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Reviving productivity growth: A review of policies

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ABSTRACT/RÉSUMÉ

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This review takes stock of the large body of evidence on aggregate productivity growth, its structural drivers, and the role of a wide range of policies. It aims to synthesise evidence on how public policies can promote productivity through their impacts on both the incentives and the capabilities of businesses and workers, taking account of different specificities of firms at the frontier and below, and integrating complementarities across policy areas. It also identifies gaps in knowledge, thus offering potential directions for future work.

Keywords: Productivity, Economic policy, Efficiency frontier, Entrepreneurship, Firm Performance, Investment, Intangible capital, Technological diffusion.

JEL Codes: D24, E6, E22, E24, J24, L5, L25, L26, O31, O32, O33, O38, O47

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Relancer la croissance de la productivité: une revue des politiques

Cette étude fait le point sur la riche base de connaissances sur la croissance agrégée de la productivité, ses déterminants structurels et le rôle d'un large éventail de politiques. Il vise à synthétiser les connaissances sur la manière dont les politiques publiques peuvent promouvoir la productivité à travers leurs impacts à la fois sur les incitations et les capacités des entreprises et de la main d'œuvre, en tenant compte des spécificités des entreprises à la frontière et en deçà, et en intégrant les complémentarités entre politiques. Il identifie également les lacunes dans les connaissances, offrant ainsi des pistes potentielles pour de futurs travaux.

Mots clés : Productivité, Politique économique, Frontière d'efficacité, Entrepreneuriat, Performances des entreprises, Investissement, Capital immatériel, Diffusion technologique.

Codes JEL : D24, E6, E22, E24, J24, L5, L25, L26, O31, O32, O33, O38, O47.

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Reviving productivity growth: A review of policies

By Christophe André and Peter Gal[1]

1. Introduction

A broad-based productivity revival would be crucial to address mounting long-term socio-economic challenges. Productivity growth is about achieving higher economic output by working and producing more efficiently; it is the main source of sustained economic growth and rising incomes over the long run (Solow, 1956[1]) (Krugman, 1994[2]) (OECD, 2015[3]). Many OECD countries face historically weak productivity growth, and stagnating living standards coupled with high or increasing inequalities. This worsens pressures on public finances from health care and ageing related expenses (Guillemette and Turner, 2021[4]) (Bloom and Luca, 2016[5]) (OECD, 2019[6]).[2] Interactions of technological change with market and policy failures can lower productivity and raise inequality concomitantly, creating opportunities for double-dividend policy interventions that are beneficial both for potential growth and inclusiveness (OECD, 2016[7]) (Brookings Institution and Chumir Foundation, 2019[8]).[3]

In most countries, subdued (or even negative) labour force growth, diminishing gains from rising educational achievements, environmental challenges and high levels of public and private debt will weigh on GDP per capita growth going forward. Income growth is set to decline, even assuming historically normal – that is, higher than recent – productivity growth rates (Fernald, 2016[9]), (Gordon, 2016[10]).

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[2] Also, given rising geopolitical tensions, more and more on national security such as defence. On the potentially positive role of defence R&D on private R&D and related spillover effects, see (Moretti, Steinwender and Van Reenen, 2023[447]); for a broader discussion on the more general role of defence R&D within innovation policies, see (Bloom, Van Reenen and Williams, 2019[60]).

[3] Recent OECD evidence documenting that productivity growth tends to correlate positively with employment and wage growth is consistent with this idea (Calligaris et al., 2023[.]).

Notwithstanding these headwinds, strong policy action could mitigate their negative impact and can also help to maximise the productivity benefits of technological change.[4]

This review provides an update of the evidence on productivity developments and their most relevant structural drivers. The time is ripe for tacking stock: the COVID-19 pandemic has accelerated digitalisation, but also produced scarring effects; uncertainty has increased on the back of geopolitical and climate risks; tendencies towards weakening competition and stalling globalisation may weaken productivity growth, while artificial intelligence (AI) and the green transition create new opportunities. The review builds closely on previous OECD work, starting with an extensive report on *The Future of Productivity* (OECD, 2015[3]), which pointed out that productivity growth at the global frontier has remained relatively robust in the 21st century despite the slowdown in average productivity growth, while the gap between frontier firms and laggards has widened markedly. This raises issues about knowledge and technology adoption and diffusion, as well as about the role of the rise of tacit knowledge as a source of competitive advantage for global frontier firms. The report pointed to three policy areas of key importance to sustain productivity growth: i) fostering innovation at the global frontier and facilitating the diffusion of new technologies to firms at the national frontier; ii) creating a market environment where the most productive firms are allowed to thrive, thereby facilitating the more widespread penetration of available technologies; and iii) reducing resource misallocation, particularly skill mismatches.

Subsequent OECD research provided further insights into these policy areas. The rise in MFP divergence was found to be much more extreme in sectors where pro-competitive product market reforms were least extensive, suggesting that policy weaknesses may be stifling diffusion in OECD economies (Andrews, Criscuolo and Gal, 2016[11]). Easing occupational entry regulations could also increase the contribution of personal and professional services to aggregate productivity growth (Bambalaite, Nicoletti and von Rueden, 2020[12]). Several papers, summarised in (Andrews, Adalet McGowan and Millot, 2017[13]), highlighted the role of "zombie" firms and inefficient insolvency frameworks in holding back productivity through resource misallocation. The policy drivers and productivity implications of digitalisation, in particular of online platforms, were also investigated in a series of works, wrapped up by (Sorbe et al., 2019[14]). They underline that for these technologies to deliver productivity gains, businesses need to implement complementary investments in intangible assets (Pisu et al., 2021[15]) and policies play a crucial role in easing the financing constraints related to intangibles (Demmou and Franco, 2021[16]). Finally, digging deeper by looking at workers within firms, (Criscuolo et al., 2021[17]) – in the context of the OECD *Global Forum on Productivity* – documented the crucial role of skills and diversity of the workforce, in particular managers, in accounting for the large productivity differences between firms.

The analytical framework of this review and the discussed public policy mechanisms therein build on this literature and more specifically on (Albrizio and Nicoletti, 2016[18]), (Nicoletti, von Rueden and Andrews, 2020[19]) and more recently on (OECD/APO, 2022[20]). It also highlights several novel or updated OECD policy indicators that have been developed since the 2015 report (including insolvency regimes, occupational licensing, as well as updated product market regulation (PMR)). It focuses on the drivers of productivity primarily in the business sector and leaves aside productivity in non-market services given their fundamentally different nature.[5]

The key takeaway from this overview is that a broad range of public policies impact productivity growth through various channels, with important complementarities between them and with different effectiveness

[4] Motivated by these challenges, the Global Forum on Productivity (GFP) of the OECD was created in 2016 to carry out more analysis, discuss and disseminate research and policy experience across countries and among a range of public bodies with responsibilities for enhancing productivity growth (oe.cd/gfp).

[5] For a brief summary on public sector productivity issues, see Box 3 in (Sorbe, Gal and Millot, 2018[74]); also, (Diewert, 2018[528]).

depending on the type of firms that are mostly impacted. In that spirit, a few basic principles are worth pointing out. First, successful reforms to lift productivity require a multi-pillared approach affecting both the *incentives* and *capabilities* of businesses and workers. Second, policies should also recognise the different challenges facing firms at the technology frontier, which are the main contributors to innovations, and firms that are lagging and mostly rely on catching up for productivity growth by adopting better technologies and business practices. Finally, public policies also need to foster a productive allocation of resources – capital and labour – in the economy, notably through nurturing a healthy level of business dynamism. Table 1 provides a high-level summary of policies affecting aggregate productivity and their transmission channels. More detailed summaries for raising incentives (Table 2) and capabilities (Table 3) can be found in Section 4.

Table 1. Raising aggregate productivity through incentives and capabilities: a stylised framework

<table>
<tr><th rowspan="2">Impacts mostly on</th><th rowspan="2">Incentives</th><th colspan="3">Capabilities</th></tr>
<tr><th>Through MFP</th><th>Through capital</th><th>Through labour</th></tr>
<tr><td>Firm level productivity near or at the frontier</td><td>For innovation through competition among leaders, appropriate intellectual property rights and public procurement</td><td>By expanding the knowledge frontier through basic research and collaboration</td><td>By enabling high risk investments in (mostly) intangible assets</td><td rowspan="2">By raising the quality of human capital through education and adult training</td></tr>
<tr><td>Firm level productivity below the frontier</td><td>For adoption and experimentation through competition (domestic & international) and fiscal incentives</td><td>By diffusing knowledge across firms and workers</td><td rowspan="2">By removing obstacles to private Investments and providing quality infrastructure</td></tr>
<tr><td>Allocation of resources across firms with different productivity levels</td><td>For better resource allocation through healthy business dynamism</td><td></td><td>By improving the matching of workers to jobs through enabling mobility</td></tr>
</table>

Note: The table allows for the possibility that both the *quality* and *quantity* of inputs matter for aggregate productivity, either through the allocation of resources across firms with different productivity levels (for labour and capital alike – last row), or by affecting labour productivity directly at the firm level (through capital intensity and through labour *quality* – first two rows). Improving capabilities through capital may jointly raise investment by lagging firms and lead to a more productive allocation of resources across firms. Improving human capital, in general, helps both leading and lagging firms. For more details, see Table 2 (on *Incentives*) and Table 3 (on *Capabilities*) in Section 4.
Sources: Building on and extending OECD (2015), Nicoletti, von Rueden and Andrews (2020) and Égert and Gal (2017).

Recently emerging or intensifying issues, mainly the nature of emerging technologies, the need for accelerating the green transition and a backlash against globalisation, further strengthen motivations, or provide new opportunities, to lift the productive capacity of our economies. First, advanced artificial

intelligence (AI) systems develop rapidly (Filippucci et al., 2024[21])[6], most recently in the field of large language models, LLMs (Baily, Brynjolfsson and Korinek, 2023[22]) (OECD, 2023[23]), but also in other domains and applications during the past decade (Agrawal, Gans and Goldfarb, 2018[24]); more general digital technologies continue to spread and even more so following the COVID-19 shock and the ensuing shift to remote and hybrid work (Barrero, Bloom and Davis, 2021[25]) (Criscuolo et al., 2023[26]). To exploit these technological developments in a way that leads to broad-based productivity growth across a wide spectrum of firms and that translates into benefits for workers, it is essential to put in place a range of complementary investments, including changes in business practices, firm reorganisation and skills upgrading (Brynjolfsson and McAfee, 2014[27]) (Pisu et al., 2021[15]) (OECD, 2020[28]).

Second, climate change and the related need for the green transition could, on the one hand, trigger innovation and productivity growth; on the other hand, strong productivity growth will also be necessary to support public finances to facilitate the transition (Acemoglu et al., 2012[29]) (OECD, 2021[30]), (Dechezleprêtre and Kruse, 2018[31]). Moreover, policies that support productivity – ranging from innovation to investments, but also raising housing supply and fostering mobility – will have to be prioritised and designed in a way that mitigates or lowers emissions.

Third, supply chain issues and more generally stalling globalisation may exacerbate all these challenges by erecting further barriers to future productivity improvements (Goldberg and Reed, 2023[32]), (Jaax, Miroudot and van Lieshout, 2023[33]). Given the vast body of evidence on the positive relationship between trade openness and productivity through various channels (Shu and Steinwender, 2019[34]) (OECD, 2017[35]), as well as the trade-offs involved for inclusiveness (Rodrik, 2021[36])) and more recently security and resilience (Crowe and Rawdanowicz, 2023[37]), this issue is likely to stay at the forefront of public policy thinking on productivity growth .

More generally, it is increasingly recognised that not all types of productivity growth translate by itself into widespread increases in incomes and well-being across the workforce, let alone the broader population.[7] While the rise in income inequality has moderated on some metrics in most OECD countries during the past decade or so (oe.cd/idd), inequalities are still elevated in historical perspective, and emerging technologies risk pushing them up again. For instance, a prominent element of technological change, automation, may accelerate further thanks to rapid developments in AI and robotics (Brynjolfsson and McAfee, 2014[27]), and the evidence so far shows that even if its impacts are mostly positive for productivity, they are very uneven across workers, with firm-level displacement effects sometimes substantial and with ambiguous overall effects on employment.[8] Moreover, in the medium-to-long term, aggregate productivity might also weaken as a result of excessive automation if the employment share of adopters shrinks fast (Bessen, 2019[38]), while demand is shifting towards lower-productivity activities and sectors (see also (Aghion, Jones and Jones, 2018[39]), building on (Baumol and Bowen, 1965[40])).

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[6] The OECD, spearheaded by the OECD Policy Observatory on AI (OECD.AI), has adopted AI Principles to promote an innovative and trustworthy use of AI, which respects human rights and democratic values, setting the first intergovernmental standard on AI and shaping an enabling policy environment for AI (https://oecd.ai/en/ai-principles).

[7] See for instance (Rodrik, 2022[50]) who introduces the term “productivism” which describes productivity growth that is more widespread across space and across different segments of the labour force. A closely related idea is “Modern Supply Side Economics" (Yellen, 2022[443]) which acknowledges that for productivity to deliver broad based benefits public policies need to focus more on “[…] human capital, public infrastructure, R&D, and investments in a sustainable environment”.

[8] A few recent selected examples include (Acemoglu et al., 2022[146]) for the US; (Acemoglu, Lelarge and Restrepo, 2020[446]); (Aghion et al., 2021[527]) for France; and (Bessen et al., 2020[448]) and (Acemoglu, Koster and Ozgen, 2023[455]) for the Netherlands. For the particular case of AI as an automation technology (Acemoglu et al., 2022[146]) document lower hiring after AI adoption at the level of establishments.

The quality of jobs also matters for productivity (Saint-Martin, Inanc and Prinz, 2018[41]): job strain – defined by situations where the requests that workers need to respond to (i.e. physical demands, work intensity, inflexible working hours) exceed the resources available to them (i.e. task discretion, training, career advancement (Cazes, Hijzen and Saint-Martin, 2015[42]) – and job insecurity affect the performance and productivity of workers through their well-being and health (Bryson, Forth and Stokes, 2017[43]; Böckerman and Ilmakunnas, 2012[44]).[9]

Closely related to public policy goals and instruments to enhance productivity, there is a very active, renewed interest in industrial policy or industrial strategy (for recent summaries, see (Millot and Rawdanowicz, 2024[45]), (Criscuolo et al., 2022[46]) and (Juhász, Lane and Rodrik, 2023[47])). Importantly, these initiatives often span a wider set of goals than raising productivity, including strategic autonomy, security, resilience in the context of geopolitical fragmentation, or decarbonisation.[10] They are often targeted at specific sectors, places or technologies in contrast with more "horizontal" policies, such as ensuring competition or investing in skills, that can affect firms and workers across the board. Nevertheless, an important common feature of all productivity enhancing policy efforts is the recognition that a broad range of public policy areas need to be leveraged in a coherent, complementary way to achieve impact. Moreover, steering technological changes that underlie productivity growth (such as AI, automation or green innovations) is increasingly being considered as a legitimate policy objective so as to mitigate potential negative effects on inclusiveness and well-being and to avoid conflicting with other goals, such as carbon mitigation (Cervantes et al., 2023[48]; Cevik and Jalles, 2023[49]; Rodrik, 2022[50]).

This paper complements other recent reviews on the key policy issues for productivity from various angles, see (Jaumotte et al., 2023[51]) with a focus on COVID-19 and digitalisation; (Cusolito and Maloney, 2018[52]) and (Dieppe, 2021[53]) with a stronger focus on developing and emerging countries; (ECB, 2021[54]) and Lopez-Garcia et al (2024) with a focus on EU and euro area countries, respectively, and (Van Ark, De Vries and Pilat, 2023[55]) covering G20 economies. (Cho et al., 2024[56]) focuses on firm- and sector level developments and the relationship with business dynamism and inclusiveness, mostly across the EU. Recent academic reviews include (Goldin et al., 2023[57]) and (Corrado et al., 2022[58]) on the reasons for the productivity slowdown, (De Loecker and Syverson, 2021[59]) with a survey on the microeconomic mechanisms and their links to macroeconomic outcomes and (Bloom, Van Reenen and Williams, 2019[60]) on policy options for spurring innovation. (McKinsey & Company, 2023[61]) provides an overview from the private sector's perspective. (Tsvetkova et al., 2020[62]) provide an extended review on how policies with a strong spatial or geographic dimension interact with other policies or play a key direct role for productivity. (Juhász, Lane and Rodrik, 2023[47]), (Criscuolo et al., 2022[46]) and (Criscuolo et al., 2022[63]) discuss industrial policies and their effectiveness for meeting a range of public policy goals, including lifting productivity growth.[11]

The structure of this review is as follows. First, it presents aggregate evidence on weak productivity growth for most OECD and partner countries (Section 2). Then it describes the main channels and mechanisms acting at the micro- and more aggregate levels that have been identified in the literature (Section 3).

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[9] A key dimension of job quality is working hours length and flexibility. Some recent or ongoing experiments about reduced hours – "4 day working week", for instance, in Japan, New Zealand, Spain and the UK – are yielding some early results on hourly productivity, but they do not yet constitute robust and conclusive evidence on the matter (see discussion in (Batut, Garnero and Tondini, 2022[530]) and (Cazes et al., 2022[499])).

[10] Some regulations and subsidies may significantly distort international competition, with a potentially large negative impact on productivity.

[11] Two recent books, with somewhat broader but related topics, also provide interesting overviews on relevant issues from which this review borrows as well: on the institutional constraints in our economies that hold back the full deployment and use of intangible assets (Haskel and Westlake, 2022[125]); and on the role and direction of technological change, with both a historical and a forward looking perspective (Acemoglu and Johnson, 2023[264]).

Building on these channels, it sets out a framework to discuss the role of a wide range of public policies in driving productivity (Section 4). Finally, it offers concluding remarks and potential directions for future work (Section 5).

2. Weak productivity growth: recapping the macro evidence

2.1. OECD productivity growth in long-term decline

Labour productivity growth has been on a declining trend since the 1970s across the OECD and weakened further since the turn of the century (Figure 1). In the United States, productivity picked up from the mid-1990s to the mid-2000s on the back of rising efficiency in the production of ICT equipment and the diffusion of internet-related innovations that were adopted in ICT using sectors, notably retail trade ((Fernald, 2015[64]) (Byrne, Oliner and Sichel, 2013[65]); (Sprague, 2021[66])_(Baily, 2023[67])). However, this rebound was relatively short-lived and productivity growth has since then been lacklustre. In most other major OECD countries, productivity growth has been on a continuous declining trend partly due to missing out on the temporary boost provided by ICT (van Ark, O'Mahony and Timmer, 2008[68]) (Cette, Fernald and Mojon, 2016[69]). Nevertheless, average annual OECD labour productivity growth was still close to 2% in the 1990s, before falling sharply to around 0.8% over the last decade. The long-term patterns are broadly similar for multi-factor productivity (MFP) growth.[12,13]

Productivity growth at the global frontier, of which the United States is representative at the macroeconomic level (Acemoglu, Aghion and Zilibotti, 2006[70]) (Caselli and Coleman, 2006[71])[14], is closely related to global innovation (see (OECD, 2015[3]) and Section 3.1.). The slowdown in the 1970s may be related to the exhaustion of the diffusion of innovations from the second industrial revolution, based on electricity and the internal combustion engine (Cowen, 2011[72]) (Gordon, 2018[73]). The rising share of services, which tend to exhibit lower productivity than manufacturing, in the economy (Baumol cost disease) also entails a moderate but persistent drag on productivity growth (Sorbe, Gal and Millot, 2018[74]) (Dieppe, 2021[53]).

The fading of the ICT-based productivity revival has triggered a lively debate on the potential of ICT to spur further productivity growth. (Gordon, 2016[10]) argues that the wave of innovation associated with ICT and the Internet has largely run its course. However, (Syverson, 2013[75]) points out that recent labour productivity developments echo those of the second industrial revolution, in which phases of strong growth were interrupted by a prolonged slowdown, and that productivity enhancements related to general purpose technologies come in waves. The so-called "techno-optimists" offer evidence of continued progress in ICT technologies, with high potential to further lift productivity (Byrne, Oliner and Sichel, 2013[65]; Brynjolfsson and McAfee, 2014[27]) (Mokyr, 2013[76]); (van Ark, 2016[77])). OECD work in the *Future of Productivity* (OECD, 2015[3]) – building on the evidence presented in (Andrews, Criscuolo and Gal, 2015[78]) – offered a reconciliation between apparently fast technological change but slow overall productivity growth: firms at the global frontier do advance their productivity at a fast pace, in particular in ICT intensive industries, but the majority of firms that are below the frontier grow at a much slower rate (see Section 3.1 for more up-to-date evidence).

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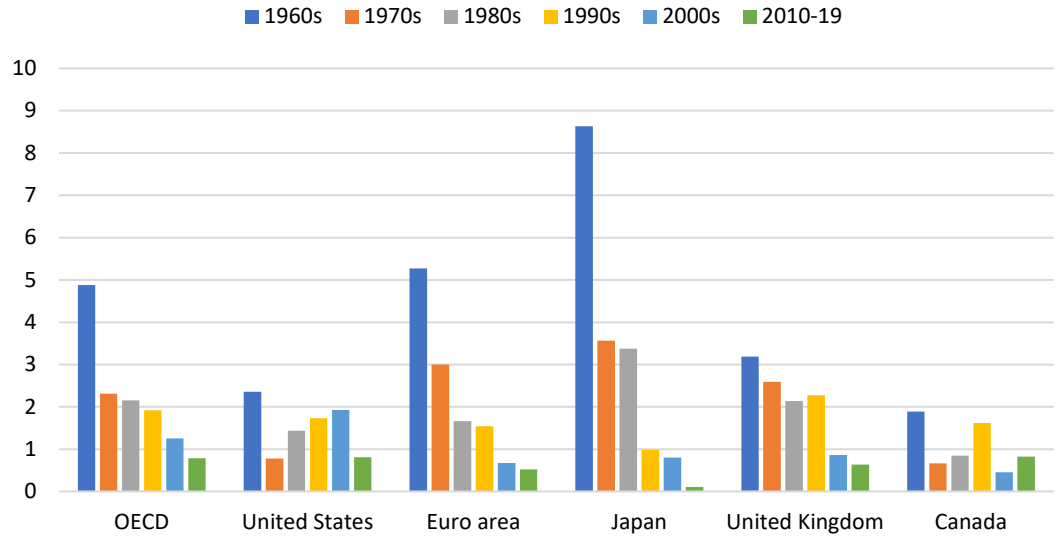
[12] MFP captures the joint efficiency of several inputs in production – at the macro level most often labour and capital –, typically calculated as a residual of a production function (Schreyer, 2001[515]) (De Loecker and Syverson, 2021[59]); see also footnote 11. For a comparison between labour productivity and MFP growth over longer horizons, see for instance the long term productivity database by (Bergeaud, Cette and Lecat, 2015[104]).

[13] Key factors behind productivity trends in euro area countries are analysed in (Lopez-Garcia and Szörfi, 2021[538]).

[14] Given that it is a technology leader in several high-tech industries such as pharmaceuticals, aerospace, communication equipment and computer machinery; see (Acemoglu, Robinson and Verdier, 2017[470]) and references therein.

Figure 1. Productivity growth has been on a declining long-term trend in most large economies

Average labour productivity, annual growth rate



Note: Labour productivity is measured as GDP per worker due to data availability for the OECD aggregate. However, where data are available, trends in GDP per hour are broadly similar. The pandemic period is excluded due to the high volatility of output and labour (see below in footnote 16; also see Figure 3 for more recent and more detailed country-by-country data using hours worked based productivity). The OECD and Euro area are aggregated using GDP-PPP weights.
Source: OECD Economic Outlook 115 Database (June 2024).

2.2. Productivity growth has slowed further since the mid-2000s

Potential per capita growth in the OECD has slowed further since the mid-2000s, reflecting both weaker MFP developments and, especially following the global financial crisis (GFC), slower capital accumulation.[15,16] The gradual GDP per capita pickup in recent years has been largely employment-driven (Figure 2). The productivity slowdown has affected most OECD countries, albeit to a different degree (Figure 3). Ireland and Spain are exceptions, where productivity increased in the wake of the GFC, largely due to the reallocation of resources away from the low-productivity construction sector following the burst of housing bubbles, and to the growing role of multinational enterprises in Ireland. Productivity growth also accelerated in Colombia and Costa Rica since the GFC, partly reflecting favourable structural economic

[15] In practice, drawing a clear line between the contribution of MFP or the contribution capital deepening is complicated by measurement and conceptual challenges. In particular, the rise of intangibles and their increasing recognition in national accounts (Haskel and Westlake, 2018[97]) leads to a rising capital contribution, while reducing that of MFP (which is obtained as a residual). The choice of defining capital deepening matters as well: capital over output (as in (Fernald, Inklaar and Ruzic, 2024[100]) enlarges the contribution attributed to MFP, compared to the case when using capital over labour, as in (Van Ark, 2023[179]) and (Corrado et al., 2023[178]) and in this paper (including in Figure 3). MFP and capital also impact each other in a dynamic sense (endogeneity): firms invest more when they expect stronger future returns, and those returns are partly driven by more advanced technologies, captured by higher future MFP values; conversely, faster future MFP growth can be fuelled by investments into novel technologies. The evidence shown in this section relies on the potential output measurement methodology at the OECD's Economics Department, presented in (Chalaux and Guillemette, 2019[91])

[16] (Esfahani, Fernald and Hobijn, 2023[469]) document that global aggregate productivity growth – which takes into account non-OECD countries and changes in the relative weights of economies – also started to slow down since the GFC, after several decades of constant growth that was hiding a slowdown in advanced economies while faster growth and a growing share of large emerging economies.

transformations. Conversely, productivity growth in Central and Eastern Europe countries slowed markedly. Productivity growth fell sharply in some of the countries that were most severely hit by the GFC, notably Iceland and Greece.

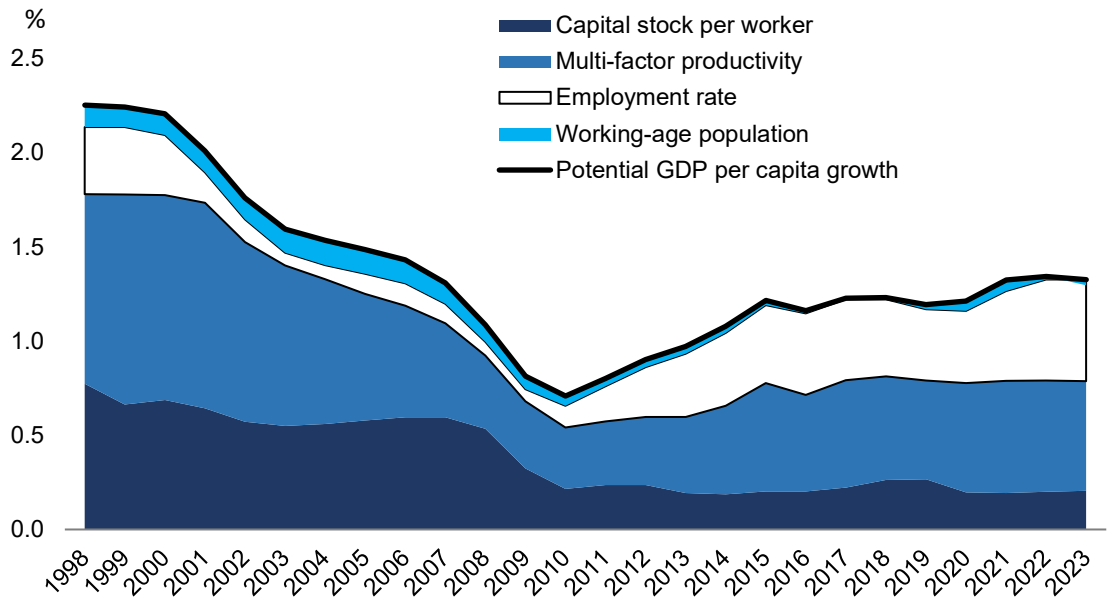
Several explanations have been put forward for the post-GFC global productivity slowdown, notably weaker innovation at the frontier and diffusion (see details in Section 3.1), the GFC's legacy through depressed investment (see below) and potential measurement errors. Measuring productivity is indeed challenging, with both outputs and inputs being prone to measurement difficulties (Josh and Riley, 2023[79]). Several measurement issues that could have led to underestimating productivity performance over recent years have been analysed in the literature but adding them up only explains a modest part of the productivity slowdown, especially because even where measurement biases may be significant, they are unlikely to have changed enough over time to account for a major part of the slowdown (Syverson, 2017[80]).[17] They include difficulties in the measurement of capital stocks and services (Gouma and Inklaar, 2023[81]) and of the quality of human capital (Nilsen et al., 2011[82]); (OECD/APO, 2022[20]) – in particular the mismeasurement of intangible assets (Corrado, Haskel and Jona-Lasinio, 2021[83]), data (Corrado et al., 2022[84]) and the related rise in markups (Crouzet and Eberly, 2021[85]) –; profit shifting by multinational firms (Guvenen et al., 2022[86]) and imperfect price index adjustments for product quality improvements (Aghion et al., 2019[87]).[18] Altogether, several studies conclude that it is unlikely that the bulk of recent weak productivity is due to increasing measurement difficulties (Ahmad and Schreyer, 2016[88]); (Ahmad, Ribarsky and Reinsdorf, 2017[89]) (Adler et al., 2017[90]) (Syverson, 2017[80]).

[17] For instance, (Aghion et al., 2019[87]) finds that output growth is understated due to commonly used imputation methods by statistical agencies for the prices of disappearing products, but the degree of this mismeasurement has not increased over time.

[18] There are also differences across countries in the measurement of hours worked, but this affects mainly relative labour levels and rankings but do not change the picture of poor and weakening global performance (Ward, Zinni and Marianna, 2018[496]) (Wingender, 2018[476]); Unobserved changes in capacity utilisation (Comin et al., 2023[451]) may also have an impact although that is mostly a cyclical phenomenon and again does not change the longer run trends.

Figure 2. MFP and capital accumulation have both contributed to the slowdown in per capita potential growth

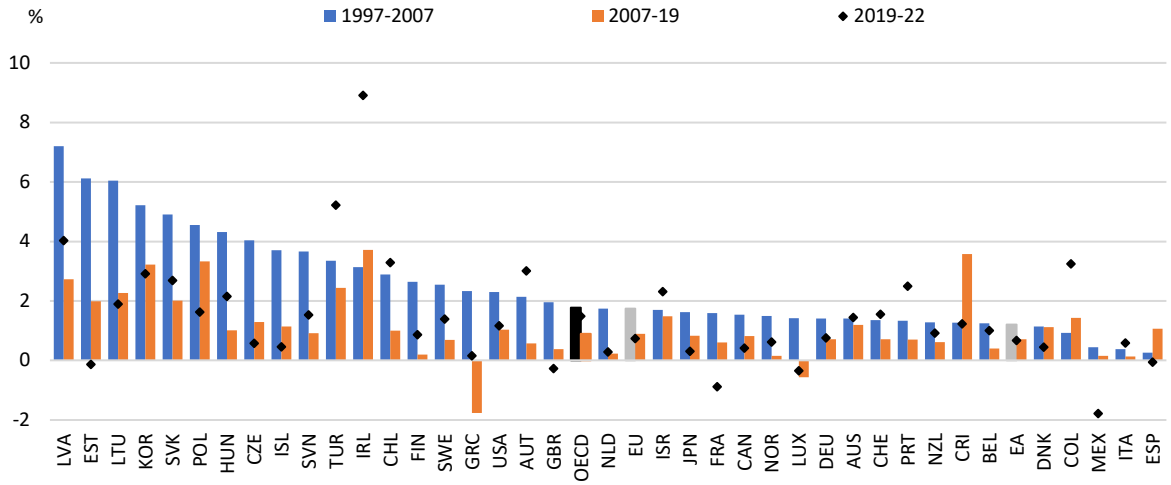
Decomposition of OECD potential GDP per capita growth (annual change, in %)



Note: All variables are smoothed except capital stock per worker. The OECD average is obtained by PPP-based GDP weights across countries. For more details, see the description of the OECD potential output estimation methodology (Chalaux and Guillemette, 2019[91]). MFP therein is referred to as "labour efficiency", given that in the underlying production function technical change is written in labour augmenting form.
Source: OECD Economic Outlook 115 Database (June 2024).

Figure 3. Labour productivity slowdown: a widespread phenomenon across countries

Labour productivity annualised growth



Note: Labour productivity refers to GDP per hour worked. OECD, Euro area and European Union are aggregated using GDP-PPP weights.
Source: OECD Productivity database.

The GFC was followed by the most severe global economic downturn since the Great Depression. Weak demand and high uncertainty have contributed to the productivity slump, notably through investment (Ollivaud, Guillemette and Turner, 2016[92]). The latter affects labour productivity through capital deepening, but also through MFP, as new capital vintages are more productive than older ones and the introduction of new equipment is generally associated with improvements in production processes.

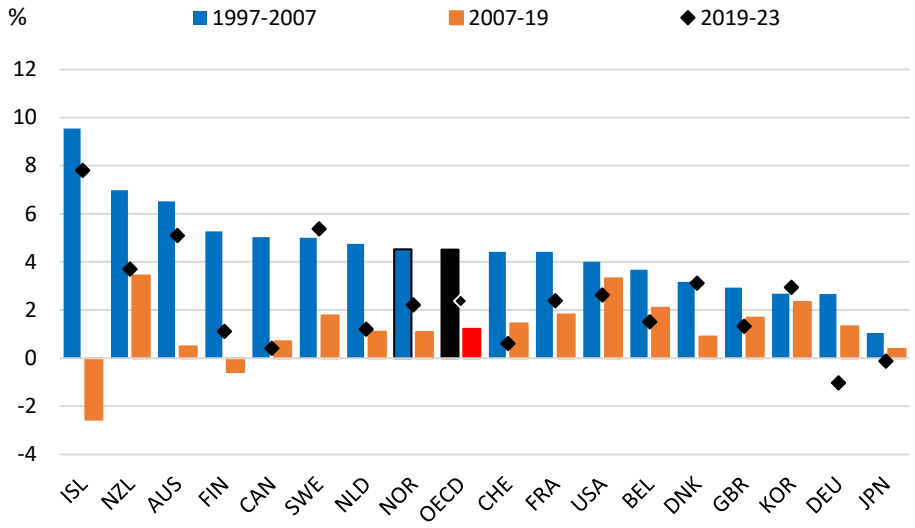
Since the GFC, investment has been lacklustre. Moreover, weak developments have been broad-based, almost entirely driven by within-sector changes, rather than the rising share of sectors with low capital intensity and investment (Hanappi, Millot and Turban, 2023[93]). Business investment has slowed markedly in all countries for which data are available (Figure 4) The investment slowdown despite readily available and cheap credit for firms with access to capital markets is in line with historical patterns showing that uncertainty and expected profits tend to play a greater role than financial conditions in investment decisions (Banerjee, Kearns and Lombardi, 2015[94]). The relatively modest role of financial conditions is consistent with the concentration of aggregate investment in a small number of large firms, which have better access to funding than small companies (Hanappi, Millot and Turban, 2023[93]). Even so, weak banks, particularly in Europe, may also have hampered investment by propping up zombie firms, leading to credit misallocation (Andrews and Petroulakis, 2017[95]).

Intangible investments, including R&D, patents, software, databases, designs, managerial skills, and organisation and distribution networks play a growing role in increasingly service- and knowledge-based economies (Corrado, Hulten and Sichel, 2005[96]), (Haskel and Westlake, 2018[97]); they are sometimes referred to as knowledge based capital (OECD, 2013[98]), (Andrews and Criscuolo, 2013[99]). Only part of them, referred to as *intellectual property products* are recorded in the national accounts. Even so, that part now accounts for about a fifth of total investment on average in the OECD, up from less than 13% in 2007. In the US, the latest figure is near 40% of total private non-residential investment; and it is almost two-thirds when including estimates of all intangibles (Corrado et al., 2022[58]). Notwithstanding the rise of intangibles, total investment since the GFC has been weak overall, which worsened the labour productivity slowdown directly and may have contributed to the MFP slowdown indirectly as well through technology embodied in new capital goods and intangibles.

Regarding the role of MFP, the latest downturn in US labour productivity growth that started before the GFC, since the mid-2000s, was mostly driven by its slowdown (Fernald, Inklaar and Ruzic, 2024[100]). This suggests that the efficiency in the use of inputs has improved more slowly since then, which could reflect among other things a slowdown in research productivity (Bloom et al., 2020[101]) or innovation (Fernald, Inklaar and Ruzic, 2024[100]), reduced business dynamism or obstacles to factor reallocation (Decker et al., 2017[102]) (see Section 3.1). The longer-term slowdown observed in other advanced economies has also been mostly MFP driven, as mentioned in Section 2.1.

Figure 4. Investment has been sluggish since the GFC

Real business investment annualised growth



Note: OECD refers to the unweighted average of the countries shown in the chart.
Source: OECD Economic Outlook 115 Database (June 2024).

The COVID-19 pandemic has generated hopes of a productivity boost, but also raised the risks of a scarring through labour markets, human capital and the allocation of resources more broadly (See Section 3.2). On the positive side, the need for remote working, the related acceleration of digitalisation (Calvino, Criscuolo and Ughi, 2024[.]), as well as the necessary experimentation with new ways of organising work and relationships with suppliers and customers could enhance productivity (Di Mauro and Syverson, 2020[103]). The data shows so far that labour productivity growth has been 0.6 percentage point stronger in the OECD since 2019 than in the period between the GFC and the pandemic and about two-thirds of countries have experienced higher average productivity growth in the post-pandemic period (Figure 3). However, given the various conflicting impacts of the pandemic and the short period that has passed since, it is too early to assess the impact on long-term productivity trends.[19]

The productivity slowdown reflects both slower growth in the countries at the "frontier" – defined as the top 5 countries in terms of labour productivity levels – and weaker catch up by laggards. Labour productivity growth at the frontier, defined as average growth in the five countries with the highest productivity levels at the beginning of the period, slowed from 1.4% in the decade preceding the GFC to 0.5% since the crisis (Figure 5)[20]. Convergence to the frontier has also slowed since the mid-1990s, which could reflect

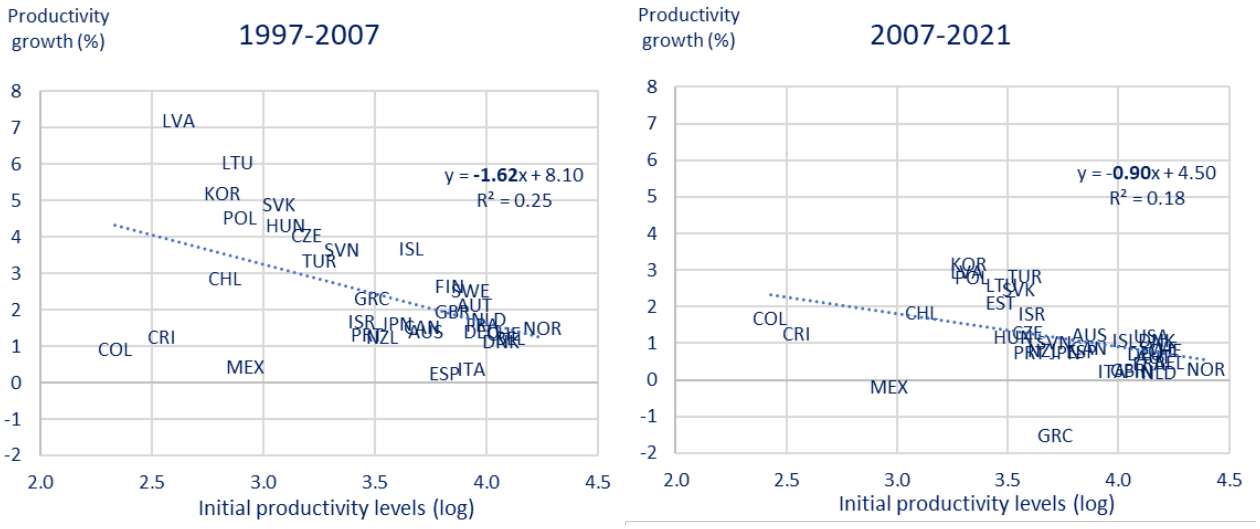
[19] Chapter 1 of (OECD/APO, 2022[20]) discusses in detail the immediate and potential longer-term impacts of COVID-19 on productivity, documenting large shifts in output, inputs and thus productivity during 2020 and 2021 as economic activity was severely disrupted. (Bloom et al., 2023[473]) uses data from a monthly firm survey and confirm the large swings in measured productivity; however, they also conclude that forecasts by company managers imply little lasting impact on aggregate productivity despite strong heterogeneities across firms and sectors. Note also that the way labour markets adjusted, partly due to policy choices related to job retention, can create larger than usual differences between productivity measures on a per worker and per hour basis.

[20] The chart excludes Ireland and Luxembourg, which are outliers due to the heavy weight of multinational companies in their economies. Convergence is somewhat stronger in both periods when the most recent OECD members, Colombia and Costa Rica, are omitted.

increasing difficulty to catch up as the gap with the frontier narrows or rising obstacles to convergence. Slowing frontier and weaker convergence at the macro level align with the latest micro-level findings, further elaborated below in Section 3.1. In a long-run perspective, convergence has been erratic and hampered by inappropriate institutions, technology shocks, financial crises and wars (Bergeaud, Cette and Lecat, 2015[104]) (Cusolito and Maloney, 2018[52]). Over the past decades, the Japanese financial crisis, the GFC and European sovereign debt crisis have stalled convergence in some countries. Nevertheless, some countries that converged before the GFC, notably Central and Eastern Europe countries, Korea and Turkey continued to catch up since then, albeit at a slower pace. Colombia and Costa Rica, who joined the OECD respectively in 2020 and 2021 and were growing slowly before the GFC, came closer to the average convergence path after the crisis.

Figure 5. Catch-up continues but at a slower pace, combined with slower growth at the frontier

Initial level and change in GDP per hour worked



Note: Initial productivity levels are measured by the log of GDP per hour worked, USD Thousand, constant prices, 2015 PPPs, in the initial year of the periods indicated. Productivity growth is the annual average productivity growth of GDP per hours worked over the periods in percentages. Productivity at the frontier is the average productivity growth of the five countries with the highest productivity levels at the beginning of the relevant period. Ireland and Luxembourg are omitted due to extreme values in their productivity levels and growth rates, linked to their relatively small size compared to large multinational companies operating there.
Source: OECD Productivity database.

3. Drivers of productivity: from micro-to-macro and back

3.1. From micro to macro: how productivity is built up in the aggregate

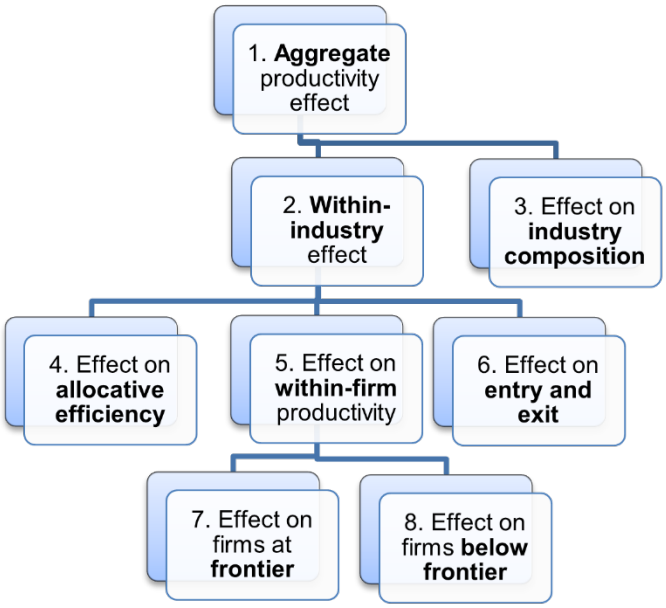
To help structure the upcoming policy discussion[21] (Section 4), this section presents a framework on how aggregate, macro-level productivity is impacted by public policies or structural changes at the firm (micro) and industry level. Figure 6 illustrates the main idea: aggregate productivity effects (box 1 on the figure) can arise through industry-level changes in productivity (box 2) as well as through a changing composition across industries (box 3). For instance, the rapid development of specific technologies (such as ICT) can raise the productivity of certain sectors (such as ICT using industries) and thus contribute to higher

[21] The framework in this section also borrows from (Bartelsman, 2010[484]).

aggregate productivity[22], while structural changes that induce a shift of employment towards lower productivity sectors – such as the accommodation and restaurants, whose demand tend to rise with income – can exert a drag on aggregate productivity.[23] [24]

Figure 6. From micro to macro: the potential impacts of policies and structural changes at different levels of aggregation

However, foreign firms have a strong incentive to prevent such spillovers to competitors, which erode their competitive advantage.



Source: OECD.

Digging deeper, within industries, a wide dispersion of firm productivity and a continuing reallocation of resources across them shape industry aggregate productivity. Even within very narrowly defined manufacturing industries, firms at the 90th percentile of the productivity distribution are about twice as productive – measured by multi-factor productivity – than those at the bottom 10th percentile, while in services the differences can be even larger (De Loecker and Syverson, 2021[59]; Berlingieri et al.,

[22] Digitalisation affects labour productivity growth through ICT investments, but also through digital intermediate inputs, which feed into numerous goods via production linkages (Deutsche Bundesbank, 2023[537]).

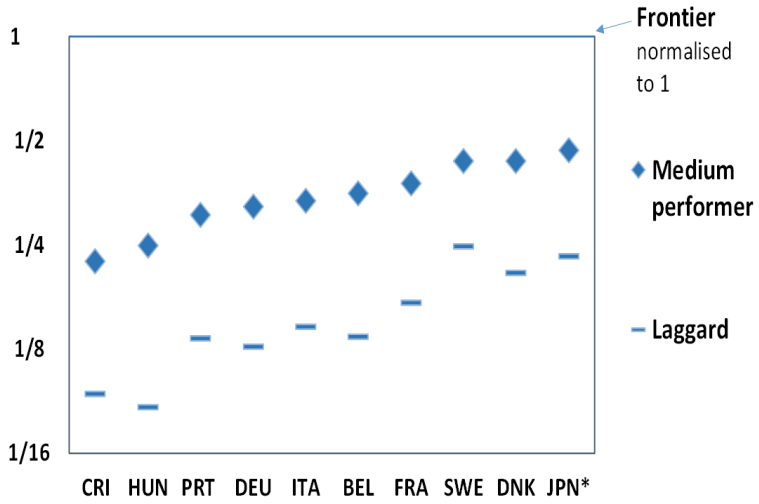
[23] Input-output links across sectors can also impact aggregate productivity, something not easily captured in Figure 6. For instance, recent work by (Acemoglu, Autor and Patterson, 2023[461]) shows that large sectoral differences in innovation and productivity growth present bottlenecks for productivity growth, because firms who need to combine inputs from those sectors are constrained by the sector with the slowest productivity growth. A lack of competition – measured by strict product market regulations – in upstream industries was also shown to hold back productivity in downstream sectors (Bourlès et al., 2013[256]).

[24] The rise of self-employment (Baker et al., 2018[495]), in particular gig-economy work spurred by digitalisation (Schwellnus et al., 2019[493]) is difficult to integrate into this framework, both for conceptual reasons – for instance, they are by definition a one-employee business hence cannot attract more labour resources –, but also due to productivity measurement challenges of such activities (Ward, Zinni and Marianna, 2018[496]).

2017[105]).[25] Recent work by the OECD Global Forum on Productivity shows that the typical "median performer" firm – at the 40-60 percentile of the productivity distribution – is about a third as productive as the leading firms at the "frontier" – top 10% –, within the same industry, and that these gaps are larger in less advanced countries (Costa Rica, Hungary, Portugal) than in most developed ones (Sweden, Denmark, Japan), suggesting a link with aggregate performance (Criscuolo et al., 2021[17]) (Figure 7).

Figure 7. Productivity differences across firms within sectors are large and widespread

Log-differences in value added based labour productivity between firms at the top 10% of the productivity distribution (national "frontier") and at the median (40-60%, "medium performer") and at the bottom 10% ("laggard").



Note: Averages across detailed industries of the non-farm, non-financial business sector, on average over the period 2000-2019 (exact range depending on the country), using microeconomic data on firms. For more details, see (Criscuolo et al., 2021[17]), Appendix A.
*Firms with at least 50 employees.
Source: (Criscuolo et al., 2021[17]) in the context of the *Human Side of Productivity* project of the GFP.

Firms that are more productive tend to be larger, especially in manufacturing (Berlingieri, Calligaris and. Criscuolo. 2018[.]). This positive correlation accounts for a large part of aggregate productivity, between 20 and 60% in manufacturing, depending on the country (Bartelsman, Haltiwanger and Scarpetta, 2013[106]; Andrews and Cingano, 2014[107]). The strength of this relationship is often referred to as (static) allocative efficiency. In a dynamic sense, the *re*-allocation of resources from less to more productive firms, including the entry of more productive firms and the exit of less productive ones, is also important: historically, it can account for the majority of aggregate productivity growth in certain episodes, up to 50% in US

[25] Whether using revenue based productivity measures – which are more common due to the lack of output prices in most firm-level datasets – or physical quantity based productivity – which reflect technological differences more accurately since they are not impacted by market power and local demand conditions – the dispersion remains very high (Foster, Haltiwanger and Syverson, 2008[460]). See (Bartelsman and Wolf, 2018[529]) for comparing various measures of productivity dispersion across firms, and how certain economic forces - such as innovation and experimentation - lead to larger dispersion, while others – in particular market selection towards the most efficient producers – are conducive to lower dispersion.

manufacturing (Foster, Haltiwanger and Krizan, 2001[108]) and as high as 90% in the US retail sector during the 90s when ICT adoption reshaped the industry (Foster, Haltiwanger and Krizan, 2006[109]).[26]

Against this background, it is useful to consider the following three channels through which the wide productivity dispersion and the nature of (re)allocative efficiency can influence industry and macro level outcomes (building on (OECD, 2015[3]) and (Albrizio and Nicoletti, 2016[18])):

- Innovation: firm-level productivity growth at - or near – the top of the productivity distribution, the "frontier" (box 7 in Figure 6);
- Diffusion: firm-level productivity growth below the productivity frontier (box 8);
- (Re-)allocation of resources across firms with different productivity levels within the same industry, including entry and exit of businesses (boxes 4 and 6).

The section proceeds along this structure, focusing mainly on recent developments and links with structural trends and policy levers.

3.1.1. Innovation: is pushing the frontier becoming more difficult?

Productivity growth at the global frontier of firms[27] – defined as firms with the highest 5% of productivity, see Figure 8– over the past two decades has been substantially stronger (around 3.5% per year) than aggregate productivity growth (around 1% per year) over the same period. However, this growth of the frontier started slowing down since the GFC, to around 2.5% per year (Figure 8, Panel A). This is detectable mostly in manufacturing (Panel B), in tandem with the slowdown in global trade (Section 3.2), and to a lesser degree also in services (Panel C). However, it barely shows up in ICT services (Panel D) whose most productive firms enjoyed very high growth rates on the back of the rise of digitalisation. Overall, slowing productivity growth of the frontier of firms is in line with the macroeconomic picture presented in Section 2.2.2 where countries at the top of the productivity distribution also tend to improve productivity less dynamically than in the past.[28]

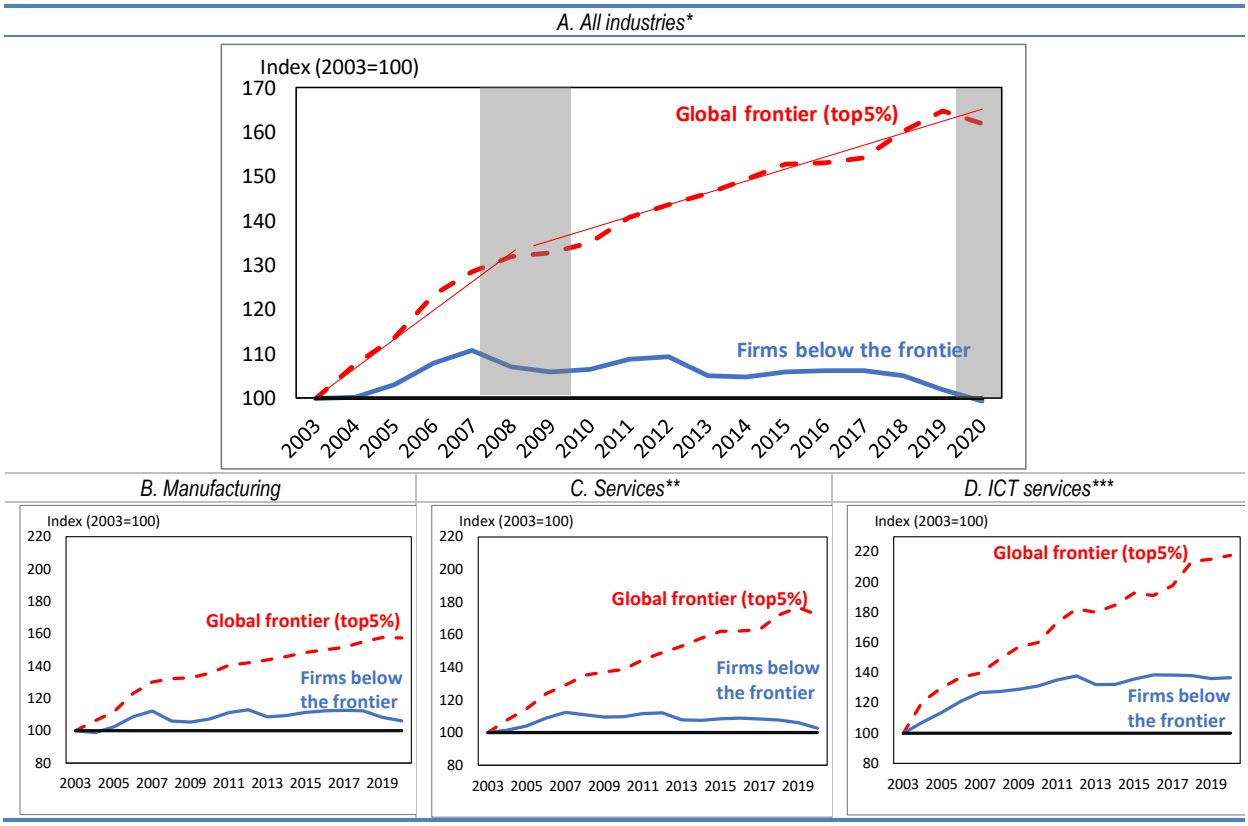
[26] For early reviews of the evidence on productivity dispersion and reallocation, see (Bartelsman and Doms, 2000[456]), (Baily and Solow, 2001[466]) then (Syverson, 2011[402]) and more recently (De Loecker and Syverson, 2021[59]). OECD analysis of firm-level productivity builds on the tradition in this literature, extending the often US-focused academic evidence to a cross-country comparable setting, using both commercial data sources (Orbis, see (Andrews, Criscuolo and Gal, 2016[11])) and through anonymised access to confidential data sources by statistical agencies (the MultiProd project (Berlingieri et al., 2017[105]), using distributed microdata analysis as in (Haltiwanger, Bartelsman and Scarpetta, 2004[457]).

[27] For a recent review of the academic literature on the market failures and the potential role of public policies related to innovation, see (Bryan and Williams, 2021[510]).

[28] It is also consistent with UK evidence by (Schneider, 2018[477]), and with signs of slowing innovation in the US (see more in Section 3.1).

Figure 8. Productivity divergence at the firm level with strong but slowing frontier since the GFC

Labour productivity of the top 5% of firms at the global frontier and all other firms below the frontier



Note: Index (2003 = 100), approximated by changes in logs. Average across detailed industries using firm-level data. 3 year moving average. Labour productivity is defined as value added per employee (MFP based measures yield very similar figures, with somewhat weaker overall dynamics both at the frontier and below). The "Global frontier" is defined as the average of the productivity for the top 5% firms in the productivity distribution within each detailed (2-digit) NACE Rev2 industry from 24 OECD countries for which firm level data is available. "Firms below the frontier" is the average productivity of all other firms within the detailed industry. See more details in the paper cited in the source.
*Non-farm non-financial business sector (NACE Rev2 industries 10-82, excluding 19, 64-66, and 68).
**Services cover non-financial business services NACE Rev2 industries 45-82 excluding 64-66 and 68.
***ICT services cover NACE Rev2 industries 58-63.
Source: updated calculations following the methodology in (Andrews, Criscuolo and Gal, 2016[11]) using the 2023 vintage of the Orbis firm-level financial accounts database by Moody's/BvD, with acknowledgments to Natia Mosiashvili for preparing the derived productivity database.

Productivity at the frontier is driven by innovation, including the invention of new technologies, as well as novel business practices such as the organisation of production and firm operations (Baily, 2023[67]) (OECD, 2015[3]). Various indicators suggest that the *amount of* innovative efforts is not growing sufficiently fast and the *nature of* innovations is also changing and may have become less productivity-enhancing. In terms of the financial and human resources dedicated to innovative efforts, OECD wide R&D spending – in real terms – has been rising at around 3% per year during the past 30 years (Figure 9, Panel A), even during the pandemic in the United States, but with a moderate slowdown in the EU in 2021.[29] The number

[29] It is mostly business R&D that is responsible for the recent rise, in particular in software, computers and electronics, as well as, although to a lesser extent, in pharmaceuticals and biotech; with automotives and aerospace and other industries falling behind (Chapter 1 of the latest OECD Science, Technology and Innovation Outlook (OECD,

of researchers is growing steadily at about the same rate over the same period (Figure 9, Panel B). International research collaboration, an important source of global knowledge creation, has been rising steadily among OECD countries, even during the pandemic years (Figure 9, Panel C).[30] These patterns might seem comforting, but there is strong evidence that as the body of collective knowledge accumulates, breakthrough ideas are becoming harder to find (Jones, 2009[110]), requiring more substantial research effort to sustain even the same pace of innovation output as in the past (Bloom et al., 2020[101]).[31] Indeed, a key intermediate measure of innovation "output", patenting, is showing weaker growth in recent years than in the past or in comparison with the steadier dynamics of innovation "inputs", such as R&D spending and research personnel (Figure 9, Panel D).[32]

2023[114])). Moreover, business R&D is heavily concentrated across firms, even within individual industries: the ten largest spenders account for 10-50% of total business R&D, depending on the country and the industry, as documented by recent novel microeconomic evidence from 21 OECD countries (Appelt et al., 2022[491]).

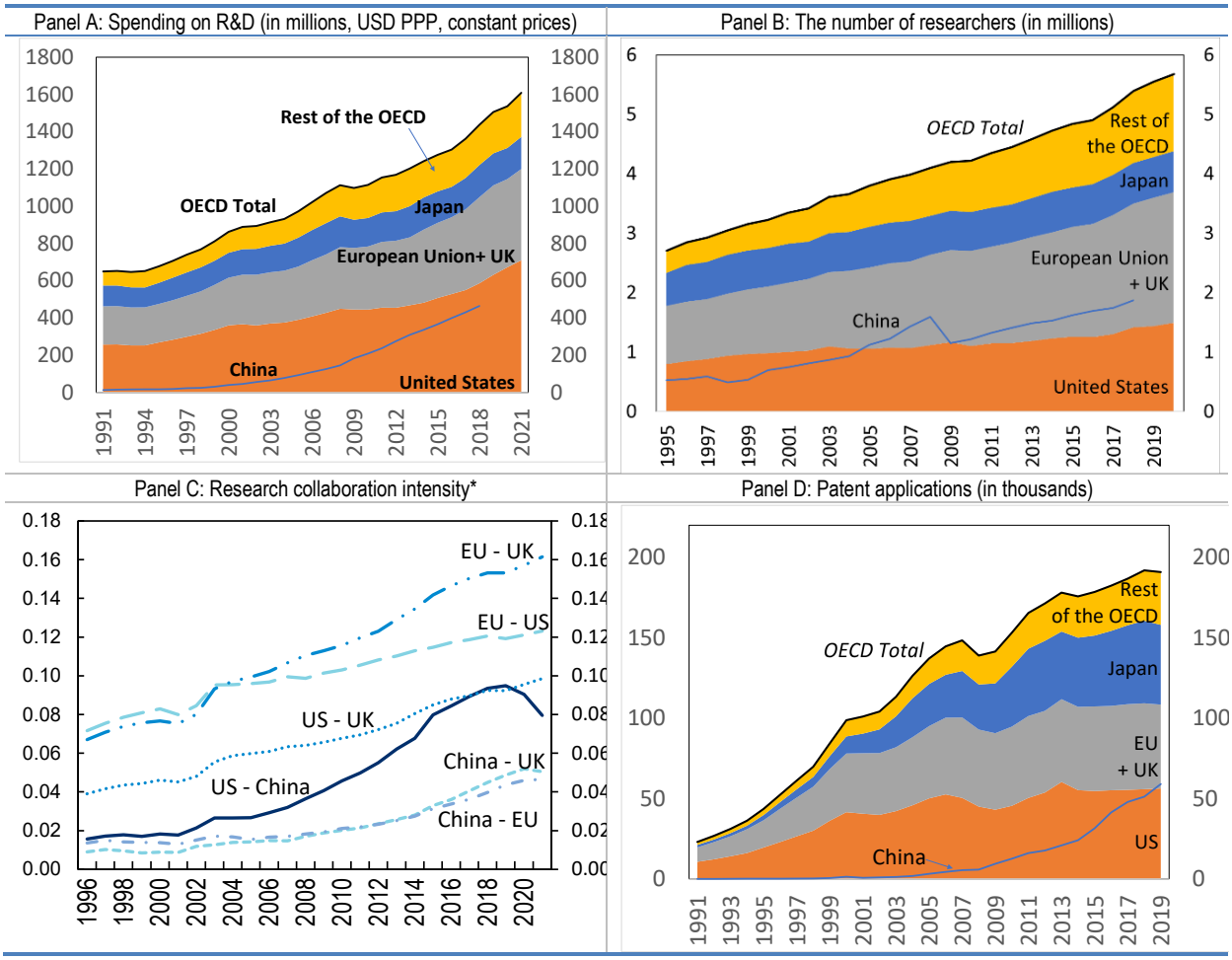
[30] Research collaboration intensity between OECD economies and China stopped growing or fell back slightly since pandemic times, due to less intensive collaboration in several fields ranging from materials, chemicals to computer science and engineering; however, it continued to rise in medical and environmental fields (Chapter 2, (OECD, 2023[114])). Examining the geography of collaboration in the United States, (Freeman, Ganguli and Murciano-Goroff, 2015[500]) conclude that not only internationally but also within the country, there is a rising intensity of collaboration between researchers located in different cities.

[31] A striking example highlighted by (Bloom et al., 2020[101]) is that the number of researchers needed to double computer chip density every two years (Moore's law) is now more than 18 times higher than in the 1970s. The authors also bring further examples from the field of agriculture productivity and medical innovations. Such tendencies may consistent with the notion of "additive growth", a novel idea recently introduced by (Philippon, 2022[475]) who finds that the evolution of US MFP is better characterised by a non-exponential, linear trend, with occasional level shifts around major innovations, instead of by constant exponential growth.

[32] There is also recent evidence for the fall in the cost of patent filings (Antonelli and Fusillo, 2023[483]) in Europe, which may seem to contradict these trends at a first glance. Explanations, to be confirmed by further analysis, can include an increasing share of R&D spending and research effort is going into areas that are harder to patent (improving internal processes, developing proprietary software (Bessen, 2022[120]), for instance), fewer ideas turn into patentable outputs, or a genuine difference between Europe and US in this respect.

Figure 9. Global innovation inputs and collaboration rising with diminished payoffs for patenting

Research and development spending, the number of researchers as innovation inputs and patent applications as innovation output



Note: *Research collaboration intensity between two economies is calculated by dividing the number of scientific publications by authors with affiliations in both economies by the square root of the product of the publications for each of the two. Patent applications are those that are filed under the Patent Cooperation Treaty; the patterns are very similar if we use as an alternative measure the families of patent applications filed within five IP offices (IP5). Panel A is shown in 2015 prices.
Source: OECD Main Science and Technology Indicators (2023) (Panels A, B, D); OECD calculations based on Scopus Custom Data, Elsevier, Version 6.2022, February 2023 (Panel C).

Relatedly, the nature of innovations is becoming less radical (Bloom et al., 2020[101]) (Park, Leahey and Funk, 2023[111]). Explanations vary, ranging from ageing (Kaltenberg, Jaffe and Lachman, 2023[112]), – given the negative association between patenting quality and quantity and inventors' age – to increased competition among researchers who may prefer taking safer paths, especially to kick-off their careers (Park, Leahey and Funk, 2023[111]). Inventors also work in larger proportions for incumbent firms, which tend to focus more on less radical innovations (Akcigit and Goldschlag, 2023[113]). Also, the continued rise in R&D spending is mostly due to businesses, while expenditure by academia and public bodies either stagnate or grow more slowly (OECD, 2023[114]). However, firms tend to do less and less basic research and more and more applied innovation, as several in-house research labs have been closed down over

the past decades (Arora, Belenzon and Sheer, 2021[115]) (Arora et al., 2020[116]) (Mezzanotti and Simcoe, 2023[117]).[33]

Taken together, these tendencies may indicate that matching previous high impact innovations is becoming increasingly harder. Innovations that require particularly large scale and multidisciplinary approaches might receive less resources than necessary to achieve breakthroughs (Arora and Belenzon, 2023[118]).[34] Start-ups are often unfit on both aspects, and universities alone can rarely experiment at large scale. Despite these headwinds to ground-breaking innovations, successful collaboration between the various players of the innovation system, including both new and established firms and outside researchers, spurred by government support and coordination efforts, can still deliver remarkable outcomes, as the rapid COVID-19 vaccine development and deployment demonstrates.[35]

Innovation spans beyond R&D or patents, including a wide range of advancements related to business processes or new products using existing technologies (Haskel and Westlake, 2018[97]; Moser, 2013[119]) (Andrews and Criscuolo, 2013[99]). These broader innovation outputs are the result of investments in a range of intangible assets, including data, software and organisational capital (supply chain management, team structure and composition, and training). Such assets are more spread out across the economy than heavily concentrated R&D.[36] They cover retail (e.g. supply chain management innovations by supermarket chains or online retailers), as well as finance and consulting services (which often build in-house software and develop proprietary algorithms (Bessen, 2022[120])). A successful combination of these various assets is a distinctive feature of leading firms.

Several types of intangibles – R&D spending and investments in software and data – that have grown steadily over the years have been also fairly resilient to the pandemic (see Figure 9). This is partly thanks to the unprecedented policy support measures, the heavy innovation efforts in the pharmaceutical industry as well as due to further push towards digitalisation spurred by social distancing (Fink et al., 2022[121]). However, it also reflects some types of intangibles being less cyclical than tangible investments (Corrado et al., 2022[84]). Nevertheless, COVID-19 might still have held back innovation through several channels. First, the creation of new ideas might have lost pace due to the reduced intensity of personal interactions *during* COVID related lockdowns. The reason is that densely populated areas are conducive to new idea creation, especially combining knowledge from several fields, which is one of the key reasons behind the productivity advantages of cities (Glaeser, 1999[122]) despite the trend that more and more innovations can be created through online collaborations at a distance (Berkes and Gaetani, 2020[123]). Second, if less frequent visits to workplaces in city centres *remains the norm* post-COVID thanks to remote working (Aksoy et al., 2022[124]) it can lead to even more persistent negative effects.

Moreover, there are more general concerns about the difficulties of fully exploiting the potential of intangibles due to outdated institutions and regulations – ranging from intellectual property rights, antitrust regulations and barriers to services and digital trade (see Section 4.2) – that were designed mostly for a

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[33] (Gordon, 2018[73]) puts it more bluntly when claiming that recent major innovations such as the internet or smartphones do not seem to yield economic or societal gains on the same scale as previous ones such as electricity or the internal combustion engine.

[34] Past examples for innovation that relied on such inter-disciplinary approaches include the transistor, or more recently, machine translation (Arora and Belenzon, 2023[118]).

[35] In particular Pfizer-BioNTech and Moderna (Arora and Belenzon, 2023[118]). Other major inventions that are used in a wide range of applications and with strong government involvement include jet engines, radar and GPS; but there are also eventual failures such as the Concorde supersonic airplane (Bloom, Van Reenen and Williams, 2019[60]).

[36] Chemicals; computer and electronic products; transportation equipment; and information services (ICT) (see for instance (Corrado et al., 2022[58])).

"tangible era" (Haskel and Westlake, 2022[125]). This may be holding back innovations and new business models that rely heavily on experimenting with and combining various intangibles assets.[37]

Going forward, rapid developments in AI may bring the possibility to speed up productivity through various means (Furman and Seamans, 2019[126]) (Brynjolfsson, Rock and Syverson, 2018[127]). It can be applied to a wide range of industrial activities – from optimising multi-machine systems to enhancing research and development (OECD, 2020[128]) –, and thanks to recent advances in natural language processing and image recognition, also in a growing share of services activities (Baily, Brynjolfsson and Korinek, 2023[22]). Recent studies of Large Language Models (LLMs) such as GPT of OpenAI, document a significant but uneven boost to productivity from their use in specific tasks such as software coding, taxi driving and responding to standard customer support cases in call centres (Kanazawa et al., 2022[129]) (Brynjolfsson, Li and Raymond, 2023[130]).[38] Relying on these AI models are found to yield considerable gains for inexperienced or less skilled workers (up to 14% higher output per hour) but very minimal ones for experienced ones. Market valuations of firms whose labour force is more exposed to the latest class of generative AI models increased substantially more compared to other firms, indicating high profit expectations stemming from either higher productivity or higher market power or a combination of the two (Eisfeldt, Schubert and Zhang, 2023[131]).[39]

According to surveys conducted among business executives, the most impacted sectors are likely to be finance, high tech and life sciences, and AI would prove also helpful with tasks in software engineering and R&D (McKinsey & Company, 2023[132]).[40] The productivity of research itself might also get a substantial boost (Aghion, Jones and Jones, 2018[39]) (OECD, 2023[133]) (European Commission, 2023[134]), as seen already, for instance, in pharmaceutical and broader medical applications and in advanced materials (OECD, 2020[128]). Given the very rapid development of these AI models, it will be crucial to continue actively investigating their impacts going forward.[41]

The direction of technological change that these innovations represent matters for the size and spread of the arising productivity gains. (Acemoglu and Restrepo, 2018[135]) develop the idea that innovations that involve automating human tasks are not necessarily productivity enhancing.[42] Their framework departs from the classical works on exogenously determined – as in (Solow, 1956[1]) – or endogenous technical

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[37] Relatedly, some recent findings suggest that intangibles may be "running out of steam" (Van Ark, 2023[179]), meaning their growth contributions may be diminishing.

[38] On more general AI technologies and in a wider range of sectors, see the positive effects identified by (Czarnitzki, Fernández and Rammer, 2023[488]).

[39] Recent work on a widely publicised AI large language model (LLM) GPT-4 for categorising jobs that are most exposed to its use (either by augmenting or by substituting labour) concludes that beyond providing direct assistance the full potential of these models lies in yet unexplored combinations with other digital tools that can be built upon them (Eloundou et al., 2023[444]).

[40] They also point out marketing and sales activities although they are not considered productivity enhancing per se.

[41] See more in the work of the OECD AI Policy Observatory (https://oecd.ai) which put forward the OECD AI Principles, as well as the Global Partnership on AI hosted by the OECD (https://gpai.ai/).

[42] The simplest measure of labour productivity, output over employment, mechanically increases when the same amount is produced using less labour which is substituted by technology (automation). However, when taking into account capital inputs, as in MFP, or when correcting for the quality of output, this is not necessarily the case, especially if the gains in production are not large or could have been produced at equal or better quality by humans ("so-so" automation; see (Acemoglu and Johnson, 2023[264])). Moreover, in the absence of sufficiently growing demand, excessive automation can reduce the employment share of the firms or sectors relying on it, hence they will receive less weight in aggregate productivity, negating the initial positive effects. This can happen to whole sectors, as the fall in employment but high and rising productivity in several manufacturing activities exemplifies (Bessen, 2019[38]).

change – as in (Lucas, 1988[136]) and (Romer, 1989[137]) – in that new technologies can differ in the degree to which they substitute or complement human tasks. In the same vein, emerging technologies that have greater potential to augment human capabilities than AI deserve special consideration. For instance, the continuous advances in computing capacity, in combination with innovative developments in biotech and physical sensors, may pave the way for the emergence of novel fields such as synthetic biology and immersive technologies (augmented reality). These fields in turn have the potential to enable substantial advances across many sectors, including health care and education. Furthermore, once quantum computing transitions from the experimental stage to a more advanced phase, it may hold the capability to solve real-world problems, delivering ground-breaking innovations but also significant disruptions within the digital realm.[43]

3.1.2. Diffusion: slow and uneven

For firms below the frontier, the diffusion of frontier technologies and leading management practices are crucial to catch up or at least keep pace with top firms. However, the large productivity gaps between firms at the global frontier and all others have been rising (Figure 8 and (Andrews, Criscuolo and Gal, 2016[11]). Similar tendencies are seen at the country level with respect to the "national" frontier in the United States (Decker et al., 2020[138]) and in other OECD countries, as also documented by the MultiProd distributed microdata project of the OECD (Berlingieri, Blanchenay and Criscuolo, 2017[139]; Berlingieri et al., 2017[105]).[44] The pace of this divergence is faster in business services than in manufacturing, which may be linked with typically lower competition and less standardized means of production within services (Figure 8 Panel B and C). Productivity gaps are also rising more rapidly in intangible intensive sectors (Corrado et al., 2021[140]) and in ICT intensive ones where learning from best practices is harder due to the prominence of "tacit knowledge" (Figure 8 Panel D) (Andrews, Criscuolo and Gal, 2016[11]) and the key role of "proprietary software" (Bessen, 2022[120]).

Such widening performance gaps would not necessarily cause concern for aggregate productivity growth if strong dynamism was underlying this trend, with firms previously below the frontier catching-up and conversely, previously leading firms falling behind the frontier. But the evidence is not reassuring: while there is indeed churn at the frontier, and less productive firms do experience faster productivity growth on average, the speed of this catch-up has been slowing, both globally (Andrews, Criscuolo and Gal, 2016[11]) and within many countries (Berlingieri et al., 2020[141]); (Cette, Corde and Lecat, 2017[142]). Also, the share of firms remaining at or near the top of the productivity distribution is rising (Andrews, Criscuolo and Gal, 2016[11]), with similar entrenchment observed for other firm performance metrics such as profits or size (Autor et al., 2020[143]) (Decker et al., 2020[138]) (Bessen et al., 2020[144]).[45]

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[43] See more on these issues in the recently launched Global Technology Forum of the OECD: https://www.oecd.org/digital/global-forum-on-technology/

[44] There are also a few country-specific studies, see for instance (Andrews et al., 2022[478]) for Australia, (Cette, Corde and Lecat, 2017[142]) for France and (Haldane, 2018[480]) for the UK. To the best of our knowledge, of internationally comparable and comprehensive firm-level information on productivity for the most recent post-pandemic years is not yet available; (CompNet, 2023[481]) includes information up to 2020 and shows that lagging firms faced a large, unprecedented drop in their productivity in the initial pandemic year while the productivity of firms at the top suffered much less, consistent with findings from alternative firm-level sources presented in Figure 8.

[45] The weak diffusion of productivity across firms are also linked with worsening income inequality for workers (see (Song et al., 2018[498]) for evidence from the United States and (Criscuolo et al., 2020[176]) for extending that internationally). Indeed, given that wages and productivity go hand in hand across firms, lifting the productivity of lagging firms allows to realise "double dividends" as it will likely help with reducing wage disparities as well (OECD, 2021[416]).

Several explanations have been put forward for the rising and more persistent performance gaps between firms, and the concomitant slowdown in aggregate productivity growth. First, this may simply be a temporary phenomenon due to adoption lags of the latest technologies as they need time to diffuse. coupled with insufficient or delayed complementary investments in intangibles (aligning business processes, management practices and training workers) (Brynjolfsson, Rock and Syverson, 2018[127]). Many of these intangibles are not recorded and lead to an initial underestimation of productivity when they are being carried out, followed by an over-estimation when they are used in actual production, as explained in the productivity J-curve hypothesis by (Brynjolfsson, Rock and Syverson, 2021[145]).

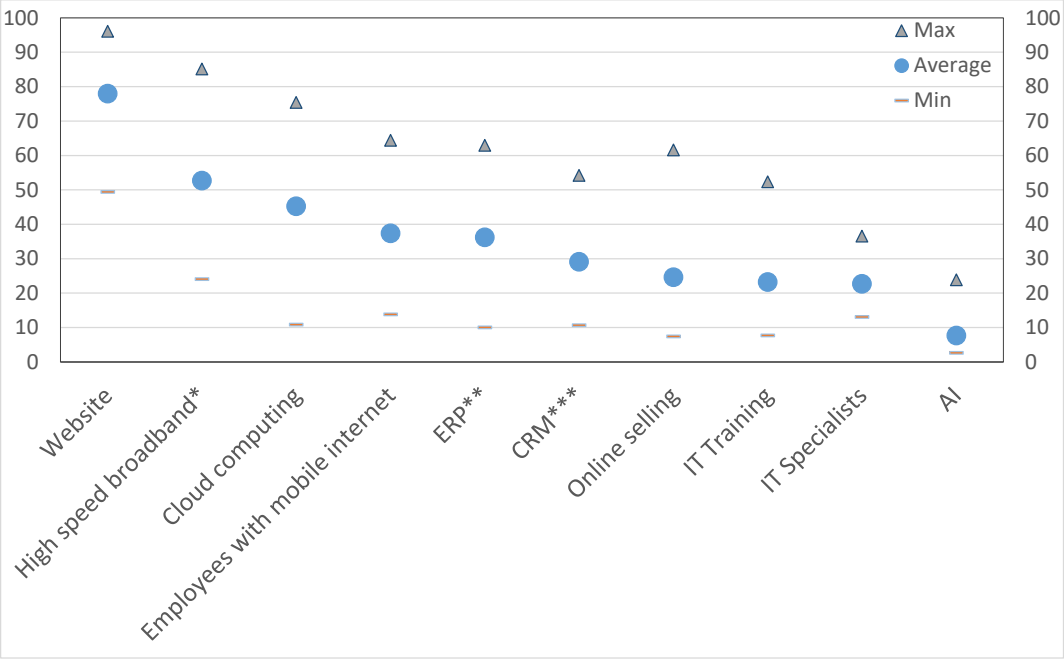
Indeed cross-country evidence confirms a still uneven adoption of digital technologies (Calvino, Criscuolo and Ughi, 2024[.]) – including more basic, network enabler assets such as broadband connectivity, but also software systems to assist with production and organisation (Sorbe et al., 2019[14]), and of course the latest AI tools (Acemoglu et al., 2022[146]) (Calvino and Fontanelli, 2023[147]).[46] Adoption differences are substantial along several dimensions: larger, initially more productive firms, urban regions and knowledge intensive sectors are more digitalised (Pisu et al., 2021[15]) (European Investment Bank, 2023[148]) (Figure 10). The speed of productivity catch-up is found to be weaker in sectors that are digital or more generally, ICT intensive (Berlingieri et al., 2020[141]). This is due to the difficulties of putting in place the necessary complementary investments in skills – both managerial and digital technology related ones ((Sorbe et al., 2019[14]) and (Pisu et al., 2021[15])). There is indeed a wide dispersion in managerial practices across firms with strong links to productivity (Bloom and Van Reenen, 2007[149]) (Bloom and Van Reenen, 2010[150]). Learning from best practice on how to combine all these intangibles with digital technologies, either through business connections, or through training, also generates productivity benefits (Bloom et al., 2019[151]) (See Section 4 for more on public policies).[47]

[46] This is in line with previous evidence on slower adoption and diffusion for a broad range of technologies and innovations by (Comin and Mestieri, 2018[468]).

[47] Complementary intangible investments such as learning processes, organisational reshuffling and changes in business models associated with digital adoption take time, which can result in a several-year lag between digital and related intangible investments and productivity gains. See for instance the J-curve idea by (Brynjolfsson, Rock and Syverson, 2021[145]).

Figure 10. Digital technologies and their use: adoption is incomplete and varies a lot across countries

Share of firms reporting the use of various digital technologies and skills for the average OECD country (average) and for the country with highest (Max) and lowest (Min) adoption; 2022 or latest available year

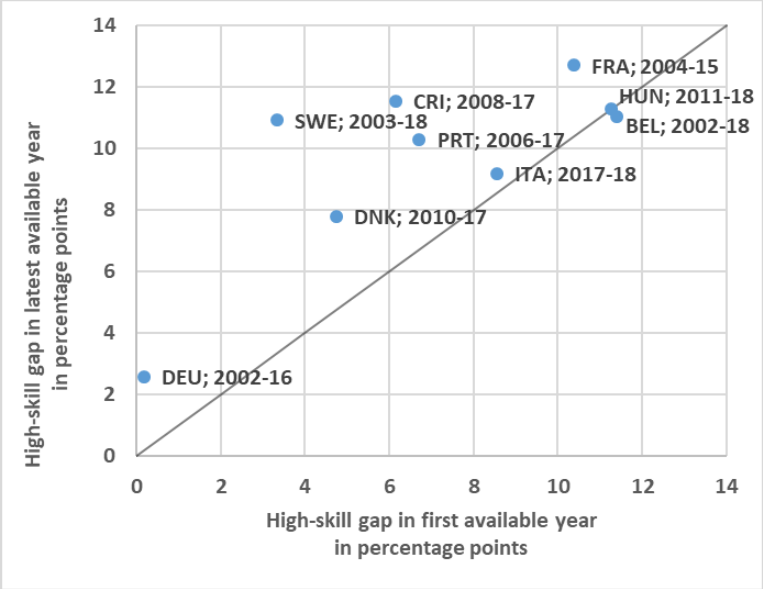


Note: *With at least 100Mbit/s download speed; **ERP: The use of Enterprise resource management software; ***CRM: the use of customer relationship management software. Firms with at least 10 employees.
Source: OECD ICT Access and Usage by Businesses Database.

Second, the changing nature of innovations, namely less basic and more applied innovation, leads to fewer spillovers since applied innovation is more specific (Akcigit, Hanley and Serrano-Velarde, 2020[152]). Moreover, there is emerging evidence in the United States on potentially anti-competitive use of intellectual property, as indicated by the rising concentration of patenting activity by firms, and the changing nature of patents in a way that seeks to excessively protect intellectual property and thus holds back diffusion (Akcigit and Ates, 2023[153]). Third, skills are increasingly concentrated in the best performing firms (Figure 11). Fourth, the slower pace of economic policy reforms observed during the 2010s (OECD, 2019[154]), including a less vigorous update of product market regulation to keep up with technological developments, may lead to lower competitive pressures and hold back incentives to adopt the latest technologies (Andrews, Criscuolo and Gal, 2016[11]).

Figure 11. Top productivity firms have become even more high-skill intensive over time

High-skilled employees as share of all employees: the difference between top 10% and median productivity firms, in previous versus more recent years



Note: The figure shows the change in the high skill gap at the productivity frontier vs the median performer, computed as the difference in the share of high skilled employees at frontier versus median firms, between the first and last sample year of the analysis by country. Productivity is measured as log of value added per worker. For more details, see (Criscuolo et al., 2021[17]).
Source: (Criscuolo et al., 2021[17]) in the context of the Human Side of Productivity project of the GFP.

Finally, the changing nature of competition and innovation, spurred by the rise of intangibles and in particular digital assets, can offer a joint explanation for both slowing technology creation at the frontier and weaker diffusion across the economy. Some intangible investments that lead to innovation are not easy to imitate or build on, unlike scientific knowledge embodied in patents. Prime examples are organisational capital, management and proprietary software and data – in-house built and customised to business needs –, which have played an increasingly important role in preventing the spread of best practices embodied in digital technologies (Bessen, 2022[120]) (De Ridder, 2024[155]). Network effects that often arise in the use of digital tools (e.g. platforms (Brynjolfsson and McAfee, 2014[27])) might also play a role in locking in consumers and contributing to sustained leading positions of a few firms (Shapiro and Varian, 1999[156]). The forces of "creative destruction" (Schumpeter, 1942[157]) via the entry of new firms should offer innovative firms only temporary productivity and profitability advantages (Aghion and Howitt, 1992[158]; Aghion, Akcigit and Howitt, 2014[159]). However, if firms at the frontier can combine and leverage a diverse range of intangible assets in a way that allows them a persistent lead, in combination with gaining market power, this can discourage or prevent other firms from developing innovations themselves and gaining market share, hurting productivity prospects in the longer run through stifling competition.[48]

The rise of concentration and markups – a measure of market power – is indeed documented by a large body of literature (in the United States (Autor et al., 2020[143]) (Philippon, 2019[160]); (Furman and Orszag,

[48] These ideas and empirical findings are increasingly formulated and backed up by micro-founded general equilibrium models of innovation and growth. In that spirit, for instance, (Akcigit and Ates, 2023[153]) show that that a decline in knowledge diffusion can be responsible not only for the rising productivity gap between leaders and follows but for many other facts observed in the US and in most advanced economies, such as rising concentration and falling business dynamism.

2018[161]) (De Loecker, Eeckhout and Unger, 2020[162]) and more globally (Bajgar, Criscuolo and Timmis, 2021[163]) (Díez, Leigh and Tambunlertchai, 2018[164]), and in a recent summary by Calligaris et al. (2024[165], see Figure 12). While the literature generally points to an increase in concentration in Europe, the evidence on mark-ups is mixed. (Díez, Leigh and Tambunlertchai, 2018[164]) and (De Loecker and Eeckhout, 2018[166]) find that markups have increased. However, (Gutierrez and Philippon, 2022[167]) find no increase in profit margins in Europe, in contrast with the United States, a development for which they credit EU competition policy. (Bighelli et al., 2022[168]) find that markups did not increase in Europe after 2009 and that the rise in concentration was mainly driven by a reallocation of economic activity toward large and concentrated industries, which contributed for half of European productivity growth over the period 2009-2016. Another suggestive evidence about weakening competition, associated with the rising common ownership of firms, is the negative correlation between firm-level productivity and common intra-industry ownership in OECD countries documented by (Bas et al., 2023[169]). Some of these trends are found to be particularly strong in digital and intangible intensive industries (Bajgar et al., 2023[170]) (Calligaris, Criscuolo and Marcolin, 2024[171]) since they are often characterised by low marginal costs of production and easy to scale up outputs.[49]

Notwithstanding the potential negative productivity implications of these trends through slower diffusion and other channels as discussed above, their exact interpretation are a subject of active discussion and research. For instance, (Autor et al., 2017[172]) and (Bessen, 2020[173]) contend that increased concentration is a result of *higher* – not lower – market competition and of the rise of highly productive firms.[50] Also, the rise of markups might reflect, to a large extent, more benign changes in technologies that lead to larger upfront investments and lower marginal costs, as found by (Foster, Haltiwanger and Tuttle, 2022[174]) in US manufacturing and as discussed by (Berry, Gaynor and Morton, 2019[175]). Regarding implications for income inequalities, the rising dispersion in firm performance is a contributing factor, as larger differences in profits and productivity go hand in hand with larger differences in firm-level average wages, which are a crucial element of overall income inequalities ((Furman and Orszag, 2018[161]) (Brookings Institution and Chumir Foundation, 2019[8]) (Criscuolo et al., 2020[176])).

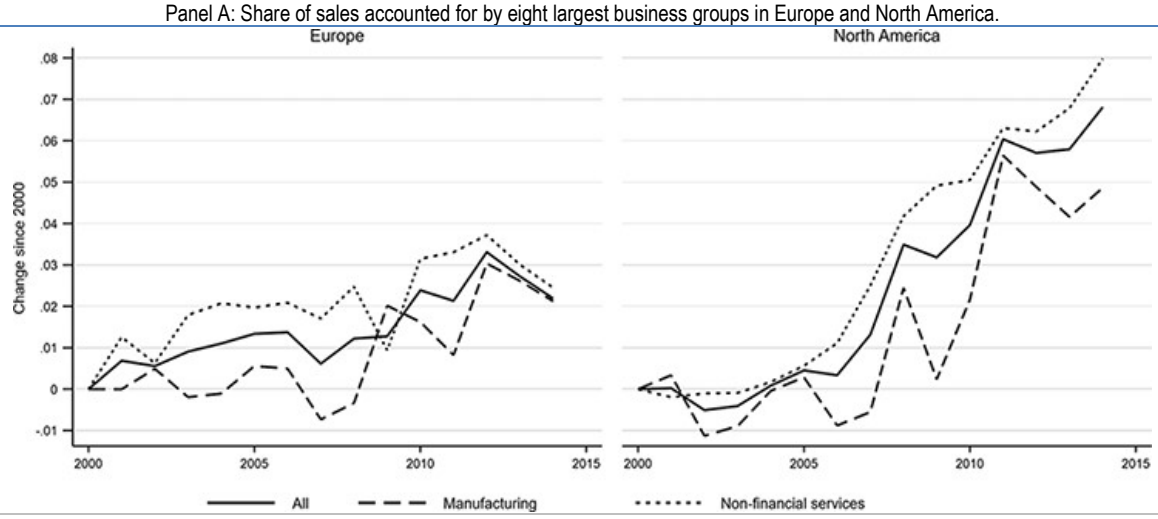
Amidst the ongoing debates surrounding *current* drivers and implications, a growing concern emerges about potential *long-term* impacts on productivity, particularly through stifling competition, holding back investment (Gutiérrez and Philippon, 2017[177]) and hindering innovation. Put differently, current efficiency gains achieved by leading firms through adeptly utilising intangible capital could be offset by a faltering diffusion of knowledge and best practices to other firms ((Corrado et al., 2023[178]); (Van Ark, 2023[179])).

[49] Indeed, the largest component of intangible assets is data, at around 5% of GDP (Corrado et al., 2022[84]).

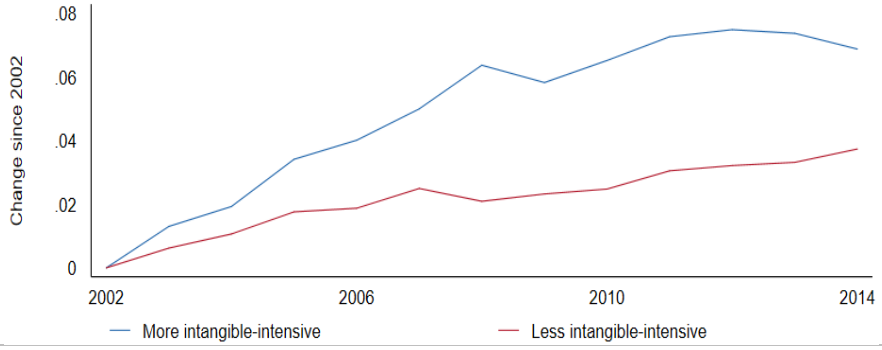
[50] For further discussions on the link between markups and concentration on one side and competition on the other, and related measurement issues, see Syverson (2019[.]) and Shapiro and Yurukoglu (2024[.]). Complicating matters, (Rossi-Hansberg, Sarte and Trachter, 2021[486]) find that the increase in market concentration at the national level often coincides with a decline in concentration at the local level, raising the question of the "relevant" market.

Figure 12. Rising concentration and mark-ups across various industry groups

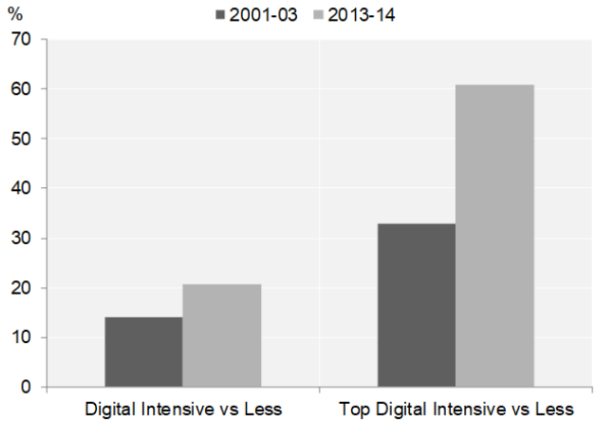
Panel A: Share of sales accounted for by eight largest business groups in Europe and North America.



Panel B: Share of sales accounted for by eight largest business groups by the intangible intensity of the sector.



Panel C: Markups over time and across sectors with different digital intensity



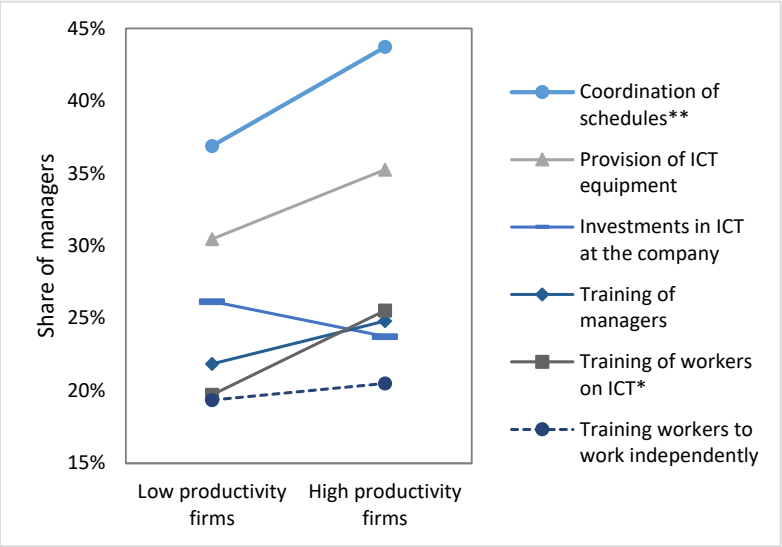
Note: Panel A: Panel B: The figure shows changes in the (unweighted) mean concentration across country-industry pairs compared to the base year 2002, separately for country-industries above- and below-median intensity of intangible investment. Panel C: Average percentage differences in mark-ups, if the industry of operation is digital intensive vs less intensive (specifications on the left in the graph), or if the industry of operation is among the top 25% of digital intensive industries vs. not (specifications on the right in the graph). See more details in the sources.
Source: Panel A: (Bajgar et al., 2023[170]) using Orbis-Worldscope-Zephyr (Bureau van Dijk/Moody's) and OECD-STAN. Panel B: (Bajgar, Criscuolo and Timmis, 2021[163]). Panel C: (Calligaris, Criscuolo and Marcolin, 2024[171]), digital intensity based on (Calvino et al., 2018[180]).

The pandemic sparked hopes for a faster diffusion of digital technologies and a significant surge in investments in related complementary intangibles, including skills and firm organisation. This drive was primarily fuelled by the sudden shift to remote working impacting around 30-40% of the workforce (Dingel

and Neiman, 2020[181]) (Ker, Montagnier and Spiezia, 2021[182]). Moreover, remote work became prevalent not only within firms but also *in various* business interactions with clients, suppliers and stakeholders (Criscuolo et al., 2023[26]) (Aksoy et al., 2022[124]) (Barrero, Bloom and Davis, 2021[25]) (Adrjan et al., 2021[183]). While digital diffusion indeed accelerated, it seems to have favoured firms that were initially more able and productive, leading to a deepening of existing divides ((OECD, 2021[184]) (European Investment Bank, 2023[148]), Figure 13).

Figure 13. More productive firms envisage more complementary investments to better accommodate telework

The share of managers at low and high productivity firms who plan to introduce various measures related to telework

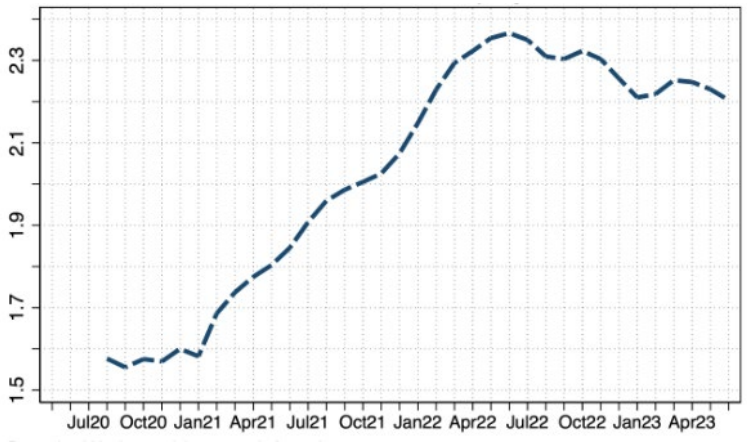


Note: Low productive firms are in the bottom 50% of the within-sector productivity distribution, high productive firms in the top 50%.
Source: (Criscuolo et al., 2023[26]).

A burgeoning literature leveraging diverse information sources seeks to analyse real-time the prevalence of telework and its productivity – as well as well-being – implications. The findings reveal varying impacts across countries, industries and firms depending on the quality of digital infrastructure and skills but also management culture. Generally, very high intensity or full telework is found to be detrimental (Barrero, Bloom and Davis, 2023[185]) (Criscuolo et al., 2023[26]). Currently, most businesses have returned to more normal operations, but often with increased levels of telework compared to pre-pandemic ("hybrid" working mode). Managerial long-term plans reflect a trend of maintaining telework at higher levels than at the onset of the pandemic (2.2 *vs.* 1.6 telework days per week), with a downward trend since the mid-2022 (Figure 14). While hybrid working can improve work-life balance, leading to increased employee engagement and reduced turnover, potentially fostering better firm performance (Barrero, Bloom and Davis, 2023[185]), it can also pose work organisation and human resource management challenges, partly due to differing assessments of efficacy and desirability by employees and employers (Bloom, Han and Liang, 2022[186]).

Figure 14. Managers envisage high telework intensity, but are gradually revising their views

Telework intensity plans after the pandemic ends, as envisaged by employers (average days per week)



Source: Work From Home Research (www.wfhresearch.com), Survey of Working Arrangements and Attitudes (SWAA), (Barrero, Bloom and Davis, 2021[25]).

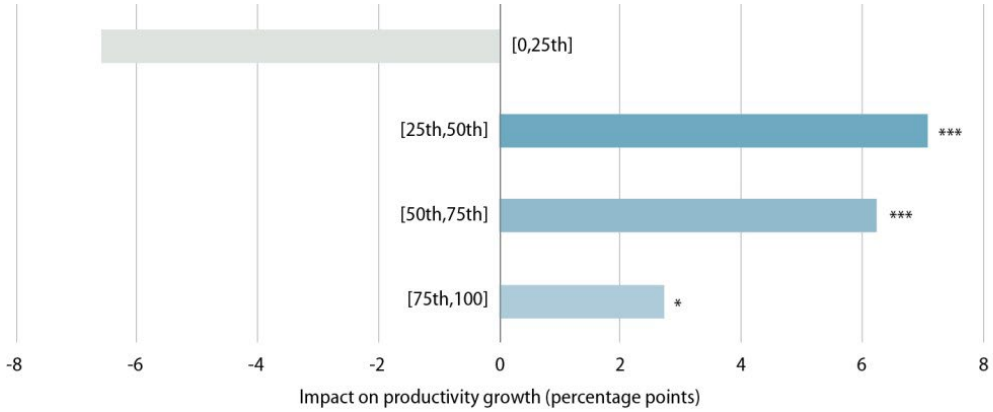
Another important form of digitalization, online platform use, has also accelerated during the pandemic, speeding up their spread that had been already ongoing for many years (Costa et al., 2021[187]). When used to connect consumers with suppliers, they can reduce information asymmetries about product and service quality thanks to review and rating systems (Bailin Rivares et al., 2019[188]).[51] They are contributing positively to productivity growth in the sectors where they operate through fostering the catch-up of firms that not at the frontier, but are sufficiently advanced already (Figure 15). However, the weakest firms were found to fall further behind, indicating that they cannot keep up with the more intensive competition that platforms bring to the market.[52]

[51] These recent studies reached similar conclusions despite using different ways to measure platform intensity: either by Google search intensity (Bailin Rivares et al., 2019[188]) or by data traffic on the platform websites (Costa et al., 2021[187]).

[52] Closely related to the rise of platform use is the growing prevalence of platform-mediated gig-economy work, which accelerated during the pandemic (Garin et al., 2023[494]). The productivity and policy implications – in particular the potential benefits due to better matching the supply and demand for tasks as well as the downsides of using labour to low-productivity tasks in precarious conditions – are discussed in (Schwellnus et al., 2019[493]).

Figure 15. Online platforms promote catching-up to the frontier for sufficiently advanced firms

Change in firm-level labour productivity growth attributable to a one standard deviation increase in online platform activity in the same sector, by initial productivity levels



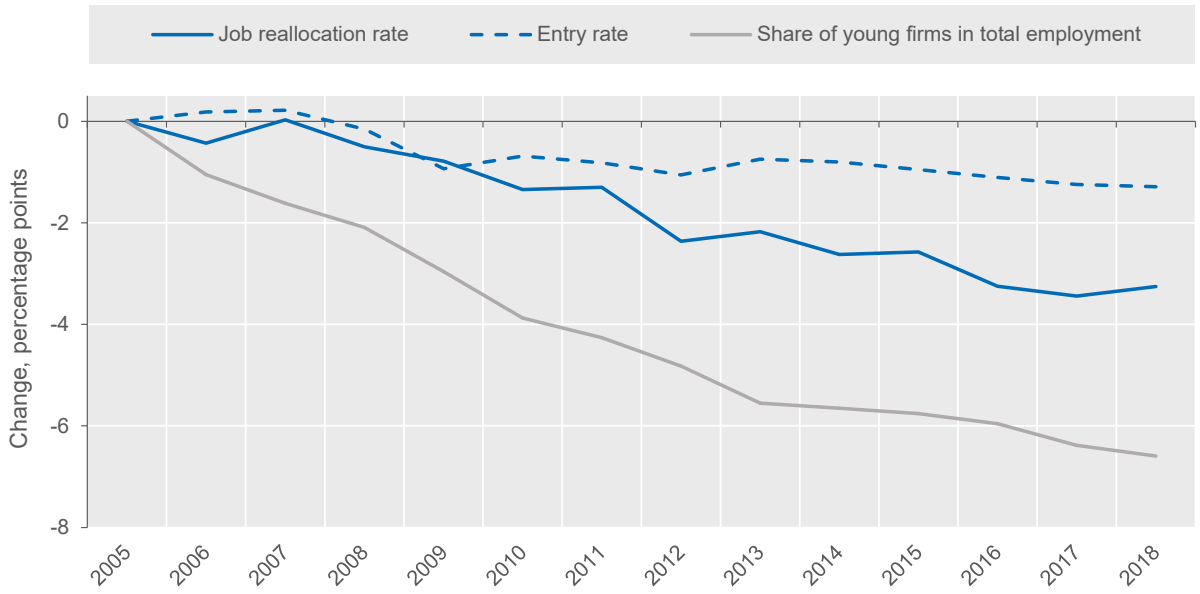
Note: Productivity is measured by labour productivity (the log of value added per employees) at the firm level. See more information in the source.
Source: Costa et al (2021).

3.1.3. (Re-)allocation of resources: in need of strong and sustained dynamism

Cross-country differences and changes over time in allocative efficiency and the selection of firms along the entry and exit margins are important drivers of aggregate productivity (Bartelsman, Haltiwanger and Scarpetta, 2013[106]).[53] However, business dynamism has been trending down since the turn of the century, as documented for the United States (Decker et al., 2014[189]), Europe (Biondi et al., 2023[190]) and many other OECD countries (Criscuolo, Gal and Menon, 2014[191]) (Calvino, Criscuolo and Verlhac, 2020[192]) (see also Figure 8). The decline has been particularly pronounced in digitally intensive sectors (Calvino and Criscuolo, 2019[193]), which is consistent with the diminishing contribution of ICT intensive sectors to aggregate productivity growth (Section 2).

[53] Static and dynamic allocative efficiency decompositions pre-, during and post-GFC confirm the important contribution of the allocation of resources for shaping aggregate productivity, as documented in the OECD MultiProd v2.0 database (www.oecd.org/sti/ind/multiprod.htm) as well as by the Competitiveness Research Network (www.comp-net.org), focused mainly on European countries.

Figure 16. Firm entry and job reallocation rates have trended down since the turn of the century



Note: This figure reports average within-country-industry cumulative changes in the share of employment in young firms, changes in job reallocation rates, and changes in entry rates based on the year coefficients of regressions within country-industry, for the period 2005-18, including 16 countries: AUT, BEL, CAN, DEU, DNK, ESP, FIN, FRA, HRV, HUN, ITA, NOR, NZL, PRT, SVN, SWE. Each point represents cumulative change in percentage points since 2005.
Source: OECD DynEmp database, updated from Calvino, Criscuolo and Verlhac (2020[11]), published in (Cho et al., 2024[56]).

Reduced dynamism on the market can hold back innovation through several channels (Aghion, Cherif and Hasanov, 2021[194]). At the top of the productivity distribution, when firms are more entrenched thanks to their rents and exclusive business models (platforms) it reduces their incentives to innovate. Further down the productivity distribution, less dynamism means a lower threat of competitors' entry, which reduces the incentives of lagging firms to adopt best practices from the leaders or to innovate themselves. Finally, a lack of firm dynamism may also hold back workers' dynamism and incomes, reducing opportunities to increase earnings (Andrews et al., 2019[195]). Indeed, the upward mobility of workers along the wage distribution plays a key role in holding back further rises in income inequalities (OECD, 2018[196]).

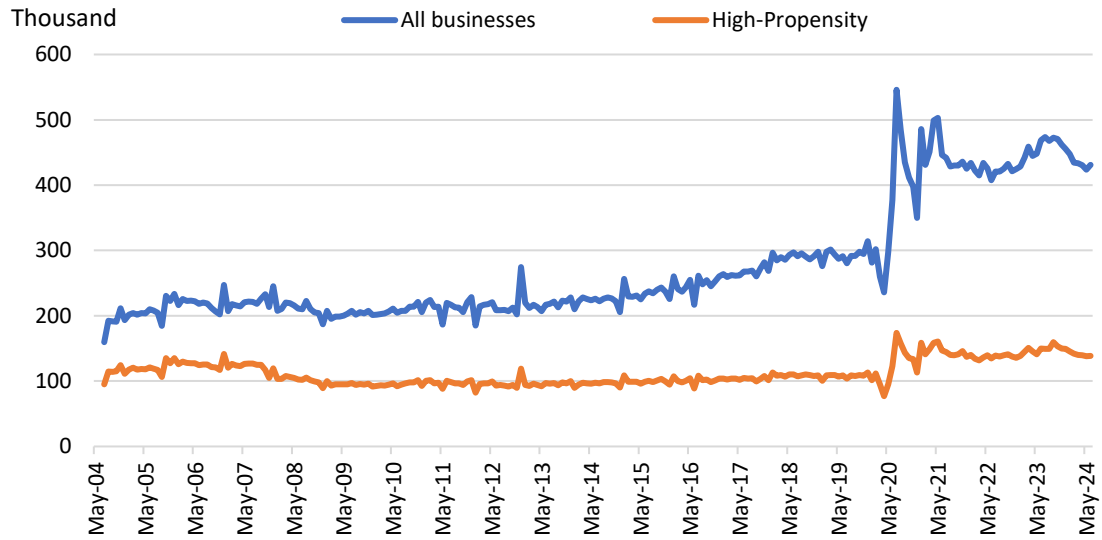
Along with business churn, the productivity enhancing nature of reallocation has also diminished.[54] For the United States, (Decker et al., 2017[102]) estimate that this chips away 3-4 percentage points from aggregate labour productivity growth over a roughly 10-year horizon. Misallocation of capital inflows during the euro convergence process in Southern Europe induced a significant decline in sectoral total factor productivity (Gopinath et al., 2017[197]) (Gamberoni, Giordano and Lopez-Garcia, 2016[198]). Falling job reallocation, firm entry and share of young firms in employment in several countries (Figure, 16) also weighed on aggregate productivity (Adalet McGowan, Andrews and Millot, 2018[199]). Low exit rates following the GFC were partly the result of low interest rates (Banerjee and Hofmann, 2020[200]) and weakened bank balance sheets in some countries (Andrews and Petroulakis, 2017[95]) (Albuquerque and Lyer, 2023[201]).

Regarding recent developments during and since the COVID-19 crisis, the number of US firm registrations, including those for businesses with a high propensity to become employers, jumped and have remained high (Figure 17). Evidence is emerging that these registrations are reflected in business entries and job creations, which are highly concentrated in sectors such as retail and high-tech industries, and consistent

[54] Calligaris et al. (2023[1]) show that productivity and employment changes tend to be positively associated.

with a reallocation of activities following work-from-home patterns as well as with the further spread of digitalisation during the pandemic (Decker and Haltiwanger, 2023[202]) (Fikri and Newman, 2024[203]). New business creations have also moved up in many other OECD countries.[55] However, it is still too early to assess whether this really constitutes a turn in business dynamism and whether this could spur productivity growth. The entry of innovative firms is generally followed by an initial increase in the dispersion of productivity across firms and a decline in overall productivity growth, before showing positive effects (Foster et al., 2019[204]). Regarding market exit rates, after their sharp fall in most countries during the pandemic due to policy support and a freeze of bankruptcies procedures, their subsequent rise, especially among low-productivity firms, may push up aggregate productivity. The within-sector reallocation of labour from least to most productive firms remained positive during 2020 in the majority of OECD countries included in recent studies (Calligaris et al., 2023[205]) (Andrews, Charlton and Moore, 2021[206]), often due to the higher survival rate of high productivity firms. This indicates that policy support was not only effective in temporarily preserving businesses and jobs but managed to avoid distortions for productivity (Figure 18).

Figure 17. US business registrations have risen since the COVID-19 crisis

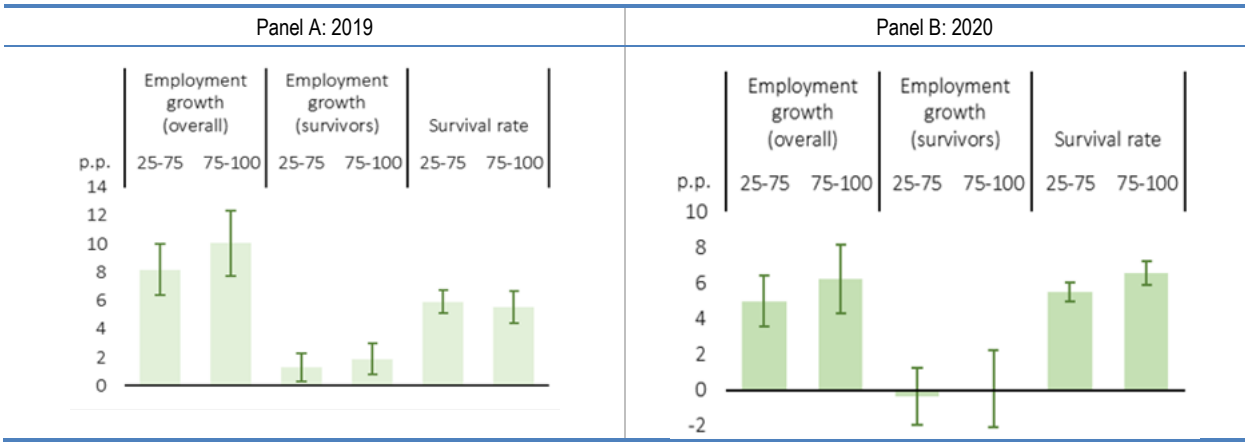


Note: High-Propensity refers to business applications that have a high-propensity of turning into businesses with payroll, based on characteristics associated with a high rate of business formation. High-propensity applications include applications: (a) from a corporate entity, (b) that indicate they are hiring employees, purchasing a business or changing organizational type, (c) that provide a first wages-paid date (planned wages); or (d) that have a NAICS industry code in manufacturing (31-33), retail stores (44), health care (62), or restaurants/food service (72).
Source: U.S. Census Bureau.

[55] See a detailed note by (Calvino et al., 2022[482]) based on the OECD Timely Indicators of Entrepreneurship Database covering 19 OECD countries and the latest OECD SME and Entrepreneurship Outlook (OECD, 2023[474]).

Figure 18. Labour reallocation continued to be productivity enhancing during the pandemic, although less so than in 2019

Employment growth (of all and surviving firms) and survival rates, in differences relative to the bottom quartile (0-25 percentile) of the productivity distribution



Source: Calligaris et al (2023).

Going forward, reallocation needs may be even more important as a means of economy-wide resilience and quicker recovery of productive capacity in the face of possibly more frequent shocks ranging from supply chain disruptions due to geopolitical risks to extreme weather events related to climate change. The further spread in digitalisation can facilitate such reallocations. Online job platforms and sophisticated HR tools to pre-screen applicants can provide more efficient job-to-worker matches and can also reduce job seeking time and effort (Bhuller et al., 2023[207]) (Broecke, 2023[208]). Similarly, other types of platforms equipped with review and ratings systems and detailed search functions can provide better matches between buyers and suppliers and were shown to be associated with productivity enhancing reallocations (Bailin Rivares et al., 2019[188]). Finally, better remote work possibilities enabled by novel digital tools and better ICT infrastructure can provide crucial means to adjust to shocks that disrupt physical interactions, as has been demonstrated during the pandemic (OECD, 2021[184]).

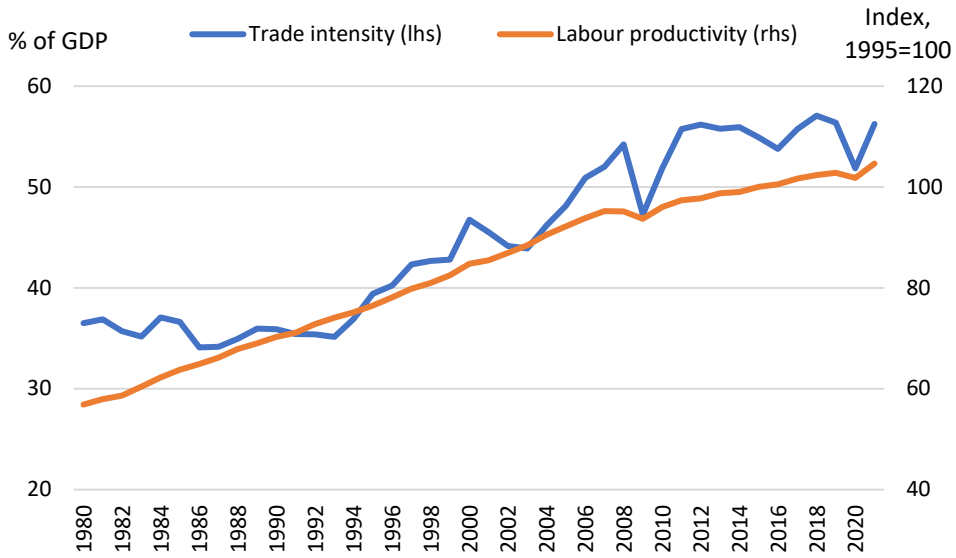
3.2. From macro to micro: the impact of macro trends and shocks on firms

3.2.1. Globalisation in retreat?

International trade growth decelerated markedly around the mid-2000s – concomitant with slowing productivity after a decade of strong expansion driven by ICT and increasing global economic integration (Figure 19). The expansion of global value chains (GVCs) has also almost stalled since 2011, although at historically high levels (Jaax, Miroudot and van Lieshout, 2023[33]). The slowdown in international trade expansion partly reflects China and other Asian economies' declining reliance on imported intermediate goods, as they have built up domestic production capacities. Automation has also facilitated reshoring to high-income countries by reducing the labour share of production costs (Baldwin, 2022[209]). However, trade barriers have also expanded since the GFC (Bown, 2018[210]). Geopolitical tensions have intensified in the past few years, raising risks of geoeconomic fragmentation (Aiyar et al., 2023[211]). Such developments are particularly concerning for small countries heavily reliant on trade, including emerging economies. The COVID-19 pandemic and the war in Ukraine have exposed the vulnerability of key GVCs (Schwellnus, Haramboure and Samek, 2023[212])]), pointing to a rising trade-off between expected level and volatility of output as uncertainty heightens (Kopytov et al., 2022[213]).

Obstacles to international trade and investment risk weakening medium to long-term productivity growth through several channels (OECD, 2017[35]). Access to export markets spur innovation by increasing market size. Import competition can encourage incumbents to innovate.[56] Access to foreign inputs may improve competitiveness by lowering costs and enhancing intermediate goods' quality (Shu and Steinwender, 2019[34]) (Akcigit and Melitz, 2022[214]). Furthermore, globalisation facilitates the international diffusion of knowledge and technology, through international use of patents, trade and foreign direct investment (FDI). This is particularly relevant for emerging economies, even though technology leaders also benefit from each other's research and innovation (IMF, 2018[215]). Another channel through which advanced economies may see reduced productivity and income benefits is through a sectoral reallocation away from more productive manufacturing to services, as explained by (Rodrik, 2021[36]). To the extent that import competition shrinks the share of manufacturing employment, this sectoral shift can reduce aggregate productivity and the individual wages of the workers involved in the transition.

Figure 19. The slowdown in productivity has coincided with the plateauing in international trade



Note: Trade refers to the sum of imports and exports divided by GDP.
Source: OECD Economic Outlook 113 Database (June 2023) and World Bank.

Greater participation in GVCs is also associated with faster domestic productivity growth (Gal and Witheridge, 2019[216]). Manufacturers benefit most from greater use of imported intermediate inputs, while services sectors increase their sales of intermediates to exporters. In Europe, firms further from the efficiency frontier have benefitted more than others from GVC integration since 2005 (Criscuolo and Timmis, 2018[217]). Trading with higher-productivity partner countries also yielded greater productivity

[56] Patenting activity declined among US manufacturing firms that were exposed to more imports from China, driven mostly by initially less profitable businesses (Autor et al., 2020[471]). Similar results were found in Chile, where only the most productive local firms increase innovation after being more exposed to foreign competition (Cusolito, Garcia-Marin and Maloney, 2023[472]). These results confirm the idea that when the distance to the global frontier is too large – as is the case for the majority of domestic firms, especially for less advanced economies – then the incentives to innovate can get reduced when exposed to more foreign competition, in line with initial evidence from the UK (Aghion et al., 2009[467]) and in line with neo-Schumpeterian growth theory (Aghion, Akcigit and Howitt, 2014[159]).

benefits, both at the firm (Criscuolo and Timmis, 2018[217]) and the industry level (Gal and Witheridge, 2019[216]). Hence, weakening GVC integration may also slow productivity convergence among countries.

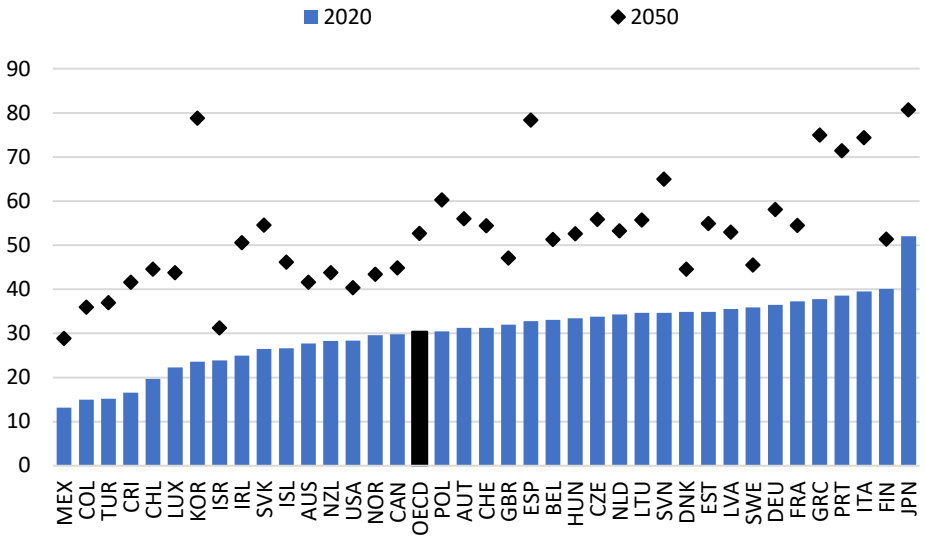
The stagnation of FDI since the GFC may have also contributed to slow productivity growth. Indeed, enabling and encouraging foreign direct investments (FDI), while preserving the security and resilience of supply chains can raise productivity through technology transfers and knowledge spillovers. Local firms may learn from more productive foreign firms operating in their market and hire skilled workers trained in multinational companies. FDI can also raise productivity directly if foreign firms expand investment in high-productivity sectors or are more productive than local competitors. Increased competition from foreign firms may push local companies to innovate. The impact of FDI depends on a range of economic, market and policy factors (Lipsey, 2002[218]); (Almfraji and Almsafir, 2014[219]). FDI creates approximately 180 000 jobs every month worldwide and foreign firms tend to be more productive than domestic firms, pay higher wages and offer women greater career opportunities (OECD, 2022[220]). (Baltabaev, 2013[221]) finds that on average a five-percentage point increase in FDI raises MFP by nearly 0.2% per year in a sample of 49 countries between 1974 and 2008, with countries further from the technology frontier benefitting most. FDI, encouraged by sound macroeconomic management, political stability, well-managed labour markets and huge investments in human capital and infrastructure, was a key factor in “East Asia’s economic miracle” (Stiglitz, 1996[222]). The liberalisation of FDI also contributed, along with other structural reforms, to the productivity rebound following Sweden’s early-1990s financial crisis (Heyman, Norbäck and Persson, 2019[223]).

However, foreign firms have a strong incentive to prevent such spillovers to competitors, which erode their competitive advantage. Hence, spillovers through backward linkages may be more likely. In that case, foreign firms’ outsourcing to local companies raises their productivity, through direct knowledge transfers, higher quality requirements and economies of scale. Local firms may also benefit from better quality or cheaper inputs. (Keller and Yeaple, 2009[224]) (Haskel, Pereira and Slaughter, 2007[225]) and (Javorcik, 2004[226]) find robust evidence of positive productivity spillovers from FDI in the United States, in the United Kingdom and in Lithuania, respectively.

3.2.2. Population ageing

Populations in OECD countries are ageing rapidly, with the average old-age dependency ratio projected to rise from around 30% in 2020 to over 50% in 2050 and much steeper increases in some countries ((André, Gal and Schief, 2024[227]); Figure 20). On average, while the proportion of older people rises, the working-age population is projected to stagnate. However, in some countries, notably in Asia and Eastern and Southern Europe, the working-age population may shrink by up to more than a third by 2050 (Figure 21). To some extent, the impact of ageing could be mitigated by higher labour participation rates (Sheiner, 2014[228]). Even so, raising productivity will be crucial to maintain consumption levels as the share of the working-age population declines. Productivity itself may be affected by ageing. On the one hand, ageing may lower productivity if workers’ efficiency declines with age or if ageing reduces business dynamism or if it shifts production towards lower-productivity sectors, like health care and leisure. On the other hand, labour scarcity could lead to more automation, thereby raising productivity.

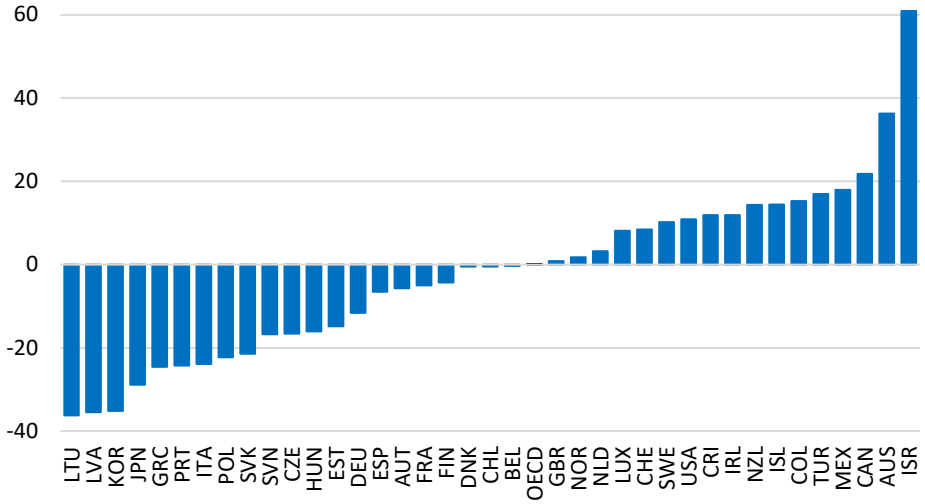
Figure 20. The old-age dependency ratio will rise in all OECD countries



Note: The old-age dependency ratio is defined as the number of individuals aged 65 and over per 100 people of working age defined as those aged between 20 and 64.
Source: OECD, Pensions at a Glance dataset.

Figure 21. The working-age population will shrink in some countries

Percentage change in the population aged 20-64 between 2020 and 2050



Source: OECD, Pensions at a Glance dataset.

At the microeconomic level, studies that combine firm and worker-level data tend to find that prime-age workers are more productive than younger ones. However, there is no conclusive evidence that older workers are more or less productive than prime-age workers. Combining workers from diverse age groups was found to bring productivity benefits, which is likely due to the positive complementarities between their different strengths and skills, with experienced managers playing a key role (OECD, 2020[229]). The

macroeconomic impacts of ageing are also mixed. Drawing on variations in the predetermined component of population ageing across US states, (Maestas, Mullen and Powell, 2023[230]) find that a 10% increase in the share of over-60 year olds in the population reduces per capita GDP by 5.5%, with two-thirds of the decline related to labour productivity and one-third to employment. Similarly, a negative impact of ageing on productivity growth was found at the regional level, particularly in urban areas, where difficult to automate tradable services predominate, and business dynamism – which tends to decline as population growth slows (Hopenhayn, Neira and Singhania, 2022[231]) – is a strong driver of productivity (Daniele, Honiden and Lembcke, 2019[232]).[57] Overall, workforce ageing is estimated to reduce MFP growth in Europe by 0.2 percentage points per year over 2014-2035 (Aiyar and Ebeke, 2016[233]). However, (Acemoglu and Restrepo, 2017[234]) and (Acemoglu and Restrepo, 2022[235]) find no negative link between ageing and growth when looking at a larger sample of OECD and non-OECD countries, which they associate with greater adoption of robots and other automation technologies in ageing societies, which can raise productivity.[58] For a more detailed, recent discussion on these issues, see (André, Gal and Schief, 2024[227]). Also, given the mixed evidence and rising importance of the issue, the role of ageing on productivity would benefit from more research to better inform public policies.

3.2.3. The green transition

The green transition requires large-scale investments, changes in production processes and worker skills, and reallocation of labour and capital, across all economic sectors. Insufficient action against climate change and other environmental damage, such as air and water pollution[59], loss of biodiversity and waste generation, would lower long run productivity growth through many channels. These include lower agricultural yields, loss of land and capital via rising sea-levels, reduction in natural amenities, disruptions and destruction of productive capital through worse and more frequent natural disasters, and potential impacts on human health (OECD, 2015[236]), (Batten, 2018[237]), (IMF, 2020[238]), (Berg, Curtis and Mark, 2023[239])).

Despite the green transition's long-run benefits, there is concern about its short-run impact. The green transition could bring two opposite effects. On the one hand, environmental policy will increase compliance costs and may crowd out some investment, thereby reducing firms' productivity and competitiveness, potentially inducing offshoring to places with less stringent regulations and hence lower abatement costs (OECD, 2021[.30]). On the other hand, the Porter hypothesis ((Porter, 1991[240]), (Porter and Linde, 1995[241])) predicts that environmental regulations may increase productivity by promoting efficiency improvements and encouraging innovation in new technologies. However, efficiency gains due to investment or innovation may take time to materialise, and it is an empirical question if the positive effects dominate and at what horizon (Ambec et al., 2013[242]).

Recent OECD studies show that climate policies in OECD countries have been effective at reducing greenhouse CO_2 emissions, with relatively small effects on aggregate employment, investment and productivity (OECD, 2021[.30]). An initial negative impact of higher energy prices on multi-factor productivity growth at the firm level can subsequently be reversed, with firms displaying positive productivity gains in the medium term (Figure 22). This sign reversal is, however, contingent on firm, institutional and macroeconomic characteristics. As it appears to result from investment, energy price increases are more

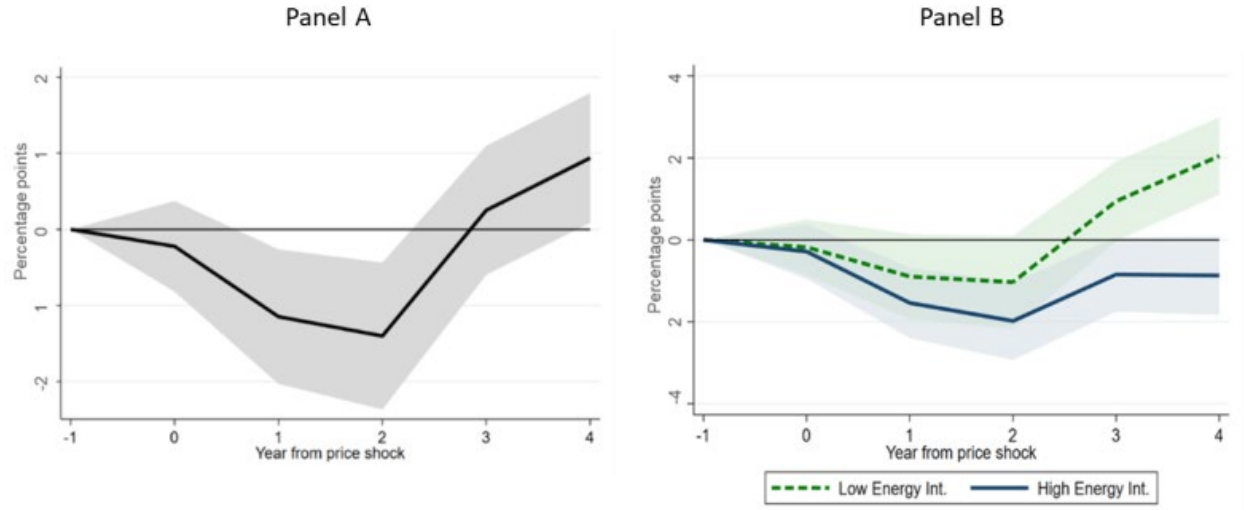
[57] A higher proportion of workers in their 40s was found to show a strong positive association with higher productivity growth by (Feyrer, 2007[479]), in line with the micro evidence on the positive role of prime-age workers.

[58] However, the positive correlation between population aging and per capita output growth breaks down when the policy rate is at the lower bound, as in the aftermath of the GFC (Eggertsson, Lancastre and Summers, 2019[520]).

[59] On the impact of air pollution on productivity, see Dechezleprêtre, Rivers and Stadler (2019) and Aguilar-Gomez et al. (2022).

likely to boost productivity when coupled with conditions favouring investment in green technologies, as for example in countries with more stringent environmental policy or displaying a positive output gap (André et al., 2023[243]).

Figure 22. The medium-term response of productivity to energy price shocks



Note: Panel A: The thick black line represents the average change in firms productivity growth following a 10% energy price shock. Panel B: The blue solid (green dashed) line represents the average change in firms productivity growth following a 10% energy price shock in high (low) energy intensity sector. The shaded area represents the 90% confidence interval around the estimates. The sample covers manufacturing and construction firms from 21 countries over the 1995-2020 period. See more details in the source.
Source: (André et al., 2023[243]).

3.2.4. Scarring effects of the pandemic

The COVID-19 pandemic induced a major economic shock with significant disruptions to productivity through various channels: innovation, diffusion and allocative efficiency, as discussed in Section 3.1. Some of them may have potentially longer-term negative impacts, "scarring effects". Such potential disruptions to innovation include a potentially harmful reduction of in-person interactions that may persist (see more in Section 3.1 under *Innovation*). Losses in general human capital accumulation have occurred due to school closures, weighing on the quality of skills in the future and thus holding back both innovation and diffusion (see Section 4.3 under *Human capital)*. While the allocation of resources was relatively unaffected in most OECD countries, thanks to government interventions that seemed to benefit more the higher-productivity firms (Calligaris et al., 2023[205]), these programs led to higher levels of public debt and thus leave fewer resources available for boosting long term growth. On the positive side, increased remote working possibilities might allow for a broader matching of workers to geographically distant jobs (see Section 4.2 under *Innovation*). Digitalisation might have also received a boost, although the related productivity benefits still need to be confirmed.

3.2.5. Financial conditions

The resurgence of inflation and the associated rise in interest rates in the recent years ended an era of favourable financing conditions that characterised the pre-COVID19 period. Even though financial tightening is partly cyclical, access to finance may have become lastingly more challenging than over the past decades. High public and private debt levels and the large financing needs for the green transition and climate adaption risk constraining access to finance further and pushing up long-term interest rates going forward. Geopolitical tensions and climate change may generate more frequent economic and financial shocks and a rise in risk premia (Chiţu et al., 2022[244]) (Financial Stability Board, 2020[245]). The impact of changes in the financial environment on productivity is very uncertain. On the one hand, access to finance may become more difficult and more costly for many firms, hampering investment and

innovation.[60] On the other hand, insofar as low interest rates have propped up zombie firms, or induced a misallocation of assets across firms (Albrizio et al., 2019[246]), higher interest rates may trigger productivity-enhancing resource reallocation.

4. The role of public policies for productivity growth

4.1. An organising framework of policy areas for productivity growth

This subsection presents an organising framework for analysing key policy areas and the channels through which they affect productivity, by building on and combining existing approaches. As shown in Table 1 in the Introduction, it rests on two main pillars: incentives and capabilities[61], which makes clear the multipronged nature of tackling productivity challenges with strong complementarities between policy areas. It breaks down capabilities into MFP, capital and labour quality, matching the main supply-side components of output, in line with the OECD quantification of structural reforms framework (Égert and Gal, 2017[247]). Table 1 also indicates why and how the main impacts arise for aggregate productivity, as in (OECD, 2015[3]) and in Section 3.1: is it via pushing the productivity frontier; or by helping the catch-up of firms below the frontier; or through improving the allocation of resources across firms.

The distinction between productivity leaders and laggards is crucial for analysing the key productivity challenges that countries are facing, given the large and persistent differences between firms.[62] The reallocative capacity of economies across firms with different productivity levels within or even across sectors (row 3 in Table 1) is also a key pillar of aggregate productivity growth, especially in the face of large or frequent shocks such as recent and current events (health crisis, geopolitical conflicts, climate disruptions).

In Table 1, incentives and capabilities are seen from the perspective of both businesses (managers, more precisely) and workers. For instance, competition acts as an incentive for firms, while better management and skills improve their capabilities. Regarding workers, income taxes affect their incentives, whereas education and healthcare improve their capabilities.

This setup serves to provide a high-level map of the vast range of available public policy areas, with the aim of providing an overview and potentially guide the prioritisation of reforms in a particular country, depending on where the most acute problems lie. It should not be taken as a rigid and mutually exclusive categorisation since many mechanisms are admittedly more complex and may be open to different interpretations. For instance, promoting competition may benefit all segments of the productivity distribution, but to different degrees depending on the strength and type of competition (see (Aghion et al., 2005[248]) on neck-and-neck competition near the frontier). Also, depending on the exact measurement approach of MFP, some aspects of capital (e.g. intangible capital) or labour quality (e.g. education levels) might show up either in MFP or in one of these input contributions.

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[60] Recent evidence for the US points to a significant negative effect of monetary policy tightening on innovation (Ma and Zimmermann, 2023[516]). Consistent with a persistent negative role of tighter financial conditions on productivity, firms with fragile balance sheets were found have slower productivity growth following the GFC by (Duval, Hong and Timmer, 2019[533]) using cross-country firm level data.

[61] This follows (Andrews, Criscuolo and Gal, 2016[11]) and (Nicoletti, von Rueden and Andrews, 2020[19]) who apply it mostly in the context of digital technology adoption and productivity.

[62] Often, similar distinctions are drawn, with similar dichotomies: between large and small (or small and medium sized, SME) firms; between multi-national (MNE) versus domestic oriented firms. As discussed in (Andrews, Criscuolo and Gal, 2015[78]), there are indeed important overlaps between, say, the most productive firms and the largest MNEs – but the similarities are far from perfect.

4.2. Incentives

This subsection focuses on public policy areas with the potential to incentivise the business sector for carrying out productivity improvements, be it via innovation or adoption or through a more efficient and productivity enhancing (re)allocation of resources – labour and capital – across firms. Table 2 presents a high-level summary, building on the framework shown in Table 1.

Table 2. Public policies affecting the incentives of firms and workers to raise productivity

Impacts mostly on:	**Policies that raise incentives for improving productivity**
Firm level productivity *near or at the frontier*	For innovation, adoption and experimentation **Competition** Mostly near the frontier: ▪ Upgrade and adapt antitrust measures to rising digitalisation by bolstering the capacity and expertise of regulatory bodies in this domain. This would help them adequately assess the impact of fast changing market conditions (e.g. rising concentration) and rapidly emerging technologies (e.g. AI) ▪ Aim to strike a balance between ensuring competition and maximising consumer benefits from network effects; regulatory sandboxes could be considered to experiment. All other firms: ▪ Set product market regulations at appropriate levels, in particular streamline permits and licensing ▪ Ensure the contestability of online digital platforms to maximise productivity benefits for service providing firms relying on them ▪ Uphold international trade openness, in particular prefer geographic diversification to more radical approaches when aiming to meet security and resilience goals. Reduce global trade policy uncertainties ▪ Ease barriers to service trade, including digital trade, where there is still large potential to intensify trade links even among relatively well-integrated partners
Firm level productivity *below the frontier*	**Intellectual property** regimes: keeping them up to date ▪ Re-design intellectual property protection, in particular the patent system, in a way that better balances market competition with the incentives to innovate, as outlined by OECD guidelines on intellectual property and competition ▪ Improve the appropriability of intermediate innovation efforts, for instance by encouraging access to research lab outputs by other firms in exchange for license fees **Fiscal incentives** and **public procurement** for innovation and diffusion: boosting supply and creating demand ▪ Improve support for R&D by including more? not-yet-profitable businesses ▪ Create demand for innovations through public procurement, which can also contribute to meeting carbon emission mitigation goals through specific energy efficiency requirements ▪ Provide incentives for employers to offer training to improve skills and thus increase the absorptive capacity of firms **Labour market institutions** ▪ Wage setting institutions, including minimum wage, bargaining and unions, play a complex role for firm- and aggregate productivity. Given mixed evidence, more work would be needed to draw clear conclusions

Allocation of resources *across firms with different productivity levels*	For a more dynamic and productivity enhancing (re)allocation of resources Mitigate **policy uncertainty**, which is particularly harmful for long term investment decisions Make the most of **entry and exit**: ▪ Reduce barriers to entrepreneurship ▪ Design insolvency regimes that mitigate the cost of failure and facilitate corporate restructuring Contain **hiring and firing costs**: ▪ Limit mandatory occupational entry requirements to necessary cases ▪ Continue reforming employment protection, notably concerning unfair dismissals and severance pay, to allow firms to adapt to changing economic conditions, while maintaining adequate worker protection. **Environmental protection** related regulations and incentives ▪ Favour market-based incentives as they were found to be most productivity-friendly ▪ Past carbon pricing increases did not yield productivity losses on average, but with important heterogeneous impacts across firms. Industry-level productivity can even rise if the least productive firms are driven out of the market. Active, continued evaluation of future policy changes are needed given that they are likely to become more substantial to meet carbon mitigation goals.

Note: For more details and specific recommendations and country examples, see the main text in Section 4.2. .

4.2.1. Innovation, adoption and experimentation

Competition

Stronger competition on product markets can sharpen the incentives of firms both for the creation and for the adoption of innovations in several ways. It can raise the quality of management (Bloom and Van Reenen, 2007[149]) which can translate into higher productivity, especially when combined with more investments (Backus, 2020[249]). Tight competition also induces a stronger selection across firms, with the weakest productivity firms exiting the market (Olley and Pakes, 1996[250]) (Melitz, 2003[251]).[63] As higher mark-ups and rising concentration suggest weakening competition and aggregate productivity growth disappoints (Section 3.1), it is crucial for public policies to re-evaluate their stance and update their approaches if needed to unleash the economic benefits from stronger competition.

Among the policy levers for ensuring competitive markets, the appropriate setting of product market regulations (PMR) is an important starting point. The OECD has been compiling country-by-country indicators on a wide range of service sectors – which are typically more regulated than manufacturing – (Nicoletti, Scarpetta and Boylaud, 2000[252]) going back to the 70s in network industries up until the most recent period (Vitale et al., 2020[253]) with the aim of covering digital markets as well (Nicoletti, Vitale and Abate, 2023[254]). Using these detailed indicators, cross-country macroeconomic analysis confirmed that anti-competitive product market regulatory stance (captured by higher PMR indicator values) is linked with

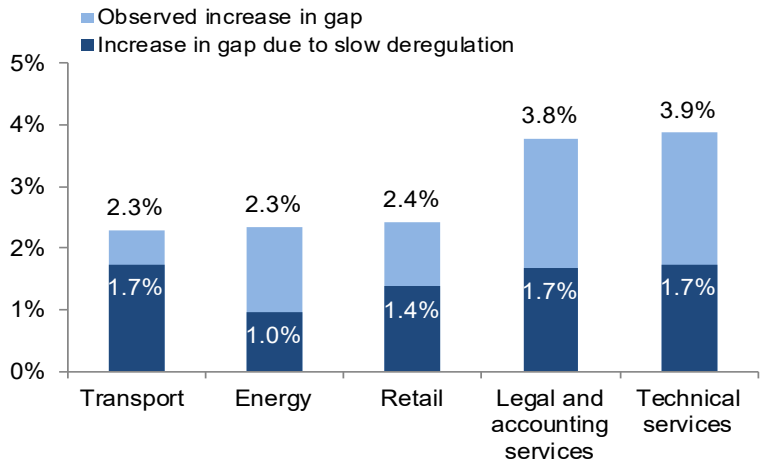
[63] In theoretical models of creative destruction, there are two mechanisms: a negative "business stealing" channel when intensified competition from new entrants to the market reduces the incentives to innovate ((Schumpeter, 1942[157]) and (Aghion and Howitt, 1992[158])), and a positive "escape-competition" channel where incumbents near the frontier, neck-in-neck, put pressure on current leaders to remain at the top (Akcigit and Kerr, 2018[464]). Empirical work confirms that depending on the strength of competition, innovation may rise (when competition is weak) or decline (when competition is already strong) with further increases in competition across UK industries (Aghion et al., 2005[248]). EU firms responded by more investments in R&D, IT equipment and managerial quality and in turn more patenting activity and higher productivity after more import competition from China's expansion in international trade (between 2000 and 2007); initially more productive firms also attracted more resources as less productive firms exited faster (positive reallocation) (Bloom, Draca and Van Reenen, 2016[465]).

lower MFP levels (Égert, 2016[255]).[64] At a more disaggregate level, (Bourlès et al., 2013[256]) finds that the pro-competitive reforms in regulated services can also lift productivity in other sectors, such as manufacturing, through providing better quality or cheaper inputs to production. Furthermore, when combined with enhanced active labour market programmes, easing regulatory barriers to competition in product markets promotes equality, as well as productivity (OECD, 2016[7]).

While pro-competitive regulatory reforms have been implemented in a large number of countries and sectors over the past decades, there is still room to go further by streamlining permits and licensing, in particular in certain professional services (OECD, 2023[257]). Indeed, firm-level analysis finds that ambitious deregulation reforms, similar to the ones observed in the telecom sector in many countries, could have mitigated the rise of productivity gaps between leading and lagging firms (Figure 23 and (Andrews, Criscuolo and Gal, 2016[11])).

Figure 23. Faster product market reform would have mitigated productivity divergence

Estimated contribution to the annual change in the MFP gap of the slower pace of reform relative to the fastest reforming industry (telecoms)



Note: The figure shows the annual change in the multi-factor productivity gap between the frontier and laggard firms, and the part that is explained by slower deregulation than that observed in the fastest deregulating industry (telecom). The sample is in general 1998-2013. See more details in the source.
Source: Andrews, Criscuolo and Gal (2016).

Easing occupational licensing, in particular through less burdensome entry requirements into certain professional services (discussed more below under *Reallocation of resources*), can also intensify competitive pressures on incumbents and allows for a selection among a broader pool of applicants, both contributing to faster productivity growth (Bambalaite, Nicoletti and von Rueden, 2020[12]). Indeed, this same study found significantly stronger productivity growth at the firm level in countries and sectors with less stringent licensing requirements. In a hypothetical example of easing licensing from the most (Germany) to the least regulated country (Sweden) to the least, the firm-level productivity growth benefits amount to 1.5 percentage points.

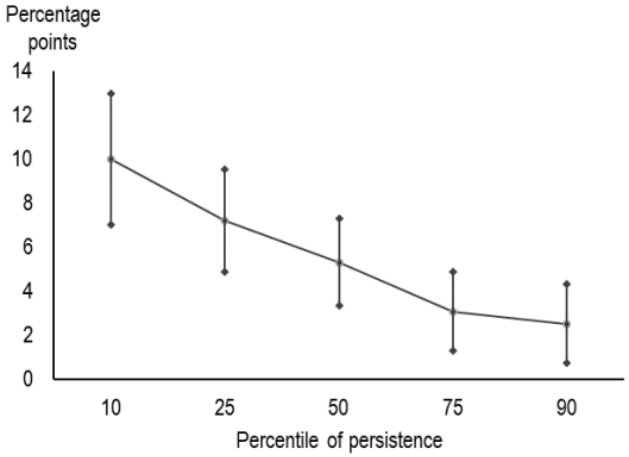
Competition in digital markets is an area of active policy interest and research, given that rising corporate market power seems to rise even more rapidly in those markets (Section 3.1). This may have broader

[64] In fact, when included jointly with other policy drivers in regressions explaining MFP, typical past reforms observed for PMR seems to deliver the largest effect compared to typical reforms in other areas (Égert and Gal, 2017[247]).

negative productivity implications beyond digital sectors: for instance, online platforms for consumer services (in retail, tourism, transport, etc.) may provide productivity benefits for firms that are present on the platforms through better matches with interested customers, these gains seem more moderate when the online platform market is characterised by more entrenchment among the largest firms (Bailin Rivares et al., 2019[188]) (Costa et al., 2021[187]) (Figure 24).

Figure 24. The link between online platforms and productivity is weaker when the largest platforms have more persistent dominance

The marginal impact of online platform use intensity* on productivity growth as a function of the strength of persistence of the largest platforms**



Note: *use intensity is measured by website traffic on the platform websites. **The strength of persistence (measured by the "percentile of persistence" on the horizontal axis) captures the degree to which the largest platforms remain the largest from one period to the next. See more details in the source.
Source: Costa et al (2021) using data from Orbis (Moody's/Bureau Van Dij), Semrush, and Crunchbase.

Public policies should ensure data portability across platforms to ensure the contestability of these markets, as a means of *ex ante* regulatory approaches, which aim to prevent that barriers to market access emerge and stifle competition. However, data portability requirements consisting in one-off transfers from one digital company to another at the request of a user (as in the EU General Data Protection Regulation, GDPR) may not be enough to promote competition. Complementing static data portability (i.e. one-off data transfer) requirements with continuous data portability and interoperability can offer more effective alternatives to boost competition among digital companies while preserving network effects (Krämer, 2020[258]) (Pisu et al., 2021[15]). Such technical requirements, on the other hand, put extra burden on digital service providers, which may be harder for the youngest and smallest players to bear, thus stifling entry or post-entry growth (Nicoletti, Vitale and Abate, 2023[254]).

Ex-post regulatory policy interventions and more generally competition enforcement and antitrust policy face their own trade-offs, in particular in data and digital markets but more broadly in intangible based economic activities (Haskel and Westlake, 2022[125]). For instance, tackling abuse through structural measures such as forcing a break-up, or behavioural remedies by restricting a firm's ability to carry out its business, have to weigh benefits for competition against potential downsides for consumer welfare due to losses in variety or quality. Such challenges, in combination with the increasing sophistication of these markets and emerging dominant technologies call for government regulatory bodies to bolster their capacity and expertise in these domains (Nicoletti, Vitale and Abate, 2023[254]). More generally, reversing

the declining resource trends faced by antitrust authorities, particularly in the United States, becomes crucial to effectively address these challenges (Philippon, 2019[160]).

Some type of AI technologies – for instance generative AI such as large language models – carry other types of complications due to the need to balance contestability with requirements for safety and trustworthiness. For instance, if current established players play an active role in shaping novel regulations in this emerging field, or if regulations will result in extra costs that larger established firms are more likely to absorb, then regulation may also come at the cost of entrenching and protecting first movers (The Economist, 2023[259]). On the other hand, an opensource approach is likely be more conducive to competition, but it might lead to the uncontrolled proliferation of untested AI models. Regulatory sandboxes are attractive ways to experiment with and test the safety of new models in a limited, restricted domain of use (Díaz-Rodríguez et al., 2023[260]), as is also recommended by the EU's AI Act introduced in 2021 (European Commission, 2021[261]). Also, since AI tools can be scaled up and cross borders very easily, all the risks and benefits are of global nature and thus ideally require global governance (Korinek, Schindler and Stiglitz, 2021[262]). More generally, (Acemoglu and Restrepo, 2019[263]) argue for more technologically-directed innovation support, favouring those that come with complementary roles to human tasks and discouraging purely automation-oriented solutions (see also Section 3.1). A promising example might be immersive technologies such as augmented or virtual reality which work together with humans to extend and enhance their capabilities rather than substituting them, such as automation including robotics and AI (Acemoglu and Johnson, 2023[264]).

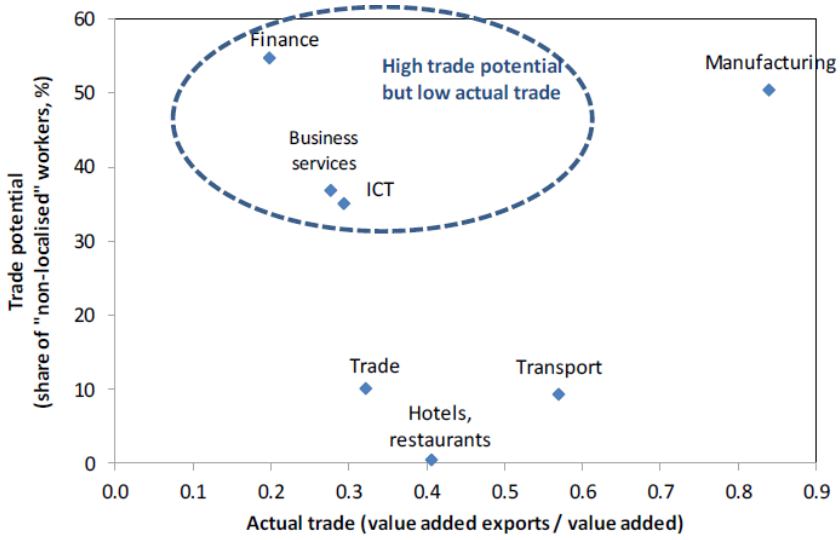
Openness to international trade also raises competitive pressures (Section 3.2). This is illustrated by the strong unconditional labour productivity convergence across a large panel of advanced and developing countries in manufacturing, which is the sector most exposed to competition (Rodrik, 2012[265]). Greater trade openness is also linked with higher MFP at the macroeconomic level (Égert, 2016[255]). The rise in trade barriers – tariffs and non-tariff alike – since the GFC, intensifying geopolitical tensions and the vulnerabilities in GVCs exposed by the COVID-19 pandemic and the war in Ukraine have raised concern about a retreat in globalisation (Goldberg and Reed, 2023[32]) (Section 3.2), pointing to the need for policymakers to facilitate trade and reduce uncertainty (Jaax, Miroudot and van Lieshout, 2023[33]).

There is scope to reduce risks from GVC integration without jeopardising efficiency gains (Crowe and Rawdanowicz, 2023[37]). Strategies involve, from the most to least radical and consequential for GVCs, "reshoring", "near-shoring" and "friendshoring", as well as simply diversifying or stockpiling inputs. However, some of these strategies rely on geopolitical notions of "friends" which can change over time, adding to business uncertainty. Diversifying thus seems like a more attractive option, although it may not be feasible for sectors relying on geographically concentrated natural resources. The role of public policy in this area may be limited, beyond aiming to provide a stable and predictable environment to minimise policy uncertainties, since businesses themselves already respond to incentives to mitigate business risk and increase resilience, trading-off potential impacts on efficiency and productivity. In addition, given the complexity of GVCs, every policy intervention – be it financial incentive or regulatory fine-tuning – may generate unexpected consequences for supply chains and the availability of critical inputs from abroad.

While trade in goods is decelerating, advances in digital technology offer new opportunities for trade in services, which continues to grow rapidly (Baldwin, 2022[209]). Services account for more than two-thirds of global GDP. Some require face-to-face interaction, but digitalisation allows outsourcing an increasing share, especially intermediate business services. Knowledge intensive services such as business and financial services and ICT still offer further opportunities for openness, given their inherently higher tradability than what is actually traded (Figure 25, (Sorbe, Gal and Millot, 2018[74])). Increased competition could push up productivity, especially in places where services have been lagging. This is particularly relevant for Europe, where the productivity slowdown largely results from weak growth in market services (van Ark, O'Mahony and Timmer, 2008[68]). Reducing further trade barriers, which are higher for services

than for goods[65], would lower trade costs, which reduce gains from digital transformation and undermine competitiveness. Easing trade barriers in business services is found to have sizable productivity effects on downstream manufacturing sectors that rely on such services, in particular telecommunications, financial services and air transport (Benz et al., 2023[266]). Digital trade remains fragmented, with policies impeding access to communication infrastructure and information flows across networks, including through regulatory barriers affecting the cross-border transfer of data (Ferencz, 2019[267]).

Figure 25. Knowledge intensive services have a large underexploited trade potential



Note: The share of "non-localised" workers is based on the measure of offshorability from (Blinder and Krueger, 2013[268]), which is a proxy for trade potential to the extent that an industry with few localised workers could in theory (and in the absence of policy frictions) locate an important share of its production in a different country from where consumers are located. It is also interesting to note that certain industries (e.g. hotel, restaurants) have a low share of non-localised workers but still generate exports through tourism (where consumers rather than workers are mobile internationally). Actual trade defined is the ratio of value added in exports to value added, averaged across 35 OECD countries for each sector.
Source: (Sorbe, Gal and Millot, 2018[74]).

Intellectual property regimes: keeping them up to date

Innovation at the frontier is mostly about bringing new technologies and business models to the market (Aghion and Howitt, 1992[158]) (OECD, 2015[3]). Given the appropriability of several types of innovations, patents have a crucial role to play in ensuring that the economic benefits remain at least for a temporary period with the initial inventor, which in turn creates stronger incentives for innovating in the first place (Nordhaus, 1969[269]). The knowledge embedded in patents also plays a role in diffusing technologies to other firms as they incorporate and build on the initial invention. However, the impact of patents on innovation seems heterogeneous across industries or technologies, and cumulative innovation – which

[65] Restrictions in services trade are documented in detail by the OECD's Services Trade Restrictiveness Index (STRI, http://oe.cd/stri and (Nordås, 2016[487])).

closely builds on an existing stream of innovations in the same broad field – seems to be at a disadvantage (Moser, 2013[119]).[66]

The latest OECD guidelines on intellectual property rights and competition aim to strike a balance between the correct functioning of markets and adequate incentives to innovate, particularly for the rapidly growing digital economy (OECD, 2023[270]) (Pisu et al., 2021[15]). Notable recent proposals to further enhance the efficacy of protecting intellectual property include (Frankel et al., 2023[271]) who emphasise that the appropriability of innovation *efforts* (i.e. intermediate outcomes of innovations) should be improved, sharpening the incentives for firms for investing in breakthrough innovations, which have higher risks of failure. These efforts often fail but the learning value of engaging with the innovation can spill over to other, competing firms. Granting access to the indirect revenues from these knock-on innovations would increase the incentives of firms to engage in such risky invention efforts. Relatedly, and as a complement to patenting, (Aghion, Cherif and Hasanov, 2021[194]) proposes that policies encourage firms to set up advanced research labs whose output can be accessed by other firms in exchange for a small licence fee. This would provide incentives not only for generating new ideas but would also allow for their better diffusion.

The growing importance of intellectual property and the intangible nature of innovations creates yet more challenges for competition enforcement. Harmful practices by firms include mergers to undermine incentives for innovation; anti-competitive settlements in patent litigation relating to prospective entry (e.g. by generic suppliers in the pharmaceutical sector); the possibility of anticompetitive conduct in the context of standard-setting processes; and unilateral abuses of market power derived (at least in part) from IP rights in high-technology industries (OECD, 2023[270]). On the other hand, the prevalence of buyouts by established players might provide stronger incentives for innovators to enter the market in the absence of effective financing for intangible rich innovative activities (Haskel and Westlake, 2022[125]) (on obtaining capital for high risk activities, including through easier pledgeability of intellectual property, see Section 4.3).

Fiscal incentives and public procurement for innovation and diffusion: boosting supply and creating demand

Given large spillovers effects on other firms beyond the inventor coupled with potential financing barriers to innovation, governments provide support to innovation and diffusion through various fiscal means. Related to the *supply* of innovation, they exempt innovation activities from taxes or provide subsidies, while on the *demand* side, they can use public procurement and standard setting.

A key policy tool in the first category, R&D tax incentives, shows rising popularity among many OECD countries (Figure 26). Thanks to their generosity as measured by the rise in implied marginal subsidy rate – although with some loss of momentum since the pandemic – (Panel A), government spending has also been growing steadily and has taken over the amount spent on *direct* R&D support (Panel B). The effectiveness of R&D tax incentives are confirmed by robust evidence (Hall, 2020[272]), in particular at the firm level (Dechezlepretre et al., 2023[273]) as well as for positive spillovers on other firms (Lucking, Bloom and Van Reenen, 2019[274]), most recently by using novel microeconomic data from 20 countries (OECD, 2020[275]). At the macro level, studies find that the broader business environment is crucial for R&D support to deliver productivity gains, including competition friendly regulations, debtor protection in bankruptcy laws and low barriers to trade and investment (Westmore, 2013[276]) (Égert, 2016[255]). Moreover, the details of design and implementation are key for effectiveness: support should not favour disproportionately the

[66] Indeed, stronger patent protection after important court decisions seems to have slowed down innovative efforts in the United States software industry in the 1980-90s (Bessen and Maskin, 2009[489]). However, no major negative impacts of human gene patents were observed on follow-up research and product development (Sampat and Williams, 2019[490]).

already profitable companies – which can be a risk when support is provided as a relief from corporate income taxes – but should also aim at businesses that are potentially loss-making due to investments in innovation – which may typically be the case for innovative young firms and start-ups (Neubig et al., 2016[277]) (OECD, 2015[3]).[67] By focusing support on R&D costs (e.g. personnel wages) or by providing more direct support through grants or loans can mitigate such risks. Current tax relief systems tend to favour SMEs but still put loss-making firms at a disadvantage, a difference that changed little during the past two decades (Figure 26, Panel A).[68]

Creating demand for innovations through public procurement and standard setting are also part of the toolbox of governments (OECD, 2011[278]). For instance, they can stipulate that products or services must meet specific sustainability, energy efficiency, or safety standards, which can incentivize firms to develop innovative solutions to meet these requirements.[69] By relying on them, governments can also create a signalling effect as lead users, and thus influence the direction of innovation and technical change as well as their diffusion. These are important advantages when considering societal challenges such as mitigating and adapting to climate change (Baron, 2017[279]), or discouraging excessive automation (Acemoglu and Johnson, 2023[264]). Nevertheless, such measures should be targeted to clearly articulated policy objectives and their impacts should be carefully evaluated to avoid the risks of large player dominance and technological lock-in. Careful studies on the effectiveness of such measures are scarce. A few examples include (Czarnitzki, Hünermund and Moshgbar, 2020[280]) who found supportive evidence in Germany following reforms to the procurement legal framework, although mostly in the domain of incremental rather than radical innovations. Government R&D contracts were found to crowd-in corporate R&D in the United States, especially when coupled with downstream procurement for innovative products or services (Belenzon and Cioaca, 2021[281]).[70]

[67] Further discussion of design features can be found in (Appelt et al., 2016[534]), which notes that it is not generally possible to state unambiguously whether specific design features should be recommended, as contextual elements are decisive. Nevertheless, the authors point to several key elements for well-designed support, including taking into account the heterogeneity among potential R&D performers; including carry-forward provisions, cash refunds or reductions in social security and payroll taxes to ensure that small and young firms and projects involving basic research fully benefit; balancing R&D tax incentives and direct support to foster innovation where the market is less likely to deliver it on its own; treating income-based incentives (e.g. "patent box") with caution, as they risk benefitting disproportionately established and big firms; avoiding measures to attract potentially mobile R&D by MNEs, which is likely to have only limited effects and can lead to a “race to the bottom” between countries. For a detailed comparison of design and implementation details across OECD countries and beyond, see (González Cabral et al., 2023[492]). For further analysis of the impact of R&D tax incentives in OECD countries, see (OECD, 2023[535]).

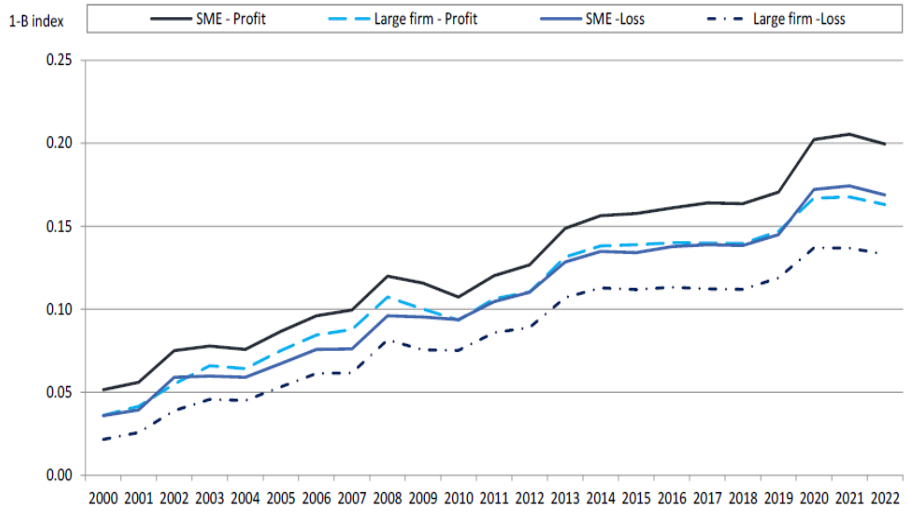
[68] More generally, higher corporate and personal income taxes were found to be detrimental to innovation, especially at more aggregate levels given location choices and entry-exit as additional channels on top of what is observed at the micro level (Akcigit et al., 2021[450]). The international mobility of top inventors plays a further role, their choices are also significantly affected by top income taxes (Akcigit, Baslandze and Stantcheva, 2016[463]).

[69] For a review of public procurement for innovation strategies and best practice in OECD and some non-member countries, see (OECD, 2017[536]).

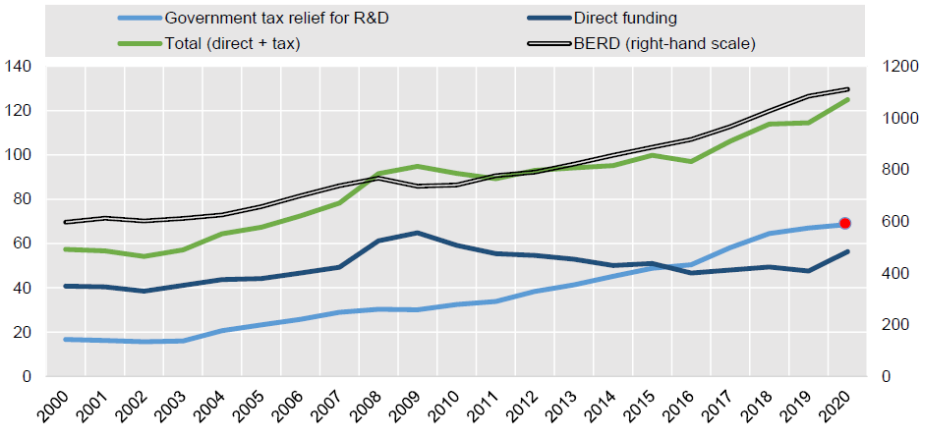
[70] A recent OECD review on industrial policy tools – of which public procurement can also be considered part of – by (Criscuolo et al., 2022[63]) discusses further the available evidence and goes into more details about design and implementation challenges.

Figure 26. The rise in R&D tax reliefs over the past two decades

Panel A: Implied marginal R&D tax subsidy rates (OECD average)



Panel B: Government spending on tax-related and direct support for business R&D (Billion USD, constant 2015 prices)



Note: Panel A displays the tax treatment of R&D expenditure for SMEs and large enterprises, separately for profitable and loss-making firms, averaged for 38 OECD countries. The B-index specifies the pre-tax income needed for a "representative" company to break even on a marginal, monetary unit of R&D outlay, taking into account provisions in the tax system that allow for an enhanced treatment of R&D expenditures. In Panel B, direct support estimates include government R&D grants and public procurement of R&D services, but exclude loans and other financial instruments that are expected to be repaid in full. The 2020 for R&D tax relief is a preliminary estimate.
Source: From the '"*Report on the OECD R&D Tax Incentives Database*", https://one.oecd.org/document/DSTI/STP/NESTI(2023)2/FINAL/en/pdf (June 2023). Database: http://oe.cd/rdtax.

To foster technology diffusion, raising the absorptive capacity of lagging firms is a precondition. Updating skills to be able to work with novel technologies is a crucial element of that. However, the benefits of employee training do not accrue entirely to their current employer to the extent that training improves transferable, general skills to be carried over to positions in other companies. Given this externality, there is a tendency of underproviding training by companies to their current employees, thus creating a rational for support measures to incentivise employee training through training levies and tax incentives (OECD, 2019[282]).[71] Lower entry barriers, through stronger product market competition, also increase firms'

[71] See also Calvino et al. (2022[.]) on fiscal incentives for investment in digital technologies and the role of complementary factors to close the Italian digital gap.

incentives to take up training (Bassanini and Brunello, 2011[283]). On the employee side, their training participation can be encouraged through subsidies and mandating paid training leave. Transferable skills acquired through training will also encourage worker mobility and may also help firms finding more suitable applicants – to be discussed further, along with country examples, in Section 4.3 under *Human capital,* and *Mobility* in particular.

Labour market institutions

Labour market institutions can have complex impacts on productivity, since they affect the incentives of firms in choosing their organisational structure, the types of skill and training strategies they rely on and how much they can adjust these in response to technological change or other structural change. Hence their overall impact depends on the exact institutional details and the broader business environment including the availability of skills, the nature of product markets and the ability to substitute labour with capital.

For instance, a minimum wage might raise the motivation and thus the productivity of workers with low wages. However, the few studies in this field yielded varied results, with (Coviello, Deserranno and Persico, 2022[284]) offering a reconciliation and conclusion that the effects are positive only when combined with intensive monitoring of worker effort. (Lawson, Lelarge and Spanos, 2023[285]) find that in France, output losses associated with minimum wage increases are strongly mitigated by revenue productivity increases resulting from endogenous organisational responses of firms, which however depend on the technological environment.[72] The nature of collective or firm level bargaining and labour unions have been shown to lead to various productivity outcomes. (Garnero, Rycx and Terraz, 2019[286]) provides a brief overview on the trade-offs and difficulties in isolating the role of individual policies. They also show using detailed linked employer employee data from Belgium that firm-level agreements can result in higher labour productivity with respect to sector level agreements.[73] Nevertheless, given the complex and context-specific nature of these findings – as noted by an overview by (Duval and Loungani, 2019[287]) –, further work would be needed in these areas.

Available evidence is more conclusive regarding strict employment protection legislation (EPL), which can harm productivity by holding back the amount of experimentation that firms carry out to adjust their business operations. It can also delay adopting new technologies by making the related labour adjustments more costly (see industry level evidence by (Bartelsman, Gautier and De Wind, 2016[288]) (Bassanini, Nunziata and Venn, 2009[289]) (Tressel and Scarpetta, 2004[290]); firm level evidence on MFP in the United States by (Autor, Kerr and Kugler, 2007[291]), in Japan by (Okudaira, Takizawa and Tsuru, 2013[292]) and in France by (Aghion, Bergeaud and Van Reenen, 2021[293])).[74] Beyond negatively affecting firm-level productivity through these channels, strict EPL can also hold back aggregate productivity through hampering the reallocation of workers across firms, which is discussed further below under *Reallocation.*

[72] Revenue productivity combines physical productivity and prices. The impact of minimum wage increases on *physical* productivity differs across firm types.

[73] More broadly related to labour market institutions and outcomes, lower income inequality has been linked with higher average productivity in the context of the "Nordic model", which rely on a combination of institutional features covering wage negotiations and bargaining in several Scandinavian countries. (Barth, Moene and Willumsen, 2014[452]) (Stiglitz, 2015[453]).

[74] The productivity benefits from using online digital platforms were also found to be lower when EPL is strict (Bailin Rivares et al., 2019[188]), possibly by hindering firms' ability to reorganise their workforce to better adjust to the disruption caused by the presence of platforms.

4.2.2. Reallocation of resources

Adjusting key economic inputs and resources, such as labour and capital, is costly due to various reasons spanning technological constraints but also policy related factors. Moreover, as a general feature of nearly all public policy measures, not only the current policy stance and the implied actual adjustment costs matter, but also the uncertainty about their future evolution. Higher policy uncertainty can put an extra break on holding back costly adjustments by businesses, in turn diminishing the chances of productive reallocation across firms (Pindyck, 1982[294]) (Bloom, Bond and Van Reenen, 2007[295]) (Bloom, 2014[296]).[75] The negative consequences of policy uncertainty on economic adjustment has been analysed in particular in the context of climate policy uncertainty, green investment and innovation (Kyaw, 2022[297]) (Berestycki et al., 2022[298]) as well as regarding trade policies (Handley and Limão, 2022[299]). (Caldara et al., 2020[300]). Reducing policy uncertainty is thus a general imperative for all governments aiming to foster productivity growth.

Entry and exit

New entrants can bring novel, more radical ideas and business models to the market. Moreover, a stronger threat of entry can raise the competitive pressure on incumbents (Section 3.1).[76] An important component of product market regulations relates to barriers to entrepreneurship, such as the time and effort needed to obtain permits before starting a business, which are especially important among services (Vitale et al., 2020[253]). Indeed, high regulatory barriers to entrepreneurship were found to amplify the observed declines in firm entry rates (Calvino, Criscuolo and Verlhac, 2020[192]). They are also linked with faster declines in job reallocation, even more so in digitally intensive sectors (Calvino and Criscuolo, 2019[193]). In the latest OECD PMR database, barriers to entry still vary significantly across countries, indicating further room for reform in some countries (Figure 27).

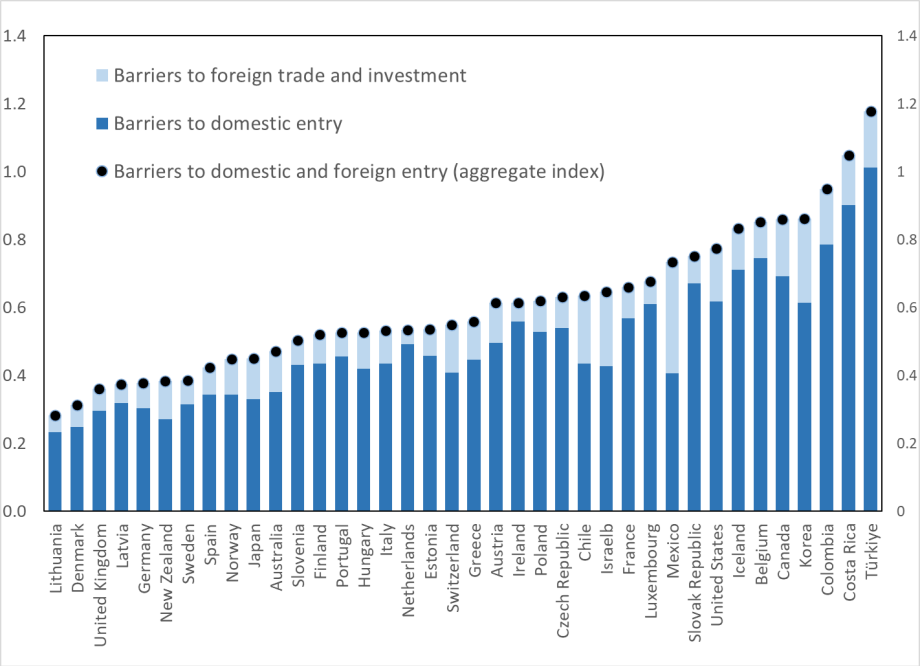
More broadly, occupational licensing can also be thought of as part of entry barriers into certain professions (see more below under *Hiring and firing costs*). A financial system that provides adequate funding for new entrants often without collateral, especially in the case of intangible intensive activities, is also a key ingredient (see more under Section 4.3 under *Capital*). Finally, business entry can also be spurred by reducing the cost of eventual business failure, restructuring, and adjusting the labour force which in turn encourages experimentation with more risky technologies (see immediately below).

[75] Uncertainty, including policy induced uncertainty, may not only hurt productivity through suppressing business adjustment and reallocation, but also by reducing incentives to engage in long-term innovation activities, diminishing growth prospects at the productivity frontier as well.

[76] Empirical and theoretical results show that this mostly applies to firms that are sufficiently advanced and relatively close to the frontier, to “escape competition”, while those further away are discouraged because there is less hope to be able to survive (Aghion et al., 2009[467]).

Figure 27. Barriers to entry still vary significantly across OECD countries, driven primarily by differences in domestic entry regulations

OECD PMR high level indicator *Barriers to domestic and foreign entry* and its lower-level components (2018)



Note: Barriers to domestic entry are the sum of the "Administrative burden on startups" and "Barriers in services and network sectors" subcomponents. Preliminary results from the latest data collection round for the upcoming 2023 PMR indicators (*forthcoming)* confirm the main qualitative picture presented here which are based on the latest publicly available indicators (see the source).
Source: OECD Product Market Regulation Database (2018) https://www.oecd.org/economy/reform/indicators-of-product-market-regulation/

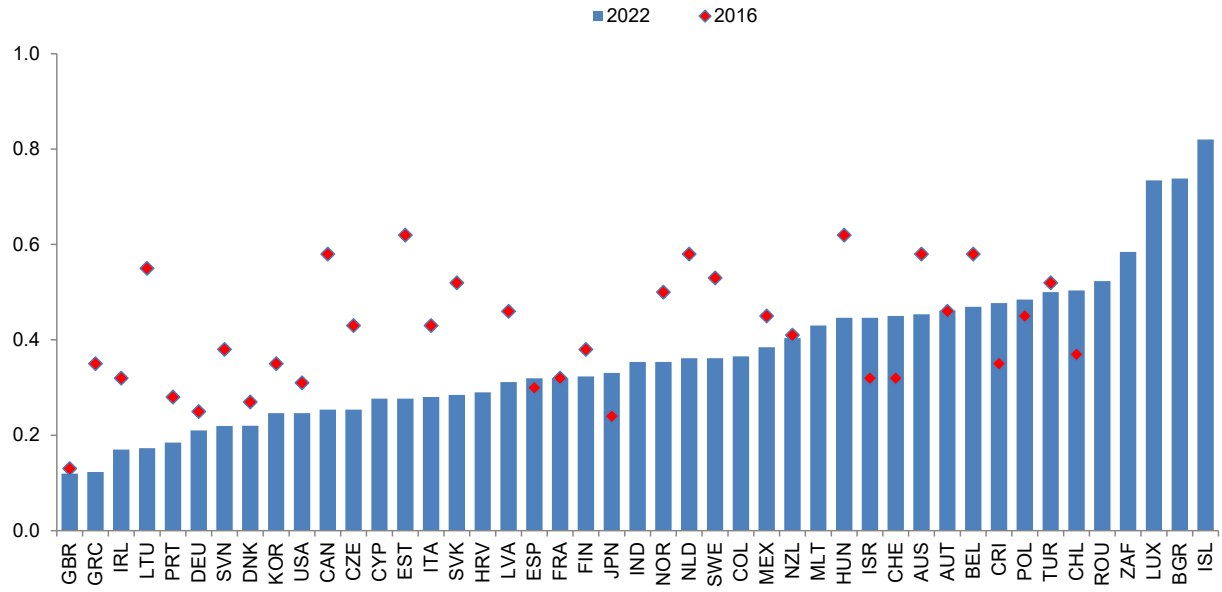
On the exit margin, efficient insolvency frameworks play a pivotal role. They support business dynamism and productivity gains by allowing a timely exit of non-viable low productivity companies ("zombie" firms) and the associated reallocation of resources towards more productive firms, while helping viable firms to restructure. More broadly, they also allow for the experimentation with business models by reducing the cost of failure. Following the GFC, countries where inefficient insolvency regimes hampered prompt restructuring have experienced lower growth and a rising share of zombie firms, with a negative impact on aggregate productivity growth (Adalet McGowan, Andrews and Millot, 2018[199]); (Banerjee and Hofmann, 2020[200]). Reducing barriers to corporate restructuring (as measured by the OECD insolvency indicator in 2010) to the sample's minimum level could have raised laggard firms' average annual MFP growth in 2011-13 by up to 2.7% in some European countries, as discussed by (Adalet McGowan, Andrews and Millot, 2017[301]).[77] Insolvency regimes that reduce the cost of entrepreneurial failure also potentially enhance the MFP gains from lowering administrative entry barriers in product markets. Policies that facilitate efficient corporate restructuring can revive productivity growth by targeting three inter-related sources of weakness: the survival of zombie firms, capital misallocation and stalling technological diffusion.[78]

[77] This estimate may represent an upper bound for today's potential gains, as substantial insolvency regime reforms have been implemented in European countries since 2010.

[78] For a more detailed discussion, summarising a series of work on the role of insolvency regimes and zombie firms for productivity growth, see (Andrews, Adalet McGowan and Millot, 2017[13]).

Over recent year, many countries have implemented insolvency regime reforms, notably to enhance early warning systems and pre-insolvency procedures. Nevertheless, wide differences across countries remain in the 2022 vintage of the OECD Insolvency indicator (Figure 28), which summarises the most relevant features of insolvency frameworks for resource reallocation and productivity growth (Adalet McGowan and Andrews, 2018[302]). There is a particular need to introduce or develop further simplified frameworks for small businesses, although many countries have projects in this area (André and Demmou, 2022[303]). As zombie firms are often linked to weak banks, measures to resolve non-performing loans need to complement insolvency reforms (Andrews and Petroulakis, 2017[95]) ; (Bricongne et al., 2016[304])). The design of insolvency regimes is likely to have a greater impact on productivity in intangible-intensive industries, as innovative projects imply a higher risk of failure. Indeed, productivity gains from lowering barriers to efficient corporate restructuring increase with a sector's intangible asset intensity (Figure 29).

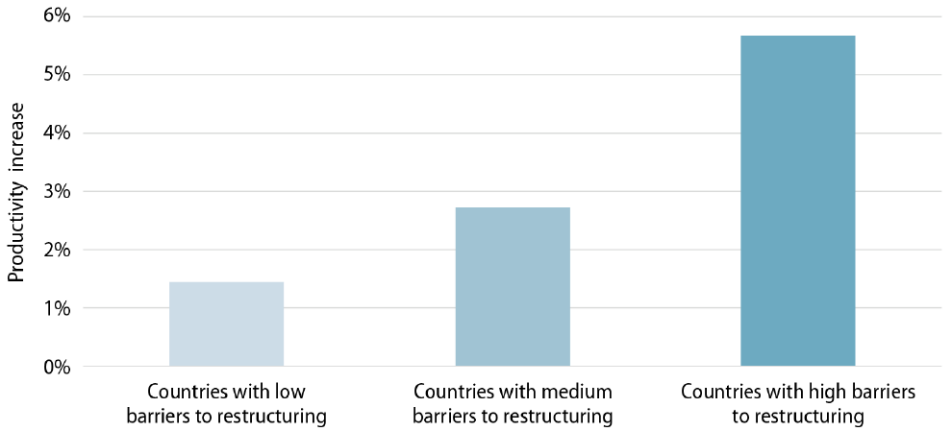
Figure 28. Insolvency frameworks vary widely across countries, with most of them moving towards more favourable conditions



Note: The scores are scaled from zero to one, with lower scores indicating more favourable frameworks.
Source: OECD 2016 and 2022 questionnaires on insolvency frameworks (https://www.oecd.org/economy/growth/oecd-insolvency-indicator.htm).

Figure 29. Productivity in intangible-intensive sectors benefits most from sound insolvency regimes

Productivity gains (in high relative to low intangible-intensive sectors) from moving to the regime best suited to reduce barriers to corporate restructuring



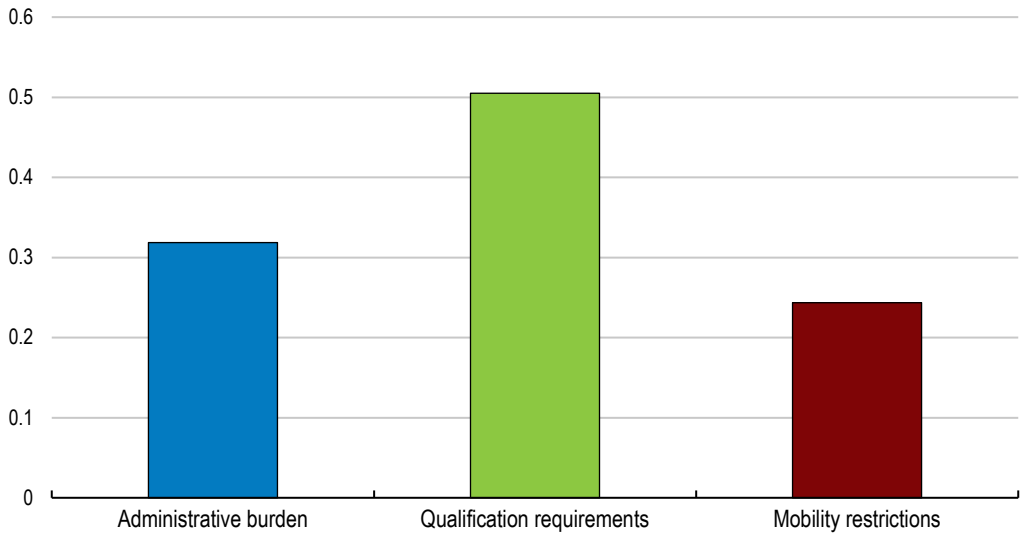
Note: The figure shows the differential productivity increase in intangible-intensive sectors compared to traditional sectors following an increase in insolvency regime soundness to the highest level according to the World Bank index latest year (2019). See more details in the source.
Source: (Demmou and Franco, 2021[16]).

Hiring and firing costs

On the hiring margin, the prevalence and the nature of occupational licensing can play an important role. They typically cover three broad sets of regulations, as captured by the OECD Occupational Entry Requirements (OER) database (von Rueden and Bambalaite, 2020[305]): (I) administrative burdens, capturing limitations and procedural hurdles set on obtaining the legal authorisation to practice; (II) qualification requirements recording the educational attainment required from professionals prior to entering the occupation; and (III) mobility restrictions accounting for labour mobility across jurisdictions (countries or subnational levels of government). Notwithstanding their main economic rationale to provide assurances to employers about meeting minimum skill requirements, they can make recruiting processes more costly and can reduce the pool of eligible applicants, (see more in (Bambalaite, Nicoletti and von Rueden, 2020[12]) and (Kleiner and Krueger, 2010[306])). Given that more than 20% of workers are licensed in the EU (Koumenta and Pagliero, 2019[307]) and in the United States, this can have wide-ranging effects in particular in certain professional services (legal, financial and business services). Recent OECD work using firm-level data identified positive productivity impacts of easing occupational entry regulations through improved allocative efficiency effects (Figure 30) as well as through higher firm-level productivity growth ((Bambalaite, Nicoletti and von Rueden, 2020[12]); see more above under *Innovation, adoption and experimentation)*. In practice, this means it is crucial to find the right balance, ideally by limiting mandatary occupational entry requirements to cases when it is necessary for safety and health reasons.

Figure 30. Less stringent occupational entry regulations are conducive to faster employment growth at productive firms

Change in employment growth between the average firm at the highest and lowest productivity quartiles* separately for three areas of the occupational entry regulation indicator.



Note: *Following the hypothetical reform case of easing occupational entry restrictions from the most (Germany) to the least (Sweden) regulated country in the sample. See more details in the source.
Source: (Bambalaite, Nicoletti and von Rueden, 2020[12]).

Concerning firing costs, employment protection legislation (EPL) can be a key factor. EPL aims to protect workers from undue or unfair dismissals, forces firms to at least partly internalise the social costs related to layoffs, and provides stability for employees.[79] However, if set at too high levels, they can be detrimental to firm- and aggregate productivity through several channels. First, they reduce the ability of firms to adjust employment in the face of disruptions to technology or demand (Bassanini and Garnero, 2013[308]) (Bravo-Biosca, Criscuolo and Menon, 2016[309]), which lead to lower allocative efficiency across firms (Andrews and Cingano, 2014[107]) (Gamberoni, Giordano and Lopez-Garcia, 2016[198]) (Petrin and Sivadasan, 2013[310]). Second, as mentioned above under *Innovation, adoption and experimentation*, they prevent firms from experimenting with new business structures and organisational setups that entail different skill needs and hence a different worker composition.

The latest cross-country picture on EPL, captured by the updated OECD Employment Protection Legislation database (Chapter 3 of (OECD, 2020[311])), reiterates the important differences found between more loosely regulated English speaking countries and continental European ones, despite substantial reforms following the GFC in European several countries (including France, Greece, Italy and Portugal). These reforms were sometimes with the aim of reducing the dual nature of labour markets with large job protection differences between temporary and permanent employment contracts, which can exert an additional negative effect on productivity through the increased turnover linked with temporary workers (Hijzen, Mondauto and Scarpetta, 2017[312]) (Damiani, Pompei and Ricci, 2016[313]). The employment protection framework should be further balanced by providing the means for firms to adapt to changing economic conditions and ensuring worker protection. For instance, measures against unfair dismissals

[79] See a brief overview in a recent OECD Employment Outlook ((OECD, 2020[311]), Chapter 3).

and in particular their enforceability in practice are crucial in this respect, as well as sufficiently long notice periods combined with potentially lower severance pay (Chapter 3 of (OECD, 2020[311])).

Taxes and fiscal support related to capital allocation[80]

Macro, industry and firm level evidence all confirm the negative role that corporate income taxes reduce business investment ((Hanappi, Millot and Turban, 2023[93]), (Schwellnus and Arnold, 2008[314]) and see further references in (Égert, 2021[315])). There are important heterogeneities, however: highly profitable multinational companies, and larger firms in general, were found to be much less sensitive to changes in the tax rate (Zwick and Mahon, 2017[316]) (Millot et al., 2020[317]). Moreover, behind the statutory tax rate lies an increasing complexity of exemptions and depreciation schedules that can lead to substantially smaller effective tax rates. Partly thanks to these trends, the average sensitivity of investment to corporate tax changes have been reduced since the GFC, which warrants a careful calibration of the corporate tax system to take account of the significant heterogeneities across firms. (Hanappi, Millot and Turban, 2023[93]) provides a recent overview on the role of choosing the tax base, tax allowances to provide directed support for certain types of investments, and how to consider the Global Minimum Tax under the Global Anti-Base Erosion Rules.[81]

Environmental protection related regulations and incentives

Carbon pricing and environmental regulations are crucial to steer the green transition and ease the reallocation of resources towards more climate friendly – and often more advanced and more productive – technological solutions. The literature suggests that environmental regulations so far did not, on average, hurt productivity growth (OECD, 2021[30]) (Dechezleprêtre and Kruse, 2018[31]). Kalantzis and Niczyporuk (2021[.]) find a positive and causal relationship between energy efficiency investment and labour productivity in Europe. Higher effective carbon prices, as a result of emission trading schemes such as the EU ETS, do not seem to have had a negative impact on economic outcomes and even had a positive effect on capital intensity and revenues (Dechezleprêtre, Nachtigall and Venmans, 2023[319]) (Venmans, Ellis and Nachtigall, 2020[320]). The EU ETS is also estimated to have improved innovation in low carbon technologies of regulated firms, as measured by patenting activities, by as much as 10 to 30% (Calel and Dechezleprêtre, 2016[321]). Even so, optimal policy would combine carbon taxes with research subsidies (Acemoglu et al., 2012[29]).

Most ex-post empirical assessments of the carbon pricing impact on competitiveness in OECD and G20 countries in the electricity and industrial sectors find no significant *average* effects of carbon pricing or energy prices on turnover, value added, employment, profits, foreign direct investments, productivity or innovation (Ellis, Nachtigall and Venmans, 2019[322]). However, average responses to environmental policy measures hide important heterogeneities: firms and industries with initially high productivity managed to adjust well and raised their productivity after tightening environmental policies, whereas those with low productivity tended to become less productive. Some of the least productive firms may be driven out of the market, with a positive impact on aggregate productivity estimates (Albrizio, Kozluk and Zipperer, 2017[318]) (Figure 31).[82] Moreover, the conclusions of the literature should be taken with caution, as greater price increases and wider price differences across countries could yield different effects and as exemptions to

[80] For attracting investment to specific locations through place-based incentives, see Section 4.3 under Capital.

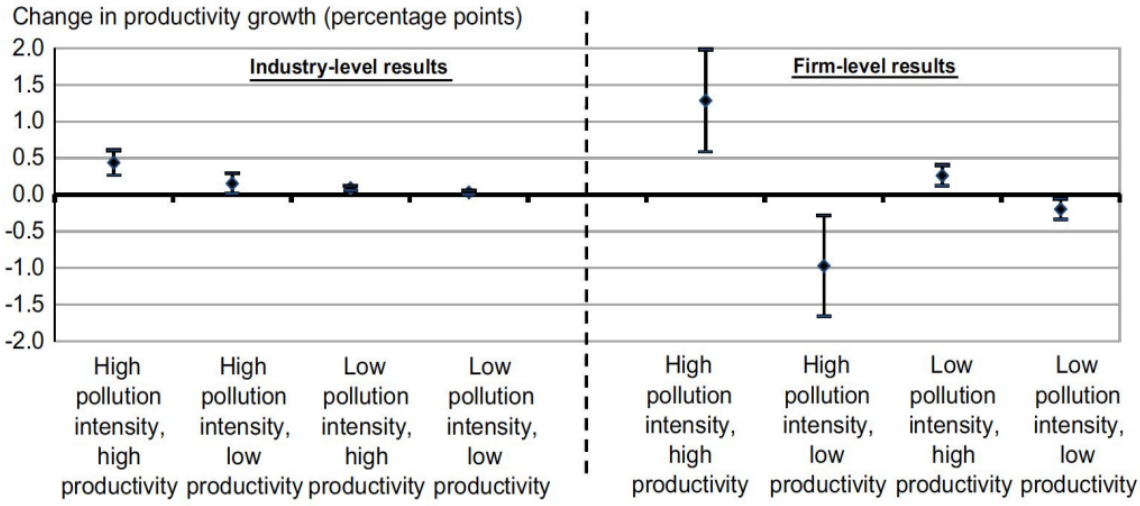
[81] These rules were agreed upon in the OECD's initiative to limit Base Erosion and Profit Shifting in (OECD, 2015[497])) which are meant to put a break on international tax competition and avoid tax revenue losses due to international profit shifting.

[82] On the impact of firm survival on productivity estimates, see Greenstone, List and Syverson (2012[.]).

carbon taxes for industry or generous levels of free allowances to firms covered by emissions trading schemes have often blunted price signals.

To help with the adjustment to higher energy prices, governments would do well to incentivise firm-level decarbonisation by letting price signals on fossil fuel energy operate, especially in expansionary periods of the business cycle when the cost of adjustment is lower (André et al., 2023[243]). Further, governments should reduce policy uncertainty, improve predictability of retail energy prices, and increase awareness of environmentally related challenges and solutions through environmental policy. As environmental policy is becoming more stringent, banks are becoming more rewarding – offering more favourable credit conditions – towards greener firms, thus easing their financial constraints and thus contributing to the investment needs underlying the green transition (D'Arcangelo et al., 2023[323]).

Figure 31. Empirical evidence: small effects on aggregate, heterogeneous impacts across firms, and within-sector reallocations



Note: One-year effect of a mean in-sample increase in environmental policy stringency, i.e. 0.12 change in the value of the EPS index in one single year. Effects on productivity growth are estimated to last for three years after the policy change and then fade away:
Source: (Albrizio, Kozluk and Zipperer, 2017[318]).

4.3. Capabilities

This section discusses policy areas to improve the capabilities of the business sector. They are complementary to those affecting mainly incentives, and cover areas where governments have a more direct role in creating better conditions for productivity improvements. They are discussed along the supply side components of output: MFP, capital (physical and intangible) and labour (human capital). Even though labour (employment and hours worked) and capital are production inputs and hence are not part of MFP *per se*, they are still relevant for aggregate (labour) productivity in various ways. First, their quality can impact measured productivity; second, the reallocation of labour and capital towards more productive firms can impact *aggregate* productivity; third, capital intensity directly impacts labour productivity. Table 3 presents a high-level summary, building on the framework shown in Table 1.

Table 3. Public policies affecting the capabilities of firms and workers to become more productive

	Policies that improve capabilities		
Impacts mostly on:	Mostly through MFP *Expanding innovation and adoption capabilities*	Mostly through capital *Enabling private investment and providing public infrastructure*	Mostly through labour *Improving human capital and better matches to jobs*
Firm level productivity *near or at the frontier*	**Creating knowledge** through basic research and collaboration: - Promote talent development for potential inventors - Prioritise public innovation funding for basic research due to greater positive externalities - Facilitate collaboration between academia, public sector and businesses	Enabling **high risk** investments (especially) in intangible assets: - Develop deep equity markets, including venture capital - Extend collateral availability by ensuring intellectual property is pledgeable - Consider allowing institutional investors to invest in intangible-based businesses	**Education** system: providing strong foundational skills and basic qualifications: - Elevate educational standards and effectiveness given the importance of the quality of foundational skills, starting from the pre-primary level - Raise the autonomy of educational institutions combined with external accountability and optimise student-to-teacher ratios. - Scars from the pandemic and adapting to advanced, cognitive AI requires ongoing evaluation and supportive interventions, with a shift towards critical thinking Adult **skills and management quality**: keeping them up-to-date by training and lifelong learning: - Ensure training aligns with market needs and provides flexible options - Offer combined training in technical and social skills - Provide targeted support for lower-skilled, unemployed, and older populations - Enhance managerial skills through subsidised training programs
Firm level productivity *below the frontier*	**Diffusing knowledge** both across and within national boundaries: - Attract and leverage FDI for knowledge transfer - Strengthen the absorptive capacity of domestic firms, especially SMEs - Enhance the adoption of digital technologies by ensuring quality digital infrastructure	Reducing barriers to **private investments:** - Reduce the corporate tax bias that favours debt over equity financing - Aim to reduce the cost of financial intermediation, including by encouraging the digitalisation of the financial sector Providing quality **infrastructure** with a place-based focus**:** - Ensure high quality infrastructure in network sectors (transport, energy and telecommunications) given their important externalities - Prioritise localised, decentralised efforts, while ensuring coordination among administrations - Pursue place-based policies to create healthy regional ecosystems, including university-driven knowledge networks Enabling **green investments:** - Establish clear and predictable regulatory frameworks for the climate transition - Incentivise consumer and industrial demand for green products - Monitor potential crowding-out effects as public green investment expands	
Allocation of resources *across firms with different productivity levels*			Enabling **mobility** to deliver productive job-to-worker matches: - Foster hiring practices based on actual skills by recognising acquired competences - International migration can also help addressing labour shortages, accompanied by active monitoring and evaluation - Limit use of non-compete clauses - Reduce housing costs in productive places, notably by easing land-use restrictions - Improve transport connectivity

Note: For more details and specific recommendations and country examples, see the main text in Section 4.2.

4.3.1. MFP: expanding innovation and adoption capacities

Creating knowledge through basic research and collaboration

Having in place the right incentives for investing in innovation should be accompanied by having in place an innovation ecosystem on which firms can draw on. First, it is crucial to enable potential future inventors to develop their talent and pursue careers to generate novel ideas (Bell et al., 2018[324]). There is a large pool of underexploited human capital, both along gender (only 12% of women are investors, (Brouillette, 2023[325])) and income (Bell et al., 2018[324]), which hurts both productivity and inclusiveness. Second, resources allocated to innovation support should put relatively more emphasis on basic research and less on applied research, given the broader economic benefits that basic research can potentially have and the lower appropriability that may result in stronger under-supply by firms (Akcigit, Hanley and Serrano-Velarde, 2020[152]) (Czarnitzki and Thorwarth, 2012[326]) (Griliches, 1986[327]). Stronger support to basic research includes funds allocated to firms – especially as they have been doing less and less of it for various reasons (Section 3.1) – as well as to academia and public research centres. Beyond generating new knowledge, recent work for the United States found that the near presence of research universities are found to be an important driver of the creation of local high quality entrepreneurship (Tartari and Stern, 2021[328]), with similar previous findings more globally (Valero and Van Reenen, 2019[329]). Specific institutions – often sponsored by governments – also play a role in preserving and providing access to scientific knowledge, as discussed by (Mokyr, 2011[330]) and demonstrated by a specific example in biological research in the United States by (Furman and Stern, 2011[331]).

Third, collaboration between basic research provider institutions – typically academia and the public sector – and the business sector should be encouraged and facilitated. Indeed, new knowledge is often created through collaboration efforts across several actors of the innovation system, as some innovations are either too complicated to carry out by academia alone or not applied enough to be conducted by the corporate sector (see more in Section 3.1 under *Innovation*). Such collaboration can benefit from university connections with the global knowledge frontier and to provide firms with access to research labs, knowledge and human talent. The share of academic research by businesses was found to be associated with faster catch-up of industries with the global frontier, possibly through the more intensive adoption of foreign advanced technologies (Saia, Andrews and Albrizio, 2015[332]). Conversely, governments can also promote the commercialization of academic inventions by encouraging the setup of technology transfer (or technology licensing) offices (OECD, 2015[3]).

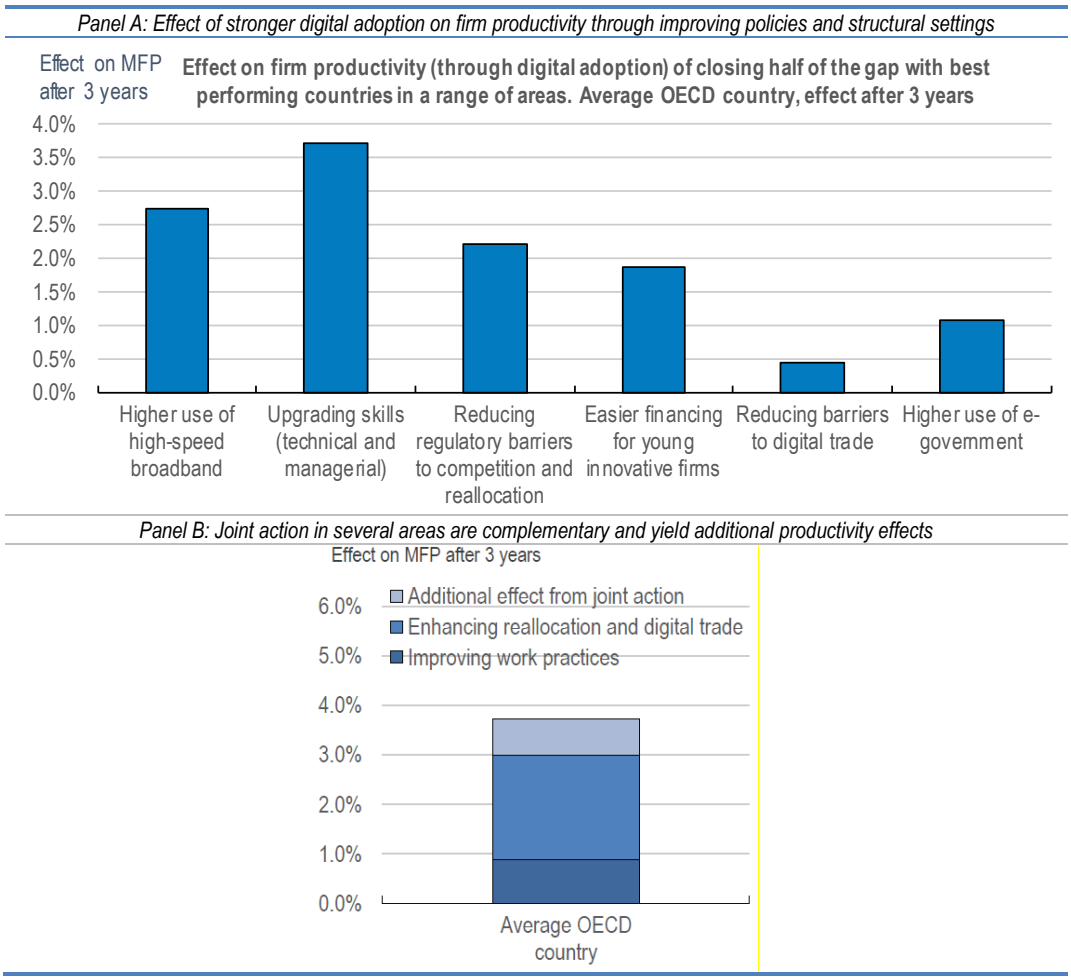
Diffusing knowledge across businesses

Frontier knowledge created through innovation and embedded in the latest technologies and business practices should diffuse in the economy across firms to create broad-based productivity benefits. This involves domestic and international knowledge flows, both through supply-demand relationships as in trade but also through technology transfers via investments (Perla, Tonetti and Waugh, 2021[333]; Akcigit and Melitz, 2022[214]) (Buera and Oberfield, 2020[334]) (Ayerst et al., 2023[335]) (Keller, 2010[336]).

Beyond creating a favourable business environment to attract FDI, policies can affect a country or region's ability to translate FDI into productivity gains through enhancing the absorptive capacity of domestic firms, notably SMEs (OECD, 2022[220]). This is essential to limit duality between a high-productivity export-oriented sector and a low-productivity inward-looking sector. Lean product market regulations and trade openness support competition, learning effects and the integration of local suppliers into GVCs. Labour market regulations, active labour market policies and investments in human capital can prevent labour shortages (Becker et al., 2020[337]) and facilitate knowledge spillovers through workers' mobility. Access to finance is also essential for SMEs to integrate into international production networks and innovate. Quality infrastructure, including digital, also facilitates linkages between foreign firms and the domestic economy. Some countries, like Costa Rica, Portugal and Türkiye have also developed technical support programmes to strengthen the absorptive capacities of domestic firms and especially SMEs (OECD, 2022[220]).

Figure 32. A range of policies can support productivity through digital adoption

The impacts of public policies on MFP through spurring digital technology adoption



Note: Panel A shows the estimated effect on multi-factor productivity (MFP) through the adoption of selected digital technologies (Enterprise Resource Planning, Cloud Computing, Customer Relationship Management Software and High-Speed Broadband) of the average firm as a result of changes in policy and structural settings. Panel B presents the estimated effect on multi-factor productivity (MFP) of the average firm (through digital adoption) from improving work practices and reduced regulation strictness in areas related to reallocation (employment protection legislation, administrative burdens on start-ups) and barriers to digital trade. For each of the underlying policy and structural indicators, it is assumed that half of the gap to the best performing country in the sample is closed. For more details, see the sources.
Source: (Sorbe et al., 2019[14]) based on (Nicoletti, von Rueden and Andrews, 2020[19]) and (Gal et al., 2019[338]).

A prime example of technology diffusion is the spread of digital technologies, which is far from complete (see Section 3.1 under *Diffusion*, in particular Figure 10). Various policies have been identified that can spur the more widespread adoption of digital tools (Nicoletti, von Rueden and Andrews, 2020[19]) and in turn help with the productivity catch-up of lagging firms (Gal et al., 2019[338]) (Figure 32Figure 32). Most importantly, an enabling infrastructure should be in place that ensures high-speed broadband connectivity (see more below under *Capital)*. Upgrading technical and managerial skills (see more below under *Human capital*), reducing regulatory barriers to competition (see more in Section 4.2 under *Incentives*) and easier access to finance for young and innovative firms (see more below under *Capital*) are also crucial drivers. Moreover, there are also important complementarities across some of these domains, in particular better management practices translate into higher productivity through digital technologies when combined with

a policy environment that allows for a smooth reallocation of resources (flexible labour and product markets) (Pisu et al., 2021[15]; Sorbe et al., 2019[14]).

4.3.2. Capital: enabling private investment and providing public infrastructure

Enabling high risk investments (especially) in intangible assets

Access to equity capital[83], especially for young firms, is essential to support innovation and productivity growth (Samila and Sorenson, 2011[339]); (Andrews, Criscuolo and Menon, 2014[340]); (Corrado et al., 2021[140]). The asymmetry in the tax treatment of debt and equity is hampering more innovative and intangible firm financing (Haskel and Westlake, 2022[125]) (Kaousar Nassr and Wehinger, 2016[341]) (Demmou and Franco, 2021[16]). Well-developed venture capital markets, as well as reduced debt bias in corporate tax systems, are associated with higher MFP growth for firms below the frontier, suggesting that equity financing can be an important driver of technological diffusion as well (Andrews, Adalet McGowan and Millot, 2017[13]).[84] Debt accumulated during the COVID-19 pandemic may make debt financing more challenging and raise further the need for equity finance (Demmou et al., 2021[342]).

Financing investments in intangible assets, which are increasingly important for productivity growth, is generally more challenging than acquiring tangible assets, due to the specific characteristics of intangibles, such as valuation uncertainty and the difficulty to pledge them as collateral (Demmou, Franco and Stefanescu, 2020[343]). More favourable financing conditions raise productivity both through a within-firm and a between-firm (allocative efficiency) effect generating more intensive labour reallocation towards more productive firms, an impact that is found larger in intangible intensive sectors than in traditional ones (Demmou and Franco, 2021[16]).

More developed financial markets and especially deeper equity markets, enhance productivity more in intangible-intensive firms than in others (Figure 33, Panel A). A lack of tangible assets usable as collateral constrains investment financing through banks. Accordingly, the productivity benefits from collateral are much larger in high than in low intangible-intensive firms (Figure 33, Panel B). Policies can foster intangible investment financing by extending collateral availability for intangible intensive firms through ensuring intellectual property – patents, trademarks, copyrights and design rights – is pledgeable when seeking bank credit.[85] Moreover, policy measures should also aim for setting appropriate framework conditions for deepening equity markets where they are underdeveloped. They can also increase incentives for investment in more long-term focused and productive capital and encourage the development of venture capital (Demmou and Franco, 2021[16]). In the United States, changes to pension fund investment regulations in 1979 allowing wider portfolio diversification, made a significant contribution to the growth of venture capital (Lerner and Nanda, 2020[344]). Reforms allowing pension funds and insurance companies to invest in intangibles-based companies should be contemplated by other countries (Haskel and Westlake, 2022[125]). More generally, higher institutional ownership of firms tends to be associated with higher productivity levels and growth, but the relation vanishes when institutional investors' time horizon is short. Policies could address short-termism through tax provisions, competition-friendly regulations and guidelines affecting compensation schemes (Bas et al., 2023[169]). [86]

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[83] (Demmou and Franco, 2021[16]) provide a recent overview of the topic.

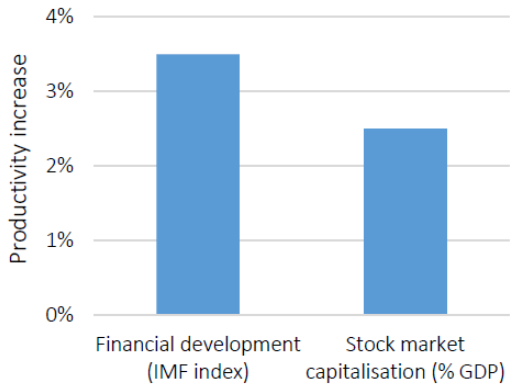
[84] For country examples with successful venture capital systems, see Annex D of (Demmou and Franco, 2021[16])

[85] For fine-tuning such an IP-backed loan system to smaller companies with more limited capacities, as well as for aligning the incentives of banks with such practices, see more discussion in (Demmou and Franco, 2021[16]).

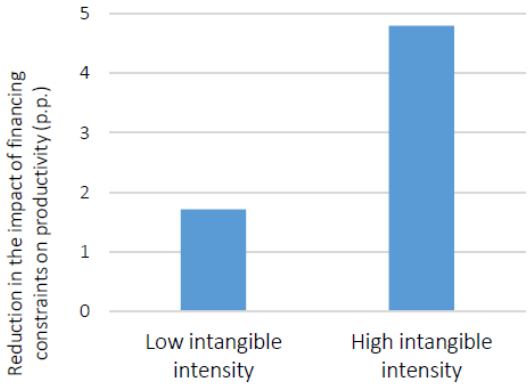
[86] For a recent summary of various policy channels on investment, see (Égert, 2021[315]).

Figure 33. Improving financial systems promises strong productivity benefits, especially in intangible-intensive sectors

Panel A: Financial development and in particular deep equity markets foster productivity in intangible-intensive sectors



Panel B: Increasing collateral availability raises productivity through reducing the impact of financial constraints, especially in intangible intensive sectors



Note: Panel A shows the productivity gains in high relative to low intangible-intensive sectors following a one standard deviation increase in the financial development index or the ratio of stock market capitalisation to GDP. Panel B shows the reduction in the impact of financing constraints on productivity by raising collateral availability in percentage points, separately for firms with low and with high intangible intensity. See more details in the sources.

Source: (Pisu et al., 2021[15]) based on (Demmou and Franco, 2021[16]). IMF Financial development index: (Svirydzenka, 2016[345]). Financial constraint index: (Demmou, Franco and Stefanescu, 2020[343]).

Despite venture capital's strong contribution to financing high growth firms, its ability to finance substantial disruptive innovation remains limited, as it focusses on very narrow range of technological innovations (especially software, digital services, and biotechnologies), its orientations are set by a small number of investors, and active involvement in portfolio companies seems to have weakened in the United States over recent years (Lerner and Nanda, 2020[344]). "Deep tech innovations", which are facing both technical and commercial challenges, are disadvantaged in a startup-based innovation system, because they do not fully capture the value they create (Arora, Fosfuri and Roende, 2022[346]). Hence, interventions to facilitate access to venture finance need to be complemented by other policies to foster disruptive innovation such as fiscal incentives and public procurement (see Section 4.2).

The expansion of digital financial services can raise productivity in downstream industries, especially those relying on intangible assets (Bontadini et al., 2023[347]). Fintech provides opportunities to widen access to capital and help financing innovation. However, despite technological advances, the cost of financial intermediation has declined only marginally since the GFC. Reaping the potential benefits of Fintech may require changes in financial regulations to encourage the entry of new firms and the setup of efficient and transparent intermediation and trading systems (Philippon, 2017[348]).[87]

Providing quality infrastructure, with a place-based focus

Quality infrastructure raises productivity by lowering firms' costs and offering them access to better quality and more diversified inputs, as well as through network effects. Efficient transport infrastructure and high connectivity broaden product markets, allowing more competition and economies of scale, provide access to a wider pool of workers (through mobility or remote work, see further below under *Human capital*) and

[87] See more on the potential of Fintech technologies (such as blockchain or crowdsourcing) for start-up financing in Annex E of (Demmou and Franco, 2021[16]).

facilitate knowledge spillovers (Demmou and Franco, 2020[349]). Nevertheless, the private sector tends to undersupply infrastructure, as social benefits generally exceed private returns, due to non-rivalry in consumption and/or non-excludability in use. Hence, public investment is necessary to reach the socially optimal level of infrastructure (Fournier, 2016[350]); (Ramey, 2020[351]). [88] In addition, by boosting job creation, public investment can mitigate income inequality (OECD, 2016[7]).

Government investment can crowd in private investment by improving conditions for doing business. However, it can also crowd it out through higher interest rates and capital good prices. The literature suggests that on average public infrastructure has a positive impact on output and productivity, especially in the long run ((Égert, Koźluk and Sutherland, 2009[352]); (Bom and Ligthart, 2014[353]) ; (Ramey, 2020[351])).[89] However, impact estimates vary widely across studies. This partly reflects differences in data samples and methodology, but other factors are essential. The impact of public investment on aggregate productivity depends on the productivity of public capital, the level of infrastructure relative to the social optimum and the way investment is financed ((Ramey, 2020[351])).

The type of capital matters. Core infrastructures (roads, railways, airports and utilities) are generally found to have a greater growth impact than other public capital (Bom and Ligthart, 2014[353]); For example, several studies point to a large long-run impact of the US Interstate Highway programme on output and productivity in the 1950s and 1960s (Aschauer, 1989[354]); (Fernald, 1999[355]); (Leduc and Wilson, 2013[356]). (Égert, Koźluk and Sutherland, 2009[352]) highlight the importance of network sectors (roads, motorways, railways, electricity and telecommunications), which generate externalities and economies of scale. Sound governance and pro-competitive regulatory and ownership policies in these sectors are associated with significantly higher productivity growth in downstream sectors.[90]

Digital infrastructure is essential to allow firms to boost their productivity through the adoption of new digital tools (See Section 3.1), exploit new opportunities for trade in services (See Section 4.2) and reinforce their integration in global value chains (See above under *MFP*). OECD estimates suggest that a 10-percentage point increase in the share of firms using high-speed broadband internet at the industry level is associated with a 1.4% increase in multi-factor productivity for the average firm in the industry after one year, and 3.9% after three years (Gal et al., 2019[338]). Internet access is almost universal in OECD countries, but access to broadband remains limited in some countries, notably in remote and rural areas. Pro-competitive reforms in telecommunication sectors, such as encouraging the emergence of new entrants or enabling infrastructure sharing, can reduce prices and in many cases also spur investment (OECD, 2019[357]). To increase coverage in rural and remote places, governments may need to invest directly in high-speed networks or subsidise private investments in networks, using call for tenders (OECD, 2018[358]).

National and sub-national investment programmes may also have different effects on productivity. The literature suggests infrastructure investment by local or regional governments yields on average higher long-term gains than central government investment (Bom and Ligthart, 2014[353]). Widening regional

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[88] The use of public-private partnerships (PPPs) affects some of these dimensions. A recent review on the merits of PPPs concludes that the evidence is mixed regarding their attractiveness as compared to other alternatives of either government service provision or full privatisation, due to the difficulties of designing long-term contracts that stand the test of time, and this might become even more so given more frequent shocks related to climate change (Fabre and Straub, 2023[458]). The critical role of contract design is also emphasized by (Demmou and Franco, 2020[349]).

[89] (Ramey, 2020[351]) suggests the aggregate production function elasticity of output to public capital is probably between 0.065 and 0.12. Performing a meta-analysis of 68 studies for the 1983-2008 period, (Bom and Ligthart, 2014[353]) report a long-run elasticity of 0.122.

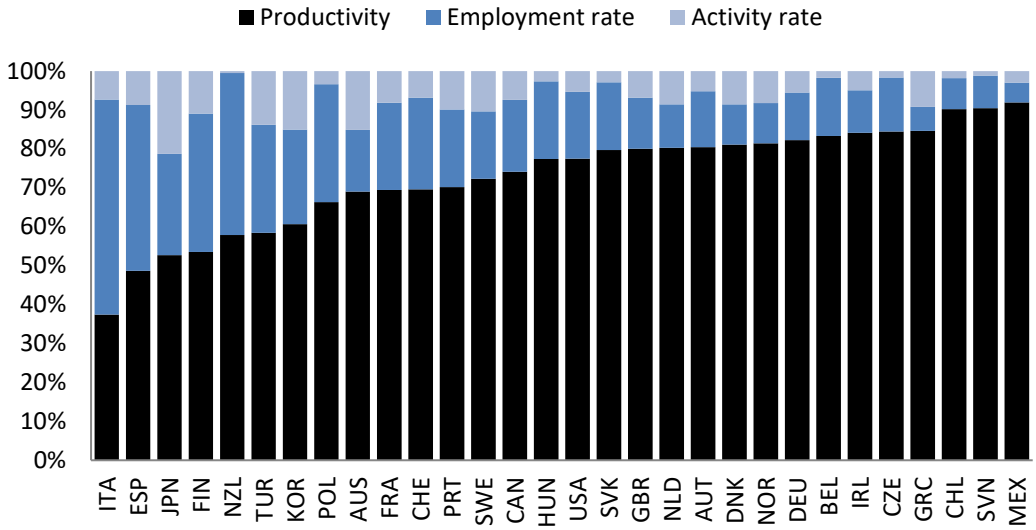
[90] For example, raising governance quality from a relatively low (e.g. Portugal) to a relatively high standard (e.g. Finland) is associated with a 0.24 percentage point increase in yearly productivity growth over ten years for the average firm in an average infrastructure-dependent sector (Demmou and Franco, 2020).

economic disparities over the past decades in most OECD countries (Blöchliger, Bartolini and Stossberg, 2016[359]) and associated social and political tensions have revived interest in regional or local productivity drivers and place-based policies ((Shambaug and Nunn, 2018[360]); (Ausrin, Glaeser and Summers, 2018[361]); (Grover, Lall and Maloney, 2022[362])).

Differences in productivity are the main driver of regional disparities in GDP per capita in most countries (Figure 34). Some productivity determinants like agglomeration, infrastructure and geography, are intrinsically localised, but even other factors, such as human capital, labour regulations and industry-level innovation and dynamism, have a spatial dimension (Tsvetkova et al., 2020[62]). Several studies find a positive association between the degree of decentralisation and economic activity and productivity (Lessmann, 2009[363]); (Blöchliger, Bartolini and Stossberg, 2016[359]). Nevertheless, coordination between local administrations is also essential. Fragmented metropolitan governance structures tends to lower levels of productivity (Ahrend et al., 2017[364]).

Figure 34. Differences in productivity drive regional disparities

Decomposition of disparities in regional GDP



Note: Disparities in regional GDP per capita are decomposed into the contributions of labour productivity (GDP per worker), labour resource utilisation (those employed as a share of the active working population) and the activity rate (per cent of the active working population in total population).
Source: Blöchliger et al. (2016).

Place-based policies – spatially targeted government interventions to enhance economic performance in particular geographical areas – have received renewed attention in recent years, although past records are mixed ((Shambaug and Nunn, 2018[360]) (Grover, Lall and Maloney, 2022[362])).[91] Assessing the impact of place-based interventions on overall productivity is challenging, both because of the lack of counterfactual to assess local productivity developments and due to the difficulty of evaluating their potential (positive or negative) impact on other areas. Recent studies suggest place-based policies may be worth considering where economic fundamentals are already promising (Grover, Lall and Maloney, 2022[362]) and where they build on the inherent forces, competitiveness, and comparative advantages of places (Navaretti and Markovic, 2021[365]). To boost productivty, policies aiming at strenghtening regional

[91] Place-based policies use a wide range of instruments, such as job creation programmes in disadvantaged areas, special economic zones with favourable tax and regulatory treatment and support for industry clusters.

innovation ecosystems need to take into account existing capcities, adress bottlenecks and institutional barriers, and involve extended commitments by multiple stakeholders (Guzman et al., 2023[366]).

Productivity and employment outcomes vary between place-based policy types. For example, well-targeted discretionary subsidies, infrastructure spending and investment in higher education and university research can raise productivity (Neumark and Simpson, 2015[367]). Across OECD countries, universities play a major role in regional growth. They stimulate the creation of knowledge networks, often support entrepreneurship and young firms, and help build and retain local skills. This generates business dynamism, capacity to absorb knowledge, and helps attract and retain skilled workers and companies, thereby raising productivity (Tsvetkova et al., 2020[62]).[92]

Enabling green investments

Carbon pricing provides incentives for green investment (Section 4.2), but other policy settings may constitute obstacles. Clear, coherent and reliable frameworks are also necessary for green investment to pick up. Climate policy uncertainty is associated with lower investment, particularly in pollution-intensive sectors that are most exposed to climate policies, and among capital intensive companies (Berestycki et al., 2022[298]). A stable and predictable regulatory environment is crucial for long term investments related to the climate transition, including physical assets such as energy supply facilities, but also intangibles such as R&D on new and more efficient energy producing and transporting technologies. Cumbersome and lengthy licensing, permitting and patenting procedures hamper the development of green and low-carbon projects in many countries (Ang, Röttgers and Burli, 2017[368]) (McKinsey & Company, 2022[369]).

Governments can encourage private green investment by supporting future demand. For example, incentivising consumer and industrial demand for solar energy and electric cars allows suppliers to scale up production and increase productive efficiency. Support for complementary investments – e.g. charging stations – can also help scaling up and generate powerful spillovers.

Government support to the green transition has increased markedly in the wake of the COVID-19 crisis. Support measures involving government spending toward low-carbon technologies amounting to USD 1.29 trillion across 51 OECD, EU and G20 have been identified, even though the coverage may not be complete. These measures could reduce greenhouse gas emissions by 11% by 2050 in OECD and EU countries, while R&D investment and learning-by-doing would lift productivity, driving a rise in GDP of 1.1% in the European Union and 0.4% in the United States by 2035 (Aulie et al., 2023[370]). Public green investment may crowd in private investment in green sectors. However, green investments also risks crowding out investments in other sectors, especially as they are currently still insufficient to reach net zero emissions by 2050. Potential crowding-out effects will need to be monitored closely as environmental regulations become more stringent.[93]

4.3.3. Human capital: education, skills and better matches to jobs through mobility

High quality human capital is a prerequisite for strong and sustained economic growth, as has been shown in a vast and long-standing body of literature at both the macro- and micro level (see (Deming, 2022[371]) and (Flabbi and Gatti, 2018[372]) for recent summaries and (Becker, 1964[373]) as an early seminal

[92] For example, strong effects of post-secondary education decentralisation on the average productivity of Swedish workers are found, suggesting a meaningful impact on regional development (Andersson, Quigley and Wilhelmson, 2004[521]). On the positive role of research universities on high quality entrepreneurial activity in the United States, see (Tartari and Stern, 2021[328]).

[93] A negative effect on productivity could arise from the reallocation of resources towards low-productivity sectors, like construction, in response to measures to enhance the energy efficiency of buildings.

reference). It explains at least half of global variation in income per capita across countries (Deming, 2022[371]).[94] As for firms, recent work by the OECD Global Forum on Productivity using linked employer-employee data has quantified the joint impact of the *human side* – including not only standard human capital elements, such as skills, but also diversity. It found that it accounts for about a third of the gap between leading (near the top of the distribution) and typical firms within industries (near the median level of productivity) (Figure 35) (Criscuolo et al., 2021[17]).[95] As noted by this study, public policies should rest on several pillars to enable firms to catch-up by improving human capital, through pursuing three broad objectives: (1) increase the supply of skilled employees, (2) facilitate the skill upgrading of the existing workforce, and (3) improve the matching between the existing supply of employees and the firms' demands. Indeed, improving the supply without promoting upgrading and allowing for better matching may disproportionately benefit high-productivity firms who are better able to attract talent. Conversely, a focus on skill development, especially of the lower skilled and those that are underrepresented in the labour force, and improving the mobility of workers into more productive matches with better paid jobs can yield double dividends not only raising productivity, but also improving inclusiveness. Given this multi-pronged nature of boosting human capital, the discussion below proceeds along these three dimensions: providing foundational skills and specialised expertise through the education system; updating and adjusting adult skills; enabling the geographic mobility to facilitate productive job-to-worker matches.[96]

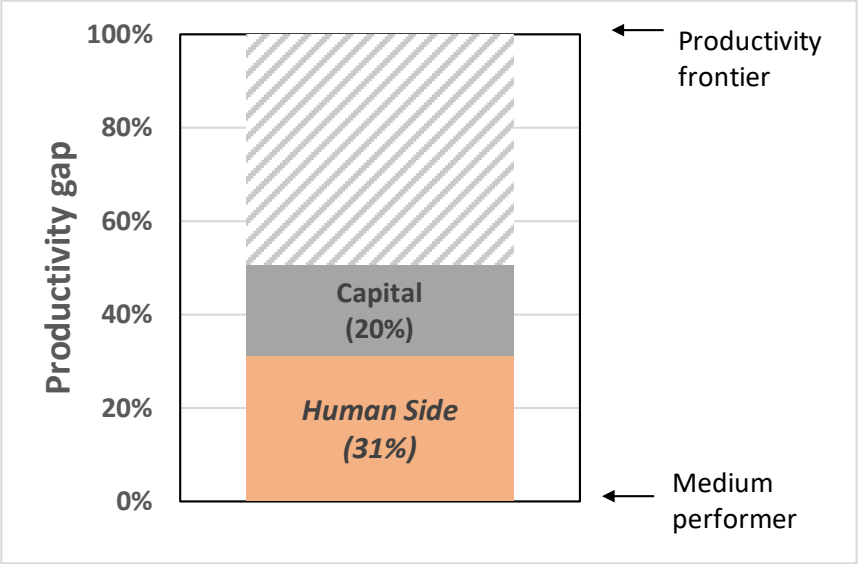
[94] Evidence presented by (Caselli, 2005[504]) questions the importance of accounting for input quality, including human capital and health, for explaining the large cross-country differences in output per capita. However, with more refined measures of human capital, accounting for the role of the experience of workers, and with different assumptions about the nature of the aggregate production function regarding skill types, this conclusion has been challenged (Jones, 2014[507]) (Hendricks and Schoellman, 2023[505]) with counter-arguments from (Caselli and Ciccone, 2019[506]). This debate surrounding the exact contribution of human capital highlights the role of improved measurement in explaining a larger and larger fraction of productivity differences, as well as the role that different theoretical assumptions can play in the attribution of observed productivity differences to inputs or the residual (see similar issues about capital, in particular linked to the rise of intangibles, in Section 2.2, footnote 13).

[95] The role of the skill composition for firm level productivity is also documented using similar granular data by recent studies in the United States (Blackwood et al., 2022[454]) and Sweden (Pagano et al., 2022[531]).

[96] Yet another human capital dimension that is significant for growth, especially when considering developing economies – but which was exposed more globally by the pandemic –, is health and the role of health care systems. For a seminal work on the benefits of health for output per worker, see (Well, 2007[501]); previously (Bloom, Canning and Sevilla, 2004[503]) documented similar benefits.

Figure 35. Upgrading the Human Side can help to close the productivity gap

Estimated productivity gains from adjusting workforce and managerial skill composition to those firms at the frontier (as a fraction of the average productivity gap of medium performer firms from the frontier)



Note: The figure shows the contribution of productivity enhancing adjustments of the workforce composition and capital intensity respectively to the catch up of a typical medium performer towards the productivity frontier in the same industry and country. See more details in (Criscuolo et al., 2021[17]).
Source: (Criscuolo et al., 2021[17]) in the context of the *Human Side of Productivity* project of the GFP.

Strong foundational skills and solid basic qualifications through well-functioning education systems

Foundational skills – such as literacy, numeracy, and problem-solving abilities – lay the ground for all subsequent learning and professional endeavours, and play a crucial role in obtaining basic qualifications. The OECD's Programme for International Student Assessment (PISA, see (OECD, 2019[374])) has been instrumental in helping governments with assessing the quality of such skills through comparing student outcomes across countries, along with several aspects of the education systems. Another influential international benchmarking exercise is the Survey of Adult Skills (PIAAC, (OECD, 2019[375])). Both of these surveys provide a rich source of information and help refining the evidence base about education and growth at the macroeconomic level, which had traditionally been based on the average *quantity* of education (measured by enrolment or completed years in schooling, see (Barro, 1991[376])).[97] Indeed, a recently developed novel macroeconomic human capital measure based on a cohort-weighted aggregation of PISA and PIAAC indicator scores shows that the quality matters substantially (3-4 times) more than the quantity of education for macro-level productivity (Égert, de la Maisonneuve and Turner, 2022[377]), in line with the conclusions of (Hanushek and Woessmann, 2008[378]). Improving the quality of foundational skills through educational policies would also be complementary to future training effectiveness (see below under *Adult skills*).

In terms of the specifics of the education system, recent work by (Égert, Botev and Turner, 2020[379]) has identified a number of features that are linked with better outcomes. First, higher attendance at *pre*-primary

[97] A broader measure of human capital, covering developing countries and health outcomes, see the recent World Bank initiative the Human Capital Index (Kraay, 2019[502]); also (Barro and Lee, 2013[485]) for a more traditional measure on educational attainment.

education; second, greater autonomy of schools and universities, in particular in countries where schools are subject to external accountability; third, a lower student-to-teacher ratio; fourth, a high age of first "tracking" in secondary education (i.e. the practice of separating students into different types of schools based on ability or achievement); and fifth, low barriers to funding to students in tertiary education. The growth dividends of education systems with such features were also found to be higher in response to an increase in public spending on education.

Going forward, it is important to take account of and address steps to heal the COVID-19-induced scar on the performance of students (see evidence from the United States by (Halloran et al., 2023[380]) (Betts et al., 2021[381]) and internationally by (de la Maisonneuve, Égert and Turner, 2022[382])). 24 out of 30 countries with available data implemented national programmes at the primary to upper secondary level to give students additional support in the school year 2021/22, though the proportion is lower (19 out of the 28) at pre-primary levels, followed by general a scaling back foreseen for 2022/23 (OECD, 2022[383]). Evaluating the effectiveness of such measures and adjusting them is crucial, given the higher propensity of students to drop out or have learning difficulties with potential adverse impacts in the longer term (Thorn and Vincent-Lancrin, 2021[384]).

The pandemic-induced challenge is compounded by another, technology-driven one: the rise of generative, human language-based AI models that increasingly assist with tasks covering nearly the full spectrum of tasks, not only routine but cognitive ones alike. They may necessitate a radical rethinking of the education systems, including tertiary education, to provide complementary skills (OECD, 2023[23]). This may involve more emphasis on developing critical thinking and evidence-based research skills, which in turn helps to discriminate between the quality and reliability of content proposed by AI, as well as to learn prompting the right inputs – or questions, in the case of human language-based systems – to maximise the usefulness of AI outputs.[98]

Adult skills and management quality: keeping them up-to-date by training and lifelong learning

The strong role of experience and learning by doing as a complement to the initial skillset provided by the education system has been long recognised (Arrow, 1962[385]) (Mincer, 1974[386]) and also confirmed relying on more recent granular data (Caplin et al., 2022[387]). However, on-the-job learning alone may not be sufficient to meet the challenges of the rising reallocation and reskilling needs in the economy (see Section 3.1) and should be accompanied by more active efforts to update or refocus skills. Indeed, the green transition and the further rise in digitalisation will require new skills throughout the economy even in the short to medium run, calling for updating not only education curricula but in particular stepping-up reskilling and upskilling efforts (OECD, 2023[388]). These structural changes may likely involve stronger reallocation (see Section 3.1 and below under *Mobility*), hence mitigating the negative labour market effects from firm-closure related dismissals is also important, a goal to which training can also contribute (Andrews, Ferrari and Saia, 2018[389]).

As such, lifelong learning and adult training more specifically is a priority, especially given the low fraction of workers taking part in training (ranging from 5 to 20% across OECD countries) and the even lower numbers among lower skilled or lower paid workers, despite the unequivocal productivity benefits that have been demonstrated in various settings (see evidence from Belgium by (Konings and Vanormelingen, 2015[390]), from Italy by (Conti, 2005[391]), from the Netherlands by (De Grip and Sauermann, 2012[392]) and from the UK by (Dearden, Reed and Van Reenen, 2006[393])). Boosting the training and training

[98] Borgonovi et al. (2023[.]) show that leading firms – those who post most AI jobs – exhibit a higher demand for AI professionals combining technical expertise with leadership, innovation, and problem-solving skills.

effectiveness requires a joint focus on three actors simultaneously: individuals, companies, and training providers (OECD, 2019[282]).

In particular, training should be more closely aligned with labour market needs, and the quality and effectiveness of training could be improved by providing quality labels to guide workers and firms. Working to achieve a wide range of flexible and modular adult learning options available, so as to make the take-up of trainings easier to reconcile with working lives, is a priority as well (OECD, 2023[394]; OECD, 2019[282]). Accordingly, financial incentives to businesses and employees should also cover and favour more flexible learning options. Moreover, providing stronger targeted support for the low skilled, the unemployed, migrants and older people[99] is critical, given their lower take-up rates, generally greater need for and more difficulties in upgrading skills (Andrieu et al., 2019[395]). The positive productivity impacts of such targeted policies are accompanied by benefits to inclusiveness. Norway and Denmark are seen as generally good examples in many aspects according to the OECD dashboard on adult training (OECD, 2019[282]), along with Sweden and Ireland in specific areas (OECD, 2019[396]).

Regarding the types of skills, complementing specific, technical skills with social skills to ensure smooth communication is becoming more important in increasingly knowledge-based economies (Deming, 2017[397]) (Weinberger, 2014[398]). Even in occupations relying intensively on digital skills, a mix of technical and high-level cognitive skills are needed in combination (Grundke et al., 2018[399]) (OECD, 2022[400]). More generally, successful firms combine workers with various skill levels: even firms at the industry frontier rely on workers with low and especially medium skill levels, as shown by (Criscuolo et al., 2021[17]) (see Figure 36), which re-iterates the double dividend nature of the gains from focusing policy efforts on lower skilled and less well paid segments of labour markets.[100]

Managerial skills and management quality more broadly deserve a special focus given their outsized role in driving firm performance (see (Bloom and Van Reenen, 2010[150]) and (Syverson, 2011[402]) for reviews).[101] (Metcalfe, Sollaci and Syverson, 2023[403]) emphasise the idea that both individual manager skills *and* company-wide management practices matter, and the latter can be considered as part of organisational (intangible) capital of the companies. Conversely, individual skills are less transferable across the organisation, although they can still be improved through learning. The evidence on large-scale management training programs demonstrates their effectiveness for firm-performance (Giorcelli, 2019[404]) – which were even larger when combined with adopting new technologies – , as well as via spillovers to other firms (business partners) (Bianchi and Giorcelli, 2022[405]).[102] For instance, the recently introduced Management Organisational Practices Survey of the United States Census Bureau reports that three quarters of its respondents evoke business customers and suppliers as inspiring new management practices (Bloom et al., 2019[151]).

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[99] To further counter the potential negative effects of ageing, governments can work together with social partners to fight age discrimination and promote a healthy working environment (OECD, 2020[229]).

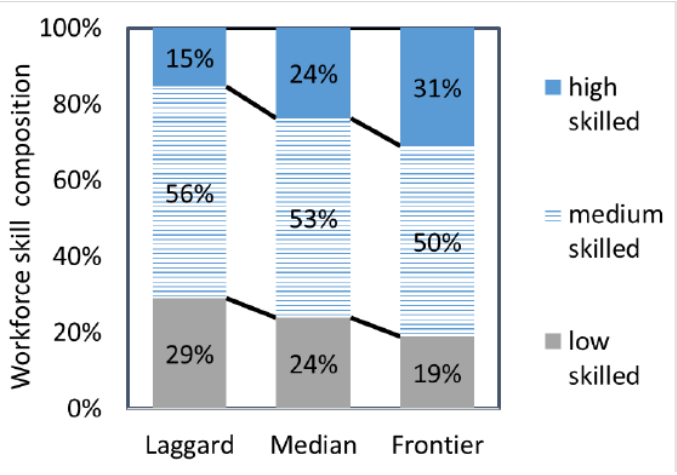
[100] The same study also points out the productivity benefits from employing a diverse workforce along gender and cultural background. It also discusses the role public policies in this context, such as providing a supportive infrastructure (e.g. childcare facilities) and aligning the tax-benefit system to remove disincentives for second earners and immigration policies.

[101] Recent cross-country OECD work documents the disproportionate role of managerial skills in relation to productivity difference between firms (Criscuolo et al., 2021[17]) and industries (Cammeraat, Samek and Squicciarini, 2021[508]). Evidence for the public sector is rare, partly due to the added difficulty of output measurement - a recent exception with robust positive results is by (Fenizia, 2022[509]) in Italy.

[102] For robust evidence on the role of recent management training in less developed economies, see (Bloom et al., 2012[512]) in India and (Iacovone, Maloney and McKenzie, 2021[511]) in Colombia.

Figure 36. Even the most productive firms rely on a range of skills

The share of different skill groups by firms at different segments of the productivity distribution



Note: Frontier, median and laggard firms refer to 90th, 40-60th and 10th percentile of the within-country, within-industry productivity distribution. Productivity is measured as log of value added per worker. The skill measure is based on occupations ranked by cognitive skills (results using skills based on educational attainment or wages yield very similar figures). See more in the source.
Source: (Criscuolo et al., 2021[17]) in the context of the *Human Side of Productivity* project of the GFP.

Governments can fund or subsidise training programs aimed at enhancing managerial skills. Such programs can be offered in collaboration with business schools, universities, or specialized training institutions. Raising awareness of the importance of good management practices can help, given that many firms acknowledge their ignorance about best practices (Bloom and Van Reenen, 2010[150]). This can take place through the creation of platforms or events where businesses can share best practices. Highlighting case studies of companies that have benefited from improved management can also help. Business links between firms, in particular supplying to or purchasing from advanced firms can also be a source of managerial learning, pointing to the importance of deep integration with leading firms in global value chains (Section 3.2). Foreign direct investment, as demonstrated by the beneficial management effects of multi-national ownership (Bloom, Sadun and Reenen, 2012[406]) and spillovers (see Section 4.24.2. under *Innovation*), can also "import" superior management practices.

Enabling mobility to deliver productive job-to-worker matches

A smooth and efficient matching of workers to jobs is especially important given the current context of high reported vacancies and shortages in many economies, sectors and occupations (OECD, 2023[407]). There are also advantages for managing the green transition (Tyros, Andrews and de Serres, 2023[408]) (Celasun et al., 2023[409]) and automation-related disruptions (Bessen et al., 2020[410]), as well as for reorganising domestic value chains in light of changing international trade and investment linkages (Crowe and Rawdanowicz, 2023[37]) (see more in Section 3.2). Smooth labour reallocation and low barriers to worker mobility are also key for matching workers with jobs, which can raise both firms' productivity and wages. In fact, the link between the two is stronger in countries where mobility is higher (Criscuolo et al., 2021[411]). Improving the matching of skills to jobs allows using existing skills more efficiently and, by raising returns on human capital, provide more incentives for employees to acquire skills.

Training qualifications or government recognised certificates not only encourages the skill upgrade of the existing workforce (see above under *Adult* skills) but also provides a means to move away from hiring practices based mostly on initial educational qualifications and towards actual skills (OECD, 2019[282]). Such measures can reduce the cost and improve the quality of hiring – and also provide strong incentives

for workers to engage in such training – which are paramount given strong reallocation and reskilling needs due to digitalisation and the green transition. The recognition of acquired competences is difficult to achieve in practice, in particular for younger and smaller companies; they would benefit from sharing best practices and from pooling relevant information about applicants' skills. Governments can help in particular by improving the recognition of prior learning, be it through formal means leading to new qualifications but also those acquired in informal settings such as during work experience – a good example is the Skillnet system in Ireland (Meghnagi and Tuccio, 2022[412]; OECD, 2019[396]).

International migration of workers can alleviate risks of labour shortages, especially in countries facing rapidly ageing populations. However, there often raises concern that immigration may lower productivity if immigrants have lower skills than natives and/or if more abundant labour reduces incentives for capital deepening. Nevertheless, the literature generally points to a positive long-term effect of immigration on income and MFP in OECD economies (Aleksynska and Tritah, 2014[413]).[103] High-skilled immigrants raise productivity directly, but low-and medium-skilled immigrants also lift productivity, reflecting skills complementarities with natives. Indeed, more cultural diversity in firms, in particular among managers, is associated with higher firm level productivity (Criscuolo et al., 2021[17]). Moreover, income gains from migrations are broadly shared across the population (Jaumotte, Koloskova and Saxena, 2016[414]). Hence, excessively stringent immigration rules may hit economic growth both through labour supply and productivity. Labour migration policies vary widely across OECD countries and need to be tailored to specific socio-economic, institutional and political contexts. They need to set clear goals, with effective monitoring and evaluation, involve all stakeholders and address public opinion by making trade-offs explicit and relying on robust evidence (Chaloff and Kone, 2016[415]).

Certain practices of businesses, such as non-compete clauses, can hold back aggregate productivity by inhibiting reallocation of workers and also contribute to persistent income inequalities by impeding workers to seek better paying jobs (OECD, 2021[416]).[104] Non-compete clauses are often considered to have a positive impact on employers' investment in intangible capital and training, in particular when incumbent companies cannot protect their investment in knowledge through patents or other types of contracts, such as training pay-back clauses (OECD, 2022[417]). However, there is growing evidence that non-compete clauses have sizeable costs in terms of mobility and reduced wages and entrepreneurship, leading to lower productivity growth (Starr, Prescott and Bishara, 2020[418]), (Hermansen, 2020[419]), (Starr, Prescott and Bishara, 2020[418]), (Johnson, Lipsitz and Pei, 2023[420]).[105]

High housing costs may prevent workers from moving to the most dynamic places (Ganong and Shoag, 2017[421]) (Cavalleri, Luu and Causa, 2021[422]), with a negative effect on productivity. Large agglomerations allow economies of scale, better labour market matching among a wider pool of workers and knowledge spillovers. International studies suggest that a doubling in population size raises the productivity level of a city by 2% to 5% (OECD, 2015[423]). Restrictive land-use regulations contribute to a lack of housing supply responsiveness in many countries (Glaeser and Gyourko, 2018[424]) (Cavalleri, Cournède and Özsöğüt, 2019[425]). Loosening these regulations, while taking into account objectives of environmental sustainability and social inclusion (OECD, 2017[426]), could increase the responsiveness of supply, mitigating upward pressure on prices and making housing more affordable (OECD, 2021[427]). High transaction costs,

[103] A positive long-run impact of immigration on productivity is found on a wider set of countries (Ortega and Peri, 2014[522]) (Alesina, Harnoss and Rapoport, 2016[523]), Canada (Gu, Hou and Picot, 2020[524]) and the United States (Peri, 2012[525]). (Kangasniemi et al., 2012[526]) finds a positive effect in the United Kingdom, but negative effect in Spain. A negative impact of non-EU immigration on labour productivity is found in Italy (Vittori, Ricci and Ferri, 2023[532]).

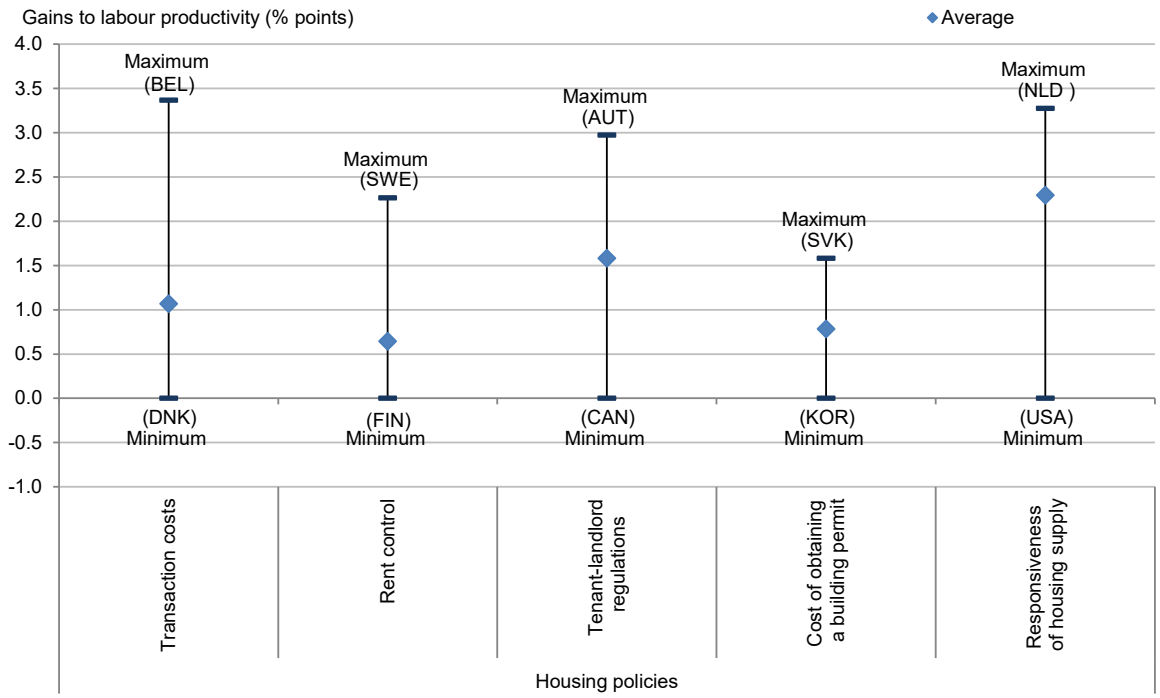
[104] In April 2024, the US Free Trade Commission decided to ban non-compete clauses to promote competition.

[105] The literature mainly investigates the effects of non-compete clauses in the United States. However, such clauses are also widely used in some EU countries (OECD, 2022[417]).

excessively strict rent control and tenant-landlord regulations, and a high cost of obtaining a building permit also hamper mobility and skill matching, which lowers productivity (Figure 37). Policy reforms combining mortgage interest relief removal, land-use governance streamlining and rent control easing can help unlock housing supply, make housing markets more efficient and, ultimately, housing more affordable (Cournède, Ziemann and De Pace, 2020[428]), which in turn would facilitate mobility and raise productivity. The shift towards lower density areas and working from home since the COVID-19 pandemic, part of which is likely to last, may facilitate job mobility by broadening the range of location choices (Liu and Su, 2021[429]) (Ziemann et al., 2023[430]).

Figure 37. Better housing market policies can lift productivity by reducing skill mismatches between workers and jobs

Estimated labour productivity gains from housing policy reforms that reduce skill mismatch



Note: How to read: Moving from the average level of the transaction costs indicator to the level of Denmark, which is the minimum in the sample, would raise labour productivity by 1.1 percentage points. The sample covers from 19 to 27 countries depending on the indicator. Estimates are based on: i) logit regressions of probability of mismatch controlling for age, marital and migrant status, gender, education, firm size, contract type, a dummy for working full-time and working in the private sector; and ii) OLS regressions of labour productivity on skill mismatch. Tenant-landlord regulation includes the ease of evicting a tenant, degree of tenure security and deposit requirements.
Source: (Adalet McGowan and Andrews, 2015[431]), "Skill Mismatch and Public Policy in OECD countries", OECD Economics Department Working Paper, No. 1210.

Efficient transport networks also facilitate access to employment. A recent international meta-analysis suggests that better access to public transport and higher levels of job accessibility increases employment probabilities and that jobseekers may benefit from public policies targeted at improving their access to public transport, in particular for people without access to cars and in areas with fewer job opportunities

(Bastiaanssen, Johnson and Lucas, 2020[432]).[106] Improving public transport and promoting their use can also significantly reduce CO_2 emissions, local pollution and congestion (ITF, 2021[433]).

Remote working possibilities, which have expanded rapidly during the COVID-19 pandemic, can contribute to strengthening labour market matching. Governments have various tools (digital infrastructure; showing example to change culture) to enable firms to offer telework options both to current employees and to future hires (Criscuolo et al., 2023[26]).

5. Concluding remarks and potential avenues for future work

This paper presented a broad overview of the main structural drivers of productivity growth in recent decades, combining insights from firm-level and macroeconomic studies. This also provides a background against which the role of public policies is discussed, focusing on creating the right incentives and boosting the capabilities of businesses, both at the technological frontier and below. These concluding remarks offer a recap and re-iteration of the key takeaways from a policy standpoint, while also indicating where our current knowledge is more tentative and would benefit from further analysis.

Competition is a fundamental driver of productivity, both at the top of the productivity distribution, through shaping incentives to innovate, and among lagging firms via boosting the incentives to increase the adoption of latest technologies and business practices. But competition seems to have been weakening in many countries and activities over recent years. Concentration and mark-ups have been rising in many industries, contributing to wage inequalities and diminishing opportunity for the upward mobility of workers. The expansion of international trade, FDI and global value chains, which spur productivity through both competition and knowledge diffusion, has stalled. Trade in services has potential to grow further but faces higher institutional barriers than trade in goods. Business dynamism has generally declined. The design of intellectual property rights regimes and some labour market practices, like occupational licensing and non-compete clauses may also hamper competition and slow the diffusion of innovations.

These adverse trends reinforce the need to keep the competition policy framework up-to-date, including not only the regulatory stance in product and labour markets but antitrust enforcement as well. Moreover, a number of specific areas may benefit from a better understanding, in particular a better understanding of entry-exit dynamics; how new digital technologies, in particular AI, may affect competition given the potential importance of data and network effect driven market power; and how trade barriers can be reduced in areas outside the current discussions around security and resilience, such as services.

The overall, longer term productivity impact of the latest digital technologies, such as AI, remains uncertain, calling for continued analysis in this domain (Filippucci et al., 2024[21]). Ongoing OECD work on their macroeconomic effects aims to illustrate the relative importance of various mechanisms (the size and nature of micro-level gains; the economic structure and the speed of adoption) which are also amenable to the policy environment and may also be shaped by other ongoing megatrends, such as demographic challenges (ageing and shrinking workforce-driven pressures for automation). Work is under way by the Global Forum on Productivity on the labour market impacts of labour shortages in many OECD countries, with a focus on the role of new technologies, including AI. Future extensions could include information on firm-level productivity and job postings.

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[106] A negative relationship between public transport travel time and employment is found in England (Johnson, Ercolani and Mackie, 2017[517]). A negative relationship between changes in labour market accessibility and changes in unemployment is found in Sweden (Norman, Börjesson and Anderstig, 2017[518]). Better public transport accessibility is found to have a positive and permanent effect on individual earnings in Copenhagen (Pons Rotger and Sick Nielsen, 2015[519]).

A further policy challenge for future productivity growth is that reallocation needs in our economies are becoming more pressing due to various sweeping global trends. First, as climate disorders intensify, the need to accelerate the green transition and adaption is rising. Discrepancies in environmental norms across countries may distort competition, thereby affecting productivity. The impact of high temperatures on economic activity and growth through adverse effects on labour productivity should also be analysed. More information and analysis are needed in this area, to inform adequate policy responses.

A second reallocation challenge is related to rising geopolitical threats to international openness. Addressing them requires not only internal re-organisation of domestic value chains but reconfiguring business partnerships internationally. Finally, the rise of digitalisation and AI might also involve increasing shifts in resources across firms and sectors, with potentially wide-ranging impacts not only on productivity but also on labour markets, as mentioned above.

A broad policy toolkit to navigate and adjust to these transitions is required. Concerning innovation support, policies should focus both on its supply and demand side. This may occur through potentially bolder interventions than before the severity of these shocks became evident, in particular regarding the direction of innovation and the types of technologies developed and embedded in new investments as part of a modern industrial policy (Millot and Rawdanowicz, 2024[45]).

Financing the reallocation of capital and innovation is also key, although may become more difficult, at least in the near term. Higher interest rates may reduce innovation spending and patenting, with a negative long-term impact on productivity (see Section 3.2). This compounds structural issues, such as the challenge in financing intangible investment, the debt bias in tax systems and underdeveloped risk capital markets in some countries (see Section 4.3). In this environment, policies will need to find new ways to alleviate financial constraints on innovation and entrepreneurship, while preserving financial soundness. For example, it would be worth exploring whether Fintech can offer new opportunities to develop equity-based financing and, with appropriate regulation, strengthen financial stability (Philippon, 2017[348]).

Regarding the reallocation of labour, it is crucial to continue re-evaluating the appropriate stance of labour market institutions balancing efficiency and equity, not only related to job protection but also regarding non-compete clauses and wage setting. To enable the geographic mobility of workers, governments should put in place a combination of effective housing and transport policies combined with widespread high quality public infrastructure. Place-based policies aim to take account of the complementarities and synergies between these areas in a given locality or region. Deploying workers in new tasks also intensifies up- and re-skilling needs, with important implications for adult learning and training policies.

These challenges are made even more pressing in the face of demographic changes, in particular population ageing and the shrinking share of the active population. The literature has presented a wide array of complex implications for productivity covering micro and semi-aggregated (sector-level and regional) approaches (for a recent summary, see (André, Gal and Schief, 2024[227])), but the overall macroeconomic effects – including through changing demand patterns, savings and innovation behaviour – and the policy implications may benefit from further analysis.

Finally, three important topics that were left outside the scope of this review need mentioning, as they are also important from a policy standpoint:

- Many countries have recently set up pro-productivity institutions, such as productivity commissions, councils or boards.[107] Well-designed pro-productivity institutions can generally improve the quality of the policy process and political debate and make a significant contribution to evidence-based policymaking (Renda and Dougherty, 2017[434]) (Dougherty, A. and von Trapp, 2021[435]). Pro-

[107] For a review of recent analytical work and policy recommendations from ten national productivity commissions in OECD countries, see (Pilat, 2023[462]).

productivity institutions can take different forms, but it is essential to guarantee their analytical independence and access to micro-level data on firms and workers to inform policies (Cavassini et al., 2022[436]).

- Non-market sector productivity analysis – including not only public administration but large parts of health care and education in many OECD countries – is becoming increasingly important as rising incomes and population ageing are bound to raise their share in GDP and digital transformations, including AI, offer opportunities to raise efficiency. Furthermore, better education and infrastructure (see Section 4.3) can generate large spillovers to business-sector productivity, as well as foster employment and inclusiveness. Better health also generates productivity gains (Aghion, Howitt and Murtin, 2010[437]). In addition, health plays a key role in shaping inequality of opportunities and socio-economic outcomes (Coyle, 2023[438]) (OECD, 2019[439]). However, large gaps remain in non-market sector productivity measurement, hampering analysis and policy advice.[108]
- Institutions and policies, including policies that promote macroeconomic stability, the rule of law and trust, favour productivity growth (Acemoglu, Johnson and Robinson, 2005[440]) (Dieppe, 2021[53]). Improving institutional settings can significantly contribute to boosting productivity growth, especially in developing and emerging economies.

[108] Non-market services produced by general government account for around 15% to 20% of GDP across OECD countries. These services are provided free of charge or at prices that are not economically significant (in practice covering less than half of production costs). In the absence of market prices, non-market output is often measured in the National Accounts as the sum of its production costs, which rules out productivity gains by definition (Lequiller and Blades, 2014[513]). Some countries, like the United Kingdom, now include public sector productivity estimates in their official statistics and their quality is improving (van Ark, 2022[514]). Nevertheless, measuring public service quality remains challenging and different country approaches make international comparisons difficult. For more details, see Box 3 in (Sorbe, Gal and Millot, 2018[74]).

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