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Financial constraints and Spanish manufacturing firms' R&D and exporting strategies[a]

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ABSTRACT

The aim of this paper is analysing the role of internal and external financial constraints in the firms' joint decision to export and invest in R&D. Our empirical strategy consists of estimating a bivariate probit that explicitly acknowledges that a firm R&D and export decisions are interrelated. To proxy for internal financial constraints we use both a direct (cash-flow) and indirect measure (total factor productivity). External financial constrains are proxied using firms' financial costs. Further, we analyse both if firms size and the onset of the current economic crisis have an impact on the relationship between financial constraints and firms' R&D and export decisions. Using a representative sample of Spanish manufacturing firms for the period 1990-20010, we find that both internal and external finance constraints are relevant for the two firms' strategic decisions analysed.

Keywords: exports, R&D, financial constraints, manufacturing firms, bivariate probit.

JEL Classification: F14, O32, G32, L60, C35

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1. INTRODUCTION AND RELATED LITERATURE

In its latest Economic Outlook (19-November-2013) the OECD points out that in Spain "*Demand for credit is weak, but the interest rates for new loans to small and medium enterprises have risen substantially, suggesting that credit supply restrictions also follow*". In the same line (and in the same week) the *troika* (European Commission, ECB and IMF) also warned that private banks would rather invest in public debt to lending, as they achieve very cheap loans, almost free, from the ECB and invest them in government bonds with a yield of 4% at 10 years.

In the same OECD report mentioned above, it is also mentioned that "*Improving growth in export markets,… will help to foster a weak recovery in 2014 and 2015*".

However, this improvement in exports has been at the cost of an important internal devaluation that cannot be the basis of a sustainable competitive advantage. Further, increasing difficulties to access financial markets may endanger export participation for SMEs, and so the growth of Spanish exports.

The only way to create a sustainable comparative advantage in the long run is to increase R&D investments that result in new process and product innovations, which would allow Spanish firms to compete in international markets. Furthermore, international markets participation can reinforce the increase in the competitiveness of Spanish exporting firms.

However, firms R&D and exporting activities share some features that make them likely to suffer from financial restrictions. Both activities involve important start-up costs that need to be paid upfront (before firms obtain any returns from these activities) and that are, up to a large extent, sunk.[1] Firms exporting and/or undertaking R&D activities will need to cover these costs

[1] For exporting these start-up costs are related, among others, to: acquisition of knowledge about foreign markets, adaptation of products to foreign regulation or tastes, setting up a distribution network, etc. As for R&D investment, these costs may include creating an R&D department, purchasing specific physical assets, hiring or training specialized workforce, but also collecting information on new technologies, organizational changes and adjustments

either by using own funds and/or borrowing. Furthermore, both exporting and performing R&D activities imply a higher associated risk as compared to other firms' activities. This is so as firms exporting (in contrast to selling in the domestic market) stand risks such as exchange rate fluctuations and contracts that cannot be easily enforced in foreign countries (Wagner, 2012). Moreover, R&D investments are risky *per se*, as their outcomes (product innovations, process innovations or patents) are uncertain. This higher risk associated to these activities adds to firms' liquidity needs. Therefore, firms' financial restrictions might be crucial in determining its ability to export or to perform R&D and, thus, those firms less financially constrained (either internally and/or externally) may enjoy an important comparative advantage.

On the basis of these particular features of firms' R&D and exports strategies, the theoretical foundations of our analysis stem from three strands of the literature. The first analyses the relationship between financial constraints and firms' export decisions. In this line, Chaney (2013), Muuls (2008) and Manova (2013) introduce the role of financial constraints into Melitz (2003) original model of heterogeneous firms. In Chaney (2013), firms must incur extra costs to access foreign markets, and if they face external finance constraints to financing these costs only those ones with sufficient internal funds will be able to export. Muuls (2008) finds that the higher the financial constrains faced by firms, the lower the probability of exporting. Analogously, in Manova (2013) financial constraints affect both the extensive and intensive export margins, as more financially constrained firms are less likely to export and, if they do, they export less. Greenaway *et al.* (2007) is the first of a growing number of empirical works analysing the links between financial constraints and exports using firm level data. Wagner (2012) offers an exhaustive survey of these empirical works that reveals the following stylized facts: i) exporting

to new technologies.

firms are less financially constrained than non-exporters; ii) less constrained firms self-select into exporting; and, iii) participation in export markets does not contribute to relax firms' financial constraints.[2]

The second strand of the literature focuses on the analysis of the relationship between financial constraints and firms' R&D decisions. Although the theoretical models predict a negative relationship between financial constraints and R&D, based on the existence of information asymmetries (Leland and Pyle, 1977), high adjustments and sunk costs (Arrow, 1962) and lack of collaterals, empirical evidence is ambiguous and far from conclusive (see Hall and Lerner, 2010, for a survey).[3] In applied works, the most common strategy to identify the presence of financial constraints is using an indirect approach based on the differential sensitivity of R&D investments to cash flow (Fazzari *et al.*, 1988). Results suggesting that R&D is sensitive to firms' cash flow are expected to signal a large wedge between internal and external costs of funds, what would imply firms being financially constrained. On the contrary, evidence of lack of sensitivity (or low sensitivity) is interpreted as if external access to finance does not represent any friction or does not come at a higher cost than the opportunity cost of internal finance.

However, this indirect procedure has important shortcomings and has been seriously criticized in relation to its ability to properly identify external financial constraints (Kaplan and Zingales, 1997). First, it considers that firms have a preference for internal finance, although there could be some firms that prefer external funding. Second, it assumes (when explaining R&D activities) that measures such as cash flow only reflect the sensitiveness of these investments to costlier external sources of finance. However, this is subject to important critiques as it could mean a larger scope of R&D investment opportunities or uncontrolled demand conditions in

[2] An exception to stylized facts ii) and iii) is Greenaway *et al.* (2007) who find opposite results.

[3] More recent works such as Aghion *et al.* (2012), Mancussi and Vezzulli (2012), Beneito *et al.* (2013) or Brown *et al.* (2012) find evidence of a negative impact of financial constraints on R&D investments.

estimation that are both positively correlated with firms' internal finance and R&D decisions. Third, if firms extensively rely on external funds for investments and, simultaneously, the availability of both types of finance are correlated, then, there may exist an omitted variable bias when estimating the relationship between R&D and a measure of internal finance (Moyen, 2004, Beneito *et al.*, 2013). As a solution to these issues, some studies consider including as explanatory variables both a firm's internal and external finance measure (see Brown *et al.*, 2009, Brown and Petersen, 2009, and Brown *et al.*, 2012, who consider both internal finance and external equity finance).

The final strand of the literature focuses on the interaction between exports and innovation. Within this literature, the theoretical works by Constantini and Melitz (2008), Atkeson and Burstein (2010), Ferguson (2010) and Long *et al.* (2011), among others, show how trade liberalization increases R&D returns and, therefore, creates incentives for firms' R&D investments. In their models, a firm increases its expected profits from exporting by investing in R&D, and exporting also contributes positively to the returns to R&D investments. In the empirical literature, Bustos (2011), Lileeva and Trefler (2010), Máñez *et al.* (2009a, 2013), Aw *et al.* (2007, 2008, 2011) and Damijan *et al.* (2008) find evidence about exporting being correlated with innovation. All in all, a crucial implication of these works is that R&D and export decisions are interrelated.

Finally, to the best of our knowledge, the only paper investigating the relationship between financial constraints and the firms' simultaneous decisions of exporting and performing R&D is Gorodnichenko and Schnitzer (2010). In line with this recent literature, we analyse jointly the two firms' decisions when evaluating the effects of financial constraints. However, taking into account all the considerations previously discussed, we acknowledge that, in principle, firms may rely on external sources to finance exporting and R&D activities or that these sources represent, at least, a marginal way of financing these activities once firm's internal finance is exhausted.

Therefore, we are interested on the effects that both internal and external finance have on productivity-enhancing investments (such as exporting and/or performing R&D activities). Should we find that the availability of internal finance and the ease to access external finance are relevant to explain firms' export and R&D decisions, this would be in favour of the existence of financial constraints, as an increase of each of them would stimulate those activities. Differently to Gorodnichenko and Schnitzer (2010), we do not use self-reported indicators of external financial constraints. In our work we include measures of firms' internal and external finance, which are considered to influence exporting and R&D decisions directly. Further, we do not rely either on innovation output measures –such as product and process innovation– that we consider an indirect way to capture the effects of financial constraints on the incentives to invest in R&D.

We estimate a discrete choice model of the joint decision to export and perform R&D activities. We characterize these firms' decisions as depending on both firms' internal and external measures of finance and other controls. Our estimation methodology takes into account the potential simultaneity in the two firms' decisions through the estimation of a bivariate probit, in which we also account for individual effects (Mundlack, 1978, Chamberlain, 1984, and Wooldridge, 2005). The dataset used in this paper are drawn from the Spanish firms' manufacturing survey (ESEE hereafter) for the period 1990-2011. This is an annual survey sponsored by the Spanish Ministry of Industry and carried out since 1990 that is representative of Spanish manufacturing firms.

The main results of the paper are manifold. First, both internal and external finance constraints are relevant for the firms' strategic decisions of exporting and R&D. This highlights the relevance of the banking institutions for Spanish manufacturing firms to promote both exporting and innovation activities. Second, we do not confirm the existence of omitted variable bias when we do not include in the regressions measures for internal and external finance altogether, what could be driven by firms' not only using both types of resources to finance such investments but

also by a certain specialization in the use of them for different components of the investments. Third, we find that small firms are more financially constrained than their larger counterparts. This result is relevant for Spanish manufacturing as more than 90% of firms are classified as small (less than 200 employees). Fourth, our results also indicate that Spanish firms start suffering severely financial constraints from 2009, as a consequence of the world's financial crisis after 2007. From this year onwards, firms' investment decisions (to export and perform R&D) became more sensitive to internal finance resources. This might be interpreted as a direct effect of a more difficult access to bank credits.

The remainder of the paper is organized as follows. Section 2 describes the data, the main variables in the analysis, and presents some descriptive statistics. Section 3 highlights the estimation method and discusses the main results from our analysis. Finally, Section 4 concludes.

2. DATA AND DESCRIPTIVE ANALYSIS.

2.1. Data description.

The data used in this paper are drawn from the ESEE for the period 1990-2011. This is an annual survey sponsored by the Spanish Ministry of Industry and carried out since 1990 that is representative of Spanish manufacturing firms classified by industry and size categories.[4] It provides exhaustive information at the firm level.

The sampling procedure of the ESEE is the following. Firms with less than 10 employees were excluded from the survey. Firms with 10 to 200 employees were randomly sampled, holding around 5% of the population in 1990. All firms with more than 200 employees were requested to participate, obtaining a participation rate around 70% in 1990. Important efforts have been made

[4] We have data at industry 2-digit NACE level.

to minimise attrition and to annually incorporate new firms with the same sampling criteria as in the base year, so that the sample of firms remains representative over time.

The original size of ESEE for the period 1990-2011 is 40,595 observations (corresponding to around 2,000 firms *per* year). From this sample, we sample out those firms' observations that fail to supply relevant information about all the variables involved in our analysis. Further, as our TFP estimation method requires that firms supply information for at least three consecutive years, we remove all firms that do not accomplish this criterion. After cleansing the data we end up with a sample of 14,964 observations corresponding to 1,915 firms.

The ESEE provides information both about whether the firm exports and/or performs R&D activities. In particular for the firm's export status, we use the following question: "Indicate whether the firm, either directly, or through other firms from the same group, has exported during this year (including exports to the European Union)". The question we use for the firm's R&D status is: "Indicate if during this year the firm has undertaken or contracted any R&D activity".

Looking at the distribution of firms exporting and/or performing R&D in the data, we observe that 45.57% of firms neither export nor carry out R&D activities, 4.89% only perform R&D activities, 31.33% only export and, finally, those undertaking both activities represent 21.20%.

In what follows, we explain in detail the variables that we use to measure internal and external constraints.

2.2. The measurement of external financial constraints.

In Spain, similarly to Italy, bank loans are the most common form of external financing for firms and constitute the bulk of firms' financial debt (Schiantarelli and Sembenelli, 2000).[5] Thus, we expect the cost of borrowing to be an important determinant of firms' financial constraints.

[5] In our sample around 97% of firms are not listed in the stock market. Therefore financial institutions and, specially, the banking system are very important for financing firms' investments.

There is an important number of empirical works that have used indirect measures of firms' financial costs such as: firms' size and age, leverage, collateralisable assets, firms' default risk (Bester, 1985, Reeb *et al.*, 2001, Anderson *et al.*, 2003). The results of these papers suggest that smaller, younger, more leveraged firms, with less collateralisable assets, with higher default risk, and uncertainty about returns from investments will suffer from higher costs of financing.

However in this work, we use a direct measure of firms' financial costs. Following Beneito *et al.* (2013), we use the cost of firms' new long-term debt. This cost is calculated as a weighted average of the unit cost of debts the firm has borrowed in a given year both from banks (the bulk of debt) and from other long-term lenders:

$$\text{cost}_{it} = \frac{\left(\text{cost}_{it}^{Banks} \cdot Banks_{it}\right) + \left(\text{cost}_{it}^{Other} \cdot Other_{it}\right)}{Banks_{it} + Other_{it}} \quad (1)$$

where $Banks_{it}$ and $Other_{it}$ are firms' new long-term debts with banks and other long-term lenders, respectively, and cost_{it}^{Banks} and cost_{it}^{Other} stand for their associated costs (as a percentage). Figure 1 shows the general evolution of the calculated average cost of firms' borrowing. As it can be seen, there has been a significant decrease in the average cost of debt, especially from 1990 until 1999. We also observe that this cost slightly increases in 2000 and in 2008.

[Insert Figure 1 around here]

To avoid contamination from changing macroeconomic policies (such as overtime reductions of interest rate), in the link between higher cost of debt and tighter financial constraints, in estimations we will introduce the financial cost variable as the deviation ($cost\_d_{it}$) of the current firm's cost of financing with respect to the average cost paid by manufacturing firms in the same year:[6]

[6] We have also experimented with an alternative measure where the deviation is calculated with respect to the industry average the firm belongs to. Results were qualitatively similar, but we consider our measure is more reliable as there can be industries with worse borrowing conditions, that would not be captured using industry averages.

$$cost\_d_{it} = cost_{it} - \sum_{i} \frac{cost_{it}}{N_t} \quad (2)$$

Large and positive values of this variable should correspond to firms with high financial costs, and large negative values should correspond to firms that may access external financing at a lower cost. In our estimations, in the next section, negative values for the estimate of $cost\_d_{it}$ should be interpreted as evidence in favour of the existence of external financial constraints.

We believe that using a direct measure of external financial constraints, as it is the financial cost of debt, allows a more accurate approach to firms' external financial constraints than using indirect measure such as "payment incidents" (Aghion *et al.*, 2012), or the reported indicators of financial constraints available for some countries in the CIS survey. This indicator has the problem of being a qualitative measure of financial constraints reflecting perceived financial constraints (Damijan *et al.,* 2009).

2.3. *The measurement of internal financial constraints.*

In this work we will use both a direct and an indirect measure of financial constraints, namely cash flow and productivity. There is a plethora of works that use cash flow related measures as proxies for internal financial constraints. Firms' own funds availability is crucial when access to external financing becomes difficult. In this line, both Manole and Spatareanu (2010) and Buch *et at.* (2010) use cash flow as a measure of internal constraints. Stiebale (2011), Ito *et al.* (2011) and Berman and Héricourt (2010) use the ratio of cash flow on assets or capital as a measure of internal constraints. Bellone *et at.* (2010) construct an index to measure firms' financial constraints and use, among other variables, firms ability to generate cash flow.[7]

[7] Other studies using cash flow as a measure of firm internal financing are, among others, Hall (1992), Harhoff (1998), Cincera (2002) and Bond *et al.* (2003).

Our second (in this case indirect) measure of internal financial constraints is total factor productivity (TFP hereafter). Chaney (2013) argues that more productive firms are more able to generate a larger amount of internal liquidity (funds) what increases the likelihood of exporting. Quoting him, "*only those firms that are productive enough can generate sufficient cash flows to be able to overcome fixed costs associated with exporting and, therefore, to export."* This is already in the spirit of theoretical models of trade with heterogeneous firms (Melitz, 2003). This type of arguments can also be naturally extended to firms' R&D investments decisions. Therefore, we expect productivity to be a good indicator of the firms' capacity to generate cash flow, since most productive firms capture larger market shares and, hence, make larger profits.

Our measure of firm's cash flow has been calculated as firm's sales minus the sum of purchases, external services and labour costs. It is obtained in nominal terms and then deflated using industrial price indexes. Our TFP measure has been estimated using a modified version of the control function approach proposed by Olley and Pakes (1997) and Levinshon and Petrin (2003). First, we consider a more general process driving the law of motion of productivity in which we recognise the potential role that both export and R&D might have in shaping future firms' productivity (endogenous Markov process). Moreover, in the specification of the production function we acknowledge that firms with different export and R&D strategies (i.e., only exporters, only R&D firms, firms that both invest in R&D and export and firms that neither perform R&D nor export) may have different demands for intermediate inputs (materials). Further, we integrate these features into the generalized method of moments (GMM) framework proposed by Wooldridge (2009).[8]

Using similar arguments to those exposed for financial constraints, in estimation we will use our two measures of internal financial constraints in deviations with respect to the average by

[8] See Máñez *et al.* (2013) for a detailed description of the process to estimate TFP.

industry and year.[9] Large negative values should correspond to firms facing tight internal financial constraints; large positive values should correspond to firms with a large availability of own funds. Therefore, we expect a positive sign for the estimates of the deviations with respect to the year and industry mean of both TFP and cash flow variables (*TFP_d*$_{it}$ and *Cash flow_d*$_{it}$, respectively).

2.4. Some descriptives about external and internal financial constraints.

In this section we explore the relationship between exporting and R&D strategies (i.e., exporting only, performing R&D activities only, both or none) and our measures of financial constraints. For this purpose, we estimate the following reduced form equation:

$$y_{it} = \beta_0 + \beta_1 Export_{it} + \beta_2 R\&D_{it} + \beta_3 Both_{it} + controls_{it} + e_{it} \quad (3)$$

where the dependent variable y_{it} is alternatively the cost of new long-term borrowing, cash flow (in logs), and the log of TFP. The variables *Export*$_{it}$, *R&D*$_{it,}$ and *Both*$_{it}$ capture firms' export and R&D strategies. Thus, *Export*$_{it}$ is equal to one if the firm *i* only exports in *t* (and zero otherwise), *R&D*$_{it}$ is equal to one if the firm *i* only undertakes R&D activities in *t* (and zero otherwise), and *Both*$_{it}$ is equal to one if the firm *i* both exports and engages in R&D activities in *t* (and zero otherwise). We also control for size (as measured by the number of employees), industry and year dummies.

The differences (in %) between firms with different exporting/R&D strategies for the variables in logs are computed from the estimated coefficients β as 100(exp(β)-1). Table 1 shows that regardless of their combined export/R&D strategy, firms that perform any of these activities show higher TFP and larger cash flow than firms that neither undertake R&D nor export. Further, firms exporting or engaged in both activities have access to external financing at a lower cost than firms that neither export nor perform R&D.

[Insert Table 1 around here]

Analogously, the joint consideration of the estimates in Table 1 and the pairwise tests in Table

[9] TFP and cash flow variables are in logarithms.

2 suggests that firms that both export and undertake R&D have access to external finance at a lower cost, have a larger cash flow, and higher TFP than firms that only export or only perform R&D activities. As for the comparison between the firms that only export and only perform R&D, our estimates and pairwise tests suggest that the only significant difference between them is that firms that only export have a higher productivity than firms that just perform R&D.

[Insert Table 2 around here]

Finally, in Table 3 we present the pairwise correlations of the variables TFP_d_{it}, Cash flow_d_{it} and cost_d_{it} as defined above, as these are the variables used in our estimations. All correlations are highly statistically significant and, more importantly, show the expected signs. Furthermore, firms ranked as more externally financially constrained are ranked simultaneously as firms with more internal financial constraints (regardless of using TFP_d_{it} or Cash flow_d_{it}, as a proxy for internal financial constraints). Likewise, the direct measure of financial constraints (Cash flow_d_{it}) and the indirect measure (TFP_d_{it}) are positively correlated indicating the appropriateness of using TFP as a proxy for firms' capability to generate cash flow (Chaney, 2013). Finally, results in Table 3 confirm the interpretation of our financial constraints variables in deviations as appropriate measures to rank firms from less to more external and/or internal financial constrained.

[Insert Table 3 around here]

3. ESTIMATION RESULTS.

To analyse the role of financial constraints on the joint firms' R&D and export decisions, we estimate the following bivariate probit model:

$$E_{it} = \begin{cases} 1 & \text{if} \quad \beta^E X_{it-1} + \gamma^E Z_{it-1} + \mu_t^E + s_i^E + \varepsilon_{it}^E \geq 0 \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

$$R\&D_{it} = \begin{cases} 1 & if \quad \beta^{R\&D} X_{it-1} + \gamma Z_{it-1} + \mu_t^{R\&D} + s_i^{R\&D} + \varepsilon_{it}^{R\&D} \geq 0 \\ 0 & otherwise \end{cases}$$

where X_{it-1} is a vector of variables controlling for firms' internal and external financial constraints; Z_{it-1} is a vector of control variables (age, size, foreign capital participation, market share, demand conditions, number of competitors, sales to public administrations and appropriability conditions) that might affect firms' expected returns of exporting or performing R&D;[10] μ_t is a vector of year dummies and s_i is a vector of industry dummies. Finally, ε_{it} is an error term that we assume has two components, a permanent firm-effect (α_i) and a transitory component (u_{it}).

In our estimations, we model fixed effects (α_i) following Mundlack (1978), Chamberlain (1984) and Wooldridge (2005). Following these approaches, the distribution of the unobserved effects, α_i, is parameterized conditional on the vector of controls in all time periods, Z_{it}. Further, as in Mundlack (1978) we use time-averages for this vector, i.e., $\overline{Z}_i = T^{-1}\sum_{t=1}^{T} Z_{it}$. Thus, $\alpha_i = \alpha_0 + \overline{Z}_i\alpha_1 + a_i$, where $a_i \left| \left(\overline{Z}_i\right) \approx \text{Normal}\left(0, \sigma_a^2\right)\right.$. The components of $\overline{Z}_i$ are added as additional explanatory variables in each time period t in equations (4).

3.1. Financial constraints and the R&D and export decisions: baseline results.

Table 4 shows the results of our baseline specification. In the first two columns of Table 4 we report the results for an specification in which we proxy for internal financial constraints using firms' cash flow, whereas in the last two columns we use firms' productivity (TFP) as a proxy. These firms' variables (likewise the variable firm's cost of debt) are calculated in deviations, as explained in Section 3.

[10] The definition of these variables are in Appendix A.

Before discussing our results, it is important to note that the estimated correlation between the two equation errors (coefficient ρ) is positive and significant (see the tests at the bottom of Table 4). This confirms the interdependence of firms' export and R&D investment decisions and, hence, the convenience of estimating jointly the two decisions when analysing the role that financial constraints play on both decisions.

[Table 4 around here]

Our estimates indicate that both internal and external financial constraints are relevant in the firms' export and R&D decisions. The estimates of the variables used to proxy for internal financial constraints suggest that more productive firms and firms with higher cash flow are more likely to engage in exports and R&D activities. The estimate of the variable proxying for external financial constraints (financial costs of debt) is negative and significant. This estimate is robust to using either TFP or cash flow as proxies for internal financial constraints. Therefore, our results imply that firms facing higher financial costs are less prone to engage in exporting and in performing R&D activities. However, the interaction variables between internal and external financial constraints (cost_d·Cash flow_d and cost_d·TFP_d) are not statistically significant, suggesting that internal and external financial constraints are neither complementary nor substitutes. This result is reinforced by the fact that we did not confirm the existence of omitted variable bias when not including in the regressions controls for internal and external financial constraints simultaneously, what may be the result of firms not only using both types of resources to finance exporting and R&D investments but also by a certain specialization in the use of them for different components of the investments.[11]

As regards results for some of the control variables in estimation, we get that innovation appropriability conditions are relevant for both firms' investment decisions. Further, facing an expansive demand and market share have a positive and significant impact on the firm's R&D

[11] These results are not reported in the paper but are available from the authors upon request.

decision. Additionally, when taking into account also the Mundlack's means for these variables (taking then into account their permanent effect through firms' individual effects), the role of an expansive demand gets reinforced in the two decisions (becoming also significant for the export decision), and the variable of foreign participation emerges as very relevant for the export decision.[12]

To assess the goodness-of-fit of our baseline estimation we predict the probabilities of exporting and performing R&D for each firm in the sample (using our estimates) and compare them with the sample figures from the data. We obtain that our model, when using cash flow as a measure of internal finance (or when using TFP as a measure for internal finance) predicts well 83.11% (83.56%) and 70.47% (70.54%) of the actual patterns of export an R&D decisions, respectively. Therefore, our model predicts quite closely the observed firm's decisions.

3.2. Some robustness checks of the baseline results.

The role of size

Our results suggest that both internal and external financial constraints are important in shaping firms' exporting and R&D investment decisions. However, we consider that further insight is needed to check whether the impact of financial constraints might be different for SMEs and large firms.[13] Damijan and Kostevc (2011) explain why the effect of financial constraints for SMEs and large firms on the export and R&D decisions might be different.[14] First, large firms usually have larger internal funds than SMEs. Additionally, they have better access to financial markets both in

[12] We do not report in our tables of results the estimates for the Mundlack's means of the control variables, although they are available from the authors upon request.

[13] Following the ESEE classification, we will consider as SMEs those firms with less or equal than 200 workers and as large those with more than 200 workers.

[14] Damijan and Kostevc (2011) put forward these arguments in reference to the decision to export. However, they are easily extensible to the decision to export and to perform R&D.

terms of volume of funds they can borrow, and the cost of these funds. Second, SMEs are usually more risk averse, which may make them to refuse taking external debt to finance both R&D and exporting ventures. In this line, Bonnet *et al.* (2005), using a French sample to analyse how financial constraints affect new firms, find that there is a non-negligible share of firms that even when facing internal constraints do not resort to external loans, and when they do, they borrow a smaller amount than the one corresponding to their size. These self-imposed constraints generate a vicious circle reducing the ability of SMEs to export and/or invest in R&D more than what their size would imply. Further, SMEs reluctance to have leverage levels similar to large firms (even when externals funds are available) might be explained by the concentration of risk in exporting few products or undertaking few R&D projects, in comparison to the larger export/R&D portfolio of large firms. This concentration of the risk means that failure of one of the projects could endanger firm's survival itself.[15]

Among the papers that empirically analyse whether firms' size plays a role in the relationship between exporting and financial constraints, we highlight Forbes (2007) who shows, for a sample of Chilean firms, that in a period of raising capital flow taxes, small firms suffer more from financial constraints. Further, these financial constraints loosen with the size of the firm. In the same line, Zia (2008), using a loan-level dataset for Pakistan, shows how the removal of subsidized export loans reduced the exports of small firms but did not affect those of large firms. Damijan *et al.* (2010), using a sample of Slovenian firms, find that an improvement in the access to external funds implied a higher increase of the intensive margin (export sales) for small firms than for medium and large firms.

As regards the papers that analyse whether firms' size has any impact on the R&D investment sensibility to financial constraints, Hao and Jaffe (1993), using a panel of high-

[15] Eaton *et al.* (2008), Bernard *et al.* (2007, 2009) and Damijan *et al.* (2010) show that small firms usually export to one or two countries and a little number of products, being then more vulnerable to foreign market failures.

technology industries, show that the sensitivity of R&D investments to cash flow is higher for small than for large firms. For German firms, Harhoff (1998) concludes that only small firms R&D investments are sensitive to cash. Ughetto (2008) using a sample of (small, medium and large) Italian firms concludes that R&D is sensitive to cash flow only in the case of small firms. Czarnitzki and Binz (2011), using a sample of German manufacturing SMEs, show that whereas smaller firms' R&D investments are sensitive to improvements in the access to financial markets, larger firms' R&D investments are not.

To check whether size has an impact on the relationship between financial constraints and R&D/export decisions for Spanish manufacturing firms, we perform a separate analysis for the large and SMEs (see Tables 5 and 6, respectively).[16] The implications of our estimates are twofold: i) for large firms, and regardless of the proxy used for financial constraints, neither the R&D nor the export decisions are sensitive to internal or external financial constraints;[17] and, ii) for SMEs both internal and external financial constraints are relevant in the firms' R&D and export decisions (the estimates of the variables proxying for financial constraints have the expected sign and are significant at conventional levels). Consequently, these results indicate that measures addressed to relax internal and external financial constraints would increase the extensive R&D and export margins among SMEs in Spain, where SMEs represent more than 90% of the total number of firms.

[Tables 5 and 6 around here]

Sensitiveness to the financial crisis after the second half of 2007

[16] To keep tables short, from Table 5 onwards, we do not report the estimates for the crossed product between internal and external financial constraints variables, since they never render statistical significance.

[17] For large firms we obtain expected signs but not statistically significant at conventional levels.

The second sensitiveness we address is related to the financial crisis. In particular, we aim to test whether the financial and economic crisis that started in the second half of 2007 has had any impact on the relationship between financial constraints and firms' export and R&D decisions. As we plot in Figure 2, the Spanish rate of growth of loans to non-financial institutions starts decelerating from 2007, becoming negative by the end of 2009. This evidence suggests that the Spanish economy suffers from severe financial constraints since 2009, being especially harsher from 2010.[18]

In order to check whether the start of the crisis and its worsening magnify or moderate the effect of financial constraints on export and R&D decisions, we perform a sensitivity analysis explained as follows. We sequentially estimate an augmented version of our baseline specification in Table 4 including interaction terms between the financial constraints variables and three different time dummies: i) a dummy variable that takes on value 1 for the years beyond 2007 (D08_11 variable); ii) a dummy variable that takes on value 1 for the years beyond 2008 (D09_11 variable); and, finally, iii) a dummy variable that takes on value 1 for the years beyond 2009 (D10_11 variable).

Table 7 shows the results when we use cash flow to proxy for internal constraints. The estimates for internal and external financial constraints variables maintain their expected signs and significance. The analysis of the effects of the deepening of the crisis requires checking the sign and significance of the interaction terms in the three different estimations shown in Table 7 (these interaction terms capture the differential effects of the financial variables on R&D and export decisions for the periods defined by the corresponding dummy variables). In the R&D equation, both for the periods 2008-2011 and 2009-2011, the estimates of the interaction terms of the external constraints variable (cost_d·D08_11 and cost_d·D09_11, respectively) are negative and significant, suggesting an increased sensibility of the R&D investment decision to the

[18] For an analysis of the causes of this credit crunch see Carbó (2009).

financial cost (in comparison to the pre-crisis years). However, the estimates of the interaction terms of the cash flow variable for the same periods are non-significant (either in the export or the R&D equations) and, therefore, there is no additional effect to the pre-crisis years as regards internal financial constraints.

[Table 7 around here]

However, when the interaction terms are built interacting the financial cost variable and the cash-flow variable with the D10_11 dummy (years 2010-2011), the financial cost interaction variable turns out non-significant, whereas the cash flow variable becomes significant. This occurs both for the export and the R&D decisions. These results may indicate that from the beginning of the financial crisis up to 2009 inclusive, the financial cost of new external debt has reinforced its negative effect on investments such as R&D. However, since 2010, the cost of external finance stops contributing with an extra effect to discourage R&D investments. However, the variable taking extra relevance and reinforcing its previous effect is the one of firm's internal funds. This is probably related to the worsening conditions to access to credit, independently of its cost, what makes firms more dependent on their own capacity to generate internal funds to finance their investments.

The above sensitiveness analysis has also been performed using TFP (see Table 8) as a measure proxying for firms' internal funds. The results obtained are similar to the obtained with cash flow, with the only exception that the variable proxying for external financial constraints in the R&D decision loses its significance.

[Table 8 around here]

4. CONCLUDING REMARKS.

Exporting and R&D activities share some features that make them likely to be subject to financial constraints. In this paper, we investigate the relationship between financial constraints and the firms' simultaneous decisions to export and perform R&D activities, acknowledging that, in principle, firms may access both to internal and external sources of finance. For this purpose, we estimate a discrete choice model of exporting and R&D in which we characterize the firms' joint decisions as depending on firms' internal and external measures of finance and other controls. The data used in this paper are drawn from the Spanish firms' manufacturing survey (ESEE) for the period 1990-2011. The results we obtain are manifold. First, both internal and external finance constraints are relevant, highlighting the relevance of the banking system for promoting such investments in the case of Spanish manufacturing firms, and also that firms, very likely, do not only use both types of resources of finance but also have a certain specialization in their use for different components of the investments. Second, we find that small firms are more financially constrained. Third, we also obtain that Spanish firms start suffering severely financial constraints, as a consequence of the world's financial crisis that started in 2007, especially after 2009. From this year onwards, firms' investment decisions became more sensitive to internal finance resources as a consequence of tougher access to bank credits, independently of the cost of new debt.

These results recommend economic policies aimed as easing firms' access to external finance, especially targeting SMEs as those firms are the ones suffering more in hardship periods. Promoting firms exports and R&D strategies might ensure a sustainable comparative advantage in the long run, which would allow Spanish firms to improve their competitiveness in international markets.

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Figure 1. Evolution of the cost of borrowing (cost of new long-term debt), 1990-2011.

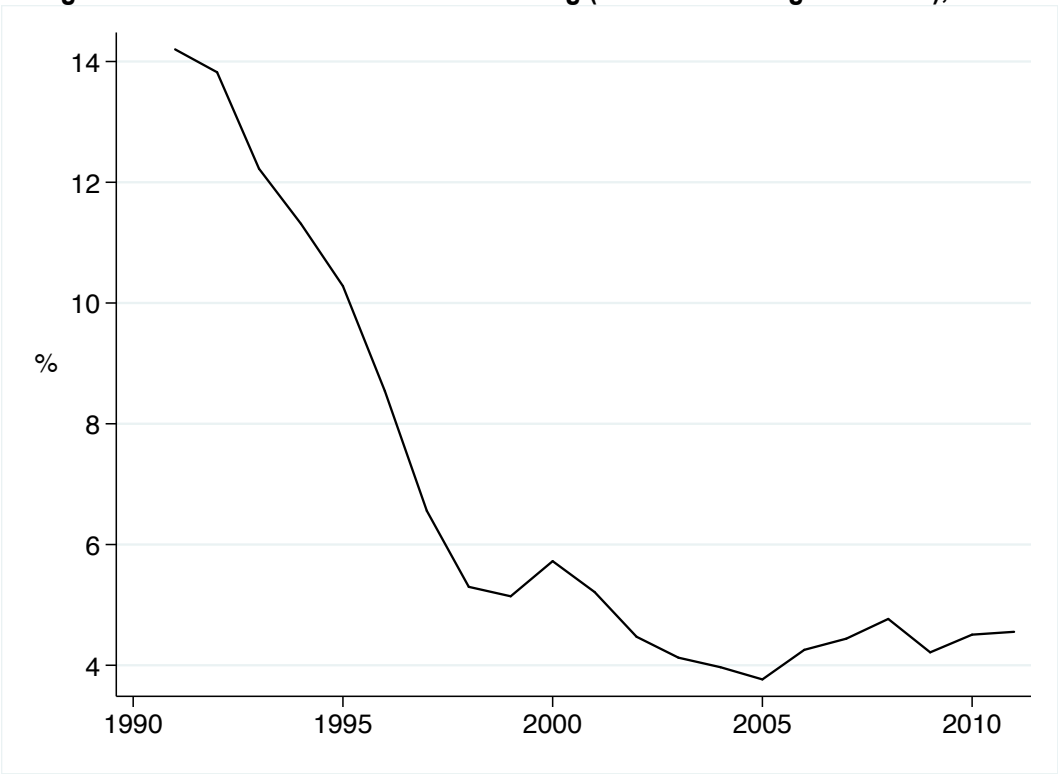

Figure 2. Yearly growth of loans to non-financial institutions, 1990-2013.

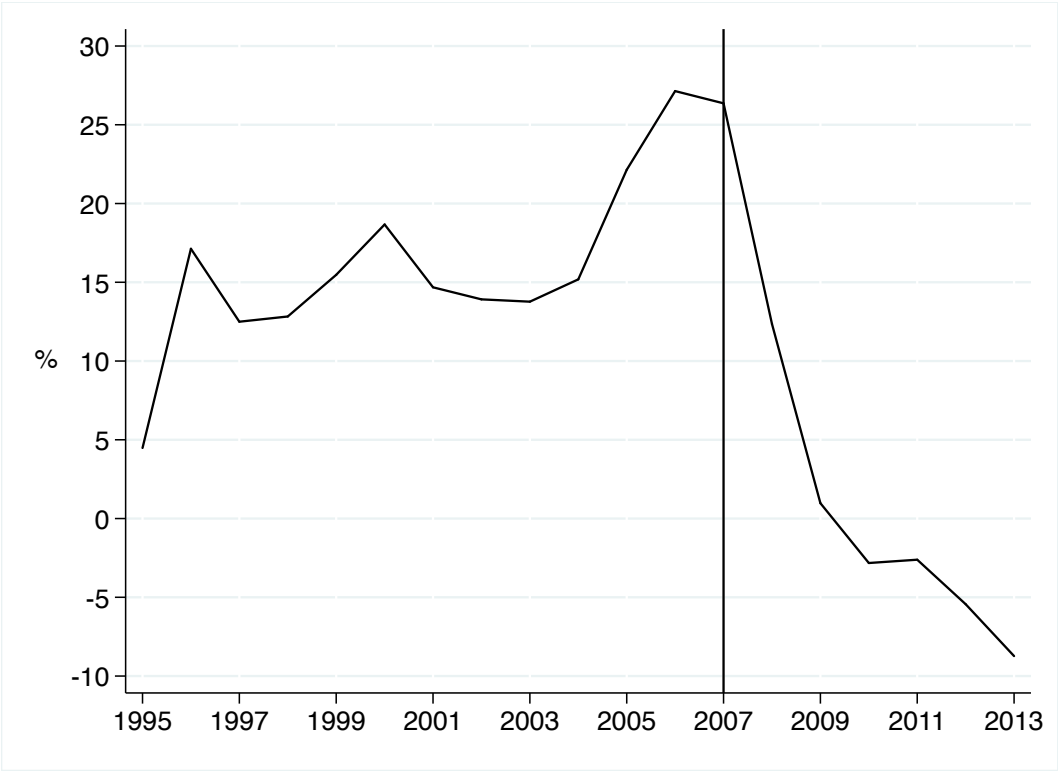

Table 1. Differences across export and R&D strategies undertaken by firms.

	Export	R&D	Both
Cost of new long-term debt	-0.04**	-0.04	-0.13***
Cash flow	53.41***	45.48***	81.83***
TFP	4.65***	2.74***	6.91***

Note: ***, ** mean significance at the 1% and 5% level, respectively.

Table 2. Test of the differences across export and R&D strategies undertaken by firms.

	Coefficient	*p*-value
Cost of new long-term debt		
Both *vs.* Export	-0.09***	0.000
Both *vs.* R&D	-0.09**	0.041
Export *vs.* R&D	0.01	0.979
Cash flow		
Both *vs.* Export	28.42***	0.000
Both *vs.* R&D	36.35***	0.000
Export *vs.* R&D	7.93	0.311
TFP		
Both *vs.* Export	2.26***	0.000
Both *vs.* R&D	4.17***	0.000
Export *vs.* R&D	1.91**	0.043

Note: ***, ** mean significance at the 1% and 5% levels, respectively.

Table 3. Correlation between the measures ranking financially constrained firms.

	Cost_d_{it}	**Cash flow_d_{it}**	**TFP_d_{it}**
Cost_d_{it}	1.000***	-	-
Cash flow_d_{it}	-0.259***	1.000***	-
TFP_d_{it}	-0.133***	0.565***	1.000***

Notes:

1. Cost_d_{it} is the deviation of the firm's financial cost with respect to the average cost paid by manufacturing firms the same year.
2. *** means significance at the 1% level.

Table 4. The effect of financial constraints on export and R&D decisions.

	Internal financial constraint measure: Cash flow_d		Internal financial constraint measure: TFP_d	
	(1) Export	(2) R&D	(3) Export	(4) R&D
Cost_d	-0.031**	-0.046***	-0.034**	-0.030*
	(0.044)	(0.002)	(0.033)	(0.058)
Cash Flow_d	0.116***	0.108***	-	-
	(0.000)	(0.000)		
TFP_d	-	-	0.362***	0.367***
			(0.000)	(0.001)
Cost_d·Cash Flow_d	0.013	0.011	-	-
	(0.156)	(0.198)		
Cost_d·TFP_d	-	-	0.064	-0.007
			(0.292)	(0.914)
Age	0.527***	0.641***	0.540***	0.800***
	(0.000)	(0.000)	(0.000)	(0.000)
Size	0.006	0.161*	0.093	0.253***
	(0.926)	(0.057)	(0.169)	(0.002)
Foreign	0.032	-0.090	0.129	-0.062
	(0.788)	(0.371)	(0.267)	(0.539)
Market share	0.000	0.002	0.001	0.003***
	(0.942)	(0.168)	(0.420)	(0.010)
Expansive demand	0.001	0.088***	-0.001	0.054*
	(0.973)	(0.006)	(0.968)	(0.087)
Recessive demand	0.080**	0.081**	0.022	0.055
	(0.025)	(0.043)	(0.511)	(0.144)
Num. of competitors 0-10	-0.046	0.042	-0.090*	0.001
	(0.331)	(0.445)	(0.063)	(0.979)
Num. of competitors 10-25	-0.061	0.047	-0.066	0.024
	(0.299)	(0.479)	(0.257)	(0.717)
Num. of competitors>25	0.010	-0.009	-0.069	-0.092
	(0.860)	(0.890)	(0.209)	(0.141)
Sales to public admin.	0.059	0.090	0.082	0.143*
	(0.435)	(0.212)	(0.310)	(0.055)
Appropriability	0.090**	0.155***	0.099***	0.124***
	(0.013)	(0.000)	(0.004)	(0.000)
Constant	-1.626***	-2.727***	-2.069***	-2.960***
	(0.000)	(0.000)	(0.000)	(0.000)
	Log-likelihood: -12520.423 Observations: 13753 (1865 firms) ρ = 0.380 (s.e. = 0.035) LR test ρ = 0, $\chi^2(1)$ = 95.56		Log-likelihood: -13541.348 Observations: 14964 (1915 firms) ρ = 0.376 (s.e. = 0.035) LR test ρ = 0, $\chi^2(1)$ = 90.03	

Notes:

1. All specifications include year, industry dummies and Mundlak means.
2. *p*-values between brackets (robust standard errors clustered by firm).
3. ***, ** and * indicate significance al 1%, 5% y 10%, respectively.

Table 5. The effect of financial constraints on export and R&D decisions: Large firms.

	Internal financial constraint measure: Cash flow_d		Internal financial constraint measure: TFP_d	
	(1) Export	(2) R&D	(3) Export	(4) R&D
Cost_d	-0.015	-0.035	-0.020	-0.024
	(0.740)	(0.144)	(0.588)	(0.313)
Cash flow_d	-0.005	0.048	-	-
	(0.917)	(0.149)		
TFP_d	-	-	-0.025	0.169
			(0.915)	(0.400)
Age	0.677***	0.739***	0.840***	0.878***
	(0.001)	(0.000)	(0.000)	(0.000)
Size	-0.228	0.116	-0.218	0.165
	(0.328)	(0.498)	(0.403)	(0.365)
Foreign	0.149	0.019	0.226	0.098
	(0.367)	(0.876)	(0.162)	(0.452)
Market share	0.001	0.001	0.002	0.003
	(0.872)	(0.534)	(0.641)	(0.211)
Expansive demand	-0.100	0.076	-0.116	0.086
	(0.279)	(0.190)	(0.201)	(0.150)
Recessive demand	0.082	0.023	-0.030	-0.008
	(0.422)	(0.756)	(0.782)	(0.909)
Num. of competitors 0-10	0.095	-0.086	-0.009	-0.037
	(0.526)	(0.472)	(0.956)	(0.768)
Num. of competitors 10-25	-0.144	-0.124	-0.270	-0.064
	(0.383)	(0.386)	(0.122)	(0.665)
Num. of competitors>25	0.044	-0.186	-0.111	-0.342**
	(0.841)	(0.202)	(0.599)	(0.021)
Sales to public admin.	0.146	0.043	0.325	0.072
	(0.412)	(0.743)	(0.103)	(0.590)
Appropriability	0.185**	0.174**	0.230**	0.188***
	(0.044)	(0.021)	(0.014)	(0.009)
Constant	-0.457	-1.807***	-0.590	-1.914***
	(0.624)	(0.008)	(0.498)	(0.003)
	Log-likelihood: -2933.9671 Observations: 4145 (596 firms) ρ = 0.339 (s.e. = 0.067) LR test ρ = 0, $\chi^2(1)$ = 21.50		Log-likelihood: -3039.8146 Observations: 4410 (599 firms) ρ = 0.297 (s.e. = 0.068) LR test ρ = 0, $\chi^2(1)$ = 16.61	

See notes to table 4.

Table 6. The effect of financial constraints on export and R&D decisions: SMEs.

	Internal financial constraint measure: Cash flow_d		Internal financial constraint measure: TFP_d	
	(1) Export	(2) R&D	(3) Export	(4) R&D
Cost_d	-0.041**	-0.055***	-0.048***	-0.042**
	(0.011)	(0.004)	(0.006)	(0.036)
Cash flow_d	0.149***	0.130***	-	-
	(0.000)	(0.000)		
TFP_d	-	-	0.426***	0.411***
			(0.000)	(0.001)
Age	0.487***	0.638***	0.502***	0.797***
	(0.000)	(0.000)	(0.000)	(0.000)
Size	0.032	0.135	0.133*	0.250***
	(0.674)	(0.139)	(0.053)	(0.005)
Foreign	0.005	-0.184	0.128	-0.199
	(0.972)	(0.266)	(0.406)	(0.205)
Market share	-0.000	0.002	0.000	0.003*
	(0.894)	(0.299)	(0.781)	(0.078)
Expansive demand	0.020	0.089**	0.024	0.037
	(0.544)	(0.020)	(0.462)	(0.317)
Recessive demand	0.079**	0.112**	0.028	0.088*
	(0.044)	(0.021)	(0.441)	(0.050)
Num. of competitors 0-10	-0.051	0.099	-0.095*	0.018
	(0.316)	(0.116)	(0.063)	(0.779)
Num. of competitors 10-25	-0.028	0.114	-0.026	0.058
	(0.653)	(0.150)	(0.674)	(0.450)
Num. of competitors>25	0.018	0.048	-0.052	-0.027
	(0.755)	(0.507)	(0.357)	(0.701)
Sales to public admin.	0.041	0.154*	0.035	0.212**
	(0.615)	(0.076)	(0.690)	(0.015)
Appropriability	0.068*	0.156***	0.078**	0.110***
	(0.085)	(0.000)	(0.039)	(0.002)
Constant	-1.574***	-2.531***	-2.086***	-2.800***
	(0.000)	(0.000)	(0.000)	(0.000)
	Log-likelihood: -9345.98 Observations: 9608 (1436 firms) ρ = 0.380 (s.e. = 0.039) LR test ρ = 0, $\chi^2(1)$ = 74.48		Log-likelihood: -10266.78 Observations: 10554 (1488 firms) ρ = 0.388 (s.e. = 0.040) LR test ρ = 0, $\chi^2(1)$ = 75.64	

See notes to table 4.

Table 7. The effect of financial constraints on export and R&D decisions and after 2007 financial crisis: Cash flow as a proxy for internal financial constraints.

Variables	(1) Export	(2) R&D	(3) Export	(4) R&D	(5) Export	(6) R&D
Cost_d	-0.030*	-0.037**	-0.033**	-0.040***	-0.033**	-0.043***
	(0.054)	(0.017)	(0.032)	(0.009)	(0.034)	(0.005)
Cash flow_d	0.121***	0.102***	0.117***	0.104***	0.115***	0.104***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cost_d·D08_11	-0.044	-0.114**	-	-	-	-
	(0.320)	(0.022)				
Cash flow_d·D08_11	-0.027	0.032	-	-	-	-
	(0.259)	(0.177)				
Cost_d·D09_11	-	-	-0.023	-0.106*	-	-
			(0.671)	(0.088)		
Cash flow_d·D09_11	-	-	-0.002	0.035	-	-
			(0.928)	(0.187)		
Cost_d·D10_11	-	-	-	-	-0.085	-0.077
					(0.274)	(0.328)
Cash flow_d·D10_11	-	-	-	-	0.092*	0.134**
					(0.069)	(0.011)
Age	0.523***	0.645***	0.526***	0.638***	0.516***	0.622***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size	0.007	0.155*	0.004	0.156*	0.002	0.155*
	(0.921)	(0.066)	(0.954)	(0.064)	(0.981)	(0.065)
Foreign	0.025	-0.088	0.028	-0.089	0.028	-0.092
	(0.832)	(0.380)	(0.814)	(0.377)	(0.815)	(0.362)
Market share	0.000	0.002	0.000	0.002	0.000	0.002
	(0.847)	(0.199)	(0.917)	(0.184)	(0.961)	(0.189)
Expansive demand	0.001	0.089***	0.001	0.088***	0.001	0.087***
	(0.967)	(0.005)	(0.965)	(0.005)	(0.968)	(0.006)
Recessive demand	0.079**	0.080**	0.079**	0.080**	0.080**	0.081**
	(0.027)	(0.045)	(0.027)	(0.046)	(0.026)	(0.043)
Number of compe. 0-10	-0.050	0.045	-0.047	0.044	-0.047	0.041
	(0.292)	(0.407)	(0.320)	(0.424)	(0.318)	(0.447)
Number of compe. 10-25	-0.065	0.051	-0.062	0.048	-0.062	0.047
	(0.263)	(0.447)	(0.285)	(0.475)	(0.288)	(0.479)
Number of compe. > 25	0.003	-0.000	0.009	-0.004	0.010	-0.007
	(0.955)	(0.997)	(0.870)	(0.949)	(0.860)	(0.913)
Sales to public admin.	0.055	0.088	0.056	0.089	0.057	0.090
	(0.466)	(0.223)	(0.457)	(0.219)	(0.451)	(0.217)
Appropriability	0.090**	0.159***	0.091**	0.159***	0.091**	0.155***
	(0.013)	(0.000)	(0.013)	(0.000)	(0.012)	(0.000)
Constant	-1.626***	-2.748***	-1.629***	-2.75***	-1.644***	-2.763***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Log-likelihood: -12516.69 Observations: 13753 (1865 firms) ρ = 0.381 (s.e. = 0.035) LR test ρ = 0, $\chi^2(1)$ = 95.70		Log-likelihood: -12519.87 Observations: 13753 (1865 firms) ρ = 0.381 (s.e. = 0.035) LR test ρ = 0, $\chi^2(1)$ = 95.72		Log-likelihood: -12516.82 Observations: 13753 (1865 firms) ρ = 0.381 (s.e. = 0.035) LR test ρ = 0, $\chi^2(1)$ = 96.10	

See notes to table 4.

Table 8. The effect of financial constraints on export and R&D decisions and after 2007 financial crisis: TFP as a proxy for internal financial constraints.

Variables	(1) Export	(2) R&D	(3) Export	(4) R&D	(5) Export	(6) R&D
Cost_d	-0.028*	-0.016	-0.031*	-0.022	-0.033**	-0.027*
	(0.091)	(0.307)	(0.063)	(0.172)	(0.043)	(0.081)
TFP_d	0.369***	0.392***	0.346***	0.365***	0.357***	0.347***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Cost_d·D08_11	-0.063	-0.127***	-	-	-	-
	(0.133)	(0.003)				
TFP_d·D08_11	-0.009	-0.101	-	-	-	-
	(0.952)	(0.524)				
Cost_d·D09_11	-	-	-0.072	-0.122**	-	-
			(0.156)	(0.023)		
TFP_d·D09_11	-	-	0.183	0.023	-	-
			(0.242)	(0.889)		
Cost_d·D10_11	-	-	-	-	-0.090	-0.090
					(0.247)	(0.246)
TFP_d·D10_11	-	-	-	-	0.382*	0.620***
					(0.091)	(0.004)
Age	0.540***	0.800***	0.539***	0.797***	0.534***	0.791***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size	0.091	0.254***	0.089	0.252***	0.090	0.249***
	(0.177)	(0.002)	(0.190)	(0.002)	(0.184)	(0.003)
Foreign	0.129	-0.059	0.129	-0.061	0.126	-0.064
	(0.266)	(0.560)	(0.267)	(0.550)	(0.278)	(0.529)
Market share	0.001	0.003***	0.001	0.003***	0.001	0.003***
	(0.419)	(0.009)	(0.428)	(0.010)	(0.418)	(0.010)
Expansive demand	-0.001	0.054*	-0.001	0.054*	-0.001	0.054*
	(0.976)	(0.083)	(0.976)	(0.085)	(0.980)	(0.083)
Recessive demand	0.022	0.054	0.022	0.054	0.022	0.054
	(0.508)	(0.150)	(0.509)	(0.150)	(0.510)	(0.151)
Number of competitors 0-10	-0.089*	0.000	-0.088*	0.002	-0.089*	-0.000
	(0.066)	(0.996)	(0.067)	(0.976)	(0.064)	(0.997)
Number of competitors 10-25	-0.065	0.024	-0.065	0.024	-0.066	0.023
	(0.265)	(0.720)	(0.270)	(0.711)	(0.257)	(0.727)
Number of competitors>25	-0.068	-0.094	-0.066	-0.091	-0.068	-0.092
	(0.214)	(0.134)	(0.230)	(0.144)	(0.211)	(0.139)
Sales to public admin.	0.080	0.141*	0.081	0.143*	0.081	0.143*
	(0.326)	(0.059)	(0.317)	(0.055)	(0.317)	(0.055)
Appropriability	0.101***	0.128***	0.101***	0.127***	0.099***	0.125***
	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.002)
Constant	-2.077***	-2.970***	-2.084***	-2.97***	-2.086***	-2.985***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Log-likelihood: -13536.26		Log-likelihood: -13537.69		Log-likelihood: -13538.03	
	Observations: 14964		Observations: 14964		Observations: 14964	
	(1915 firms)		(1915 firms)		(1915 firms)	
	ρ = 0.376 (s.e. = 0.035)		ρ = 0.376 (s.e. = 0.035)		ρ = 0.376 (s.e. = 0.035)	
	LR test ρ = 0, $\chi^2(1)$ = 89.51		LR test ρ = 0, $\chi^2(1)$ = 89.56		LR test ρ = 0, $\chi^2(1)$ =89.84	

See notes to table 4.

Appendix A.

Definition of the explanatory variables (except financial constraints variables).

Age	Log of the number of years since the firm was born.
Size	Log of the number of the firm's employees.
Foreign	Dummy variable taking value 1 if the firm's capital is participated by a foreign firm.
Market share	The firm's market share in its main market (in %).
Expansive demand	Dummy variable taking value 1 if the firm declares to face an expansive demand.
Recessive demand	Dummy variable taking value 1 if the firm declares to face a recessive demand.
Number of competitors 0-10	Dummy variable taking value 1 if the firm asserts to have less than (or equal to) 10 competitors with significant market share in its main market.
Number of competitors 10-25	Dummy variable taking value 1 if the firm asserts to have more than 10 and less than (or equal to) 25 competitors with significant market share in its main market.
Number of competitors > 25	Dummy variable taking value 1 if the firm asserts to have more than 25 competitors with significant market share in its main market.
Atomistic market	Reference category for the previous ones in estimation. Dummy variable taking value 1 if the firm asserts to be in a market where no firm has significant market share.
Sales to public admin.	Dummy variable taking value 1 if more than 25% of firm's sales go to the public sector.
Appropriability	Ratio of the total number of patents over the total number of firms that assert to have achieved innovations in the firms' industry (20 industries of the two-digit NACE-93 classification) (in %).
Year dummies	Dummy variables taking value 1 for the corresponding year.
Industry dummies	Industry dummies accounting for 20 industries of the NACE-93 classification.