

EFIGE country report: France

How does innovation affect the internationalisation pattern of firms?

Antoine Berthou and Jules Hugot



EFIGE IS A PROJECT DESIGNED TO HELP IDENTIFY THE INTERNAL POLICIES NEEDED TO IMPROVE EUROPE'S EXTERNAL COMPETITIVENESS

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FRANCE COUNTRY REPORT

How does innovation affect the internationalisation patterns of firms?¹

By Antoine Berthou and Jules Hugot. [CEPII]²

Main policy questions and policy implications

This country report focuses on the patterns of internationalisation of French firms compared to other European countries. We provide a descriptive analysis of the EFIGE database, as well as some insights for future research to be conducted using Bruegel's cross-country representative survey.

For France, this report underlines the crucial importance of innovation in building a competitive manufacturing sector. The results of the survey show that exporters are more innovative, have a greater tendency to invest in research and development, and are more likely to be certificated over the quality of their products and their production processes. Hence, success in foreign markets is, before all, related to the overall performance of firms. The report also highlights the crucial role of innovation financing.

Several policy implications emerge. First, as highlighted in previous policy reports, firms' innovation over products and production processes is an important determinant of the success of domestic firms on home and foreign markets. Promoting firms' innovation propensity therefore has the potential of raising the competitiveness of the domestic production structure, as it increases the quality of goods offered by firms. Second, the establishment of vertical relations with other firms, research centres and universities is a critical determinant of domestic firms' innovation propensity. Buying an innovation can help a firm upgrade its technology within a short period of time. Third, investing in R&D is costly and requires external financial resources. When failures in credit markets occur, a public policy may be required so as to allow firms to innovate. More research is needed on the effect of public financing to determine the circumstances under which public support to firms promotes innovation most efficiently.

Executive summary

Section 1 – Structure of firms and internationalisation

In the first section of the report, we explore the structure of France's manufacturing industry and internationalisation patterns of firms.

- 1 Larger firms have a greater propensity to export and a larger share of turnover exported.
- 2 According to the EFIGE survey, the share of firms that export is similar in France and in Germany.
- 3 German firms export more as a proportion of their turnover.

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- 4 Differences between France and Germany in terms of exports performance are explained by differences in the structure of industrial production in each country: in each sector, German firms are distributed over larger size classes.

Section 2 – Competitiveness: driving forces and constraints

We then investigate in more details the determinants of firms' growth according to the views of respondents.

- 5 A sound macroeconomic environment appears to be a major factor of growth.
- 6 Lowering production costs, improving product's quality and broadening the product range are the main determinants of firms' future success, with equal weight.
- 7 The lack of financial resources is an important factor hampering innovation.

Section 3 – Innovation: a closer look at a major growth lever

The third section investigates French firms' innovation patterns in more details, considering internationalised and domestic firms separately, and compares the results to what can be observed in other European countries.

- 8 Internationalised firms have a greater tendency to innovate in terms of products and production processes, even when firms' size, age and productivity are taken into account. They invest more in R&D, use more quality certification and externalise more of their R&D.
- 9 French firms tend to certificate less in comparison with their European competitors. As certification is closely related to quality, this lack of certification among French firms may affect their performance on foreign markets.

Section 4 – Funding of R&D activities

Section 4 compares the financing patterns of R&D and physical investment.

- 10 Investments in R&D are mostly self-financed, which may signal that they are more credit constrained.

Section 5 - Analytic approach: isolating the factors related to export and innovation

The last section uses quantitative methods to determine to what extent export activity is related to innovation patterns, independent of other firms' characteristics such as size and productivity.

- 11 Firms that have carried out innovations in the past few years are more likely to export, independently of their size and productivity. One reason is that innovation raises firms' products quality and success on foreign market.
- 12 Firms affiliated to a foreign company and those outsourcing part of their R&D are more inclined to innovate.
- 13 Firms that have access to external financial and those benefiting from public financial incentives for doing R&D investments have a greater tendency to innovate.
- 14 As public support may help to circumvent financing constraints for R&D investment, more research is needed in this area to determine the type of public support that is best suited to help firms to innovate.

Introduction

The process of globalisation and the successive steps towards a deeper European integration have intensified the economic links between France and foreign countries. While greater trade openness and the process of specialisation of economies is expected to increase revenue per capita in the long run, the resulting increase of competition is also a source of tension among countries and within countries due to the reallocation of production factors. Consequently, competitiveness has become a major subject of debate among European policymakers.

At the core of this debate lies the question of what drives the export performance of countries. Over the past 15 years, economic researchers have been using firm-level data to provide new answers to this question. Several studies have shown that internationalised firms differ from pure domestic firms in a number of dimensions: they are larger, more productive and pay higher wages than firms selling only to domestic consumers (Bernard and Jensen, 1999; Bernard and Jensen, 2004; Mayer and Ottaviano, 2007). These studies, however, hardly find any evidence for developed countries that the export activity helps improving firms' productivity. Accordingly, export performance is generally considered as a consequence of the good economic fundamentals of the home economy. In this context, domestic firms' innovation propensity is often put forward as one important factor of firms' expansion on domestic and foreign markets.³

This report explores the relationship between European firms' internationalisation and their innovation patterns, making use of the recently available EFIGE survey. Our focus is on France, as part of a broader project focusing on European firms' performance. Whereas most studies rely on census data that mostly allow to relate firms' productivity to the export status, the survey data help to get a clearer picture about the innovation patterns of firms. The data provided in the EFIGE survey allow us to relate innovation patterns of surveyed firms to their degree of internationalisation through export activity and Foreign Direct Investment (FDI). We mainly focus the analysis on France and use the survey results to see whether the empirical pattern for France is shared with different European countries.

The EFIGE survey took a sample of more than 16,000 firms in seven different European countries. All firms were asked to give some general information about their activity, workforce, investment, use of information technologies and R&D activities, internationalisation, market and pricing strategy and finance. The French part of the survey gathered data from more than 3,000 firms located in France and operating in all industry sectors.

The report begins with the microeconomic structure of exports for France, Germany and a group of countries including the remaining five European countries in the EFIGE survey. Results show that German firms export more than French firms as a proportion of their turnover. Most importantly, in each sector, the median German firm is larger than the median French firm. Differences in firms' size therefore help to explain the aggregate exports performance of Germany: larger firms typically export more as a percentage of their turnover.

We then investigate in more detail the determinants of firms' growth according to the views respondents. French firms say that a sound macroeconomic environment is a major factor of growth. Moreover, they recognise that lowering production costs, improving product's quality and broadening the product range are the main determinants of their future success, with equal weight. As these three factors are related to firms'

³ The role of firms' size and innovation as determinants of aggregate exports performance is emphasized in different policy reports in France, in particular Fontagné and Gaulier (2008).

innovation, we also report on the opinions of managers regarding barriers to such investment. Among French firms, managers declare that the lack of financial resources is an important factor hampering innovation.

The third Section of the survey investigates French firms' innovation patterns in more detail, considering internationalised and domestic firms separately, and compares the results to what can be observed in other European countries. The findings confirm that internationalised firms have a higher propensity to innovate in terms of products and production processes. They invest more in R&D, use more quality certification, and externalise more their R&D. One interesting pattern is that French firms tend to certificate less than their European competitors. Finally, investments in R&D appear to be much more credit constrained than physical investment, as they are mostly self-financed.

The last Section of the survey uses quantitative methods to determine the extent to which export activity is related to innovation patterns, independently of other firms' characteristics such as size and productivity. Econometric estimations confirm that firms that have carried out innovations in the past few years are more likely to export, independently of their size and productivity. One reason is that innovation raises firms' products quality and their appeal on foreign markets. Estimation results also show that firms affiliated to a foreign company, those outsourcing part of their R&D, and those benefiting from public financial incentives for doing R&D investments are more likely to innovate. As shown by the survey, access to external financial resources is also a major determinant of innovation propensity. Public financial support can tackle the issue of financial constraints, although there is also the possibility that such support is targeted to firms making innovations, leaving the relationship between the two ambiguous. More research is therefore needed on this question to determine the circumstances under which public support promotes innovation.⁴

Overall, this report has three main policy implications. First, as highlighted in previous policy reports, firms' innovation in their products and production processes is one important determinant of the success of domestic firms on home and foreign markets. Promoting firms' innovation propensity therefore has the potential of raising the competitiveness of the domestic production structure, as it increases the quality of goods offered by firms. Second, the establishment of vertical relations with other firms, research centres and universities is a critical determinant of domestic firms' innovation propensity. Buying an innovation can help a firm upgrade its technology within a short period of time. Third, investing in R&D is costly and requires external financial resources. In the presence of market failures in credit markets, a public policy may be required in order to allow firms to innovate. More research is needed on the effect of public financing, to determine the circumstances under which public support for firms most efficiently promotes innovation.

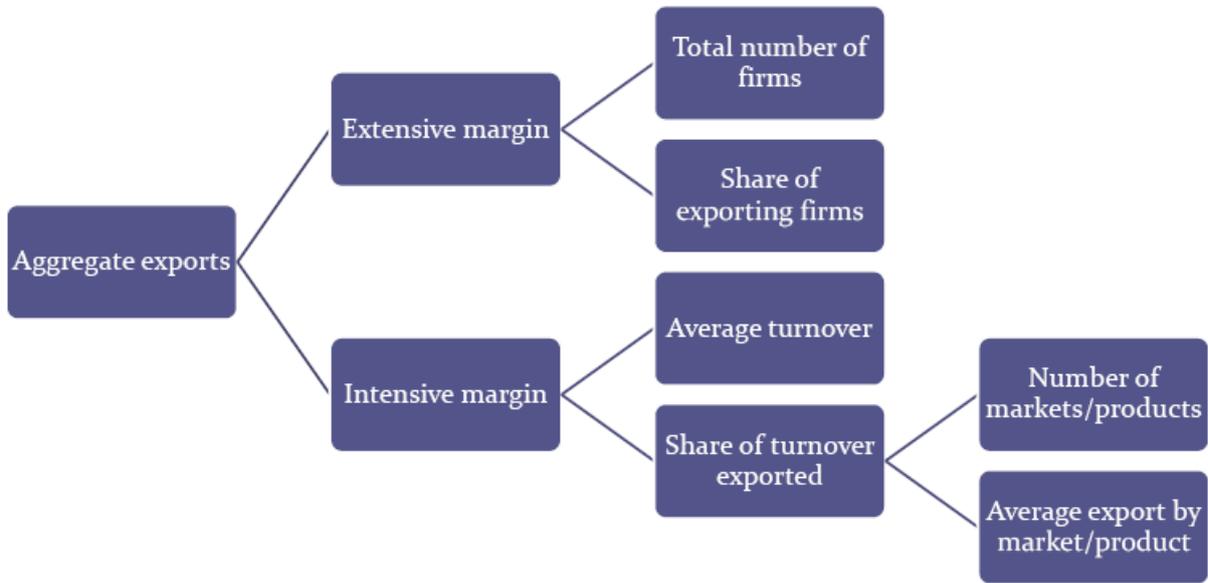
1. Structure of firms and internationalisation patterns

In this section, we explore the relationship between the size of firms to their internationalisation patterns.

The overall volume of exports of a country can be broken down into two margins. A country can export more whether because more firms do export or because each exporting firm exports more than it used to. Economists refer to the number of exporting firms as the 'extensive margin' and to the average exports by firm as the 'intensive margin' (**Figure 1**). We explore these two margins to identify the critical points that make Germany a more export-oriented economy.

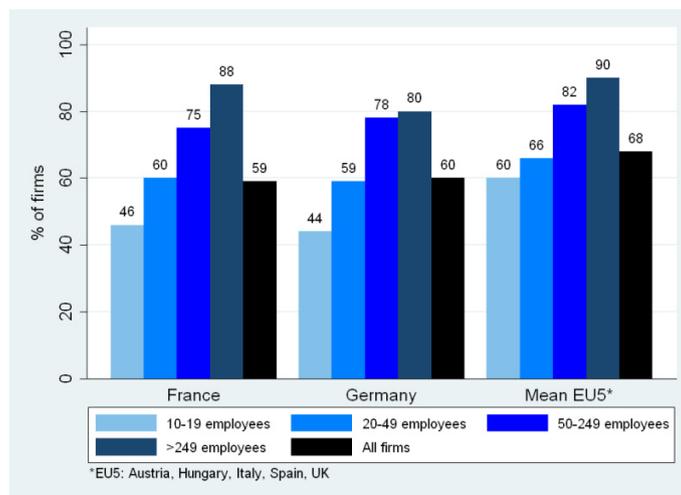
⁴ Hall and Lerner (2009) discuss the question of the effectiveness of public subsidies for small firms in promoting innovation. They report some evidence, mostly for the US where data is available, that public support promotes firms' innovation. They acknowledge, however, that more evidence is needed on this issue.

Figure 1 – The margins of trade



In the survey, 59 percent of French firms report export activity (Figure 2). The propensity to export is strongly related to the size of firms: only 46 percent of firms with between 10 and 20 employees are exporters (88 percent of firms above 250 employees do export). This pattern is very close to the pattern observed in Germany. The average share of exporters for EU5⁵ is larger by 9 percent due to a larger share of exporting firms in all size categories. This result can be attributed to the small size of two countries of the EU5 aggregate: Austria and Hungary. Indeed, these countries are small, open economies that tend to export more than other countries. However, the proportion of exporters is comparable in France and Germany. The German edge in terms of ability to export must therefore result from the intensive margin (ie the average volume exported by exporters).

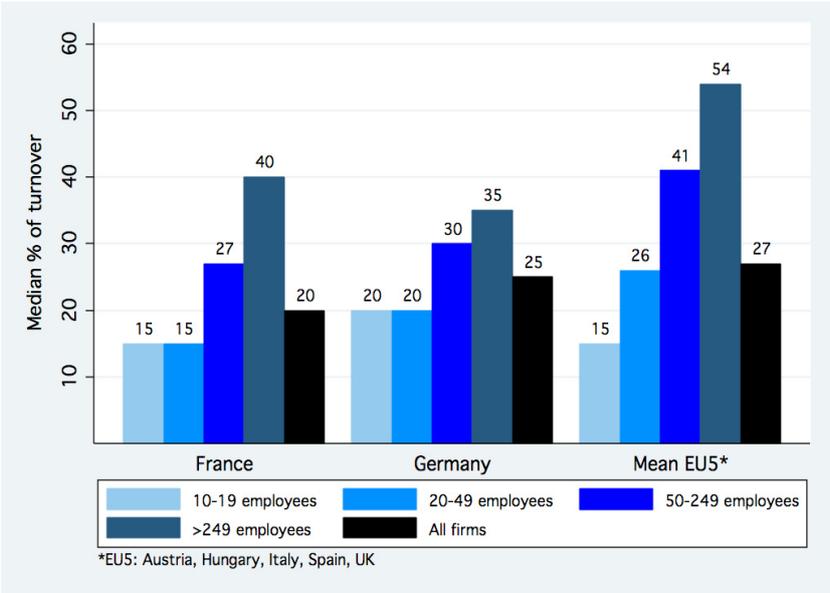
Figure 2 – Share of exporters among all firms



⁵ The results we present for EU5 are the average results for the countries that participated in the FIGE survey excluding France and Germany, for which we present separate results.

The intensive margin also varies with the size of firms. **Figure 3** shows that firms' export intensity is positively related to firm size: larger firms export more of their total turnover. This pattern is observed for all countries, meaning that countries characterised by larger firms are also characterised by larger aggregate exports. Important differences are observed between French and German firms regarding their export intensity: the median French exporter exports about 20 percent of its turnover, against 25 percent for the German median exporter. This number is comparable to German and other EU5 firms.

Figure 3 – Median share of turnover exported by exporters



As discussed above, the distribution of firms' size is also, potentially, an important determinant of aggregate export performance: even with similar cross-country export propensity and export intensity, countries characterised by larger firms in terms of turnover will also have higher aggregate exports. Below are figures for the size distribution of firms for France, Germany, and the EU5 countries.

The turnover of the median French firm is indeed smaller than the turnover of the median German firm by 36 percent (3.3 million Euros vs. 4.5 million Euros)⁶. This imbalance is much more important for internationalised firms: the median turnover of French internationalised firms is smaller by 30 percent compared to Germany. For non-internationalised firms, this difference is only 9 percent (**Figure 4**). More specifically, the entire distribution of firms is different in France and in Germany. French firms concentrate on smaller size categories, while German firms are more present in the *Mittelstand*, that is German small- and medium-sized firms. **Figure 5** shows that 29 percent of French internationalised firms have less than 20 employees, while there are only 21 percent of German firms in the same category. In return, the share of German internationalised firms with 20-249 employees is 8 percent larger than the French share.

⁶ We do not consider the average turnover due to the poor sampling design of the survey. Such a consideration would entail a risk for a few outliers to bias our results. Indeed, in the French sample, four firms have more than 10,000 employees while in the German sample, the largest firm has 9,500 employees.

Figure 4 – Median turnover

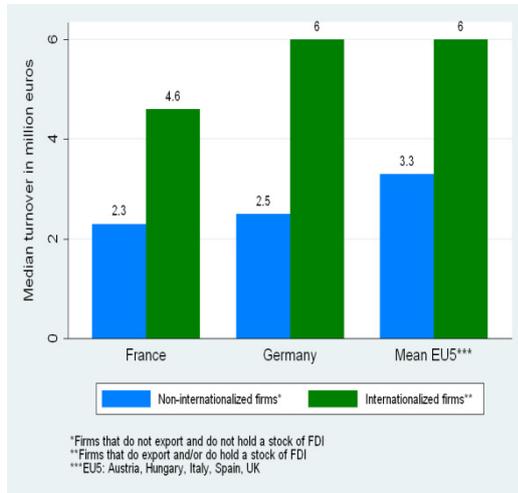
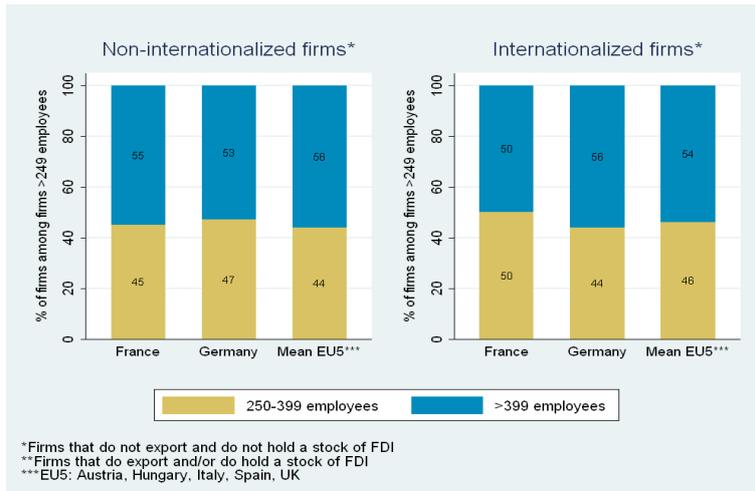


Figure 5 – Distribution of firms by number of employees



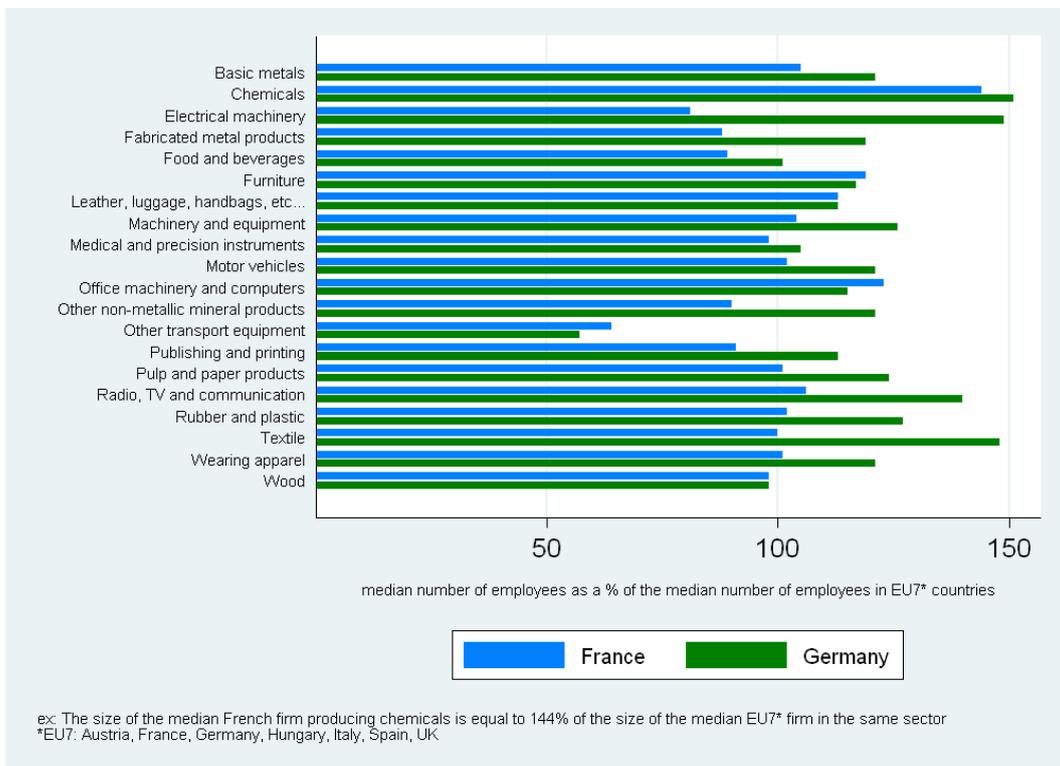
Figure 6 focuses on firms with 250 employees or more. Large firms (above 249 employees) represent 7 percent of internationalised firms in both France and Germany. However, even within this category, French firms are mostly found in the smallest category. Half of the French firms in the largest size category have more than 400 employees. In Germany, 56 percent of the firms in the same category have more than 400 employees. In France, internationalised firms are mostly likely found in larger-size categories compared to purely domestic firms (**Figure 5**). As a consequence, even though French and German firms ship similar shares of their turnovers, the simple fact that German exporters are mostly likely to be found in larger size categories means German firms export larger volumes. In other words, differences between France and Germany regarding the size distribution of firms are an important factor for explaining differences in aggregate export performance.

Figure 6 – Distribution of firms above 249 employees by number of employees



One explanation for the concentration of French firms in small size categories would be the possible specialisation of the French manufacturing sector in areas in which firms are 'by nature' smaller. To check this hypothesis, we compare for each sector the median number of employees in France and Germany to the median number of employees in European firms (Figure 7). If the distribution of French firms in terms of size were to be attributed to a sector composition effect, then only some sectors would gather smaller firms in France. Figure 7 shows that this is not true since French firms are smaller than German firms in almost every sector.

Figure 7 – Average firm size by sector relative to the average firm size for EU7



There are theoretical reasons that explain why German firms are larger than French firms. If European economies were perfectly integrated, the difference between countries in terms of internal market size would not impact on the size of firms. However, economists have shown that border effects keep hampering trading activities across European borders (Head and Mayer, 2000). One reason may be that language and culture barriers remain even though custom tariffs have been removed. Another reason may be the cost for a firm to understand and adapt to the legal system of a foreign country (la Porta et al, 2008). This lack of integration reduces the possibilities of benefitting from economies of scale and gives some advantage to firms located in large countries.

How do economies of scale work? First, economies of scale can be external relative to the firm. Firms produce externalities that help other firms to grow. Firms in larger countries benefit from network effects due to the presence of a larger number of firms in the same sector. For example, countries in which many firms operate in a given sector will have an organised labour market for this specific sector (eg specialist press, dedicated websites, recruitment fairs, etc). These external activities will likely make it less costly for firms to recruit new employees. Second, economies of scale can result from internal adjustments. Indeed, if the internal market is larger, firms will tend to grow in order to supply their market. This growth will generate economies of scale that will, in turn, reduce production costs and allow firms to grow even larger.

* * *

We have shown that the exports performance of Germany compared to France cannot be attributed to the proportion of exporters in the EFIGE survey (the extensive margin). The difference, therefore, results from the combination of a larger export intensity of the median exporter and a larger size of turnover for most firms: most German firms are larger and therefore export larger values. Hence, differences in the structure of French and German industries help to explain differences in aggregate export performances. The following sections of the report explore the sources of these differences among European countries and pay particular attention to innovation issues.

2. Competitiveness: driving forces and constraints

The previous section has shown that the size of firms is intimately related to their internationalisation patterns. Therefore, the factors that hamper the growth of firms are also likely to hamper their internationalisation. In this section, we focus on the determinants of export competitiveness put forward by firms' managers. We show that contrary to what is often heard, price competitiveness is far from being the leading determinant of overall firm performance.

Figure 8 – Factors hampering the growth of firms (Percentage of answers)

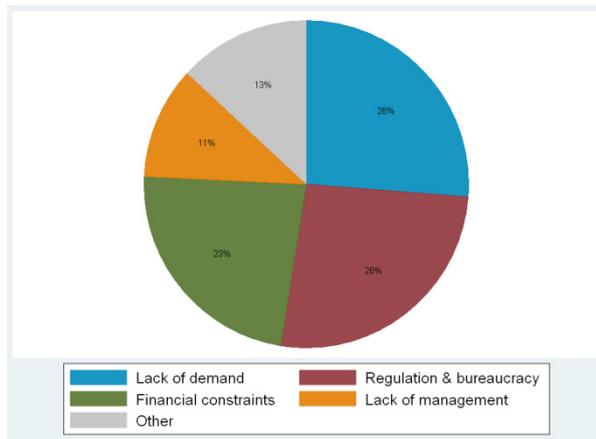


Figure 9 – Main competitive factors (Percentage of answers)

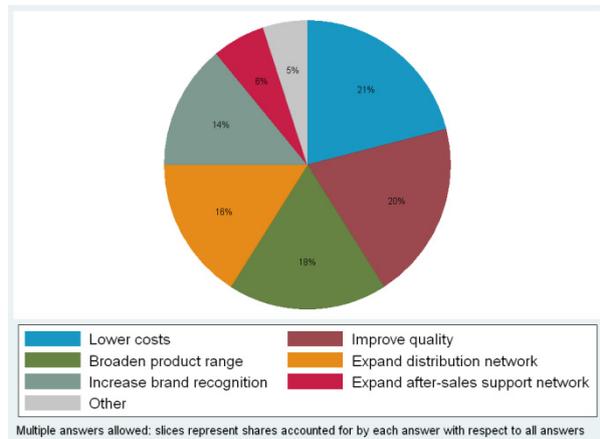
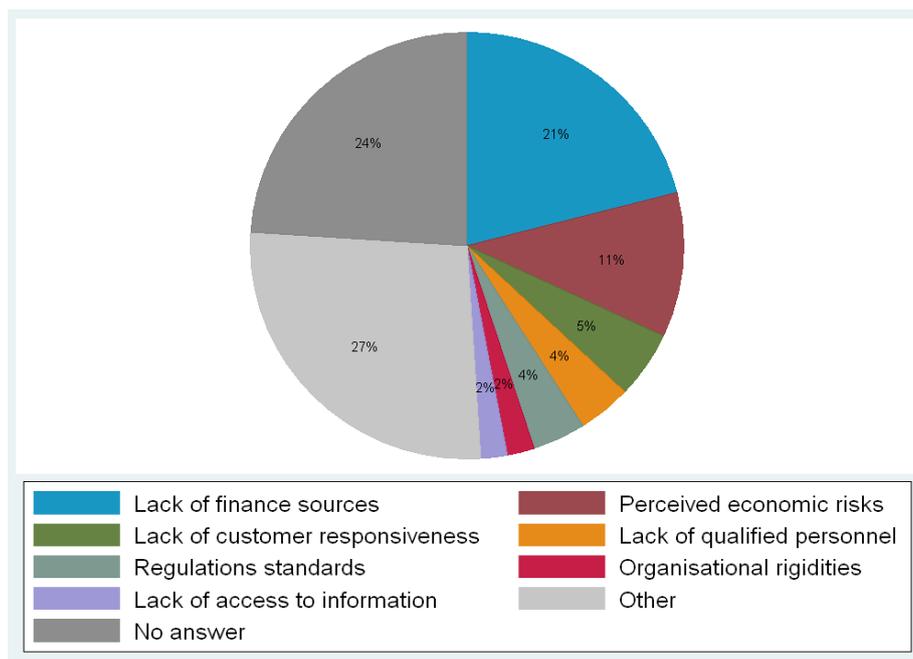


Figure 8 focuses on the factors that hamper the overall growth of firms. According to respondents, the main factors are the lack of demand and ‘institutional’ factors related to regulations and bureaucracy. Financial constraints come in third position (23 percent of answers), pointing to a potential field of action for public policies. **Figure 9** focuses on the determinants of the ability of firms to gain market shares. According to respondents, the main factors that could bring success to their firms are lowering production costs and improving quality. Each factor accounts for about 20 percent of answers. Then, broadening the product range (18 percent) and expanding the distribution network (14 percent) also appear crucial points. The striking result is that improving the quality of products appears to be equally important in determining the future success of firms. All in all, about 60 percent of answers are directly related to the ability to innovate. Indeed, both improving the quality of existing products and broadening the product range require innovation and therefore investment in R&D.

Figure 10 – Factors hampering innovation (percentage of answers)



We now turn more specifically to the factors that are claimed by managers to hamper innovation. The main factor put forward is the lack of financial resources (Figure 10). One should be cautious when interpreting this answer. First, financial constraints can refer either to the difficulty to finance innovation because the firm does not have enough money available, or to the reluctance of banks or other external financial providers to fund a research programme. Second, the survey from which we draw this graph has been conducted in 2009-2010, ie right in the aftermath of the economic crisis. The large share of respondents who claimed that the lack of financial resources is the main reason why their firm might not innovate could thus be lower now due to the recovery.

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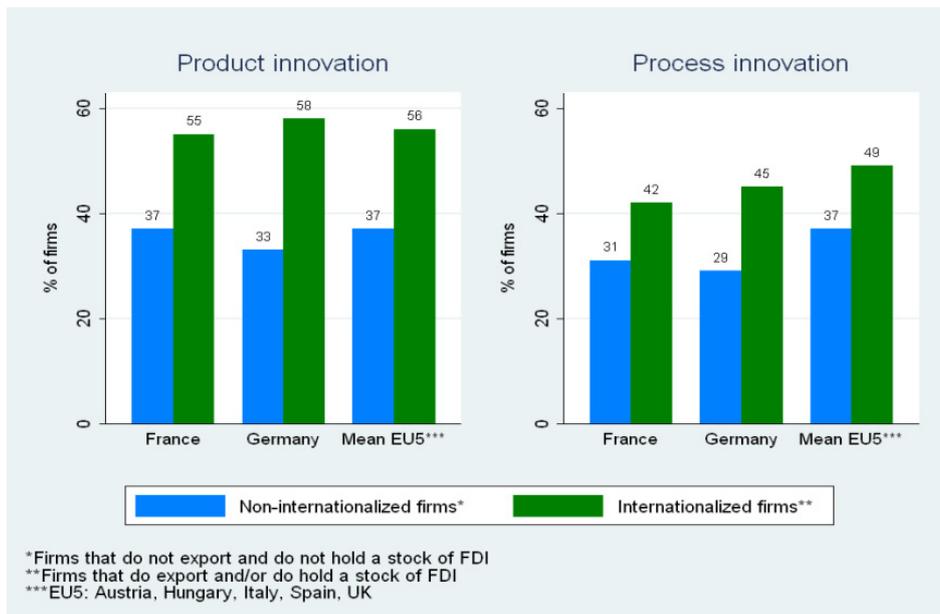
The factors that determine the ability of firms to export can be classified in two categories. First, they need a stable macroeconomic environment combined with a growing demand to satisfy. They also need to access credit easily and at a low cost. However, in order to begin to export or to export more, firms also need to have specific characteristics: they need to be better than other firms in terms of productivity, ability to innovate, etc. If we consider the general macroeconomic environment as given, then these factors can determine firm performance on home and foreign markets.

3. A closer look at innovation patterns

Previous charts have emphasised the importance of innovation in driving the growth of firms and indirectly their success on export markets. This section explores the situation of French firms in terms of innovation intensity, and its determinants such as investment in R&D, sourcing and funding of R&D activities. As in previous sections, we provide comparisons along two distinct dimensions: (1) is the firm internationalised or not? (2) where is the firm located? This approach allows for the identification of the empirical patterns that differentiate internationalised from non-internationalised firms, taking into account country specificities.

A product innovation can take various forms. It can consist of introducing a product that is completely new on the market or introducing a product designed to compete with other firms. By contrast, a process innovation can rely on the adoption of a new production technology or at least its improvement. French firms innovate about as much as other European firms (Figure 11). 48 percent of French firms claim to have carried out a product innovation over the 2007 to 2009 period. During the same period, 37 percent of French firms report that they have carried out a process innovation. Regardless the type of innovation and the country, internationalised firms have a greater tendency to innovate (11-25 percent of difference with domestic firms).

Figure 11 – Share of firms that carried out an innovation over the period 2007-2009



One way to identify the ability of firms to innovate is to focus on quality certification. Certification can be seen from two different points of view. First, it provides a clearer picture about firms' propensity to innovate internally or externally. Second, certification is also an objective measure of the quality of firms' production process and the products the firm sells to its consumers. Hence, the descriptive evidence about quality certification completes the picture about firms' propensity to innovate in Figure 11. Survey results summarised in Figure 12 show that French firms rely on quality certification much less than other countries. Only 18 percent of domestic French firms in the survey had a quality certificate for one of their products (33 percent in Germany). This percentage rises for internationalised firms (27 percent) but remains much lower than in Germany (54 percent) and even lower than the average for the five remaining countries of the survey (37 percent). Importantly, differences among France and its European partners are mainly significant with regards to the proportion of firms that went through a certification process during the previous year. This implies that the dynamic of quality certification differs significantly among European countries: French firms were less likely to certify their products and processes in recent years.

Figure 12 – Quality certification over the reference year (2008)

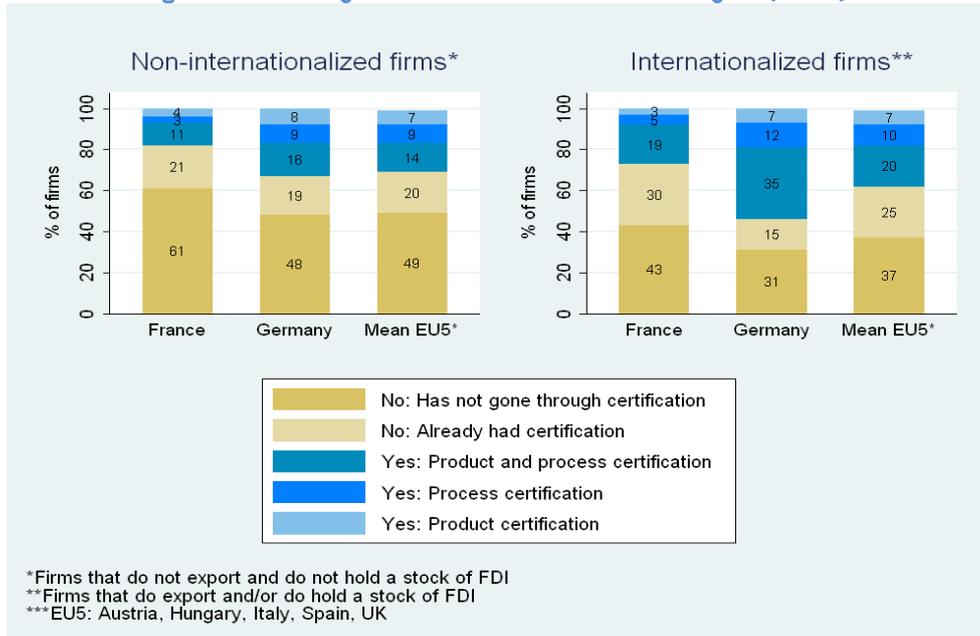
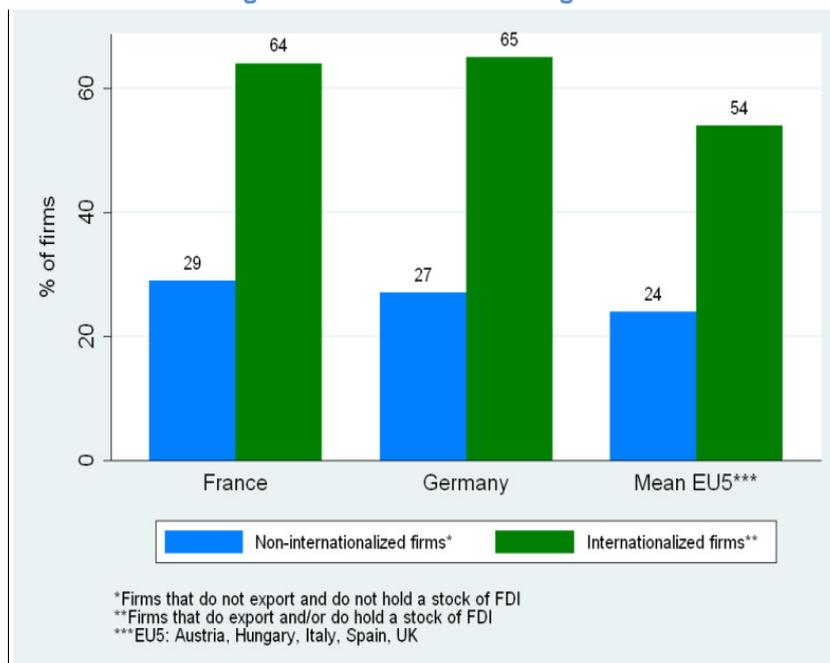


Figure 13 reports survey results on the R&D propensity of firms. In both France and Germany, about 30 percent of domestic firms report to be involved in R&D activities in some way. However, there is a sharp difference in both countries between domestic and internationalised firms, with about 65 percent of the latter doing R&D. Little difference can be observed, however, between France and Germany regarding the propensity to do R&D, either for domestic or internationalised firms. Hence, more difference is recorded regarding quality certification in Figure 12, which also better reflects the innovation intensity (i.e. the output of R&D). Figure 13 though shows that R&D activity is positively related with the internationalisation status.

Figure 13 – Share of firms doing R&D



While the previous figures focused on the propensity of firms to innovate, quality certificate or do R&D, we now focus the question of the sources of firms' R&D. We start by reporting in **Figure 14** the propensity of firms to do R&D in house or to externalise R&D activity. The externalisation of R&D can be further broken down into externalisation propensity within the group, and also from external sources. Multiple answers were allowed. For both France and Germany, more than 90 percent of firms doing R&D do at least a part of it internally. Internationalised firms have a much greater tendency to externalise R&D than domestic firms, both within group and from external sources. Here, important differences are observed between France and Germany. French firms externalise more the R&D within the group, whereas German firms externalise more from external sources.

Figure 14 – Sourcing of R&D among the group of firms that invest in R&D

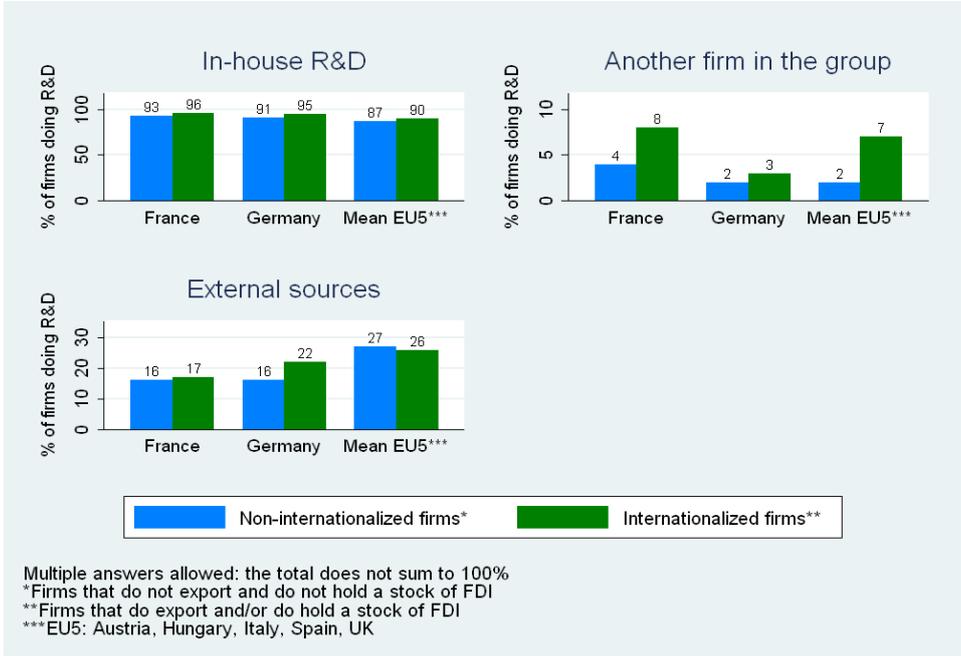
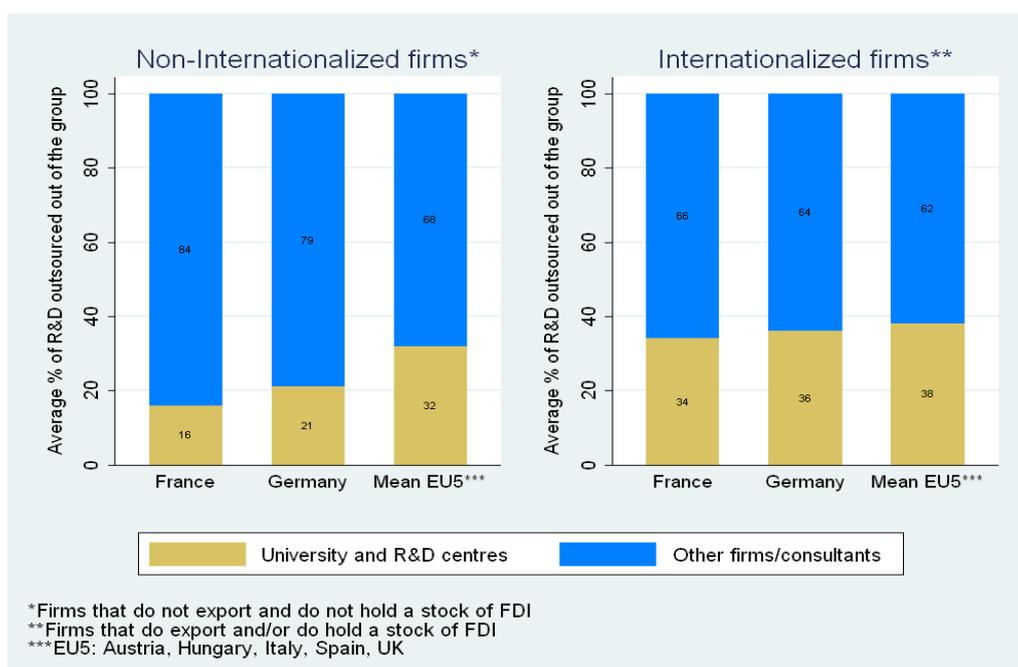


Figure 15 further explores firms' externalisation patterns regarding R&D from different firms, where external sources refer to university and R&D centers or to other firms. First, in France, internationalised firms have a greater propensity to outsource their R&D in universities and R&D centers (34 percent) than domestic firms (16 percent). This pattern is largely shared among European economies. Differences among European countries are mainly identified within the group of domestic firms, where German non-internationalised firms and those firms of the EU5 countries have a greater tendency than French firms to externalise R&D in universities.

Figure 15 – Sourcing of R&D – Share of each source among R&D acquired from external sources



* * *

To summarise, this section suggests that internationalised firms (ie those reporting export or FDI activity) are more innovative, with respect to the products they develop and also their production process. This is related to several features regarding the pattern of investment. First, internationalised firms report a greater propensity to quality certificate their products and production process. Second, they have a greater propensity to invest in R&D. Third, they also externalise more their R&D, especially from universities and research centers. This picture, which is shared among European economies, completes the already well-known fact that exporters, or firms investing abroad, are more productive. In particular, findings report that exporting firms tend to be more productive before they start selling goods abroad. The reverse relation does not hold, however. Exporting does not seem to feed back into higher productivity growth (Bernard and Jensen, 1999). While the FIGE survey results do not offer any direction in the causality, they are in line with the view that investment in R&D, and the establishment of linkages between universities and firms, promote the internationalisation of domestic firms.

The propensity to innovate and invest in R&D among French firms is comparable to what can be observed in other European countries. This may, however, hide differences regarding innovation intensity.⁷ An interesting difference though, between France and Germany, is that German firms put more effort in doing quality certification, both regarding products and production processes. This may explain part of the success of German firms on foreign markets, given that certification can be associated with the perception of quality by consumers. This is in line with recent empirical works by academic researchers showing the importance of quality differentiation in countries' exports performance.⁸

⁷ Numbers regarding innovation intensity in the survey are subject to caution and we decided not to include them in this report.

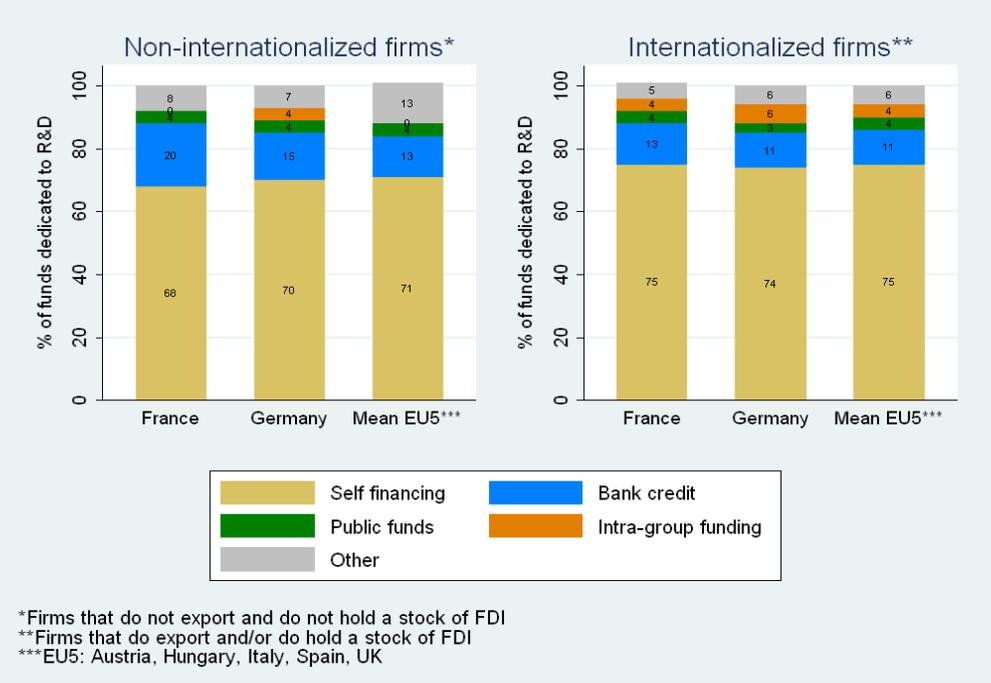
⁸ Schott (2008), among others, shows the importance of quality specialisation to explain countries' exports performance to the US. Similar analysis was performed by Fontagné et al (2008).

4. Funding of R&D activities

We now turn to the sources of financing used by firms for their R&D activities. How is R&D related to external finance as compared with physical investment? What is the role of credit constraints in determining firms' ability to invest in R&D?

Figure 16 shows that more than two thirds of the funding of R&D activity consists of self-financing, and the second source of finance is bank credit (13-20 percent). Public funding represents about 4 percent of total financing for all countries that were surveyed for this report. Interestingly, internationalised firms and domestic firms share similar characteristics regarding the financing of R&D in all European countries, although bank credit appears to be more important for domestic firms. Results for France are in line with the European empirical pattern, although German firms appear to be using a higher proportion of intra-group financing.

Figure 16 – Funding of R&D – Average share of each source for firms that invest in R&D

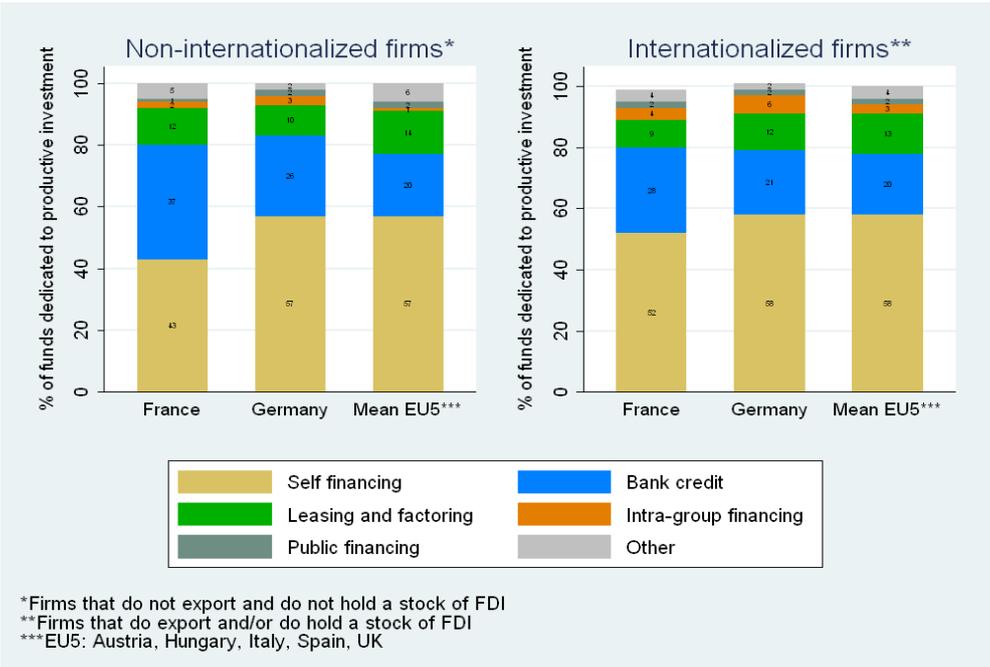


The structure of R&D financing can be compared to the benchmark case of physical investment (plants, machines, equipment, etc) to provide a comparative view on the dependence on external financial sources. Survey results reported in Figure 17 show that R&D activities are less commonly financed through bank credit than physical investment (respectively 13 percent and 28 percent of total financing for internationalised French firms). In return, internal finance has to compensate for this relative lack of credit: internal resources account for 68-75 percent of the sources to finance R&D among European firms.

These results are in line with the idea that the complexity of innovation projects makes it difficult for external borrowers to evaluate the quality and future return of R&D and innovation projects. Researchers, starting with Stiglitz and Weiss (1981), have shown that such a situation creates information asymmetries between the

borrowers and lenders, increasing the cost of financing. It is therefore not surprising that given the complexity of R&D projects, and the time lag between the investment decision and the cash harvest period, information asymmetries arise, thus increasing the proportion of the cost of innovation projects that has to be self-financed. A second reason why innovation projects require a higher proportion of self-financing is that these projects produce intangible assets that are sunk and can hardly be redeployed. The EFIGE survey results confirm that R&D financing relies disproportionately on self-financing, as Hall (1992 and 2002) had found.

Figure 17 – Funding of Productive investments – Average share of each source for firms that invest



* * *

This section has shown that R&D activities have a much worse access to external finance, compared to physical (tangible) investments. This pattern can be observed for both domestic and internationalised firms, among all the European countries of our sample.

These findings have important consequences with regards to the growth and export/import patterns of firms. As already mentioned in this report, academics have provided evidence that export activity and the productivity of firms have a strong positive correlation. For developed economies, the findings are that this relationship is unidirectional: the most productive firms self-select on foreign markets but do not increase their productivity after entry, with export experience. Hence, the growth of a country's exports is simply the result of productivity growth and investment into innovative projects, which can affect both the price and quality of products sold by domestic firms in foreign markets. The finding that firms rely disproportionately more on self-finance for their R&D projects, that we presented above, therefore suggests that financial constraints can have a strong effect on the aggregate growth of exports through the effect on innovation

propensity.⁹ This leaves room for alternative forms of financing of innovation, such as venture capital, which is often used by start-ups to finance their projects. In the presence of market imperfections taking the form of financing constraints, public subsidies may also help firms to innovate.

The next section further investigates this issue and presents estimation results on the effect of private and public financing on innovation propensity. We also discuss some of the recent empirical works related to the financing of innovation projects.

5. Analytic approach: isolating the factors related to export and innovation

The previous sections have provided empirical regularities that can be observed for internationalised firms compared with domestic firms, on the one hand, and for French firms compared with firms in other European countries, on the other hand. In the EFIGE survey, internationalised firms perform better in terms of innovation. They also have larger turnovers and larger numbers of employees. This section further explores the relative importance of firms' characteristics associated with internationalisation and export intensity. Our focus is on the contributions of innovation and firms' use of external finance. We then explore the question of what explains European firms' propensity to innovate.

The regressions reported are based on the whole sample of the EFIGE survey including the seven EU countries that were surveyed. We systematically include a set of country and industry fixed effects in order to control for country-specific and/or industry-specific factors that are likely to impact on output variables. **Table 1** explores the potential determinants of export decisions (extensive margin). In the estimated equation, the export decision dependent variable is binary and is set to '1' if the firm exports and to '0' otherwise. The equation is estimated using a probit model that allows the effect of each explanatory variable on the probability of exporting to be assessed.

Following the literature (Bernard and Jensen, 2004; Mayer and Ottaviano, 2007), we control the most obvious factors likely to explain export decision: the size of the firm, the productivity of its labour and its belonging to a multinational group (regression 1). As expected, all the coefficients are positive and significant at a 1 percent level of confidence. We then introduce two controls for product and process innovations (regression 2). The coefficients are also positive and significant. Note that the coefficient for product innovation is about three times larger than the coefficient for process innovation. Firms having carried out product innovation during the past three years are more likely to export by about 15 percent. Process innovation is associated with a 5 percent higher probability to export, as compared to firms not having carried out such innovation. Finally, we include controls that identify whether firms used external finance, received any public financial or benefitted from tax incentives. All three variables are positively correlated with the firms' export propensity.

We then add three controls that reflect the ability of firms to fund their activity through various sources of finance (regressions 3 and 4). The coefficients are also positive and significant. Finally, we introduce all the above-mentioned variables, which do not significantly alter the results obtained when considering each factor individually (regression 5). This last model shows that none of the variables actually do reflect the same information: even controlling size and productivity, the relationship between innovation to export decisions remains strong. This result confirms that beyond the traditional factors that explain firms' export propensity, both product and process innovation are important determinants, while access to external finance continues

⁹ Manova (2009) shows that financial development promotes the extensive and intensive margins of countries' exports disproportionately in industries where firms have fewer tangible assets to offer as collateral.

to play a direct influence. These results may be interpreted by the fact that, while starting exporting is costly and requires some forms of external finance, product innovation is closely related to firms' products appeal on foreign markets and allows the firm to access additional consumers located abroad.

Table 1 – Factors associated with the ability to export

Dependent variable: Export status	(1)	(2)	(3)	(4)	(5)
log Number of employees	0.077*** (0.006)	0.086*** (0.005)	0.097*** (0.005)	0.095*** (0.005)	0.062*** (0.006)
log Labour productivity	0.081*** (0.006)	0.088*** (0.006)	0.089*** (0.006)	0.091*** (0.006)	0.079*** (0.006)
log Age of the firm	0.056*** (0.006)	0.056*** (0.006)	0.056*** (0.006)	0.059*** (0.006)	0.059*** (0.006)
MNF head	0.208*** (0.015)				0.193*** (0.016)
MNF subsidiary	0.107*** (0.018)				0.117*** (0.018)
Carried out product innovation		0.153*** (0.010)			0.142*** (0.010)
Carried out process innovation		0.054*** (0.010)			0.046*** (0.010)
Used external financing			0.057*** (0.010)		0.040*** (0.010)
Received public financial incentive				0.061*** (0.012)	0.037*** (0.013)
Benefited from tax incentive				0.060*** (0.012)	0.035*** (0.013)
Observations	10,600	10,599	10,197	10,522	10,126

Standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Country and industry fixed effects are included in the regressions. Coefficients are not reported.

Marginal effects for export status going from non-exporter to exporter obtained from a probit regression

Table 2 explores how these firm-level characteristics are related to firms' export intensity, measured as the share of turnover exported.¹⁰ Firms' characteristics explaining the export intensity are the ones that were used in the previous empirical specification to explain export decision. As previously highlighted, estimated results suggest that larger and more productive firms have higher export intensity. Being affiliated to a multinational firm increases foreign sales. Surprisingly, when all firm-level controls are included into the specification (column 5), using external finance has a negative effect on export intensity, once firm size and productivity are controlled. Also, the coefficients on the two innovation variables become insignificant. Hence, both innovation and finance are positively related to the surveyed firms' export activity, but essentially through the export status rather than through the size of their exports.

¹⁰ We implemented a Heckman procedure to identify the effect of each variable on the export intensity. This allows for the effect of these variables on the export decision to be controlled, which may bias our estimates due to the correlation between export decision and export intensity.

Table 2 – Factors associated with the ability to export a large share of the turnover

Dependent variable: Share of turnover exported	(1)	(2)	(3)	(4)	(5)
log Number of employees	1.083*** (0.021)	1.087*** (0.027)	1.097*** (0.022)	1.103*** (0.022)	1.096*** (0.025)
log Labour productivity	1.057*** (0.024)	1.026*** (0.031)	1.038*** (0.025)	1.050*** (0.025)	1.073*** (0.032)
MNF head	0.295*** (0.059)				0.317*** (0.063)
MNF subsidiary	0.368*** (0.057)				0.358*** (0.06)
Carried out product innovation		-0.056 (0.057)			0.08 (0.059)
Carried out process innovation		-0.079* (0.038)			-0.036 (0.035)
Used external financing			-0.147*** (0.037)		-0.102*** (0.035)
Received public financial incentive				-0.059 (0.045)	-0.006 (0.043)
Benefited from tax incentive				0.047 (0.044)	0.074* (0.041)
Observations	10132	10132	10132	10132	10132

Standard errors in parentheses (***) p<0.01, ** p<0.05, * p<0.1)

Country and industry fixed effects not reported

Results obtained using a two-stage Heckman procedure to correct for selection bias

Table 3 focuses on the factors that could explain the fact that some firms innovate while others do not. Estimation results show that both size and productivity positively influence the innovation propensity of firms. The effect of age, however, is less significant. The share of turnover invested in R&D is also positively related to innovation: increasing the share of the turnover invested in R&D by 10 percent would increase the likelihood to innovate by about 1.6 percent. The effect on process innovation is much smaller, however, and has little economic effect though it remains highly significant. To a similar extent, being affiliated to a multinational firm influences considerably the propensity to engage in product innovation, especially when the firm is the head of the group, but does not affect process innovation.

Firms outsourcing R&D activities are also found to innovate more. This pattern is true when firms innovate within or outside the group. This emphasises the positive role of multinational companies, which help affiliated firms to upgrade their level of technology through transfers, with potentially large effects on aggregate productivity growth. Outsourcing R&D outside the group also helps firms to achieve a higher technology level. Of particular interest is the role of universities, which was already highlighted in this report.

As expected, having access to external finance is positively associated with the innovation propensity of the surveyed firms. These results suggest that access to finance can help firms to export, by helping them pay foreign entry costs, develop a distribution network or comply with foreign regulations (see the results in Table 1 above). It also has a direct and strong effect on product and process innovations, both being positively related to export propensity.

Finally, public incentives aimed at supporting R&D activities are found to be positively related to innovation. Although our identification strategy does not point to a specific direction to this relationship (public incentives may well be targeted to the most innovative firms), this is firsthand evidence that R&D targeted public policies are effective and significantly affect the innovation propensity of firms.

Table 3 – Factors associated with the ability to innovate

Dependent variables:	Product innovation	Process innovation
log Number of employees	0.032*** (0.007)	0.053*** (0.006)
log Labour productivity	0.012* (0.007)	0.011 (0.007)
log Age of the firm	0.012* (0.007)	-0.004 (0.007)
Share of turnover invested in R&D	0.016*** (0.001)	0.007*** (0.001)
MNF head	0.119*** (0.023)	-0.007 (0.021)
MNF subsidiary	0.049** (0.022)	0.016 (0.021)
Benefited from public incentive to invest in R&D	0.219*** (0.016)	0.105*** (0.016)
Outsourced R&D within the group	0.069* (0.036)	0.109*** (0.034)
Outsourced R&D outside of the group	0.173*** (0.019)	0.139*** (0.018)
Used external financing	0.034*** (0.013)	0.094*** (0.012)
Observations	8,299	8,299

Standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Country and industry fixed effects not reported

Marginal effects for dependent variable going from no innovation to innovation obtained from a probit regression

* * *

This analytical section has shown that beyond the traditional determinants of export activity, access to finance and innovation are also positively associated with the decision to export. Access to finance also has an indirect effect on the export decision of firms through its positive effect on innovation. Firms investing more in R&D have a greater tendency to innovate. Moreover, firms innovate more if they are affiliated to a foreign company, outsource part of their R&D and benefit from public financial incentives to invest in R&D.

The important role of public financing in promoting innovation is in line with the idea that specific programmes implemented by governments help to alleviate financing constraints. Hall and Lerner (2009) review some empirical works, mainly for the US, which show that such programmes are effective. Lerner (1999) provides interesting results for the US and showing that firms that benefited from public grants grow faster. The empirical methodology allows, in particular, the issue of the direction of causality to be determined, by matching firms that have received grant and those that haven't. One explanation highlighted by the author for this effect is that receiving a grant may act as a sign on the market of the quality of the firm's project, which may in turn help the firm to get extra financing through venture capital.

Conclusion

This report builds upon data from the newly collected EFIGE dataset to highlight the empirical regularities observed in internationalised firms in comparison with domestic firms. The focus of the report is on France, although some comparison is made with Germany and a group of five other European countries.

We start by exploring differences in the industrial structure between France, Germany, and the five remaining European countries that appear in the survey. A strong empirical pattern appears: the median German firm is larger than the median French firm in most industries. German firms also export a higher proportion of their turnover, which can be explained by their larger size. These factors help explain why Germany exports more than France in proportion of GDP.

We then explore in more details the relationship between the innovation of firms and their internationalisation. Results clearly show that firms' internationalisation status is closely connected with their ability to innovate. Firms reporting export or FDI have a greater propensity to invest in R&D, make more certification with respect to the quality of their products and processes, and externalise more their R&D. One interesting result for France is that French firms are less inclined to certify their products and processes than other European countries.

Econometric results show that controlling for firms' size and productivity, exporting firms are also more innovative, both with respect to products and process. One explanation is that innovation improves the quality of firms' products and increases their sales performance. The estimated results also show that firms' innovation propensity may be constrained by the lack of financial resources. Our results show, without pointing to a direction in the causality, that firms receiving public incentives to innovate have a greater tendency to do so.

Overall, this report has three main policy implications. First, as highlighted in previous policy reports, firms' innovation over products and production processes is one important determinant of the success of domestic firms on home and foreign markets. Promoting firms' innovation propensity therefore has the potential of raising the competitiveness of the domestic production structure, as it increases the quality of goods offered by firms. Second, the establishment of vertical relationships with other firms, research centres and universities is a critical determinant of domestic firms' innovation propensity. Buying an innovation can help a firm upgrade its technology within a short period of time. Third, investing in R&D is costly and requires external financial resources. In the presence of market failures in credit markets, a public policy may be required in order to allow firms to innovate. More research is needed on the effect of public financing to determine the circumstances under which public support for firms most efficiently promotes innovation.

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The EFIGE Project

The European Firms in a Global Economy (EFIGE) project aims to explore the patterns of internationalisation of European firms. The EFIGE project is supported by the Directorate General Research of the European Union, through the Seventh Framework programme (FP7). It is led by Bruegel, in collaboration with the CEPII and six other European research institutions.

For the first time, a highly detailed firm-level survey has been carried out to collect both quantitative and qualitative data on European firms on a harmonised basis. Until this survey, researchers had to rely on data collected through country-specific methodologies. The interviews were conducted by the German company GfK Eurisko in 2009-2010.

A sample of manufacturing firms over 10 employees located in seven EU member countries – Austria, France, Germany, Hungary, Italy, Spain and the United Kingdom – was asked to answer more than 150 questions. The final sample gathers 16.000 firms that returned valid questionnaires. The five largest countries account for 3.000 firms each, while Austria and Hungary each account for only 500 firms. Firm-specific weights were attached to each firm in order to compensate for the over or underrepresentation of certain categories. Using the weights thus allows researchers to obtain results that are representative for the country as a whole.

The firm-level data collected from the survey were then matched with data taken from firms' balance sheets (Amadeus dataset). The resulting dataset can be broke down into six major topics: general information (part A), workforce (part B), investment, information technologies and R&D (part C), internationalisation (part D), market and pricing (part E) and finance (part F).