

Is digitalisation the gamechanger it promised to be for firms' productivity growth?*

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In a recent working paper, we show that while firms in digital sectors are considerably more productive than their less-digital counterparts, the impact of digitalisation on productivity growth is only moderate. In fact, digitalisation is a gamechanger only for those firms that are already relatively more productive than their competitors, acting instead like a sideshow for most firms in the economy. Policies accelerating digital adoption can boost productivity and potential output but are more likely to be successful when targeted.

*This SUERF policy brief is a summary of Anderton et al. (2023, ECB Working Paper 2794). The views expressed herein are those of the authors and do not necessarily represent those of the European Central Bank, the Deutsche Bundesbank or OFCE, SciencesPo.

Although digitalisation promised to be a productivity gamechanger, we are still facing at the aggregate level a “productivity paradox” whereby rapid advances in digitalisation over the past couple of decades have coincided with a protracted slowdown of aggregate productivity growth. By contrast, several studies based on micro firm-level data find that digitalisation is associated with improvements to firms' productivity.¹ These results are difficult to reconcile. Moreover, the transition into a digital economy has been established as a priority by policymakers and international institutions alike, with various policies being implemented with the aim of accelerating digital adoption and thereby boosting productivity. This is the case for the EU's “Digital Single Market” and the “Next Generation EU”.

In a recent ECB Working Paper, we address this topic by investigating the role of digitalisation on firm-level productivity growth.² To do so, we build on a large-scale balance sheet dataset for firms operating in Europe between 2000 and 2019 from Bureau van Dijk's Orbis.³ We include in the analysis a sample of 19.3 million firm-level observations containing information on nearly 2.4 million unique firms, with firms being in the sample for at least three consecutive years and on average for 8.1 years. These data allow for the estimation of a revenue-based measure for total factor productivity (TFP) at the firm level, implemented following the methodology in Gandhi et al. (2020).⁴

At first glance, the productivity of firms in digital intensive sectors is considerably higher than the productivity of firms in non-digital intensive sectors.⁵ Chart 1 displays the interquartile range and the median firm's TFP level by employment size in both digital intensive and non-digital intensive sectors. It unveils some interesting facts. First, larger firms are relatively more productive than smaller firms: the median large firm with more than 250 employees is 39% more productive than the median micro firm with between one and 9 employees in the non-digital sectors and is 55% more productive than the median micro firm in digital intensive sectors. Second, firms in digital sectors are in general more productive than firms in non-digital sectors across all size categories. Finally, the interquartile range for TFP is higher in the digital sector than in the non-digital sector. This implies that firms in digital sectors are in general more productive than firms in non-digital sectors.

¹ See Gal, P., G. Nicoletti, T. Renault, S. Sorbe, and C. Timiliotis (2019), “[Digitalisation and productivity: In search of the holy grail – firm-level empirical evidence from EU countries](#)”, OECD Working Paper no. 1533, and Cusolito, Ana Paula, Daniel Lederman, and Jorge Peña (2020), “[The effects of digital technology adoption on productivity and factor demand: firm-level evidence from developing countries](#)”, World Bank Policy Research Working Paper no. 9333 for recent examples.

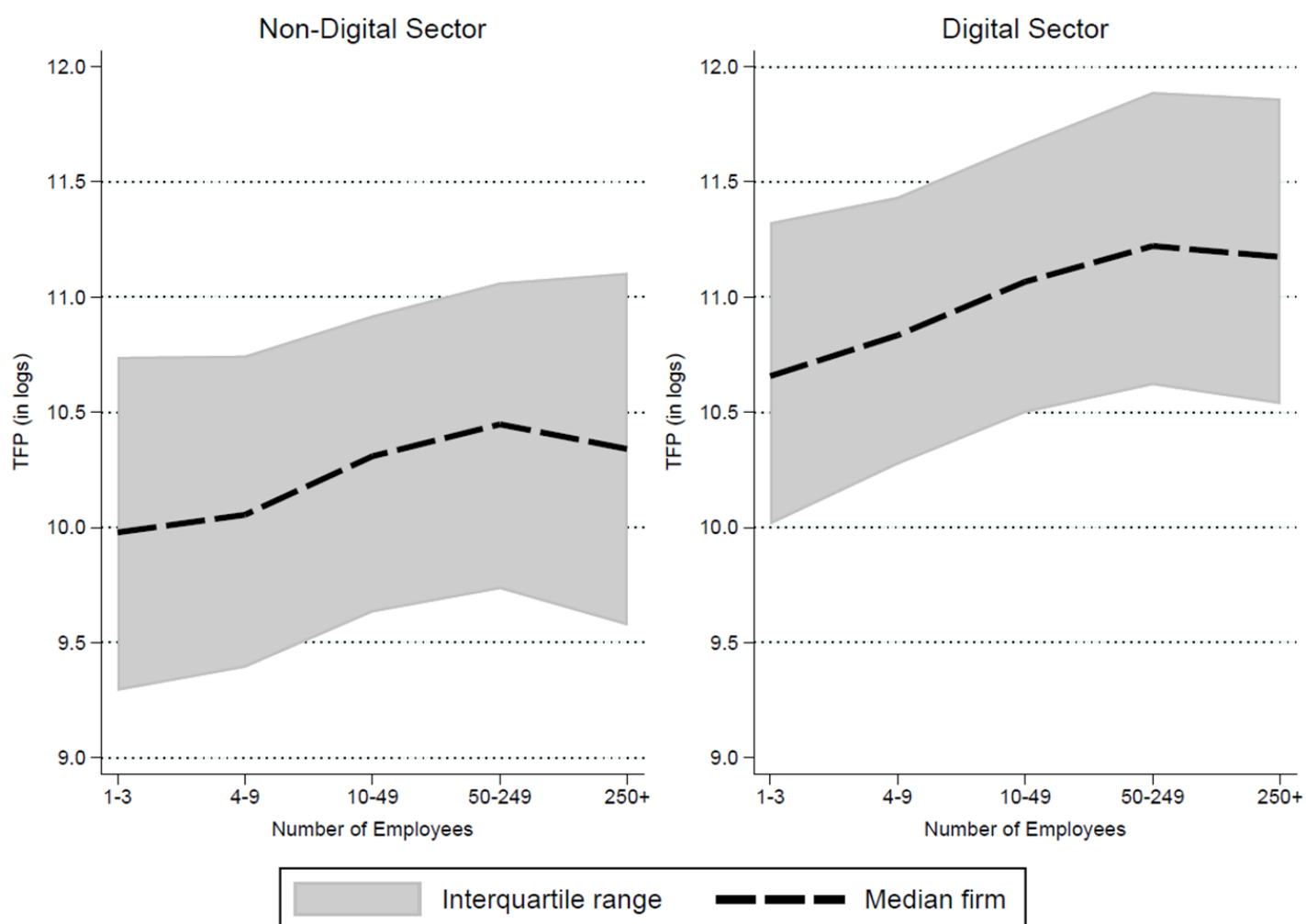
² See Anderton, R., Botelho, V., and P. Reimers (2023), “[Digitalisation and productivity: gamechanger or sideshow?](#)”, ECB Working Paper no. 2794.

³ The set of countries included in the analysis comprises Austria, Belgium, Estonia, Finland, France, Germany, Italy, Latvia, Norway, Portugal, Slovenia, Spain, and Sweden.

⁴ See Gandhi, A., S. Navarro, and David A. Rivers (2020), “[On the identification of gross output production functions](#)”, Journal of Political Economy Vol. 128, no. 8.

⁵ Digital and non-digital sectors are defined following Calvino, F., C. Criscuolo, L. Marcolin, and M. Squicciarini (2018), “[A taxonomy of digital intensive sectors](#)”, OECD Science, Technology and Industry Working Papers, no. 14.

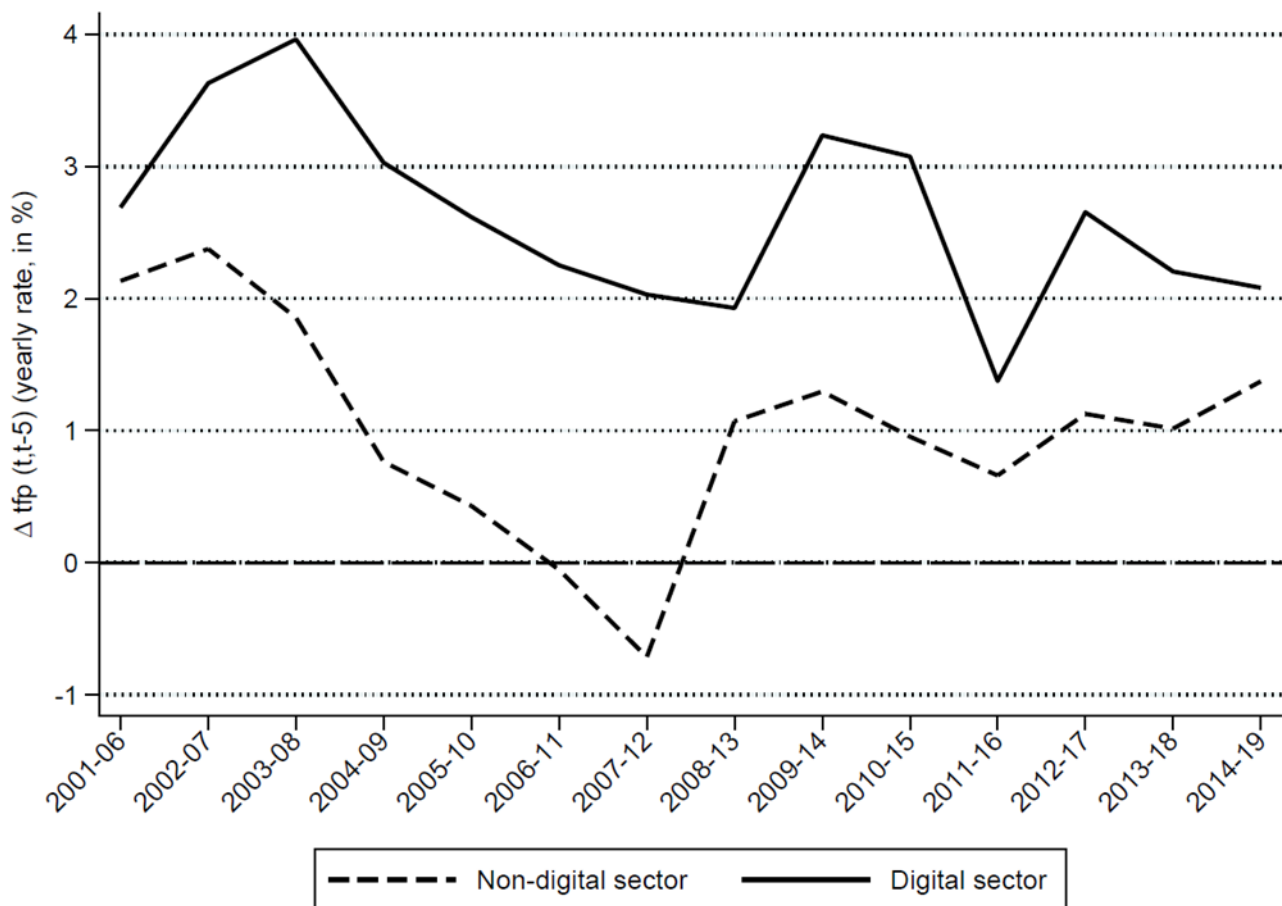
Chart 1: Interquartile range and median firm's TFP by employment size in digital and non-digital sectors



Sources and notes: Bureau van Dijk's Orbis and own calculations. Total factor productivity, in logarithms; Digital and non-digital sectors are defined following Calvino et al. (2018). Digital sectors are those with a high digital intensity in 2013-15.

Moreover, firms in digital intensive sectors seem to improve their productivity faster than firms in non-digital sectors. Chart 2 shows the average yearly TFP growth for European firms in digital and non-digital intensive sectors over five year periods. It unveils that firms in digital sectors consistently record a stronger average TFP growth than firms in non-digital sectors. Firms in both were negatively affected by the global financial crisis and by the European sovereign debt crisis. However, while for firms in digital sectors the average TFP growth decreased from around 4% per year during the 2003-08 period to 2% per year in 2007-12, firms in non-digital sectors were considerably more affected, with average TFP growth decreasing from 2% to a negative -0.6% over the same periods. It therefore seems that firms in digital sectors were also more insulated from the effects of both crises in terms of their productivity dynamics.

Chart 2: Average yearly TFP growth for European firms in digital and non-digital sectors over five year periods



Sources and notes: Bureau van Dijk's Orbis, and Anderton et al. (2023). TFP growth measured in percentages. Digital and non-digital sectors are defined following Calvino et al. (2018). Average TFP growth rates are weighted by the firms' employment levels at year $t - 5$ and presented in yearly growth rates.

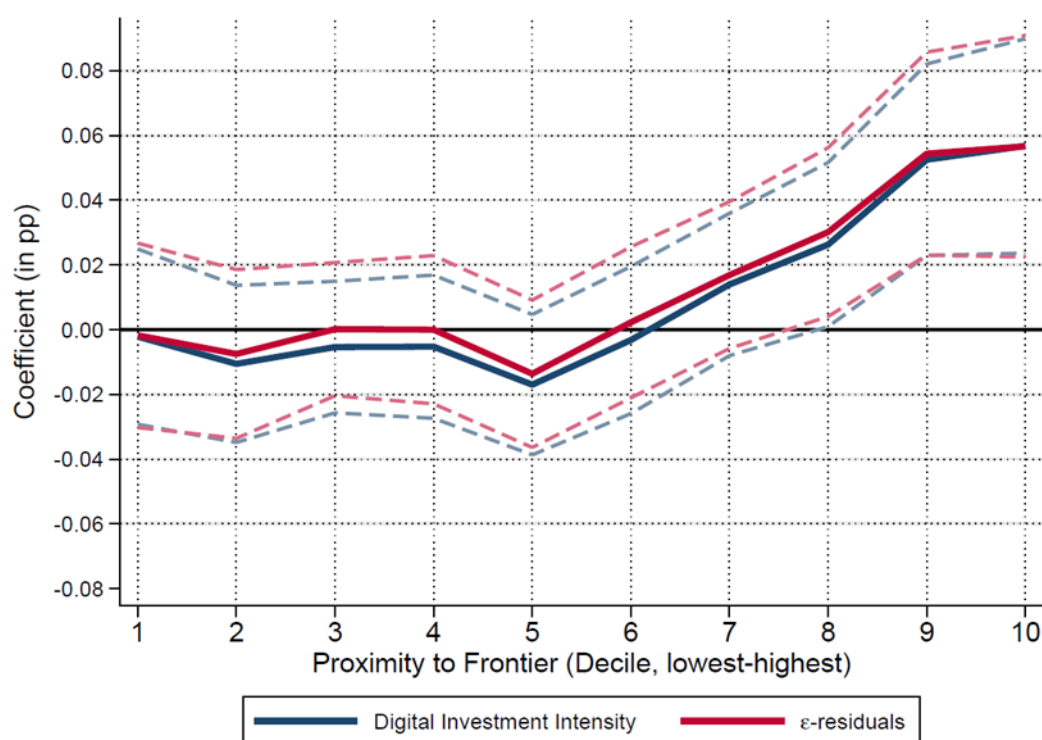
Is then digitalisation a massive gamechanger which delivers large productivity gains, or instead more of a sideshow with only limited impacts? We argue that the differences in productivity for the aggregated results above are not primarily due to digitalisation, but are driven by the different characteristics of firms and productivity dynamics in digital intensive and non-digital sectors. To identify the impacts of digitalisation we use as a proxy for digitalisation the digital investment intensity at the country and sector level over time, which we calculate as the ratio between the real investment in digital technologies and the real total investment.⁶

⁶The investment in digital technologies broadly comprises the investment in information and communication technologies and intellectual property products, which encompass the investment in computer software and databases and also expenditures on research and development. Anderton et al. (2023) also account for the fact that digital investment intensities might have increased driven by the long-term decline in the price of digital technologies. They cater for this channel by considering a second measure of digitalisation measuring the extent to which the digital investment intensity exceeds, or falls short of, what would be expected from declines in the relative price of digital investment. This measure is denoted as ε -residuals.

In our empirical model, we account for other channels that could drive the TFP growth at the firm level. On top of the impact of digitalisation, we cater for: (i) possible catching-up effects of low productivity firms that, in order to survive, need to become more productive over time; (ii) the technological diffusion and adoption of best practices from the most productive firms in their sectors of activity (i.e., frontier firms) to the remaining firms of the economy (i.e., laggard firms); (iii) different firm characteristics such as employment size, the age of the firm, and the financial health of the firm; (iv) differential degrees of market concentration; (v) and country-sector and year fixed effects to account for other time invariant heterogeneities at the country and sector level and for the business cycles.

We confirm that, on average, European firms with higher shares of investment in digital technologies exhibit a faster rate of productivity growth. However, we find that a 1% increase in digital investment intensities is only associated with a mild increase in TFP growth by 0.02 percentage points. This suggests that most of the productivity growth gains by firms in digital intensive sectors is driven from other channels not necessarily connected to their investment in digital technologies. Importantly, not all firms experience the same productivity returns of digital investment. Chart 3 records the estimated impact of a 1% higher digital investment intensity on the average firm's TFP growth by its proximity to the productivity frontier.⁷ It reveals that digitalisation boosts productivity mainly for firms who are already relatively more productive than their peers, while less productive laggard firms are less able to reap the potential productivity gains from digitalisation.

Chart 3: The impact of a 1 percentage point increase in digital investment intensity on firms' TFP growth by proximity to the productivity frontier



Sources and notes: Bureau van Dijk's Orbis, Eurostat, OECD, and Anderton et al. (2023). Dashed lines correspond to the 95% confidence interval.

⁷ We measure the proximity to the frontier at the country-sector-year level: For each year and in a given country and sector, we sort firms according to their TFP. The 5% most productive firms are the productivity frontier. We then compute for all the other firms in the same country, sector, and year, the distance between their TFP level and the average TFP level of these frontier firms. We group these firms by deciles and show the estimated impact of digitalisation on the firms' TFP growth by decile.

Our results suggest that digitalisation can be a productivity gamechanger for some firms, but it is more of a productivity sideshow for most firms. In this way, policymakers should not consider digitalisation as a “one-size-fits-all” policy to boost productivity. Instead, policy actions incentivising the investment and adoption of digital technologies are more likely to be successful if targeted towards relatively more productive firms and towards specific innovations that can make use of digital technologies to improve the potential output of the economy. ■

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