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Credit constraints and firm export: Microeconomic evidence from Italy☆

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ABSTRACT

This paper estimates the impact of credit rationing on firms' export. We use detailed survey data from Italian manufacturing firms that provide a firm-specific measure of credit rationing based directly on firms' responses to the survey rather than indirectly on firms' financial statements. After controlling for productivity and other relevant firm attributes, and accounting for the endogeneity of credit rationing, we find that the probability of exporting is 39% lower for rationed firms and that rationing reduces foreign sales by more than 38%. While credit rationing also appears to depress domestic sales, its impact on foreign sales is significantly stronger. The analysis also suggests that credit rationing is an obstacle to export especially for firms operating in high-tech industries and in industries that heavily rely on external finance.

1. Introduction

The ability of a country and its businesses to grow is tightly related to the possibility of exporting and penetrating into foreign markets. Indeed, policy-makers debate intensely on the policies that can encourage the expansion of firms beyond national borders. However, such an expansion encounters several challenges. Exporting involves higher entry costs than selling to the domestic market: firms need to acquire information about foreign markets, customize products to fit local tastes and set up distribution networks. Das et al. (2007) estimate that for Colombian exporters average entry costs range from 344,000 to 430,000 U.S. dollars. Furthermore, because most entry costs must be paid up front, only firms with sufficient liquidity can cover them. These features render financial markets crucial for firms' export activity. In particular, when liquidity constraints plague financial markets, whether a firm is constrained or not may influence the firm's decision to sell abroad and the volume of foreign sales. While a growing literature has recently formalized these arguments theoretically (see, e.g., Manova, 2010, and Chaney, 2005), probably because of a dearth of data, the micro-level evidence on this issue remains scant.

The objective of this paper is to help fill this gap using detailed microeconomic data on a large sample of Italian firms. The main source of information for our analysis is a survey conducted by the Italian banking group Capitalia in 2001. The survey constitutes an ideal testing ground for three main reasons. First, it provides unusually detailed information not only on firms' export participation decisions and foreign sales but also on the constraints that firms face in the credit market. Indeed, our measure of credit rationing is taken directly from firms' responses to the survey rather than indirectly inferred from firms' financial statements. Second, the small and medium size of the businesses in our sample, in conjunction with the characteristics of the Italian financial system, ensure that the firms that are constrained by banks essentially lack access to alternative sources of financing. In fact, in Italy stock and bond markets are relatively underdeveloped so that a small or medium-sized firm that is denied loans by banks is typically forced to scale down its investment plans. Finally, a third salient feature of the survey is that by combining it with data on Italian banking regulations we can use an instrumental variable estimation approach and tackle endogeneity issues. This is important because, even if one controls for productivity and other relevant firm characteristics, it is likely that the probability that a firm is credit rationed is related to some unobserved attributes of the firm that also influence its export decisions. In addition, an observed correlation between a firm's export and its liquidity constraints could also reflect the impact that the firm's activity in foreign countries has on its access to the credit market.

After controlling for various firm attributes that may affect exports, we estimate that the probability of exporting is 39% lower for credit rationed firms than for non-rationed firms and that rationing reduces foreign sales by more than 38%. Therefore, limited access to liquidity appears to impact both the probability that a firm exports (the "extensive margin") and firm-level exports, conditional on exporting (the "intensive margin"). Remarkably, while liquidity constraints

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appear to depress domestic sales, we find that their negative impact on foreign sales is significantly more pronounced. This may support the hypotheses put forth in the literature that the liquidity needs associated with set-up costs are especially large for exports (Manova, 2010) and that the enforceability of credit contracts is particularly difficult in international transactions (Chaney, 2005).

Because our measure of rationing is binary, we do not observe how severe rationing a firm faces. For example, some firms could be denied a larger amount of bank credit than others; moreover, some businesses could have easier access than others to forms of financing alternative to bank loans. To address these issues, we exploit information on firms' characteristics and on the industries in which firms operate. Our results reveal that credit constraints especially hinder export by firms with short relationships with creditors and by firms with few creditors. This can reflect the fact that firms with a short credit history or with few creditors suffer more from credit frictions when trying to expand abroad. In line with expectations, the analysis also reveals that liquidity constraints depress firms' export especially in industries with high external financial dependence (as defined by Rajan and Zingales, 1998). Finally, our results suggest that credit constraints impede firms' export primarily in high-tech sectors. This is interesting because these sectors are allegedly less exposed than traditional sectors to the competition of fast-growing economies (e.g., China and India).

The paper is organized as follows. Section 2 reviews the prior literature. Section 3 describes the institutional setting. Section 4 discusses the predictions of theoretical studies. In Section 5, we describe the data. Section 6 examines the impact of credit rationing on firms' export participation decisions. Section 7 looks at its effect on foreign sales. In Section 8, we investigate the heterogeneous response to rationing across firms or industries with different characteristics. Section 9 concludes.

2. Prior literature

This paper is related to the theoretical literature on the effects of credit imperfections on firms' investment and growth (see, e.g., Bernanke and Gertler, 1990; Clementi and Hopenhayn, 2006; Antràs and Caballero, 2009). More specifically, it takes to the data the predictions of a growing literature on the impact of credit imperfections on firms' export (e.g., Manova, 2010; and Chaney, 2005). We shall return to the implications of these theories. From an empirical viewpoint, our work is broadly related to the literature on the implications of financial imperfections for investment decisions (see, e.g., Fazzari et al., 1988; and, for reviews, Schiantarelli, 1996, and Galindo and Schiantarelli, 2003). In particular, it contributes to the studies that link financial development to the patterns of international trade (e.g., Beck, 2002; Svaleryd and Vlachos, 2005; Do and Levchenko, 2007). There is evidence that countries with more developed financial markets have a comparative advantage in industries that rely more on external finance. However, existing studies usually measure the financial development of a country using the amount of credit granted by banks and other financial institutions to the private sector (as a share of GDP). Therefore, firms are assumed to face the same tightness of credit constraints within the country. In contrast, we can observe credit rationing at the firm level and can then provide firm-level evidence on the role of financial constraints in international trade.

Recently, a few micro-level studies have related indirect measures of credit constraints to firms' international activities. Using data from the United Kingdom, Greenaway et al. (2007) investigate the relationship between export and measures of firms' financial health drawn from financial statements. They find no evidence that firms with better financial health are more likely to start exporting, while they obtain evidence that the participation in export markets improves firms' financial health. Berman and Héricourt (2010) analyze a sample of firms in developing and emerging economies and capture firms' liquidity needs with balance-sheet variables. Their results reveal that better financial health promotes entry into the export market but has no impact on the volume of foreign sales. Muûls (2008) finds that Belgian firms with lower creditworthiness are less likely to export and, if they do export, they sell less abroad. Using customs data from China, Manova et al. (2009) demonstrate that foreign affiliates and joint ventures have better export performance than private domestic firms, especially in sectors that heavily depend on external finance. This may suggest that credit frictions hinder export and that foreign firms can overcome such frictions by obtaining liquidity from parent companies. Relative to these studies, we have access to a direct measure of credit rationing rather than to measures derived indirectly from financial statements. Moreover, we can establish a causal effect of credit conditions on firms' export by using measures of regulation of the local credit market as instruments for rationing.

3. Institutional setting

Italy provides an ideal environment for disentangling the impact of credit constraints on firms' export. The industrial structure consists primarily of small and medium-sized businesses and banks are the main source of external finance. In 1999, the ratio between the stock market capitalization and the gross domestic product was 66.1%, compared with 180.8% in the United States. In this context, the external financing of investment and export costs mainly occurs through banks, so that the effect of credit rationing on export that we estimate from our sample can be considered as representative of the effect for Italian firms in general. The central role of banks in the financing of investment and export renders the Italian financial system close to that of other countries of continental Europe, such as France and Germany, and to Japan. However, banks are also a key source of finance in the United States. According to Berger and Udell (1998), in 1993 all financial institutions accounted for 26.71%, and commercial banks 18.75%, of the financing of nonfarm, nonfinancial, and non-real estate U.S. firms. This indicates that in the United States banks play a significant role in firm financing. Collectively, these considerations suggest that our analysis can constitute a first step in understanding the effect of liquidity constraints on firms' export.

A second important feature of the Italian banking system is its delimitation within local areas. These areas roughly coincide with Italian provinces (Sapienza, 2002; Guiso et al., 2003), local entities defined by the Italian law that are similar in size to U.S. counties. In our analysis, we face an issue of endogeneity of firms' credit rationing. The segmentation of the banking system in local areas, in conjunction with the banking regulation, allows us to identify exogenous restrictions on the local supply of banking services which can be used as instruments. In fact, as we elaborate below, until the early nineties the banking regulation that was in place in Italy severely limited the development of the banking system, affecting firms' ability to obtain credit.

4. Theoretical background

The theoretical literature has studied extensively the distortionary impact that credit frictions can have on firms' decisions and dynamics. Bernanke and Gertler (1990) and Clementi and Hopenhayn (2006) respectively demonstrate that credit constraints depress firms' investment and growth. In recent years, the literature has increasingly recognized the role of financial markets in firms' international orientation and stressed that exports are particularly vulnerable to credit imperfections. The studies that yield the most relevant implications for our firm-level empirical analysis are Manova (2010) and Chaney (2005), which embed credit constraints into the heterogeneous firm model of trade of Melitz (2003) and investigate

the implications for firms' export decisions. There are two premises of these models. The first is that firms must sustain sizeable fixed costs for entering a foreign market and that these costs must be paid up front. Hence, potential exporters must have enough liquidity at hand. The second premise is that firms cannot fully pledge the returns of foreign sales to financiers. For example, information on foreign markets is not only hard to obtain for firms but also difficult to verify for creditors. Therefore, a financier could be unwilling to put its own money at risk, trusting a firm that wants to enter a foreign market. Moreover, the enforceability of contracts in international transactions is limited. In fact, sales are made in foreign countries that can have different laws and regulations from the country of origin of the borrower and the lender.

While Manova and Chaney share the same view about the importance of credit frictions, the way they model such frictions differs. Manova assumes that firms must borrow to finance export costs. Because more productive firms earn higher profits and can offer investors greater returns in the event of repayment, they are less likely to be credit constrained and more likely to export. Chaney assumes instead that firms must finance the costs for entering foreign markets using cash flows from domestic sales. Because more productive firms can generate larger cash flows from domestic sales, they are less likely to be liquidity constrained and more likely to export. Manova and Chaney thus offer the same predictions regarding which firms will export.

Hypothesis 1. The extensive margin of export. Credit constrained firms are less likely to export.

While they share the same view about the extensive margin of export, Manova and Chaney hold divergent views about the effect of credit constraints on the intensive margin, that is how much a firm will export conditional on exporting. Manova predicts that credit constraints will depress the volume of foreign sales, while Chaney suggests that they will not affect it. These different predictions stem from the assumptions about the way variable production costs are financed. Manova studies a scenario in which firms need to raise outside capital to finance part of the variable costs associated with foreign sales. She shows that some firms with intermediate productivity have the incentive to reduce their exports below the unconstrained first-best level. In fact, if they tried to export at the first-best, they would not obtain sufficient export revenues to repay financiers. In contrast, by reducing their volume of exports below the first-best, they reduce the amount of external finance needed and, hence, the repayment necessary to satisfy the participation constraint of financiers. In Chaney's model, instead, conditional on exporting, only the productivity of a firm affects the volume of exports. In fact, once a firm has gathered enough liquidity to pay the fixed cost of entering a foreign market, it will be able to cover the variable costs of expanding the scale of production with its own funds. Moreover, Chaney stresses that if a firm is rationed in the credit market, it will be able to partially cover the costs of additional exports by resorting to foreign trade creditors.

Hypothesis 2. The intensive margin of export. The impact of credit constraints on the volume of exports is ambiguous a priori. While some theoretical models predict that credit constrained firm export less, others imply that liquidity constraints are neutral for the volume of foreign sales.

In light of the different implications of the literature, we will estimate the impact of credit constraints on export with a special care in distinguishing the extensive from the intensive margin.

5. Data and measurement

In this section, we provide details on the data and on the measurement of the variables.

5.1. Data sources

Our main source of information is the "VIII Indagine sulle Imprese Manufatturiere," a survey conducted by the Italian banking group Capitalia-Mediocredito Centrale at the beginning of 2001. The survey was directed to manufacturing firms within Italy with more than ten employees. In particular, it comprises the universe of firms with more than 500 employees and a stratified sample of firms with fewer than 500 employees, for a total of 4680 firms. To guarantee representativeness of the smaller firms, the sample is stratified by gross product per employee, size, industry, and location. The 4680 firms in the sample account for 9.2% of the population of Italian manufacturing firms in terms of employees and 9.9% in terms of value added. The survey investigates whether the firms undertook export activities. It also contains details about firm financing and credit rationing, data on firms' demographics, and annual data on firms' financial conditions drawn from balance sheets and income statements. We complement the survey with three other sources of data: the province-level and the industry-level databases of the Italian National Statistics Office (ISTAT), the Statistical Bulletin of the Bank of Italy (SBBI), and the book "Struttura funzionale e territoriale del sistema bancario italiano 1936–1974" (SFT) of the Bank of Italy.

The 2001 survey was the eighth conducted by Capitalia since 1968. The Capitalia survey is a very comprehensive statistical analysis of Italian manufacturing firms aimed at providing information for the strategies of the banking group, one of the largest in Italy, and for public policies for the promotion of firms' competitiveness, including their expansion abroad. The information in the survey is collected in two parts. The first part is a questionnaire administered by specially trained interviewers to a manager or to the administrator of the firm. The second part consists of quantitative balance-sheet data collected from firms. The procedure for the construction of the sample is very accurate. First of all, Capitalia keeps two lists of master data: a list of basic master data and a supplementary list of registries. Whenever a firm refuses the interview, Capitalia replaces the registry with another from the supplementary list. Whenever the interview is conducted successfully, it is kept in the database and subjected to several checks of logical consistency. More details about the data and the construction of the sample are provided in the Appendix.

Given the survey nature of our data, the reader could be concerned that the firms overstate or understate the frictions they face in the credit market. We have good reasons to believe that this is not the case. First, Capitalia-Mediocredito Centrale is a leader in the financing of enterprises and the staff in charge of the survey is highly qualified. Second, the Italian law (675/1996) on the treatment of personal data forbids using them for objectives different from that officially stated in the survey, that is, the elaboration of statistical tables. Hence, the firms should have no incentive to lie on the credit frictions they face in order to establish a record as appealing borrowers.

5.2. Measurement

5.2.1. Exports

The survey provides us with information about whether a firm exported or not in 2000, and the export destinations and foreign sales if the firm exported. The questionnaire asks: "Did the firm export at least part of its products in the year 2000?" Nearly 68.5% of the firms in the sample exported in 2000. To double check the representativeness of this figure for the universe of Italian firms, we combined data from the Italian Institute for Commerce (ICE) with data from the Italian National Statistics Office (ISTAT).[1] In each year between 1998 and 2005, between 63% and 70% of the manufacturing firms with more than 10 employees exported. The figure of 68.5% is also in the

[1] See, respectively, the "Annuario Istat-ICE" and the ISTAT publication "Struttura e dimensione delle imprese".

range of what is found by other studies for European countries. Using data from the French Manufacturing Census over the period 1990–2002, Bellone et al. (2007) find that 73% of French firms with at least 20 employees engaged in exports. For Sweden, Hansson and Lundin (2004) obtain that around 89% of manufacturing firms with more than 50 employees exported during the period 1990–1999 (data drawn from a survey conducted by Statistics Sweden). For the United Kingdom, Greenaway and Kneller (2004) find that 66% of firms exported in 1995, while Greenaway et al. (2007) report that in a panel of 9292 manufacturing firms observed over the period 1993–2003, almost 70% of firms exported in at least one year.

The Capitalia survey also asks the firms about the geographic area(s) where they exported their products. The EU market is the most popular destination—92.5% of exporters sell in the European Union, implying that very few exporters skip the EU and sell only to other foreign markets. Among firms which export to the EU market, 38% also export to the United States and Canada, 36% to Asia excluding China, 22% to Russia and Central-Eastern Europe, 27% to other European countries, 22% to Central and South America, 17% to Africa, 12% to Australia and Oceania, and 9% to China. A cross-tabulation between firms' sector of activity and export decisions reveals that the majority of exporters operate in "traditional" sectors (food, textiles, clothing, leather, and furniture) and in industrial machinery manufacturing. Moreover, the propensity to export (the ratio between number of exporters and total number of firms) is higher in the North than in the Center or South.

In 2000, on average foreign sales were 11.08 billion lira (about 6.2 million U.S. dollars at the exchange rate in 2000), accounting for 35.7% of the total sales of a firm. In the sample, only a few firms engage in FDI or outsourcing (with the large majority of them concentrated among exporters). This is not surprising given that the sample median firm size is 25 employees and typically only large firms can sustain the sizeable fixed costs associated with FDI or outsourcing.

5.2.2. Credit rationing

Our measures of credit rationing are based on firms' response to the following questions in the survey. (i) "In 2000, would the firm have liked to obtain more credit at the market interest rate?" In the case of an affirmative answer to (i), the following question is asked: (ii) "In 2000, did the firm demand more credit than it actually obtained?" Our first measure treats as rationed the firms that responded "yes" to both questions. The staff of Capitalia labels this measure "strong credit rationing." We also consider a second, broader measure and identify rationed firms as those that gave a positive response to question (i), regardless of their answer to (ii). The staff of Capitalia labels this measure "weak credit rationing." The firms classified as weakly rationed but not strongly rationed can be firms that are not denied credit but that are (or expect to be) requested an interest rate higher than the market rate. In turn, this would affect the size of the loans these firms can afford. Alternatively, these can also be firms that are discouraged from applying for credit. Both the measure of strong rationing and the measure of weak rationing capture credit constraints, but they reflect a different intensity of rationing. Therefore, one can probably expect strong rationing to have a larger impact on firms' export decisions. As shown in Table 1, based on the measure of strong rationing, 4.4% of exporters and 5.1% of non-exporters are rationed. However, the *t*-test suggests that the probability of being rationed is not significantly different between exporters and non-exporters. The measure of weak rationing implies a higher incidence of rationing: 18.5% of exporters and 21.6% of non-exporters are rationed according to this measure. If we use this measure, the likelihood of facing rationing is significantly higher for non-exporters than for exporters.

The above figures for rationing are in the range of those obtained by papers that study the rationing of individuals (households) in Italy. Using the Survey of Households Income and Wealth, Guiso et al. (2004) find that in 1989–1998 about 1% of Italian households were turned down when they applied for credit while 2% were discouraged from borrowing. Their measure of rationing combines these two groups of households. Outside the Italian context, Levenson and Willard (2000) use the 1987–1988 wave of the National Survey of Small Business Finances (NSSBF) for U.S. businesses and find that about 4.3% of firms were denied credit (that is, suffered from strong credit rationing). They also estimate that this figure rises to 8.52% if one includes firms that were discouraged from applying for credit because they expected a denial of their application. Using data from the 1998 wave of the NSSBF, we found that 4.7% of firms were denied credit.

In the whole sample only 4.6% of firms are strongly rationed. Fig. 1 draws the distribution of credit rationed firms across provinces. It is clear that there is a wide variation in the distribution of those rationed firms across provinces and regions. At the same time, the figure reveals that rationed firms are not clustered in few provinces. Although firms in Northern provinces are less likely to be rationed overall, we still find that some Northern provinces have a relatively high share of rationed firms. On the other hand, some Southern provinces have a relatively low share of rationed firms.

5.2.3. Control variables

We add the following measures of firms' financial conditions as controls: (i) liquidity ratio, defined as the firm's current assets less current liabilities over total assets, (ii) leverage ratio, defined as the firm's ratio of total liabilities to equity, and (iii) the ratio of cash flow to total assets, where the firm's cash flow is calculated as profits net of tax expenditures plus depreciation. All these variables can reflect the extent of a firm's credit risk and its financial health and, hence, help capture the probability of credit rationing (see Whited, 1992; Greenaway et al., 2007).

Whether a firm exports or not is also likely to be determined by various other factors. There is ample evidence that exporters are more productive, bigger, more capital intensive and have better educated workers (see, e.g., Bernard and Jensen, 2004). Thus, we add controls for these factors. We calculate labor productivity as value added per worker, measure firm size by the number of employees, capital intensity by fixed assets per worker, and workforce composition by the shares of secondary school graduates and college graduates. In addition, we include dummy variables indicating whether a firm is a corporation, it belongs to a consortium or a business group. In fact, a consortium or a group may allow a firm to share the distribution network with other firms and thus face a lower cost for entering foreign markets. A consortium or a group may also provide a firm with financial resources for sustaining export costs (e.g., through internal capital markets). In the analysis of export participation decisions, we also include a dummy variable indicating whether the firm distributed its products through specialized intermediaries. The survey asks firms to report the percentage of their total sales in 2000 by the following distribution channels: domestic distribution network, foreign distribution network, specialized intermediaries that sell goods to firms, specialized intermediaries that sell goods to households, direct sale to firms, direct sale to households, franchising, or other. In the international marketing literature it is widely agreed that by distributing their products through specialized intermediaries firms can significantly save on the costs for setting up foreign distribution networks (see, e.g., Pelliccelli, 2007, and Valdani and Bertoli, 2006, for a discussion with examples on Italian businesses).

Furthermore, since there are differences among the South, Center and North of Italy in infrastructure and institutions, we enlist dummy variables indicating whether the firm is headquartered in the South or Center. The inclusion of geographical dummies is also useful because the North of Italy is closer to the most important markets where Italian firms can export (especially, the EU markets). We also include a dummy variable indicating whether the firm has an ISO 9000 certification, which is a system whereby the European Union certifies

Table 1
Summary statistics.

	Export status			Strong rationing			Weak rationing		
	Exporter	Non-exporter	*t*-test	Non-rationed	Rationed	*t*-test	Non-rationed	Rationed	*t*-test
Credit rationing									
Strong rationing	0.044	0.051	−0.91						
Weak rationing	0.185	0.216	−2.09						
Export participation and sales									
Export participation				0.687	0.652	0.91	0.694	0.651	2.09
Log(foreign sales)				7.780	7.687	0.40	7.849	7.464	3.65
Log(domestic sales)	8.725	8.625	2.67	8.698	8.434	2.65	8.731	8.505	4.85
Log(total sales)	9.335	8.625	21.40	9.124	8.867	2.83	9.159	8.916	5.60
Firm characteristics									
Liquidity ratio	0.133	0.092	5.36	0.125	0.014	6.97	0.136	0.053	9.92
Leverage ration	0.761	0.763	−0.30	0.757	0.853	−9.23	0.747	0.821	−11.53
Cash flow	0.849	0.336	3.18	0.712	0.177	1.85	0.785	0.285	3.69
Labor productivity	0.046	0.042	5.21	0.045	0.039	4.86	0.046	0.041	7.01
Log(employment)	3.581	3.130	17.29	3.441	3.396	0.67	3.462	3.347	3.34
Secondary education	0.315	0.279	4.91	0.305	0.285	1.20	0.306	0.293	1.58
College education	0.040	0.024	7.64	0.035	0.032	0.85	0.035	0.034	0.37
Fix assets/employment	0.046	0.045	0.28	0.045	0.051	−0.99	0.045	0.047	−0.63
Log(firm age)	3.029	2.930	4.18	3.004	2.867	2.16	3.016	2.922	3.17
ISO9000	0.419	0.327	5.26	0.388	0.424	−0.89	0.392	0.380	0.59
Consortium	0.111	0.086	2.35	0.103	0.108	−0.19	0.100	0.115	−1.07
Corporation	0.971	0.940	3.90	0.961	0.975	−1.07	0.959	0.972	−1.72
Group	0.190	0.146	3.27	0.176	0.177	−0.04	0.181	0.156	1.53
North	0.675	0.571	5.85	0.648	0.525	3.01	0.662	0.559	4.89
South	0.093	0.169	−5.93	0.113	0.203	−2.76	0.098	0.194	−5.88
Center	0.232	0.260	−1.78	0.240	0.272	−0.90	0.239	0.247	−0.43
Number of observations	2361	1083		3286	158		2773	671	

(a) This table reports the mean statistics and the *t*-test statistics for the test of mean differences. A firm is strongly rationed if the firm demanded more credit than it received in 2000. A firm is weakly rationed if the firm would have liked to obtain more credit at the market interest rate in 2000. (b) Liquidity ratio is defined as the firm's current assets less current liabilities over total assets. Leverage ratio is defined as the firm's ratio of total liabilities to equity. Cash flow is calculated as profits net of tax expenditures plus depreciation and is normalized by total assets. Labor productivity is calculated as value added per worker. Secondary and college education represent the share of secondary school graduates, respectively. Log(employment) captured firm size. Fix assets/employment measures capital intensity of a firm. All of these variables are computed as averages over 1998–1999. (c) ISO 9000 is a dummy variable indicating whether a firm has an ISO 9000 certification. Consortium, corporation and group are dummy variables indicating whether a firm is a corporation, belongs to a consortium or a business group. North, South, and Center are dummy variables indicating whether a firm is headquartered in the North, South, or Center of Italy. (d) See Section 5.2 for more detail about measurement.

the efficiency of production and, hence, the quality and productivity of a firm. Finally, we include industry dummy variables to account for other sources of comparative advantage and for the pattern of world demand for goods.

The database provides us with information on firm attributes for the years prior to 2000. In order to avoid the possible endogeneity of firm attributes, we calculate measures of firms' financial conditions, labor productivity, firm size, capital intensity and workforce composition as averages over 1998–1999. Table 1 lists the summary statistics on firm attributes by export status and rationing status. Exporters are in better financial conditions than non-exporters (with a higher liquidity ratio and more cash flow). Exporters are also more productive, larger, older, and have a better educated workforce. In addition, they are more likely to have an ISO 9000 certification, be member of a consortium or a business group. Table 1 also reveals that on average credit rationed firms have a lower liquidity ratio and less cash flow, but a higher leverage ratio than non-rationed firms. In addition, rationed firms tend to be younger and smaller (with less employees) than non-rationed ones, which is consistent with the findings of Levenson and Willard (2000) for the U.S. businesses surveyed by the National Survey of Small Business Finances, for example. Moreover, rationed firms have lower labor productivity (value added per worker) than non-rationed ones.

After controlling for firms' financial conditions and other firm attributes, our estimated effect of credit rationing largely reflects the impact of limited supply of credit on firms' export decisions. Note that for some firms we lack data on firm attributes, especially labor productivity and capital intensity. As a result, in the analysis that follows the sample reduces to 3444 firms. Our sample remains representative after we drop firms with missing data.

5.2.4. Instruments

If we simply regress the indicator of export participation or the amount of foreign sales on credit rationing and control variables as detailed above, we may still overstate or understate the effect of rationing for two reasons. The first is the omitted variable bias. Whether or not a firm is rationed is likely to be correlated with several firm characteristics. Although we include various controls for such characteristics, rationing may correlate with unobserved firm attributes. For example, since lenders may have more information about firms than reported in the data, low productive firms (observed by lenders) could be more likely to face rationing. Such firms may also have a lower probability of exporting or export less if they do export. Thus, not fully controlling for productivity could lead to overstate the negative effect of rationing on export. Alternatively, firms with severe agency problems among their stakeholders (creditors, owners and managers) could be more exposed to rationing. Such firms could export more than firms with mild agency problems: exporting is a risky activity and entrepreneurs could export to shift risk to creditors; or managers could enter foreign markets for the sole purpose of expanding the size of the firm and gaining prestige ("empire building"). Thus, not fully accounting for such agency problems could lead to understate the negative effect of rationing on export. The second type of problem is that rationing and exporting decision could be determined jointly. We will further elaborate on this issue.

Our strategy to tackle these endogeneity issues is to identify exogenous restrictions on the local supply of banking services. We expect these restrictions to influence directly firms' ability to obtain financing and, hence, the probability of rationing. In contrast, we do not expect these restrictions to affect directly firms' export. Following Guiso et al. (2003, 2004) and Herrera and Minetti (2007), our instruments

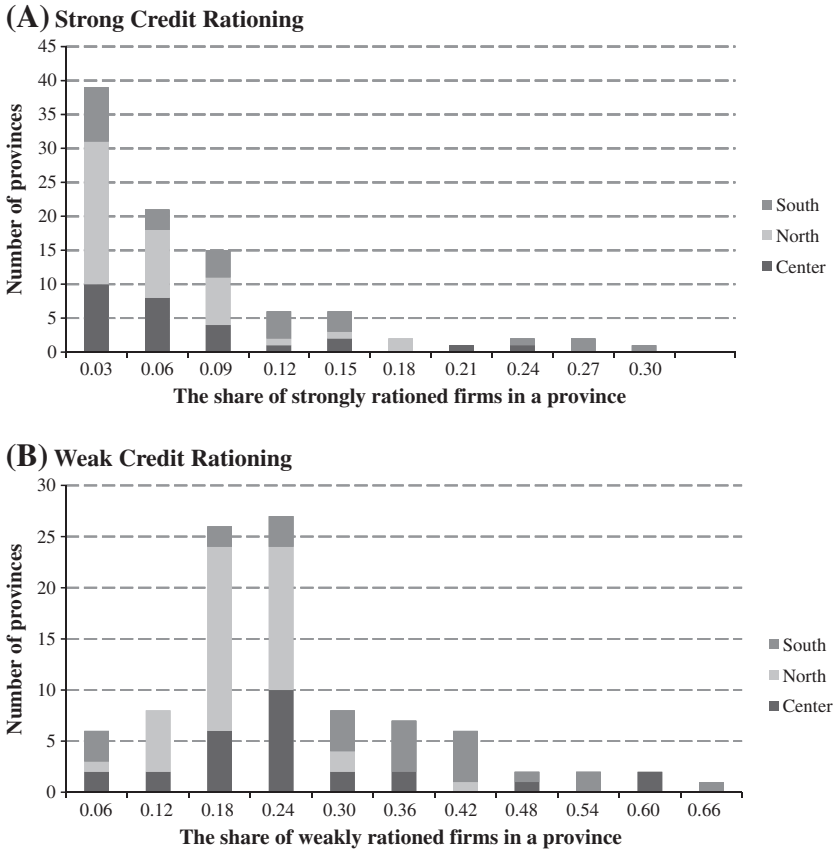

Fig. 1. The distribution of credit rationed firms across Italian provinces.(A) Strong credit rationing. (B) Weak credit rationing.

include: (1) provincial data on the number of savings banks and the number of cooperative banks in 1936 (per 1000 inhabitants); (2) provincial data on the number of branches created annually by incumbent banks net of branches closed (per 1000 inhabitants and imputed as the average in 1991–1998); and (3) the number of times a bank headquartered in the province engaged in a merger in the period 1989–1995.[2] To understand the choice of these instruments, we have to discuss the Italian banking regulation. In the early 1930s, the Italian regulatory authorities became increasingly concerned about banking instability and concluded that an excess of competition favored such instability. As a result, in 1936 the Comitato Interministeriale per il Credito e il Risparmio (CICR) enacted strict norms for the entry of banks into local credit markets: from 1938 each credit institution could only open branches in an area of competence (one or multiple provinces) determined on the basis of its presence in 1936. Banks were also required to shut down branches outside their area of competence. Guiso et al. (2003, 2004) demonstrate empirically that the 1936 regulation had a profound impact on the local supply of banking services (creation and location of new branches) and, hence, on firms' ability to obtain credit. For example, between 1936 and the late 1980s in Italy the number of bank branches grew less than 90% (versus more than 1200% in the United States). Three aspects of the regulation are suitable for our objectives. First, while the regulatory prescriptions were uniform across Italy, the constrictiveness of regulation varied across provinces. In particular, it depended on the relative importance of different types of banks in the local market in 1936, for example on the importance of savings banks (less constrained by the regulation) and cooperative banks (more constrained). Second, as shown by Guiso et al. (2003, 2004), the distribution of types of banks across provinces in 1936, and hence the constrictiveness of regulation in a province, stemmed from "historical accident." Indeed, this distribution stemmed from the interaction between the waves of bank entry of previous decades and the history of Italian unification. For instance, the importance of savings banks in some provinces of the North East and the Center reflected the fact that these institutions originated in Austria and expanded first in the territory dominated by the Austrian Empire (Lombardia and the North East) and in the nearby states (Tuscany and the Papal States). A third key aspect of the regulation is that the different limits on different types of banks were exogenous, and in particular stemmed from the different connections of the various types of banks with the Fascist regime. The regulation remained substantially unchanged until the late 1980s. Thereafter, between the late eighties and the early nineties, it was progressively relaxed under the pressure of two European directives on the coordination of banking regulations. In particular, the geographical restrictions to lending were broadened and the procedure to open new branches was eased. In fact, between the end of the eighties and the end of the nineties, the number of branches grew by 80% in Italy (versus 40% in the United States).

The above arguments imply that the creation and location of new branches, as determined by the regulation in 1936 and its progressive removal during the 1990s, are unlikely to be correlated with structural characteristics of the provinces. Thus, to capture the local constrictiveness of regulation, we include the provincial number of savings banks and cooperative banks in 1936. Furthermore, since the regulation and its removal impacted directly banks' potential to open new branches in the

[2] Unlike Guiso, Sapienza and Zingales, and Herrera and Minetti, we constructed provincial rather than regional data on the number of savings banks and cooperative banks in 1936. Note that between 1991 and 2001 the number of provinces rose from 95 to 103. We imputed the data for firms that declared to be headquartered in new provinces on the basis of the original province.

local markets besides the location of branches, we expect that the number of branches created by incumbent banks helps capture the local constrictiveness of regulation as well as the shock induced by its removal. The 1936 regulatory restrictions on the creation and location of bank branches had also a direct impact on banks' incentive to merge (Sapienza, 2002). As we shall see, the estimates obtained by including bank mergers as an instrument are virtually identical to those obtained excluding it. Because the indicator we construct is not a very precise measure of merger activity in provinces, and since the regulation was literally about branch formation rather than about mergers, we mostly report the results obtained without mergers as an additional instrument. Overall, we expect that in provinces where the regulation was less constrictive firms suffered from less severe rationing. Therefore, we expect that the probability of being rationed decreases with the number of savings banks (less constrained by the regulation) and the number of net branches created, but increases with the number of cooperative banks (more constrained by the regulation).

In Fig. 2 we provide evidence that our instruments are strongly correlated with the share of credit rationed firms in a province. Based on the measure of strong rationing, panel A plots the share of rationed firms in a province against the number of branches created annually by incumbent banks (net of branches closed). It shows a negative slope of -2.10 ($t=-3.46$). Similarly, panel B displays a strongly negative correlation between the share of rationed firms and the number of savings banks at the province level. Panels C and D show a similar pattern for the measure of weak rationing. Therefore, consistent with our expectation, firms are significantly less likely to be credit rationed in provinces with a larger number of savings banks in 1936 and with more net branches created by incumbent banks during 1991–1998.

There are additional issues worth discussion regarding our instruments. First, cyclical variations in the economic activity of a province after deregulation could be correlated with our instruments and with firms' export decisions in 2000. Thus, we control for the average growth rate of the value added of the province in 1991–1998. Second, the characteristics of the banking sector in a province after the period of regulation could also be correlated with our instruments and affect firms' export decisions. Thus, we add the number of branches per 1000 inhabitants in 1991–1998 as a control for the financial depth of the province. Finally, the reader might wonder whether the infrastructural development of a province is correlated with the instruments and also influences firms' export decisions. To assuage this concern, in the following analysis we will verify the robustness of the results to including province-level indicators of infrastructural development as controls.

6. The extensive margin of export

In this section, we examine the effect of credit rationing on the extensive margin of export, that is, the probability of exporting. Let π_i^* represent the difference between firm i's operating profits when exporting and its operating profits when not exporting. This difference is determined by firm characteristics (e.g., productivity) and by credit constraints. In fact, as implied by the theoretical models in Manova (2010) and Chaney (2005), credit constraints can influence a firm's ability to pay off the fixed costs of entering a foreign market. Therefore, we parameterize π_i^* as

$$\pi_i^* = \alpha_1 + \beta_1 C_i + Z_i\gamma_1 + \varepsilon_i,$$

where C_i is a binary variable that equals 1 if firm i faces credit rationing, 0 otherwise; Z_i is a vector of controls for firm characteristics that may affect firm i's differential operating profits π_i^* (see Section 5.2.3 for the list of control variables); and ε_i captures the unobserved firm attributes and any other unknown factor that may also affect π_i^*.

Firm i will export if $\pi_i^* > 0$. Under the assumption that ε_i is a normally distributed random error with zero mean and unit variance, the probability that firm i exports can be written as

$$\begin{aligned}\text{prob}(Export_i = 1) &= \text{prob}(\alpha_1 + \beta_1 C_i + Z_i\gamma_1 + \varepsilon_i > 0) \\ &= \Phi(\alpha_1 + \beta_1 C_i + Z_i\gamma_1),\end{aligned} \quad (1)$$

where $\Phi(\cdot)$ represents the standard normal cdf. As predicted by Manova (2010) and Chaney (2005), for instance, when a firm faces credit rationing it may not have enough liquidity to cover the cost of entering a foreign market and, hence, may be less likely to export. That is, we expect $\beta_1 < 0$.

As noted, an issue with estimating Eq. (1) is that credit rationing C_i may be endogenous. The probability of being rationed is likely to be determined by the extent of credit risk of a firm, other firm attributes, and the supply side of the credit market. We model the probability of credit rationing using the following probit

$$\text{prob}(C_i = 1) = \text{prob}\left(I_p\delta + Z_i\lambda + \mu_i > 0\right) = \Phi\left(I_p\delta + Z_i\lambda\right), \quad (2)$$

where I_p are variables that capture exogenous restrictions on the supply side of the credit market in a province, Z_i are exogenous variables in Eq. (1) and μ_i is a normally distributed random error with zero mean and unit variance. Lenders evaluate the credit risk of a firm on the basis of the firm's characteristics, as captured by the Z_i vector. The vector I_p includes province-level data on the number of branches created annually by incumbent bank net of branches closed over the period 1991–1998 and on the number of savings banks in 1936. These variables capture exogenous regulatory restrictions on the local credit supply and are unlikely to be correlated with the unobserved firm characteristics that affect a firm's exporting decision. Thus, they are used as instruments for C_i.[3]

Eqs. (1) and (2) constitute a recursive bivariate probit model. The endogeneity of credit rationing in Eq. (1) arises from the possible correlation between the unobserved determinants of a firm's export participation decision (subsumed in ε_i) and the unobserved determinants of credit rationing (subsumed in μ_i). The effect of credit rationing on the probability of exporting can be identified under the assumption that the set of instruments I_p are excluded from Eq. (1). Although C_i enters Eq. (1) as an endogenous variable, we can estimate Eqs. (1) and (2) using a standard bivariate probit software (Greene, 2002, pages 715–716). Moreover, since the instruments are at the province level, we cluster standard errors by province.

6.1. Exporting or not?

Column 1 of Table 2 displays the estimates of Eq. (1) in which the measure of strong credit rationing is used and is treated as exogenous. We find no evidence that strong rationing has a statistically significant effect on the probability of exporting. The estimates also suggest that firms with a higher liquidity ratio are more likely to export. If one interprets a high liquidity ratio as a signal of good financial health and possibly low credit constraints, this might hint at some impact of credit constraints on export. However, the probability of exporting is higher for firms with a higher leverage ratio and lower cash flow. The effect of leverage could suggest that highly indebted firms use exports to shift the risk associated with their high leverage to creditors. As for the negative coefficient on cash flow, it may be caused by the size effect because cash flow is normalized by total assets and bigger firms are more likely to export. On the other hand, consistent with other firm-level studies (e.g., Bernard and Jensen, 2004), we find that exporters are more productive,

[3] We experimented with provincial data on the number of cooperative banks in 1936 (per 1,000 inhabitants) as an additional instrument for credit rationing but this turned out to be insignificant.

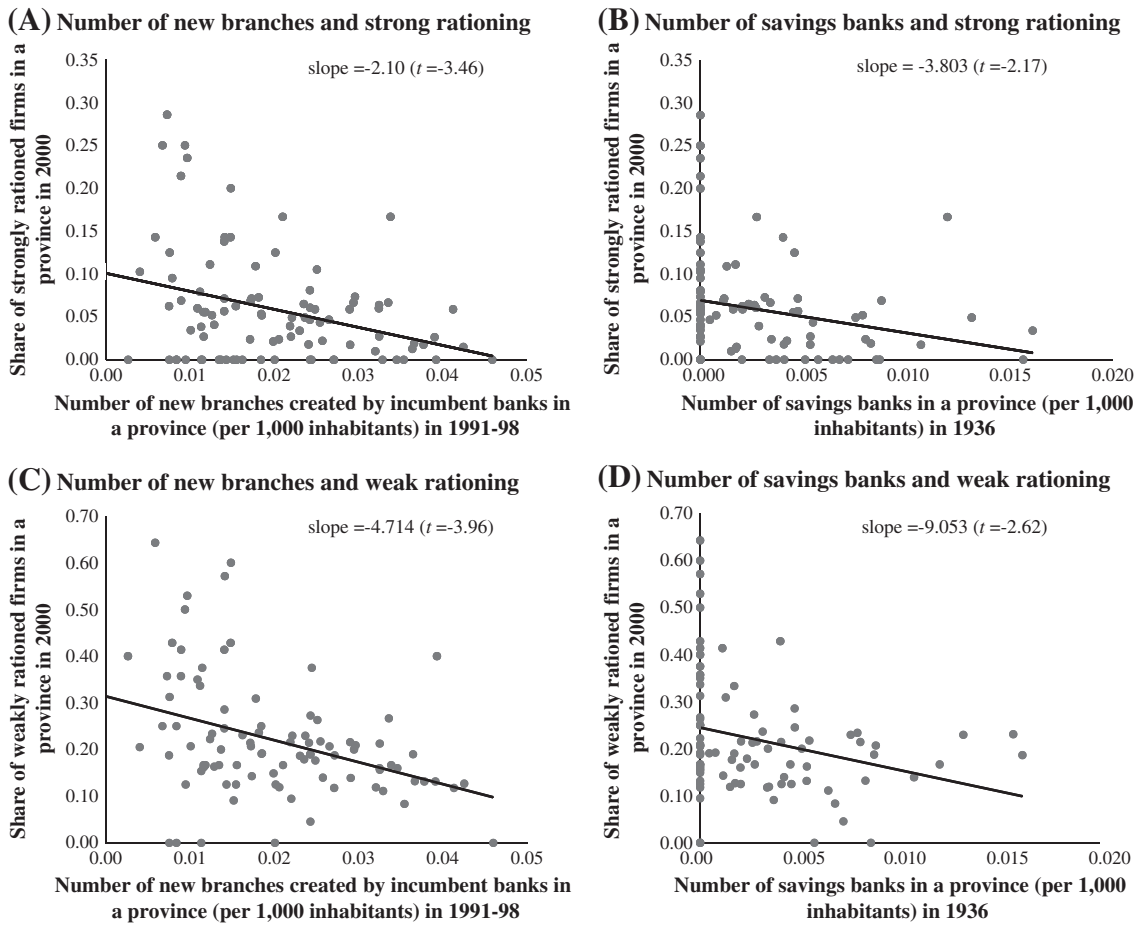

Fig. 2. Simple correlations between credit rationing and its instruments. (A) Number of new branches and strong rationing. (B) Number of saving banks and strong rationing. (C) Number of new branches and weak rationing. (D) Number of saving banks and weak rationing.

bigger, more capital intensive, and have better educated workforce. In line with our expectations, we also obtain that firms which have the ISO 9000 certification, belong to a consortium, and have access to specialized intermediaries for distributing products are significantly more likely to export. Furthermore, firms in the South and Center are less likely to export than those in the North.

Columns 2 and 3 report the results for the bivariate probit model in Eqs. (2) and (1). We use the number of branches created annually by incumbent banks net of branches closed over 1991–1998 and the number of savings banks in 1936 as instruments for the measure of strong credit rationing. As displayed at the bottom of column 2 of Table 2, the coefficients on both instruments are statistically significant. The χ^2-statistic for the test of joint significance is 14.84 with a p-value lower than 0.001. The negative signs are also consistent with our priors: the probability of rationing is lower for firms located in the provinces where more branches were created over 1991–1998 and there were more savings banks in 1936. Moreover, column 2 shows that firms with higher credit risk, i.e. with a lower liquidity ratio and higher leverage, are more likely to be rationed.

Let us now turn to the results for the exporting equation in column 3. We find that credit rationing has a statistically significant negative effect on exporting. In order to gauge the economic size of this estimate, we compute the average treatment effect of rationing on the probability of exporting as $\Phi(\alpha_1+\beta_1+Z_i\gamma_1)-\Phi(\alpha_1+Z_i\gamma_1)$ (see Wooldridge, 2002, page 477). We obtain a value of -0.386, which implies that after controlling for firm attributes and endogeneity of rationing, strong rationing reduces the probability of exporting by 38.6%. Thus, unlike the univariate probit model in which the endogeneity issue is ignored, the estimate from the bivariate probit model suggests a large negative effect of strong rationing. In addition, the estimate of the correlation coefficient $corr[\varepsilon_i,\mu_i]$ is 0.608 with a standard error of 0.143 ($p=0.002$), implying that the unobserved determinants of the export participation decision (ε_i) and those of rationing (μ_i) are significantly and positively correlated. This means that we can reject the hypothesis that rationing is exogenous.

The results show that the coefficient on strong rationing changes from positive and insignificant to negative and significant when instrumented. There are various reasons why ignoring the endogeneity of rationing may lead to understate its negative effect on the probability of exporting. One reason is that one could be omitting variables, such as (proxies for) agency problems among the firm's stakeholders, that increase both the probability of export and the probability of rationing (see Section 5.2.4). Another reason is that, while the export activity of a firm could facilitate the firm's access to more sources of financing, it could also increase the probability of rationing. For example, the revenues of exporters can be more difficult to pledge to lenders (Obstfeld and Rogoff, 1996). For a domestic lender it can be hard to verify export revenues generated in a foreign country. Moreover, the lender may be unable to receive protection from the courts of a foreign country and, hence, obtain the repayment promised by the exporter. More in general, enforcement of credit contracts can be problematic when it involves international transactions. In addition to these problems, in some cases an exporter's access to more sources of financing can be a double-edged sword. On the one hand, it can help him overcome liquidity problems of his domestic financier(s). On the other hand, it can reduce the incentive of the financiers to monitor the exporter, thus exacerbating information asymmetries and credit rationing (Petersen and Rajan, 1994; Boot and Thakor, 2000).

Table 2
Export participation.

	Strong rationing						Weak rationing									
	Probit		Bivariate probit				Probit		Bivariate probit				Bivariate probit			
	Exporting		Credit rationing		Exporting		Exporting		Credit rationing		Exporting		Credit rationing		Exporting	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err
Credit rationing	0.028	0.118			**−1.230**	0.345	−0.029	0.066			−0.394	0.652			0.017	0.900
Liquidity ratio	**0.751**	0.263	**−0.649**	0.255	**0.656**	0.265	**0.746**	0.265	**−0.552**	0.154	**0.690**	0.264	**−0.546**	0.153	**0.752**	0.267
Leverage ratio	**0.817**	0.300	**1.615**	0.379	**0.902**	0.299	**0.829**	0.296	**1.308**	0.232	**0.929**	0.373	**1.306**	0.237	*0.814*	0.458
Cash flow	**−0.016**	0.006	−0.024	0.027	**−0.016**	0.006	**−0.016**	0.006	−0.019	0.020	**−0.016**	0.005	−0.021	0.020	**−0.016**	0.006
Labor productivity	**5.331**	1.678	*−4.142*	2.450	**4.968**	1.591	**5.279**	1.671	**−4.489**	1.692	**4.834**	1.888	**−4.538**	1.723	**5.328**	1.968
Log(employment)	**0.488**	0.044	0.019	0.066	**0.480**	0.042	**0.488**	0.044	−0.035	0.053	**0.479**	0.046	−0.030	0.054	**0.488**	0.044
Secondary education	**0.411**	0.167	−0.219	0.235	**0.378**	0.164	**0.409**	0.166	−0.171	0.146	**0.390**	0.173	−0.146	0.147	**0.411**	0.177
College education	**2.333**	0.493	−0.148	0.680	**2.254**	0.500	**2.337**	0.494	0.614	0.400	**2.371**	0.494	0.555	0.402	**2.329**	0.517
Fix assets/employment	**1.550**	0.633	*0.538*	0.287	**1.548**	0.604	**1.560**	0.628	0.329	0.263	**1.579**	0.627	0.357	0.274	**1.556**	0.652
Log(firm age)	0.032	0.040	0.037	0.063	0.031	0.042	0.032	0.040	0.032	0.037	0.035	0.041	0.027	0.037	0.032	0.041
ISO9000	**0.184**	0.053	0.057	0.092	**0.182**	0.052	**0.184**	0.053	−0.011	0.062	**0.181**	0.052	−0.014	0.063	**0.184**	0.051
Consortium	**0.191**	0.094	−0.030	0.124	**0.196**	0.095	**0.192**	0.094	0.097	0.084	**0.200**	0.094	0.107	0.083	**0.190**	0.093
Corporation	**0.540**	0.129	0.217	0.237	**0.548**	0.131	**0.543**	0.129	**0.296**	0.142	**0.564**	0.135	**0.293**	0.141	**0.539**	0.139
Group	**−0.219**	0.083	0.063	0.107	**−0.210**	0.078	**−0.219**	0.082	−0.014	0.080	**−0.218**	0.083	−0.019	0.080	**−0.219**	0.081
Specialized intermediaries	**0.471**	0.052	**−0.182**	0.077	**0.444**	0.052	**0.470**	0.051	−0.087	0.069	**0.457**	0.058	−0.085	0.069	**0.471**	0.054
South	**−0.342**	0.123	0.188	0.202	**−0.307**	0.114	**−0.338**	0.121	**0.360**	0.108	**−0.290**	0.145	**0.360**	0.099	**−0.343**	0.163
Center	**−0.222**	0.109	*0.231*	0.131	*−0.204*	0.107	**−0.221**	0.109	0.046	0.066	*−0.210*	0.112	*0.108*	0.061	**−0.222**	0.111
Provincial value-added growth	−5.656	4.465	*−8.154*	4.669	−6.130	4.395	−5.712	4.487	−1.422	2.995	−5.836	4.478	−3.032	3.017	−5.687	4.447
# Branches	0.519	0.408	−0.350	0.637	0.381	0.393	0.512	0.408	−0.276	0.349	0.452	0.433	**−0.672**	0.281	0.519	0.426
# New branches by incumbents			**−14.270**	4.371					**−8.126**	3.861			**−7.343**	3.322		
# Savings banks			**−42.340**	15.940												
# Mergers													**0.015**	0.003		
Corr(ε, μ)			**0.608**	0.143					0.210	0.365			−0.027	0.515		
Log-likelihood	−1772.8		−2338.1				−1772.7		−3345.7				−3341.0			

(a) All regressions involve 3442 firms and include industry dummy variables. (b) The number of new branches created annually by incumbent banks net of branches closed (per 1000 inhabitants) are computed as the average in 1991–1998. The number of savings banks (per 1000 inhabitants) is for 1936. The number of mergers gives the number of times a bank headquartered in the province engaged in a merger over 1989–1995. These variables serve as instruments for credit rationing. (c) Provincial value-added growth and the number of branches (per 1000 inhabitants) are computed for 1991–1998. See the notes to Table 1 and Section 5.2 for more detail about other variables. (d) In all the regressions standard errors are clustered by province. The coefficients in bold are statistically significant at the 5% level, and those in italics are statistically significant at the 10% level.

Another point worth making is that the sign change of the coefficient on strong rationing is not caused by the bivariate probit. The coefficient on strong rationing remains negative (−0.755 with a standard error of 0.846) when a linear probability model is used and is estimated by two-stage least squares (2SLS). However, the linear probability model suffers from limitations. In particular, for certain combinations of the explanatory variables, the predicted probabilities can be greater than one or less than zero. In our setting, where the share of strongly rationed firms is relatively low, this problem is exacerbated in the first stage regression for the probability of rationing. Thus, the linear probability model is not a good approximation in our case.

Columns 4–6 report the results when the measure of weak credit rationing is used. By this measure, a higher fraction of firms are classified as rationed. Both columns 4 and 6 show that this measure has no significant effect on export participation. The statistically insignificant estimates can reflect the fact that this measure captures a less severe form of credit constraints (see Section 5.2.2). Another possible reason for the insignificant result is that the instruments for this measure are weak, leading to less precise estimates. Because it turns out that the number of savings banks in 1936 is not significantly correlated with the measure of weak credit rationing, in columns 5–6 we report the results that use the number of branches created by incumbent banks (net of branches closed) as the only instrument. To investigate further whether the estimates can be improved by including additional instruments, we also use the number of times a bank headquartered in the province engaged in a merger in the period 1989–1995 as an instrument. Column 7 shows that both instruments are statistically significant. In addition, the χ^2-statistic for the test of joint significance is 25.93 with a p-value less than 0.001. However, as displayed in column 8, the estimated coefficient on the measure of weak credit rationing remains statistically insignificant. Therefore, columns 7–8 suggest that the result for this measure is unlikely to be caused by weak instruments.

As discussed earlier, the reader may be concerned that in provinces where it was easier to finance exports it was also easier to finance physical and telecommunication infrastructures that support exports. If this is the case, omitting (proxies for) province-level infrastructural development from our set of controls could invalidate our instruments. To assuage this concern, we obtained data on indicators of infrastructural development of Italian provinces. The Association of Italian Chambers of Commerce (Unioncamere) in collaboration with the "Guglielmo Tagliacarne" research institute periodically constructs province-level indices of development for various categories of infrastructures (roads and expressways, railways, ports, airports, and telecommunications). Each index captures the provincial endowment of a type of infrastructures relative to the potential need for such infrastructures in the province, thus accounting for the different size and population of the provinces. We considered the indices constructed for the years 1997–2000 and then included them as controls in the regressions. None of the coefficients on these indices turned out to be significant. Furthermore, the results for credit rationing remained virtually unaffected.[4]

To summarize, Table 2 provides evidence that strong rationing has negative effects on the export participation decision. On the other hand, since we can only observe a cross-sectional relationship between export participation decision and rationing but we lack information about the history of firms' export participation, our estimates might understate the effect of rationing on export participation. Specifically, if firms paid fixed entry costs and were exporting in 1999 (one year prior to the sample year), being rationed or not in 2000 might not have a large effect on exporting decisions in 2000. In Section 6.3, we will provide some indirect evidence supporting this argument.

6.2. Financial variables

In the financial constraints literature, firms' liquidity and leverage are often used to proxy for the probability of credit constraints. Following this literature, we thus include them as controls for a firm's financial conditions in order to avoid the potential problem of omitted variables (and we find that they have a significant impact on the probability of exporting). However, controlling for these financial variables might reduce the coefficient on our rationing measure. This view gains some support from the results shown in panel A of Table 3. Excluding the liquidity ratio or/and the leverage ratio reinforces the negative effect of strong rationing on export participation while we still find no significant effect of weak rationing on export participation (see panel B).

Next, we construct alternative indirect measures of credit rationing using other information in the survey. The survey asks each firm to indicate the number of banks from which it borrowed in 2000. Nearly 96% of the firms have more than one bank, and the median number of banks is four. Multiple credit relationships may help firms overcome a liquidity crisis of their main bank and, hence, mitigate the risk of credit rationing (Detragiache et al., 2000). However, multiple relationships can also dilute the incentives of banks to acquire information on borrowers thus exacerbating informational asymmetries and the risk of rationing (Petersen and Rajan, 1994). In panel C of Table 3 the number of banks is used as a proxy for the risk of rationing. Although the probit estimates suggest that the probability of exporting is significantly higher for firms that borrowed from multiple banks in 2000, the effect disappears when the number of banks is treated as endogenous and is instrumented by the number of cooperative banks in 1936 (column 8).[5]

The duration of the main credit relationship, measured by the number of years the firm has been operating with its current main bank, is also used by the literature as a proxy for the strength of credit ties (Petersen and Rajan, 1994).[6] This literature finds evidence that long-term relationships increase credit availability. This implies that when a firm faces credit rationing, the intensity of rationing may be less severe if the firm has a longer credit relationship with its main bank. As reported in column 9 of panel D in Table 3, the probit estimates suggest that firms with a longer relationship with their main banks are more likely to export. However, as shown in column 10 of panel D, once it is treated as endogenous and is instrumented by the number of cooperative banks in 1936, the duration of the main relationship does not seem to affect the probability of exporting.[7]

Therefore, although both the number of creditors and the duration of the main credit relationship may indicate the likelihood of being rationed, they seem less accurate than our measures of credit rationing in capturing whether a firm is actually facing credit constraints or not.

6.3. Entry into multiple markets

The survey provides information on export destinations. Limited by the data, we define markets in terms of broad geographical areas. In our sample, 29% of exporters sell to a single foreign market and nearly 90% of them choose the EU market. Another 29% of exporters

[4] The estimates are available upon request. Note that, as stressed by the Tagliacarne institute, although the indices are constructed carefully, they present some unavoidable problems. For example, the index for each type of infrastructures is a weighted sum of various subindices of density and quality of the infrastructures. The choice of weights is somewhat subjective. Thus, we chose to use the indices in robustness tests but not in the main regressions.

[5] The probit with a continuous endogenous variable is estimated using the conditional maximum-likelihood estimator. The coefficient on the number of cooperative banks in the equation of the number of banks is 6.038 ($t=2.71$).

[6] In the survey, the main bank of a firm is defined as the bank that granted the largest amount of credit in 2000.

[7] The estimated coefficient on the number of cooperative banks in the equation of the duration of the main credit relationship is −5.00 with a t -statistic of −1.73.

Table 3
Export participation: financial variables.

	Bivariate		Bivariate		Bivariate					
	Probit	Probit	Probit	Probit	Probit	Probit	Probit	IV probit	Probit	IV probit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: effect of strong rationing after excluding liquidity ratio or/and leverage ratio										
Strong rationing	0.055	**−1.275**	0.010	**−1.404**	0.030	**−1.534**				
	(0.115)	(0.334)	(0.119)	(0.287)	(0.116)	(0.275)				
Liquidity ratio	**0.283**	0.137								
	(0.144)	(0.145)								
Leverage ratio			0.231	**0.405**						
			(0.160)	(0.160)						
Panel B: effect of weak rationing after excluding liquidity ratio or/and leverage ratio										
Weak rationing	−0.007	−0.324	−0.040	−0.370	−0.025	0.769				
	(0.067)	(0.868)	(0.065)	(0.721)	(0.066)	(0.680)				
Liquidity ratio	*0.275*	0.179								
	(0.146)	(0.279)								
Leverage ratio			0.249	0.379						
			(0.156)	(0.345)						
Panel C: measuring the risk of credit rationing by using the number of banks										
Log(number of banks)							**0.232**	−0.859		
							(0.046)	(0.813)		
Panel D: measuring the risk of credit rationing by using the duration of the main credit relationship										
Log(years with the main bank)									**0.068**	0.502
									(0.034)	(1.204)

(a) All regressions in panels A and B include controls for cash flows, labor productivity, log(employment), secondary education, college education, fixed assets/employment, firm age, ISO 9000, consortium, corporation, group, specialized intermediaries, South, Center, provincial average growth rate of value added, the number of branches (per 1,000 inhabitants) in 1991–98, and industry dummy variables. See the notes to Table 1 and Section 5.2 for more detail about data measurement. In columns 2, 4 and 6 the number of savings banks in 1936 and the number of new branches created by incumbent banks in 1991–1998 are used as instruments for strong rationing, and the number of new branches created by incumbent banks is used as an instrument for weak rationing. (b) In panels C and D, the number of banks and the duration of the credit relationship with main banks are used as alternative measures of the risk of credit rationing. All regressions in columns 7–10 include the same controls as those in Table 2. In columns 8 and 10, the probit model with a continuous endogenous variable (i.e., the number of banks in column 8 or the duration of the main credit relationship in column 10) is estimated using the conditional maximum likelihood estimator and the number of cooperative banks in 1936 is used as an instrument. (c) In all the regressions standard errors are clustered by province. The coefficients in bold are statistically significant at the 5% level, and those in italics are statistically significant at the 10% level.

serve two foreign markets, and the remaining 42% export to at least three markets. Entering multiple markets may allow exporters to diversify demand risk, but in principle may involve extra entry costs. However, we suspect that overall the cost of entering additional foreign markets could be lower than that involved in entering the first foreign market. Fixed entry costs entail a wide range of expenses that firms may need to incur in order to break into a new foreign market. For instance, firms may need to produce goods beyond certain quality and be technically efficient; they may also need to acquire information about foreign market demand, modify products to fit local tastes, and adapt marketing strategies. Some of these costs can be spread across markets: the knowledge firms have gained in their first export market may be applied to other export markets; moreover, firms may not need to further tune up their production line and internal organization when entering additional markets. Overall, this may reduce the fixed costs for entry into additional export markets, especially when these do not differ sharply from the first export market. Furthermore, because it usually takes time for a firm to expand into a new market, firms that serve multiple markets are more likely to be established exporters and have incurred fixed entry costs prior to our sample year, which implies that these firms would be less affected by our measures of rationing than firms that serve a single foreign market. Hence, we expect that the impact of rationing on export participation is weaker for firms that export to multiple foreign markets than for those that serve a single foreign market.

We first examine the choice between exporting to a single market and selling to the domestic market only. Since the estimation excludes firms that export to multiple markets, on the ground of the reasoning above, we expect a strong negative effect of rationing on export participation. The estimates are in row 1 of Table 4 (only the coefficients on rationing are reported). Columns 2 and 4 show that rationing significantly reduces the probability of exporting, as expected. Interestingly, although the measure of weak rationing has no significant effect on export participation for exporters in general (see discussions in the last section), it does have a sizeable negative impact on firms that export to a single market. In row 2, we present the results for the choice between exporting to multiple markets and selling to the domestic market only. The estimation excludes firms that export to a single market. Column 2 shows that by the measure of strong rationing, credit rationing has a statistically negative effect on export participation. However, the magnitude of the effect is statistically smaller than that for single-market exporters as shown in row 1. Moreover, column 4 reveals that by the measure of weak rationing, credit rationing has no statistically significant effect on export participation. Therefore, consistent with our expectation, rationing has a stronger negative impact on single-market exporters than on multiple-market exporters.

The vast majority of Italian exporters use the EU market as a stepping stone toward non-EU markets. In row 3 of Table 4, we look at how rationing may affect the decision whether or not to enter non-EU markets by firms that have already exported to the EU. The estimate shows that among firms that have already exported to the EU, rationing does not seem to be a barrier for their entry into a second foreign market. In fact, rationed firms are more likely to expand into non-EU markets than non-rationed firms. However, the effect of rationing is not uniform across the various destinations: rows 4–11 of Table 4 reveal that it has a stronger negative effect when the second foreign market differs from the EU more sharply (the estimation is again conditional on exporting to the EU). Based on the measure of strong rationing as shown in column 2, we find that rationed firms are substantially less likely to export to Africa. Interestingly, rationed firms are more likely to export to North America once they have exported to the EU. Column 4 shows that, when using the measure of weak rationing, credit rationing still has a significantly negative effect

Table 4
Entry into multiple markets.

	Strong rationing				Weak rationing				
	Probit		Bivariate probit		Probit		Bivariate probit		
	(1)		(2)		(3)		(4)		
	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	#Obs
All firms									
Single/multiple foreign markets									
(1) Exporting to a single market	−0.046	0.140	**−1.841**	0.081	−0.014	0.087	**−1.378**	0.211	1731
(2) Exporting to multiple markets	0.073	0.129	**−1.112**	0.372	−0.039	0.073	−0.483	0.421	2794
Entering non-EU markets									
(3) Any non-EU market	0.143	0.116	**1.376**	0.523	−0.038	0.076	0.678	0.475	2171
(4) Africa	−0.218	0.245	**−1.804**	0.133	0.022	0.093	**−1.048**	0.530	2171
(5) China	−0.024	0.214	−1.336	2.999	0.078	0.110	−0.554	0.506	2168
(6) Russia	0.115	0.161	−0.980	0.810	*−0.141*	0.081	−0.438	0.722	2171
(7) Central & South America	0.066	0.187	−0.829	0.893	−0.059	0.093	0.416	0.480	2168
(8) Asia (excluding China)	−0.105	0.133	−0.555	0.946	−0.008	0.080	0.589	0.439	2171
(9) Australia and New Zealand	−0.054	0.256	1.380	0.940	−0.079	0.109	0.320	0.648	2168
(10) Other Europe	0.136	0.150	0.963	0.743	−0.028	0.092	*0.994*	0.601	2171
(11) USA & Canada	−0.052	0.141	**1.221**	0.546	−0.039	0.076	**1.380**	0.312	2168
Employment <500									
(12) Exporting to a single market	−0.039	0.138	**−1.841**	0.081	−0.004	0.087	**−1.342**	0.262	1726
(13) Exporting to multiple markets	0.079	0.130	**−1.059**	0.399	−0.039	0.074	−0.423	0.418	2750
Employment <100									
(14) Exporting to a single market	−0.011	0.137	**−1.822**	0.085	−0.009	0.090	**−1.419**	0.208	1663
(15) Exporting to multiple markets	0.075	0.129	**−1.058**	0.479	−0.027	0.075	*−0.611*	0.351	2487
Employment <50									
(16) Exporting to a single market	0.022	0.126	**−1.790**	0.071	0.006	0.094	**−1.512**	0.059	1536
(17) Exporting to multiple markets	0.065	0.135	**−1.253**	0.421	0.005	0.079	*−0.660*	0.380	1564

(a) This table reports the estimated coefficients on credit rationing. All regressions include controls for liquidity ratio, leverage ratio, cash flow, labor productivity, log(employment), secondary education, college education, fixed assets/employment, firm age, ISO 9000, consortium, corporation, group, specialized intermediaries, South, Center, provincial average growth rate of value added, the number of branches (per 1000 inhabitants) in 1991–1998, and industry dummy variables. See the notes to Table 1 and Section 5.2 for more detail about data measurement. (b) In column 2, the number of savings banks in 1936 and the number of new branches created by incumbent banks in 1991–1998 are used as instruments for the measure of strong credit rationing. In column 4, the number of new branches created by incumbent banks is used as an instrument for the measure of weak credit rationing. (c) In all the regressions standard errors are clustered by province. The coefficients in bold are statistically significant at the 5% level, and those in italics are statistically significant at the 10% level.

on exporting to Africa and a positive effect on entering the North American market and other European markets.

In the above analysis we exploit the information on entry into multiple markets to partially deal with the lack of data on the export history of a firm. However, there is an alternative explanation for the stronger negative effect of rationing on single-market exporters than on multiple-market exporters. Firms that export to multiple destinations tend to be much larger and more productive than firms that export to a single destination (Bernard et al., 2009; Eaton et al., 2004). Because small firms are more sensitive to credit rationing, the results in rows 1–2 of Table 4 may reflect heterogeneity in the effect of credit rationing between big and small firms. To examine this alternative explanation, we look at subsamples of smaller firms. As shown in rows 12–17 our estimates remain stable and are very close to the results when all firms are included.

7. The intensive margin of export

In this section, we investigate the impact of credit frictions on the intensive rather than on the extensive margin of export by looking at the effect of credit rationing on foreign sales. In practice, we replace specification (Eq. (1)) with the following equation

$$y_i = \alpha_2 + \beta_2 C_i + Z_i\gamma_2 + \nu_i, \quad (3)$$

where y_i is the logarithm of foreign sales; C_i is a binary variable that takes the value of 1 if firm i faces credit rationing, 0 otherwise; and Z_i is the vector of controls for firm characteristics (see Section 5.2.3 for the list of control variables). Since C_i may be endogenous in Eq. (3), we also estimate the effect of rationing on foreign sales using an instrumental variable approach. Because the endogenous variable C_i is binary, we first obtain fitted probabilities of credit rationing $\hat{C}_i$ from the probit of Eq. (2), and then use $\hat{C}_i$ as the instrument for C_i in the two-stage least square (2SLS) estimation of Eq. (3). This method is fully robust to misspecification of the probit model of credit rationing and is more efficient than the 2SLS estimation in which the first stage regression directly includes the number of branches created annually by incumbent banks net of branches closed during 1991–1998 and the number of savings banks in 1936 as instruments for C_i. Since the instruments are at the province level, we cluster standard errors by province. Furthermore, the 2SLS estimate of the coefficient of C_i provides an estimate of the average treatment effect of credit rationing on the intensive margin of export (see Wooldridge, 2002, pages 621–623).

7.1. Foreign sales

Columns 1–2 of Table 5 report the results when the measure of strong credit rationing is used. Column 1 lists the ordinary least square (OLS) estimates of Eq. (3) in which rationing is considered exogenous. There is no evidence that rationing has a statistically significant effect on foreign sales. On the other hand, more productive, larger, and more capital intensive firms and firms that have a higher liquidity ratio and better educated workers have significantly higher foreign sales. Similar to the result for the export participation decision, more levered firms sell more abroad.

Column 2 shows that when the endogeneity of rationing is accounted for, the effect of rationing on foreign sales becomes significantly negative. The magnitude of the effect is large: the point estimate is −3.043 (column 2) with a 95% confidence interval between −0.489 and −5.597. This suggests that controlling for all other factors, rationing reduces foreign sales by more than 38%.[8] The 2SLS estimates of other variables are very close to the OLS estimates. The bottom of

[8] Since foreign sales are in logarithm, a coefficient of −0.489 implies that foreign sales by credit rationed firms are 62% (= $exp(-0.489)$) of those by non-rationed firms, which means that credit rationing reduces foreign sales by 38%.

Table 5
Foreign sales.

	Strong rationing				Weak rationing			
	OLS		2SLS		OLS		2SLS	
	(1)		(2)		(3)		(4)	
	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err
Credit rationing	−0.087	0.180	**−3.043**	1.285	**−0.170**	0.082	**−1.764**	0.711
Liquidity ratio	**0.657**	0.207	**0.511**	0.250	**0.645**	0.206	**0.489**	0.215
Leverage ratio	**1.386**	0.271	**1.788**	0.322	**1.433**	0.271	**1.992**	0.400
Cash flow	−0.009	0.013	−0.015	0.012	−0.009	0.013	−0.009	0.012
Labor productivity	**17.400**	2.185	**18.100**	2.437	**17.220**	2.174	**15.680**	2.292
Log(employment)	**1.154**	0.039	**1.159**	0.039	**1.149**	0.039	**1.094**	0.055
Secondary education	**0.704**	0.152	**0.638**	0.167	**0.702**	0.152	**0.665**	0.168
College education	**2.487**	0.481	**2.352**	0.543	**2.512**	0.477	**2.714**	0.513
Fix assets/employment	**1.276**	0.198	**1.377**	0.239	**1.282**	0.199	**1.368**	0.261
Log(firm age)	−0.059	0.041	−0.071	0.049	−0.056	0.041	−0.027	0.041
ISO9000	−0.110	0.069	−0.094	0.074	−0.112	0.070	−0.125	0.082
Consortium	−0.032	0.094	−0.042	0.110	−0.030	0.094	−0.014	0.111
Corporation	−0.041	0.218	−0.016	0.207	−0.035	0.216	0.028	0.219
Group	**0.191**	0.071	**0.209**	0.083	**0.192**	0.069	**0.211**	0.073
South	−0.071	0.162	−0.057	0.189	−0.054	0.161	0.114	0.200
Center	0.130	0.119	0.164	0.127	0.134	0.118	0.183	0.128
Provincial value-added growth	−2.055	4.352	−0.555	5.111	−2.024	4.301	−1.309	4.519
# Branches	0.514	0.460	0.048	0.531	0.484	0.446	0.072	0.422
R^2	0.512		0.396		0.513		0.397	
First stage regression of credit rationing								
Fitted probability of rationing			**1.136**	0.202			**1.662**	0.340

(a) All regressions involve 1680 firms and include industry dummy variables. See the notes to Table 1 and Section 5.2 for more detail about measurement. (b) The fitted probability of credit rationing serves as the instrument for credit rationing and is computed using the estimates of Eq. (2). See Section 7 for more detail. (c) In all the regressions standard errors are clustered by province. The coefficients in bold are statistically significant at the 5% level, and those in italics are statistically significant at the 10% level.

column 2 displays the estimated coefficient on the fitted probabilities of rationing $\hat{C}_i$ (other coefficients from the first stage regressions are not tabulated). It is clear that $\hat{C}_i$ is significantly correlated with C_i in the first stage regression.[9] Columns 3–4 of Table 5 display the estimates when we use the metric of weak rationing. There are two main differences from the results for strong rationing. First, as shown in column 3, the OLS estimate of the rationing effect is statistically significant and negative. Second, compared to the result in column 2, the 2SLS estimate of the effect is smaller when the measure of weak rationing is used. This is reasonable because this measure includes firms that suffer from less severe rationing. The point estimate of the effect is −1.764 (column 4) with a 95% confidence interval between −0.352 and −3.176, which implies that holding all other factors constant, rationing reduces foreign sales by more than 30%. Thus, using the measure of weak rationing, we still find that rationing has a sizable negative impact on foreign sales.

We carried out a number of robustness checks (the results are available upon request). In a first robustness check, we dropped the liquidity ratio and the leverage ratio from the regressions and found that the above results carry through. We also used the number of banks and the duration of the main credit relationship as alternative proxies for the risk of rationing. We found that these variables do not affect foreign sales, which suggests that they are less accurate than our measures of rationing in capturing whether a firm faces credit constraints or not. Finally, as we did for the extensive margin of export, in the regressions we inserted province-level indices of development of various categories of infrastructures (roads and expressways, railways, ports, airports, and telecommunications) computed for the years 1997–2000. The coefficients on the indices turned out to be generally insignificant and the results for rationing remained virtually unaffected.

[9] The fitted probabilities of rationing $\hat{C}_i$ are obtained by estimating Eq. (1). The coefficients on the number of new branches created by incumbent banks in 1991–98 and the number of savings banks in 1936 are −17.77 ($t=-4.31$) and −38.63 ($t=-2.45$), respectively. The instruments are also jointly significant: $\chi^2=21.39$ and $p<0.001$.

7.2. Sample selection

There are two sources of sample selection which can bias our estimates of the effect of rationing on foreign sales. The first is due to firms' self-selection into the export market. We can only observe positive foreign sales for exporters; for non-exporters, foreign sales are zero. To deal with this selection problem, we use a Heckman type sample selection model by adding an inverse Mills ratio to Eq. (3) (see Wooldridge, 2002, page 567). The inverse Mills ratio is estimated from a probit model of export participation decision on the instruments for rationing and on the controls discussed in Section 5.2.3, which include a dummy variable indicating whether the firm distributed its products through specialized intermediaries. We find that firms that had access to specialized intermediaries for distributing products are significantly more likely to export: the estimated coefficient in the probit model is 0.474 with a standard error of 0.051. On the other hand, we find no difference in foreign sales between firms that had access to this marketing channel and those that did not. Thus, the indicator of whether a firm distributed its products through specialized intermediaries is excluded from the regression of foreign sales, which helps identify the effect of rationing on foreign sales. We then estimate Eq. (3) by adding the inverse Mills ratio computed using the probit estimates. We also treat rationing as endogenous, instrumenting it using the fitted probabilities of rationing as detailed above. Columns 1–2 of Table 6 report the results using the measure of strong rationing. The estimated effect of rationing on foreign sales remains significantly negative (row 1 and column 2). On the other hand, row 2 shows that the inverse Mills ratio is not statistically significant, which suggests that the null hypothesis of no sample selection bias cannot be rejected. This conclusion holds when the measure of weak rationing is used (columns 3–4).

The second source of sample selection stems from the way survey questions were designed. Sales were broken down into subcontracted and non-subcontracted. Here, subcontracting means an industrial relationship by which a firm entrusts another with the execution of a step of its own production process or of an activity linked to the production process itself, or of the provision of intermediate inputs or

Table 6
Foreign sales: accounting for sample selection.

	Strong rationing				Weak rationing				
	OLS		2SLS		OLS		2SLS		
	(1)		(2)		(3)		(4)		
	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	#Obs
Zero exports									
(1) Credit rationing	−0.080	0.179	**−3.002**	1.305	**−0.167**	0.083	**−1.760**	0.715	1680
(2) Inverse Mills ratio	−0.337	0.239	−0.156	0.302	*−0.397*	0.222	−0.268	0.284	
Missing reports of exports									
(3) Credit rationing	−0.083	0.181	**−2.998**	1.277	**−0.169**	0.083	**−1.746**	0.702	1680
(4) Inverse Mills ratio	0.216	0.340	0.101	0.377	0.234	0.340	0.386	0.355	
Share of subcontracted sales									
(5)=100%	−0.342	0.241	*−3.709*	2.208	−0.180	0.112	−1.365	0.941	1162
(6) >90%	−0.368	0.222	*−4.144*	2.383	**−0.246**	0.104	*−1.449*	0.826	1309
(7) >70%	−0.168	0.215	**−3.698**	1.612	**−0.203**	0.093	**−2.002**	0.817	1464
(8) >50%	−0.138	0.188	**−3.825**	1.463	**−0.203**	0.085	**−2.265**	0.833	1569
(9) >30%	−0.112	0.185	**−3.560**	1.320	**−0.180**	0.084	**−2.048**	0.757	1618
(10) >10%	−0.090	0.180	**−3.125**	1.307	**−0.176**	0.083	**−1.830**	0.734	1673

(a) All regressions include controls for liquidity ratio, leverage ratio, cash flow, labor productivity, log(employment), secondary education, college education, fixed assets/employment, firm age, ISO 9000, consortium, corporation, group, South, Center, provincial average growth rate of value added, the number of branches (per 1000 inhabitants) in 1991–1998, and industry dummy variables. (b) Rows 5–10 report the coefficients on credit rationing. For instance, row 6 displays the results for firms that sold at least 90% of their products through subcontracting. (c) In all the regressions standard errors are clustered by province. The coefficients in bold are statistically significant at the 5% level, and those in italics are statistically significant at the 10% level.

components which will be integrated into a more complex product. Only for subcontracted sales are firms required to report further sales breakdown by destinations (the same province, the rest of Italy, and abroad). Hence, we have information about foreign sales only for firms which sold their products through a subcontracting relationship (78.1% of exporters). In order to examine whether firms that had subcontracted sales are systematically different from those without sub-contracted sales, and whether this sample selection would cause any bias of the estimates in Table 5, we again use a Heckman type sample selection model by adding an inverse Mills ratio to Eq. (3). To achieve better identification, we again exploit the information about sales breakdown by distribution channels. Specifically, to obtain the inverse Mills ratio we estimated a probit model that predicts the probability of subcontracting using the exogenous variables in Eq. (3), the instruments for credit rationing, and a dummy variable indicating whether the firm sold its products directly to firms (without intermediaries). The estimated coefficient on this indicator is 0.519 with a standard error of 0.063. On the other hand, we find no significant partial effect of this indicator on foreign sales. As reported in rows 3–4 and columns 1–2, the inverse Mills ratio is statistically insignificant, indicating that we cannot reject the hypothesis that the sample selection into subcontracting does not cause significant bias of our estimates. Again, this conclusion carries through when the measure of weak rationing is used, as shown in columns 3–4.

There is an additional issue we need to deal with. Because only subcontracted sales are further broken down by destinations, we can observe the full amount of foreign sales only for exporters who sold all their products through subcontracting. In our sample, 69% of the exporters with subcontracted sales had only such sales. However, for the remaining exporters who sold their products through both subcontracted and non-subcontracted sales, we can only observe their exports through subcontracted sales. In our sample, just 7% of exporters sold over 50% of their products directly. In order to verify how sensitive our results are to the fraction of sales through subcontracting, we adopt different cutoffs and re-estimate Eq. (3) using subsamples. The results are in the bottom panel of Table 6. For instance, in row 6 our estimation involves firms that sold at least 90% of their products through subcontracting. Rows 5–10 show that the coefficient on rationing is statistically significant in almost all cases and the magnitude of the estimates is reassuringly stable.

7.3. Are foreign and domestic sales different?

The above findings suggest that rationed firms have significantly lower foreign sales. Do these exporters also curtail sales in the domestic market, controlling for all the other factors (e.g., firm size, productivity, and workforce)? To address this question, we estimate Eq. (3) by replacing the dependent variable with the logarithm of domestic sales. The results are in row 2 of Table 7. For comparison, row 1 carries over the results for foreign sales from the first row of Table 5. The 2SLS estimates suggest that rationing depresses domestic sales. When the measure of strong rationing is used, we obtain that this effect is substantially weaker than that on foreign sales: the point estimate of the effect on domestic sales is −1.571, which is just half the size of the effect on foreign sales. We find somewhat less compelling evidence for this when the measure of weak rationing is used. All in all, these results corroborate the view that credit frictions affect export disproportionately.

Similar to the data issue surrounding foreign sales, we have information on domestic sales only for firms which reported subcontracted sales. To account for the possible sample selection bias, we again use a Heckman type sample selection model as detailed in the last section. As displayed in rows 3–4, we find no strong evidence of selection bias—the inverse Mills ratio is not statistically significant. Row 5 of Table 7 lists the estimates for total sales. In all cases, rationed firms have statistically smaller total sales than non-rationed firms. The results in Table 7 also suggest that the contraction of foreign sales is an important source of total sales reduction for rationed businesses.

8. Heterogenous effect of credit rationing

In the above analysis, we have postulated that credit rationing has the same effect across firms and industries. Now we study whether its effect on export participation and foreign sales differs across types of firms and industries. The results are gathered in Table 8.

Because our measure of rationing is binary, we cannot observe how tight rationing is. Building upon the theoretical arguments in Section 6.2, one may conjecture that rationing is more severe for firms with a shorter credit relationship with their main banks and for firms with fewer creditors. In rows 1–2, the sample is split based on the

Table 7
Domestic sales and total sales by exporters.

	Strong rationing				Weak rationing				
	OLS		2SLS		OLS		2SLS		
	(1)		(2)		(3)		(4)		
	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	Coeff.	Std err	#Obs
Foreign sales									
(1) Credit rationing	−0.087	0.180	**−3.043**	1.285	**−0.170**	0.082	**−1.764**	0.711	1680
Domestic sales									
(2) Credit rationing	*−0.190*	0.103	*−1.571*	0.819	**−0.105**	0.045	**−1.498**	0.545	1647
Missing reports of domestic sales									
(3) Credit rationing	*−0.190*	0.103	*−1.596*	0.822	**−0.103**	0.046	**−1.517**	0.562	1647
(4) Inverse Mills ratio	−0.066	0.213	−0.120	0.230	−0.050	0.217	0.074	0.270	
Total sales									
(5) Credit rationing	**−0.154**	0.053	**−1.976**	0.529	**−0.101**	0.028	**−1.893**	0.483	2360

All regressions include controls for liquidity ratio, leverage ratio, cash flow, labor productivity, log(employment), secondary education, college education, fixed assets/employment, firm age, ISO 9000, consortium, corporation, group, South, Center, provincial average growth rate of value added, the number of branches (per 1000 inhabitants) in 1991–1998, industry dummy variables. In all the regressions standard errors are clustered by province. The coefficients in bold are statistically significant at the 5% level, and those in italics are statistically significant at the 10% level.

number of years that a firm has been operating with its current main bank (using the industry median as the cutoff). We find that rationing significantly reduces the probability of exporting and foreign sales for firms with a short relationship, suggesting that a short relationship intensifies rationing. We then group firms according to the number of banks from which the firm borrowed in 2000. Again we use the industry median as the cutoff. Row 3 of Table 8 provides evidence that for firms with fewer creditors rationing reduces the rate of export participation and substantially reduces foreign sales. Overall, the results in rows 1–4 suggest that the rationing effect differs systematically across firms with different financial characteristics.

Next, we examine whether the effect of rationing varies across firms of different age, size and growth rate. Younger firms might suffer from stronger information asymmetries in the credit market and face tighter constraints if they are rationed. Consistent with our conjecture, rows 5–6 of Table 8 show that strong rationing has a pronounced negative effect on foreign sales for younger firms, but not for older firms. Since bigger firms have typically more financial resources, rationing may be less severe for bigger firms if they face rationing. Furthermore, the fixed costs necessary for entering foreign markets are probably less of a burden for big firms: such businesses possess better knowledge and networks, can develop a larger international sales force, and can spread the fixed costs of exports across a larger volume of output than smaller businesses. Thus we expect a larger negative effect of rationing for small firms than for big ones. We define big firms as those with assets during 1998–1999 above the industry median. As displayed in rows 7–8 of Table 8, the effect of rationing on the probability of exporting does not appear to be significantly different across firms of different size. Perhaps, this stems from the fact that there is actually a limited size variation across the firms in our

Table 8
Heterogeneity in the effect of credit rationing.

	Export participation					Foreign sales				
	Strong rationing		Weak rationing			Strong rationing		Weak rationing		
	(1)		(2)			(3)		(4)		
	Coeff.	Std err	Coeff.	Std err	#Obs	Coeff.	Std err	Coeff.	Std err	#Obs
Heterogeneity across firms										
(1) Short credit relationship	*−0.984*	0.518	**−0.790**	0.402	1702	**−2.402**	0.939	*−1.254*	0.729	813
(2) Long credit relationship	−0.837	2.640	−0.796	1.321	1543	−1.374	1.001	−1.735	1.621	763
(3) Few creditors	**−1.488**	0.325	**−0.892**	0.358	1979	−1.446	1.835	*−1.718*	0.895	901
(4) More creditors	−0.873	1.051	0.157	0.952	1450	−1.762	1.225	−1.222	1.019	773
(5) Young firms	**−1.119**	0.511	0.820	0.713	1782	**−4.266**	1.493	−4.408	2.656	833
(6) Old firms	**−1.550**	0.619	−0.656	0.700	1660	−1.608	1.562	−1.346	0.882	847
(7) Small firms	**−1.317**	0.605	−0.095	1.037	1726	−0.132	1.493	−1.177	0.766	722
(8) Big firms	**−2.046**	0.119	−0.601	0.636	1716	**−1.934**	0.936	−1.133	0.742	958
(9) Low growth firms	**−1.204**	0.608	−0.632	0.551	1643	−2.004	1.354	−0.226	1.203	799
(10) High growth firms	*−1.400*	0.718	0.770	0.770	1786	−1.737	1.343	**−2.712**	0.964	877
Heterogeneity across industries										
(11) High external finance dependence	*−1.064*	0.579	**−0.982**	0.301	1770	**−4.140**	0.920	**−2.610**	0.663	928
(12) Low external finance dependence	−1.200	0.924	−0.398	0.896	1672	−0.396	1.966	0.899	1.561	752
(13) High-tech	−1.312	1.182	*−0.974*	0.530	976	**−3.374**	0.685	**−2.997**	0.869	555
(14) Low-tech	*−1.051*	0.598	−0.406	0.669	2466	−2.750	1.881	−0.878	1.021	1125

Columns 1–2 report the bivariate probit estimates of the effect of credit rationing on the probability of exporting. Columns 3–4 report the 2SLS estimates of the effect of credit rationing on foreign sales. All regressions include controls for liquidity ratio, leverage ratio, cash flow, labor productivity, log(employment), secondary education, college education, fixed assets/employment, firm age, ISO 9000, consortium, corporation, group, South, Center, provincial average growth rate of value added, the number of branches (per 1000 inhabitants) in 1991–1998, and industry dummy variables. For export participation in columns 1–2, we also include a dummy variable indicating whether a firm distributed its products through specialized intermediaries. The number of new branches created by incumbent banks and the number of savings banks are used as instruments for strong rationing, and the number of new branches created by incumbent banks is used as an instrument for weak rationing. In all the regressions standard errors are clustered by province. The coefficients in bold are statistically significant at the 5% level, and those in italics are statistically significant at the 10% level.

sample. Indeed, in line with the characteristics of the Italian industrial structure, the large majority of businesses are small or medium-sized.

The growth prospects of a firm could also play a role in determining the intensity of rationing. To check this, we sort firms based on the sale growth rate during 1998–1999. The effect of rationing on export participation appears to be similar between high-growth and low-growth firms. On the other hand, the results for foreign sales are somewhat sensitive to how rationing is measured (see rows 9–10). We find no significant effect when using the measure of strong rationing, but a significantly negative effect for high-growth firms when using the measure of weak rationing.

The bottom panel of Table 8 reports the results obtained by allowing the effect of rationing on export to differ across industries. For industries that rely more on external finance, rationing may have a larger negative effect. The Rajan and Zingales (1998) index of external finance dependence has been widely used in the literature that investigates the relationship between financial development and economic growth or international trade (see, e.g., Svaleryd and Vlachos, 2005). As is made clear by rows 11–12 of Table 8, rationing has a significantly negative effect on export participation and foreign sales for firms operating in high external finance dependence industries (value of the Rajan–Zingales index above the median), but no effect for firms in industries with low dependence.[10] Finally, we examine whether rationing affects exports more in high-tech or in traditional industries. This question is interesting for two reasons. First, it is argued that industrial countries can better face the competition of fast-growing economies (e.g., China and India) if they specialize in products with high technological content and intensity of human capital. Second, breaking down industries into high-tech and traditional ones can yield insights into the mechanisms through which credit frictions can impede firms' international orientation. For example, finding that firms in high-tech sectors are disproportionately exposed to rationing may suggest that the fixed costs that firms need to finance involve some degree of technological sophistication. We sort our sample into two groups of industries (high-tech and traditional) following the classification in Benfratello et al. (2008).[11] The results for foreign sales (in rows 13–14 of Table 8) reveal that rationing negatively affects exports in high-tech industries while we detect no significant impact in traditional industries. This suggests that credit imperfections could be particularly harmful precisely in the sectors least exposed to the competition of fast-growing economies.

9. Conclusion

In this paper, we use detailed survey data on 4680 Italian firms to estimate the impact of credit rationing on firms' exporting decisions and foreign sales. Our measure of rationing comes directly from firms' responses to the survey rather than being derived from firms' financial statements. Controlling for productivity and other business characteristics, and accounting for the endogeneity of rationing, we find that the probability of exporting is 39% lower for rationed firms and that credit rationing reduces foreign sales by more than 38%. We also uncover evidence that the impact of credit rationing on foreign sales is significantly larger than its negative effect on domestic sales.

We further investigate the heterogeneous response to credit rationing across firms and industries. We obtain that rationing reduces firms' exports especially in industries with high external finance dependence. Moreover, credit frictions appear to hinder firms' export particularly in high-tech sectors, that is, the sectors allegedly least exposed to the competition of fast-emerging economies.

This paper leaves interesting issues open for future research. In a dynamic perspective, a firm's decision to export is often seen as a step in a life cycle that starts with the firm's inception and also involves the firm's investments in innovation. In particular, on the one hand, the introduction of new products and processes can be a key prerequisite for entering foreign markets successfully; on the other hand, the entry into foreign markets can create further innovation opportunities. Analyzing the impact of financial markets on these rich interactions could further advance our understanding of the determinants of firms' international orientation.

Data Appendix

Four main data sources are used: the 2001 Survey of Manufacturing Firms (SMF), the province-level and the industry-level databases of the Italian National Statistics Office (ISTAT), the Statistical Bulletin of the Bank of Italy (SBBI), and the book "Struttura funzionale e territoriale del sistema bancario italiano 1936–1974" (SFT) of the Bank of Italy. The SMF is conducted every three years by the "Observatory on Small and Medium Enterprises" of the banking group Capitalia. It comprises the universe of firms with more than 500 employees and a stratified sample of firms with fewer than 500 employees, for a total of 4680 firms. To guarantee representativeness of the smaller firms, the sample is stratified by gross product per employee. The sampling plan is constructed subdividing the universe of firms with more than ten employees into homogeneous groups (strata consisting of 5 classes, 4 sectors defined according to the Pavitt taxonomy and two macro-areas, North and Center–South). The size and composition of the sample are obtained using the Neyman formula, which defines the size in order to minimize the sample variance. The survey is conducted through a system of computer assisted telephone interviews (Cati) with a person inside each firm. For each firm, the person is identified by an initial phone call to the company during which the research initiative is presented. During the interviews, a questionnaire is administered to the reference person. The information collected includes employment, investment, export sales and their destination, location, industrial sector, year of foundation, sales, financing and credit rationing, and balance sheet items. Capitalia ensures the accuracy of the survey in several ways. It designs an exploratory experiment to verify the application of the Cati software for the management of interviews. In addition, the system includes an automatic control (to check for violations of rules of formal logic, e.g., consistency with the domain of variation of individual variables) and a further survey which repeats interviews for a subsample of companies to verify the level of accuracy of the results obtained with the original interviews. When relevant discrepancies from the original interviews are detected, the interviewer in charge is responsible for redoing all interviews.

The data from ISTAT include national price indices, provincial population and value added. The SBBI is a quarterly publication that contains data on financial intermediaries, interest rates and monetary aggregates. This data set contains demographic information on bank branches sorted by province. The SFT contains historical data on the regional structure of the Italian banking system, such as the number of financial institutions by type (e.g., savings bank) and province. It also contains information on the implementation of the financial reform in 1936.

The sample covers the following manufacturing industries: Food; Tobacco; Textiles; Apparel; Leather; Lumber and wood products; Paper; Printing and publishing; Petroleum and coal products; Chemicals; Rubber and plastics; Nonmetallic and mineral products; Primary metal products; Machinery manufacturing; Electronic computing equipment; Electrical machinery; Radio and television communication equipment; Medical, dental and ophthalmic equipment; Motor vehicles; Other transportation; and Furniture.

[10] We classify industries into high or low external finance dependent based on Table 1 of Rajan and Zingales (1998).

[11] The high-tech sectors are: Chemicals; Non-electric machinery; Office equipment and computers; Electric machinery; Electronic material, measuring and communication tools, TV and radio; Medical apparels and instruments; Vehicles; Other transportation.

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