

# CHAPTER

# 11.6

# INTANGIBLE INVESTMENT AND INNOVATION IN THE EU: FIRM- LEVEL EVIDENCE FROM THE 2017 EIB INVESTMENT SURVEY<sup>49</sup>

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## Executive summary

Investment in knowledge creation is one of the main drivers of long-term prosperity and inclusive economic growth for advanced economies. Innovation is expected to help address pressing societal challenges – including an ageing population, climate change and various health and environmental issues. New products, processes or services will have to be developed, creating new growth opportunities for firms as well as new skills needs and job opportunities for workers.

Firms' innovation activities are typically difficult to measure well. This chapter is based on the EIB Investment Survey (EIBIS), an annual survey with rich information on investment and finance activities of 12 500 firms in all 28 EU Member States. The survey also covers innovation activities with questions on the share of investment in intangible assets as well as that spent to develop or introduce new products, processes and services.

Results from EIBIS show that, when it comes to intangible assets, EU firms in manufacturing invest relatively more in R&D, while companies in services spend a higher share of investment on software and databases. Compared to large companies, small and medium-sized enterprises (SMEs) tend to place a larger share of their investment in intangibles, even after controlling for each country's industry make-up. More productive firms and exporters also invest more in intangibles. This suggests that intangible investments are key for innovation, productivity and economic growth. Firms that invest more in intangibles rely more on internal finance to finance their investments. They also tend to be less satisfied with external finance conditions and are more likely to be finance constrained.

There is a large variation across EU Member States and sectors in how much firms invest on developing or introducing new products, processes and services. Manufacturing firms, high productivity firms and exporters are more likely to introduce products that are new to the global market as they have to compete on international markets. The degree of innovation increases with the diversification of financial instruments: firms using several financial instruments are more likely to invest in R&D and in new products, processes or services compared to firms that use a more limited number of financing instruments.

Public policies in the EU should aim to foster innovation at the technological frontier. However, they should also support firms that adopt existing technologies and innovation diffusion across all companies. Policymakers should take into account the differences between firms which invest in intangibles or introduce new products, processes or services and those that do not, when they design and develop new schemes, in particular innovative financial instruments, to increase and diversify the sources of external finance for innovative firms. At the same time, the diversity of intangible assets should be emphasised so that policies do not only promote R&D investment or manufacturing firms but also innovation by firms in all sectors of the economy.

## 1. Intangible investment in the EIB Investment Survey

Investment in knowledge creation is one of the main drivers of long-term prosperity and inclusive economic growth for advanced economies. Innovation is expected to help address pressing societal challenges – including an ageing population, climate change and various health and environmental issues. New products, processes or services will have to be developed, creating new growth opportunities for firms as well as new skills needs and job opportunities for workers (OECD, 2016). An environment that facilitates investment in innovation and highly innovative firms will support an economy's competitiveness. The ecosystem should also enhance the effective diffusion, circulation, commercialisation and use of this knowledge, especially for firms that do not innovate at the technological frontier (European Commission, 2016).

Firms' innovation activities are typically difficult to measure well. This chapter is based on the EIB Investment Survey (EIBIS), an annual survey with rich information on investment and finance of 12 500 firms in all 28 EU Member States. The results use the second wave of the survey which was conducted in 2017 and refer to investments made by firms in the 2016 fiscal year. The survey covers innovation activities with questions on the share of investment spent on intangible assets as well as on that spent to develop or introduce new products, processes and services.

**The EIB Investment Survey (EIBIS) finds that, in 2016, 37% of investment went into intangible assets, while 63% went into fixed assets.**

The survey covers four different categories of intangible assets: R&D (including the acquisition of intellectual property); software, data, IT networks and website activities; training employees; and organisation and business process improvements. For fixed tangible assets, the two categories are: land, buildings and infrastructure; and machinery and equipment. EIBIS finds that, in 2016, 37% of total investment by non-financial corporations in the EU went into intangible assets, while 63% went into fixed assets<sup>50</sup>. While the share of intangible investment remained stable between 2015 and 2016, expenditure in intangibles went up together with an increase in total investment made by EU firms.

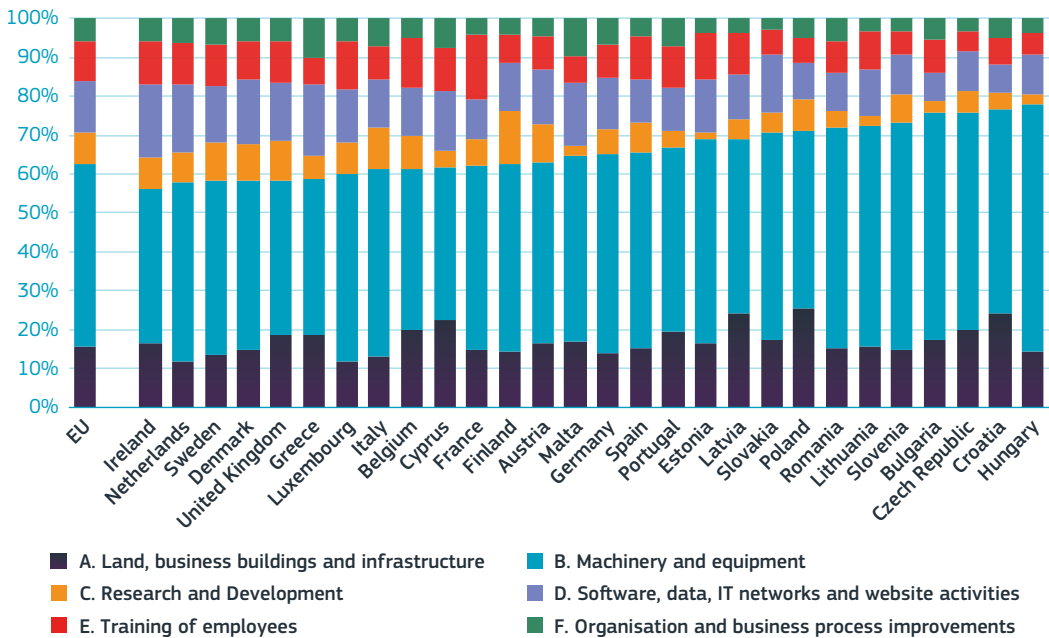
Machinery and equipment represent almost half (47%) of investment by non-financial companies in the EU in 2016. Land, business buildings and infrastructure account for 17% of total investment. Software and databases make up the largest component of intangible investment in the EU, representing around 13% of total investment, followed by employee training (10%), R&D (8%) and organisational and business process improvements (6%).

50 Investment is highly correlated with fixed assets or turnover. This chapter uses data on the share of intangible investment in total investment, although the findings reported here are similar if intangible investment intensity is defined as the ratio of intangible investment to turnover (or to fixed assets).

There is substantial variation in the share of intangibles across EU Member States, ranging from less than 25% in Hungary, Croatia, Czech Republic and Bulgaria to more than 40% in Greece, the UK, Denmark, the Netherlands and Ireland (Figure II.6.1). The lower share of intangible investment in the Central, Eastern and South-eastern Europe (CESEE) region may be explained by firms in the region catching up in terms of investment in tangible fixed assets.

But across countries, differences in the share of intangible investment are not only driven by the industry composition in each Member State's economy. The higher share of intangible investment in the Northern countries may partly be due to the relatively favourable tax treatment and a better ecosystem for investment in intangibles in these countries. This suggests that there is room for public policy to give incentives to firms to invest more in intangibles in several EU economies.

**Figure II.6.1 Investment by area (%) in EU Member States<sup>1</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

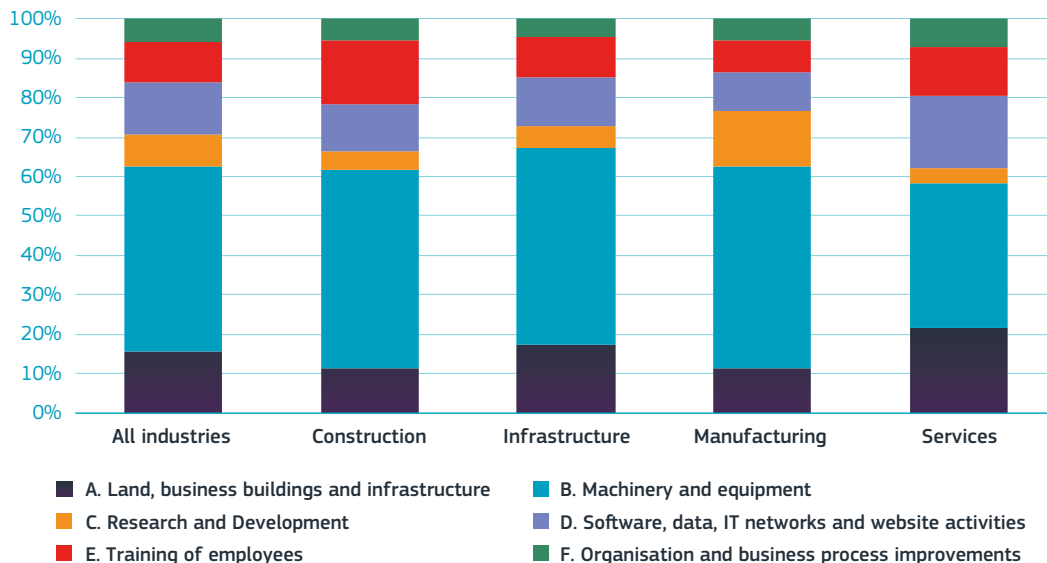
Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Note: <sup>1</sup>EIB Investment Survey question: In the last financial year, how much did your business invest in each of the following with the intention of maintaining or increasing your company's future earnings? Base: All firms which have invested in the last financial year (excluding don't know / refused responses). Countries are ordered according to share of intangible investment.

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**Figure II.6.2 Investment by area (%) in industrial sectors in the EU<sup>1</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Note: 'EIB Investment Survey question: In the last financial year, how much did your business invest in each of the following with the intention of maintaining or increasing your company's future earnings? Base: All firms which have invested in the last financial year (excluding don't know / refused responses).

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### **Firms in manufacturing invest relatively more in R&D, while firms in services invest a higher share of investment in software and databases.**

The share of intangible investment also varies across industries, with firms in infrastructure investing a third of their investment in intangibles, while this share is 42% for firms in services (Figure II.6.2). Construction is the only industry where there was a marked fall in the share of intangible investment, from 43% of total investment in 2015 to 38% in 2016.

Investments in software, data, IT networks and website activities are particularly relevant for firms in services as this may allow them to

adopt the latest technologies thereby differentiating them from their competitors. Software and databases is also the largest component of intangible investment for firms in infrastructure, which typically invest less in intangible than firms operating in other industries.

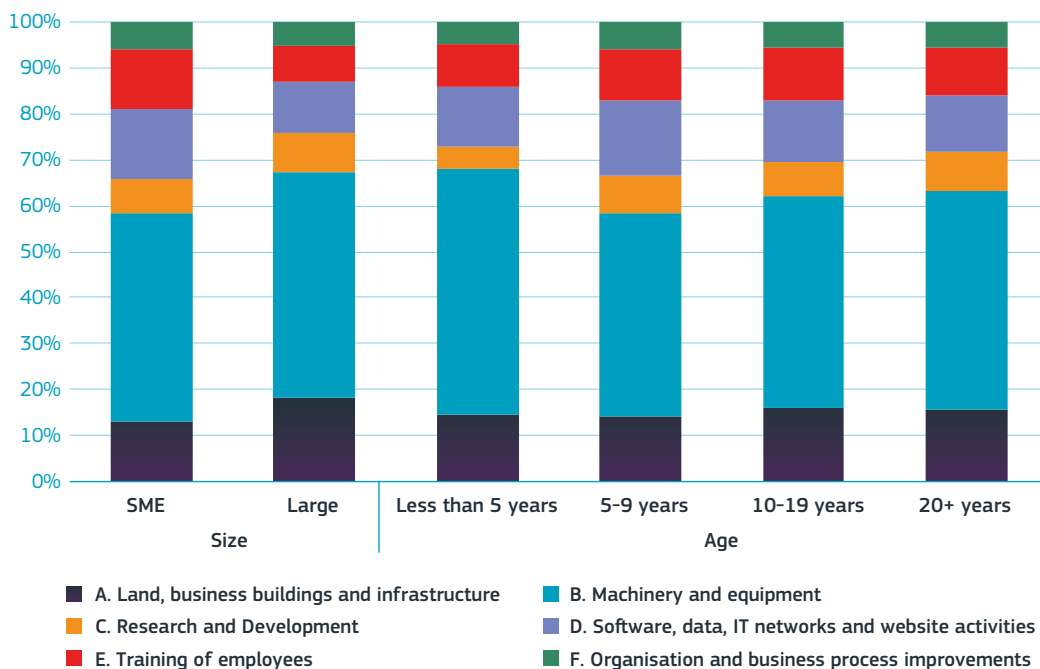
Manufacturing firms conduct much more R&D than the other industries, with R&D investment representing almost 15% of total investment. The share of R&D investment in construction and infrastructure is around 5% of total investment and less than 4% for services. At the same time, company training is the largest component of intangible investment for firms in construction, which could reflect an attempt to compensate for years of labour shedding.

### Compared to large companies, SMEs tend to invest a larger share of their investment in intangibles ...

While the size of the investments is much smaller for SMEs, they tend to invest a higher share in intangibles (42%) compared to larger firms – whose share is one-third (Figure II.6.3). The largest differences are for investment in

software and databases, and employee training. Remarkably, large firms and SMEs invest almost the same shares in R&D and in organisation and business process improvements. The share of intangible investment does not vary much with the company's age, except for very young firms (under five years old), which tend to invest a larger share in machinery and equipment.

**Figure II.6.3 Investment in the EU by area (%) in firms classified by firm size and firm age<sup>1</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Note: <sup>1</sup>EIB Investment Survey question: In the last financial year, how much did your business invest in each of the following with the intention of maintaining or increasing your company's future earnings? Base: All firms which have invested in the last financial year (excluding don't know / refused responses).

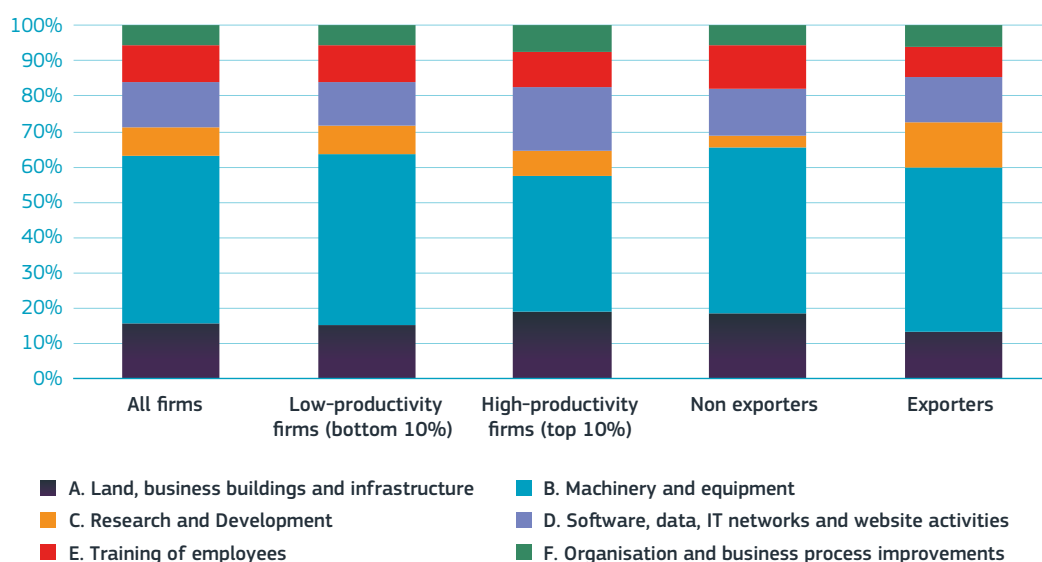
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... as well as more productive firms, which invest more in the four components of intangibles, especially in software and databases, and exporters, which invest more in R&D.

High-productivity firms tend to invest more in intangible assets (Figure II.6.4). While low-productivity firms invested less than 30% of their total investment in intangible assets, high-productivity

firms invested 50%<sup>51</sup>. In particular, high-productivity firms invest a much higher share in software, data, IT networks and website activities: almost 20% of total investment, compared to only 11% for low-productivity firms. But high-productivity firms also spend a higher share of investment in the other three intangible assets. The economic literature stresses that firms that export are more productive (Melitz and Redding, 2015): indeed, exporters tend to invest more in intangibles, especially in R&D.

**Figure II.6.4 Investment in the EU by area (%) in firms classified by level of productivity and export status<sup>1,2</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Notes: <sup>1</sup>Total factor productivity is the residual of a pooled OLS regression where value added (in logarithm) is the dependent variable and the number of employees and fixed assets (both in logarithm) are explanatory variables. The regressions include the interactions of country and year (2015 and 2016) and are estimated separately for 7 different industries. High-productivity firms (top 10%) are defined as firms in the top 10% of the distribution of total factor productivity in 2016 (i.e. there are 10% of firms with high productivity in each country). Low-productivity firms (bottom 10%) are defined as firms in the bottom 10% of the distribution of total factor productivity within each country in 2016 (i.e. there are 10% of firms with low productivity in each country). Exporters are firms that directly exported goods and services to another country. <sup>2</sup>EIB Investment Survey question: In the last financial year, how much did your business invest in each of the following with the intention of maintaining or increasing your company's future earnings? Base: All firms which have invested in the last financial year (excluding don't know / refused responses).

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51 Regression analysis that takes into account the effects of country, industry, firm size and firm age also finds that firms that invest more in intangible assets (in particular R&D) tend to perform better.



Clearly, while the correlation between intangible assets and firm performance does not imply causation, this firm-level evidence is in line with the macroeconomic literature that finds the decisive role of intangible assets, and especially R&D, as a source of productivity growth (Thum-Thyssen et al., 2017). There is some evidence that the complementarities between investment areas also seem to matter. For instance, firms that invest in machinery and equipment and in employee training at the same time tend to have higher value added or higher turnover.

### **Firms that invest more in intangibles tend to rely less on external finance to finance their investments ...**

Given the increasing role of intangible investment as a source of economic growth for advanced economies, it is critical for effective policymaking to better understand how firms finance their investments in order to relaunch productive investments in the EU. Companies in the EU rely to a large extent on internal funds (62%) to finance their investment activities, while external finance represents only

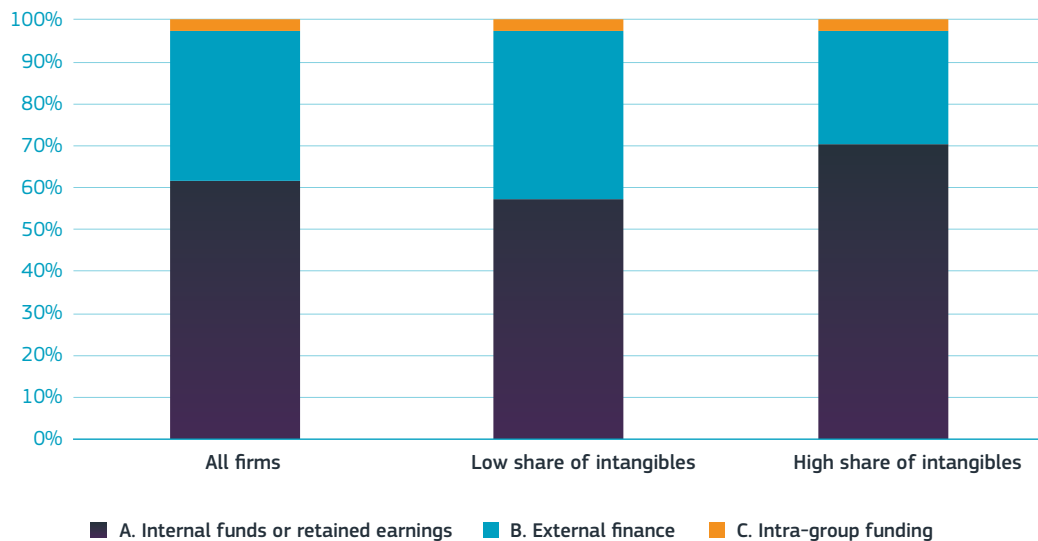
36% of investment finance<sup>52</sup>. But there is some variation across sectors: infrastructure firms (42%) are more likely to rely on external funds, possibly because they have more collateral to access external finance. The share of external finance also varies with the development of the financial sector across countries: more than 40% of the investment done by firms in France, Belgium and Italy rely on external finance, while the share of external finance for investment activities is less than 20% in Greece and Cyprus.

By comparing firms with high intangible investment intensity with those with lower intangible intensity we can identify any differences in the way firms finance their investment<sup>53</sup>. Firms that spend most of their investment on intangibles tend to rely more on internal finance, with a share of 71%, compared to those with lower intangible investment intensity – whose share of internal finance is only 57% (Figure II.6.5). This may also indicate that firms with high intangible investment intensity have more problems providing the requested collateral to access external sources of finance.

<sup>52</sup> See also Box 1 for a more in-depth analysis of the sources of finance and investment activities in R&D.

<sup>53</sup> Firms with high intangible investment intensity are defined as those that invest 50% or more in intangibles from total investment. In the EU, 34% of firms invest a majority of their investment in intangibles. This share varies across industry (ranging from 29% in infrastructure to 39% in services), country (ranging from less than 20% in Hungary, the Czech Republic, Slovakia and Croatia to more than 40% in Sweden and the UK), or firm size classification (larger firms tend to invest less in intangible assets). The results are similar when using a different threshold to define high intangible investment intensity (e.g. above the median of intangible intensity in each country).

**Figure II.6.5 Investment in the EU by sources of finance (%) in firms classified by intangible investment intensity<sup>1,2</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Notes: <sup>1</sup>Firms with a high share of intangible investment invest 50% or more of their investment into intangible assets.

<sup>2</sup>EIB Investment Survey question: Approximately what proportion of your investment in the last financial year was financed by each of the following? Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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**... and are typically less satisfied with the conditions of external finance accessed and are more likely to report that they are finance constrained.**

There are also substantial differences in the satisfaction with external finance between firms with high intangible investment intensity and those with low intangible investment intensity. Firms who invest more in intangibles are more likely to report that they are dissatisfied with the conditions for external finance that they accessed. This holds true along different dimensions of external finance, particularly regarding the amount obtained, the cost of funding and the collateral requirements.

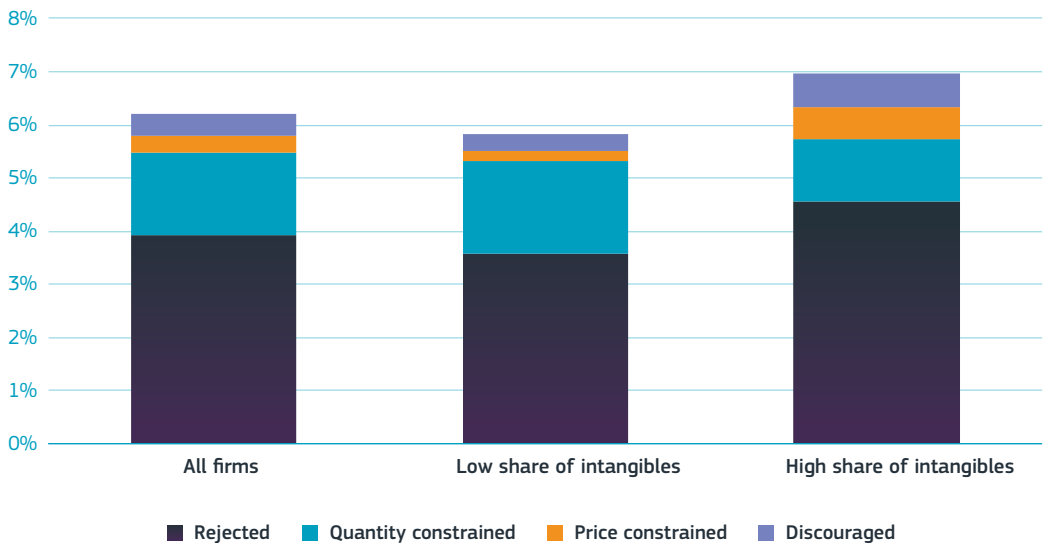
Firms with high intangible intensity do not only report being less satisfied with the conditions for external finance they access, but are also more likely to be financially constrained (Figure II.6.6). Finance-constrained firms can be classified in four categories (Figure II.6.7): those that were unable to access finance when seeking it (“rejected”); firms receiving less than they asked for (“quantity constrained”); those which did not seek external finance because they thought that the borrowing costs would be too high (“price constrained”); and firms which did not seek external finance because they thought that they would be turned down (“discouraged”).

When they apply for external finance, firms with high intangible intensity report being rejected much more frequently. They are also more likely to report that they found the loan offer too expensive or that they simply did not apply because they were discouraged. While more productive firms and exporters are *less* likely to be finance constrained, firms that invest more in intangible assets are *more* finance constrained. This could be linked to the fact that intangible assets cannot always be used as collateral.

Policymakers should take into account the differences between firms that invest little and those that invest a lot in intangible assets when they design and develop new schemes, in particular innovative financial instruments, to support intangible investment in the EU. Differences include the fact that they are more

productive and export more, the lower share of external finance for firms that invest more in intangibles, or that they are more likely to be financially constrained. Clearly, some new policy measures could be developed to increase and diversify the sources of external finance for firms that invest in intangibles. More generally, the strong association between intangible investment and productivity at both the firm-level and the macroeconomic level indicates that there is scope for governments to take policy measures to make investment in intangible assets more attractive for firms in the EU. At the same time, the diversity of intangible assets and their complementarity should be emphasised so that public policies do not only promote R&D investment or manufacturing firms, but also cover other intangible investment by firms in all sectors of the economy.

**Figure II.6.6 % share of firms in the EU that are financially constrained, by category and classified by intangible Investment intensity<sup>1</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

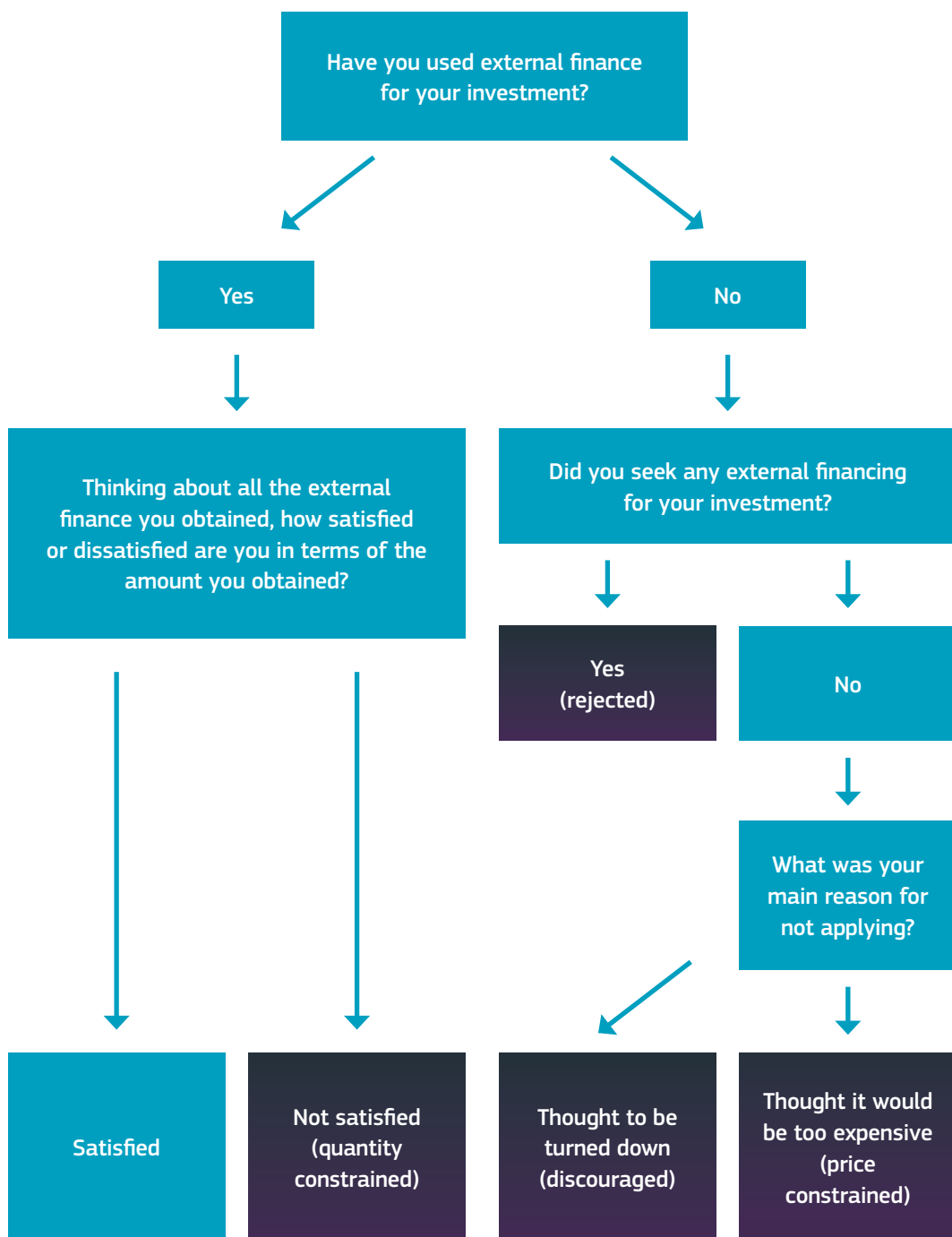
Data: EIB Investment Survey.

Note: <sup>1</sup>Firms with a high share of intangible investment invest 50% or more of their investment into intangible assets.

Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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Figure II.6.7 An indicator of finance-constrained firms with EIBIS



Source: EIB (2017).

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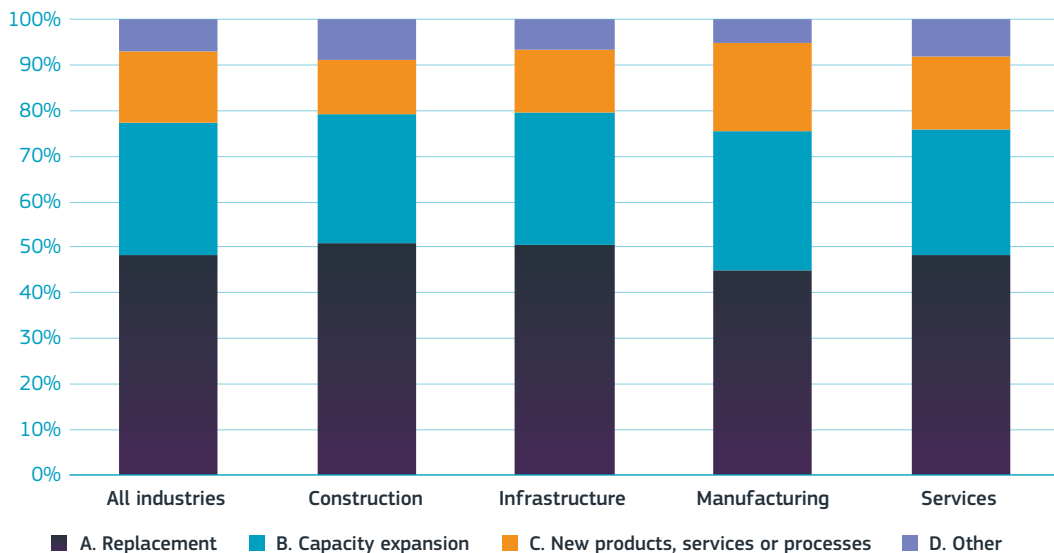
## 2. Investing in new products, processes or services

In addition to R&D and intangible investment, EIBIS asks a question about the share of investment spent on different investment purposes. In 2016, almost half (48%) of total investment was spent on replacing existing buildings, machinery, equipment and IT (Figure II.6.8), while around 29% went into capacity expansion and 16% was spent on developing or introducing new products, processes or services. Clearly, replacement remains the investment priority for firms in the EU.

**Compared to other sectors, firms in manufacturing tend to spend a higher share of their investment on developing or introducing new products, processes and services ...**

When discussing innovation, the category that is more directly relevant is whether firms invest to develop or introduce new products, processes or services. Firms in manufacturing tend to spend more on new products, with a 19% share of total investment compared to services (16%), infrastructure (14%) and only 12% of total investment in construction. While there is little variation in the share of investment for different purposes across firm size, older firms tend to spend a higher investment share on replacement and a lower share on capacity expansion (Figure II.6.9). However, older firms do not spend less on developing or introducing new products, processes or products, which suggests that new products, processes or services do not only come from young and small firms.

**Figure II.6.8 Investment in the EU by purpose as % of total investment<sup>1</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

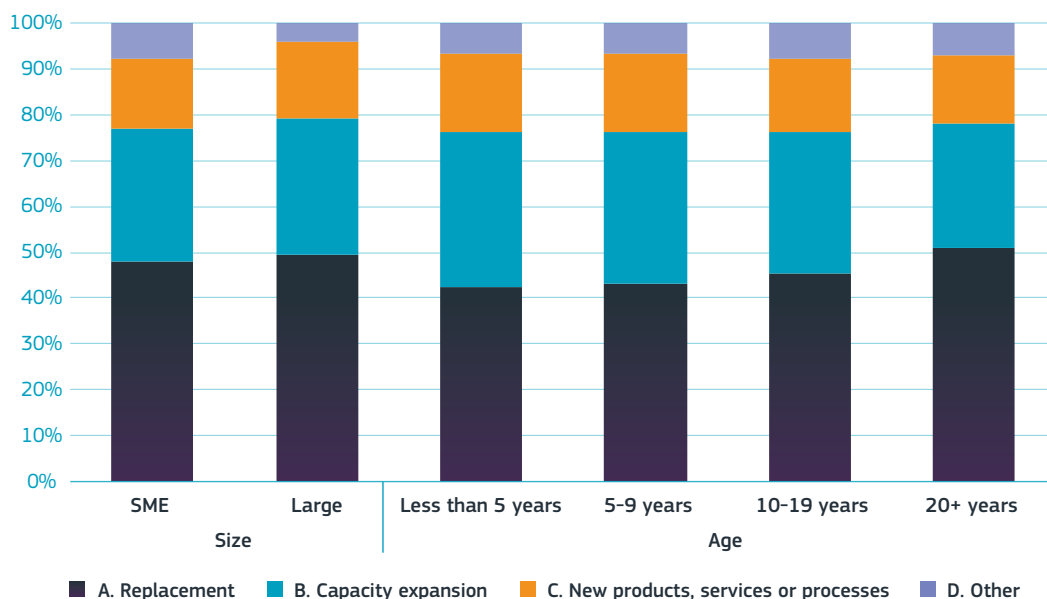
Note: <sup>1</sup>EIB Investment Survey question: What proportion of the total investment in the last financial year was for...? Base: All firms which invested in the last financial year (excluding don't know / refused responses)

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More productive firms and exporters invest a larger share of investment in developing or introducing new products, processes or services (Figure II.6.10). And this pattern is not only driven by manufacturing firms, which indicates that firms wanting to remain at the technological or productivity frontier and needing to compete with firms from other countries in export markets must invest in new products to maintain their market share.

The variation in investment purposes across countries is also substantial (Figure II.6.11). The share of investment spent on developing or introducing new products, processes or services varies from less than 12% of total investment in Slovenia and Slovakia to more than 18% in Denmark, Finland and Italy. Firms operating in different EU Member States have different investment priorities due to the economic cycle but also to more structural features of the economy, such as the concentration and competition in some specific industries, as well as the public support provided to innovative firms.

**Figure II.6.9** Investment in the EU by purpose as % of total investment in firms classified by size and firm age<sup>1</sup>, 2016



Science, Research and Innovation performance of the EU 2018

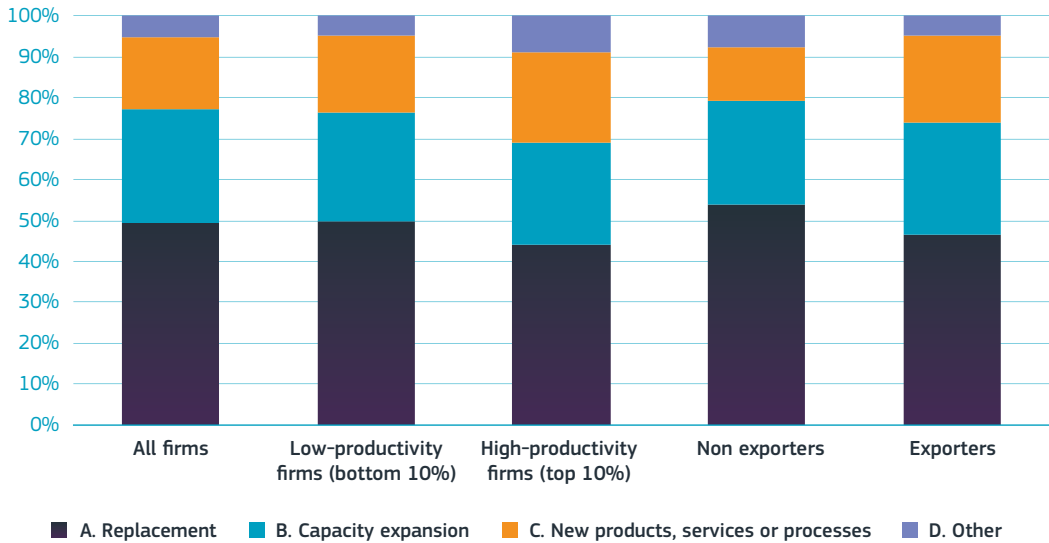
Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Note: 'EIB Investment Survey question: What proportion of the total investment in the last financial year was for...?' Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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**Figure II.6.10 Investment in the EU by purpose as % of total investment in firms classified by level of productivity and export status<sup>1,2</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

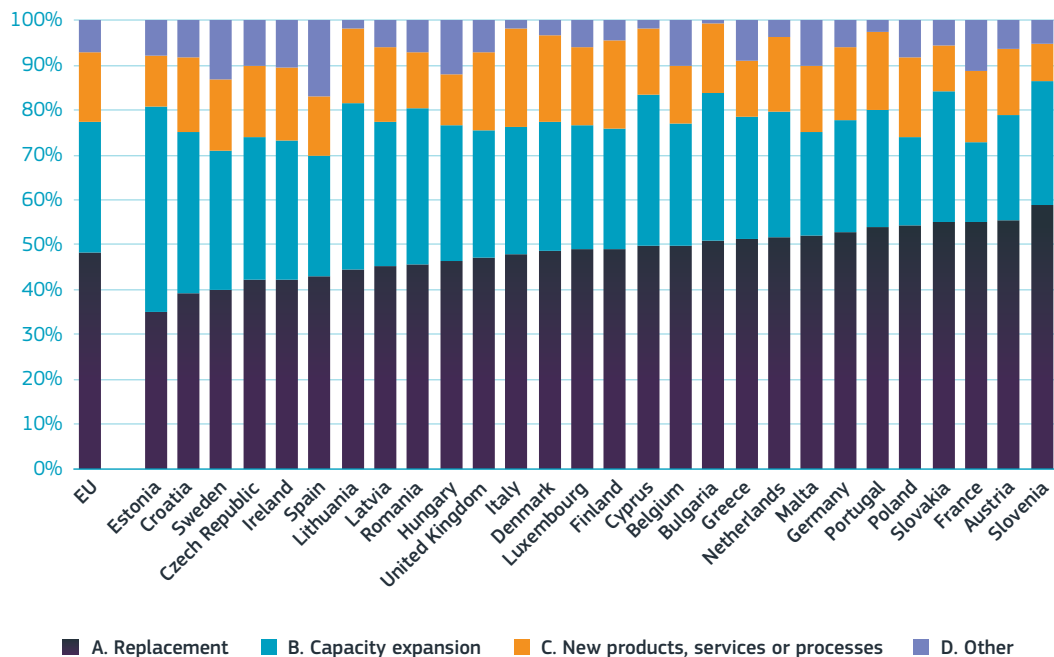
Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies  
 Data: EIB Investment Survey.

Notes: <sup>1</sup>Total factor productivity is the residual of a pooled OLS regression where value added (in logarithm) is the dependent variable and the number of employees and fixed assets (both in logarithm) are explanatory variables. The regressions include the interactions of country and year (2015 and 2016) and are estimated separately for 7 different industries. High-productivity firms (top 10%) are defined as firms in the top 10% of the distribution of total factor productivity in 2016 (i.e. there are 10% of firms with high productivity in each country). Low-productivity firms (bottom 10%) are defined as firms in the bottom 10% of the distribution of total factor productivity within each country in 2016 (i.e. there are 10% of firms with low productivity in each country). Exporters are firms that directly exported goods and services to another country.

<sup>2</sup>EIB Investment Survey question: What proportion of the total investment in the last financial year was for...? Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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**Figure II.6.11 Investment by purpose as % of total investment, by EU Member State<sup>1</sup>, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Note: <sup>1</sup>EIB Investment Survey question: What proportion of the total investment in the last financial year was for...? Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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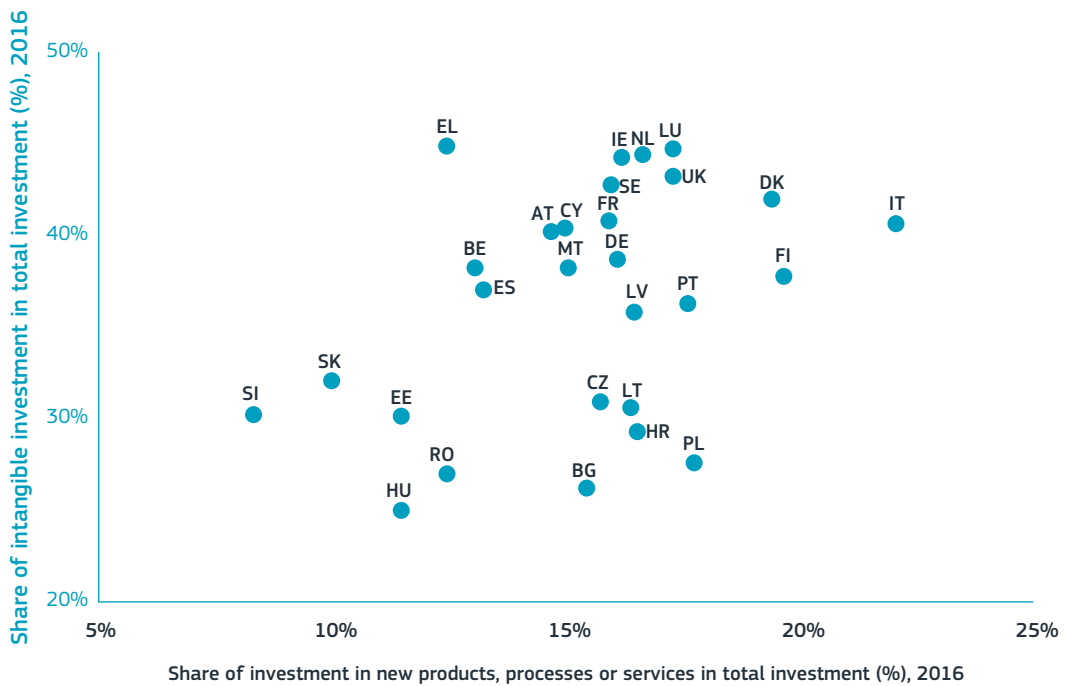
### ... and their innovation activities are correlated with investment in intangibles.

There is a positive correlation between the share of investment of the total investment spent on intangibles (R&D, company training, organisational capital, and software and databases) and the share invested in developing or introducing new products, services or processes (Figure II.6.12)<sup>54</sup>. When looking at the different components of intangible assets, R&D investment is the main driver of this positive correlation between intangible assets and investing in the development or introduction

of new products, processes or services. However, investments in organisation and business process improvements matter as well, across all sectors. In addition, investing in software and databases is also relevant for firms in services and infrastructure. This emphasises yet again the importance of the complementarity across intangible assets for firm innovation, suggesting that public policies aiming to support innovation in the EU should not only promote R&D investment.

Given the increasing role of intangible investment as well as the need to develop and introduce new products, processes or services to maintain the

**Figure II.6.12 % share of investment in new products, processes or services<sup>1</sup> and % share of investment in intangible - EU Member States, 2016**



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

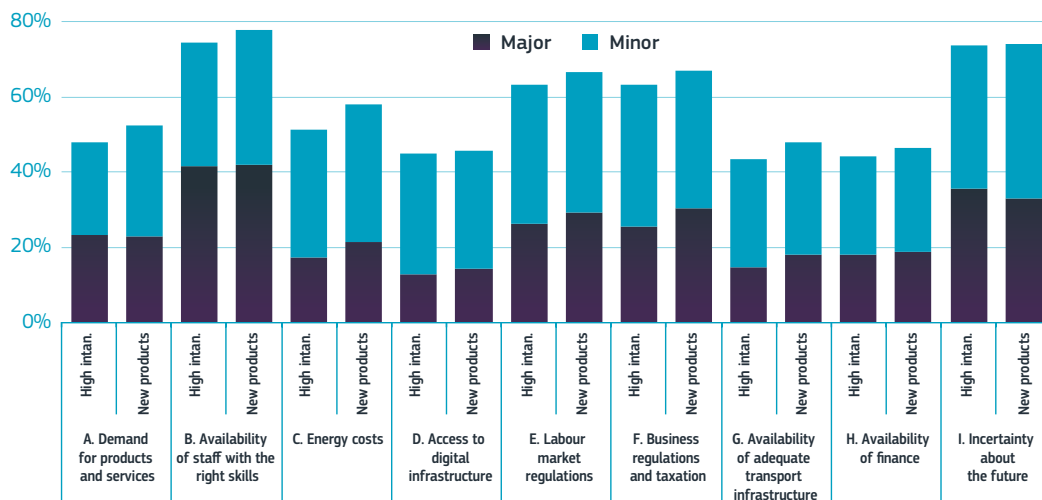
Data: EIB Investment Survey.

Note: <sup>1</sup>EIB Investment Survey question: What proportion of the total investment in the last financial year was for developing or introducing new products, processes or services? Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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54 The results also hold true in a regression at the firm level that controls the effects of country, sector, firm size and firm age.

**Figure II.6.13** Long-term obstacles to investment for firms in the EU that invest more than 50% in intangibles or for firms in the EU that invest in developing or introducing new products, processes or services - % share of firms<sup>1,2</sup>, 2016



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Notes: <sup>1</sup>Firms with a high share of intangible investment invest 50% or more of their investment into intangible assets.

Firms with "new products" invest into developing or introducing new products, processes or services. <sup>2</sup>EIB Investment Survey question: Thinking about your investment activities, to what extent is each of the following an obstacle? Is a major obstacle, a minor obstacle or not an obstacle at all?

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competitiveness of EU firms, it is important to understand the constraints that hold back investment for innovative firms. EU firms consider uncertainty about the future and the availability of staff with the right skills as the main structural barriers to investment, with more than two-thirds considering them to be an obstacle to their investment activities. The majority of EU firms consider that business regulations and taxation, labour market regulations, and energy costs are also serious long-term obstacles.

A focus on firms with a high share of intangible investment and on those that develop new products, processes or services suggests that innovative firms tend to face similar long-term obstacles (Figure II.6.13), which is likely to be driven by the high correlation between the two

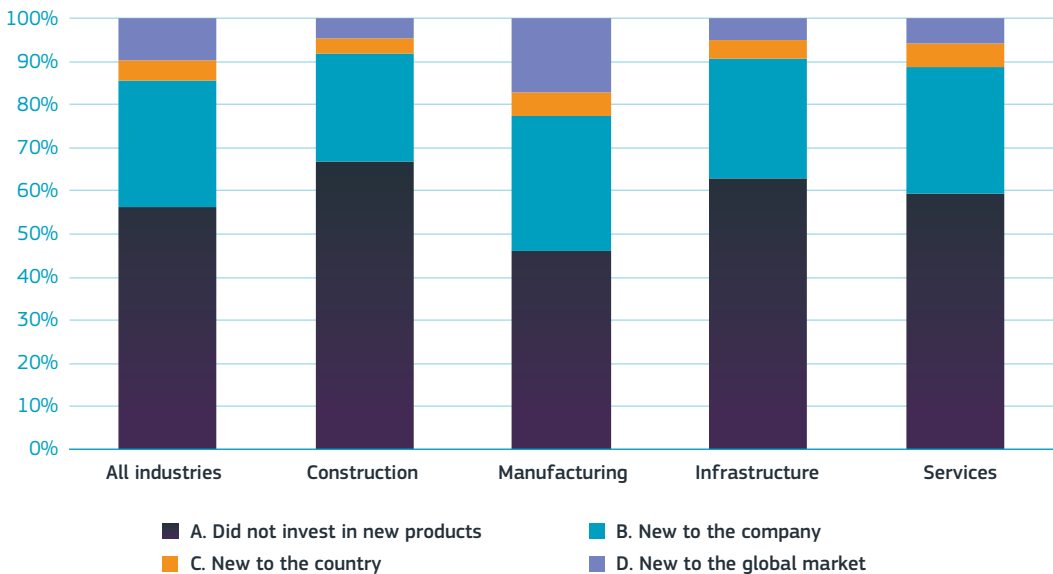
measures of innovative activities. Importantly, some structural barriers to investment are more severe for innovative firms than for the remaining EU companies. For instance, innovative firms – especially those that develop or introduce new products, processes or services – are much more likely to report that the availability of staff with the right skills is an obstacle to investment. In addition, labour market and business regulations also tend to be more serious constraints for innovative firms. At the same time, they are less likely to report energy costs as a long-term obstacle. Differences in the severity of obstacles experienced by firms that invest in intangible and in new products, processes or services, compared to those that do not, should be taken into account when developing policy measures to support innovation in the EU.

### There is a large variation in innovative activities across EU Member States and sectors, with manufacturing firms much more likely to introduce products that are new to the global market.

Firms in manufacturing are more likely to introduce products, processes or services that are new to the global market (Figure II.6.14). This is partly driven by the fact that manufacturing firms conduct more business R&D and are more likely to export their goods and services. In fact, high-productivity firms and exporters tend to develop and introduce more products that are new to the country and global market, suggesting that innovation at the technological frontier is especially relevant for them if they want to remain competitive (Figure II.6.15).

However, innovation does not necessarily need to come through the development or introduction of products, processes or services that are new to the global market. Firms can also adopt existing technologies. For instance, in Italy and Portugal, where the majority of the firms invested in introducing and developing new products, processes and services, more than two-thirds of the innovators consider that the new products were new to the company only (as opposed to new to the country or new to global markets). At the same time, in some countries where a few firms invested in new products, processes or services – such as Spain or Slovenia – the small number of innovators consider that the new products are new to the global market (Figure II.6.16). But, in addition to innovation at the technological frontier, it is vital for all EU countries to foster innovation diffusion, too, so that all firms move closer to the frontier.

**Figure II.6.14 Investment in the EU in new products, processes or services new to the company, the country or global market as % of total investment<sup>1</sup>, 2016**



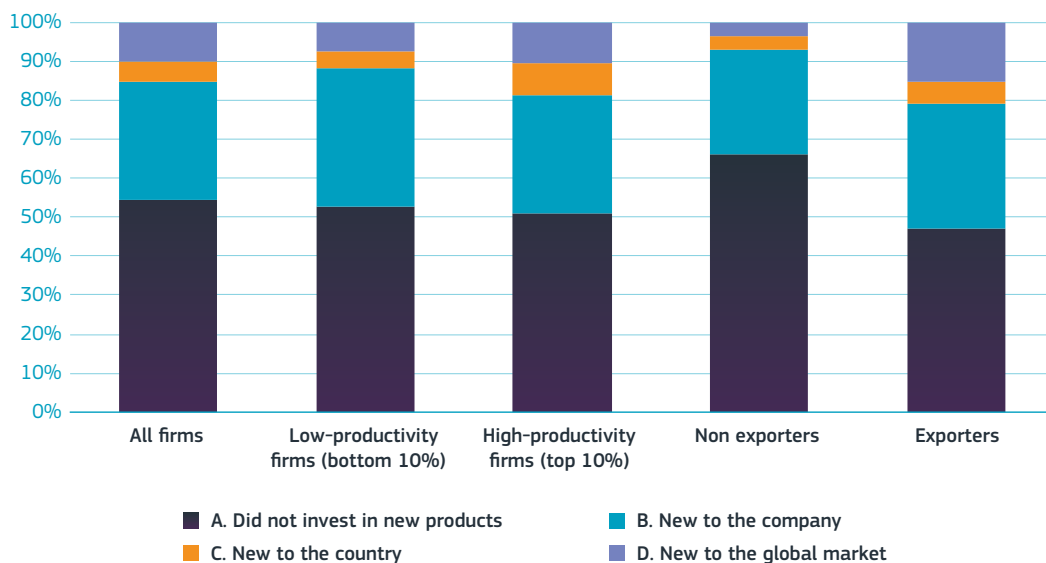
Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies  
Data: EIB Investment Survey.

Note: <sup>1</sup>EIB Investment Survey question: Were the new products, process or services new to...? Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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**Figure II.6.15** Investment in the EU in new products, processes or services new to the company, the country or global market as % of total investment in firms classified by level of productivity and export status<sup>1,2</sup>, 2016



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies  
Data: EIB Investment Survey.

Notes: <sup>1</sup>Total factor productivity is the residual of a pooled OLS regression where value added (in logarithm) is the dependent variable and the number of employees and fixed assets (both in logarithm) are explanatory variables. The regressions include the interactions of country and year (2015 and 2016) and are estimated separately for 7 different industries. High-productivity firms (top 10%) are defined as firms in the top 10% of the distribution of total factor productivity in 2016 (i.e. there are 10% of firms with high productivity in each country). Low-productivity firms (bottom 10%) are defined as firms in the bottom 10% of the distribution of total factor productivity within each country in 2016 (i.e. there are 10% of firms with low productivity in each country). Exporters are firms that directly exported goods and services to another country. <sup>2</sup>EIB Investment Survey question: Were the new products, process or services new to...? Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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To explore further the role played by finance in EU firms' innovation activities, Box 1 (prepared by Annalisa Ferrando and Senad Lekpek) introduces a cluster analysis which links various financing instruments firms use when investing in their innovation behaviour. The analysis shows that firms with diversified financial instruments are significantly more likely to invest in R&D activities and develop products new to the market or globally new compared to those

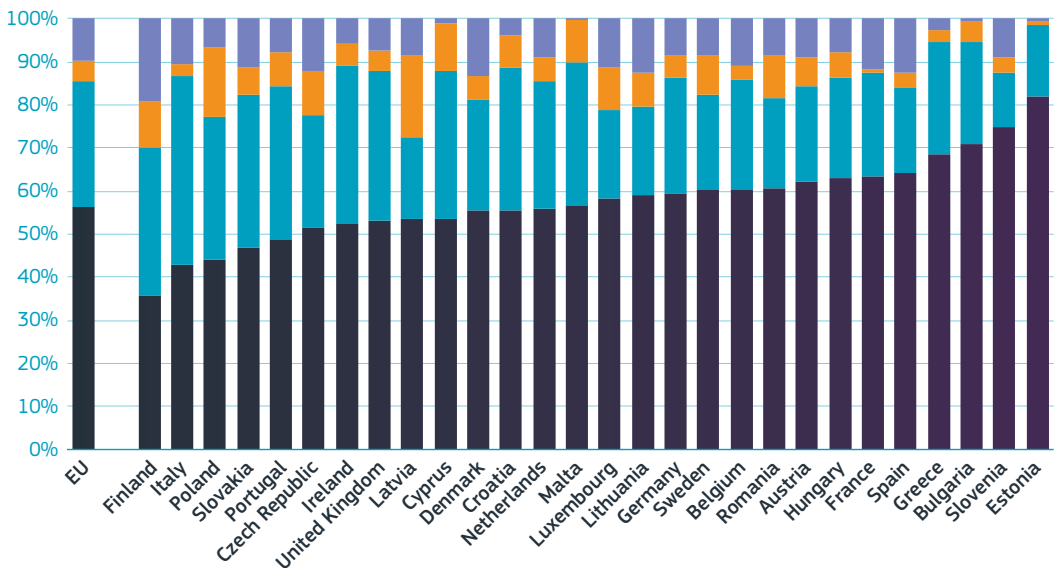
using fewer financing instruments (e.g. those that only use internal finance or bank-related products). In addition, it suggests that innovative firms are less likely to rely entirely on bank financing and use mostly internal financing.

Policymakers should support the diffusion of innovation by all firms so that the benefits of innovation are not concentrated in a limited number of companies. The EIB (2017), espe-

cially the chapter by Veugelers et al., introduces different types of innovators and discusses how they finance their innovative activities. While there is a debate among policymakers on the best way to increase incentives for investment in intangible assets and innovation through different financial instruments (including direct funding with public procurement and grants and indirect funding such as R&D tax incentives), the results in EIB (2017) suggest that grants are positively associated with innovative activities. At the same time, countries

with more favourable tax treatment for intangible investment tend to have more innovative firms. This suggests that the incentives provided by public authorities would appear to go in the right direction. But to better understand whether – and through which mechanisms – public support can lead to intangible investment and innovation, further analysis is needed to identify the policy measures that work best in different EU Member States and how to adapt them to the local context.

**Figure II.6.16** Investment in new products, processes or services new to the company, the country or global market as % of total investment, by EU Member State<sup>1</sup>, 2016



Science, Research and Innovation performance of the EU 2018

Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies

Data: EIB Investment Survey.

Note: <sup>1</sup>EIB Investment Survey question: Were the new products, process or services new to...? Base: All firms which invested in the last financial year (excluding don't know / refused responses).

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## BOX 1: Access to finance and the innovativeness of EU firms<sup>55</sup>

*Annalisa Ferrando and Senad Lekpek*

We use cluster analysis to group EU firms using information on their financing decisions in order to understand the link between finance and innovation. We identify seven financing clusters and show that the degree of innovativeness increases with the diversification of financial instruments: firms that use several financing instruments are more likely to invest in R&D activities and develop new products compared to those which use a more limited number of financing instruments.

### Identifying clusters of financing instruments for EU firms

Cluster analysis divides data into groups in a way that firms inside the groups are homogenous while the groups are very distinct from each other. We use cluster analysis to identify groups of firms that use similar financing instruments. The clusters are formed using firm-level data from EIBIS. The survey includes questions on choices of finance for firms in the EU. First, they were asked what percentage of their investment was financed: 1) internally; 2) externally; and 3) using intra-group funding. Second, firms were asked whether their external financing included one or more of the following options: 1) bank loans excluding subsidised bank loans, overdrafts and other credit lines; 2) other terms of bank finance including overdrafts and other credit lines; 3) newly issued bonds; 4) newly issued equity; 5) leasing or hire purchase; 6) factoring/invoicing discounting; 7) loans from family/friends/business partner; 8) grants; and 9) other types of finance not otherwise specified. These financing instruments were used as variables for identifying different firm clusters.

The empirical analysis is based on data from the 2016 wave of the EIBIS survey which refers to investment decisions in 2015. Of the 12 500 enterprises interviewed, 9067 answered the relevant questions for cluster identification.

**Seven distinct clusters are identified<sup>56</sup>.** Figure A presents the clusters by starting with those using a mix of finance instruments and moving towards clusters that use fewer financing options.

- ▶ **Mixed financed (intra group):** this cluster comprises 270 (3%) firms that use a mix of up to 10 different financing instruments relying in particular on intra-group financing (used by all firms in the cluster).
- ▶ **Mixed financed (grants):** this cluster includes 482 (5.3%) firms that use all 11 financing instruments with a special focus on grants (support from public sources) which are used by all firms in this cluster.
- ▶ **Mixed financed:** this cluster includes 1165 (12.8%) firms that use a mix of up to 11 financing instruments.
- ▶ **Asset/debt-backed financing:** this cluster consists of 1000 (11%) firms that rely on asset-backed financing. Specifically, all firms in this cluster use leasing or hire purchase.
- ▶ **Internal/bank loan financing:** this cluster includes 1325 (14.6%) firms that use internal funding and bank loans to finance their investment activities.

55 This analysis will be published in the EIB Investment Report 2017/18.

56 The algorithm used to identify the clusters is the Ward's method – a type of hierarchical clustering technique. To test the validity of the cluster solution we use the Elbow criteria proposed by Hair et al. (2010).

- ▶ **Internal financing only:** this cluster is the largest one in our study, comprising 4554 (50.2%) firms that finance their investment activities using internal funding.
- ▶ **Bank financing only:** the last cluster includes 271 (3%) firms that rely solely on bank financing.

**Figure A: Cluster composition**

	Mixed financed (intra- group)	Mixed financed (grants)	Mixed financed	Asset/ debt-backed financing	Internal/ bank loans financing	Internal financing only	Bank financing only	Pearson Chi <sup>2</sup>
Internal	54.1%	89.2%	83.9%	80.8%	100%	100%	0 %	3927.4**
Intra-group	100%	2.3%	1.7%	0%	0%	0%	0%	8119.6**
Bank loans	31.9%	50.4%	44.7%	35.0%	100%	0%	100%	5810.2**
Other bank finance	12.2%	20.1%	67.6%	0%	0%	0%	0%	5087.1**
Newly issued bonds	0%	1.9%	4.7%	0%	0%	0%	0%	330.0**
Newly issued equity	1.1%	1.2%	3.3%	0%	0%	0%	0%	220.2**
Leasing/ hire purchase	20.4%	23.2%	37.7%	100%	0%	0%	0%	6299.7**
Factoring/ invoicing	5.2%	8.7%	21.3%	0%	0%	0%	0%	1450.0**
Family/ friends	1.5%	6.2%	19.5%	0%	0%	0%	0%	1382.3**
Grants	1.1%	100%	0.9%	0%	0%	0%	0%	8817.4**
Other	1.1%	0.6%	5.8%	0%	0%	0%	0%	415.4**
N	270	482	1165	1000	1325	4554	271	9067
Percentage of firms	3.0%	5.3%	12.8%	11.0%	14.6%	50.2%	3.0%	

Pearson's chi-square test: \*\*p < 0.01, \*p < 0.05. The results are based on EIBIS16 survey data, referring to year 2015.

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## What are the main characteristics of firms belonging to different clusters?

Figure B presents the distribution of firm size (number of employees) for the seven clusters in our study. The figure shows that, in general, the mixed financed clusters include larger firms compared to clusters that use fewer financing instruments. For instance, 72% of firms in the Mixed financed (intra-group) cluster are large firms, 21% are medium, 5% are small, and only 1% belongs to the micro-firm size category. Similarly, in the Mixed financed (grants) cluster, 51% of companies are large, 29% are medium, 16% are small and 3% are micro firms. On the other hand, in the Bank financing cluster, 27% of firms are large, 23% are medium, 35% are small and 15% are micro-size firms.

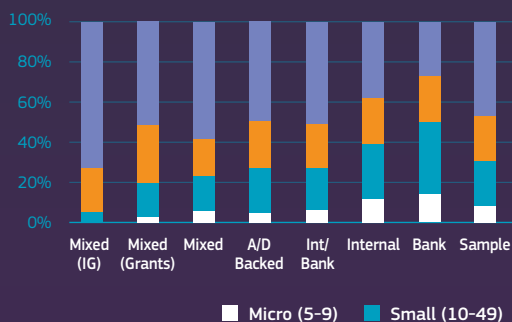
Looking at the sectoral composition, Figure C shows there are no striking differences across the seven clusters, except in the Asset/debt-backed financing cluster where firms come less often from

the services sector and more often from infrastructure. This is not surprising as leasing is more common for infrastructure firms that have more tangibles compared to service-sector companies.

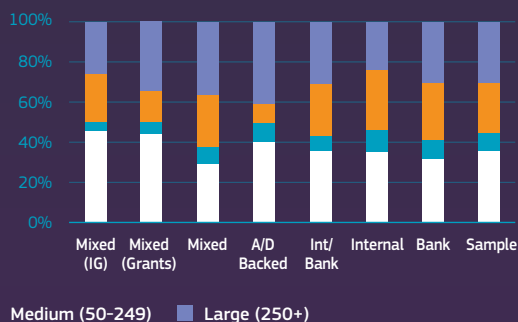
The distribution of firms in terms of their age does not differ significantly across different clusters. Similarly, when looking at the profitability of firms, in most of the clusters the fraction of firms operating at a loss is between 7% and 10%, while the remainder operate at a profit. The exception is the Mixed financed (intra-group) cluster where 36% of firms operate at a loss.

Figure D presents the financing clusters composition in the three country groups. In cohesion countries, firms are more likely to be in the internally financed cluster, and less likely to be in the bank-related financing clusters (bank financing only and internal/bank financing). Furthermore, firms from cohesion countries belong more often to the cluster that relies in particular on support from public sources of finance (Mixed financed - grants).

**Figure B: Firm size by financing clusters (weighted percentages)**



**Figure C: Sectoral breakdown of financing clusters (weighted percentages)**

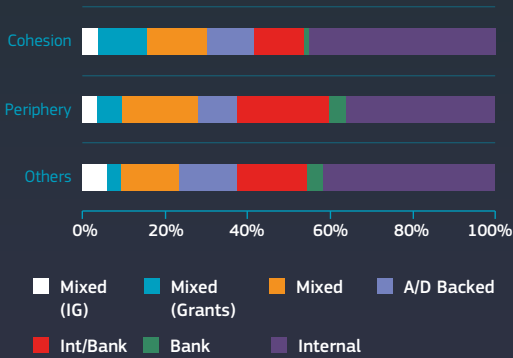


Note: EIBIS16 survey data, referring to year 2015.

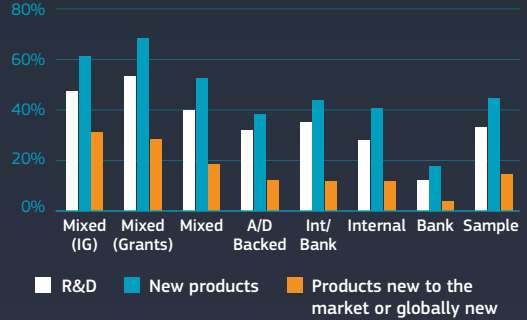
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**Figure D: Country groups and financing clusters**



**Figure E: Firm innovativeness by financing clusters**



Note: EIBIS16 survey data, referring to year 2015.

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### Financing instruments clusters and the innovativeness of EU firms

This section investigates whether the heterogeneity of firms across the innovation dimension is related to the firm finance mix. In Figure E, we plot three indicators of firm innovativeness for the seven financing clusters. The indicators show the fraction of firms that: 1) invested in research and development activities; 2) issued products new to the company; and 3) issued products new to the market or globally new. The figure shows that all three indicators are higher for firms with a more diversified financing mix. For instance, the percentage of firms that invest in R&D activities is 47% for the Mixed (intra-group) and 54% for the Mixed (grants) clusters, while the average for Bank financing and Internal financing clusters is 12% and 28%, respectively. Similarly, the fraction of firms issuing new products is 62% for the Mixed (intra-group), 69% for the Mixed (grants), and 53% for the Mixed financed cluster, while in the remaining cluster the percentage of firms issuing new products is lower. Finally, in the Mixed financed clusters the share of firms developing products new to the market or globally new ranges between 18% and 31%, compared to only 3% to 12% in the remaining clusters.

Next, to further investigate the link between firm innovativeness and finance, we run a logistic regression model. This allows us to control for the differences in firm size, age, industry and country. We use the three innovativeness indicators as dependent variables and finance clusters as independent variables. Figure F presents the results which suggest that firms in the Bank financing cluster are less likely to have invested in R&D activities compared to the Internal financing cluster (omitted – reference category). Firms in Internal/bank loans and Asset/debt-backed clusters are not significantly different from the internally financed firms. On the other hand, firms in Mixed financed and Mixed financed (grants) cluster are significantly more likely to invest in research and development activities. When it comes to issuing new products, firms in the Bank financing only cluster are less likely to have new products than the internally financed firms, while firms in all three mixed financed clusters are more likely to have new products than the internally financed firms. Similarly, firms in the three mixed financed clusters are more likely to issue products that are new to the market or globally new.

Figure F: Firm innovation and financing clusters

	R&D	New products	Products new to the market or globally new
Bank financing only	-0.13**	-0.19***	-0.08***
	(0.06)	(0.05)	(0.02)
Internal/bank loans financing	0.05	0.03	0.01
	(0.03)	(0.03)	(0.02)
Asset/debt-backed financing	0.00	-0.05	-0.02
	(0.04)	(0.04)	(0.03)
Mixed financed	0.07**	0.09**	0.05*
	(0.03)	(0.04)	(0.03)
Mixed financed (grants)	0.20***	0.22***	0.12***
	(0.04)	(0.04)	(0.04)
Mixed financed (intra-group)	0.07	0.16**	0.15***
	(0.06)	(0.06)	(0.05)
Observations	8139	8212	7827
Pseudo R2	0.148	0.073	0.093

Reported are marginal effects estimated after logistic regression. Omitted (reference) category is the Internal financing cluster. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Controls include firm size, age, country and industry dummies. The results are based on EIBIS16 survey data, referring to year 2015.

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