CENTRO STUDI LUCA D'AGLIANO

WWW.DAGLIANO.UNIMI.IT

CENTRO STUDI LUCA D'AGLIANO
DEVELOPMENT STUDIES WORKING PAPERS

N. 441

January 2019

Credit constraints and firm exports: Evidence from SMEs in emerging and developing countries

*Filomena Pietrovito**
*Alberto Franco Pozzolo***

* University of Molise
** University of Molise, Centro Studi Luca d'Agliano

ISSN 2282-5452

Credit constraints and firm exports: Evidence from SMEs in emerging and developing countries*

Filomena Pietrovito

University of Molise

Alberto Franco Pozzolo

University of Molise and Centro Studi Luca d'Agliano

Abstract

We study the relationship between credit constraints and export behavior using a large and heterogeneous sample of small and medium size firms from 65 emerging and developing countries between 2003 and 2014. We measure credit constraints by means of each firm's self-assessment of whether it is credit rationed, and we follow an instrumental variable approach that uses firm-level instruments to address the potential endogeneity of credit constraints with respect to export performance. We find robust evidence of a negative, statistically and economically significant effect of financial constraints on both the probability that a firm exports (the extensive margin of exports) and the share of exports over total sales (the intensive margin of exports).

JEL classification: D22, F10, F14

Keywords: export decisions; margin of exports; credit constraints; firm level

* We would like to thank for comments and suggestions seminar participants at the University of Molise, and conference participants at the European Trade Study Group (2016), the Italian Trade Study Group (2016), the International Finance and Banking Society (2016), the International Economic Association (2017), and the Società Italiana degli Economisti (2017). Any remaining errors are our sole responsibility. Address for correspondence: University of Molise, Department of economics, via de Sanctis, 00184 Campobasso, Italy. E-mails: filomena.pietrovito@unimol.it; pozzolo@unimol.it.

1. Introduction

Increasing exports is probably the oldest development strategy suggested in the economic literature. Export-led growth strategies have been studied extensively in the macroeconomic, development and trade literature. More recently, the new-new trade literature, started by the seminal contribution of Melitz (2003), has shifted the analysis at the firm level. However, the causes and the consequences of the internationalization of large corporations are different from those of smaller firms. For small and medium enterprises (SMEs) the choice of entering foreign markets can be hindered by a host of different factors, as stressed for example by Wagner (1995) and Gashi et al. (2014). In turn, understanding what these factors are can be extremely relevant in light of the substantial impact that internationalization can have on the performance of a firm.

Among the many features that can impact on a firm's ability to access foreign markets, an important strand of literature has focused its attention on financial factors. Indeed, to sell their products abroad, firms must pay significant fixed and sunk costs, such as those related to customs and regulatory compliance or those required for establishing a foreign distribution network, as well as variable costs, because international transactions typically require a larger amount of time to be finalized. The time span between the payment of upfront costs and the subsequent cash flows from selling products abroad is typically longer than that characterizing activities in the domestic market. Since these costs must be paid upfront, working capital requirements of exporting firms are higher than those of firms selling only in the domestic market. As a result, exporting firms typically have a higher demand for external financing. If the sunk costs of exports could be seen as investment in intangible capital, and capital and credit markets were perfect, the financing decision of a firm would be irrelevant for its investment behaviour. But in presence of taxation, information asymmetries, and other financial market imperfections, the cost of new debt and equity may differ substantially from that of internal finance, generated by cash flows and retained earnings (Modigliani and Miller, 1958; Fazzari et al., 1988). In such a case, the efficiency of external financial markets can have first-order effects on the decisions of a firm, including on whether to export or not. Obviously, this problem is even stronger in the case of SMEs, that typically depend to a large extent on bank credit for financing their activities.

The literature on small business lending has provided ample evidence that SMEs suffer much more than larger firms from credit constraints, because they are more opaque and risky, and often lack adequate internal and external collateral (see Berger and Udell, 2006, for a survey on lending to SMEs, and Becchetti and Trovato, 2002, for evidence on the role of credit constraints on the rate of growth of SMEs). Of course, this is even more the case if the investment to be financed is in the intangible capital that is required to access

foreign markets. Moreover, the high degree of heterogeneity in the efficiency of credit markets in developing and emerging economies makes the issue of the links between financial development and exports a crucial aspect to design effective development policies.

Of course, the relevance of financial development to foster export-led growth policies has not gone unnoticed in the literature. Starting with the seminal contribution of Kletzer and Bardhan (1987) and Beck (2002), and following with the more recent contributions of Manova (2012) and Chaney (2016), a number of authors have studied the link between finance and export. Berman and Héricourt (2010) show that firms with low levels of financial debt over total assets and high levels of cash flows are more likely to be exporters (the extensive margin of exports), but they do not export a significantly higher share of their total sales (the intensive margin of exports). Interestingly, they also find that productivity is an important determinant of internationalization only for firms that are not credit constrained, suggesting that constrained firms cannot benefit from their higher productivity because they are unable to fund the investments in intangibles required to access to foreign markets. Focusing explicitly on SMEs, Bartoli et al. (2014) show that bank support can be a crucial ingredient favouring internationalization.

In this paper, we expand the available evidence along three dimensions. First, we analyze a larger sample of over 19,000 SMEs operating in 65 emerging and developing countries between 2003 and 2014. Second, we exploit a feature of our source of data, the World Bank Enterprise Survey (WBES), that provides detailed information on a number of firm characteristics, on their export decisions and, crucially, on each firm's self-assessment of whether it faces credit constraints. In particular, following a large strand of literature (see, for example, Levenson and Willard, 2000, and Mol-Gómez-Vázquez et al., 2018) we define a firm to be credit constrained if it is denied a loan application or it is discouraged to apply because: the procedures are too complex, the required interest rate is not favorable, the collateral requirements are too high, the size of the loan or its maturity are insufficient, or simply the firm expects that the application would not be approved.

Third, we recognize that our analysis is likely to be affected by a significant endogeneity issue. Indeed, the relationship between credit rationing and firms' export performance may suffer from at least two major endogeneity problems. First, unobserved firm-level characteristics might influence both their ability to access external finance and their participation in foreign markets. For example, firms whose managers are members of an established international network might be better able to access both external finance and the export markets. Second, as argued by Minetti and et al. (2017), a firm's access to foreign markets might be seen as a positive signal by potential investors, facilitating external funding. In addressing these endogeneity issues, we use two sets of firm-level

instruments. First, provided that formal financial institutions rely on hard information, such as those gathered from financial statements in deciding loan approval, we adopt as an instrumental variable for credit constraints a dummy indicating whether a firm has its financial statements checked and certified by external financial auditors. We argue that this occurrence is unlikely to be linked on whether the firm is exporting, but at the same time it provides relevant hard information on the firm that banks can use to better evaluate its creditworthiness, therefore reducing its opacity and increasing the probability that a loan is granted. Second, we use as an additional instrument the circumstance that a firm is allowed to pay for purchases of material inputs or services after delivery, arguing that such a firm is less likely to be credit constrained. Having two firm-level instruments also allows us to verify their exogeneity, by means of a test of over-identifying restrictions.

Our empirical results provide additional robust evidence that financially constrained firms have a lower probability of exporting (i.e., the extensive margin of exports), and, when they do so, their share of exports over total sales (i.e., the intensive margin of exports) is smaller. After controlling for individual attributes affecting the margins of exports, and for potential endogeneity, we estimate that the probability of penetrating foreign markets decreases by about 10% for credit rationed firms, and that the share of sales exported decreases by about 15%. Our evidence also shows that credit constraints are more binding for smaller firms. Finally, the negative impact of credit constraints on exports holds only for countries with less developed banking sectors, that is, where the ratio of bank total assets to GDP is below the median.

The overall picture that emerges from our analysis provides additional firm-level evidence confirming the predictions of the theoretical models of Manova (2012) and Chaney (2016), who describe the mechanisms why a better access to external finance increases the ability of firms to enter foreign markets. These findings have important policy implications for developing countries, suggesting that removing credit constraints and improving financial conditions is a crucial step to foster export performance.

The rest of the paper is organized as follows. Sections 2 discusses the existing literature related to our analysis. Section 3 describes the data used in the empirical analysis and presents their descriptive statistics. Sections 4 and 5 discuss the empirical methodology and the results obtained on the extensive and the intensive margin of trade. Section 6 presents the results of two robustness checks obtained by splitting the sample according to firm size and country financial development. Section 7 concludes.

2. Literature review

A number of theoretical studies on the international trade literature – such as Manova (2012), Feenstra et al. (2014), and Chaney (2016) – augment the standard Melitz (2003)

model of international trade with heterogeneous firms incorporating the idea that financial constraints represent an additional source of heterogeneity, that can help to account for differences in export behaviour. A common prediction of these models is that the productivity level that is required to operate in international markets for financially constrained firms is higher than that for unconstrained firms, because the former must also cover the higher costs of external finance. Building on this common assumption, Manova (2012) focuses on external financing and studies how the degree of financial development of a country affects differently the export activity of firms operating in sectors with different dependence on external finance. Chaney (2016) concentrates instead on internal financing, and argues that only those firms that have a sufficient level of liquidity are able to export. Feenstra et al. (2014) focus on the opposite relationship, studying the impact that the decision to export can have on the incentive compatibility constraint of a firm that borrows from a bank under imperfect information.

Building on these seminal theoretical contributions, a growing body of empirical literature has analyzed the impact of financial conditions on exports, distinguishing between the extensive margin, that is the decision of entering foreign markets, and the intensive margin, that is the level of exports or the share of sales exported, showing in most cases that better financial conditions improve the export performance (see Wagner, 2014, for a very effective tabular survey).

A first group of papers includes single-country, firm-level analyses. Starting from the seminal contribution by Greenaway et al. (2007), who study a large sample of UK manufacturing firms, many authors have replicated and extended their analysis, including: Egger and Kesina (2014), Feenstra et al. (2014) and Manova et al. (2015) for China; Bellone et al. (2010) and Stiebale (2011) for France; Buch et al. (2010) and Wagner (2014) for Germany; Minetti and Zhu (2011) and Secchi et al. (2016) for Italy. Despite the fact that the countries analyzed differ significantly in the level of economic development, and that these studies use different measures of financial constraints and different econometric methods, they share the conclusion that financial frictions deter export market participation and, in some cases, reduce the share of exported sales and expand the time to entry foreign markets.[1]

A second group of papers focuses on cross-country, industry-level data (Beck, 2002; Becker et al., 2012; Manova, 2008 and 2012), finding results that are consistent with the firm-level evidence. In her seminal paper, Manova (2012) follows the methodology of Rajan and Zingales (1998), and shows that sectors that are more dependent on external

[1] In a parallel study, Bartoli et al. (2014) show that, in addition to the required financing, banks can also provide services to firms planning to access foreign markets, such as advisory services; interestingly, these are more effective if the main bank of the firm is itself international.

finance have a better export performance in countries where the financial sector is more developed.

Finally, few papers use cross-country, firm-level data, mostly from the World Bank Enterprise Survey (WBES). In a seminal paper on developing economies, Berman and Héricourt (2010) study a sample of 5,000 firms from 9 countries, showing that productivity becomes increasingly important for exporting decisions (the extensive margin of trade) as financial constraints decrease. However, in their sample, neither the quantity exported (or the share of exports over total sales), nor the probability of remaining an exporter is affected by financial constraints, meaning that the role of financial constraints on margins of trade is concentrated at the time of entry. Fauceglia (2015) explores a larger sample of firms from 18 developing countries, providing evidence that firm's liquidity has a positive impact on the extensive margin of export, that is more pronounced for firms operating in less financially developed economies. Wang (2016) uses data collected by the ECB and the World Bank on 28 East European and Central Asian countries, confirming that financially constrained firms are less likely to export. However, both these papers use a smaller sample of countries and firms than our analysis, and tackle the endogeneity issues differently.

The most important empirical issue in analysing this relationship is how to identify financially constrained firms. Earlier contributions exploit the heterogeneous impact of financial shocks on firms with different degrees of dependence on external finance (Rajan and Zingales, 1998). Manova (2008), for example, shows that episodes of equity market liberalization increase exports disproportionately more in sectors that require a higher share of outside finance or have fewer collateralizable assets. Other studies adopt instead firm-specific measures of financial constraints, obtained from balance-sheet ratios. Consistent with the large literature on financial constraints (Fazzari et al., 1988; Kaplan and Zingales, 1997), the most used measures are liquidity and leverage ratios (Greenaway et al., 2007; Bellone et al., 2010; Egger and Kesina, 2014; Fauceglia, 2015), or synthetic indexes that collapse information from different firm-level characteristics, such as size, profitability and solvency (Musso and Schiavo, 2008; Bellone et al., 2010; Silva, 2011). An original approach has been pursued by Secchi et al. (2016), who use as measures of credit constraints the credit rating indices produced by banks and credit institutions. Finally, a number of studies, including ours, rely on responses to business surveys to identify firms that are credit rationed. Minetti and Zhu (2011), for instance, estimate the impact of credit rationing on exports using data on a sample of Italian manufacturing firms that provide a specific measure of credit rationing based on the self-reported assessment of whether a firm was denied credit at the market interest rate or was discouraged to apply. Wang (2016) uses a similar self-assessment measure obtained from

a survey on firms from 28 East European and Central Asian countries between 2001 and 2013.

An important issue, emphasized by many scholars in this field of literature, is that firms' financial constraints and export behaviors are jointly determined. Indeed, the theoretical and empirical analysis of Feenstra et al. (2014) focuses in particular on how exports can increase profitability and therefore reduce credit constraints, and also the models by Manova (2012) and Chaney (2016) show that the causal relationship between internationalization and the availability of external finance can go in both directions. To address this potential endogeneity problem, a number of authors have adopted an instrumental variable approach, relying on country- and sector-level measures of financial regulation or financial development as exogenous instruments for firms' credit constraints. Minetti and Zhu (2011) and Secchi et al. (2016), for example, use the data of Guiso et al. (2004) on the characteristics of local credit markets in Italy in 1936 as instruments for the probability that a firm declares to be credit constrained. Few papers use instead instruments at the firm level. Berman and Héricourt (2010) use lagged values of financial debt and cash flows, their measures of financial constraints, as instruments for contemporaneous values. Jinjarak and Wignaraja (2016) use the reply to a survey question in which each firm is asked whether it needs a loan or whether it has access to overdraft facilities as alternative instruments for the actual amount of bank loans and overdraft facilities. Reassuringly, all analyses using an instrumental variable approach tend to confirm that (exogenous) credit constraints have a negative impact on exports. In what follows, we propose a new set of firms-level instruments that, in our view and according to the diagnostic tests, make a step forward with respect to the previous literature.

3. Data and descriptive statistics

To test the hypothesis that credit constraints hinder exports, we exploit establishment-level data for about 19,000 firms from 65 emerging and developing countries over the period 2003-2014, collected within the World Bank Enterprise Survey (WBES).[2] Our initial sample includes 19,368 observations on 19,215 firms, meaning that the database includes only a very small panel component, of about 153 firms. Our analysis relies therefore on the pooled 2003-2014 data, because it is extremely hard to detect robust

[2] Data are accessible at http://www.enterprisesurveys.org; for simplicity, and since most firm in the sample have a single establishment, we use the term firms throughout the paper, though the analysis is based on establishment data.

relationships with a panel of just 153 firms from different sectors and countries, as also argued by Gorodnichenko and Schnitzer (2013).

The WBES survey includes information on the values of total sales and of total exports, allowing therefore to construct the two most common measures of firm export performance: the extensive and the intensive margins. Moreover, firms are required to answer a number of questions on their financial needs and on their relationships with banks and other credit institutions that allow to construct a set of measures of self-assessed credit constraints. Finally, the survey includes a large number of additional firm-level characteristics that can be used as control variables and instruments to deal with the problem generated by the potential endogeneity of credit rationing with respect to firm's export status.

More in detail, we define the extensive margin of exports as a dummy variable that takes the value of one if a firm exports (directly or indirectly, i.e reaching foreign markets through an intermediary that subsequently exports its products) and zero otherwise. The intensive margin of exports is instead measured as the share of the total value of a firm's exports over its total sales. About 33% of firms in our sample are active exporters, with an average export share over total sales of about 13% (Table 1).

Our key explanatory variable is a dummy that takes the value of one if the firm is financially constrained, and zero otherwise. To build this dummy we exploit the answers to three questions of the WEBS survey: 1) "At this time, does this establishment have a line of credit or a loan from a financial institution?"; 2) "Did this establishment apply for any loans or line of credit?"; and 3) "What was the main reason why this establishment did not apply for any line of credit or loan in fiscal year?". Questions 1 and 2 allow only two possible answers: yes or no. Question 3 allows instead seven different answers: a) "no need for a loan, establishment has sufficient capital"; b) "application procedure for loans or lines of credit are complex"; c) "interest rates are not favorable"; d) "collateral requirements too high"; e) "size of loan or maturity insufficient"; f) "did not think it would be approved"; g) "other". The answers to these questions allow to construct measures of the degree of financial constraints faced by each firm. Following the literature started by Jappelli (1990), we define a firm as credit constrained if it has no credit lines or loans from a financial institution and it either (i) applied for a loan, but did not obtain it, or (ii) it did not apply for a loan because of one of the answers b) to g) to question 3 above. Credit rationed firms represent about 24% of our sample (Table 1).

A key feature of our data is that they allow us to consider discouraged borrowers. Indeed, firms discouraged from applying for a bank loan have found to be a sizeable share of those that can be considered as financially constrained. Levenson and Willard (1999), for example, show that the share of SMEs that were discouraged from applying for a loan is

as large as the sum of the share of those that were denied and those that had to move to a different bank after their first application was rejected. Interestingly, Mol-Gómez-Vázquez et al. (2018) show that more bank market power increases borrower discouragement for firms operating in less developed economies and in countries with a high degree of bank market power, precisely the characteristics of the countries considered in our analysis. At the same time, Rostamkalei et al. (2018) show that it is those SMEs that have a satisfactory relationship with their banks that are more likely to self-restrain from loan applications, suggesting that their choice is not based on irrational fears but is probably due to correct expectations. In light of this evidence, failing to consider self-assessed credit rationed, SMEs would be likely to introduce a severe bias in our results.

As argued in the introduction, a major issue in studying the relationship between credit constraints and exports is the potential endogeneity of a firm's financial conditions with respect to its degree of internationalization. Following the previous literature, we tackle this problem adopting an instrumental variable approach, hinging on two firm-level characteristics. The first is a measure of the amount of hard information available on the firm. One of the questions in the WEBS survey asks whether "In fiscal year [*insert last complete fiscal year*], did this establishment have its annual financial statements checked and certified by an external auditor?" We therefore define "certification" as a dummy variable that takes the value of one if the firm's financial statement is checked and certified by an external auditor, and zero otherwise. The second instrument is a measure of shocks to the cash flow and the availability of a level of internal sources of funds of a firm, capable of affecting the probability that it is financially constrained. Firms in the WBES survey are asked "What percentage, as a proportion of the value of total annual purchases of material inputs or services were paid for after delivery?". The answer is a continuous variable ranging from 0 to 100. Since this variable has a very skewed distribution, we choose to create three dummies for each tercile of the distribution of the share, and we use the two dummies for firms in the second and third tercile as instruments for our measures of credit rationing. We argue that firms that are allowed to delay their payments are less likely to be credit constrained. We believe that these instruments are reliable and exogenous measures of financial constraints. In our sample, about 51% of firms have a financial statement that is certified and checked by an external auditor (Table 1), and about 47% of firms obtain payment after delivery on purchases.

Table 1 – Descriptive statistics

Variable	(1) All sample mean	c.v.	min	max	(2) CR = 1 mean	c.v.	min	max	(3) CR = 0 mean	c.v.	min	max	(4) *t*-test	
export dummy	0.332	1.419	0	1	0.217	1.903	0	1	0.367	1.313	0	1	20.531	***
export share	0.130	2.077	0	1	0.087	2.609	0	1	0.143	1.958	0	1	13.948	***
credit rationing	0.236	1.801	0	1	1	0	1	1	0	0	0	0		
number of employees	112	3.741	1	26,000	51	3.078	1	3,000	131	3.580	1	26,000	17.597	***
labour productivity	382.472	7.925	0	56,516	715.995	5.730	0	55,774	279.569	9.317	0	56,516	-2.220	**
firm age	22	0.818	1	210	20	0.750	1	146	23	0.826	1	210	13.867	***
share of temporary workers	0.115	1.878	0	1	0.127	1.858	0	1	0.112	1.875	0	1	-4.052	***
share of skilled workers	0.487	0.567	0	1	0.524	0.531	0	1	0.476	0.576	0	1	-10.335	***
competition in national market	0.430	1.151	0	1	0.385	1.265	0	1	0.444	1.119	0	1	7.115	***
capacity utilization	0.728	0.295	0	1.05	0.706	0.313	0	1	0.735	0.288	0	1.05	7.930	***
balance-sheet certification	0.506	0.988	0	1	0.400	1.225	0	1	0.538	0.928	0	1	16.637	***
payment after delivery (second tercile)	0.303	1.518	0	1	0.304	1.513	0	1	0.303	1.518	0	1	-0.027	
payment after delivery (third tercile)	0.327	1.434	0	1	0.219	1.890	0	1	0.360	1.333	0	1	19.407	***
political instability	1.908	0.764	0	4	1.982	0.754	0	4	1.885	0.767	0	4	-2.18	**
bank assets / GDP	0.346	0.575	0.026	0.845	0.300	0.630	0.026	0.827	0.361	0.554	0.026	0.845	14.69	***

Note: column (1) reports the descriptive statistics calculated on the whole sample; columns (2) and (3) report the descriptive statistics calculated on the sub-samples of credit rationed firms and not constrained firms, respectively. Labor productivity is in thousands of US dollars. Column (4) reports the value of the mean-difference test. The approximate degrees of freedom for the *t*-test are obtained from Welch's formula (1947). ** indicates significance at the 5% level, *** at the 1% level.

In addition to instrumenting our measures of financial constraints, we control for a number of firm characteristics that are likely to impact on their export performance. First, consistent with the large evidence showing that large companies are more internationalized, we control for firm size, measured by the number of permanent full-time employees and managers. Second, following the literature initiated by the seminal paper by Melitz (2003), arguing that only the most productive firms are able to surmount the fixed costs of accessing foreign markets, we control for labor productivity, measured by the ratio of the dollar value of total annual sales on the number of employees. Table 1 shows that this ratio has a large variability, with a coefficient of variation of about 8. As an additional measure of productivity, we also control for the share of skilled workers on permanent full-time employees, that has an average value of 49% and a coefficient of variation of 0.57.

Next, considering that the decision to export is characterized by some degree of hysteresis, we control for the age of the firm, measured by the number of years since the foundation of the firm, because it is more likely that older firms had found it profitable sometime in the past to pay the sunk costs of entering foreign markets and therefore they still export, even if the actual conditions would have made unprofitable to enter at the moment of our data collection. Also in the case of age, our data show a significant degree of heterogeneity, ranging from 1 to 210, with an average of 22 and a coefficient of variation of 0.82.

Since firms close to full capacity utilization might be unable to increase production so as to service also foreign markets, we control for potential slackness, measured by the share of temporary employees on total employees and by a self-reported measure of output capacity, given by the ratio of actual production over maximum output possible if using all facilities available. The average values are 11% for the share of temporary employees and 73% for capacity utilization, with coefficients of variation of 2 and 0.29, respectively.

Finally, we control for a self-assessed measure of orientation towards the internal market, that is a dummy variable taking the value of one if the main market in which the firm sells its main product is national, and zero if it is international. In our sample, for 43% of firms this dummy takes the value of one.

An additional variable adopted in our Heckman specification (see Section 4) is the firm's perception about political stability of the local context in which it operates. This variable reports the answer to the following question: "As I list some factors that can affect the current operations of a business, please look at this card and tell me if you think that each factor is No Obstacle, a Minor Obstacle, a Moderate Obstacle, a Major Obstacle, or a Very Severe Obstacle to the current operations of this establishment". This indicator

ranges between 0 (no obstacle) and 4 (very severe obstacle) and shows an average over the whole sample of about 2, with a coefficient of variation of 0.73.

In addition to firm specific characteristics, we also collected information on the features of the countries where they are incorporated. Since our sample covers 65 developing and emerging countries, the degree of financial development is used to measure the heterogeneous impact of credit rationing on firm's exports. Specifically, we adopt a measure calculated as the ratio of the total assets of deposit money banks to GDP. In our sample, bank assets represent on average 35% of total GDP, with values ranging from 2.6% in the Democratic Republic of Congo to 84.5% in Brazil.

Panels 2 and 3 of Table 1 also show that firms that self-assess themselves as credit constrained are significantly different from those that are not constrained along many dimensions. First, consistent with our research hypothesis, only 22% of credit constrained firms are exporters, as opposed to 37% of those that are not constrained. Moreover, among those that export, credit constrained firms export on average 9% of their total sales, while unconstrained firms export 14%. In both cases, the difference is statistically significant at the 99% level. These differences in the export performance are nonetheless likely to be explained, at least in part, by other differences in firm-level characteristics. In fact, credit constrained firms also have a smaller number of employees (51 vs. 131) and are younger (20 vs. 23 years old), two characteristics that are typically related with a lower degree of internationalization. However, although constrained firms are smaller and younger, there is also evidence that they are in general less efficient. Moreover, they are less likely to be focused mainly on national markets (38% vs. 44%) and they have lower capacity utilization (71% vs. 73%). They also have a lower probability that their financial statement is certified by an external auditor (40% vs. 54%), while they are less likely to pay large share of input purchases after delivery, as it is shown by the fact that the dummy for firms in the third tercile of the distribution is 22%, as opposed to 36% for unconstrained firms. In addition, credit constrained firms are more likely to be located in less financially developed countries.

Table 2 presents the bilateral correlations. As expected, the coefficient of correlation between the two measures of export performance, the extensive and intensive margins, is positive, high (0.68) and statistically significant at the 5% level.

Table 2 – Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1)	export export	1														
(2)	export share	0.683*	1													
(3)	credit rationing	-0.136*	-0.090*	1												
(4)	number of employees	0.197*	0.168*	-0.080*	1											
(5)	labour productivity	0.004	-0.001	0.020*	0.002	1										
(6)	firm age	0.165*	0.028*	-0.091*	0.184*	0.008	1									
(7)	share of temporary workers	-0.002	-0.007	0.030*	-0.039*	-0.012	-0.023*	1								
(8)	share of skilled workers	-0.040*	0.057*	0.074*	0.007	0.023*	-0.084*	-0.062*	1							
(9)	competition in national market	0.036*	-0.182*	-0.050*	0.046*	-0.006	0.086*	-0.028*	-0.027*	1						
(10)	capacity utilization	0.056*	0.055*	-0.059*	0.071*	0.004	-0.021*	-0.052*	0.075*	0.047*	1					
(11)	balance-sheet certification	0.209*	0.132*	-0.118*	0.157*	0.006	0.157*	0.004	-0.094*	0.117*	0.052*	1				
(12)	payment after delivery (second tercile)	0.013	0.001	0.000	-0.001	-0.006	-0.013	0.008	0.005	0.050*	0.006	0.024*	1			
(13)	payment after delivery (third tercile)	0.133*	0.032*	-0.128*	0.047*	-0.003	0.147*	-0.018*	-0.142*	0.029*	-0.005	0.101*	-0.461*	1		
(14)	political instability	0.018*	0.031*	0.028*	0.008	-0.060*	0.022*	-0.014	-0.009	0.044*	-0.021*	0.044*	0.043*	-0.041*	1	
(15)	bank assets / GDP	0.004	-0.009	-0.130*	0.038*	-0.041*	0.057*	-0.069*	0.050*	0.069*	0.082*	0.036*	-0.016	0.133*	-0.126*	1

Note: * denotes significance at 0.05 level.

The dummy variable for firms that are credit constrained shows a negative and statistically significant correlation with the extensive and intensive margins of exports, respectively -0.14 and -0.09, confirming our expectations that financially constrained firms export less. Both export margins are also positively and significantly correlated with firm size (0.20 and 0.17, respectively), age (0.16 and 0.03, respectively). Labor productivity has a low (0.004 and -0.001) and statistically insignificant correlation with export performance. Concerning our instrumental variables, our measure of credit rationing is negatively and significantly correlated with the dummy indicating that the firm has a financial statement certified by an external auditor (-0.12) and with the dummy for firms that have a share of input purchases paid for after delivery in the largest tercile (-0.13).

As it was already clear from Table 1, credit rationing is also negatively correlated with firm size and age. But since these characteristics have also ben shown to have a direct impact on export performance, it is of paramount importance that we extend our analysis to a partial correlation framework, using appropriate econometric models. We will turn to this analysis in the coming sections.

4. The empirical methodology

The empirical methodology adopted in this paper follows Berman and Héricourt (2010) and Minetti and Zhu (2011). We first examine the effect of credit constraints on the extensive margin of exports, that is, the probability of exporting. Under the assumption that ε_{ikct} is a normally distributed random error with zero mean and unit variance, the probability that firm *i* of sector *k*, in country *c*, exports its products at time *t*, can be written as:

$$\Pr(Export_{ikct}=1)=\Pr(\alpha+\beta CR_{ikct}+\gamma Z_{ikct}+\nu_k+\lambda_c+\eta_t+\varepsilon_{ikct}>0)$$

$$=\Phi(\alpha+\beta CR_{ikct}+\gamma Z_{ikct}+\nu_k+\lambda_c+\eta_t) \quad (1)$$

In this specification, analyzing the extensive margin of exports, the dependent variable $Export_{ikct}$ equals one if the firm exports at time *t*, and zero otherwise. As argued above, our key explanatory variable, CR_{ikct}, is a binary variable that equals one if firm *i* is credit rationed and zero otherwise. We also control for a set of firm characteristics that may affect exports. The vector Z_{ikct} includes size, productivity, age, share of temporary and skilled workers, competition in national market and productive capacity. We also include three sets of fixed effects, to limit the problem of possible omitted variables: 1) ν_k, that captures time-invariant sector specific characteristics, such as differences in demand or supply elasticities related to product-specific characteristics; 2) λ_c, that captures any time-

invariant country-level characteristics that may impact on exports, such as regulations or other institutional features, or geographic and cultural characteristics; 3) η_t, that captures any time-specific shock affecting simultaneously all countries. As predicted by the literature discussed above, we expect $\beta_1 < 0$. We estimate equation (1) using three different econometric techniques. First, similar to Berman et al. (2012), we use a standard linear probability model (LPM), even if the dependent variable is binary. This methodology is attractive because it consistently estimates the parameters in the linear projection of the dependent variable on the explanatory variables (Wooldridge, 2010, p. 563). In a LPM, the probability of observing a zero or a one is treated as depending on one or more explanatory variables, whose coefficients are estimated using least squares. A drawback of this model is that the estimated coefficients can imply probabilities that lie outside the [0,1] interval. For this reason, in our second specification we use a probit model.

Next, we move to the instrumental variables estimates, instrumenting our measure of credit rationing with the dummy for firms that have a certified balance sheet and the two dummies for firms that have a larger share of late input payments. However, since in this case the problems with the LPM would occur twice, because the estimated coefficients of both regressions for the probability of exporting and of being credit rationed might imply predictions that lie outside the [0,1] interval, we follow the methodology of Minetti and Zhu (2011). Assuming that μ_{ikct} is a normally distributed random error with zero mean and unit variance, the probability that a firm is credit rationed can be estimated using the following binary choice model:

$$\Pr(CR_{ikct} = 1) = \Pr(\delta I_{ikct} + \lambda Z_{ikct} + \psi_k + \tau_c + \varsigma_t + \mu_{ikct} > 0)$$

$$= \Phi(\delta I_{ikct} + \lambda Z_{ikct} + \psi_k + \tau_c + \varsigma_t) \qquad (2)$$

where I_{ikct} is a set of instrumental variables that capture exogenous restrictions on the availability of credit to firm i of sector k, in country c, at time t, and Z_{ikct} is the same vector of exogenous variables of equation (1). Equations (1) and (2) can then be estimated using a recursive bivariate probit model, in which the potential endogeneity of credit rationing with respect to the export status is controlled for allowing for the error terms ε_{ikct} and μ_{ikct} to be correlated. The recursive structure of the model is guaranteed by the fact that the set of instruments I_{ikct} are excluded from equation (1).

The impact of credit rationing on the intensive margin of exports is estimated using a companion specification, in which the dependent variable y_{ikct} is the share of direct and indirect exports over total sales:

$$y_{ikct} = \alpha_1 + \beta_1 CR_{ikct} + \gamma_1 Z_{ikct} + v_k + \lambda_c + \eta_t + \varepsilon_{ikct} \quad (3)$$

All other variables are defined as above. Also equation (2) is estimated using four econometric techniques. First, a standard linear model. Second, a tobit model, that accounts for the fact that the dependent variable is a doubly censored random variable, with values limited between zero and one. Third, to tackle the problem that credit rationing is potentially endogenous with respect to the share of exports over total sales, we use also in this case an instrumental variables approach. Since our dependent variable is in this case continuous, we estimate a standard linear two-stages least-squares (2SLS) model, in which the probability that a firm is credit rationed is instrumented with the predicted probabilities obtained from the first stage estimates of equation (2).

As an additional result, in a fourth specification, we estimate a Heckman correction model to separately account for the cases in which a firm does not export at all. In this way, we transform the selection bias problem into an omitted variable problem, which can be solved by including an additional variable: the inverse Mills ratio obtained from the probit estimates of the probability of being an exporter. In the Heckman model, the extensive margin is represented by the probability of exporting. Accordingly, we estimate the impact of the independent variables included in equation (1) on a binary variable that is equal to 1 if a firm exports in a given year and 0 otherwise. In the second step (intensive margin), we estimate equation (3) on a reduced sample of observations, excluding all cases in which a firm does not export and including among the independent variables the inverse Mills ratio from the first stage. In the Heckman model, identification of the first stage is obtained by the exclusion of the measure of political stability in the country from the second-stage specification.

5. Baseline results

a. The extensive margin of exports

Results of the baseline specification for the extensive margin of exports, obtained estimating equation (1), are presented in Table 3. The sample includes 19,368 observations.

Table 3 – Extensive margin of exports and credit rationing

Model	(1) **LPM**	(2) **Probit**	(3) **Bivariate probit** **First stage**	(4) **Second stage**
credit rationing	-0.025 **	-0.025 ***		-0.097 ***
	(0.01)	(0.01)		(0.03)
number of employees	0.138 ***	0.124 ***	-0.036 ***	0.121 ***
	(0.01)	(0.00)	(0.00)	(0.00)
labour productivity	0.029 ***	0.030 ***	-0.013 ***	0.028 ***
	(0.00)	(0.00)	(0.00)	(0.00)
firm age	-0.002	-0.001	-0.013 ***	-0.002
	(0.01)	(0.01)	(0.00)	(0.01)
share of temporary workers	0.096 **	0.103 **	0.004	0.102 **
	(0.04)	(0.04)	(0.01)	(0.04)
share of skilled workers	-0.013	-0.019	0.055 ***	-0.013
	(0.01)	(0.01)	(0.01)	(0.01)
competition in national market	-0.045 **	-0.033 *	0.003	-0.032 *
	(0.02)	(0.02)	(0.01)	(0.02)
capacity utilization	0.009	0.005	-0.091 ***	-0.002
	(0.02)	(0.02)	(0.01)	(0.02)
balance-sheet certification			-0.049 ***	
			(0.00)	
payment after delivery (second tercile)			0.001	
			(0.01)	
payment after delivery (third tercile)			-0.033 ***	
			(0.01)	
Observations	19,368	19,368	19,368	
R^2	0.28	0.25		

Note: The table reports the estimates of equation (1). Column 1 reports the coefficients obtained using the linear probability model. Column 2 reports the marginal effects obtained using the probit model. Columns 3 and 4 report the marginal effects of the bivariate probit where the first stage has as dependent variable the dummy for credit rationing and the second stage has as dependent variable the dummy for exports. Fixed effects for sector, country and year are included in all regressions. Robust standard errors are clustered by sectors and reported in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 levels.

The results obtained estimating an LPM, reported in Column 1, confirm the hypothesis that financial conditions impact on firms' export behavior: our main variable of interest, the dummy that equals one for firms that are credit constrained, has a negative coefficient of -0.025, that is statistically significant at the 5% level. Since LPM is a linear model, the coefficient provides a direct measure of the impact of the dependent variable on the probability that the firm is an exporter: a credit constrained firm is 2.5% less likely to be an exporter than a non-credit-constrained firm. Compared with the unconditional probability that a firm in our sample is an exporter, that is 33.2%, credit constraints have therefore an impact of about 7.5%. This is a sizeable economic impact, considering that it is conditional on all other firm characteristics included as controls in our specification.

The results reported in Column 1 also confirm the main findings of the literature on the determinants of firm exports: firms that export are larger, as shown by the coefficient of +0.138 of the number of full-time employees, which is statistically significant at the 1% level, and they have a higher labor productivity, as shown by the coefficient of +0.029, also significant at the 1% level. We also find evidence that exporters have a larger share of temporary workers (0.096, statistically significant at the 5% level), suggesting that for the firms operating in emerging and developing countries included in our sample, lower labor costs are a crucial component of competitiveness. They are also less oriented to the domestic market, as shown by the coefficient of -0.045, statistically significant at the 5% level, of the dummy for firms that declare that the main market in which the firm sells its most important product is national. The effect of the age of the firm, of its degree of capacity utilization, and of the share of skilled workers in its labor force is instead statistically insignificant.

Column 2 reports the results obtained estimating equation (1) with a probit model. Since in this case the estimated coefficients do not provide a direct measure of the impact of the dependent variable on the probability that the firm is an exporter, we report the marginal effects of each explanatory variable. Probit models are more efficient than LPM models, since they account for the fact that predicted probabilities cannot be outside the [0,1] interval, but they are also less robust to misspecification. Reassuringly, the results of Column 2 are broadly identical to those of Column 1. In particular, the marginal effect of the dummy for credit-constrained firms is -0.025, the same value obtained with the LPM model, and it is statistically significant at the 1% level. In addition, all other marginal effects are extremely similar to the coefficients estimated with the LPM and have comparable statistical significance.

Also the R^2s, 0.28 for the LPM and 0.25 for the probit, are similar in the two specifications. They are also relatively high values for a cross-section specification, even if we consider that we include sector, country and year fixed effects.

Next, we have estimated the probability that a firm is credit rationed as a function of all the explanatory variables included in equation (1), and of three additional variables that impact on credit rationing but not on the probability of exporting: a dummy for firms that have their balance-sheet certified by an external auditor and two dummies for the firms that are in the second and third tercile of the distribution of the share of delayed payments. We have then run a Durbin-Wu-Hausman augmented regression test including the residuals of this regression as an additional explanatory variable in our LPM and probit models. In both cases, the coefficient of the residuals was statistically significant, indicating that we cannot exclude the hypothesis that our one-stage estimates were inconsistent.[3]

In Columns 3 and 4 we then present the results of the estimation of the bivariate probit model, that accounts for the potential reverse causation of credit constraints with respect to the export status.

Column 3 reports the marginal effects of the estimation of equation (2) on the probability that a firm is credit constrained, that can be interpreted as our first stage regression within the two stages approach necessary to control for potential endogeneity of credit constraints with respect to the export status. For our purposes, what is most relevant in this model is the statistical significance of the three variables that are excluded from equation (1) and therefore allow for the identification of equation (2). Reassuringly, the marginal effect of the dummy for firms that have their balance-sheet certified by an external auditor is -0,049, and it is statistically significant at the 1% level. Similarly, the marginal effect of the dummy for the firms that are in the third tercile of the distribution of the share of delayed payments is -0.033, and it is statistically significant at the 1% level. On the contrary, the marginal effect of the dummy for the firms in the second tercile of the distribution of the share of delayed payments is very small and statistically insignificant. Reassuringly, the *F*-test for joint significance of the three variables excluded from equation (1) is 117.86, implying that they are jointly statistically significant at the 1% level.

Consistent with the literature, Column 3 also shows that smaller, less productive, and younger firms are more likely to be credit constrained. A lower degree of capacity utilization also increases the probability that a firm is credit constrained, possibly because unused productive capacity is a signal that the sales are stagnating. The positive marginal effect of the share of skilled workers over total labor force is probably due to the fact that these firms typically have a higher share of intangible assets, such as goodwill and R&D

[3] Results of the endogeneity tests are available on request.

knowledge, that are very firm-specific and therefore provide little collateral for an external investor.

Column 4 reports the estimates of equation (1), on the probability that a firm is an exporter. The dummy that equals one for firms that are credit constrained has a negative marginal effect of -0.097, statistically significant at the 1% level. The bias induced by potential reverse causation is therefore positive, reducing the marginal effect estimated with the LPM and the probit model. This is consistent with the fact that the effect of being an exporter on the probability of being credit rationed is likely to be negative, since exporters have in general better economic perspectives than firms that focus only on the domestic market. Omitting to include in the estimation of equation (1) a measure of this better perspectives causes therefore a positive omitted variable bias on the estimate of the marginal effect of credit constraints. Interestingly, the estimated marginal effects of all other control variables included in equation (1) have the same sign and comparable magnitude and statistical significance as those obtained from the LPM and the probit model.

The estimates based on the bivariate probit specification give therefore the reassuring result that not only credit rationing reduces the probability that a firm is an exporter, but that the marginal effect is larger than what obtained from the previous estimates. Recalling that the unconditional probability that a firm in our sample is an exporter is 33.2%, the marginal effect of credit constraints estimated controlling for the effect of reverse causation are just below 30%. This is indeed a sizeable economic impact.

In synthesis, the results of the estimates of the effect of credit constraints on the extensive margin of exports provide robust and convincing evidence that it is statistically and economically significant. We now turn to the impact on the intensive margin of exports.

b. The intensive margin of exports and credit rationing

The results of the baseline specification for the intensive margin of exports, obtained estimating equation (3), are presented in Table 4. The sample includes in this case between 19,033 and 19,368 observations, depending on the specifications.

Column 1 reports the results obtained estimating a standard OLS. Also in this case, the hypothesis that financial conditions impact on firms' export quantity is confirmed: our main variable of interest, the dummy that equals one for firms that are credit constrained, has a negative coefficient of -0.009, that is statistically significant at the 10% level. A credit constrained firm therefore exports 1% less than a non-credit-constrained firm. Compared with the unconditional mean of the export share, that is 13%, credit constraints have therefore an impact of about 8%, that also in this case is no negligible.

Table 4 – Intensive margin of exports and credit rationing

Model	(1) **OLS**		(2) **Tobit**		(3) **2SLS First stage**		(4) **Second stage**		(5) **Heckman two step First stage**		(6) **Second stage**	
credit rationing	-0.009	*	-0.012	**			-0.151	**			-0.154	*
	(0.01)		(0.01)				(0.06)				(0.10)	
number of employees	0.071	***	0.059	***	-0.037	***	0.065	***	0.007	***	0.055	***
	(0.01)		(0.00)		(0.00)		(0.01)		(0.00)		(0.01)	
labour productivity	0.011	***	0.013	***	-0.014	***	0.008	***	0.119	***	0.009	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
firm age	-0.027	***	-0.014	***	-0.013	***	-0.029	***	0.027		-0.053	***
	(0.01)		(0.00)		(0.00)		(0.01)		(0.00)		(0.01)	
share of temporary workers	0.047	*	0.049	**	0.004		0.047	*	-0.001	**	0.064	***
	(0.03)		(0.02)		(0.01)		(0.03)		(0.01)		(0.02)	
share of skilled workers	0.023	**	0.000		0.055	***	0.033	***	0.100		0.087	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.04)		(0.01)	
national competition	-0.131	***	-0.063	***	0.003		-0.131	***	-0.015	**	-0.281	***
	(0.02)		(0.01)		(0.01)		(0.02)		(0.01)		(0.01)	
capacity utilization	0.000		-0.002		-0.092	***	-0.013		-0.037		-0.030	*
	(0.01)		(0.01)		(0.01)		(0.01)		(0.02)		(0.02)	
balance-sheet certification					-0.046	***			0.009	***		
					(0.00)				(0.02)			
payment after delivery (second tercile)					0.003				0.042	***		
					(0.01)				(0.01)			
payment after delivery (third tercile)					-0.031	***			0.028	***		
					(0.01)				(0.01)			
political instability									0.034	***		
									(0.01)			
Mills ratio											0.133	***
											(0.03)	
Observations	19,368		19,368		19,346				19,033		6,314	
R^2	0.28		0.23		0.15				0.25		0.18	

Note: The table reports the estimates of equation (3). Column 1 reports the coefficients obtained using the OLS model. Column 2 reports the marginal effects obtained using the tobit model. Column 3 reports the marginal effects of the probit model estimated on the dummy for credit rationing and column 4 reports the coefficients obtained estimating a linear two-stages least-squares model on the share of exports, where credit rationing is instrumented using the predicted probability from the first stage. Column 5 reports marginal effects of the probit model estimated on the dummy for exports. Column 6 reports two-stage least-squares estimates on the subsample of exporting firms, where credit rationing is instrumented using the predicted probability from the first stage reported in column 3. Fixed effects for sector, country and year are included in all regressions. Robust standard errors are clustered by sectors and reported in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 levels.

The results reported in Column 1 broadly confirm also the findings on the impact of the other determinants on the intensive margin of exports: firms with a larger share of exports are larger, as shown by the coefficient of +0.071 of the number of full-time employees, which is statistically significant at the 1% level, have a higher labor productivity, as shown by the coefficient of +0.011, also significant at the 1% level, have a larger share of temporary workers (+0.047, statistically significant at the 10% level), and that they are less oriented to domestic market, as shown by the coefficient of -0.131, statistically significant at the 1% level, of the dummy for firms that declare that the main market in which the firm sells its most important product is national. In addition, we find a statistically significant effect also of the share of skilled workers (+0.023), and of the age of the firm, as shown by the coefficient of -0.027, which is statistically significant at the 1% level. This last result suggests that, controlling for age, younger firms tend to be more international than older firms, possibly because the latter have a more consolidated position in the national market.

Column 2 reports the results obtained estimating equation (3) with a tobit model, that accounts for the fact that our dependent variable, the share of exports over total sales, is bounded by construction within the [0,1] interval. Since also in this case the estimated coefficients do not provide a direct measure of the impact of the dependent variable on the probability that the firm is an exporter, Column 2 reports the marginal effects of each explanatory variable. As in the case of probit models as opposed to LPM, tobit models are more efficient than OLS, but they are also less robust to misspecification. Reassuringly, as in the case of the extensive margin, results of Column 2 are broadly identical to those of Column 1. In particular, the marginal effect of the dummy for credit-constrained firms is -0.012, slightly larger than what obtained with the OLS, and it is statistically significant at the 5% level. The impact of the age of the firm and of the dummy for firms that focus mostly on the national market estimated using the tobit specification is about half that obtained with OLS, and that of the share of skilled workers vanishes, both statistically and economically. The R^2s, 0.28 for the OLS and 0.23 for the tobit, are also broadly similar in the two specifications.

Next, as for the extensive margin, we have run a a Durbin-Wu-Hausman augmented regression test including the residuals of the regression of the probability that a firm is credit-rationed regression as an additional explanatory variable in our OLS and tobit models. In both cases, the coefficient of the residuals was statistically significant, indicating that we cannot exclude the hypothesis that our one-stage estimates are inconsistent.[4] As before, we therefore turned to IV-estimates.

[4] Results of the endogeneity tests are available on request.

Columns 3 and 4 present the results of the estimation of an IV-linear model in which the dummy for firms that are credit-rationed is instrumented using the same variables as for the extensive margin. The reason why we estimate an IV-linear model instead of an IV-tobit model is that our instrumented variable is discrete, and therefore the IV-tobit specification cannot be applied. Following the standard procedure suggested by Angrist and Pischke (2009) and Wooldridge (2010), we have used the predicted values of the estimates of equation (2), presented in Column 3, as an instrument for the dummy for credit-constrained firms in equation (3).

Column 3 reports the marginal effects of the estimation of equation (2), on the probability that a firm is credit constrained, that we have then used to construct the predicted values, used in turn as the instrument for the two-stages estimation of equation (3). As expected, the estimates replicate those of the bivariate probit model, reported in Column 3 of Table 3. Reassuringly, the coefficient of the predicted values obtained from the probit model in the first stage estimation of equation (2) is statistically significant at the 1% level.

Not surprisingly, also in the case of the intensive margin of exports, the impact of credit rationing estimated using an instrumental variable framework is much larger than that obtained without accounting for the role of endogeneity due to possible reverse causation. As reported in Column 4, the coefficient of the dummy for credit-rationed firm is -0.151, about one order of magnitude larger than that estimated with OLS and tobit, and it is statistically significant at the 5% level. Firms that are not credit-rationed export therefore twice the amount of their total sales than firms that are rationed. Interestingly, the coefficients of all other explanatory variables are broadly in line with those obtained with the OLS model.

Finally, Columns 5 and 6 present the results of a Heckman two-step estimation of equation (3) on the subsample of actual exporters, instrumenting the dummy for credit-constrained firms as in the case of the specification presented in Column 4, and controlling for the potential effect of the sample selection bias induced by excluding non-exporters. Following Minetti and Zhu (2011), to improve on the identification of the equations for the two stages, that otherwise would hinge only on the non-linearity of the first-stage probit estimates with respect to the linear second stage, we include in the first stage estimates a measure of the degree of political instability of the exporting country. The first stage estimates of the probability of being an exporter, reported in Column 5, show that its marginal effect is positive and statistically significant at the 1% level. All other estimated marginal effects are very similar to those presented in Column 2 of Table 3.

Column 6 shows that the estimated impact of credit rationing is in this case very close to that obtained with the IV-linear model, with a coefficient of the dummy for credit-

rationed firm of -0.154, statistically significant at the 10% level. Since the average share of exported sales for exporting firms is about 40%, the effect of removing the credit constraints for these firms would be to increase their export share of about 38%, again an economically significant impact.

The results in Column 6 also confirm by and large the findings on the impact of the other determinants on the intensive margin exports: firms with a larger share of exports are larger, have a higher labor productivity, and have a larger share of temporary workers. The estimated coefficients of the other control variables – the age of the firm, the dummy for firms that declare that the main market in which the firm sells its most important product is national, and the share of skilled workers – have the same sign as in the previous specifications, but their absolute value is about twice as large.

Overall, also the results of the estimates of the effect of credit constraints on the intensive margin of exports provide robust and convincing evidence that it is statistically and economically significant. In the following, we will present the results of a number of additional robustness checks.

6. Additional results on subsamples

Our baseline results provide strong evidence that credit constraints hinder the ability of firms to export. However, the average estimated effects might differ depending on other characteristics of the firms or of the countries where they are based. To analyze these aspects, we have run two additional regressions on subsamples of firms or countries. While we have estimated all the specifications presented above for each subsample, to economize on space in the following we will present and comment only the results obtained with our preferred specification, that is the bivariate probit model for the extensive margin and the IV-linear model for the intensive margin.

The first sample split that we consider is by firm size. The rationale for this exercise is that larger firms are more likely to export, and they are less likely to be credit constrained. It may therefore be the case that the impact of credit-constraints on their export behavior is different than that on smaller firms. We therefore split the sample along the median value of the number of full-time workers, which implies a definition of small-medium firms as those with less than 30 full-time workers. This allows to split our overall sample broadly into two comparable sub-samples of, respectively, 9,774 and 9,594 observations.

Table 5 – Sample split by firm size

Model	(1) *extensive margin* **small-medium firms** **Bivariate probit** **Second stage**		(2) **large firms** **Bivariate probit** **Second stage**		(3) χ^2		(4) *intensive margin* **small-medium firms** **2SLS** **Second stage**		(5) **large firms** **2SLS** **Second stage**		(6) χ^2	
credit rationing	-0.188	***	-0.099		6.270	**	-0.229	***	-0.230	*	1.880	
	(0.04)		(0.09)				(0.04)		(0.14)			
number of employees	0.061	***	0.127	***	8.050	***	0.023	***	0.063	***	21.020	***
	(0.01)		(0.00)				(0.01)		(0.01)			
labour productivity	0.015	***	0.037	***	2.740	*	0.004	*	0.011	***	1.750	
	(0.00)		(0.01)				(0.00)		(0.00)			
firm age	-0.006		0.005		0.050		-0.011	***	-0.037	***	24.850	***
	(0.01)		(0.01)				(0.00)		(0.01)			
share of temporary workers	0.061	***	0.167	**	7.260	***	0.037	***	0.068		2.150	
	(0.02)		(0.08)				(0.01)		(0.06)			
share of skilled workers	-0.011		-0.002		4.250	**	0.010		0.068	***	16.030	***
	(0.02)		(0.02)				(0.01)		(0.01)			
competition in national market	0.007		-0.073	***	11.790	***	-0.044	***	-0.192	***	303.940	***
	(0.01)		(0.02)				(0.01)		(0.02)			
capacity utilization	-0.023	*	-0.015		3.110	*	-0.035	***	-0.019		0.040	
	(0.01)		(0.03)				(0.01)		(0.02)			
balance-sheet certification					1.960						1.750	
payment after delivery (second tercile)					0.510						0.270	
payment after delivery (third tercile)					0.260						1.600	
Observations	9,774		9,594				9,680		9,491			

Note: The table reports the estimates of equations (1) and (3) on sub-samples of firms by size. Column 1 and 2 report the marginal effects obtained using the bivariate probit model on the dummy for exports. Column 4 and 5 report the coefficients obtained using the linear two-stages least-squares model on the share of exports, where credit rationing is instrumented using the predicted probability from the first stage regression (not reported). Small-medium firms are those with less than 30 full-time workers, and large firms all the others. Columns 3 and 6 report the test on whether the coefficients of covariates are equal in the two sub-samples. Fixed effects for sector, country and year are included in all regressions. Robust standard errors are clustered by sectors and reported in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 levels.

Column 1 of Table 5 presents the results of the estimates of equation (1) with the bivariate probit model on the sample of small-medium firms. The marginal effect of -0.188, statistically significant at the 1% level, confirms that credit constraints have a strong negative effect on the probability that a small firm is an exporter. On the contrary, the smaller and statistically insignificant coefficient of -0.099 reported in Column 2, shows that in the case of large firms the effect of credit constraints is smaller and estimated with less precision. Also the other determinants of the probability that a firm is an exporter have different marginal effects for medium-small firms and for large firms, as confirmed by the tests reported in Column 3.

Columns 4 and 5 report the IV-linear estimates of equation (3) for the intensive margin on the two subsamples. Interestingly, the impact of credit constraints on the intensive margin of exports is similar for all firms. Although the estimates are less precise in the case of large firms, the marginal effect is nearly identical: -0.229 for medium-small firms and -0.230 for large firms. Contrary to the impact of credit constraints, nearly all other determinants of the share of exported sales have different marginal effects for medium-small firms and for large firms, as confirmed also by the test reported in Column 6.

Overall, while these results are consistent with the large evidence that financing obstacles are more relevant for small firms, they show that this issue is only relevant at the moment of deciding whether to export, the extensive margin, but it does not affect the share of sales that are sold in foreign markets (i.e, the intensive margin).

The second sample split refers to the development of the financial system of the countries where the firms are located. Following the literature, we use the ratio of the total assets of deposit money banks to GDP as an index of financial development. While this is a rather crude index, it has been shown to be a good proxy of the overall degree of financial development, especially among developing and emerging nations, and it is available for a larger sample of countries than other more refined indices. The justification of this sample split is that credit constraints should be less relevant in countries where the financial system is on average more developed. The results reported in Table 6 strongly confirms this hypothesis. Column 1 shows that for the 8,955 firms located in countries where the ratio of bank assets to GDP is below the median, the marginal effect of being credit-rationed on the probability of being an exporter (i.e., the extensive margin) is -0.192, and it is statistically significant at the 1% level. For the 10,274 firms located in countries with more developed financial markets, Column 2 shows the marginal effect is -0.066 and it is not statistically significant. Similar differences, all statistically significant (Column 3) are found also in the effects of the other determinants of firms' export decisions. Columns 4-6 present the results for the intensive margin.

Table 6 – Sample split by financial development

	(1)		(2)		(3)		(4)		(5)		(6)	
	extensive margin						*intensive margin*					
Model	**Low bank assets/GDP Bivariate probit Second stage**		**High bank assets/GDP Bivariate probit Second stage**		χ^2		**Low bank assets/GDP IV LPM Second stage**		**High bank assets/GDP IV LPM Second stage**		χ^2	
credit rationing	-0.192	***	-0.066		4.040	**	-0.102	**	-0.176		0.010	
	(0.03)		(0.05)				(0.05)		(0.12)			
number of employees	0.103	***	0.129	***	12.550	***	0.059	***	0.069	***	5.790	**
	(0.00)		(0.01)				(0.01)		(0.01)			
labour productivity	0.033	***	0.030	***	3.450	*	0.013	***	0.010	***	0.180	
	(0.01)		(0.01)				(0.00)		(0.00)			
firm age	-0.003		0.000		0.200		-0.024	***	-0.032	***	2.580	*
	(0.00)		(0.01)				(0.00)		(0.01)			
share of temporary workers	0.105	**	0.088	**	0.000		0.058	**	0.033		0.980	
	(0.04)		(0.04)				(0.02)		(0.03)			
share of skilled workers	0.018		-0.036	*	5.780	**	0.032	***	0.034	***	0.060	
	(0.02)		(0.02)				(0.01)		(0.01)			
competition in national market	-0.027	**	-0.040		0.130		-0.113	***	-0.148	***	14.820	***
	(0.01)		(0.03)				(0.01)		(0.02)			
capacity utilization	-0.002		-0.011		2.590	*	-0.007		-0.015		0.400	
	(0.03)		(0.01)				(0.02)		(0.01)			
balance-sheet certification					10.100	***					6.180	**
payment after delivery (second tercile)					0.090						0.340	
payment after delivery (third tercile)					0.320						0.070	
Observations	8,955		10,274				8,953		10,252			

Note: The table reports the estimates of equations (1) and (3) on sub-samples of countries by financial development. Column 1 and 2 report the marginal effects obtained using the bivariate probit model on the dummy for exports. Column 4 and 5 report the coefficients obtained using the linear two-stages least-squares model on the share of exports, where credit rationing is instrumented using the predicted probability from the first stage regression (not reported). Low deposit/GDP countries are those with a share less than 32%, and high deposit/GDP all the others. Columns 3 and 6 report the test on whether the coefficients of covariates are equal in the two sub-samples. Fixed effects for sector, country and year are included in all regressions. Robust standard errors are clustered by sectors and reported in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 levels.

Interestingly, in this case the coefficient of the dummy for credit-rationed firms located in countries that are more financially developed is larger than that for firms located in less developed countries. However, the former is estimated rather imprecisely and therefore it is not statistically significant, while the latter is precisely estimated, and it is statistically significant at the 5% level.

7. Conclusions

We have analyzed the impact of credit constraints on export behavior in a large sample of firms from 25 countries, finding evidence of a negative effect on both the probability that a firm exports (i.e., the extensive margin of exports) and the share of exports over total sales (i.e., the intensive margin of exports).

While confirming the results of the previous literature, notably the seminal paper by Berman and Héricourt (2010), our analysis provides three original contributions. First, it adopts a measure of credit constraints provided by each firm's self-assessment of its conditions. Second, it uses a larger and more heterogeneous sample than previous studies, including over 19,000 firms from 65 different countries. Third, it addresses thoroughly the potential endogeneity problems of the relationship between credit constraints and exports, adopting an instrumental variable approach with firm-level instruments.

The results show that credit constraints have a significant and sizeable effect on firms' export performance, even controlling for other firm-specific characteristics and possible reverse causality. Sound economic policies helping firm's access to credit can therefore prove beneficial not just for investment and R&D, as shown by Gorodnichenko and Schnitzer (2013), but also provide an important contribution to a country's export performance.

References

Angrist, J., and Pischke, J.S. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton, N.J.: Princeton University Press.

Bartoli, F., Ferri, G., Murro, P., & Rotondi, Z. (2014). Bank support and export: evidence from small Italian firms. *Small Business Economics*, 42(2), 245-264.

Becchetti, L., & Trovato, G. (2002). The determinants of growth for small and medium sized firms. The role of the availability of external finance. *Small Business Economics*, 19(4), 291-306.

Beck, T. (2002). Financial development and international trade: Is there a link?. *Journal of international Economics*, *57*(1), 107-131.

Becker, B., Chen, J., & Greenberg, D. (2012). Financial development, fixed costs, and international trade. *The Review of Corporate Finance Studies*, *2*(1), 1-28.

Bellone, F., Musso, P., Nesta, L., & Schiavo, S. (2010). Financial constraints and firm export behaviour. *The World Economy*, 33(3), 347-373.

Berger, A. N., & Udell, G. F. (2006). A more complete conceptual framework for SME finance. *Journal of Banking & Finance*, *30*(11), 2945-2966.

Berman, N., & Héricourt, J. (2010). Financial factors and the margins of trade: Evidence from cross-country firm-level data. *Journal of Development Economics*, 93(2), 206-217.

Berman, N., Martin, P., & Mayer, T. (2012). How do different exporters react to exchange rate changes?. *The Quarterly Journal of Economics*, 127(1), 437-492.

Buch, C.M., Kesternich, I., Lipponer, A., & Schnitzer, M. (2010). Exports versus FDI revisited: does finance matter? Bundesbank Series 1 Discussion Paper No. 2010,03. Available at SSRN: https://ssrn.com/abstract=2785367

Chaney, T. (2016). Liquidity constrained exporters. *Journal of Economic Dynamics and Control*, 72, 141-154.

Egger, P. H., & Kesina, M. (2014). Financial Constraints and the Extensive and Intensive Margin of Firm Exports: Panel Data Evidence from China. *Review of Development Economics*, 18(4), 625-639.

Fauceglia, D. (2015). Credit constraints, firm exports and financial development: Evidence from developing countries. *The Quarterly Review of Economics and Finance*, 55, 53-66.

Fazzari, S. M., Hubbard, R. G., Petersen, B. C., Blinder, A. S., & Poterba, J. M. (1988). Financing constraints and corporate investment. *Brookings papers on economic activity*, 1988(1), 141-206.

Feenstra, R. C., Li, Z., & Yu, M. (2014). Exports and credit constraints under incomplete information: Theory and evidence from China. *Review of Economics and Statistics*, 96(4), 729-744.

Gashi, P., Hashi, I., & Pugh, G. (2014). Export behaviour of SMEs in transition countries. *Small Business Economics*, 42(2), 407-435.

Gorodnichenko, Y., & Schnitzer, M. (2013). Financial constraints and innovation: Why poor countries don't catch up. *Journal of the European Economic Association*, 11(5), 1115-1152.

Greenaway, D., Guariglia, A., & Kneller, R. (2007). Financial factors and exporting decisions. *Journal of international economics*, 73(2), 377-395.

Guiso, L., Sapienza, P., & Zingales, L. (2004). Does local financial development matter? *Quarterly Journal of Economics,* 119, 929–969.

Jappelli, T. (1990). Who is credit constrained in the US economy? *Quarterly Journal of Economics*, 105, 219-234.

Jinjarak, Y., & Wignaraja, G. (2016). An Empirical Assessment of the Export—Financial Constraint Relationship: How Different are Small and Medium Enterprises?. *World Development*, 79, 152-163.

Kaplan, S. N., & Zingales, L. (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints?. *The quarterly journal of economics*, *112*(1), 169-215.

Kletzer, K., & Bardhan, P. (1987). Credit markets and patterns of international trade. *Journal of Development Economics*, *27*(1-2), 57-70.

Levenson, A. R., & Willard, K. L. (2000). Do firms get the financing they want? Measuring credit rationing experienced by small businesses in the US. Small Business Economics, 14(2), 83-94.

Manova, K. (2008). Credit constraints, equity market liberalizations and international trade. *Journal of International Economics*, 76(1), 33-47.

Manova, K. (2012). Credit constraints, heterogeneous firms, and international trade. *Review of Economic Studies*, 80(2), 711-744.

Manova, K., Wei, S. J., & Zhang, Z. (2015). Firm exports and multinational activity under credit constraints. *Review of Economics and Statistics*, 97(3), 574-588.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71(6), 1695-1725.

Minetti, R., & Zhu, S. C. (2011). Credit constraints and firm export: Microeconomic evidence from Italy. *Journal of International Economics*, 83(2), 109-125.

Minetti, R., Murro, P., Rotondi, Z., & Zhu, S. C. (2017). Financial constraints, firms' supply chains and internationalization. CERBE Working Paper n. 6 (September 2017). Available at http://repec.lumsa.it/wp/wpC06.pdf

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, 48(3), 261-297.

Mol-Gómez-Vázquez, A., Hernández-Cánovas, G., & Koëter-Kant, J. (2018). Bank market power and the intensity of borrower discouragement: analysis of SMEs across developed and developing European countries. *Small Business Economics*, 1-15.

Musso, P. and S. Schiavo (2008), The impact of financial constraints on firm survival and growth, *Journal of Evolutionary Economics*, 18, 2, 135–49.

Rajan, R. G., & Zingales, L. (1998). Power in a Theory of the Firm. *The Quarterly Journal of Economics*, 113(2), 387-432.

Secchi, A., Tamagni, F., & Tomasi, C. (2016). Financial constraints and firm exports: accounting for heterogeneity, self-selection, and endogeneity. *Industrial and Corporate Change*, 25(5), 813-827.

Silva, A. (2011). Financial constraints and exports: evidence from Portuguese manufacturing firms. *International Journal of Economic Sciences & Applied Research*, *4*(3).

Stiebale, J. (2011). Do Financial Constraints Matter for Foreign Market Entry? A Firm-level Examination. *The World Economy*, 34(1), 123-153.

Wagner, J. (1995). Exports, firm size, and firm dynamics. *Small Business Economics*, *7*(1), 29-39.

Wagner, J. (2014). Credit constraints and exports: evidence for German manufacturing enterprises. *Applied Economics*, 46(3), 294-302.

Wang, X. (2016). Financial constraints and exports (January 27, 2016). Available at SSRN: https://ssrn.com/abstract=2698358 or http://dx.doi.org/10.2139/ssrn.2698358

Welch, B.L. (1947). The generalization of 'student's' problem when several different population variances are involved. *Biometrika*, 34(1-2), 28–35.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.