from more dense to less dense areas both temporarily and permanently which resulted in a drop in residential and commercial rental prices throughout 2020 (Althoff et al., 2021 and Rosenthal, Strange and Urrego, 2021). If these trends persist in the long run, they could lower the pressure on housing markets in densely populated areas (The Economist, 2021).

Even if employees did not leave cities, they worked from their homes and spent significantly less on consumer services in their neighbourhood (Althoff et al., 2021) and virtually not at all on grocery, services and amenities near their office. This could also help explain that low skill consumer service were amongst the group most affected by the pandemic especially in the richest areas of the US (Chetty, Friedman, Hendren, and Stepner, 2020). This suggests that a potential consequence of teleworking is increased inequality between high-skilled professionals and low-skilled

[35] According to their measure of productivity which accounts for commuting time, they estimate that 2.5 percent (earning weighted) productivity increase in the US. This accounts for more than half of the total 4.6 percent increase in productivity, which also reflects higher worker efficiency of telework.

workers who cannot benefit from telework or whose livelihood is negatively affected by telework.

5 Market Power before and during the COVID-19 crisis

One concern arising from the asymmetric digitalisation of firms and the differences in their agility in reacting to the COVID crisis is the fact that larger, more productive, better-managed firms may not only become relatively more efficient, but also gain stronger market power in the aftermath of the crisis.

Initial evidence on the performance of capital markets during the pandemic suggests that the largest players have seen the largest gains in market value, with 25 firms accounting for about 40 percent of total gains between February 2020 and February 2021. Most of these companies were digital technology companies and have been amongst the top performing in the last 15 years (Bradley and Stumpner, 2021), suggesting that COVID has strengthened their dominance on the stock market. Their performance on the stock market is one measure of the rising gap between frontier or “superstar” firms and the “rest”. In section 4 we discussed how the last two decades have seen both an increase in digitalisation and knowledge intensity, and a rising gap in productivity. In this section we will focus on a second feature of the last two decades, a rising market power, which has also been accompanied by a decline in business dynamism in OECD most countries (see Decker et al., 2014 for evidence for the US, and Calvino, Criscuolo and Verlhac, 2020, across OECD countries).

To do this, we rely on two imperfect proxies of market power: the rise in markups, i.e. the wedge between unit prices and marginal costs, and the rise in revenue concentration. In addition, and for the last two years, when information on markups or concentration is not available because of lack of data, we focus on M&A dynamics. Both proxies used - markups and revenue concentration - have limitations and are subject to criticisms.

Markups measure the ratio of unit price and marginal cost. If the residual demand curve for the firm is not perfectly elastic, the firm can charge a markup higher than 1 at the firm’s profit-maximizing output level. As both unit prices and marginal costs are often not observed, recent methodologies have been developed to estimate firm-level markups (e.g., De Loecker and Warzynski, 2012; De Loecker, Eeckhout and Unger, 2020). These methodologies have been criticised because of the assumptions needed (e.g. perfectly competitive input markets; no adjustment costs for at least one input; etc.) and challenges in measurement of underlying economic variables from accounting data (Traina, 2018 and Syverson, 2018 for an overview). In addition, from a conceptual point of view, high markups might also not be the results of a non-competitive environment, if high markups reflect the presence of high fixed costs and low marginal costs, that are features of digital- , intangible- and knowledge intensive production processes (De Ridder, 2019).

Concentration is also not immune to criticisms. The literature has mostly relied on a measure of concentration at industry level, a much broader measure than market

concentration.[36] Only if the large firms holding the largest share of industry activity are all leading firms in the same market for specific products or services that are close substitutes (see Werden and Froeb, 2018) will industry concentration translate in concentrated product markets. Even in the particular case where industry concentration is a good proxy for market concentration, it might still not be a good indicator of market power in the case of differentiated product or geographic markets, platform markets and innovative markets (see Syverson, 2018 for a discussion).

For example, markets can be national, but also local and international. Recent US evidence also highlights how an increase in concentration at the national level could actually lower concentration at the local market level, if the increase in concentration is driven by the expansion of the largest players into new geographical areas where local concentration was high (Rossi-Hansberg, Sarte and Trachter, 2021). However, this result could be mechanical, and is affected by the same criticisms as those of national level measures of concentration (Eeckhout, 2021). Similarly, a domestic increase in industry concentration could be somewhat compensated by increased imports from foreign markets (Gutierrez and Philippon, 2017). Thus, an increase in industry concentration will not necessarily imply an increase in market concentration.

Importantly, an increase in industry concentration might reflect an efficient reallocation of resources, rather than the lack of competitive pressure, if the firms with the largest revenue shares are the ones that are able to charge the lowest prices as they are the most innovative, intangible intensive and/or productive at each point in time. Recent studies (e.g. De Loecker, Eeckhout and Unger, 2020 and Autor et al., 2017) find that reallocation of market shares from low to high markup firms accounts for about two thirds of the overall rise of markups. Autor et al. (2017) also find that industries that are becoming more concentrated are those with faster productivity growth and higher innovation, and that larger firms have higher markups. Taken together, this evidence suggests that more productive firms are able to charge lower prices and thus benefit from higher markups. In addition, industries with high concentration may still be very competitive if concentration is the result of production technologies with high fixed costs and/or strong network effects (Crouzet and Eberly, 2018 and 2019), with close rivals still competing aggressively for the market (the so-called “competition for the market”). Finally, technological developments, integration of global markets or sustained innovation could allow the most efficient firms to increase their competitive edge over other firms, thus contributing to welfare gains and productivity growth.

However, increases in concentration, or its persistence, could be the reflection of “superstar” firms in dominant position being entrenched thanks to lobbying or anti-competitive behaviour, including the acquisition of potential competitors through

[36] For a recent notable exception, see Affeldt et al. (2021). They use a database that identifies over 20,000 product/geographic antitrust markets affected by over 2,000 mergers decisions by the European Commission Directorate General for Competition, over the period 1995-2014. Their measure concentration is a market-specific post-merger Hirsch Herfindahl Index. They find an even steeper increase in concentration than in the extant literature.

"killer acquisitions", the competition policy environment or anti-competitive regulations.

Therefore, the heterogeneous adoption and implementation of digital technologies discussed above could well increase the observed trends in both markups and concentration, if both are positively correlated with digitalisation, and it could exacerbate them if, in addition, there were an increase in Mergers and Acquisitions activities. In the next sections, we will try to provide evidence on both these questions.

The net implications for prices and consumer welfare are a priori ambiguous and will depend on which process dominates: market power vs. efficient reallocation. On the one hand, technological developments, integration of global markets or sustained innovation allow the most efficient firms to increase their competitive edge over other firms, contributing to welfare gains and productivity growth. On the other hand, when the most efficient firms are in a dominant position, they might enjoy increased market power. This brings negative implications for prices and, hence, consumers (see also De Loecker, Eeckhout and Unger, 2020, who find a negative net effect and discussion in Van Reenen, 2018).[37]

5.1 Markups

The first proxy of market power we rely on is markups, estimated following the methodology developed by De Loecker and Warzynski (2012) built on the production approach of Hall (1988). This methodology has been widely used in recent years to show an increase in average markups and in their dispersion in the US (De Loecker, Eeckhout and Unger, 2020), across OECD countries (Calligaris, Criscuolo and Marcolin, 2018, and IMF, 2019), and globally (De Loecker and Eeckhout, 2018).

Following closely the methodological choices taken in Calligaris, Criscuolo and Marcolin (2018), we estimate markups across selected euro area countries[38] using accounting data from the Moody's ORBIS database. Calligaris, Criscuolo and Marcolin (2018) show that between 2002 and 2014 markups across 26 countries have increased more in non-financial market services than in manufacturing, and more so in digital- intensive sectors, where they were already high at the beginning of the 2000s. We therefore test whether these results hold within the euro area, as well as in the second half of the 2010s. As shown in Figure 20, markups have

[37] Measures of concentration and their evolution time may suffer from misreporting and mismeasurement, especially if they are not based on the full population of businesses. In this case, measured changes in concentration may reflect attrition in the sample considered or improvement in data coverage (see for example Ali, Klasa and Yeung,,2009 for a discussion related to Compustat vs Census data in the US and Bajgar et al., 2019 in relation to Orbis in Europe).

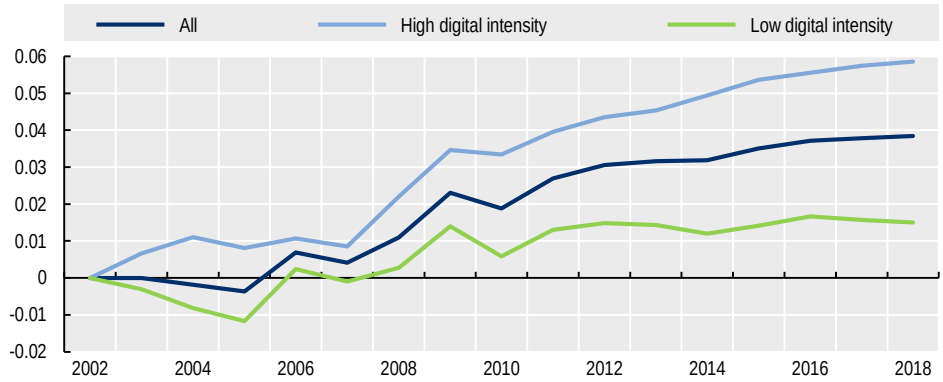
[38] Euro area countries included are: Belgium, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Netherlands, Portugal, Slovenia and Spain. .

increased more in digital intensive service sectors, with the gap having steadily increased over time.[39]

This evidence is in line with evidence from papers focusing on other proxies of market power and showing that digital assets, and in particular proprietary software (Bessen, 2017), might allow firms to increase their efficiency and market power. It is also in line with theoretical models (De Ridder, 2019) suggesting that the reduction of marginal costs and the increase in fixed costs driven by intangibles such as software, gives digital/intangible intensive firms a competitive advantage, deterring entry of new competitors. Calligaris, Criscuolo and Marcolin (2018), show that the rise in markups is positively linked with the increase in software and ICT patents stock, i.e. the intangible part of digital assets.

Figure 20

Average markups have increased especially in digital sectors after the Global Financial Crisis



Notes: Unconditional averages of firm-level log markups, assuming a Cobb-Douglas production function with 3 inputs (K, L, M) and intermediates as fully flexible input. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. Included industries cover 2-digit manufacturing and non-financial market services. In the top panel, the graph reports log markups in manufacturing (light blue line), services (green line) and overall (dark blue line), and indexes the 2002 level to 0 (hence the vertical axes represent log-differences from the starting year which, given the magnitudes, approximates well for growth rates). In the central panel, the graph reports log markups in high digital intensive industries (light blue line), low digital intensive industries (green line) and overall (dark blue line), and indexes the 2002 level to 0. In the bottom panel, the graph reports log markups in high digital intensive industries (light blue line), low digital intensive industries (green line) and overall (dark blue line) in the manufacturing (left panel) and market services (right panel), and indexes the 2002 level to 0. The digital intensity of industries is defined using the digital intensity indicator of 2013-15 constructed by Calvino et al. (2018); industries are classified as “high digital” if they are in the top quartile of the industry distribution in terms of digital intensity.
Source: Calculations based on Orbis.

Second, we look at whether the distribution of markups has become more dispersed over time, distinguishing among firms at the bottom, at the median and in the top of the markup distribution in each year. The trends reported in Panel A of Figure 21 show that firms at the top of the markup distribution are the ones driving the overall increase: since the mid-2000s, they have diverged from the rest and only after the GFC firms with median level of markups have experienced a milder increase in

[39] Figure A 10 reports trends in markups distinguishing between non-financial market services and manufacturing. The gap between services and manufacturing has become larger after the GFC of 2008 and has continued to increase since. In addition, the increase in mark-ups in the digital intensive sectors seems to be driven by high-digital intensive services (bottom panel).

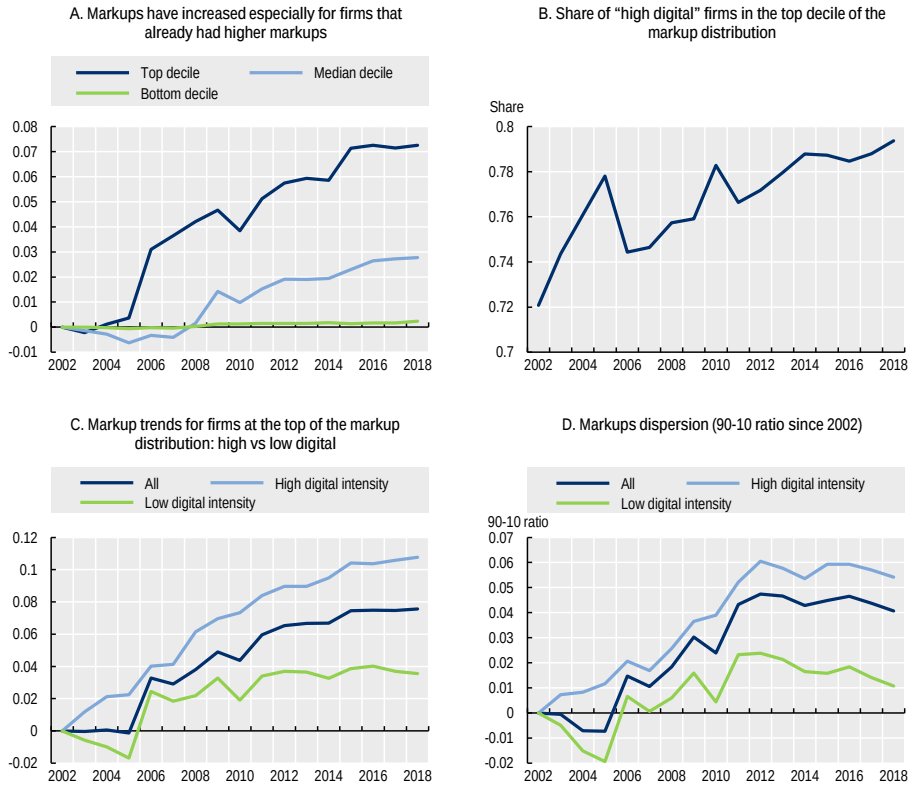
markups. The trend at the bottom of the markup distribution has instead remained flat for the last 20 years.

If the increasing role of digital technologies, in particular of intangible digital assets, does play a role in explaining the observed increase in markups, as discussed above, we should observe three trends.

First, the share of "digital intensive" firms amongst the firms with the highest markups should increase over time. Second, they should be the ones observing the largest increase when compared with others at the top of the markup distribution in other sectors. Third, the dispersion in markup should have grown the most in digital intensive sector. Panel B of Figure 21 confirms the first trend: the share of digital intensive firms amongst the top decile of the overall distribution has increased in the last twenty years. Panel C of Figure 21shows that firms in the top decile of the markup distribution in digital intensive sectors have seen the largest increase in markups relative to firms in the top decile in less digital intensive sectors. Finally, Panel D of Figure 21confirms that dispersion in digital intensive sectors has increased the most.

Figure 21

The evolution of the markups distribution



Note: Unconditional averages of firm-level log markups in the chosen part of the distribution of markups, assuming a Cobb-Douglas production function with 3 inputs (K, L, M) and intermediates as fully flexible input. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. Included industries cover 2-digit manufacturing and non-financial market services.
Panel A: reports log markups ups in the bottom (green line), the median (light blue line) and the top (dark blue line) decile of the markup distribution, and indexes the 2002 level to 0. Hence the vertical axes represent log-differences from the starting year which, given the magnitudes, approximates well for growth rates. Deciles of the distribution are defined relative to the rest of the firms in each 2-digit industry-year.

Panel B: reports unconditional average of the share of firms belonging to high digital intensive sectors in the top decile of the markup distribution defined relative to the rest of the firms in each country-year. The digital intensity of industries is defined using the digital intensity indicator of 2013-15 constructed by Calvino et al. (2018); industries are classified as "high digital" if they are in the top quartile of the industry distribution in terms of digital intensity.
Panel C:.reports unconditional averages of firm-level log markups in the top decile of the markup distribution belonging to high digital intensive industries (light blue line), low digital intensive industries (green line) and overall (dark blue line), and indexes the 2002 level to 0. Hence the vertical axes represent log-differences from the starting year which, given the magnitudes, approximates well for growth rates. The top decile of the markup distribution is defined relative to the rest of the firms in each 2-digit industry-year.
Panel D: reports dispersion in markups, measured as the 90-10 ratio of firm-level log markups, belonging to high digital intensive industries (light blue line), low digital intensive industries (green line) and overall (dark blue line), and indexes the 2002 level to 0. Hence the vertical axes represent log-differences from the starting year which, given the magnitudes, approximates well for growth rates. Dispersion of the markup distribution is defined in each 2-digit industry-year.

Source: Calculations based on Orbis.

As discussed in Section 4, the COVID-19 crisis has spurred an increase in digital adoption that has been heterogeneous across firms. The stronger increase in markups for more digital intensive firms suggest that a potential risk of this shift is an increase in markups, especially amongst firms that already had large margins.

5.2 Concentration

Numerous studies have pointed to an increase in industry concentration over recent years in the United States (e.g., Grullon, Larkin and Michaely, 2018; Autor et al., 2017), and similar evidence exists for Japan (Honjo, Doi and Kudo, 2014). More recent studies for Europe also show an increase in concentration, even though to a lesser extent than in the US (Valletti et al., 2017; Bajgar et al., 2018; Bajgar, Criscuolo and Timmis, 2021; Affeldt et al., 2021). [40]

Despite the limitations discussed at the start of the section, carefully documenting trends in industry concentration, together with trends in markups, may provide additional evidence to confirm whether structural and policy factors related to the increase in markups are also linked to increased industry concentration. Also, documenting the increased weight of few firms across industries has implications for upstream sectors (suppliers) and workers which may be faced with monopsony in their local labour market, with implications for wage levels and inequality (Manning, 2003 for a seminal paper, Azar et al., 2018 for evidence on the US; and OECD, forthcoming for cross country evidence). In addition, the systemic risks linked to the large weight of few firms and their potentially stronger lobbying power (Dellis and Sondermann, 2017) may significantly affect the design of policies in ways that might unlevel the playing field.

Based on the methodology presented in Bajgar et al. (2019) and Bajgar, Criscuolo and Timmis (2021), we present trends at the business-group-level in Europe up to 2018 relying on matched Orbis-Zephyr data[41] and the OECD STAN database. Bajgar

[40] Earlier studies for Europe (e.g. Gutierrez and Philippon, 2018; Döttling, Gutierrez Gallardo and Philippon, 2017; Valletti, et al., 2017) show that, contrary to trends in the US, concentration in Europe has been stable or decreased.

[41] The business group and subsidiary financial information is primarily sourced from Orbis. The primary source of parent-subsidiary ownership information is Orbis, which is supplemented with data from the Zephyr database of Mergers and Acquisitions (M&As), both provided by Bureau Van Dijk (BvD). Extensive cleaning and a novel apportioning methodology is then applied, as explained in more detail in Bajgar et al. (2019).

et al. (2019) and Bajgar, Criscuolo and Timmis (2021) methodology allows taking into account the structure of each business group and apportioning group sales to the countries and industries where it operates, while the OECD STAN data allow obtaining reliable and time consistent 2-digit industry sales denominators for the concentration measures considered in the paper.

The trends reported in Figure 22 confirm the increase in industry concentration in the euro area between 2000 and 2018 of the order of a (cumulated) 8 percent. The largest increases linked to the GFC flatten between 2014 and 2018.[42] Contrary to the trends in markups shown above, trends in industry sales concentration are mostly similar between high and low-digital intensive sectors. Nonetheless, the digital intensive sectors saw the strongest increase in concentration during the GFC and in its immediate aftermath.

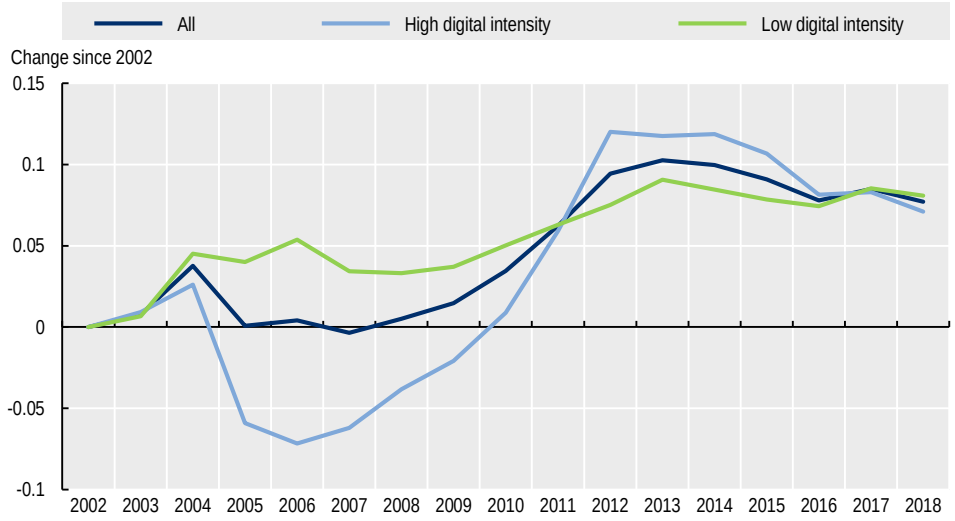
Data is not yet available to investigate trends in concentration during the COVID-19 pandemic directly and to see whether concentration has increased during the COVID-19 crisis and more so in digital intensive sectors. But concentration can increase through several channels: increased exit and lower entry, (organic growth of already large incumbent) and through mergers and acquisitions (M&As). The dynamics of entry and exit during the COVID-19 recession, couldn't as of yet be necessary linked to a strong increase in concentration: exit has been "frozen" and entry has picked up quickly in many EA countries. Reallocation of resources between incumbents, on the other hand, might go in the direction of increased concentration, since resources have been reallocated from small to large firms in the EA, as presented in Section 3. In the next section, we turn to analysing the dynamics of M&As, which could be a channel for increased concentration.

[42] That notwithstanding, recent trends in mergers and acquisition activities point to an increase in the number of acquisition of firms that operate in digital intensive sectors, but, the (revenue based) size of targets is relatively small, so this might explain why this increase does not translate in significant differential changes in the concentration numbers in these sectors.

Figure 22

Concentration has increased in the last decade

C8 cumulative change



Note: Share of sales accounted for by 8 largest business groups in the available countries of the euro area. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. Included industries cover 2-digit manufacturing and non-financial market services. In the top panel, the graph reports the cumulative weighted average change in industry concentration in manufacturing (light blue line), services (green line) and overall (dark blue line), with weights given by each industry's share in the total sales across all industries of the region. In the bottom panel, the graph reports the cumulative weighted average change in industry concentration in high digital intensive industries (light blue line), low digital intensive industries (green line) and overall (dark blue line), with weights given by each industry's share in the total sales across all industries of the region. The digital intensity of industries is defined using the digital intensity indicator of 2013-15 constructed by Calvino et al. (2018); industries are classified as "high digital" if they are in the top quartile of the industry distribution in terms of digital intensity.
Source: Calculations based on Orbis-Zephyr.

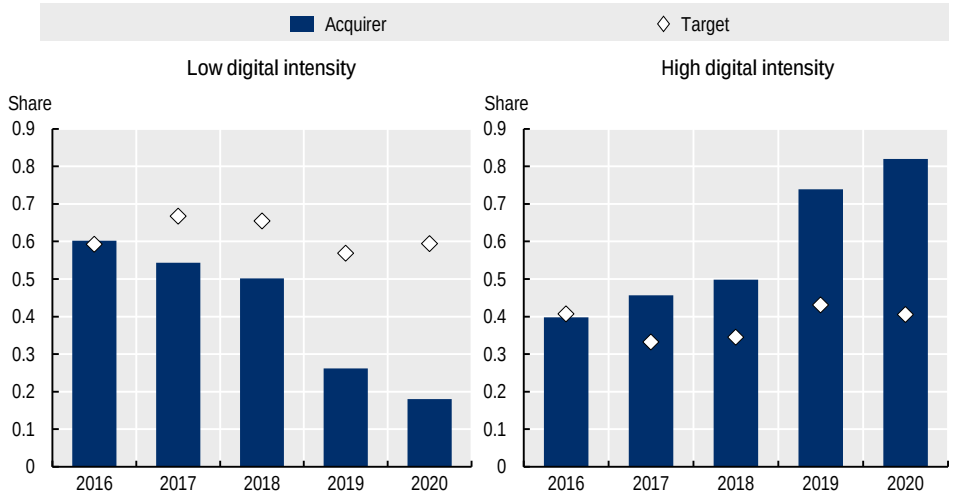
5.3 M&A dynamics during COVID-19

As discussed in the previous section, industry concentration has increased steadily until 2018 just before the COVID-19 crisis. Unfortunately, data on industry concentration during the COVID crisis are not yet available. However, timely data on M&A deals are available for all of 2020. Analysing trends in M&A activities and differences across sectors might give some initial pointers on whether pre-crisis trends might be reinforced.

Figure 23 reports the share of the total value of M&A deals accounted for by deals for which the acquirer (the bars in the figure) – or the target (the diamonds in the figure) – are in high and in low digital intensive sectors over the last five years. The figure shows that the value of M&A deals by acquirer in digital intensive sectors has gone from representing 40% to representing 80% of total deals. The trends for digital targets is much flatter and hovers around 40%.

Figure 23

Trends in share of M&A activity (in values) 2016-20, by industry's digital intensity



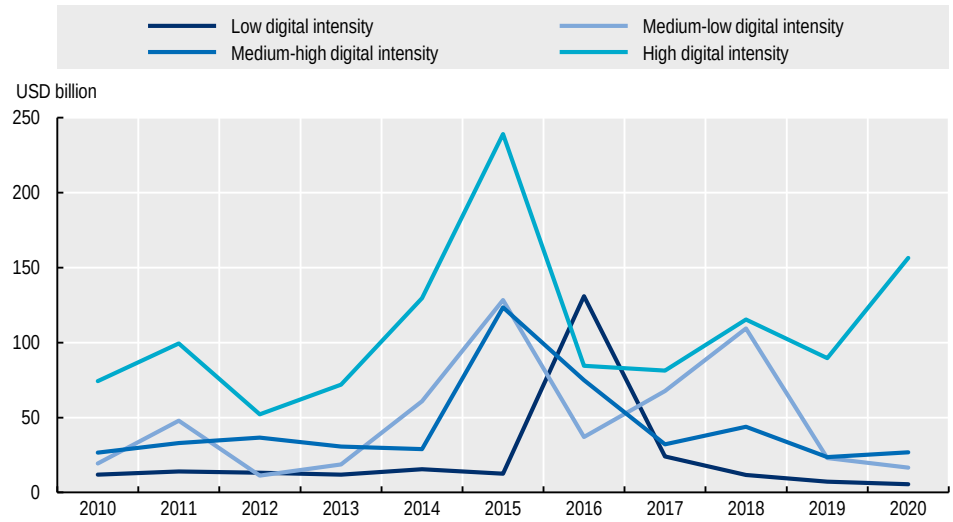
Note: Share of M&A by digital intensity for the available countries of the euro area. The sum of low and high digital intensity bars will sum to 1 in each year. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. The M&A data reflects the annual total number of acquisitions (i.e., result in a majority stake), purchasing minority stakes and issuing of new share capital from firms active in manufacturing and services sectors (i.e., NACE rev.2 codes 10-33 and 45-83, excluding 19 and 68) and involving target firms in the non-farm, non-financial business sector (i.e., NACE rev.2 codes 10-82, excluding 64-66). M&A value is expressed in 2005 $ (exchange rates from the World Bank Development Indicators).The digital intensity of sectors is defined using the industry of the target firm and the STAN A38 global digital intensity indicator of 2013-15 constructed by Calvino et al. (2018); industries are classified as "high digital" if they are in the top quartile of the industry distribution in terms of digital intensity.
Source: Calculations based on Zephyr 2021.

In fact, when looking at the total value of the deals in billion dollars, as done in Figure 24, the growth over the last two years is even more striking, as the group of deals where the acquirer belongs to high digital intensive sectors is the only one that has observed an increase even during the COVID-19 crisis. The latter increase is mainly driven by an increase of the largest deals (top decile in terms of value) by acquirers in digital intensive firms (Figure 25).

Figure 24

Trends in total values of M&A deals 2010-20, by industry's digital intensity

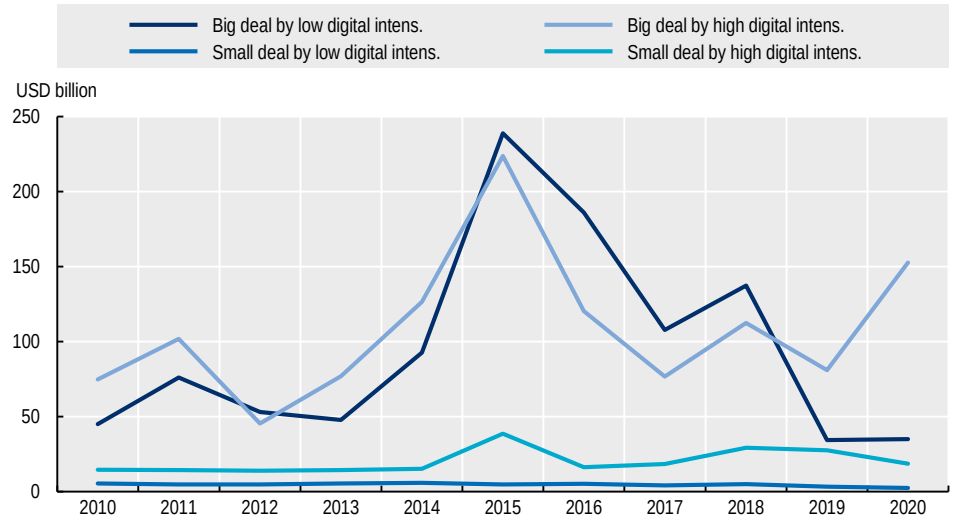
Acquirer



Note: Total value of deals by digital intensity of the acquirer firm for the available countries of the euro area. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. The M&A data reflects the annual total number of acquisitions (i.e., result in a majority stake), purchasing minority stakes and issuing of new share capital from firms active in manufacturing and services sectors (i.e., NACE rev.2 codes 10-33 and 45-83, excluding 19 and 68) and involving target firms in the non-farm, non-financial business sector (i.e., NACE rev.2 codes 10-82, excluding 64-66). M&A value is expressed in 2005 $ (exchange rates from the World Bank Development Indicators). The digital intensity of sectors is defined using the industry of the target firm and the STAN A38 global digital intensity indicator of 2013-15 constructed by Calvino et al. (2018).
Source: Calculations based on Zephyr 2021.

Figure 25

M&A values 2010-20: big vs small deals by industry's digital intensity



Note: Total value of big (overall top decile of the M&A value distribution) vs small (the rest) deals by digital intensity of the target firm for the available countries of the euro area. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. The M&A data reflects the annual total number of acquisitions (i.e., result in a majority stake), purchasing minority stakes and issuing of new share capital from firms active in manufacturing and services sectors (i.e., NACE rev.2 codes 10-33 and 45-83, excluding 19 and 68) and involving target firms in the non-farm, non-financial business sector (i.e., NACE rev.2 codes 10-82, excluding 64-66). M&A value is expressed in 2005 $ (exchange rates from the World Bank Development Indicators). The digital intensity of sectors is defined using the industry of the target firm and the STAN A38 global digital intensity indicator of 2013-15 constructed by Calvino et al. (2018); industries are classified as "high digital" if they are in the top quartile of the industry distribution in terms of digital intensity.
Source: Calculations based on Zephyr 2021.

This descriptive evidence suggests that M&A activity related to large deals in high digital intensive sectors has increased even during the COVID-19 crisis.

To provide some additional evidence on whether this could result in increased concentration, we investigate whether the volume of M&A deals, in value and number, is higher when the acquirer operates in industries that were already concentrated. Estimates reported in columns 1 and 4 of Table 3 suggest that both the total value and number of deals are indeed higher the more concentrated is the industry of the acquirer. The results suggest that this positive relationship is partly explained by the acquisitions by the largest eight firms in the industry (columns 2 and 5). Moreover, the gap in the size and the number of deals between those done by the largest eight firms and the rest is even higher in digital intensive industries (columns 3 and 6).

Taken as a whole these results suggest that the trends in M&A dynamics observed during the COVID-19 crisis might increase concentration especially in digital intensive sectors. This might reinforce any competitive advantage that large firms may have had pre-pandemic, with consequences for competition and innovation.

Table 3

Number and Value of M&As are higher in more concentrated industries

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Value of M&A deals			Log Number of M&A Deals		
Lagged concentration	0.122***	0.081**	0.081**	0.021*	0.011	0.011
	(0.043)	(0.040)	(0.040)	(0.012)	(0.011)	(0.011)
Top 8		1.949***	1.740***		0.493***	0.415***
		(0.102)	(0.120)		(0.041)	(0.041)
Top8 x Digital			0.447***			0.167**
			(0.175)			(0.078)
Observations	28145	28145	28145	28145	28145	28145
Pseudo R-Square	0.122	0.155	0.156	0.046	0.062	0.062
Country and Sector and Year FE	YES	YES	YES	YES	YES	YES
Num. Countries	12	12	12	12	12	12

Notes: This table reports the coefficients of an OLS regression based on M&A activities of acquirers from BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. The dependent variables considered are (log of) value and number of acquisitions (i.e., result in a majority stake), purchasing minority stakes and issuing of new share capital from firms active in manufacturing and services sectors (i.e., NACE rev.2 codes 10-33 and 45-83, excluding 19 and 68) in the period 2004-2020. M&A value is expressed in 2005 $ (exchange rates from the World Bank Development Indicators). The explanatory variables included are: the concentration measure in the country-industry of the acquirers two years before the M&A event (Lagged concentration), a dummy for whether the acquirer was within the biggest 8 firms (in term of gross output) in any country-sector of our sample two years before the M&A event (Top 8), and the interaction of this latter variable with a dummy that classifies industries based on the digital intensity, using the indicator constructed by Calvino et al. (2018); industries are classified as “Digital” if they are in the top quartile of the industry distribution in terms of digital intensity. All regressions control for country, sector and year fixed effects. Standard errors clustered at the country-sector level are reported in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

6 Conclusions and Policy Implications

The COVID-19 crisis has been one of the largest shocks to the global economy in the last century.

Although the current outlook remains uncertain, the success of vaccination campaigns in many euro area countries has increased confidence in a better economic outlook. Yet, governments still face significant challenges and risks during the recovery phase.

In addition to the immediate response of businesses to the shock and the short-term risks faced by countries and economies, medium- to long term consequences for productivity and business dynamics are likely to come from changes in consumers' behaviour and from the massive and rapid increase in adoption of digital technologies and telework. These developments have opened new opportunities, but also come with potential risks.

The paper has described these changes relying on timely data, whenever possible, or resorting to evidence from the extant literature, and it has discussed the channels through which they can affect productivity and business dynamics.

Monetary and fiscal policies have been key for safeguarding productive job matches, avoiding a liquidity crisis and supporting demand. Thanks to the massive support in place, the recovery has been smoother and the resilience stronger than what was expected at the beginning of the crisis. However, structural policies will be the strategic ally to ensure, in the short-run, low adjustment costs and, in the medium to long-run, higher potential output, low inflationary pressure and more equal and inclusive economies.

I will focus in particular on three areas of structural policy that in the aftermath of the COVID-19 crisis will be particularly important: (1) fostering digital diffusion and sectoral reallocation; (2) enabling entry, exit and growth of innovative firms and (3) maintaining a competitive environment for innovation.

(1) Fostering digital diffusion and sectoral reallocation

The evidence shows that this crisis has been characterised by significant sectoral reallocation. It is probably too early to classify this reallocation as cyclical or structural. However, if the observed reallocation in favour of higher productivity activities is structural, then it may support the growth of potential output and reduce inflationary pressures in the long run. In the short-to-medium run, however, this sectoral reallocation may be characterised by high adjustment costs and result in slower growth, high level of skill mismatch, frictional unemployment and temporarily higher inflationary pressure.

These short- and medium-term costs and the risk of a slower recovery may be attenuated by policies that facilitate labour mobility and provide workers with the skills needed to move from the shrinking to the expanding sectors, and especially with digital skills, which are key to adapt to the increasingly digital business environment.

COVID-19 has been a game changer for accelerating digital adoption. During lockdowns, digital technologies have been the key for preserving economic activity and ensuring resilience. In the medium to long run, digital technologies, especially if coupled with complementary investment in intangible assets, will boost productivity – ultimately supporting the growth of potential output – and have the potential to compress the productivity distribution by helping laggard firms catching-up.

However, digital adoption during the pandemic has not been homogenous. Large, more productive and better-managed firms have adopted more and better technologies, with a consequent increase in their lead relative to the rest. This might result in increased productivity dispersion, exacerbated divides in productivity and wages, as well as lowered innovation and long run growth. Laggard firms that are now left further behind, as well as potential entrants, might feel discouraged to compete with frontier firms that are much more efficient than them and therefore would not have the incentive to invest in innovation with negative implications for potential output in the long run. For this new wave of digitalisation to benefit a large number of firms and households, skills to thrive in the new digital environment will be needed by managers and workers, particularly among mSMEs.

Use of telework, probably one of the most striking shifts observed during the pandemic, has also been very heterogenous, and not only because of the suitability of tasks in different occupations and industries to be done remotely, but also because of differences in the level of digital skills of workers and the quality of the digital infrastructure available to them.

The implications of telework for productivity and innovation are ambiguous. In the short term, telework may result in higher growth due to lower commuting costs and higher worker efficiency. In the long run, however, high level of telework might result in lower levels of innovation within firms and diffusion across firms with negative consequences for potential output. A permanent increase in the use of telework also has the potential to change the geographical distribution of income and spending, with implications for the future of urban and rural areas; business supporting activities and for real estate prices in cities and business districts. If firms decide to save on office rental costs and workers decide to live further away from the office and regularly work from home, congestion and housing costs would be reduced, real estate supply pressure alleviated and real estate prices in urban areas lowered. However telework would also result in higher inequality if only a fraction of (high-skilled, high income service) workers can benefit from telework and if lower in-person presence in the office results in lower consumption of amenities in urban areas and decreased needs of auxiliary services (e.g., office cleaning and maintenance, etc.).

Telework seems to be here to stay. It is, therefore, important that policies are put in place so that telework does not become an opportunity for the few. For the benefits to be widespread amongst workers in both urban and rural areas, governments will need to invest in upgrading high-speed internet infrastructures, in offering education and training in skills for the digital transformation, and in improving management practices. Increased adoption of telework might also benefit from targeted support for both firms and workers to upgrade equipment, connections and digital security, and from adapting legal and regulatory frameworks.

Policies that support digital diffusion will therefore be crucial to reduce divides across workers, firms and regions. A combination of measures could be used for this purpose. In addition to improving competencies of workers (especially those low-skilled) and managers, and ensure their mobility; measures that increase technology awareness and boosting absorptive capacity as well as measures addressing potential financial constraints are going to play an important role.

(2) Enabling firms' entry and exit and growth of innovative firms

To ensure that new firms can leverage the new opportunities arising from the pandemic, and to reduce the gap in entry rates observed in some EA countries such as Italy, Portugal and Spain, policies should foster entrepreneurship, by reducing red tape and regulatory uncertainty and levelling the playing field. They should also support the development of an ecosystem in which new ventures can experiment and grow, thanks to easy access to financial resources (e.g., venture capital financing and/or new alternative funding sources) to knowledge, talent and technology e.g., through training, mentoring and university-business collaboration.

Policies that support firms' solvency over the short-term and improve the efficiency of liquidation procedures and of judicial systems over the medium- to long-term will also be important to exit the crisis and support sustained productivity growth. It is likely that a wave of bankruptcies has merely been delayed by governments' measures designed to safeguard productive job matches. The support measures put in place during the crisis have allowed safeguarding productive job matches and ensured a smooth recovery. According to the evidence from several countries reported in the paper, they have slowed down exit but have not distorted the productivity enhancing nature of the reallocation process. To avoid that they become an obstacle to reallocation and growth, it is important that support measures are gradually lifted or adapted as countries come out of the crisis. It is likely to be a balancing act. Too early an exit could jeopardise the survival of viable firms in temporary distress and the recovery of firm entry perpetuating a long-term decline in business dynamism. Too late an exit could "zombify" the business sector and slow down reallocation with negative implications for aggregate productivity, and result in an unnecessary increase in public debt. During this phasing-out, it will be crucial to improve the efficiency of insolvency procedures, to allow for speedy entry and exit of firms: this would support reallocation and strengthen the resilience of the economies.

Digital technology adoption goes hand in hand with investment in intangible assets and, thus, is positively related to the growing intangibility of gross fixed capital formation. National Accounts data show how intangible capital formation has remained, by and large, unaltered during the COVID-19 pandemic, while tangible investments plummeted and, as of the first quarter of 2021, had not recovered to their pre-crisis levels. This is consistent with the complementarity between intangible investment and digital transformation. While the resilience of intangible investment over the pandemic will likely help mitigate scarring, recent research suggests that growing intangibility of capital may subdue the transmission of monetary policy to the real economy (Döttling and Ratnovski, 2021) and contribute to the flattening of the Phillips curve (Lall and Zeng, 2020).

Moreover, ensuring that all firms, especially young and small, have the resources to invest in intangibles will be key to boost the digitalisation among start-ups and micro and small and medium sized firms (mSMEs). This remains challenging because of the difficulty in raising external finance to support intangible investments, and information asymmetries, sunkness and higher uncertainty related to this type of assets. Indeed, as banks tend to rely on collateralised lending, access to credit is more difficult for intangible intensive firms. At the same time, levels of venture capital and equity financing, which are more suitable to finance intangible investment for young intangible-intensive firms, are still relatively low in many EA countries relative to e.g., the US, Israel or Canada.

Co-investment funds and funds-of-funds could support the development of a stronger, European-level VC market. This could help as a VC market that effectively crosses the country boundaries to invest in innovative start-ups and mSMEs is crucial to foster economic growth in the Euro area. However, as Venture Capital is not easily scalable and focuses on specific industries, the credit market should also be reformed to support intangible investments (such as through IP-backed debt finance). The increasing intangibility of firm assets likely poses important challenges to macroprudential policies (e.g. IP assets do not generally meet the Basel III eligibility criteria for use as collateral). Thus, further reforms in macroprudential regulations may be needed to cope with changing production technologies among borrowing firms.

(3) Maintaining a competitive environment for innovation.

Policies that support an inclusive digital transformation together with measures aimed at fostering business dynamism might also help counteract any potential increase in concentration arising from the rising importance of intangible and digital capital and maintain markets that foster competition around innovation. Indeed, industry concentration was already rising before the COVID-19 crisis, having seen an acceleration during the GFC especially in digital intensive industries. Existing structural trends might have been amplified during the COVID-19 crisis as large firms, thanks also to the larger cash holding and higher level of digital adoption, were better prepared and more resilient faced with the crisis. Mergers and Acquisitions dynamics may reinforce this: large players in digital intensive sectors have entered in more and larger M&A deals.

Ensuring a level playing field and open markets will be important also to maximise the returns to investment in digital technologies. In the EU, overcoming the fragmentation of European markets, e.g., for digital services, will likely allow firms to grow and benefit from economies of scale at the European level.

If increases in industry concentration are paralleled by similar trends at the labour market level, they would result in a downward pressure on wage levels and in an increased wage inequality.

In addition to industry concentration, markups have steadily increased in the last two decade. This increase has been particularly strong in digital intensive services, a sector that is likely to grow even more after the pandemic. Increasingly, firms

belonging to digital intensive sectors have been those charging the highest markups. Thus, the increase in the adoption of advanced digital technologies and in the use of digital modes of buying and working during COVID-19 might accelerate current upward trends in markups and markups dispersion.

The immediate implications for prices, productivity and innovation are a priori ambiguous. If the increase in concentration and markups can be explained, for example, by an efficient reallocation of resources towards the most efficient firms or/and by the nature of a production process increasingly based on intangible assets with high sunk costs and low marginal costs, concentration or increasing markups will not necessarily reflect increased market power. However, in the long run, large high-markup firms might entrench their market power creating barriers to entry or buying up their competitors, a trend that seems already apparent during the COVID-19 crisis. This, in turn, could have negative impacts on innovation over the medium- to long-term.

References

Acemoglu, D., Akcigit, U., Alp, H., Bloom, N. and Kerr, W. (2018), “Innovation, Reallocation and Growth”, *American Economic Review, Vol. 108, No. 11, pp. 3450-3491.*

Affeldt, P., Duso, T., Gugler, K. P. and Piechucka, J. (2021), “Market concentration in Europe: Evidence from antitrust markets”, *DIW Discussion Papers*, No. 1930.

Aghion, P., Saint-Paul, G. (1998), “Virtues of Bad Times: Interaction between Productivity Growth and Economic Fluctuations”, *Macroeconomic Dynamics*, Vol. 2, No. 3, pp. 322-344.

Ali, A., Klasa, S. and Yeung, E. (2009), “The Limitations of Industry Concentration Measures Constructed with Compustat Data: Implications for Finance Research”, *Review of Financial Studies,* Vol. 22, No. 10, pp. 3839-3871.

Althoff, L., Eckert, F., Ganapati, S. and Walsh, C. (2020), “The Geography of Remote Work”, *NBER Working Paper*, No. 29181.

Anayi, L., Barrero, J. M., Bloom, N., Bunn, P., Davis, S., Leather, J., Meyre, B., Oikonomou, M., Mihaylov, E., Mizen, P. and Thwaites, G. (2021), “Labour market reallocation in the wake of Covid-19”, *VoxEU.org*, 13 August.

Andrews, D., Charlton, A. and Moore, A. (2021), "COVID-19, productivity and reallocation: Timely evidence from three OECD countries", *OECD Economics Department Working Papers*, No. 1676.

Andrews, D., Hambur, J. and Bahar, E. (2021), “The COVID-19 shock and productivity-enhancing reallocation in Australia: Real-time evidence from Single Touch Payroll”, *OECD Economics Department Working Papers*, No. 1677.

Andrews, D., Criscuolo, C. and Gal, P. N. (2016), “The Best versus the Rest: the Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy”, *OECD Productivity Working Papers*, No. 5.

Ates, S. T. and Saffie, F. E. (2021), "Fewer but Better: Sudden Stops, Firm Entry, and Financial Selection", *American Economic Journal: Macroeconomics*, Vol. 13, No. 3, pp. 304-356.

Autor, D., Dorn, D., Katz, L. F., Patterson, C. and Van Reenen, J. (2017). “Concentrating on the Fall of the Labor Share”*, American Economic Review Papers and Proceedings*, Vol. 107, No. 5, pp. 180–185.

Azar, J. A., Marinescu, I., Steinbaum. M. I. and Taska, B. (2018), “Concentration in US Labor Markets: Evidence From Online Vacancy Data”, *NBER Working Paper*, No. 24395,

Baily, M. N., Hulten, C., Campbell, D. Bresnahan, T. and Caves, R. E. (1992), “Productivity dynamics in manufacturing plants”, *Brookings Papers on Economic Activity. Microeconomics*, Vol. 1992, pp. 187-267.

Bajgar, M., Berlingieri, G., Calligaris, S., Criscuolo, C. and Timmis, J. (2019), "Industry Concentration in Europe and North America”, *Productivity Working Papers*, No. 18.

Bajgar, M., Berlingieri, G., Calligaris, S., Criscuolo, C. and Timmis, J. (2020), "Coverage and representativeness of Orbis data”, *OECD Science, Technology and Industry Working Papers*, No. 2020/06.

Bajgar, M., Criscuolo, C. and Timmis, J. (2021), “Intangibles and Industry Concentration: Supersize Me”, *OECD Science, Technology and Industry Working Papers*.

Barlevy, G. (2004), “On the Timing of Innovation in Stochastic Schumpeterian Growth Models”, *NBER Working Paper*, No. 10741.

Barrero, J. M., Bloom. N. and Davit, S. J. (2020), “COVID-19 Is Also a Reallocation Shock”, *NBER Working Paper,* No. 27137, May.

Barrero, J. M., Bloom, N. and Davis, S. J. (2021), “Why Working from Home Will Stick” *NBER Working Paper*, No. 28731, April.

Barrero, J. M., Bloom, N., Davis, S. J. and Meyer, B.H. (2021) "COVID-19 Is a Persistent Reallocation Shock." *AEA Papers and Proceedings*, 111: 287-91.

Bartelsman, E., Haltiwanger, J., Scarpetta, S. (2013), “Cross-Country Differences in Productivity: The Role of Allocation and Selection”, *American Economic Review*, Vol. 103, No. 1, February.

Bartelsman, E., Lopez-Garcia, P. and Presidente, G. (2019), “Labour Reallocation in Recession and Recovery: Evidence for Europe”, National Institute Economic Review, Vol. 247, pp. R32-R39.

Bartik, A, Cullen, Z. B., Glaeser, E. L., Luca, M. and Stanton, C. T. (2020), “What Jobs are Being done at Home during the Covid-19 Crisis? Evidence from Firm-Level Surveys”, *NBER Working Paper*, No. 27422.

Behrens, K., Kichko, S. and Thisse, J. F. (2021) “Working from home: Too much of a good thing”, *VoxEU.org,* 13 February.

Bénassy-Quéré, A, B Hadjibeyli, and G Roulleau (2021), “French firms through the COVID storm: Evidence from firm-level data”, *VoxEU.org*, 27 April.

Berlingieri, G., Blanchenay, P. and Criscuolo, C. (2017), “The great divergence(s)”, *OECD Science, Technology and Innovation Policy Papers*, No. 39.

Berlingieri, G., Calligaris. S., Criscuolo, C. and Verlhac, R. (2020), “Laggard firms, technology diffusion and its structural and policy determinants”, *OECD Science, Technology and Industry Policy Papers*, No. 86.

Bessen, J. (2017), “Information Technology and Industry Concentration”, *Boston University School of Law & Economics Paper Series*, No. 17-41.

Bessen, J. (2020), “Industry concentration and information technology”, *The Journal of Law and Economics*, Vol. 63, No. 3, pp. 531-555.

Bick, A., Blandin, A. and Mertens, K. (2020), "Work from Home Before and After the COVID-19 Outbreak", *Federal Reserve Bank of Dallas Working Papers*, No. 2017.

Bloom, N., Liang, J., Roberts, J. and Ying, Z. J. (2014), “Does working from home work? Evidence from a Chinese experiment”, *The Quarterly Journal of Economics*, Vol. 130, No. 1, pp. 165-218.

Bloom, N., Bunn, P., Chen, S., Mizen, P. and Smietanka, P. (2020a), “The economic impact of coronavirus on UK businesses: Early evidence from the Decision Maker Panel”, *VoxEU.org*, 27 March.

Bloom, N., Bunn, P., Chen, S., Mizen, P. and Smietanka, P. (2020b), “Coronavirus expected to reduce UK firms’ sales by over 40% in Q2”, *VoxEU.org*, 20 May.

Bloom, N., Bunn, P., Mizen, P., Smietanka, P. and Thwaites, G. (2020c), “The Impact of Covid-19 on Productivity”, *NBER Working Paper*, No. 28233.

Bloom, N., Mizen, P., and Taneja, S. (2021), “Returning to the office will be hard”, *VoxEU.org*, 15 June.

Bradley, C. and Stumpner, P. (2021), “The impact of COVID-19 on capital markets, one year in”, *McKinsey & Company*, March.

Brynjolfsson, E., Horton, J. J., Ozimek, A., Rock, D., Sharma, G. and TuYe, H. (2020), “COVID-19 and Remote Work: An Early Look at US Data”, *NBER Working Paper,* No. 27344.

Brynjolfsson, E., Rock, D. and Syverson, C. (2021), “The productivity J-curve: How intangibles complement general purpose technologies”, *American Economic Journal: Macroeconomics*, Vol. 13, No. 1, pp. 333-372.

Brynjolfsson, E. and McAfee, A. (2011), “Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy”, *Digital Frontier Press*.

Caballero, R. J. and Hammour, M. L. (1996), “On the Timing and Efficiency of Creative Destruction”, *The Quarterly Journal of Economics*, Vol. 111, No. 3, pp. 805-852.

Caballero, R. J. and Hammour, M. L. (2005), “The Cost of Recessions Revisited: A Reverse-Liquidationist View”, *The Review of Economic Studies*, Vol. 72, No. 2, pp. 313-341, April.

Calligaris, S., Criscuolo, C. and Marcolin, L. (2018), “Mark-ups in the digital era”, *OECD Science, Technology and Industry Working Papers*, No. 2018/10.

Calvino, F., Criscuolo, C. and Menon, C. (2015), "Cross-country evidence on start-up dynamics", *OECD Science, Technology and Industry Working Papers*, No. 2015/06.

Calvino, F., Criscuolo, C., Marcolin, L. and Squicciarini, M. (2018), “A taxonomy of digital intensive sectors”, *OECD Science, Technology and Industry Working Papers*, No. 2018/14, June.

Calvino, F., Criscuolo C. and Verlhac, R. (2020), “Declining business dynamism: structural and policy determinants”, *OECD Science, Technology and Industry Policy Papers*, No. 94, November.

Calvino, F. and Manaresi, F. (forthcoming), “Closing the Italian digital gap”, *OECD Science, Technology and Industry Policy Papers*.

Cammeraat, E., Samek, L. and Squicciarini, M. (2021), "Management, skills and productivity", *OECD Science, Technology and Industry Policy Papers*, No. 101, OECD Publishing, Paris.

Caselli, M., Fracasso, A. and Traverso, S. (2020), “Mitigation of risks of Covid-19 contagion and robotisation: Evidence from Italy”, COVID Economics, No. 17, pp. 174-188.

Chernoff, A., Warman, C. (2020), “COVID-19 and Implications for Automation”, *NBER Working Paper*, No. 27249.

Chetty, R., Friedman, J. N., Hendren, N. and Stepner, M. (2020) “The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data”, *NBER Working Paper*, No. 27431.

Clementi, G. L. and Palazzo, B. (2016), “Entry, Exit, Firm Dynamics, and Aggregate Fluctuations”, *American Economic Journal: Macroeconomics*, Vol. 8, No. 3, pp. 1-41, July.

Committee on the Monitoring and Evaluation of Financial Support Measures for Companies Confronted with the Covid-19 Epidemic (2021), "Summary of the final report", 9 August

Corrado, C., Criscuolo, C., Haskel, J., Himbert, A. and Jona-Lasinio, C. (2021), “New evidence on intangibles, diffusion and productivity”, *OECD Science, Technology and Industry Working Papers*, No. 2021/10.

Criscuolo, C. et al. (2020), "Workforce composition, productivity and pay: The role of firms in wage inequality", *OECD Social, Employment and Migration Working Papers*, No. 241, OECD Publishing, Paris.

Cros, M., Epaulard, A. and Martin, P. (2021), 'Will Schumpeter Catch Covid-19?', *Centre for Economic Policy Research Discussion Paper Series*, No. 15834

Crouzet, N. and Eberly, J. C. (2019), “Understanding weak capital investment: The role of market concentration and intangibles”, *NBER Working Paper,* No. 25869).

Crouzet, N., & Eberly, J. (2018). Intangibles, investment, and efficiency. In *AEA Papers and Proceedings* Vol. 108, pp. 426-31.

Davis, M. A., Ghent, A. C. and Gregory, J. M. (2021), "The Work-from-Home Technology Boon and its Consequences", *NBER Working Papers,* No. 28461.

Decker, R., Haltiwanger, J., Jarmin, R. and Miranda, J. (2014), “The role of entrepreneurship in US job creation and economic dynamism”, *The Journal of Economic Perspectives*, Vol. 28, No. 3, pp. 3–24.

Dellis, K. and Sondermann, D, (2017), “Lobbying in Europe: New Firm-Level Evidence”, *ECB Working Paper*, No. 2071.

De Loecker, J. and Eeckhout, J. (2018), “Global market power”, *NBER Working Paper*, No. 24768.

De Loecker, J., and Eeckhout, J. (2018), “Some Thoughts on the Debate about (Aggregate) Markups Measurement”, unpublished.

De Loecker, J., Eeckhout, J. and Mongey S. (2018), “Quantifying Market Power”, *Mimeo*.

De Loecker, J., Eeckhout. J. and Unger, G. (2020), “The Rise of Market Power and the Macroeconomic Implications”, *The Quarterly Journal of Economics*, Vol. 135, No. 2, pp. 561-644.

De Loecker, J. and Warzynski, F. (2012), “Markups and firm-level export status”, *American Economic Review*, Vol. 102, No. 6, pp. 2437-2471.

Demmou, L., Franco, G., Calligaris, S. and Dlugosh, D. (2021), "Liquidity shortfalls during the COVID-19 outbreak: Assessment and policy responses", *OECD Economics Department Working Papers*, No. 1647.

Dent, R. C., Karahan, F., Pugsley, B. and Şahin, A. (2016). "The Role of Startups in Structural Transformation." *American Economic Review*, Vol. 106, No. 5, pp. 219-223.

DeStefano, T. and Timmis, J. (forthcoming), “Firm Digital Adoption during COVID-19,” unpublished paper.

Díez, F. J., Fan, J., Villegas-Sánchez, C. (2021), “Global declining competition?”, *Journal of International Economics*, Vol. 132, No. 6, 103492.

Di Mauro, F. and Syverson, C. (2020), "The COVID crisis and productivity growth", *VOXEU.org* 16th April.

Disney, R., Haskel, J. and Heden, Y. (2003), “Restructuring and productivity growth in UK manufacturing”, *The Economic Journal*, Vol. 113, No. 489, pp. 666-694.

Döttling, R. Gutierrez Gallardo, G. and Philippon, T. (2017), “Is There an Investment Gap in Advanced Economies? If So, Why?”, *SSRN Electronic Journal*,

Döttling, R. and Ratnovski, L. (2021), “Monetary Policy and Intangible Investment”.

Duval, R., Hong G.H. and Timmer Y. (2020), “Financial Frictions and the Great Productivity Slowdown”, *Review of Financial Studies*, 33(2), 475-503.

Eberly, J. C., Haskel, J. and Mizen, P. (2021), “Potential Capital”. *Kellogg School of Management Working Paper*.

Eeckhout, J. (2021), “Comment on: ‘Diverging Trends in National and Local Concentration’”, *NBER Macroeconomics Annual,* Vol. 35.

European Investment Bank (2021a), “Digitalisation in Europe 2020-2021: evidence from the EIB Investment Survey”, *European Investment Bank*.

European Investment Bank (2021b), “Investment Report 2020/21: Building a smart and green Europe in the COVID-19 era”, *European Investment Bank*.

Espinoza, E. and Reznikova, L. (2020), “Who can log in? The importance of skills for the feasibility of teleworking arrangements across OECD countries”, *OECD Social, Employment and Migration Working Papers*, No. 242, June.

Eurofound (2020), “Teleworkability and the COVID-19 crisis: a new digital divide?”, *Eurofound Working Paper*, No. WPEF20020.

Eurofound (2021), “Living, working and COVID-19: Mental health and trust decline across EU as pandemic enters another year”, *Eurofound Factsheet,* April.

Falagiarda, M., A. Prapiestis and E. Rancoita (2020) “Public loan guarantees and bank lending in the COVID-19 period”, published as part of the *ECB Economic Bulletin*, Issue 6/2020

Fareed, F. and Overvest, B. (2021), “Business dynamics during the COVID pandemic”, *CPB Netherlands Bureau for Economic Policy Analysis COVID-19 Publication*, April.

Foster, L., Grim, C. and Haltiwanger, J. (2016), “Reallocation in the Great Recession: Cleansing or Not?”, *Journal of Labor Economics*, Vol. 34, No. S1, pp. S293-S331.

Foster, L., Haltiwanger, J. and Krizan, C. J. (2006), “Market Selection, Reallocation, and Restructuring in the U.S. Retail Trade Sector in the 1990s”, *The Review of Economics and Statistics*, Vol. 88, No. 4, pp. 748-758.

French National Productivity Board (2021) “The effects of the Covid-19 crisis on productivity and competitiveness - Second report”, January.

Gibbons, R. and Roberts, J. (2012), “Economic Theories of Incentives in Organizations”, in *Handbook of Organizational Economics,* ed. Gibbons, R. and Roberts, J., pp. 56-99.

Gourio, F., Messer, T. and Siemer, M. (2016), “Firm Entry and Macroeconomic Dynamics: A State-Level Analysis”, *American Economic Review*, Vol. 106, No. 5, pp. 214-218.

Grundke, R., Jamet, S., Kalamova, M., Keslair, F., Squicciarini, M. (2017), “Skills and global value chains: a characterisation”, *OECD Science, Technology and Industry Working Papers*, No. 2017/05, June.

Grullon, G., Larkin, Y. and Michaely, R. (2018), “Are U.S. Industries Becoming More Concentrated?”, *Swiss Finance Institute Research Paper Series*, No.19-41.

Guerrieri, V, Lorenzoni, G., Straub, L. and Werning, I. (2020), “Macroeconomic implications of COVID-19: Can negative supply shocks cause demand shortages?”*, NBER Working Paper,* No. 26918, April.

Gutiérrez, G. and Philippon, T. (2018), “How EU markets became more competitive than US markets: a study of institutional drift”, *NBER Working Paper*, No. 24700.

Hall, Robert E. (1988), “The Relation between Price and Marginal Cost in U.S. Industry,” *Journal of Political Economy*, Vol. 96, No. 5, pp. 921–947.

Haskel, J. and Westlake, S. (2018), “Capitalism without Capital: The Rise of the Intangible Economy”. Princeton; Oxford: *Princeton University Press*

Hershbein, B., and Kahn, L.B. (2018), “Do Recessions Accelerate Routine-Biased Technological Change? Evidence from Vacancy Postings”, *American Economic Review*, Vol. 108, No. 7, pp. 1737-1772.

Hong, G., Kikuchi, S. and Saito, Y. U. (2020), “What are the Effects of the COVID-19 Crisis on Firm Exit in Japan”, *RIETI column*.

Institut Sapiens (2021), “Quel avenir pour le télétravail? Pérenniser et sécuriser une pratique d’avenir”, *Note*, March.

Jaimovich, N. and Siu, H.E. (2020), “Job Polarization and Jobless Recoveries”, *Review of Economics and Statistics*, Vol. 102, No. 1, pp. 129-147.

Kehrig, M. (2015), “The Cyclical Nature of the Productivity Distribution” *US Census Bureau Center for Economic Studies Paper*, No. CES-WP-11-15.

Kopytov, A., Roussanov, N. and Taschereau-Dumouchel, M. (2018), “Short-Run Pain, Long-Run Gain? Recessions and Technological Transformation”, *Journal of Monetary Economics*, Vol. 97, pp.29-44.

Koren, M. and Pető, R. (2020), “Business disruptions from social distancing”, *PLoS ONE,* Vol. 15 No. 9.

Kozeniauskas, N., Moreira, P. and Santos, C. (2020), “Covid-19 and Firms: Productivity and Government Policies”, *Centre for Economic Policy Research Discussion Paper Series,* No. 15156, August.

Lall, S. and Zeng, L., (2020), “Intangible Investment and Low Inflation: A Framework and Some Evidence”. *IMF Working Paper* No. 20/190,

Lambert, P. and Van Reenen, J. (2021), “A wave of COVID-related bankruptcies is coming to the UK. What can we do about it?”. *LSE Business Review*, 2 February.

Lamorgese, A., Linarello, A., Patnaik, M. and Schivardi, F. (2021), “Management Practices and Resilience to Shocks: Evidence from COVID-19”, *CEPR Discussion Paper*, No. 15987, March.

Lenzu, S., Rivers, D. and Tielens, J. (2020), “Financial Shocks, Productivity, and Prices", SSRN 3442156.

Manaresi, F., Gonzales-Torres, G. and Scoccianti, F. (2020) “Born in Hard Times: Startup Selection and Intangible Capital During the Financial Crisis”, *Bank of Italy Occasional Papers*, No. 582.

Manaresi, F. and N. Pierri (2019) “Credit Supply and Productivity Growth”, *IMF Working Paper* No. 19/107.

Manning, A. (2003), “Monopsony in Motion: imperfect competition in labor markets”, *Princeton University Press*.

McKinsey Global Institute (2021), “Will productivity and growth return after the COVID-19 crisis?”, March.

Moreira, S. (2017), “Firm Dynamics, Persistent Effects of Entry Conditions, and Business Cycles”, *CES Working Papers,* No. 17-29.

Morikawa, M. (2021), “The productivity of working from home: Evidence from Japan”, *VoxEU.org*, 12 March.

Nickell, S., Nicolitsas, D. and Patterson, M. (2001), “Does Doing Badly Encourage Management Innovation?”, *Oxford Bulletin of Economics and Statistics*, Vol. 63, pp. 5-28..

OECD (2020), “Productivity gains from teleworking in the post COVID-19 era : How can public policies make it happen?”, *OECD Policy Responses to Coronavirus* (COVID-19), OECD Publishing, Paris.

OECD (2021), "Business dynamism during the COVID-19 pandemic: Which policies for an inclusive recovery?", *OECD Policy Responses to Coronavirus (COVID-19),* OECD Publishing, Paris.

OECD (forthcoming), “Firm performance and pay policies: The role of firms in wage inequality” (working title).

OECD (2021), “ICT Access and Use by Businesses”, *OECD Telecommunications and Internet Statistics (database)*,

OECD (2021), “OECD Economic Outlook”, *OECD Publishing*, Vol. 2021 No. 1.

OECD (2021), "The role of online platforms in weathering the COVID-19 shock", *OECD Policy Responses to Coronavirus (COVID-19)*, OECD Publishing, Paris.

OECD (2021), “The role of telework for productivity and well-being during and post-COVID-19: key highlights of a survey among managers and workers”, *OECD Publishing*.

ONS (2020), “Coronavirus and homeworking in the UK: April 2020”, *Office for National Statistics,* 8 July.

Osotimehin, S., Pappadà, F. (2017), “Credit Frictions and the Cleansing Effect of Recessions”, *The Economic Journal,* Vol. 127, No. 602, pp. 1153-1187, June.

Ozimek, A. (2020), “The Future of Remote Work”, *SSRN Paper*, July.

Pierri, N. and Timmer, Y. (2020) “IT Shields: Technology Adoption and Economic Resilience during the COVID-19 Pandemic”, *IMF Working Papers*, No. 20/208.

Ramani, A. and Bloom, N. (2021), “The Donut Effect of Covid-19 on Cities”, *NBER Working Paper,* No. 28876.

Riom, C. and Valero, A. (2020), “The Business Response to Covid-19: the CEP-CBI survey on technology adoption”, *Centre for Economic Performance COVID Analysis*, No. 009.

Rosenthal, S. S., Strange, W. C., Urrego, J. A. (2021) “Are city centers losing their appeal? Commercial real estate, urban spatial structure, and COVID-19”, *Journal of Urban Economics*,

Rossi-Hansberg, E., Sarte, P. D. and Trachter, N. (2018), “Diverging Trends in National and Local Concentration”, *NBER Working Paper*, No. 25066

Sedláček, P. (2020), “Lost generations of firms and aggregate labor market dynamics”, *Journal of Monetary Economics,* Vol 111, pp. 16-31, May.

Sostero, M., Milasi, S., Hurley, J., Fernandez Macias, E. and Bisello, M. (2020), “Teleworkability and the COVID-19 crisis: a new digital divide?”, *JRC Working Papers Series on Labour, Education and Technology*, No. 2020/05.

Syverson, C. (2019), “Macroeconomics and Market Power: Context, Implications, and Open Questions”, *Journal of Economic Perspectives,* Vol. 33, No. 3, pp. 23-43

The Economist (2021), “The new economics of global cities”, 5 September.

Tian, C. (2018), “Firm-level entry and exit dynamics over the business cycles”, *European Economic Review*, Vol. 102, pp. 298-326

Traina, J. (2018), ""Is Aggregate Market Power Increasing? Production Trends Using Financial Statements", *Stigler Center New Working Paper Series*, No. 17.

United States Census (2021), “Business Formation Statistics, July 2021”, No. CB21-130, August.

Valletti, T., Koltay, G., Lorincz, S. and Zenger, H. (2017), "Concentration trends in Europe", *presentation*, December.

Van Reenen, J. (2018) “Increasing differences between firms: market power and the macro-economy”, *CEP Discussion Papers*, No 1576.

Wang, J., Yang, J., Iverson, B. and Kluender, R. (2020), “Bankruptcy and the COVID-19 Crisis”, *Harvard Business School Working Paper*, No. 21-041, September.

Werden, G. J. and Froeb, L. (2018), “Don’t Panic: A guide to claims of increasing concentration”. *Antitrust*.

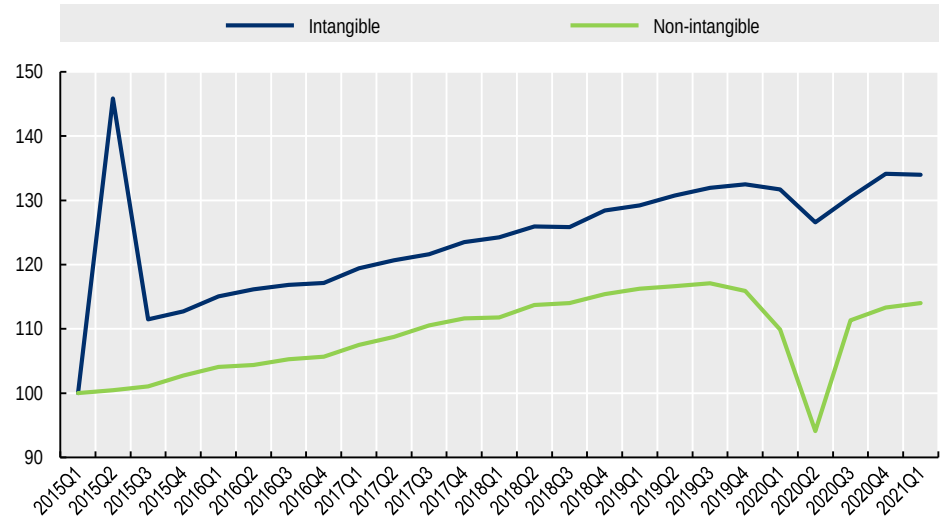
World Bank (2021), “Uneven Recovery: East Asia and Pacific Economic Update”, April.

Appendix

Appendix A

Figure A 1

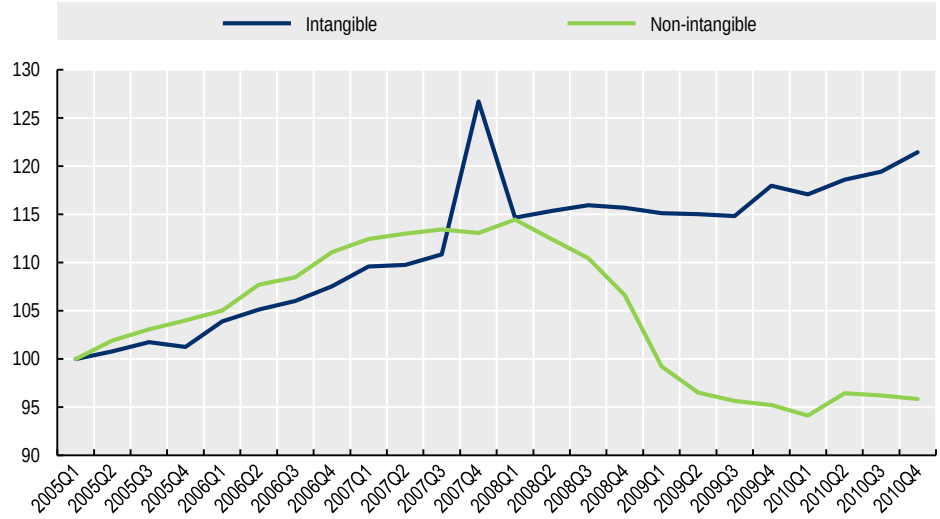
Change in quarterly gross fixed capital formation by tangibility of assets, 2015-21



Source: Calculations based on Eurostat's National Accounts database.
Note: Euro area corresponds to weighted average of 17 EA member countries (Ireland is excluded because of data consistency, Belgium because of data availability).

Figure A 2

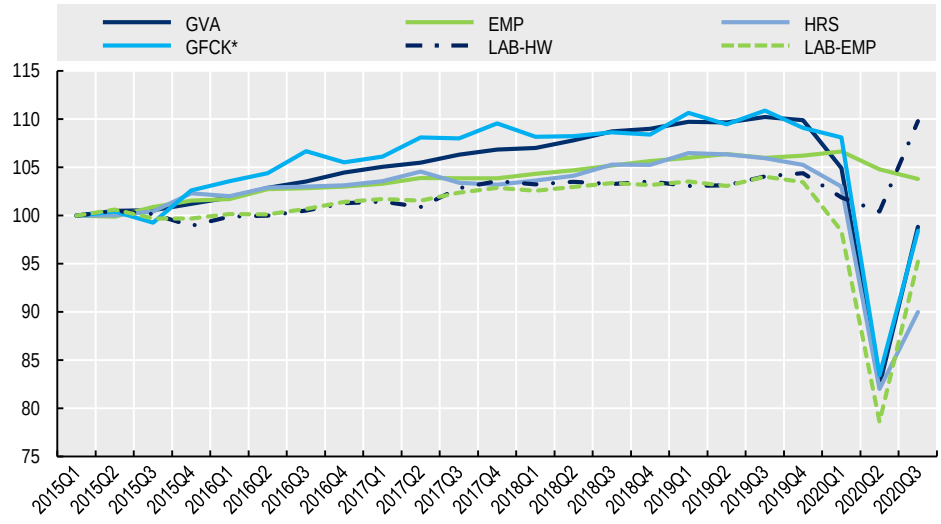
Quarterly gross fixed capital formation by tangibility of assets during the Great Financial Crisis, 2005-10

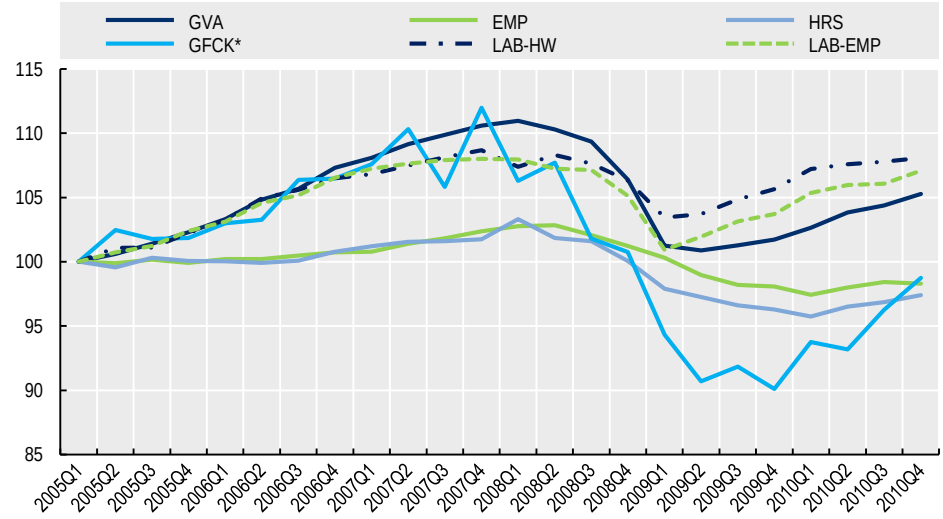


Source: Calculations based on Eurostat's National Accounts database.
Note: Euro area corresponds to weighted average of 19 EA member countries.

Figure A 3

United Kingdom

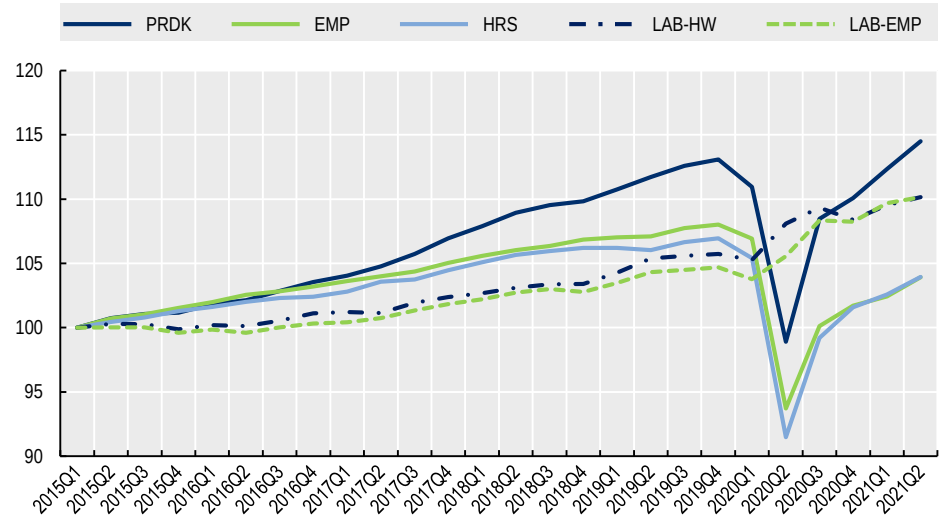


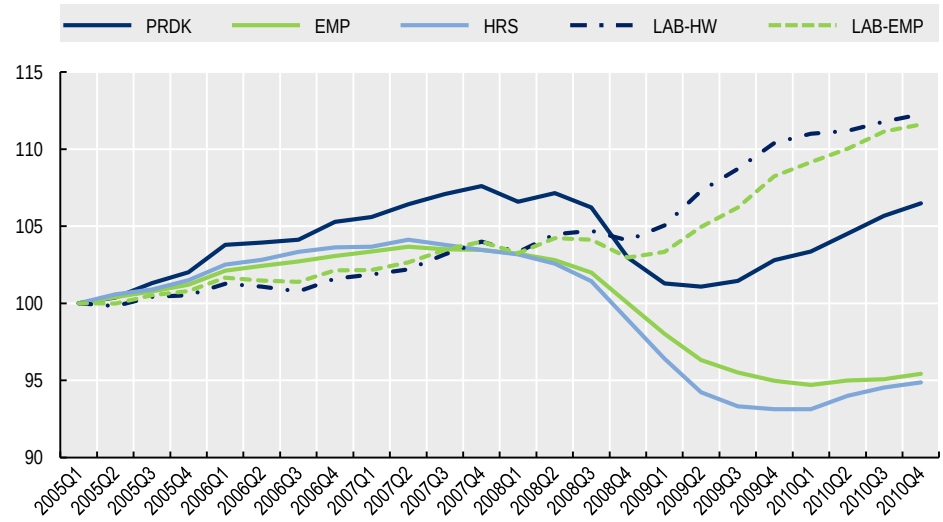


Source: Calculations based on Eurostat's National Accounts database.
Note1: Non-agriculture business sector excluding real estate (ISIC Rev. 4 divisions 05 to 66 and 69 to 82) corresponds to the total economy excluding agriculture, real estate, public and other services.
Note2: GVA is real value added, EMP total employment in persons, HRS hours worked, LAB-HW labour productivity with hours worked in denominator, LAB-EMP- labour productivity with employment in denominator and GFCK* gross fixed capital formation for all industries, as this/ is variable is not available by industry.

Figure A 4

United States



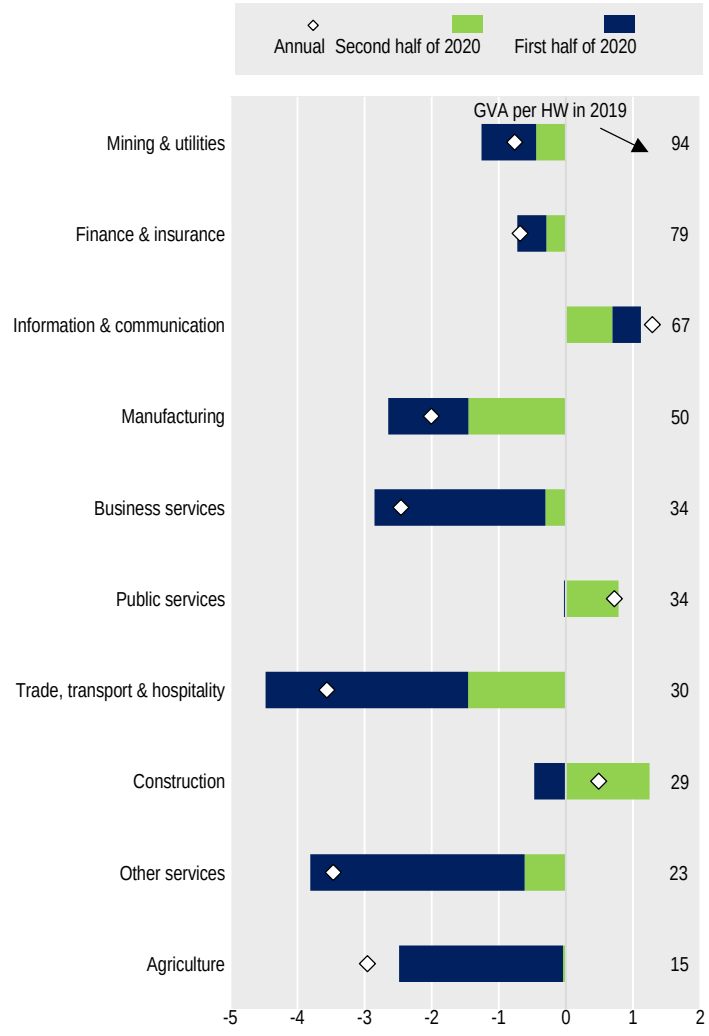


Source: Calculations based on BLS Major Sector Productivity and Costs database.
Note1: Measure is based on non-farm business sector, which contains real estate but not housing imputations.
Note2: Output is measured in terms of real Output, not Gross value added.

Figure A 5

Low productivity sectors recorded stronger job losses, 2019-20, euro area

Change in employment relative to previous half year by major sectors of economic activity

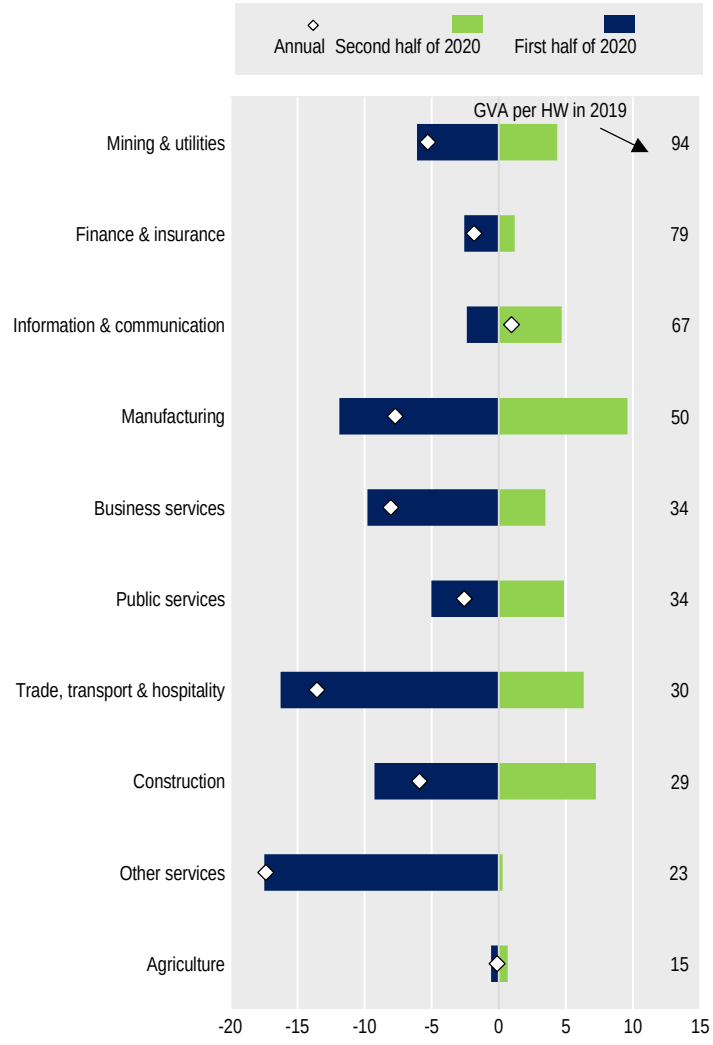


Source: Calculations based on Eurostat's National Accounts database.
Note: euro area corresponds to weighted average of 19 EA member countries.

Figure A 6

Low productivity sectors recorded largest drop in value added, 2019-20 euro area

Change in value added relative to previous half year by major sectors of economic activity

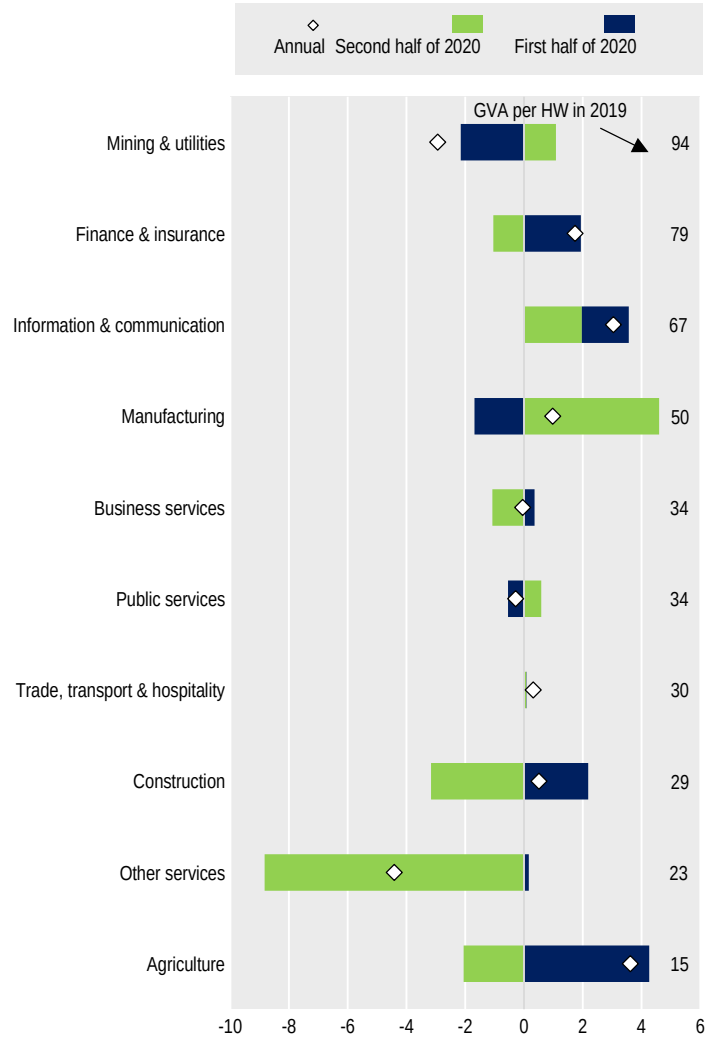


Source: Calculations based on Eurostat's National Accounts database.
Note: euro area corresponds to weighted average of 19 EA member countries.

Figure A 7

Labour productivity during the pandemic, 2019-20

Change in labour productivity relative to previous half year by major sectors of economic activity

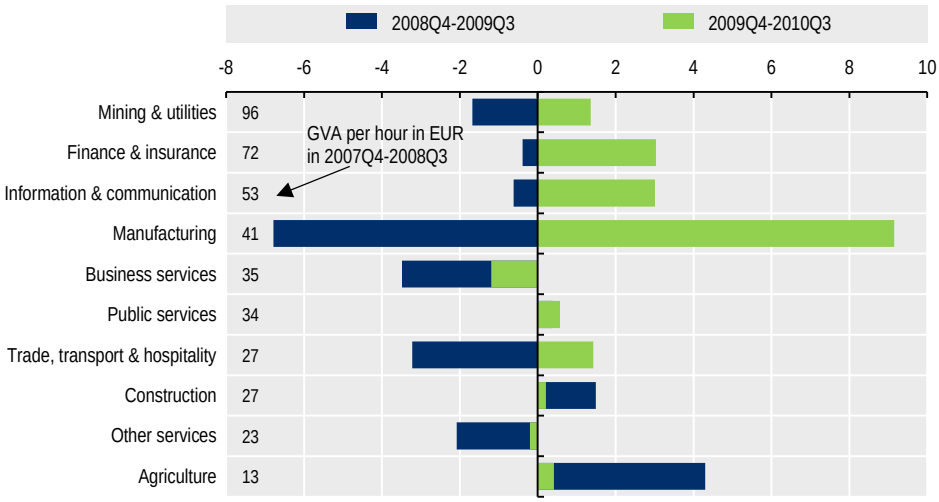


Source: Calculations based on Eurostat's National Accounts database.
Note: euro area corresponds to weighted average of 19 EA member countries.

Figure A 8

Labour Productivity during and in the immediate aftermath of the 2008 Great Financial Crisis

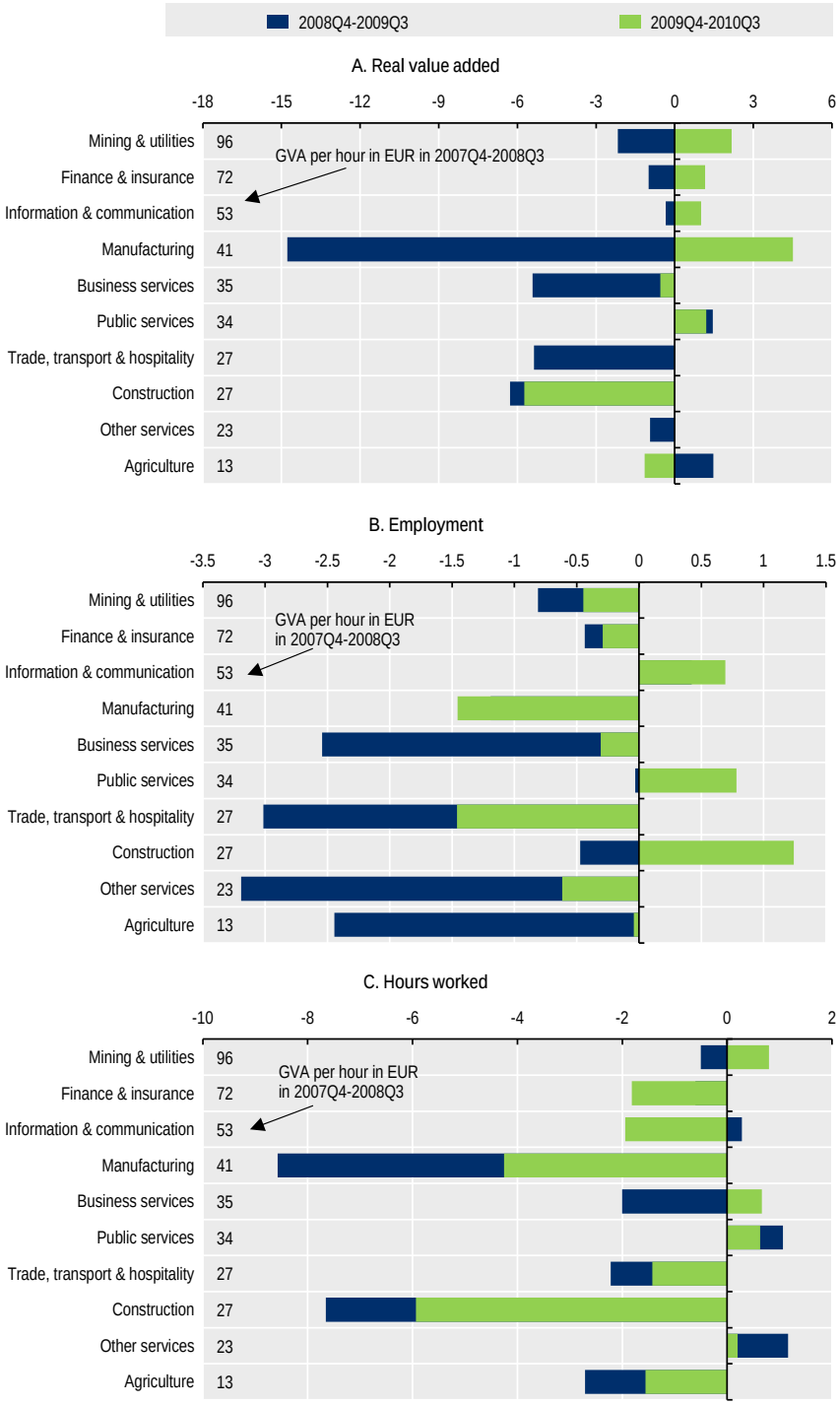
Labour productivity during financial crisis, euro area



Source: Calculations based on Eurostat's National Accounts database.
Note: euro area corresponds to weighted average of 19 EA member countries.

Figure A 9

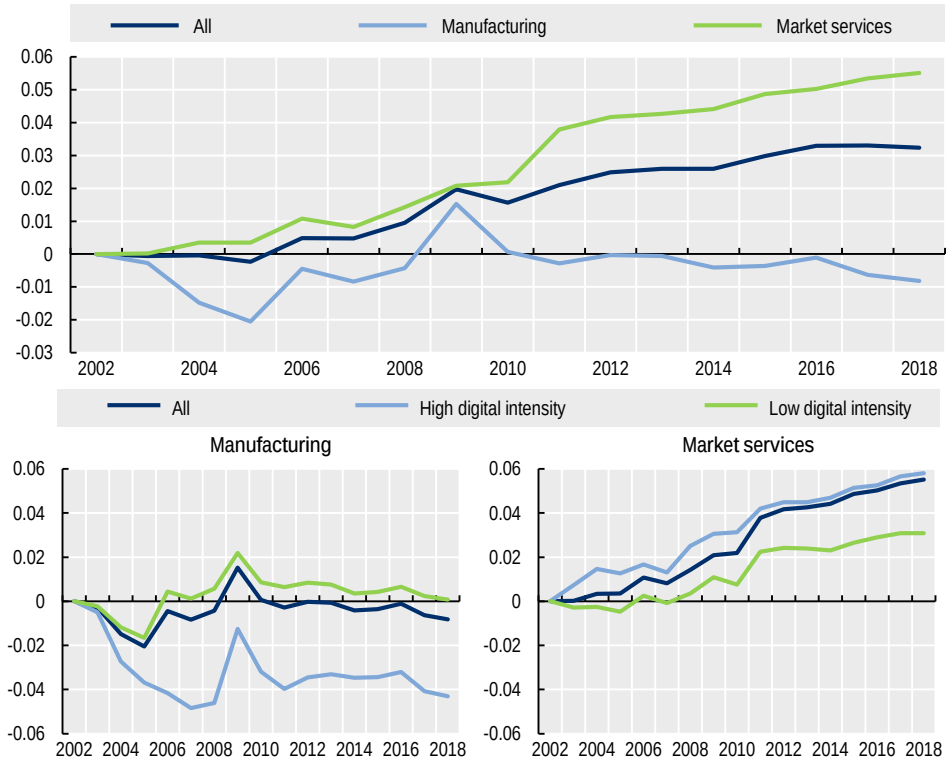
Value added, Employment and Hours worked during and in the immediate aftermath of the 2008 Great Financial Crisis



Source: Calculations based on Eurostat's National Accounts database.
Note: Euro area corresponds to weighted average of 19 EA member countries.

Figure A 10

Average markups have increased especially in services and digital sectors after the Global Financial Crisis

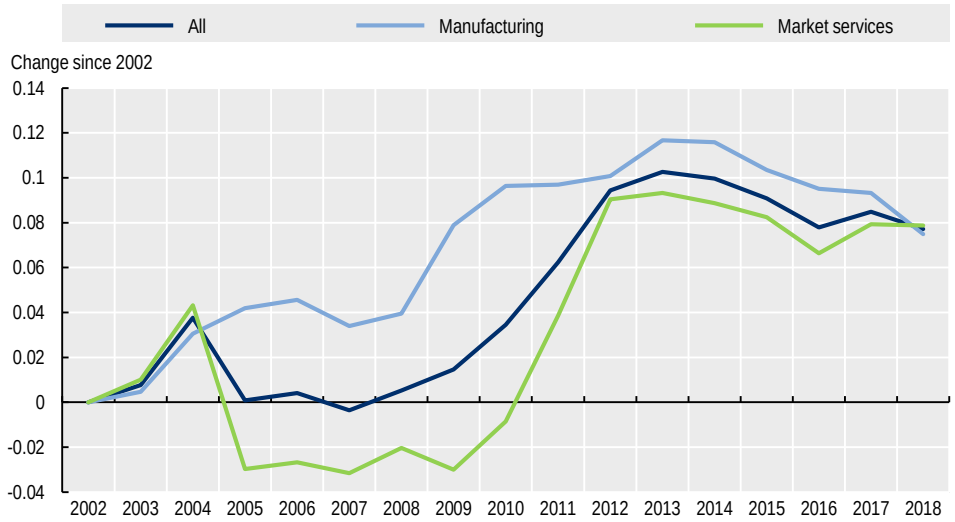


Notes: Unconditional averages of firm-level log markups, assuming a Cobb-Douglas production function with 3 inputs (K, L, M) and intermediates as fully flexible input. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. Included industries cover 2-digit manufacturing and non-financial market services. In the top panel, the graph reports log markups in manufacturing (light blue line), services (green line) and overall (dark blue line), and indexes the 2002 level to 0 (hence the vertical axes represent log-differences from the starting year which, given the magnitudes, approximates well for growth rates). In the bottom panel, the graph reports log markups in high digital intensive industries (light blue line), low digital intensive industries (green line) and overall (dark blue line) in the manufacturing (left panel) and market services (right panel), and indexes the 2002 level to 0. The digital intensity of industries is defined using the digital intensity indicator of 2013-15 constructed by Calvino et al. (2018); industries are classified as "high digital" if they are in the top quartile of the industry distribution in terms of digital intensity.
Source: Calculations based on Orbis.

Figure A 11

Concentration has increased in the last decade in both manufacturing and market services

C8 cumulative change



Note: Share of sales accounted for by 8 largest business groups in the available countries of the euro area. The countries include BEL, DEU, EST, ESP, FIN, FRA, IRL, ITA, LVA, NLD, PRT, SVN. Included industries cover 2-digit manufacturing and non-financial market services. The graph reports the cumulative weighted average change in industry concentration in manufacturing (light blue line), services (green line) and overall (dark blue line), with weights given by each industry's share in the total sales across all industries of the region.
Source: Calculations based on Orbis-Zephyr.

Appendix B

Table B 1

Sectoral characteristics by SNA A38 sectors

SNA A38 industry	Customer contact	ICT task content	ICT skill	Telework potential
Agriculture	excl.	excl.	excl.	excl.
Mining	excl.	excl.	excl.	excl.
Food and beverages	8.0	39.6	40.5	17.4
Textiles and apparel	6.0	45.2	38.4	17.0
Wood and paper prod.	6.7	53.2	44.7	19.4
Coke & ref. petroleum	excl.	excl.	excl.	excl.
Chemicals	excl.	excl.	excl.	excl.
Pharmaceuticals	excl.	excl.	excl.	excl.
Rubber and plastics	5.0	48.9	44.2	19.8
Metal products	5.0	45.4	44.2	20.6
Computer&electronics	7.0	64.0	61.1	48.2
Electrical equipment	6.0	54.7	50.7	35.4
Machinery&equipment	6.0	56.0	52.3	29.0
Transport equipment	3.0	51.3	49.7	27.0
Furniture and other	n/a	50.5	n/a	n/a
Electricity and gas	excl.	excl.	excl.	excl.
Water and sewerage	excl.	excl.	excl.	excl.
Construction	7.6	41.4	40.7	15.8
Wholesale and retail	53.1	49.4	49.1	23.4
Transport. & storage	9.8	44.9	43.3	21.6
Hotels and restaurants	49.8	37.3	38.1	8.6
Media	26.7	53.2	67.5	62.7
Telecommunications	18.0	55.1	69.5	60.1
IT	19.5	76.5	77.1	76.9
Finance	34.0	70.3	71.0	75.7
Real estate	31.0	64.3	62.5	55.5
Legal and accounting	24.0	56.8	70.1	71.6
Scientific R&D	n/a	56.8	72.7	60.5
Marketing and other	n/a	56.8	n/a	n/a
Admin. services	28.6	56.8	45.4	25.7
Public administration	excl.	excl.	excl.	excl.
Education	35.0	61.3	59.3	44.9
Health	68.4	51.4	55.1	28.4
Social work	30.0	51.4	46.1	19.4
Arts and entertainment	41.9	52.0	52.7	26.6
Other services	33.0	52.0	47.1	25.5
Households	excl.	excl.	excl.	excl.
Extraterr.organizations	excl.	excl.	excl.	excl.

Note: excl. are industries excluded from the analysis. n/a: not available./
Customer contact: measure based on Koren and Petö (2020). Share of jobs in each industry that involve face-to-face contact with customers. A job is defined as involving face-to-face contact if job tasks include tasks such as dealing with external customers, assisting and caring for others, or providing consultation and advice to others, and face-to-face communication occurs at least several times a week. Indicators constructed by matching the tasks associated with different occupations in O*NET, then matching these to the occupation structure of NAICS17 three-digit industries using the US Bureau of Labour Statistics industry-occupation matrix for February 2020. Koren and Petö's three-digit industry-level measures have been aggregated to SNA A38 industries. Three A38 industries could not be matched to the three-digit NAICS information: Pharmaceuticals, Scientific R&D, Public administration and defence.
ICT task content: measure from Grundke et al. (2017), based on the Programme for the International Assessment of Adult Competencies (PIAAC) dataset. Frequency with which surveyed individuals carry out tasks which are related to the use of ICT on the job. This frequency is measured at the individual level. The retrieved frequency is a weighted average of the individual's answers to different questions. The weights used correspond to the sampling weights reported for each individual in PIAAC.

ICT Skill: measure from Cammeraat, Samek and Squicciarini (2021). ICT skill levels are scaled to range from a minimum of 0 to a maximum of 100. The ICT skills indicator consists of a number of different selfreported tasks carried out on the job in a sample of workers in each industry: frequencies of excel use, programming language use, transactions through internet (banking, selling/buying), email use, simple internet use, word use, real-time discussions through ICT computers, reading/writing letters, emails or memos, level of computer use required for the job, and frequency of working physically over long periods.
Telework potential: based on Espinoza and Reznikova (2020) task-based measure of potential telework, aggregated to A38 industries. This measure classifies an individual job as teleworkable if the worker reports that their job organisation is highly flexible (six questions on flexibility in organising and planning their own activities), involves daily use of ICT (five questions on specific tasks including e-mail, use of word processors and spreadsheet software), and seldom or never involves long periods of physical work. Jobs are classified as telework compatible if they have at least one indicator within each of the three domains which is compatible with teleworking.