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Financial Constraints, Innovation Performance and Sectoral Disaggregation*

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Abstract

How do the effects of financial constraints on innovation performance vary by sector and firm characteristics? This paper uses innovation survey data from eleven European countries to examine the heterogeneity of these effects. So far, there has been a lack of cross-country micro-level studies exploring the effects of financial constraints on innovation performance in Western Europe and only little research about the variability of such effects between the broad sectors of production and services. Our results suggest that the impact of direct measures of financial barriers differs in production and service sectors, and also by the firm's export orientation. In particular, financial constraints appear to have more pronounced negative effects in the production sector than in the service sector. Among different types of firms, the response to financial constraints seems to be stronger for non-exporters.

JEL classification: L1; L2; O1; O3
Keywords: financial constraints; innovation; firm heterogeneity

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1 Introduction

There is ample evidence in the economics literature that achieving sustained long-term productivity and economic growth is intrinsically linked to research and development (R&D) and innovation investment (Coe & Helpman, 1995; Cainelli *et al.*, 2006; Coe *et al.*, 2009). Due to informational asymmetries with external investors and uncertain and lagged returns, this type of investment is considered to be particulary sensitive to financial constraints (Himmelberg & Petersen, 1994; Hall, 2002). The available empirical evidence, however, is not as conclusive as one might expect. Some studies provide evidence that financial frictions have a strong negative effect upon innovation (Mulkay *et al.*, 2000; Aghion *et al.*, 2008; Ouyang, 2011), while some others fail to reach the same conclusion (Harhoff, 1998; Bond *et al.*, 2005). A common feature of many earlier studies on this topic is that they try to identify which firms are more or less financially constrained by investigating the sensitivity of their R&D investment to internally generated cash flows. Kaplan & Zingales (1997), and more recently Campello *et al.* (2010), stress that traditional cash flow based indicators may fail to reveal financially constrained firms (for example, because of positive correlation of both cash flow and investment with expected future profitability) and argue in favor of direct survey-based measures of financial constraints. Another concern associated with the study of obstacles to innovation is the presence of bias arising from the endogeneity of the financial constraints variable and survey sampling issues. Recent papers that use direct indicators based on firms' own assessments and address such econometric problems (see Savignac, 2008; Hottenrott & Peters, 2012; Gorodnichenko & Schnitzer, 2013) point to significant negative effects of financial barriers on the propensity of firms to engage in innovation.[1]

Although the aforementioned literature has provided important insights, the tests implemented consider mainly one country or a group of countries with similar characteristics and involve a relatively small number of firms.[2] The shortage of systematic studies based on cross-country data renders it difficult to conclude that the reported effects are a universal phenomenon. In addition, many existing studies on this topic focus on exploring the causal effect of financial constraints on R&D investment. For example, Brown *et al.* (2012) find strong evidence that financing constraints drive R&D below the socially optimal levels. While R&D has strengths as a measure of innovation, it is an input (not the output) in the innovation process, and as suggested by Griffith *et al.* (2006), it does not take account of the productivity or the effectiveness of effort. Furthermore, public R&D and public financial support at different stages of the innovation process may sometimes even replace the firm's own R&D investment (David *et al.*, 2000; Clausen, 2009). Therefore, considering the effects on direct measures of innovation output can complement the findings of these studies and contribute to a better assessment of the overall impact of financing difficulties on innovation performance. Finally, the existing literature tells us little about the cross-sectoral variability of such effects. Since the nature of the innovation process and the intensity of usage of various innovation inputs may differ across industries, an accurate analysis of the impact of financial barriers on innovation performance should also take into account the considerable differences between the aggregate production and service sectors. The presence of distinct sectoral differences in the response to financial constraints takes on particular importance in the European context, where the share of manufacturing in employment and value added has decreased over the past decades and economies have shifted towards services (Brandes, 2008). Moreover, an enquiry

[1] See Czarnitzki & Hottenrott (2010) for an overview of the empirical literature.

[2] A negative relation between financial constraints and innovation has been shown, for example, in French manufacturing firms (Savignac, 2008), in German manufacturing firms (Hottenrott & Peters, 2012), in Portuguese firms (Silva & Carreira, 2012), and in transition economies (Gorodnichenko & Schnitzer, 2013; Männasoo & Meriküll, 2014).

in this direction sheds light on the channels through which better access to external finance can foster innovation activity and lead to higher productivity and economic growth.

The present article addresses these issues using European-comparable firm-level data from the Community Innovation Surveys (CIS). In particular, it contributes to the literature in two main aspects. First, we explore the relationship between direct measures of financial constraints and innovation performance using data from a large number of firms in both Western and Eastern European countries. Second, we examine whether these effects vary between and within the broad sectors of production and services. To avoid the spurious positive correlation due to firms not wishing to innovate (and thus without financial obstacles to innovation), we restrict the sample to include only the potentially innovative firms[3] (to be referred to as "innovative firms" from now on) and consider the effects on the propensity to have innovation success (positive share in sales of innovative products) rather than the propensity to engage in innovation activities. In addition, we tackle the endogeneity problem by estimating the probability of being a successful innovator and the likelihood to face financial constraints simultaneously using recursive-mixed-process estimators (Roodman, 2009).

By way of preview, the main findings can be listed as follows. First, the existence of financial constraints (especially, due to limited availability of internal funds) is an important hampering factor to innovation performance across European countries. Second, the role of financial constraints appears to be stronger and statistically more robust among innovative firms in the production sector than in the service sector. Within industries and especially within the production sector, innovative firms that do not engage in exporting activities appear to experience the greatest problems.

The paper proceeds as follows: Section 2 presents an overview of the related literature and develops the main hypotheses to be tested; Section 3 describes the data used; Section 4 outlines the empirical model specification and the econometric techniques applied; Sections 5 reports the estimation results and investigates their robustness; Section 6 offers a discussion of the study's conclusions.

2 Literature Review and Hypotheses Development

2.1 Financial constraints and innovation

Different types of investment, including investment in R&D, can be financed from two sources: external sources, such as bank loans and other forms of debt, and internal sources, such as retained earnings or new equity. When firms decide about their optimal levels of investment, they choose the capital structure that minimizes their long run cost of capital. Modigliani & Miller (1958) state that in perfect capital markets with no taxes, bankruptcy costs or asymmetric information, investment decisions are not dependent on capital structure. However, such conditions do not generally hold and information asymmetries or principal-agent conflicts (Stiglitz & Weiss, 1981; Jensen & Meckling, 1976) influence lending and investment decisions. As a result, the cost of capital and the impact of financial considerations on the investment decision may differ across different types of investment (Meyer & Kuh, 1957; Leland & Pyle, 1977; Myers & Majluf, 1984). Investment in R&D, compared to physical assets, is likely to be more affected by financial factors (Himmelberg & Petersen, 1994; Hall, 2002; Hall & Lerner, 2010) because it requires large sunk costs (Alderson & Betker, 1996) and produces intangi-

[3]Following Savignac (2008), potentially innovative firms are the firms that wish to innovate. Specifically, the corresponding sample includes: (i) the firms that report product (good or service) or process innovation, (ii) the firms that report ongoing or abandoned innovation activities, or (iii) the firms that report obstacles to innovation. The excluded firms are those that are not interested in innovation; that is, the firms without innovative activities and without any obstacles to innovation.

ble assets that can be difficult to use as collateral for external borrowing (Williamson, 1988; Alderson & Betker, 1996). Furthermore, investment in innovation projects is characterized by high degree of information asymmetries and agency costs that result in problems of adverse selection (Leland & Pyle, 1977) and moral hazard (Jensen & Meckling, 1976). This drives lenders to ask for a higher rate of return than in the case of less risky investments in physical assets (Hall, 2002; Czarnitzki & Hottenrott, 2010).[4] As stressed by Myers & Majluf (1984), although information asymmetries matter for external financing of all types of investment, they are particularly significant in limiting financing of innovation investments due to the complexity and specificity of the innovation process.

The discussion in the previous paragraph suggests that funding from external sources is relatively more difficult and more expensive for innovation investment in general, and R&D in particular, than for other types of investment. Consequently, firms have to rely mostly on internal funds to finance their innovation projects (Hall, 2002; Hottenrott & Peters, 2012). This also implies that if internally generated funds are not available (for instance, during periods of negative liquidity shocks) firms find themselves particularly constrained in their R&D investment decisions, and thus in producing successful innovative products. A clear implication for our empirical analysis is that firms with limited internal funds are more likely to be constrained in their innovation activities, and that the detrimental effect of internal financial constraints on innovation output is likely to be stronger than the effect of external financial constraints alone.[5]

The standard empirical strategy to identify financially constrained firms has been to analyze investments' sensitivities to changes in available sources (usually cash flows) across groups of firms with similar attributes (Fazzari *et al.*, 1988; Hoshi *et al.*, 1991). However, many papers question the use of investment-cash flow sensitivities, especially in studies that do not control for the potential endogeneity of cash flow or ignore the possibility of external finance.[6] Theoretical concerns about measurement errors raised by Alti (2003) and Moyen (2004) have shifted the focus towards more comprehensive analyses and the mechanisms behind the observation that firms depend on their cash to invest more (see, for example, Brown *et al.*, 2009).[7] As an alternative, Kaplan & Zingales (1997) and Campello *et al.* (2010) support the use of more direct approaches towards the identification of financially constrained firms based on survey data. Survey-based responses provide specific information on firms' financial constraints without relying on particular assumptions about their investment behavior and can be used to explore the linkages between financial barriers, firm characteristics and the business environment. In our context, a firm is defined to be financially unconstrained if it is able to implement its innovation projects at optimal scale, and constrained if it is unable to do so due to shortage of funding (see also Hall, 2002; Czarnitzki & Hottenrott, 2011).

[4]The cost premium for funding R&D is most likely to be higher than that for ordinary capital investment as the potential investors find it especially difficult to distinguish between good and bad R&D investments, as compared to shorter-term and less risky projects (Leland & Pyle, 1977; Hall, 2002). This is, in its essence, a standard lemons' problem (Akerlof, 1970).

[5]External financial constraints can arise because of the firm's increased need for external funds to finance its investments (for example, in R&D) and because of the high cost of external funds; that is, the cost the firm would incur conditional upon using external funds (Hennessy & Whited, 2007).

[6]There is also the argument that firms tend to smooth R&D spending over time, which leads to difficulties in measuring the impact of changes in cash in one period on subsequent investments (Hottenrott & Peters, 2012).

[7]A closely related literature deals with the cost of external finance (see, for example, Hennessy & Whited, 2007).

2.2 Explaining variation across industries

The severity of financial constraints, as well as its effect on innovation performance, may vary significantly across firms operating in production and service industries. This can be attributed to the potentially different nature of the innovation process and the different intensity of usage of various innovation inputs in the two broad sectors. First, there are important differences in the role of external knowledge and innovation-related cooperation (Gallouj & Weinstein, 1997; Gadrey & Gallouj, 1998). Several studies (see, for example, OECD, 2009) argue that innovation in service firms (as compared to innovation in production firms) relies more intensively on obtaining knowledge from outside sources, especially clients and suppliers, and on having cooperative arrangements with external partners. In fact, many types of services are co-produced with clients and have significant inputs from clients in the service development (Tether, 2003, 2005; Gallouj & Savona, 2009). Second, service sector innovations tend to have a more ad hoc nature and are often more of an incremental type as compared to production sector innovations.[8] For instance, Leiponen (2008) provides evidence that R&D in services is conducted mainly by informal teamwork on a more ad hoc basis and is less institutionalized. Third, innovation in less knowledge-intensive services is less dependent on large scale R&D projects (Gallouj & Weinstein, 1997; Tether, 2003), suggesting that higher R&D spending in services is not as closely associated with higher innovation output as in production. Fourth, innovation in services can sometimes be related to changes in work organization (organizational innovations), training of workforce and the application of ICT (see Polder *et al.*, 2009; Mothe & Nguyen Thi, 2010). Finally, innovation-specific expenditure on materials and energy tends to be lower in services (with the exception of transportation services); even though labour costs make up a large share of the expenditure, for instance, due to the importance of interaction with clients (Tether, 2003, 2005).

In summary, the combination and intensity of use of the key innovation inputs can differ substantially between the two sectors. The lesser need for R&D (which is highly sensitive to financial constraints) and the stronger role of other cooperation-based inputs (which are less dependent on the availability of funds) in service industries implies that the impact of financial barriers on innovation success may be less pronounced in services than in production. There is also suggestion in the literature that firms in service industries are more capable of self-financing their innovation activities and use fewer bank loans for this type of investment than firms in production industries (Dahlstrand & Cetindamar, 2000). This may be driven by the fact that service firms require, on average, a lower initial investment (lower sunk costs) and have to attain a lower minimum efficient scale than production firms (Silva & Carreira, 2010). Despite these sectoral heterogeneities, most of the existing empirical studies on the effects of financial constraints on innovation performance concentrate on manufacturing or production industries. One notable exception is a recent study by Gorodnichenko & Schnitzer (2013) which shows, among others, that the causal effect of financial constraints is similar for firms in services and manufacturing. It must be stressed, however, that this study uses the propensity to engage in innovation activities as the innovation output and employs World Bank's BEEPS data for about 10,000 firms in emerging market economies where the service sector has been underdeveloped. Clearly, further analysis and empirical evaluation along these lines (that also considers cross-country data from developed countries, employs alternative innovation measures and puts more emphasis on sectoral-level differences) is needed. The present article seeks to do this.

[8] Because services can be often consumer-specific, it has to be noted that it is not always easy to differentiate between service innovations and service variations (Tether, 2005).

2.3 Explaining variation across firm groups

The importance of financial factors in constraining innovation activity may also vary according to firm-level characteristics. An obvious distinction is between large and small companies. Recent attempts to analyze theoretically the impact of borrowing constraints on firm dynamics include Cooley & Quadrini (2001), Albuquerque & Hopenhayn (2004) and Clementi & Hopenhayn (2006). In Albuquerque & Hopenhayn (2004) and Clementi & Hopenhayn (2006) lenders introduce credit constraints because of limited debt contract enforceability and because of asymmetric information on the use of funds or the return on investment, respectively. Such market imperfections force firms to enter at a suboptimal small size. However, as they pay off their debt and increase their equity value, they establish creditworthiness and build up internal resources that enable them to expand to their optimal size. Consequently, according to these models, large firms have weaker borrowing constraints: if they see an investment opportunity in an innovation project, they will be in a better position to borrow and finance it than small firms. In a similar vein, Hennessy & Whited (2007) formulate a dynamic structural model and find that large firms face lower bankruptcy and equity flotation costs than small firms, which makes it less costly or less difficult for them to obtain external financing for innovation investment. Finally, as argued by Gorodnichenko & Schnitzer (2013), larger firms are less financially constrained in their innovation activities because they have higher availability of internal resources and can therefore benefit from economies of scale in R&D and marketing. Other empirical studies that look into this issue include Ughetto (2008) and Hottenrott & Peters (2012) who show that external financial constraints are more binding for R&D and innovation of small firms, and Scellato (2007) who finds that financing barriers affect more strongly the patenting activities of small enterprises.

Another important distinction is between firms that engage in exporting activities and those that do not. Exporters tend to be larger and more well-known, and thus, they may have higher levels of collateral and enjoy better relations with external investors or lenders. More importantly, exporters typically exhibit better financial health than non-exporters. The main reasons for that are summarized in Greenaway *et al.* (2007) and Bridges & Guariglia (2008). Exporting firms have access to both domestic and international financial markets and are less subject to those financial constraints induced by tight monetary policy and recessions at home. This allows them to diversify sources of financing and the associated risks, and improves the availability and stability of internal funds for investment, including investment in innovation projects. The more stable cash flow and the better availability of internal funds can also relax external financial constraints, due to greater assurances to lenders that the firm will be able to service its obligations. Furthermore, exporters need to have relatively high productivity levels to be able to cover the substantial sunk costs of exporting (see Melitz, 2003; Helpman *et al.*, 2004). Thus, being an exporter provides a signal that the firm can generate enough profits in foreign markets to recover such costs and can further relax external financial constraints (for instance, when it comes to borrowing for R&D). Finally, export status can improve firms' access to credit by signaling borrowers' resilience to domestic and foreign competition, as suggested by Bernini (2012).[9] Following these arguments, we expect that financial constraints will have stronger effects on the innovation performance of non-exporters, as these firms have to rely more on internal funds to finance innovation investment. The present article will attempt to test this hypothesis. A positive answer would also support the view that exporting and innovation are complements: a firm that does not engage in exporting (and thus cannot materialize productivity gains from such complementarities) is less likely to have innovation success under the presence of financial constraints.

[9] We note that there is also an opposite view, claiming that exporters may face tougher financial constraints as their international activities can mean more risks for lenders (Feenstra *et al.*, 2011).

3 Data

We employ cross-country micro-level data from the fourth Community Innovation Survey (CIS4) which covers the period 2002-2004. The countries considered in our study are: Bulgaria, Czech Republic, Estonia, France, Italy, Norway, Portugal, Romania, Slovakia, Spain, Sweden. The rationale for the choice of these eleven countries is twofold: first, they all have information on the dependent and key explanatory variables used in our empirical model; second, they report a sufficiently large number of innovative firms and provide data for firms in both production and service sectors. Unfortunately, for three large countries (namely, France, Italy and Spain) the information required to carry out the same empirical analysis using data from the next CIS wave (CIS2006 with observation period 2004-2006) is not available.[10] Hence, while we use CIS2006 data for robustness checks, our analysis relies primarily on CIS4 for which the sample size is very large and enables a more detailed firm-level and industry-level comparison. Due to their confidential character, the CIS data were accessed through the SAFE Center at the premises of Eurostat in Luxembourg. In this way, we avoid the possibility of micro-aggregation bias associated with the use of the publicly available micro-aggregated CIS data (Mohnen & Röller, 2005).

The CIS data set has a number of advantages relative to data sets employed in previous studies. First, it provides direct self-reported measures of firms' financial constraints and innovation, and thus, we do not need to rely on indirect proxies. Second, it is the only data source that contains cross-country information on innovation activities in Western European countries. Third, it is based on a common survey questionnaire and methodology and includes data on a large number of firms and a broad range of industries, which makes the corresponding data set suitable for cross-industry and cross-country comparison. Fourth, it entails information on both internal and external financial constraints, which allows us to identify the channels through which financing barriers may affect innovation. In order to construct instrumental variables for our measures of financial constraints, we also employ industry-level data from Amadeus: a comprehensive database containing comparable financial information for millions of companies across Europe. Our CIS4-based sample, which results from merging these two sources, contains about 38,000 innovative firms, out of which about 28,000 are from Western European countries. Notice that firms that operate in the financial intermediation sector, which are frequently subject to prudential supervision and government intervention, are not included in our sample.

4 Empirical Strategy

One distinctive characteristic of the CIS questionnaire is that it begins by asking all firms for some general information and whether they have innovation activities (completed, ongoing, or abandoned) or face any obstacles to innovation. Then, only the firms that provide positive responses to these questions (that is, the firms that wish to innovate) are requested to answer a large number of additional questions, such as those on public financial support, information sources and cooperation. In the last part of the questionnaire, all surveyed firms are asked about financial and non-financial constraints to innovation. As pointed out by Savignac (2008), questioning the firms that do not wish to innovate, and hence do not meet any financial constraints, about such constraints may lead to a positive correlation between the two variables. To cope with this issue, we restrict the sample to include only the firms that wish

[10] The CIS2008 (with observation period 2006-2008) is also not considered here as the CIS2008 questionnaire does not include questions on factors hampering innovation activities.

to innovate[11] and consider the impact of financial constraints on innovation success rather than the propensity to innovate.[12]

An econometric problem associated with the study of obstacles to innovation is the endogeneity of the financial constraints variable. This endogeneity may arise because both financial constraints and innovation patterns may be affected by common elements of unobservable heterogeneity; for example, by firm-specific risk factors, such as the uncertainty associated with the output of an innovation project, or the lack of information about the time needed to bring an innovation project onto the market (Savignac, 2008). To address this problem, we consider a recursive two-equation model that builds on the works of Piga & Atzeni (2007) and Savignac (2008) and takes the following form:

$$I^*_{isc} = \mathbf{X}'_{isc}\beta_1 + \vartheta_r R_{isc} + \vartheta_f FC_{isc} + \varepsilon_1 \quad (1)$$

$$FC^*_{isc} = \mathbf{X}'_{isc}\beta_2 + \mathbf{Y}'_{isc}\gamma + \varepsilon_2 \quad (2)$$

$$\begin{pmatrix}\varepsilon_1\\ \varepsilon_2\end{pmatrix} \sim N\left\{\begin{pmatrix}0\\0\end{pmatrix}, \begin{bmatrix}1 & \rho_{12}\\ \rho_{12} & 1\end{bmatrix}\right\}$$

where I^* and FC^* are the unobserved latent variables underlying I^0 and FC, I^0 is a dummy variable that equals one if the firm reports positive turnover from newly introduced or significantly modified goods or services[13] ('Innovation Success'); FC is a dummy variable that equals one if the firm reports that the lack of finance from either internal or external sources is highly important in hampering its innovation activities ('Financial Constraints'); $\mathbf{X}$ is a vector of control variables; R is the observed R&D intensity, measured by the logarithm of R&D expenditure as percentage of sales plus 0.1 ('R&D Intensity'); $\mathbf{Y}$ is a vector of additional control variables (to act as instruments for FC); ε_1 and ε_2 are idiosyncratic error terms, assumed to be jointly normally distributed; ρ_{12} is the correlation coefficient between ε_1 and ε_2, which accounts for the possible existence of omitted or unobserved factors that affect simultaneously the two equations; and, i, s, c index firm, industry and country, respectively. Vector $\mathbf{X}$ in Eq. (1) includes control variables commonly used in innovation production functions (see Crépon *et al.*, 1998; Mohnen & Röller, 2005; Griffith *et al.*, 2006; Lööf & Heshmati, 2006; Mairesse & Mohnen, 2010); that is, an indicator of whether the firm has cooperative arrangements on innovation activities[14] ('Cooperation'), a categorical variable reflecting different sources of information for innovation[15] ('External Search'), an indicator of whether the firm uses design pattern, trademarks, or copyright to protect inventions or innovations ('Formal Protection'), indicators of whether the firm has exporting activities ('Export') and is part of an enterprise group ('Group'), and, finally, the size of the firm, measured by the logarithm of the number of employees ('Size'). To capture unobserved heterogeneity, we also include industry (α_s) and country (α_c) fixed effects.

However, another econometric concern that arises with the above model is that the R&D intensity variable in Eq. (1) may also be endogenous relative to the dependent variable, and thus correlated with ε_1 and ε_2. This suggests that estimating only Eqs. (1) and (2) jointly

[11] This is similar to the approach followed by Brown *et al.* (2012), who concentrate their analysis on R&D reporting firms.

[12] Notice that the CIS data set provides limited information for the sample of firms not wishing to innovate, and thus, estimating first the impact of financial constraints on the propensity to innovate (using a two stage approach) is not possible.

[13] As a measure of the commercial success of innovation, this variable outperforms simple indicators coding engagement in some kind of innovation activity (Mohnen & Röller, 2005; Mairesse & Mohnen, 2010).

[14] Specifically, this indicator captures cooperation with at least one of the following partners: other enterprises within the same enterprise group, other enterprises in the same sector, suppliers, clients or customers, government, and universities. It excludes, however, cooperation with R&D institutes.

[15] These include knowledge from within the enterprise group, from clients, suppliers, competitors, consultants, universities, research institutions, conferences, professional associations and scientific journals.

may produce inconsistent results and lead to misleading inferences. To address this issue, we treat the potential endogeneity of R as an omitted variable problem and employ a control function correction method (see Blundell & Powell, 2003). The idea behind this method is to derive a proxy that conditions on the part of R that is correlated with ε_1 and ε_2, and use this proxy as a covariate in Eqs. (1) and (2). Formally, we consider a modified version of the above model that accounts for the endogeneity of both FC and R, as follows:

$$
\begin{aligned}
I^*_{isc} &= \mathbf{X}'_{isc}\beta_1 + \vartheta_r R_{isc} + \vartheta_f FC_{isc} + \alpha_s + \alpha_c + \rho_{13}\varepsilon_3 + \bar{\varepsilon}_1 && (3)\\
FC^*_{isc} &= \mathbf{X}'_{isc}\beta_2 + \mathbf{Y}'_{isc}\gamma_1 + \rho_{23}\varepsilon_3 + \bar{\varepsilon}_2 && (4)\\
R_{isc} &= \mathbf{X}'_{isc}\beta_3 + \mathbf{Y}'_{isc}\gamma_2 + \mathbf{Z}'_{isc}\vartheta_z + \varepsilon_3 && (5)\\
\varepsilon_1 &= \rho_{13}\varepsilon_3 + \bar{\varepsilon}_1\\
\varepsilon_2 &= \rho_{23}\varepsilon_3 + \bar{\varepsilon}_2\\
\begin{pmatrix}\bar{\varepsilon}_1\\ \bar{\varepsilon}_2\end{pmatrix} &\sim N\left\{\begin{pmatrix}0\\0\end{pmatrix}, \begin{bmatrix}1 & \rho_{12}\\ \rho_{12} & 1\end{bmatrix}\right\}
\end{aligned}
$$

where $\mathbf{Z}$ is a vector of additional control variables (to act as instruments for R); ε_3 is an idiosyncratic error term, such that ε_1, ε_2 and ε_3, as well as the tails $\bar{\varepsilon}_1$ and $\bar{\varepsilon}_2$, are jointly normally distributed; and, ρ_{13} and ρ_{23} are the correlation coefficients between the corresponding idiosyncratic error terms.

We estimate the proposed model using a two step procedure. In the first step, we estimate Eq. (5) by least squares and use the resulting estimates to construct the control function $\hat{\varepsilon}_3$. With the control function in place, in the second step we jointly estimate Eqs. (3) and (4) using conditional recursive mixed process (cmp) estimators (see Roodman, 2009). The cmp approach takes into account both simultaneity and endogeneity risks and produces consistent estimates for recursive systems in which the endogenous variables appear on the right-hand-side as observed. Since Eqs. (3) and (4) constitute a recursive process (imposed by the instrumentation strategy), consisting of one structural equation (innovation success equation) and one reduced-form equation (financial constraints equation), the analysis in the second step is essentially a limited information maximum likelihood (LIML) estimation. The advantage with this approach, as opposed to two-stage least squares and related linear methods, is the gain in efficiency as it takes into account the covariances of the errors and uses the information about the limited nature of the reduced-form dependent variable (Anderson, 2005; Roodman, 2009). In the special case where both dependent variables are binary (as above), the model is fundamentally a bivariate probit model with endogenous dummy regressor (see Wooldridge, 2002). Since the second step uses an estimate of ε_3 from the first step, as opposed to the true ε_3, the asymptotic sampling variance of the second-step estimates needs to take this extra source of variation into account. To do that we undertake 200 replications of the procedure to bootstrap the estimated standard errors.[16] Karaca-Mandic & Train (2003) derive the specific form of the standard formulas for two-step estimators that is applicable to the control function approach, and note that the bootstrap and asymptotic formulas (Newey, 1984; Murphy & Topel, 1985) provide very similar standard errors for such applications.

The consistency of the proposed methodology depends on the validity of instruments included in vectors $\mathbf{Y}$ and $\mathbf{Z}$, which in turn, relies on two conditions. First, the instruments must be determinants of the likelihood to face financial constraints and the value of R&D intensity, respectively. Second, they must not be correlated with the unobserved factors that may affect the propensity to have innovation success. It is easy to show that the first condition is satisfied: the estimated coefficients on the instruments must have the expected

[16] The results remain qualitatively the same when we undertake different number of bootstrap replications, such as 100 or 300.

sign and be statistically significant at conventional levels of significance. To make sure that the second condition is fulfilled, we choose variables which affect the firm's innovation performance only through the dependent variable in Eqs. (4) and (5). Specifically, vector **Y** includes four industry-level proxies of financial performance (calculated using cross-country industry averages); namely, 'Public Support', measured by the number of different types of sources of public funding for innovation, 'Collateral', measured by the logarithm of tangible assets, 'Financial Risk', measured by the gearing ratio, and 'Profitability', measured by the operating cash flow ratio.[17] We expect that firms that operate in industries that are highly dependent on funding from a variety of public sources are more likely to report financial constraints. In addition, following Canepa & Stoneman (2003), we expect that more profitable industries are less likely to experience financial constraints (due to larger amount of internal funds), whereas more risky industries and those with fewer realisable assets are more likely to be financially constrained (due to more difficult access to external funds). Such industry-level variables appear to be good instruments, since they can influence the amount of internal funds and the attractiveness of firms to external investors but cannot influence the firm's innovation performance directly. On the other hand, vector **Z** includes two variables that exert positive influence on innovation success through the R&D channel; namely, 'Continuous R&D', measured by an indicator of whether the firm engages in continuous intramural (in-house) R&D, as opposed to occasional or no intramural R&D at all; and, 'Cooperation R&D', measured by an indicator of whether the firm has cooperative arrangements on innovation activities with R&D institutes.[18] To test the validity of the aforementioned instruments, we perform the Sargan-Hansen test for over-identifying restrictions in linear LIML models. Even though there is no theoretical evidence to suggest that the assumptions necessary to perform this test are satisfied in the bivariate probit with endogenous dummy regressor, previous empirical studies argue that this is actually the best available diagnostic (Evans & Schwab, 1995; Yörük, 2009).

Notice that in order to ensure that the sample is representative of the relevant population of firms in each country, all regressions are weighted by country sampling weights. These weights correspond to the inverse of the probability of selection; that is, the total population of firms divided by the total number of surveyed firms in each country. Detailed definitions and data sources for all variable described in this section are given in Table A.2. The cross correlation matrix for these variables is displayed in Table A.4.

5 Empirical Results

5.1 Descriptive statistics: production versus services

We start by considering the differences across sectors with respect to financial obstacles and innovation inputs. Tables A.1 and A.3 display the frequency distribution of financially constrained firms for production and service industries, as well as descriptive statistics of the main variables for the two broad sectors. According to the figures, innovative firms in production industries are more likely to report financial constraints than establishments in service indus-

[17]'Collateral', 'Financial Risk' and 'Profitability' are constructed using the cross-country 3-year average of the corresponding firm-level variables based on Amadeus data for the periods 2002-2004 (for CIS4) and 2004-2006 (for CIS2006). To ensure that the industry-level measures are not sensitive to extreme values, all firm-level variables are first winsorized at 1% and 99%.

[18]This is similar to the approach followed by Griffith *et al.* (2006), who include the variable 'Cooperation' (capturing all types of cooperative arrangements on innovation activities) in the R&D intensity equation but not in the innovation outcome equation. However, tests for over-identifying restrictions - based on our sample - reveal that only cooperation with R&D institutes is a valid instrument, as cooperation with other types of cooperation partners can also affect innovation success directly.

tries, mainly due to the presence of higher barriers to external financing. In addition, firms in both sectors are more likely to report internal financial constraints than external financial constraints. Another interesting feature is the existence of apparent differences between the two sectors concerning the type and intensity of use of innovation inputs. In particular, the proportion of firms reporting that they are engaged in continuous intramural R&D and the level of R&D intensity are greater in production than in services. Production firms also have, on average, higher levels of collateral (measured by the value of tangible assets), are more likely to engage in cooperative arrangements with R&D institutes, and draw on formal measures to protect returns from innovation more frequently. On the other hand, service firms use a larger variety of sources of information to develop or improve their products or services, and are more likely to engage in innovation-related cooperation with external partners, such as customers or suppliers. A further look into the standard deviations from the sectoral means reveals the dispersion and heterogeneity of firms that operate in service industries, especially with respect to their financial performance (as captured by the indicators of financial risk and profitability). The large variance of the R&D intensity variable in the case of service firms reflects the high values of R&D investment for knowledge-intensive industries combined with the much lower values for less knowledge-intensive industries, such as hotels and catering.

5.2 Main findings

We continue our analysis by estimating Eq. (3) (with the control function $\hat{\varepsilon}_3$ embedded into the specification) for the full sample of innovative firms using a univariate probit model (see column (1) of Table 1). As a first point, we can notice that the traditional determinants of innovation performance included in our model have the expected positive sign and are statistically significant at the 1% confidence level. Specifically, the results suggest that cooperation and formal protection increase the probability of having innovation success by 4% and 13%, respectively. These results are similar to those found in papers considering the Crépon *et al.* (1998)'s three-stage model or other models on the innovation value chain in European countries (see Roper *et al.*, 2008; OECD, 2009). Consistent with the literature on "open innovation" (Chesbrough, 2003; Dahlander & Gann, 2010; Love *et al.*, 2013) and the causal effects of exporting (Salomon & Shaver, 2005; Damijan *et al.*, 2008; Vahter, 2011), we also find that external knowledge sourcing and export orientation play an important role: adding a new type of external knowledge linkage and having exporting activities are associated with 2% and 5% higher probability to be in the group of successful innovators, respectively. Finally, as shown in the vast majority of studies on innovation (see, for example, Beckeikh *et al.*, 2006; Griffith *et al.*, 2006), innovation performance is positively related with firm size and R&D effort. Turning now to our variable of interest ('Financial Constraints'), we can see that it has a surprising positive and highly statistically significant impact on innovation performance. This lends support to the endogeneity argument and the need for a two-equation model: ignoring the endogeneity of the financial constraints variable may render the estimates of a univariate probit equation biased and inconsistent.

Column (2) of Table 1 presents the results of a bivariate probit estimation where the endogenous financial constraints variable is instrumented using the specification of Eq. (4) (with the control function $\hat{\varepsilon}_3$ embedded into both Eqs. (3) and (4)). The evidence obtained validates the above statement: once the endogeneity bias is corrected, we find a negative (but statistically insignificant) relationship between financial constraints and innovation performance while all other estimates remain virtually unchanged. As pointed out in Section 2, the impact of financial constraints is expected to be more pronounced for firms that do not engage in exporting activities. To test this prediction, we re-estimate the specification in column (2) for this group of firms. The results, displayed in column (3), indicate stronger effects for non-exporters: the coefficient on 'Financial Constraints' has the expected negative sign and appears to be statistically significant at the 1% confidence level. Qualitatively, the corresponding estimate suggests that the likelihood to have innovation success is 40% lower for non-exporters who face financial constraints. It must be stressed that in all specifications of Table 1 (as well as in those of the subsequent tables), the instruments included in vectors **Y** and **Z** have the desirable properties. Specifically, they appear to be strong determinants of the likelihood to experience financial constraints and the level of R&D intensity,[19] respectively, and to be uncorrelated with the error term of the innovation success equation (the *p*-value of the over-identifying restriction tests is above standard levels of statistical significance).[20] Another finding worth mentioning is that the variables 'Size' and 'Production' (coding firms in production industries[21]) enter the financial constraint equation highly statistically significantly and with negative and positive sign, respectively, suggesting that the probability to be financially constrained is higher for small firms and for firms that operate in production industries.[22]

< Insert Table 1 here >

Drawing upon the last result, we now turn to investigate possible cross-sector heterogeneity of the causal effect of financial constraints on innovation success. To do that, we partition the full sample of innovative firms into production and service industries and re-estimate the regression specifications of columns (1)-(3) in Table 1. Columns (1)-(3) in Table 2 present the results for production industries, whereas columns (1)-(3) in Table 3 present the results for service industries. Two regularities stand out. First, the causal effect of financial constraints on innovation performance is stronger and statistically more robust in production than in services (see column (2)). Second, within the two sectors and particularly within the production sector, firms that do not have exporting activities are more sensitive to financial constraints (see column (3)). Specifically, in production, the estimated reduction in the probability of having innovation success due to the presence of financial constraints is large (22% for the full sample and 45% for the sub-sample of non-exporters) and statistically significant in both specifications. In contrast, in services, the corresponding effects are relatively small, or of the opposite direction, and fail to reach statistical significance. The observed heterogeneity in the impact of financial barriers between the two sectors is consistent with previous studies documenting that the innovation output in service industries is less dependent on R&D (which is particulary sensitive to financial constraints) and more dependent on other, less costly inputs, such as collaboration with clients and knowledge from outside sources. As shown in columns (2) and (3), while 'R&D Intensity' has stronger effects on innovation success in production industries, the impact of 'Cooperation' and 'External Search' is relatively more pronounced in service industries. In addition, our results indicate that 'Collateral' in services is not as highly associated with financial constraints as in production (see column (2)), which may capture the fact that service industries require a lower initial investment and tend to use fewer bank loans compared to production industries (see Silva & Carreira, 2010).

[19]For brevity, Tables 1, 2 and 3 do not display the results for the R&D intensity equation. However, in all regressions the estimated coefficients on the instruments 'Continuous R&D' and 'Cooperation R&D' appear to be positive and highly statistically significant (results available upon request).

[20]When we replace the industry-level public support variable with its firm-level counterpart, the Hansen-Sargan test rejects the hypothesis that the instruments are correctly specified, confirming the validity of our chosen instrument structure.

[21]Production industries include: manufacturing; mining and quarrying; electricity, gas and water supply; and, construction. Service industries include: wholesale and retail trade, repair of motor vehicles, personal and household goods; hotels and restaurants; transport, storage and communication; and, real estate, renting and business activities.

[22]Notice, however, that the variable 'Production' controls mainly for unobserved heterogeneity, since sectoral differences can also be captured, to some extent, by the other regressors in the financial constraints equation.

As mentioned in Section 2, information asymmetries and the intangible nature of assets created by innovation projects increase the cost of external fund raising for such investments, and hence, firms, first and foremost, use internal funds to finance innovation projects as compared to external debt. This, in turn, implies that firms with limited internal funds are more likely to be constrained in their innovation performance, as they may have to leave some of their innovation projects on the shelf (Hottenrott & Peters, 2012). This conjecture is supported by our results: when we re-define the 'Financial Constraints' variable to capture lack of finance from internal sources, we find a monotonous increase in the responsiveness to financial constraints both in the full sample of innovative firms and the sub-sample of production industries. Specifically, the estimated coefficients on 'Financial Constraints' and the associated marginal effects reported in columns (4)-(5) of Table 1 and 2 appear to be economically and statistically more significant compared to those in columns (2)-(3). As expected, implementing the same tests using lack of finance from external sources as proxy for financial constraints, produces weaker causal effects: the estimated coefficient on 'Financial Constraints' is smaller in absolute value and reaches statistical significance only in the equations of non-exporters (see columns (6)-(7) of Tables 1 and 2). Notice that the chosen instruments behave in the predicted way across these new specifications; that is, 'Profitability' appears to be stronger determinant of internal financial constraints, whereas 'Collateral' and 'Financial Risk' appear to be stronger determinants of external financial constraints.

< Insert Table 2 and Table 3 here >

Are the reported findings sensitive to alternative definitions of the outcome variable? To answer this question, we use as threshold for innovation success the value that corresponds to the sample's 50^{th} and 75^{th} percentiles of "share of sales with new products" (5% and 20%, respectively), and re-run the regression package of Tables 1, 2 and 3. Rows (1)-(3) of Table 4 summarize the results on the financial constraints variable[23] when we consider the median as threshold value for coding successfully innovative firms (I^m), while rows (4)-(6) when we consider the upper quartile as alternative threshold value (I^q). Overall, recoding the 'Innovation Success' variable generates estimates which are similar to our baseline estimates and lead to the same conclusions. Once again, we find that innovation performance in production industries exhibits high responsiveness to financial constraints, especially when we allow financial constraints to depend on the availability of internal funds. Furthemore, we find that the strength of the response is particularly high for firms that do not engage in exporting activities, although the difference between exporters and non-exporters seems to become smaller as we move towards higher threshold values of innovation success. This result may reflect the fact that all production firms, regardless of export status, may face difficulties in achieving very high levels of innovation performance (and thus being included in the top quartile of most successful innovators) when they are financially constrained.

The cmp procedure (Roodman, 2009) works for a large class of simultaneous-equation systems where the equations can have different types of dependent variables. Thus, in order to further explore the sensitivity of our results to the definition used for the outcome variable, we treat 'Innovation Success' as a left-censored continuous variable and re-estimate Eqs. (3) and (4) jointly using a combination of a tobit model with censoring from below at zero (for the innovation success equation) and a probit model (for the financial constraing equation). Even though using the informational content of "share of sales with new products" may allow us to identify causal effects on the intensity of innovation success, shortcomings in the distribution

[23]For brevity and comparability, Tables 4 and 5 display only the results on our variable of interest. The estimated coefficients on the remaining control variables and instruments are very similar to those reported in the baseline specifications and do not change the inferences drawn from earlier findings.

and range limits of this variable point to its subjective nature and suggest that we should perhaps not draw too strong conclusions based on its continuous variation (see also Mairesse & Mohnen, 2010). In particular, this variable: (i) has values that tend to be rounded (for example, 10%, 20%); (ii) has a highly skewed distribution with a large mass of firms reporting zero or very low level of innovative sales; (iii) may be plagued by outliers, as some countries have a surprisingly large number of firms reporting a high percentage of innovative sales (even 100%).[24] Nevertheless, replacing the binary indicator with its continuous counterpart and implementing the aforementioned estimation strategy produces results that lead to the same conclusions (see rows (7)-(9) of Table 4).

< Insert Table 4 here >

5.3 Robustness tests

To assess the robustness of the above findings we perform several tests. First, we check whether our results hold when we take into account the level of financial market development of the sampled countries, which is considered to be an indicator of the accessibility of external finance. To do that, we exclude the Eastern European countries from our sample (namely, Bulgaria, Czech Republic, Estonia, Romania and Slovakia) and run the same regressions as in Tables 1, 2 and 3. As shown in rows (1)-(3) of Tables 5, the estimates on the financial constraints variable are not much influenced by this exercise, suggesting that the reported findings are not driven by countries with relatively lower level of financial development. Second, we test the sensitivity of our results to different time samples by employing pooled data from both CIS4 and CIS2006; that is, by adding data from CIS2006 for eight out of the eleven CIS4 sampled countries. Despite the obvious problems with this approach (such as, considering firms that were surveyed in both waves), the results obtained confirm our key findings: stronger response to financial constraints for production industries (particularly when we focus on the lack of finance from internal sources) and more pronounced effects for firms with no exporting activities (see rows (4)-(6) of Table 5). In a third robustness check, we examine if excluding the variable 'R&D Intensity' from the set of controls in Eq. (1) severely biases our estimates of innovation sensitivity to financial constraints. The results in rows (7)-(9) of Table 5 indicate that the answer is no: estimating Eqs. (1) and (2) using a bivariate probit model and allowing the R&D intensity to be included in the idiosyncratic error term ε_1 produces similar results and does not change the inferences drawn.

Finally, we conduct further tests of robustness, such as dropping the non-manufacturing industries (utilities, mining and quarrying and construction) from the aggregate production sector,[25] excluding the variable 'Public Support' from the list of instruments in $\mathbf{Y}$, and running the robustness tests described in this section using the alternative definitions of the variable 'Innovation Success'. Once again, estimates based on these tests are very similar to the baseline estimates (results available upon request).

< Insert Table 5 here >

6 Conclusions

This paper contributes to the literature in two main aspects. First, we use data from about 38,000 innovative firms in both Western and Eastern European countries and provide evidence

[24]Notice that the normality assumption is rejected even we exclude the 0% and 100% shares of innovative sales.

[25]Firms in manufacturing industries constitute 90% of the production sector.

that the presence of financial constraints is strongly negatively related to innovation performance. This effect seems to be driven by limited availability of internal funds (rather than limited access to external funds), which is consistent with the idea that innovation projects tend to be financed by retained profits or equity, and thus the lack of funds from such sources is a more binding constraint. Second, we show that the responsiveness to financial constraints differs between production and service sectors, and also by the firm's export status. Specifically, we find that: (i) innovative firms in production industries are significantly and robustly more sensitive to financial frictions than those in service industries; (ii) within sectors, financial frictions are particularly detrimental for innovative firms with no exporting activities. The differential impact of financial constraints between the two broad sectors can be explained, to some extent, by sectoral differences in the type, combination and intensity of use of innovation inputs. Specifically, the success of commercializing innovative products in service firms appears to rely more on inputs that are less dependent on the availability of funds (such as, collaboration with clients and suppliers and external sources of information) and less on R&D investment which is highly sensitive to financial constraints. On the other hand, the stronger effects of financial barriers for non-exporters may reflect the relatively lower productivity and financial performance of these firms, which weakens their ability to overcome the sunk costs of innovation investments. In addition, the less stable cash flow resulting from not having international activities can signal lower ability to service their external debt and strengthen the impact of external financial constraints on their innovation output. Finally, the absence of complementary gains from engaging in both innovation and exporting can lead to higher sensitivity to financial frictions.

Our results emphasize the role of financial constraints as one of the principal driving forces behind low innovation performance for a significant portion of firms. Therefore, policies aiming at enhancing access to external finance[26] can have a strong positive impact on innovation intensity in firms with limited internal funds, which may lead to a more rapid development of new goods and services, and higher economic growth. On the other hand, the finding that innovation sensitivity to financial frictions varies across sectors contributes to a better understanding of sectoral heterogeneities, and provides micro-foundations for interpretation of different effects on productivity and economic growth. In particular, financial frictions affecting more strongly innovation performance in production industries (compared to service industries) can account for possible productivity gaps between the two sectors[27] and be seen as one of the factors that cause different responses to financial crises (see Efthyvoulou, 2012). Hence, further investigation into the mechanisms of how the occurrence of financial crises affects firm-level and sectoral-level innovation performance is an important task for future research.

[26]Examples of such policies include efforts to improve accounting standards and craft regulations that permit firms to list on equity markets at an earlier stage (see Brown *et al.*, 2012).

[27]The contributions of services and other sectors to the aggregate productivity growth in the United States and Europe are discussed, for example, in van Ark *et al.* (2008).

A Appendix

A.1 Community Innovation Surveys

- We consider a firm to be potentially innovative during the surveyed period if it answered positively to at least one of the following: (1) introduced new or significantly improved products (good or services) with respect to its capabilities, such as improved software, user friendliness, components or sub-systems; (2) introduced new or significantly improved process, distribution, method, or support activity for its goods or services; (3) had any ongoing or abandoned innovation activities; (4) faced obstacles to innovation.

- The key question about financial constraints to innovation is the following: "During the surveyed period, how important were the following factors for hampering your innovation activities or projects or influencing a decision not to innovate?". We focus on two factors: lack of funds within the enterprise group (internal financial constraints); lack of funds from outside the enterprise (external financial constraints). The answer choices are: (a) factor of high importance; (b) factor of medium importance; (c) factor of low importance; (d) factor not experienced. We consider a firm to be financially constrained if it answered that the lack of finance (either from internal of external sources) was highly important in hampering its innovation activities or projects (in terms of leading to delay, abandonment or not starting innovation projects).

A.2 Tables

Table A.1: Statistics for CIS4 firms

	All Industries	Production	Services
Number of innovative firms	38482	25373	13109
Report impact[a] on innovation activities	17588 (45.7%)	11941 (47.1%)	5647 (43.1%)
Due to lack of			
either internal or external finance	6497 (16.9%)	4364 (17.2%)	2133 (16.3%)
internal finance	4805 (12.5%)	3173 (12.5%)	1632 (12.5%)
external finance	3899 (10.1%)	2620 (10.3%)	1279 (9.8%)
both internal and external finance	2207 (5.7%)	1429 (5.6%)	778 (5.9%)
internal (but not external) finance	2598 (6.8%)	1744 (6.9%)	854 (6.5%)
external (but not internal) finance	1692 (4.4%)	1191 (4.7%)	501 (3.8%)

[a] Impact refers to serious delay, abandonment or not starting innovation projects.

Table A.2: Description of variables for innovative firms

Variable Name	Definition	Source
Innovation Success (I^0)	0-1 dummy variable, =1 if the firm reports positive turnover from newly introduced or significantly modified goods or services ("share of sales with new products"). Alternative definitions use the sample's 50^{th} and 75^{th} percentiles of "share of sales with new products" as threshold for innovation success (denoted by I^m and I^q, respectively).	CIS
Financial Constraints	0-1 dummy variable, =1 if the firm reports that the lack of finance from either internal or external sources is highly important in hampering its innovation activities	CIS
Cooperation	0-1 dummy variable, =1 if the firm has cooperative arrangements on innovation activities with other enterprises or non-commercial institutions (excludes cooperation with R&D institutes)	CIS
External Search	number of highly important sources of knowledge or information for innovation (ranges from 0 to 10)	CIS
Formal Protection	0-1 dummy variable, =1 if the firm uses design pattern, trademarks, or copyright to protect inventions or innovations	CIS
Export	0-1 dummy variable, =1 if the firm sells goods or services in other countries	CIS
Group	0-1 dummy variable, =1 if the firm is part of a firm group (two or more legally-defined firms under common ownership)	CIS
Size	number of employees in logs	CIS
R&D Intensity	[(R&D expenditure/sales)∗100 + 0.1] in logs	CIS
Cooperation R&D	0-1 dummy variable, =1 if the firm has cooperative arrangements on innovation activities with R&D institutes	CIS
Continuous R&D	0-1 dummy variable, =1 if the firm reports continuous engagement in intramural (in-house) R&D	CIS
Public Support	number of sources of public financial support for innovation (ranges from 0 to 3: local, national, EU); industry-level average	CIS
Collateral	= tangible assets in logs; industry-level average	Amadeus
Financial Risk	= ((non current liabilities+loans)/shareholders funds)∗100; industry-level average	Amadeus
Profitability	= (cash flow/operating revenue)∗100; industry-level average	Amadeus
Industry Dummies	set of industry dummies according to the firm's main business activities (NACE 2-digit level)	CIS

Table A.3: Summary statistics

	All Industries		Production		Services	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Innovation Success (I^0)	0.65	0.47	0.67	0.47	0.61	0.48
Innovation Success (cont.)	21.29	29.96	21.08	29.16	21.70	31.44
Financial Constraints	0.16	0.37	0.17	0.37	0.16	0.36
Cooperation	0.31	0.46	0.30	0.45	0.33	0.47
External Search	1.47	1.51	1.45	1.49	1.50	1.55
Formal Protection	0.33	0.47	0.34	0.47	0.31	0.46
Export	0.56	0.49	0.63	0.48	0.40	0.49
Group	0.41	0.49	0.40	0.48	0.43	0.49
Size	4.18	1.39	4.26	1.36	4.03	1.42
R&D Intensity	0.23	1.85	0.30	1.72	0.10	2.07
Cooperation R&D	0.13	0.33	0.13	0.34	0.12	0.33
Continuous R&D	0.35	0.47	0.37	0.48	0.31	0.46
Public Support	0.13	0.07	0.14	0.06	0.11	0.08
Collateral	6.67	0.84	6.97	0.74	6.09	0.72
Financial Risk	104.78	41.32	107.75	10.68	99.03	41.94
Profitability	6.27	3.57	6.07	2.85	6.64	4.63

Table A.4: Cross correlation matrix for regression variables

	Innovation Success (I^0)	Innovation Success (cont.)	Financial Constraints	Cooperation	External Search	Formal Protection	Export	Group
Innovation Success (I^0)	1.00							
Innovation Success (cont.)	0.51	1.00						
Financial Constraints	0.08	0.05	1.00					
Cooperation	0.16	0.07	0.08	1.00				
External Search	0.14	0.12	0.07	0.15	1.00			
Formal Protection	0.17	0.05	0.05	0.18	0.14	1.00		
Export	0.14	0.02	0.03	0.15	0.08	0.21	1.00	
Group	0.03	-0.07	-0.04	0.23	0.00	0.18	0.20	1.00
Size	0.05	-0.06	-0.03	0.21	0.07	0.22	0.25	0.44
R&D Intensity	0.12	0.13	0.09	0.14	0.13	0.08	0.09	-0.06
Cooperation R&D	0.12	0.05	0.06	0.52	0.13	0.14	0.11	0.16
Continuous R&D	0.20	0.09	0.07	0.25	0.14	0.26	0.26	0.18
Public Support	0.18	0.10	0.07	0.13	0.06	0.12	0.20	0.07
Collateral	0.00	-0.07	-0.05	0.03	-0.05	0.00	0.16	0.07
Financial Risk	-0.17	-0.09	-0.03	-0.18	-0.11	-0.10	-0.10	-0.10
Profitability	-0.07	-0.03	-0.02	0.03	0.05	-0.01	-0.05	0.02

	Size	R&D Intensity	Cooperation R&D	Continuous R&D	Public Support	Collateral	Financial Risk	Profitability
Size	1.00							
R&D Intensity	-0.10	1.00						
Cooperation R&D	0.17	0.10	1.00					
Continuous R&D	0.16	0.16	0.21	1.00				
Public Support	0.05	0.26	0.10	0.29	1.00			
Collateral	0.10	0.01	0.06	0.07	0.20	1.00		
Financial Risk	-0.12	0.03	-0.08	-0.06	-0.25	0.27	1.00	
Profitability	0.03	0.02	0.02	-0.01	-0.02	0.08	0.03	1.00

Table 1: Bivariate probit model: all industries

	Probit		Bivariate probit											
			Internal or External FC				Internal FC				External FC			
	All Firms		All Firms		Non-Exporters		All Firms		Non-Exporters		All Firms		Non-Exporters	
	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
Equation for innovation success[a]														
Financial Constraints	0.11***	0.04	-0.43	-0.16	-1.09***	-0.40	-0.09	-0.03	-1.16***	-0.42	-0.23	-0.09	-0.71**	-0.28
	(0.00)		(0.19)		(0.00)		(0.82)		(0.00)		(0.45)		(0.02)	
Cooperation	0.12***	0.04	0.15***	0.05	0.20***	0.08	0.13***	0.05	0.19***	0.07	0.13***	0.05	0.17***	0.07
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
External Search	0.04***	0.02	0.05***	0.02	0.05***	0.02	0.05***	0.02	0.04***	0.02	0.05***	0.02	0.04***	0.02
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Formal Protection	0.37***	0.13	0.38***	0.13	0.34***	0.13	0.37***	0.13	0.33***	0.13	0.37***	0.13	0.33***	0.13
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Exports	0.15***	0.05	0.16***	0.06			0.16***	0.06			0.16***	0.06		
	(0.00)		(0.00)				(0.00)				(0.00)			
Group	0.14***	0.05	0.13***	0.05	0.15***	0.06	0.14***	0.05	0.17***	0.06	0.13***	0.05	0.18***	0.07
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Size	0.12***	0.04	0.11***	0.04	0.03**	0.01	0.12***	0.04	0.03*	0.01	0.12***	0.04	0.05***	0.02
	(0.00)		(0.00)		(0.04)		(0.00)		(0.07)		(0.00)		(0.00)	
R&D Intensity	0.81***	0.29	0.80***	0.29	0.58***	0.23	0.81***	0.29	0.58***	0.23	0.81***	0.29	0.61***	0.24
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
$\hat{\varepsilon}_3$	-0.75***	-0.27	-0.73***	-0.26	-0.52***	-0.20	-0.75***	-0.27	-0.53***	-0.21	-0.74***	-0.27	-0.57***	-0.22
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Equation for financial constraints[b]														
Public Support			0.11***		0.12***		0.08***		0.10***		0.14***		0.15***	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Collateral			-0.10***		-0.09***		-0.05***		-0.03		-0.13***		-0.11***	
			(0.00)		(0.00)		(0.00)		(0.10)		(0.00)		(0.00)	
Financial Risk			0.08***		0.14***		0.03**		0.08***		0.16***		0.19***	
			(0.00)		(0.00)		(0.01)		(0.00)		(0.00)		(0.00)	
Profitability			-0.04***		-0.06***		-0.06***		-0.07***		-0.03**		-0.06***	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.03)		(0.00)	
Size			-0.09***		-0.10***		-0.11***		-0.12***		-0.06***		-0.06***	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Production			0.06***		0.07**		-0.01		-0.01		0.06**		0.07*	
			(0.00)		(0.02)		(0.55)		(0.61)		(0.04)		(0.05)	
$\hat{\varepsilon}_3$			0.08***		0.08***		0.07***		0.06***		0.09***		0.07***	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Over-identification Test[c]			0.79		0.43		0.52		0.08		0.95		0.45	
Over-identification Test[d]	0.22		0.22		0.85		0.22		0.85		0.22		0.85	
Number of Firms	38060		38060		16621		38060		16621		38060		16621	

Columns report estimated coefficients and associated marginal effects (evaluated at mean values). Bootstrapped p-values in parentheses. ***,**,* Statistically significant at the 1%, 5% and 10% confidence level, respectively. [a] Specifications include industry and country dummy variables. [b] Specifications include all variables in vector $\mathbf{X}$. [c] Reports the Sargan-Hansen test statistic [p-value], where H_0: over-identifying restrictions in the financial constraints equation are valid. [d] Reports the Sargan-Hansen test statistic [p-value], where H_0: over-identifying restrictions in the R&D intensity equation are valid. The Sargan-Hansen test is implemented in linear LIML models. All continuous regressors are taken in their standard normalised form with zero mean and standard deviation, so that we can directly interpret the coefficients and marginal effects across the specifications.

Table 2: Bivariate probit model: production industries

	Probit		Bivariate probit											
			Internal or External FC				Internal FC				External FC			
	All Firms		All Firms		Non-Exporters		All Firms		Non-Exporters		All Firms		Non-Exporters	
	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
Equation for innovation success[a]														
Financial Constraints	0.12***	0.04	-0.59*	-0.22	-1.22***	-0.45	-0.68***	-0.26	-1.31***	-0.47	-0.22	-0.08	-1.15***	-0.42
	(0.00)		(0.08)		(0.00)		(0.00)		(0.00)		(0.64)		(0.00)	
Cooperation	0.12***	0.04	0.15***	0.05	0.16***	0.06	0.14***	0.05	0.14***	0.05	0.13***	0.04	0.14***	0.06
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
External Search	0.04***	0.02	0.04***	0.02	0.02	0.01	0.04***	0.01	0.02	0.01	0.04***	0.01	0.02	0.01
	(0.00)		(0.00)		(0.10)		(0.00)		(0.21)		(0.00)		(0.12)	
Formal Protection	0.44***	0.14	0.44***	0.15	0.43***	0.16	0.44***	0.15	0.42***	0.16	0.44***	0.15	0.42***	0.16
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Exports	0.17***	0.06	0.18***	0.06			0.18***	0.06			0.18***	0.06		
	(0.00)		(0.00)				(0.00)				(0.00)			
Group	0.10***	0.03	0.08***	0.03	0.19***	0.07	0.09***	0.03	0.21***	0.08	0.09***	0.03	0.19***	0.07
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Size	0.16***	0.05	0.14***	0.05	0.07***	0.03	0.13***	0.05	0.06*	0.02	0.15***	0.05	0.09***	0.04
	(0.00)		(0.00)		(0.00)		(0.00)		(0.05)		(0.00)		(0.00)	
R&D Intensity	1.08***	0.37	1.05***	0.37	0.82***	0.32	1.06***	0.37	0.84***	0.33	1.08***	0.38	0.86***	0.34
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
$\hat{\varepsilon}_3$	-1.02***	-0.35	-0.98***	-0.34	-0.77***	-0.30	-0.99***	-0.35	-0.79***	-0.31	-1.01***	-0.35	-0.82***	-0.32
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Equation for financial constraints[b]														
Public Support			0.09***		0.12***		0.04**		0.06*		0.15***		0.17***	
			(0.00)		(0.00)		(0.01)		(0.06)		(0.00)		(0.00)	
Collateral			-0.10***		-0.07***		-0.03*		0.01		-0.15***		-0.11***	
			(0.00)		(0.00)		(0.08)		(0.57)		(0.00)		(0.00)	
Financial Risk			0.07***		0.14***		0.01		0.08***		0.14***		0.16***	
			(0.00)		(0.00)		(0.34)		(0.00)		(0.00)		(0.00)	
Profitability			-0.08***		-0.09***		-0.14***		-0.13***		-0.02		-0.07*	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.38)		(0.05)	
Size			-0.07***		-0.08***		-0.12***		-0.17***		-0.05**		-0.03	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.01)		(0.38)	
$\hat{\varepsilon}_3$			0.06***		0.07***		0.05***		0.07***		0.07***		0.06***	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Over-identification Test[c]			0.38		0.30		0.38		0.29		0.63		0.57	
Over-identification Test[d]	0.86		0.86		0.45		0.86		0.45		0.86		0.45	
Number of Firms	25141		25141		9019		25141		9019		25141		9019	

See notes for Table 1

Table 3: Bivariate probit model: service industries

	Probit		Bivariate probit											
			Internal or External FC				Internal FC				External FC			
	All Firms		All Firms		Non-Exporters		All Firms		Non-Exporters		All Firms		Non-Exporters	
	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
Equation for innovation success[a]														
Financial Constraints	0.10***	0.04	0.34	0.12	-0.37	-0.15	0.57	0.19	-0.18	-0.07	0.44	0.15	0.32	0.12
	(0.00)		(0.53)		(0.54)		(0.39)		(0.83)		(0.24)		(0.45)	
Cooperation	0.17***	0.06	0.15***	0.06	0.21***	0.08	0.14***	0.05	0.20***	0.08	0.15***	0.06	0.17***	0.06
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
External Search	0.05***	0.02	0.05***	0.02	0.06***	0.02	0.05***	0.02	0.06***	0.02	0.05***	0.02	0.05***	0.02
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Formal Protection	0.26***	0.09	0.25***	0.09	0.34***	0.13	0.24***	0.09	0.25***	0.10	0.25***	0.09	0.24***	0.09
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Exports	0.12***	0.05	0.12***	0.04			0.11***	0.04			0.12***	0.04		
	(0.00)		(0.00)				(0.00)				(0.00)			
Group	0.16***	0.06	0.16***	0.06	0.14***	0.05	0.17***	0.06	0.14***	0.06	0.16***	0.06	0.15***	0.06
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Size	0.04***	0.02	0.05**	0.02	0.01	0.01	0.05***	0.02	0.02	0.01	0.05***	0.02	0.03	0.01
	(0.00)		(0.01)		(0.57)		(0.00)		(0.47)		(0.00)		(0.23)	
R&D Intensity	0.50***	0.19	0.50***	0.19	0.45***	0.17	0.50***	0.19	0.45***	0.18	0.50***	0.19	0.45***	0.18
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
$\hat{\varepsilon}_3$	-0.43***	-0.16	-0.43***	-0.16	-0.38***	-0.15	-0.43***	-0.16	-0.39***	-0.15	-0.43***	-0.16	-0.39***	-0.15
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Equation for financial constraints[b]														
Public Support			0.14***		0.12***		0.12***		0.10***		0.17***		0.14***	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Collateral			-0.03		-0.09***		0.01		-0.01		-0.07**		-0.15***	
			(0.20)		(0.00)		(0.77)		(0.62)		(0.01)		(0.00)	
Financial Risk			0.09***		0.14***		0.04**		0.07***		0.20***		0.25***	
			(0.00)		(0.00)		(0.02)		(0.00)		(0.00)		(0.00)	
Profitability			-0.04***		-0.06***		-0.05***		-0.06***		-0.04***		-0.05**	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.01)	
Size			-0.10***		-0.10***		-0.08***		-0.08***		-0.09***		-0.08***	
			(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
$\hat{\varepsilon}_3$			0.11***		0.09***		0.10***		0.06***		0.13***		0.08***	
			(0.00)		(0.00)		(0.00)		(0.02)		(0.00)		(0.00)	
Over-identification Test[c]			0.73		0.99		0.54		0.63		0.99		0.94	
Over-identification Test[d]	0.26		0.26		0.79		0.26		0.79		0.26		0.79	
Number of Firms	12919		12919		7602		12919		7602		12919		7602	

See notes for Table 1

Table 4: Alternative definitions of the innovation success variable

	FC	Industries	Firms	Coefficient	$P > \|z\|$	dy/dx	No of firms
Threshold for 'Innovation Success': the sample's 50^{th} percentile of "share of sales with new products" (I^m)							
(1)	Internal or External	All	All Firms	-0.66	0.21	-0.26	38060
		All	Non-Exporters	-0.91***	0.00	-0.32	16621
	Internal	All	All Firms	-0.51	0.30	-0.20	38060
		All	Non-Exporters	-1.03***	0.00	-0.35	16621
	External	All	All Firms	-0.07	0.85	-0.03	38060
		All	Non-Exporters	-0.39	0.28	-0.15	16621
(2)	Internal or External	Production	All Firms	-0.75***	0.00	-0.29	25141
		Production	Non-Exporters	-0.97***	0.00	-0.33	9019
	Internal	Production	All Firms	-0.81***	0.00	-0.31	25141
		Production	Non-Exporters	-1.12***	0.00	-0.37	9019
	External	Production	All Firms	-0.05	0.91	-0.02	25141
		Production	Non-Exporters	-0.75*	0.07	-0.27	9019
(3)	Internal or External	Services	All Firms	0.83	0.18	0.31	12919
		Services	Non-Exporters	0.23	0.75	0.09	7602
	Internal	Services	All Firms	0.91	0.14	0.33	12919
		Services	Non-Exporters	-0.80	0.38	-0.28	7602
	External	Services	All Firms	0.63	0.12	0.24	12919
		Services	Non-Exporters	0.56	0.16	0.22	7602
Threshold for 'Innovation Success': the sample's 75^{th} percentile of "share of sales with new products" (I^q)							
	FC	Industries	Firms	Coefficient	$P > \|z\|$	dy/dx	No of firms
(4)	Internal or External	All	All Firms	-1.24*	0.08	-0.31	38060
		All	Non-Exporters	-1.10***	0.00	-0.26	16621
	Internal	All	All Firms	-1.09	0.17	-0.27	38060
		All	Non-Exporters	-0.91*	0.05	-0.22	16621
	External	All	All Firms	-0.74	0.27	-0.20	38060
		All	Non-Exporters	-0.47	0.36	-0.13	16621
(5)	Internal or External	Production	All Firms	-1.20**	0.03	-0.30	25141
		Production	Non-Exporters	-1.30***	0.00	-0.29	9019
	Internal	Production	All Firms	-1.22***	0.00	-0.29	25141
		Production	Non-Exporters	-1.20*	0.05	-0.25	9019
	External	Production	All Firms	-0.50	0.47	-0.15	25141
		Production	Non-Exporters	-0.80	0.22	-0.19	9019
(6)	Internal or External	Services	All Firms	0.43	0.53	0.15	12919
		Services	Non-Exporters	-0.30	0.59	-0.09	7602
	Internal	Services	All Firms	0.34	0.64	0.12	12919
		Services	Non-Exporters	-0.62	0.25	-0.16	7602
	External	Services	All Firms	0.51	0.27	0.19	12919
		Services	Non-Exporters	0.36	0.47	0.12	7602
Treat 'Innovation Success' as a left-censored continuous variable							
	FC	Industries	Firms	Coefficient	$P > \|z\|$	dy/dx	No of firms
(7)	Internal or External	All	All Firms	-0.14	0.64	-0.05	38060
		All	Non-Exporters	-0.29**	0.02	-0.09	16621
	Internal	All	All Firms	-0.14	0.68	-0.05	38060
		All	Non-Exporters	-0.29*	0.06	-0.09	16621
	External	All	All Firms	-0.03	0.91	-0.01	38060
		All	Non-Exporters	-0.19	0.55	-0.06	16621
(8)	Internal or External	Production	All Firms	-0.11	0.27	-0.04	25141
		Production	Non-Exporters	-0.27**	0.03	-0.08	9019
	Internal	Production	All Firms	-0.13***	0.00	-0.05	25141
		Production	Non-Exporters	-0.28***	0.00	-0.08	9019
	External	Production	All Firms	-0.02	0.94	-0.01	25141
		Production	Non-Exporters	-0.19	0.43	-0.06	9019
(9)	Internal or External	Services	All Firms	0.64*	0.05	0.32	12919
		Services	Non-Exporters	-0.31	0.53	-0.10	7602
	Internal	Services	All Firms	0.66*	0.08	0.34	12919
		Services	Non-Exporters	-0.32	0.44	-0.10	7602
	External	Services	All Firms	0.59**	0.01	0.31	12919
		Services	Non-Exporters	0.65	0.14	0.32	7602

Columns report estimated coefficients, bootstrapped p-values and associated marginal effects (evaluated at mean values). The marginal effects in rows (7)-(9) are for the expected value of the dependent variable conditional on being uncensored. ***,**,* Statistically significant at the 1%, 5% and 10% confidence level, respectively.

Table 5: Robustness tests

	FC	Industries	Firms	Coefficient	$P > \|z\|$	dy/dx	No of firms
Exclude Eastern European countries							
(1)	Internal or External	All	All Firms	-0.69	0.13	-0.27	28129
		All	Non-Exporters	-1.35***	0.00	-0.44	11607
	Internal	All	All Firms	0.20	0.71	0.08	28129
		All	Non-Exporters	-1.41***	0.00	-0.44	11607
	External	All	All Firms	-0.34	0.25	-0.13	28129
		All	Non-Exporters	-0.99***	0.00	-0.34	11607
(2)	Internal or External	Production	All Firms	-0.79***	0.00	-0.31	18122
		Production	Non-Exporters	-1.38***	0.00	-0.43	5969
	Internal	Production	All Firms	-0.68*	0.05	-0.27	18122
		Production	Non-Exporters	-1.46***	0.00	-0.43	5969
	External	Production	All Firms	-0.49	0.23	-0.19	18122
		Production	Non-Exporters	-1.26***	0.00	-0.40	5969
(3)	Internal or External	Services	All Firms	0.43	0.55	0.16	10007
		Services	Non-Exporters	-1.11	0.12	-0.39	5638
	Internal	Services	All Firms	0.71	0.36	0.25	10007
		Services	Non-Exporters	-1.30	0.21	-0.43	5638
	External	Services	All Firms	0.45	0.30	0.16	10007
		Services	Non-Exporters	0.23	0.68	0.09	5638
Add data from CIS2006 for eight countries							
	FC	Industries	Firms	Coefficient	$P > \|z\|$	dy/dx	No of firms
(4)	Internal or External	All	All Firms	-0.57**	0.01	-0.22	51010
		All	Non-Exporters	-1.08***	0.00	-0.41	22665
	Internal	All	All Firms	-0.28	0.47	-0.10	51010
		All	Non-Exporters	-1.12***	0.00	-0.42	22665
	External	All	All Firms	-0.27	0.24	-0.10	51010
		All	Non-Exporters	-0.64*	0.05	-0.25	22665
(5)	Internal or External	Production	All Firms	-0.59*	0.07	-0.22	33878
		Production	Non-Exporters	-1.15***	0.00	-0.43	12464
	Internal	Production	All Firms	-0.60**	0.02	-0.22	33878
		Production	Non-Exporters	-1.24***	0.00	-0.46	12464
	External	Production	All Firms	-0.20	0.63	-0.07	33878
		Production	Non-Exporters	-0.95**	0.02	-0.37	12464
(6)	Internal or External	Services	All Firms	0.11	0.85	0.04	17132
		Services	Non-Exporters	-0.31	0.60	-0.12	10201
	Internal	Services	All Firms	0.49	0.52	0.16	17132
		Services	Non-Exporters	0.02	0.98	0.01	10201
	External	Services	All Firms	0.27	0.47	0.09	17132
		Services	Non-Exporters	0.35	0.41	0.13	10201
Exclude 'R&D Intensity' from the list of controls							
	FC	Industries	Firms	Coefficient	$P > \|z\|$	dy/dx	No of firms
(7)	Internal or External	All	All Firms	-0.51	0.11	-0.19	38060
		All	Non-Exporters	-0.99***	0.00	-0.37	16621
	Internal	All	All Firms	-0.60*	0.05	-0.23	38060
		All	Non-Exporters	-1.16***	0.00	-0.43	16621
	External	All	All Firms	-0.17	0.52	-0.06	38060
		All	Non-Exporters	-0.56	0.11	-0.22	16621
(8)	Internal or External	Production	All Firms	-0.54	0.16	-0.20	25141
		Production	Non-Exporters	-1.09***	0.00	-0.41	9019
	Internal	Production	All Firms	-0.74***	0.00	-0.28	25141
		Production	Non-Exporters	-1.23***	0.00	-0.44	9019
	External	Production	All Firms	-0.15	0.73	-0.05	25141
		Production	Non-Exporters	-0.98***	0.00	-0.37	9019
(9)	Internal or External	Services	All Firms	0.20	0.74	0.07	12919
		Services	Non-Exporters	-0.46	0.35	-0.18	7602
	Internal	Services	All Firms	0.33	0.65	0.12	12919
		Services	Non-Exporters	-0.86	0.30	-0.33	7602
	External	Services	All Firms	0.33	0.41	0.12	12919
		Services	Non-Exporters	0.24	0.56	0.09	7602

Columns report estimated coefficients, bootstrapped p-values and associated marginal effects (evaluated at mean values). ***,**,* Statistically significant at the 1%, 5% and 10% confidence level, respectively.

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