The Future of Productivity

Productivity growth is the main driver of living standards. But productivity has slowed over the 2000s, even before the crisis, partly owing to a slowdown in diffusion of global frontier innovations to other firms. Policy reforms can help revive the diffusion machine, optimise the use of scarce resources – especially skills – and clear the path for higher productivity growth.

Main findings

The productivity slowdown over the past decade has raised concerns about the long term growth outlook. Yet, the future of productivity is highly uncertain with contrasting views on the potential for innovation to further propel growth.

In this context, countries should look to tap sources of productivity growth where there is potentially large and sure scope for improvement. Two key sources emerge.

First, future growth will depend on harnessing the forces of knowledge diffusion, which propelled productivity growth for much of the 20th century:

- Productivity growth of the globally most productive firms remained robust in the 21st century but the gap between those high productivity firms and the rest has been increasing over time. This rising gap raises questions about why seemingly accessible knowledge and technologies do not diffuse to all firms.
- Diffusion is shaped by four factors – global connectedness, experimentation with new ideas, investment in knowledge-based capital (KBC) and efficiency of resource allocation – which are heavily influenced by policies.

Second, there is much scope to boost productivity and reduce inequality by better allocating skills to jobs and fostering the growth of the more productive firms in general:

- Around one-quarter of workers report a mismatch between their skills and those required to do their job. A better use of talent could translate in up to 10% higher labour productivity in some economies.
- The aggregate benefits of diffusion are magnified by policies that foster the growth of the most productive firms. However, the most advanced firms often have productivity levels close to the global frontier, but their aggregate impact can be muted if they are small.

Policies to sustain productivity growth include:

- Product market reforms and bankruptcy laws that do not excessively penalise failure, can facilitate diffusion by improving: i) firms' incentives to experiment; ii) the allocation of resources (e.g. skills); and iii) the potential benefits of GVC participation.
- Policies that do not impede labour mobility can underpin the growth of productive firms, partly by reducing skill mismatch.
- Public investment in basic research is required to support the continued emergence of breakthrough innovations, but both governments and the private sector are investing less in basic research. Knowledge diffusion mechanisms are needed to transfer this research to other actors.
- A level playing field that does not favour incumbents over entrants is crucial, but this feature is often missing from many policies.

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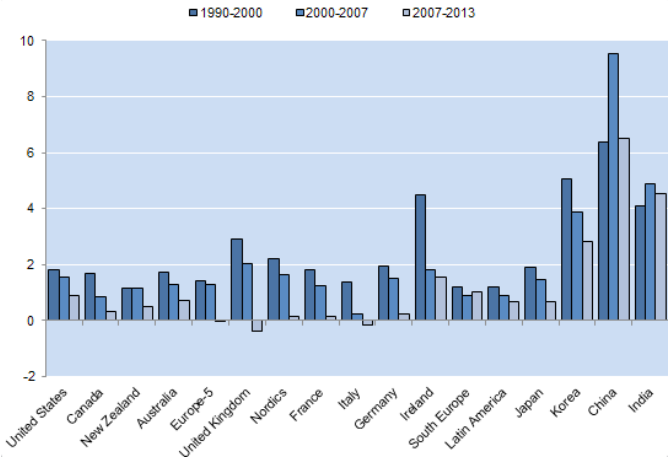
http://www.oecd.org/eco/the-future-of-productivity.htm

Productivity: now more than ever

Productivity is about "working smarter", rather than "working harder": it reflects our ability to produce more output by better combining inputs, thanks to new ideas, technological innovations and new business models. Innovations such as the steam engine, electrification and digitisation have underpinned radical changes in the way in which we produce goods and services, in turn increasing living standards, well-being and leisure time. For these reasons, differences in income per capita across countries mainly reflect productivity shortfalls. However, productivity growth has slowed in most OECD countries over the past decade (Figure 1), fuelling concerns of persistent low growth. Against this backdrop, this note discusses some impediments to productivity growth and proposes a policy approach to reviving growth in our economies.

Figure 1. Productivity growth slowed even before the crisis

GDP per hour worked (unless otherwise noted)



Notes: Growth rates for the period ranges are the annual averages. Country groupings are aggregated using GDP-PPP weights. Europe-5 includes: Austria, Belgium, Luxembourg, the Netherlands and Switzerland; Nordics includes: Denmark, Finland, Iceland, Norway and Sweden; Southern Europe includes: Greece, Portugal and Spain; and Latin America includes: Brazil, Chile and Mexico. Labour productivity data for China and India refer to GDP per worker.

Source: OECD calculations based on the Conference Board Total Economy Database.

Over the coming decades, productivity will be the main driver of growth. Nevertheless, the outlook for future productivity growth is hotly debated. For some, all the low hanging fruits have already been picked, the ICT revolution has run its course and other promising advances in biotechnology or highly-automated manufacturing are distant apparitions. For others, the ICT revolution continues apace accompanied by dramatic changes in the nature of production, both of which fuel new, disruptive business models that are enabling a new wave of innovation and productivity growth across the economy.

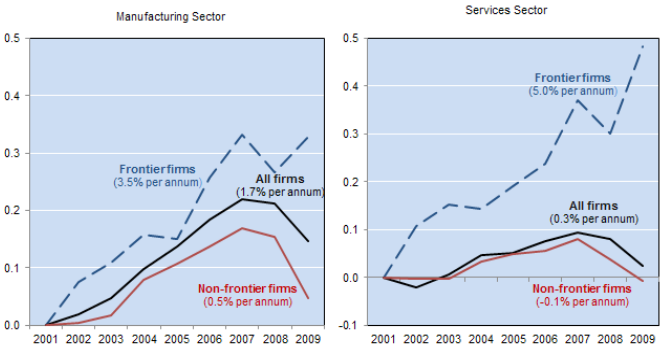
The breakdown of the diffusion machine

New OECD research shows that the main source of the productivity slowdown is not so much a slowing of innovation by the most globally-advanced firms, but rather a slowing of the pace at which innovations spread out throughout the economy – a breakdown of the diffusion machine. Productivity growth of the globally most productive firms remained robust in the 21st century, despite the slowdown in aggregate productivity, but the gap between those high productivity firms and the rest has been increasing over time.

Labour productivity at the global technological frontier increased at an average annual rate of 3.5% in the manufacturing sector over 2000s, compared to just 0.5% for non-frontier firms, while the gap is even more pronounced in the services sector (Figure 2).

Figure 2. Solid growth of the globally most productive firms but spillovers to the other firms have been weak

Labour productivity; index 2001=0



Notes: "Frontier firms" corresponds to the average labour productivity of the 100 globally most productive firms in each 2-digit sector. "Non-frontier firms" is the average of all other firms. "All firms" is the sector total. The average annual growth rate is shown in parentheses.

Source: Andrews, D., C. Criscuolo and P. Gal (2015). "Frontier firms, technology diffusion and public policy: micro evidence from OECD countries", OECD Mimeo.

The relative strength of such global frontier firms likely reflects their capacity to "innovate", optimally combine technological, organisational and human capital in production processes throughout global value chains (GVCs) and harness the power of digitalisation to rapidly diffuse and replicate leading-edge ideas.

More significantly, the rising gap between those high productivity firms and the rest raises key questions about the obstacles that prevent all firms from adopting seemingly well-known and replicable innovations. Future growth will depend on harnessing the forces of knowledge diffusion, which propelled productivity growth for much of the 20th century. This is particularly vital in the services sector, given that services account for an increasing share of economic activity, and logistics, finance, business services and communications are the oil that greases the wheels of globalization. Reviving the diffusion machine will also promote inclusive growth. The observed rise in wage inequality appears to partly reflect the increasing dispersion in average wages paid across firms, suggesting that raising the productivity of laggard firms could promote improvements in wage equality.

Barriers to diffusion

Innovations at the global frontier do not immediately or inevitably diffuse to all firms. At first, innovations become accessible to the most productive firms in an economy. Even then, frontier innovations need to be adapted to national circumstances, by national frontier firms, and only then can they be adopted by laggards. This diffusion process is shaped by some key factors:

- Global connections via trade, FDI, participation in GVCs and the international mobility of skilled labour provide scope for knowledge diffusion from global frontier firms to national frontier firms. Globalization also implies stronger competition, which sharpens the incentives to adopt best practices.

- Experimentation by firms – especially new entrants –with new technologies and business models.

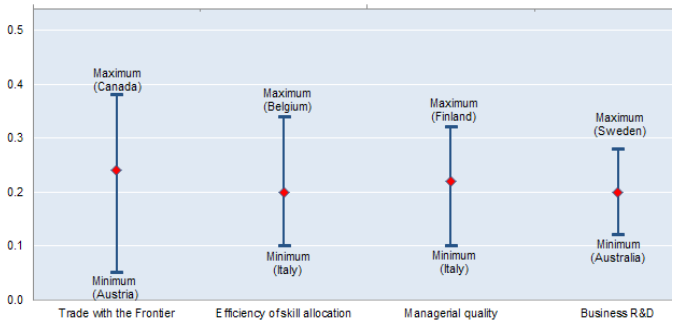
- Synergic investments in R&D, skills, organisational know-how (i.e. managerial quality) and other forms of knowledge-based capital to enable economies to absorb, adapt and reap the full benefits of new technologies.

- Efficient reallocation of scarce resources to underpin the growth of the most innovative firms. This is particularly vital given that firms need to achieve sufficient scale to cover the fixed costs of entry into global markets and to incentivise experimentation, by making it easier to scale-up successful ideas.

OECD countries differ significantly with respect to these structural factors – implying that diffusion comes easier to firms in some economies than others. Figure 3 presents estimates of how the benefits of a 2% acceleration in productivity growth at the global frontier – roughly equivalent to that observed in the United States during the late 1990s ICT boom – diffuse to economies, depending on these factors. For example, countries that trade very intensively with the frontier economy (e.g. Canada) would realise 0.35 percentage points higher productivity growth per annum from more rapid diffusion, compared to a country with fewer such trade linkages (e.g. Austria). Higher efficiency of skill allocation, R&D investment and managerial quality have similar effects and these gains are economically significant, particularly given an average MFP growth of only ½ per cent per annum over the period of analysis.

Figure 3. Structural factors shaping productivity diffusion from the global frontier

Estimated frontier spillovers (% per annum) associated with 2% point increase in MFP growth at the global frontier; 1995-2007



Notes: The chart shows how the sensitivity of MFP growth to changes in the frontier leader growth varies with different levels of policy variables. The diamond refers to the estimated frontier spillover effect associated with a 2% MFP growth at the frontier around the average level of the policy. The label "Minimum" (Maximum) indicates the country with the lowest (highest) value for the given structural indicator in a given reference year.

Source: A. Saia, D. Andrews and S. Albrizio (2015), "Productivity spillovers from the global frontier and public policy: industry level evidence", OECD Economics Department Working Paper, No. 1238.

Misallocation, big time

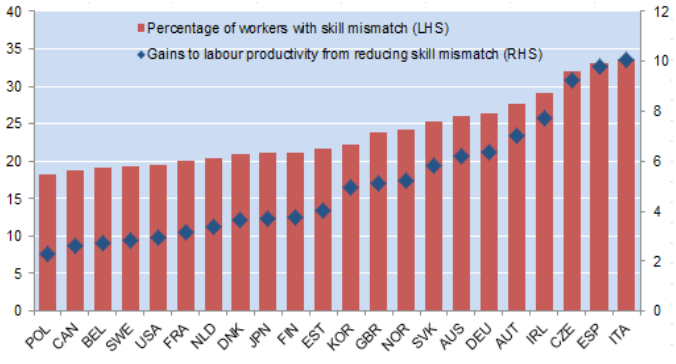
Besides supporting diffusion of productivity enhancements at the frontier, efficient resource allocation has important direct effects on productivity growth. The larger are the more productive firms, the greater the extent to which their good performance gets reflected in overall economic growth. Unfortunately, the most productive and dynamic firms do not always grow to optimal scale. In some economies, the most advanced firms have productivity levels close to the global frontier, but they are under-sized.

High rates of skill mismatch emerge as a key constraint on the growth of innovative firms. On average across countries, roughly one-quarter of workers report a mismatch between their existing skills and those required for their job – i.e. they are either over or under-skilled – but this figure is closer to one-third in Italy, Spain and the Czech Republic (Figure 4). Over-skilling is generally more common than under-skilling, with the average likelihood of being over-skilled roughly two and a half times greater than that of being under-skilled.

Higher skill mismatch is associated with lower labour productivity performance, with over-skilling being particularly costly. When firms draw from a scarce and fixed pool of skilled labour, trapping highly-skilled labour in relatively low productivity firms can make it more difficult for more productive firms to attract the workers necessary for their expansion. This is what tends to occur in industries with a high share of over-skilled workers. New OECD evidence shows that better use of human talent in countries where skill mismatch is very high, such as Italy and Spain, could boost the level of labour productivity by around 10% (Figure 4). This could close about one-fifth of the gap in labour productivity between Italy and the United States (or Sweden). Reducing skill mismatch – particularly over-skilling – can also promote inclusive growth since a better matching of skills to jobs makes workers more productive, implying scope for higher wages, and reduces the risk that under-utilised skills will quickly depreciate.

Figure 4. Large scope to boost productivity by reducing skill mismatch

Per cent



Notes: The figure shows the percentage of workers who are either over- or under- skilled and the simulated gains to allocative efficiency from reducing skill mismatch in each country to the best practice level of mismatch. The figures are based on OECD calculations using OECD, Survey of Adult Skills (2012).

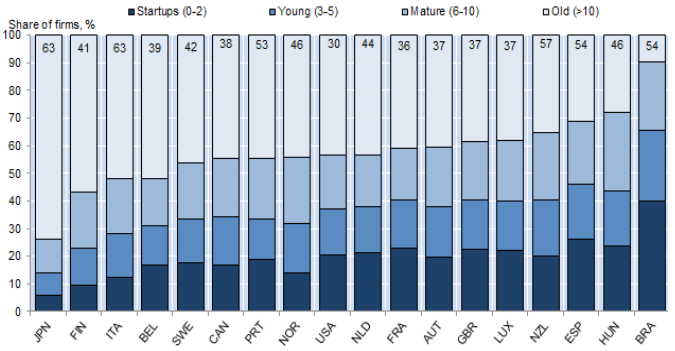
Source: Adalet McGowan, M and D. Andrews (2015), "Labour market mismatch and labour productivity: Evidence from PIAAC data", OECD Economics Department Working Paper, No. 1209.

High rates of skill mismatch often coincide with the presence of many small and old firms. These firms are often unproductive and tend to be harmful for aggregate productivity to the extent that they absorb valuable resources, thereby constraining the growth of more innovative firms. In fact, it is crucial that young firms are able either to grow rapidly or exit. If they linger too long, resources are wasted. Against this background, cross-country differences in the age and size profile of firms are particularly significant. For instance, only 22% of small firms in Finland

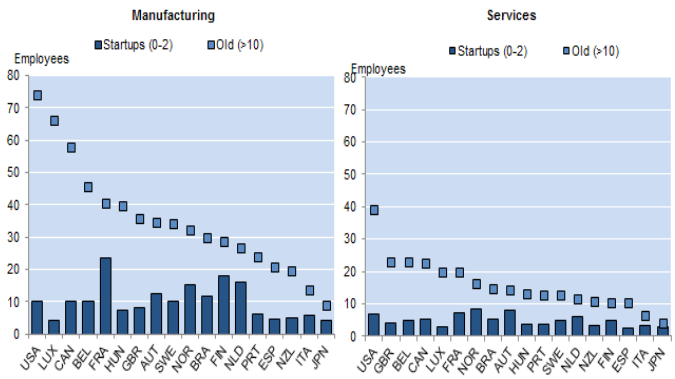
– which account for 41% of total employment – can be classified as "young" (i.e. less than 5 years old), against more than 50% in the United States and other countries (Figure 5, Panel A). This likely reflects the inability to grow to scale and the fact that low potential firms can survive when market selection is weak, with significant cross-country differences emerging in the relative sizes of old and new businesses. While old businesses in the United States are more than seven times larger than start-ups, this ratio drops to just above two in Italy and Norway, and below two in France, Finland or the Netherlands (Figure 5, Panel B).

Figure 5. The strength of market selection and post-entry growth varies across countries

A: Many small and old firms suggest less intense market selection in some countries



B: Post-entry growth – average size of young and old firms



Notes: Panel A shows the share of firms by age group in the total number of micro and small firms (below 50 employees). The numbers at the top of the chart shows the share of small firms in the overall population of firms. Panel B reports the average size of start-up firms (from 0 to 2 years old) and firms more than 10 years old.

Source: Criscuolo, C., P. Gal and C. Menon (2014), "The Dynamics of Employment Growth: New Evidence from 18 Countries", OECD Science, Technology and Industry Policy Papers, No. 14.

Policies to boost productivity growth

Keep the innovation engine running

Although productivity growth at the global frontier appears robust enough, a policy framework that incentivizes innovation at the frontier is crucial. In fact, given the overall decline in the rate of business start-ups and the rising age of firms at the global productivity frontier – which could foreshadow a slowdown in the arrival of radical innovations and future productivity growth – incentives for innovation are urgent.

- Higher and more efficient **public funding of basic research** are crucial for moving the global frontier and to compensate for the inherent underinvestment in basic research due to the partial appropriability of the resulting discoveries. This is particularly important, given that public innovation budgets are increasingly being directed towards more applied forms of research. Given the tight fiscal climate, this is going to be easier if countries share the costs and risks of such research through stronger collaboration.

- Pushing out the frontier also requires enabling **experimentation** with radical new technologies and business models. Since innovation is about trial and error, failure needs to be recognised as an opportunity to learn and rebound, rather than being seen as the end of the game. Thus, the policy environment should enable successful firms to grow, but also let less successful firms exit the market, so that scarce resources can be released to underpin the growth of the successful ones.

Revive the diffusion machine

Securing future growth prospects depends on re-harnessing the forces of knowledge diffusion. This requires a policy framework that supports basic research and experimentation but also one that fosters:

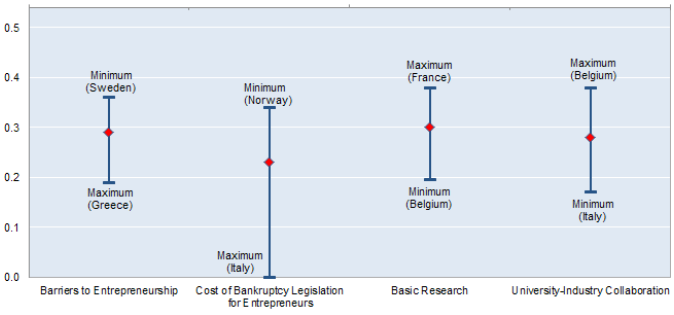
- **Pro-competition reforms to product markets, especially in services,** incentivising firms to adopt better technologies and improve managerial performance. Given a 2 percentage point acceleration in frontier growth, the estimates in Figure 6 imply a gain to annual MFP growth of around 0.2 percentage points higher in a country with low administrative barriers to entrepreneurship (e.g. Sweden), than in one where such barriers are relatively high (e.g. Greece). Such reforms will also help reduce the costs and improve the quality of goods and services, which will boost the benefits of participation in GVCs.

- **Closer collaboration between firms and universities** to: i) allow firms, especially smaller ones, to benefit from university connections with the global knowledge frontier; and ii) provide them with access to research labs, advanced machinery, knowledge and skills that they would not be able to afford otherwise.

- **A level playing field that does not favour incumbents over entrants.** Many policy measures, from environmental to fiscal measures, are designed to favour incumbents. In the area of innovation policies, it is important that R&D tax incentives are designed so as to be equally accessible to incumbent, young and new firms. Indeed, many young innovative firms typically make losses in the early years of an R&D project and thus will not benefit from the program unless it contains provisions for immediate cash refunds for R&D expenditure or allows such firms to carry associated losses forward to deduct against future tax burdens.

Figure 6. Policy factors shaping productivity diffusion from the global frontier

Estimated frontier spillover (% per annum) associated with 2% point increase in MFP growth at the global frontier



Notes: The chart shows how the sensitivity of MFP growth to changes in the frontier leader growth varies with different levels of policy variables. The diamond refers to the estimated frontier spillover effect associated with a 2% MFP growth at the frontier around the average level of the policy. The label "Minimum" (Maximum) indicates the country with the lowest (highest) value for the given policy indicator in a given reference year.

Source: A. Saia, D. Andrews and S. Albrizio (2015), "Productivity spillovers from the global frontier and public policy: industry level evidence", OECD Economics Department Working Paper, No. 1238.

The aggregate benefits of diffusion will be magnified when structural policies foster the growth of the most productive firms. The primary reforms that promote firm growth are those that make **product markets more competitive**. Beyond that, reforms that reduce skill mismatch and the scarcity of risk capital are important, given that weak firm growth often reflects that innovative firms cannot attract the skilled workers and capital they need to expand. Three key channels emerge through which policies can raise productivity via a more efficient allocation of resources and in particular human talent.

First, **policies that promote efficient firm exit** – such as bankruptcy legislation that does not excessively penalise business failure – can reduce the likelihood that valuable resources are trapped in inefficient firms. For example, reducing the stringency of bankruptcy legislation from its most restrictive level in Italy – where mismatch and the share of old and small firms are very high (see Figures 4-5) – to the median level in Canada is associated with a 10 percentage point decrease in mismatch (Figure 7). This in turn facilitates more effective knowledge diffusion (Figure 6). Product market reforms can also contribute to a more efficient allocation of skills and resources in general, via stronger competitive pressures.

Second, **policies that make labour mobility** smoother can reduce an inefficient allocation of resources, in particular labour and skills, to underpin the growth of productive firms (Figure 7).

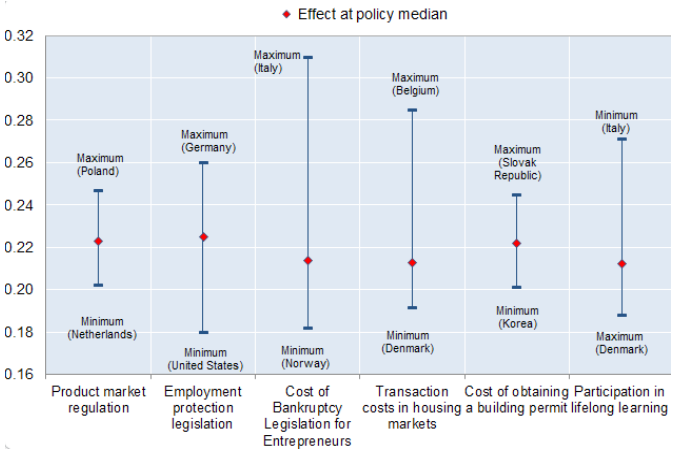
Focusing on the efficient allocation of skills for example:

- By creating lock-in effects, **transaction costs affecting the buying and selling of dwellings** – e.g. stamp duties and notarial fees – can exacerbate skill mismatch via lower residential mobility. Reducing transaction costs from the highest level (Belgium) to the median level (Finland) is associated with a 7 percentage point reduction in mismatch. Policies that restrict housing supply, such as stringent land-use regulations, can also reduce skill mismatch by providing cheaper housing, thereby creating more scope for labour mobility.
- Reducing the stringency of e**mployment protection legislation** from the maximum levels (in Germany) to the median levels is roughly associated with a 3 percentage point reduction in skill mismatch.

Finally, **adult learning policies** that make skills complementary to technical progress can support inclusive productivity growth by better matching skills to jobs. For example, increasing participation in lifelong learning programs from the low level in Italy to the median level in Estonia is associated with a 6 percentage point decrease in mismatch.

Figure 7. Policy reforms can help reduce skill mismatches

The probability of skill mismatch and selected policies



Notes: The dot is the average probability to have mismatch evaluated at the median level of the policy and individual characteristics, which include age, marital and migrant status, gender, level of education, firm size, contract type, a dummy for working full-time and working in the private sector. The distance between the Min/Max and the median is the change in the probability of skill mismatch associated with the respective policy change.

Source: Adalet McGowan, M and D. Andrews (2015), "Skill mismatch and public policy in OECD countries", OECD Economics Department Working Paper, No. 1210.

SUGGESTED FURTHER READING

The book summarising the project is:

Adalet McGowan, M., D. Andrews, C. Criscuolo and G. Nicoletti (2015), The Future of Productivity OECD, Paris.

Supporting papers and other relevant research include:

Adalet McGowan, M. and D. Andrews (2015a), "Labour Market Mismatch and Labour Productivity: Evidence from PIAAC Data", OECD Economics Department Working Papers, No. 1209.

Adalet McGowan, M. and D. Andrews (2015b), "Skill Mismatch and Public Policy in OECD Countries", OECD Economics Department Working Papers, No. 1210.

Andrews, D., C. Criscuolo and P. Gal (2015), "Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries", OECD Mimeo.

Andrews, D. and C. Criscuolo (2013), "Knowledge Based Capital, Innovation and Resource Allocation", OECD Economics Department Working Papers, No. 1046.

Andrews, D. and F. Cingano (2014), "Public Policy and Resource Allocation: Evidence from Firms in OECD Countries", Economic Policy, No. 29(78), pp. 253-296.

Braconier, H., G. Nicoletti and B. Westmore (2014), "Policy Challenges for the Next 50 Years", OECD Economics Department Policy Papers, No. 9.

Calvino, F., C. Criscuolo and C. Menon (2015), "Cross-country Evidence of Start-Up Dynamics", OECD Science, Technology and Industry Working Paper.

Criscuolo, C., P. Gal and C. Menon (2014), "The Dynamics of Employment Growth: New Evidence from 18 Countries", OECD Science, Technology and Industry Policy Papers, No. 14.

Saia, A., D. Andrews and S. Albrizio (2015), "Public Policy and Spillovers From the Global Productivity Frontier: Industry Level Evidence", OECD Economics Department Working Papers, No. 1238.

Joint Economics Department and the Directorate for Science, Technology and Innovation Policy Note

This series of Policy Notes is designed to make available, to a wider readership, selected studies that have been prepared for use within the OECD. This particular Policy Note is based on a joint study between the Economics Department and the Directorate for Science, Technology and Innovation.

Comment on this Policy Note is invited, and may be sent to OECD, 2 rue André Pascal, 75775 Paris Cedex 16, France, or by e-mail to Dan.Andrews@oecd.org or Chiara.Criscuolo@oecd.org

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