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Bridging the divide: new evidence about firms and digitalisation

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Executive summary

USING NEW EVIDENCE on the digitalisation activities of firms in the European Union and the United States, we document a trend towards digital polarisation based on firms' use of the latest digital technologies and their plans for future investment in digitalisation. A substantial share of firms are not implementing any state-of-the-art digital technologies and do not have plans to invest in digitalisation. However, there is also a substantial share of firms that are already partially or even fully implementing state-of-the-art digital technologies in their businesses and that plan to further increase their digitalisation investments.

SMALL MANUFACTURING FIRMS and old small firms in services are significantly more likely to be and remain non-active in terms of digitalisation. Our results do not provide any evidence that EU firms are more likely than their US counterparts to be stuck on the wrong side of the digitalisation divide. Taking into account firm size and firm age, there are no significant differences between the EU and the US in terms of having more or fewer persistently non-digital firms.

AS PERSISTENTLY DIGITALLY-INACTIVE firms are also less likely to be innovative, to add employees or to command higher mark-ups, it is important for policymaking to remove barriers that trap these firms in persistent digital inactivity. Lack of access to finance is a major barrier for EU firms compared to their US counterparts, particularly for the EU's persistently non-digital firms, and especially for older, smaller companies in services. Improving their access to finance might therefore go a long way towards addressing the corporate digitalisation divide in the EU.

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1 Introduction

Digital technologies have proliferated in the business sector, from the provision of digital products and services online to robotised production processes, the internet of things, big data and artificial intelligence, and applications, including use of digital systems to manage back office tasks. Numerous optimistic statements have been made that the digitalisation of the business sector will boost growth and productivity and trigger a fourth industrial revolution. However, there has been so far little hard evidence of a significant productivity boost. More than 30 years after Robert Solow's (1987) statement *"you can see the computer age everywhere but in productivity statistics"*, macro-level productivity growth remains subdued. Meanwhile, digitalisation is feared as a source of disruption, with the risk that only a few firms will emerge as winners while many firms and workers lose out, leading to a more polarised economic structure.

There is some evidence that this polarisation is happening and digital technologies are leading to winner-takes-all markets. Andrews *et al* (2017) showed an increasing productivity gap between firms at the global frontier and laggards. Frontier firms are typically larger, more innovative and have higher rates of digital technology adoption[1]. There is also evidence of rising market concentration (Autor *et al*, 2017; Philippon, 2019) and rising mark-ups by firms (De Loecker and Eeckhout, 2017). In particular, Diez *et al* (2018) found that mark-ups have risen among firms that already have the highest mark-ups within their industries, consistent with winner-takes-all patterns. The trends of rising market concentration and mark-ups tend be more pronounced in the sectors in which digital technologies, especially digital services, are developed or widely adopted (Calligaris *et al*, 2018). Digital technologies often come with features such as scale and synergies, which give an advantage to large firms and foster market concentration (Haskel and Westlake, 2017).

The discussion on winner-take-all markets and rising mark-ups by firms that already have the highest mark-ups is perhaps most associated with Big Tech firms, such as Alibaba, Alphabet, Apple, Amazon, Facebook, Huawei and Microsoft. All these companies are from the US or China. European firms are not present among the Big Tech giants and European Union firms are not among the leading digital research and development investors (Veugelers, 2018; EIB, 2018).

The EU has fallen behind in the digital technologies and services race but might be able to take up leading positions in new races. This will depend on the integration of digital technologies, including the internet of things (IoT) and artificial intelligence (AI), into manufacturing and services (eg Bughin *et al*, 2019). For example, car manufacturing, a pivotal sector for the EU economy, is now done in the context of a whole series of digital services (smart electricity grids, personalised entertainment systems, smart mobility), which are all part of a network centred on the physical platform represented by the car and based on IoT and AI.

If European firms are unable to integrate new digital technologies into their business models, they will lose out, even in those sectors where they are currently still leading. There is growing concern that EU firms in non-digital sectors lag behind in the adoption of digital technologies, especially in the services sector (EIB, 2018). This correlates with subdued EU productivity growth.

Although these are first-order concerns, there is little large-scale cross-sector and cross-national firm-level evidence about digital technology use, which would allow the position of EU firms on the digital technology divide compared with their US peers to be checked. Using the results of a large-scale survey on the digitalisation activities of EU and US firms, conducted in 2018 by the European Investment Bank, this Policy Contribution addresses

1 Andrews *et al* (2016) define global frontier firms as the top 5 percent of firms in terms of labour productivity levels, within each two-digit sector, in each year, across all countries since the early 2000s. All other firms are defined as laggards.

this evidence gap. Based on data on the current use by firms of state-of-the-art digital technologies in manufacturing and services, and on their future plans for investment in digitalisation it maps the corporate digital investment divide and identifies which firms are located on which side.

2 Digital investment and skills survey data

In 2018, the European Investment Bank interviewed 1,700 companies in the EU and the US about their digital investments[2]. To categorise companies according to their stage of digitalisation, we used information from these interviews on:

1. How far companies have gone in adopting the most prominent state-of-the-art digital technologies;
2. Companies' investment plans for digital technologies.

The EIB data covers firms with at least five employees in the manufacturing and services sectors. The sample was stratified by industry group (manufacturing and services sector), size class and region (Table 1)[3].

Table 1: Breakdown of firms surveyed for their digital investment plans

	Manufacturing	Services
European Union	456	432
West and North Europe	198	198
South Europe	122	89
Central and East Europe	146	145
United States	411	389
Northeast	93	83
Midwest	126	136
South	106	82
West	86	88
Size (no. employees)		
Micro (5-9)	143	172
Small (10-49)	291	333
Medium (50-249)	287	223
Large (250+)	146	93

Source: EIB (for details see chapter 8 of EIB, 2018). Note: West and North Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden and the United Kingdom. South Europe: Cyprus, Greece, Italy, Portugal and Spain. Central and East Europe: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. US regions according to US Census Bureau geographical divisions.

2 For details, see chapter 8 of EIB (2018).

3 The sample size of the 2018 EIB survey is relatively small. The survey is representative at the level of the three aggregate groups of countries in the EU and the four regions in the US (Table 1) but not at individual EU country level. Similarly, it is representative for the manufacturing and services sectors, but does not provide more detailed information on industry classification within those broad sectors. The full database underlying the results reported in this Policy Contribution is not publically available. For details, see chapter 8 of EIB (2018).

2.1 Adoption of digital technologies

We first evaluated the current digitalisation status of companies (divided into manufacturing and services companies) according to how far they have gone in adopting the state-of-the-art digital technologies listed in Table 2[4].

Table 2: State-of-the-art digital technologies covered by the assessment

Manufacturing
3D printing, also known as additive manufacturing;
Automation via advanced robotics – a second generation of robots, which are more autonomous, flexible and often more easily programmable;
Internet of things: electronic devices that communicate with each other without human assistance;
Big data and analytics.
Services
Digitalisation and automation of internal routines, including back-office, purchasing and logistics management, for example, software that automates routine tasks such as billing and accounting;
Web-based applications for marketing and sales, for example, using a specific app through which customers can order goods or services;
Provision of digital products and services over the internet, for example offering of automated market intelligence or digital content streaming;
Big data and analytics.

Source: EIB (for details see chapter 8 of EIB, 2018).

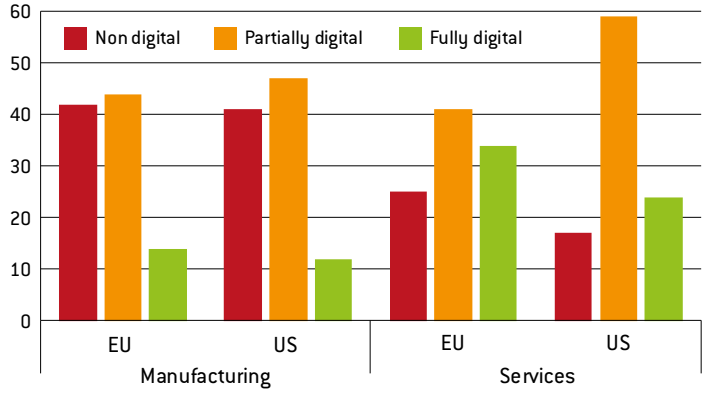
We labelled as 'fully digital' companies that said their entire business is organised around at least one of the four digital technologies listed in Table 2. If at least one of the technologies is implemented in parts of a firm's business, we labelled them as 'partially digital'. We labelled as 'non-digital' all companies that have not heard about any of these digital technologies or have only heard about them but have not implemented any of them. Firms in the services sector tend to be more digitalised and are more likely to be 'fully digital', which could be related to the different set of state-of-the-art digital technologies used in the survey to characterise the level of digitalisation.

A first finding is that EU firms are not lagging behind their US counterparts. Figure 1 shows no evidence that EU manufacturing firms are less digitally active compared to their US counterparts. For the services sectors, the share of EU firms that are non-digital is larger than in the US. However, the share of EU firms that have organised their entire business around digital technologies is larger than in the US. But these differences disappear when comparing EU and US firms within the same firm size and age category[5].

4 The relevant question from the EIB survey was: 'Q32. Can you tell me for each of the following technologies if you have (i) not heard about them, (ii) have heard about them but not implemented, (iii) implemented them in parts of your business, or (iv) whether your entire business is organised around them?' For details see chapter 8 of EIB (2018).

5 For a more detailed discussion, see Rückert *et al* (2019).

Figure 1: Share of firms that are digitally active (in %), 2018



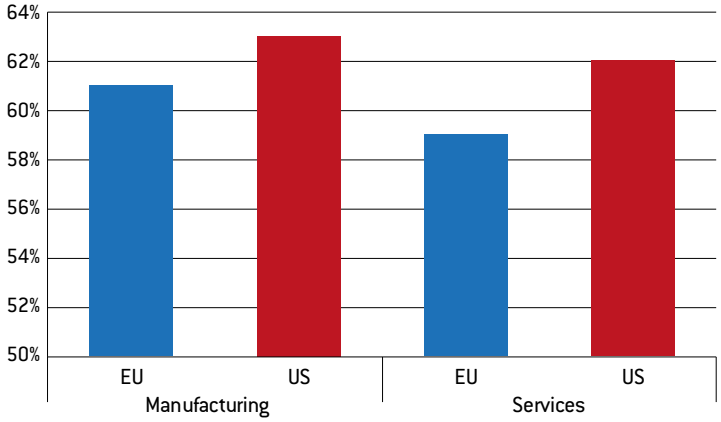
Source: Bruegel based on EIB data.

2.2 Digital investment plans

In terms of companies' digital investment plans for the next three years[6], we classified companies as 'increasing' if they plan to increase their investments in digital technologies, or if they have not yet made digital investments but plan to start doing so. We label all other firms as 'stable/inactive/reduced'.

Around 60 percent of companies plan to increase their digital technology investment spending (Figure 2). Although EU firms score somewhat lower than their US counterparts, both in manufacturing and services, there a re no major statistically significant differences between companies in the EU and US when it comes to future investment in digital technologies.

Figure 2: Share of firms that plan to increase investment in digital technologies in the next three years (2018)



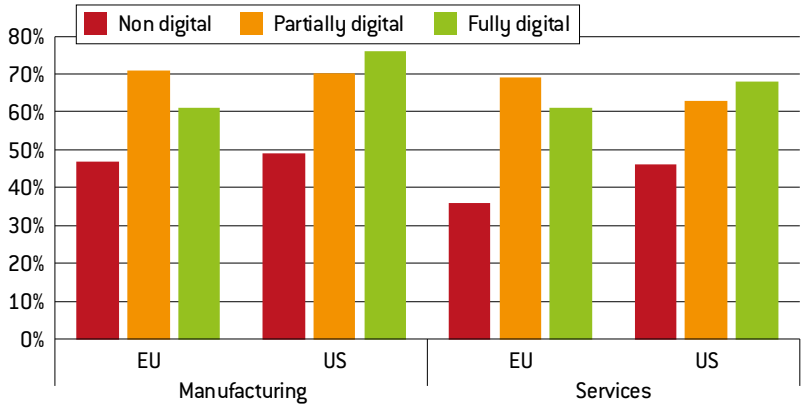
Source: Bruegel based on EIB data.

6 The relevant EIB survey question for firms that have already implemented one of the digital technologies read: 'Over the next three years, do you expect your investment spend in digital technologies to (i) increase, (ii) stay around the same, (iii) decrease, (iv) no investment planned in digital technologies?' The similar question for non-digital firms reads: 'Looking ahead to the next three years, do you plan to invest in digital technologies?'

3 Who is on which side of the digital divide?

Combining firms' current state of digital investments with their plans for digital investments allows us to characterise firms according to their positions on the digital divide. Figure 3 shows how digitally active firms are significantly more likely to have plans to expand their digital investments further. On the other side, firms that are currently not using state-of-the-art digital technologies are less likely to have future digital investment plans. This is the case in both the EU and the US, in the manufacturing and services sectors. This evidence of polarisation confirms the existence of a corporate digitalisation divide[7].

Figure 3: Share of firms that plan to increase investment in digital technologies in the next three years, by digitalisation intensity (2018)



Source: Bruegel based on EIB data.

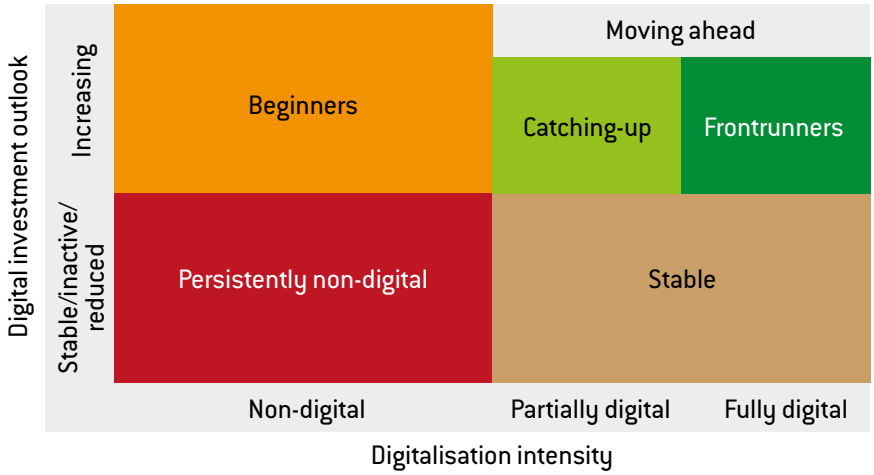
The next question is which firms are on which side of the digitalisation divide? Figure 4 categorises firms according to their current level of digitalisation and their digital investment outlook.

Firms that have not invested so far in state-of-the-art digital technologies and that are not planning to do so in the coming years can be considered as falling behind. We categorise them as 'persistently non-digital'. Companies that are currently non-digital but are planning to start investing in the coming three years are categorised as 'beginners.'

Of the firms that are currently digitally active, those that are planning to increase their digital investments in the coming three years are listed as 'moving ahead.' 'Stable' companies are already digitalised but do not intend to increase their digital investment spending in the coming three years. We further split up the moving-ahead firms depending on whether they are currently fully or partially digitally active. 'Frontrunners' are those firms that are currently already fully digitally active and that are also increasing their digital investments; the rest we label as 'catching-up.'

7 For multivariate analysis results on the likelihood of firms having plans to expand their digital investments depending on their state of current digitally activity, see Rückert *et al* (2019).

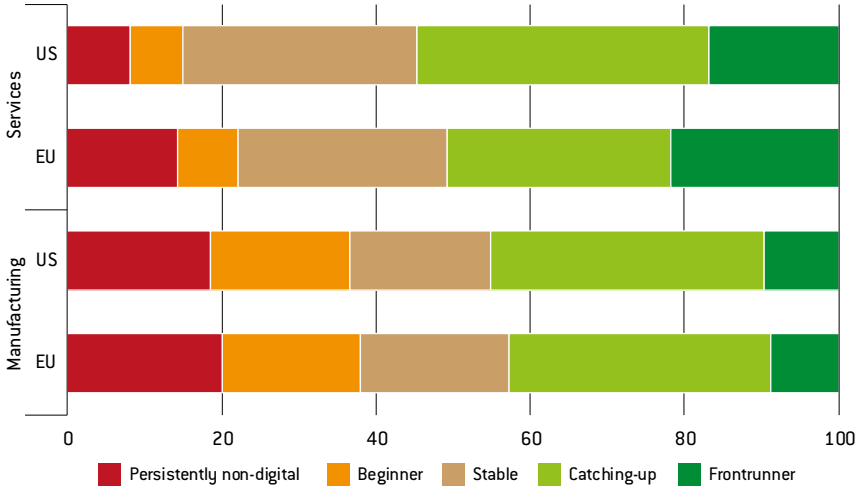
Figure 4: Corporate digitalisation divide categories



Source: Bruegel based on EIB data.

Figure 5 sorts the surveyed companies in the EU and the US in manufacturing and services into the digitalisation divide categories of Figure 4. For manufacturing firms, there are no major differences in terms of digitalisation divide profiles between the EU and the US. In services, however, the EU seems to have more firms left behind by digitalisation. At the same time, the EU has somewhat more 'frontrunners' in services compared to the US. There is therefore some evidence of a greater digitalisation divide among services companies in the EU than the US, but these differences are not significant[8].

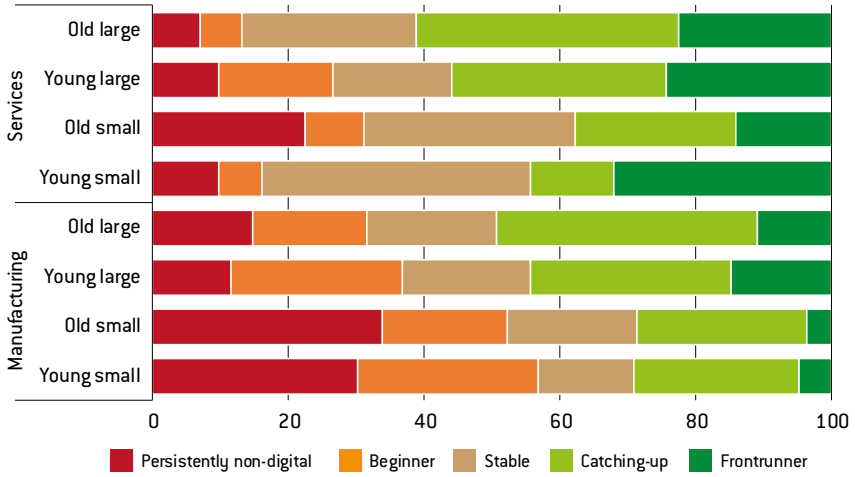
Figure 5: Digitalisation divide in the EU and US, by sector (2018)



Source: Bruegel based on EIB data.

8 Multivariate analysis confirms that there are no statistically significant differences between EU and US firms in terms of the likelihood that they are persistently non-active or moving ahead, when comparing within sectors and controlling for firm size and age. The greater probability of EU firms being 'frontrunners' in services, compared to US firms, is only marginally significant (see Rückert *et al*, 2019).

Figure 6: Digitalisation divide, by sector and age-size categories (2018)



Source: Bruegel based on EIB data. Note: Young = less than 10 years old; small = fewer than 50 employees.

4 Performance and digital polarisation

Why is it important to identify on which side of the digitalisation divide firms are? Does it matter for firm performance, or broader economic performance, whether firms are falling behind or moving ahead? To address these questions, we looked at how firms with different positions relative to the digitalisation divide perform in relation to employment growth, innovation and mark-ups. This analysis is purely correlational and cannot be interpreted as causal.

4.1 Employment growth

The EIB in 2018 asked firms about their current number of employees and the number of employees three years ago (see section 2 for information about the EIB survey). Figure 7 shows that firms with no plans to start or increase digital investments are also less likely to have expanded employment in the past three years. Firms that are 'persistently non-digital' score particularly poorly on adding jobs over the past three years, especially in the EU[9]. In contrast, companies that plan to increase their digital investments, whether 'beginners' or 'movers ahead' (ie 'catching-up' and 'frontrunners'), are more likely to have increased employment. Firms' positioning on the digitalisation divide thus matters for employment growth: those moving ahead are more likely to increase employment, while those left behind are less likely to grow. Job destruction effects from digitalisation thus seem more likely to be found in firms falling behind, rather than in firms that are forging ahead.

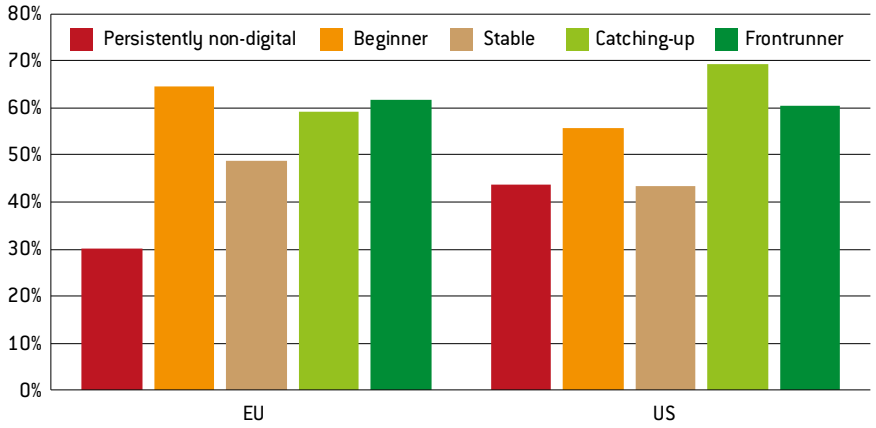
4.2 R&D and innovation

The EIB data also allows us to draw out innovation profiles. In line with Veugelers *et al* (2019), we identified companies as 'non innovation-active' if they do not invest in R&D and do not invest in order to develop or introduce new products, processes and services. These firms are not engaged in incremental or radical innovation and are not adopting innovation developed elsewhere. We would expect digital technologies to empower innovation and therefore firms that are moving ahead with digitalisation to be also innovation-active. Figure 8 confirms that those firms left behind on the wrong side of the digital divide are also more likely to be 'non

9 The results are qualitatively similar when we split the sample by sector and conduct the analysis separately for firms in manufacturing or services.

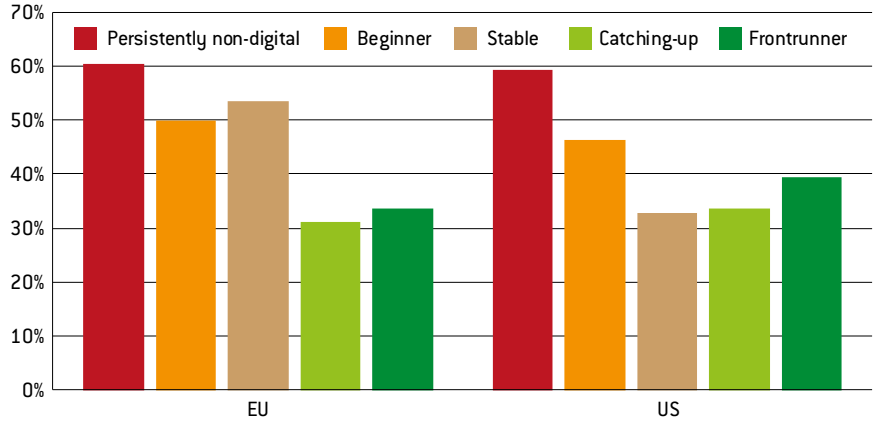
innovation-active'. Firms moving ahead are significantly more likely than companies in other digitalisation categories to be leading innovators[10].

Figure 7: Share of firms with positive employment growth in past three years (2018)



Source: Bruegel based on EIB data.

Figure 8: Share of 'non innovation-active' firms (2018)



Source: Bruegel based on EIB data. Note: Firms are considered non innovation-active if they do not invest in R&D and do not invest in order to develop or introduce new products, processes and services (Veugelers *et al*, 2019).

4.3 Mark-ups

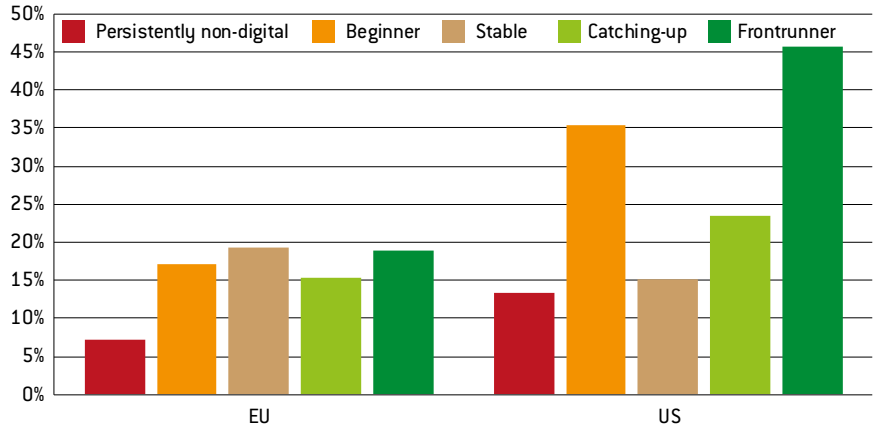
Digitalisation is often linked to increasing market concentration among a few big companies with market power. We estimated mark-ups for the firms in our sample and correlated them with the digitalisation profiles[11]. In line with the literature, we are interested in testing whether firms left behind on the wrong side of the digitalisation divide (ie 'persistently non-digital' firms) have lower mark-ups and whether firms that are moving ahead have higher mark-ups.

Figure 9 shows that persistently non-digital firms are also significantly less likely to be the firms with the top mark-ups in their sectors. Beginners and, even more so, frontrunners are likely to be in the top quintile of the distribution of mark-ups in their sector. This is most evident for US firms.

10 For a more detailed discussion on multivariate analysis results on the link between the digital divide and innovation, see Rückert *et al* (2019).

11 The estimation of mark-ups is based on the approach of De Loecker and Eeckhout (2017).

Figure 9: Share of firms in the top quintile of the distribution of mark-ups (2018)



Source: Bruegel based on EIB data.

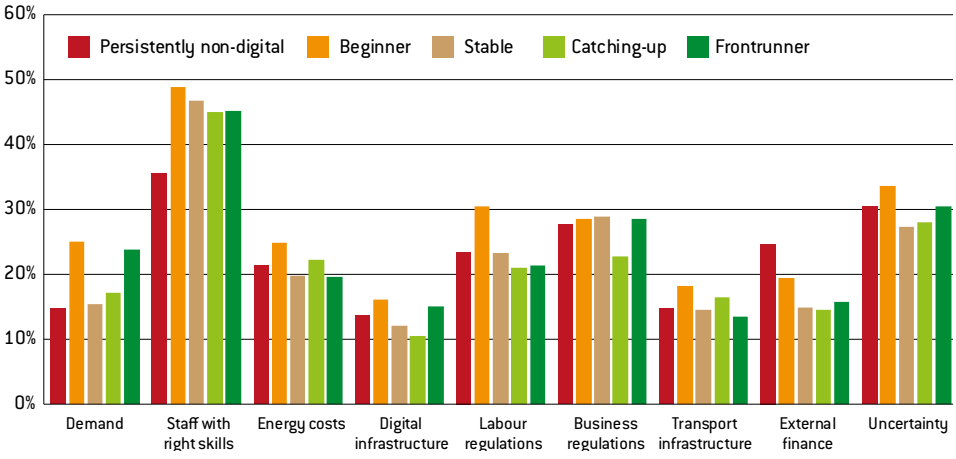
5 Barriers to, and incentives for, investment in digitalisation

Finally, we looked at the different barriers and incentives firms perceive when contemplating investment in digitalisation. We did this for each of the digitalisation divide categories. Identifying any barrier that specifically impedes firms that are left behind on the wrong side of the digital divide is relevant for the identification of policy levers to help move these firms away from of their 'persistently non-digital' status.

5.1 Perceived barriers to investment in digitalisation

Figure 10 shows that the 'availability of staff with the right skills' is the most important barrier to investment activities: 44 percent of all firms report this as a major obstacle to investment. This finding supports the central role of skill formation in any digital policy mix. 'Uncertainty about the future' and 'business regulations (eg licences, permits, bankruptcy) and taxation' complete the top three major barriers. Perhaps surprisingly, 'access to digital infrastructure' is the barrier identified least frequently as a major obstacle. Policies to ensure access to digital infrastructure seem to be therefore not (or no longer) necessarily as relevant as previously.

Figure 10: Share of firms that reported an obstacle to investment as 'major' (2018)

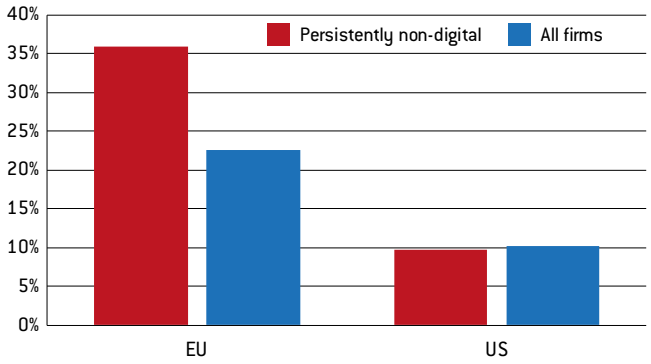


Source: Bruegel based on EIB data.

'Persistently non-digital' firms do not report that the barriers to investment affect them more severely than other firms. This evidence would suggest that the lack of digital investment is not so much a consequence of greater impediments, but of fewer incentives or less ambition. Lack of availability of external finance is the only barrier that is more often rated by persistently non-digital firms as a major impediment to investment: one out of four persistently non-digital firms rates this as a major barrier compared to one out of six for all firms.

Figure 11 shows that the availability of external finance seems to be a more severe barrier for EU firms than US firms. Unlike in the US, persistently non-digital firms in the EU are significantly more likely than other EU firms to report access to finance as a major impediment. This suggests that addressing the access to finance issue should be a primary focus for EU policymakers to lift their persistently non-digital firms into digitalisation.

Figure 11: Share of firms that report the availability of external finance as a major obstacle to investment (2018)

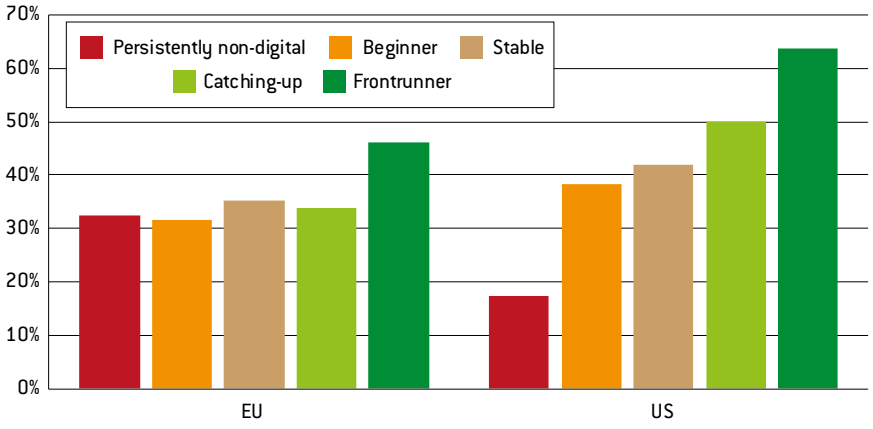


Source: Bruegel based on EIB data.

5.2 Increased competition because of digitalisation

The 2018 EIB survey also asked about firms' expectations of future competitive pressure arising from digitalisation: whether they expect that digital technologies will lead to an increase in the number of firms competing in their sector or not. As escaping competition might be a major incentive for firms to engage in digital investment, we explored for which firms competition can work as incentive.

Figure 12: Shares of firms that expect digital technologies to lead to an increase in the number of firms competing in their sector (2018)



Source: Bruegel based on EIB data.

Overall, 40 percent of surveyed firms expected an increase in competition in their sector as a result of digitalisation. In general, US firms are more likely than EU firms to expect an increase in competitive pressure, reflecting a more competitive US single market (Figure 12). Persistently non-digital firms seem to feel more shielded from competitive pressure, as they are less likely to expect an increase in competition arising from digitalisation. This perceived lack of competitive pressure contributes to a lack of incentives for persistently non-digital firms to engage in digitalisation. Competitive pressure seems to motivate in particular firms in the moving ahead category, especially in the US, to further advance in terms of digitalisation.

6 Conclusions and implications for policy

Our analysis confirms the trend towards a digitalisation divide between companies. A substantial share of firms does not implement any state-of-the-art digital technology and has no plans to start investing in digitalisation. However, a substantial share of firms already partially or even fully implements state-of-the-art digital technologies in their businesses, and has plans to further increase their digitalisation investments.

In terms of the types of firms that are more likely to be persistently non-digital, firm size and firm age matter. Small manufacturing firms and old small services firms are significantly more likely to be persistently non-digital. Economies with more old SMEs are therefore more vulnerable to corporate digital polarisation.

Taking into account sector and firm-size differences, our results do not provide any evidence that EU firms are more likely to be stuck on the wrong side of the digitalisation divide compared to their US counterparts. There are no significant differences between the EU and the US in terms of having more or fewer persistently non-digital firms. Our results show that it matters for firms' performance if they are falling behind and for economies if they have too many firms left behind on the wrong side of the digital divide. Persistently non-digital firms are less likely to be innovative, less likely to create new jobs and less likely to command higher mark-ups, while digitalisation frontrunners are more likely to be innovative and increase their workforces, and can command significantly higher mark-ups. Lifting firms out of persistent digital non-activity should therefore be high on the policy agenda.

The EIB survey carried out in 2018 also looked at the barriers firms perceive when contemplating investment (see EIB, 2018, chapter 8, for details). Overall, our analysis shows that policymaking in the EU should be concerned about the lack, and particularly about the long-standing lack, of digital investment by some of its firms. SMEs in manufacturing and old SMEs in services are likely to be in the danger zone of permanent digital inactivity and deserve special policy attention. Addressing barriers to skills should be a priority for policymakers in order to support firms to digitalise further, irrespective of where they stand in relation to the digital divide. Similarly, addressing the regulatory burden and the uncertainties regulation can create should also be high on the digital policy agenda.

The higher sensitivity of US firms and frontrunners to competition when investing in digitalisation is a reminder for EU policymakers of the importance of a well-functioning EU integrated market. This underpins the call for an industrial policy at EU level which should have the single market and competition policy as its core horizontal instruments, to ensure a large, competitive market environment that will push firms to invest in digitalisation (as advocated by Altomonte and Veugelers, 2019). Beyond completing the digital single market, the single market for non-digital products should be completed, particularly non-digital services (as diverse as retail, transport, hotels and banks). On skills, there is a role for the EU to make it easier for firms to access digital skills across national borders. This requires, among other things, more work on mutual recognition of diplomas and the introduction of a European professional card to reduce intra-EU mobility costs. A recalibration of the European Social Fund, providing greater support to specific national digital education initiatives and to the

training and retraining of workers, would also help to address this first-order impediment to digital investment.

The evidence reported here finds access to finance to be a more severe obstacle to investment for EU firms compared to their US counterparts, particularly for the EU's persistently non-digital firms. Addressing problems of access to finance may therefore go a long way to address the EU's corporate digitalisation divide.

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