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# Export quality differentiation under credit constraints

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## KEYWORDS

credit constraints, distance, heterogeneous firms, product quality

## 1 | INTRODUCTION

Access to external capital is crucial to conduct international trade. The negative impact of credit constraints on the probability of exporting has been assessed both theoretically and empirically (Chaney, 2016; Manova, 2013; Minetti & Zhu, 2011). Exporters require external capital to face additional up-front costs associated with setting up a distribution network in the destination market, product customisation and advertising (Sutton, 2001, 2007). Expenses associated with output quality upgrading (Amiti & Khandelwal, 2013; Fielor, Eslava, & Xu, 2018; Verhoogen, 2008) and technology upgrading (Bustos, 2011) are a central component of export up-front costs. The literature finds that firms supplying high-quality products are more likely to succeed in exporting (Grossman & Helpman, 1991; Iacovone & Javorcik, 2010; Martin & Mejean, 2014), report higher export revenues (Eckel, Iacovone, Neary, & Javorcik, 2015; Manova & Yu, 2017) and reach distant markets (Hummels & Skiba, 2004; Mayneris & Martin, 2015). As a consequence, financing constraints may strongly affect export revenues by hampering quality differentiation at the firm level.<sup>1</sup> Nonetheless, to date, empirical evidence assessing the influence of credit constraints on output quality is limited.

This paper empirically investigates the effect of credit constraints on the decision of Italian small and medium-sized enterprises (SMEs) to export products of higher quality with respect to those sold

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<sup>1</sup>We refer to quality differentiation as the difference in the quality content of products supplied to two different markets.

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domestically.<sup>2</sup> In particular, it dissects the interaction between credit constraints and quality differentiation considering the role of distance to the importing market. This study relies on detailed firm-level data to investigate within-firm quality differentiation rather than assuming that firms supply goods of equal quality to the domestic and the export market.

We employ direct information on quality differentiation available from survey data and investigate the role of financing constraints using a firm-level measure of credit constraint based on the credit score of an external rating agency. The score is an annually updated measure available to each institution operating in the Italian credit market frequently used by bank managers when deciding on whether to open or to increase a firm's credit line. We study how financing constraints affect the probability that the firm supplies a product of higher quality to the foreign market. Given that output quality is positively correlated with the unit value at which a product is sold (Khandelwal, 2010), our study sheds light on how credit constraints affect this important component of the intensive margin of trade. Indeed, failure to pursue quality differentiation can prevent constrained firms from obtaining higher revenues in the export market.

Results show that credit-rationed SMEs are less likely to differentiate output quality for the export market. After controlling for various firm attributes, firms reporting a deterioration of the credit score by a standard deviation are 36% less likely to export goods of higher quality relative to their domestically sold output. We also investigate how distance to the export market and credit rationing jointly affect quality differentiation. The negative relation between credit constraints and quality differentiation is stronger on firms selling their products outside Europe. Indeed, the negative effect of a standard deviation worse external score is 28 percentage points larger on firms exporting outside Europe with respect to those exporting within Europe.

A potential concern is the endogeneity of the credit score. Quality differentiation might be considered as an indicator for the economic performance of the firm, thereby affecting its credit score. Moreover, unobservable characteristics could lead us to find biased results. Our first strategy to partially address endogeneity concerns treats the recent economic crisis as an exogenous shock to credit supply. We exploit variation in the score explained by the economic crisis as a proxy for credit rationing, after controlling for variables representing the economic and financial performance of the firm. Results show that, among two equally productive firms, the one whose score was more negatively affected by the crisis is less likely to differentiate export quality. The second procedure relies on two instrumental variables: the difference between the 8 years lagged credit score and its average at the province level, and an historical proxy for credit supply at the regional level (Guiso, Sapienza, & Zingales, 2004, 2006). Both strategies confirm the negative relation between credit constraints and quality differentiation.

To guide the empirical investigation, we lay out a theoretical framework based on Feenstra and Romalis (2014). In this model, firms choose output quality taking into consideration distance to the foreign market. The per-unit trade cost affecting the firm's optimal quality choice rises with distance (Hummels & Skiba, 2004; Martin, 2012). As a consequence, the firm is more likely to export high-quality rather than low-quality products to distant markets. We extend this setting by introducing credit availability, represented by the upper bound on cash flow that the firm receives as credit to finance the fixed cost of production, similarly to Sutton (2001, 2007) and Fan, Lai and Li (2015). The ratio between optimal output quality for the foreign and the domestic market depends then on distance as well as credit availability. We obtain two testable predictions: (a) the lower the credit availability, the more constrained is the firm, and

<sup>2</sup>SMEs have an important role in the European and the Italian economy. In 2011, Italian SMEs accounted for 49% of total export revenues. In 2014, SMEs represented 90% and 80% of firms exporting from Italy and Europe, respectively (Cernat et al., 2014). Evidence confirms that, during economic downturns, credit sources tend to dry-up more rapidly for small and medium firms than for large companies (ECB; 2013).

the less likely it is to increase the ratio between exported and domestic output quality; and (b) the more distant the export destination, the larger is the negative effect of credit rationing on quality differentiation.

Model predictions are tested on Italian firm-level data. We employ the "VIIIth UniCredit Survey on Italian SMEs", ran in June–September 2011, to obtain, among others, direct information on firms' international activities, output characteristics and credit rationing. Our findings are robust to considering alternative indicators of credit rationing, such as industry-level finance dependence (Rajan & Zingales, 1998). Results are confirmed when taking into consideration alternative proxies for the economic performance of the firm.

## 1.1 | Related literature

This work lies at the intersection between two strands of the literature. The first studies the relation between output quality and importing market attributes, such as distance and average income. These papers show that export quality is increasing with distance to the destination and average income in the importing market (Crinò & Epifani, 2012; Hallak, 2006; Hummels & Skiba, 2004; Martin, 2012; Mayneris & Martin, 2015). We consider the role of average income in the importing market both in the theoretical analysis and in the empirical analysis. We find that distance to the importing market affects quality differentiation also when considering variation in average income across importing markets.

The second strand studies how credit constraints affect the probability that a firm becomes an exporter and its output quality choice. Chor and Manova (2012) find that industries relying more on external finance report a higher sensitivity of exports to the cost of external finance and that this sensitivity increased during the financial crisis.<sup>3</sup> Manova (2013) finds that financially developed economies export more in financially vulnerable sectors since their firms are able to enter more markets and report higher export revenues. Minetti and Zhu (2011) assess that credit constraints affect negatively export participation and foreign sales of Italian manufacturing firms. Muùls (2015) concludes that credit-constrained firms export and import less than non-constrained ones and that the intensive margin of export is negatively and significantly associated with credit constraints.<sup>4</sup> Our findings suggest that the inability to differentiate product quality across markets might be a factor leading constrained exporters to obtain lower export revenues.

The empirical literature on credit constraints and output quality has mainly relied on industry-level proxies of credit rationing and on measures of product quality obtained from international trade data. Fan et al. (2015), using Chinese data, find that credit constraints, proxied by industry-level finance dependence, lead firms to reduce quality, proxied by unit values of exported products.<sup>5</sup> Employing the methodology proposed by Khandelwal (2010) to estimate product quality, Crinò and Ogliari (2017) confirm the negative correlation between financing constraints and average quality at the product–country level. Their study shows that heterogeneity in product quality is affected by the interplay of cross-industry heterogeneity in financial vulnerability and cross-country differences in financial

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<sup>3</sup>On the impact of financial shocks on exporting firms, see also Amiti and Weinstein (2011).

<sup>4</sup>Refer also to Besedeš et al. (2014).

<sup>5</sup>Choi and Lugovskyy (2015) suggest that the impact of financial development on export prices has different implications for countries with different levels of productivity and income. Eckel and Unger (2015) propose a theoretical framework investigating the correlation between firm-level f.o.b. prices and financial frictions.



frictions. Bellone, Bernini and Guillou, (2015), using the same proxy for product quality, confirm that highly leveraged firms export goods of lower quality.

The present study contributes to this strand of the literature by relying on a firm level, externally assessed, measure of credit rationing to show that credit constraints affect quality differentiation. This measure enables us to determine how severe credit rationing is for each firm. Furthermore, to the best of our knowledge, this paper is the first to provide empirical evidence on the interplay between distance to the importing market, quality differentiation and credit rationing.

The paper unfolds as follows. In Section 2, we illustrate the theoretical framework guiding the empirical analysis. In Section 3, the data set is described. Section 4 discusses the main result. In Section 5, we study the interplay of credit rationing and distance to the destination market. Section 6 reports on the robustness checks, while Section 7 concludes the paper.

## 2 | MODEL

We extend the framework proposed by Feenstra and Romalis (2014) in order to account for the role of credit constraints. This model enables us to investigate how credit constraints affect the optimal quality choice taking into consideration the role of distance to the importing market.<sup>6</sup> We study how firm  $j$ , exporting to country  $k$ , sets the ratio between output quality for the two markets, domestic and foreign, given its credit availability.

### 2.1 | The consumer

Each consumer in the importing country  $k$  consumes  $i = 1, \dots, N$  differentiated varieties of a product in a sector. Products are supplied by different exporting countries, while  $j$  refers to the single firm. The price and quality of good  $i$  in  $k$  are  $p_i^k$  and  $z_i^k$ , respectively. Demand in  $k$  is determined by the expenditure function:

$$(1) E^k = U^k \left[ \int_i \left( p_i^k / z_i^{\alpha^k} \right)^{(1-\sigma)} di \right]^{\frac{1}{1-\sigma}},$$

with  $\alpha^k = h(U^k)$  for  $U^k > 0$ . Quality  $z_i^k$  is raised to the power  $\alpha^k$ ,  $z_i^{\alpha^k} \equiv (z_i^k)^{\alpha^k}$ . The term  $\alpha^k$  depends positively on per-capita income in  $k$ ; thus, this expenditure function allows for non-homothetic demand for quality. Quality is a shift parameter in the expenditure function. Taking the derivative of the expenditure function with respect to  $p_i^k$ , we obtain the Hicksian demand for  $i$  in country  $k$ :

$$q_i^k = \frac{\partial E^k}{\partial p_i^k} = \frac{\partial E^k}{\partial P_i^k} \frac{1}{z_{ij}^{\alpha^k}}. \tag{1}$$

Quality-adjusted demand is  $Q_i^k = z_{ij}^{\alpha^k} q_i^k$ , while the quality-adjusted price is  $P_i^k = \frac{p_i^k}{z_{ij}^{\alpha^k}}$ , so to have

$$Q_i^k = \frac{\partial E^k}{\partial P_i^k}.$$

<sup>6</sup>The model proposed by Manova (2013) investigates the effect of credit constraints on selection into exporting and trade margins without deriving any direct prediction regarding the effect of credit constraints on product quality. The model derived in Fan et al. (2011) does not consider the role of per-unit trade costs which are crucial to study the role of distance to the importing country.

## 2.2 | The firm

Firm  $j$  in the exporting country,  $i$ , makes its optimal choice on the quality,  $z_{ij}^k$ , of the good to be sold in the foreign market  $k$  and on its price,  $p_i^k$ . Feenstra and Romalis (2014) consider both specific and iceberg trade costs:  $T_i^k$  is the per-unit trade cost which is larger than one and increasing in distance between country  $i$  and country  $k$ . The iceberg trade cost,  $\tau_i^k$ , applies to the total value of traded products, including the specific per-unit trade cost.<sup>7</sup> If we denote by  $p_i^{*k}$  the f.o.b. (free on board) price in the exporting country,  $i$ , the c.i.f. (cost, insurance and freight) price in the importing country,  $k$ , is equal to  $p_i^k \equiv \tau_i^k (p_i^{*k} + T_i^k)$ . Following the original model, output is produced employing a composite input in quantity  $x_{ij}^k$ . To produce one unit of a product with quality  $z_{ij}^k$ , the firm transforms a quantity  $x_{ij}^k$  of variable input using a Cobb–Douglas technology:  $z_{ij}^k \equiv (x_{ij}^k \varphi_{ij})^\gamma$ . With  $\varphi_{ij}$  defining firm's productivity and  $0 < \gamma < 1$ , indicating diminishing returns to quality. Assuming that the unitary cost of the variable input  $x_{ij}^k$  is  $w_i$ , the marginal cost of producing a good with quality  $z_{ij}^k$  is  $c_{ij}(z_{ij}^k, w_i) \equiv w_i (z_{ij}^k)^{1/\gamma} / \varphi_{ij}$ . This marginal cost is increasing in output quality. Recalling that  $q_{ij}^k$  represents demand in country  $k$ , the total cost of producing for country  $k$ ,  $TC_{ij}^k$ , is the sum of the variable cost,  $c_{ij}(z_{ij}^k, w_i) q_{ij}^k$ , and of the fixed cost to start producing an output with quality  $z_{ij}^k$  for market  $k$ .  $F_{ij}^k \equiv f^k w_i (z_{ij}^k)^{1/\gamma}$ , where  $f^k$  represents the part of the fixed cost varying according to destination and not depending on product quality.<sup>8</sup> This cost is paid by firms exporting to  $k$  for expenditures in R and D, marketing and innovation, as in Sutton (2001, 2007). The higher is output quality, and the larger is the fixed cost faced by the firm. The total cost function is then equal to:  $TC_{ij}^k = c_{ij}(z_{ij}^k, w_i) q_{ij}^k + F_{ij}^k$ .

Firm's profits in market  $k$  read as follows:

$$\pi_{ij}^k = \left[ p_{ij}^{*k} - c_{ij}(z_{ij}^k, w_i) \right] \tau_i^k q_{ij}^k - F_{ij}^k. \quad (3)$$

Rewriting (3) in quality-adjusted terms, using the definition of the fixed cost in quality-adjusted terms,  $\frac{F_{ij}^k}{z_{ij}^{\alpha k}} \equiv f^k \frac{w_i (z_{ij}^k)^{1/\gamma}}{z_{ij}^{\alpha k}}$ , and of the quality-adjusted c.i.f price,  $P_{ij}^k \equiv \tau_i^k (p_{ij}^{*k} + T_i^k) / z_{ij}^{\alpha k}$ , we obtain the following:

$$\frac{\pi_{ij}^k}{z_{ij}^{\alpha k}} = \left[ P_{ij}^k - \tau_i^k \frac{(c_{ij}(z_{ij}^k, w_i) + T_i^k)}{z_{ij}^{\alpha k}} \right] Q_{ij}^k - f^k \frac{w_i (z_{ij}^k)^{1/\gamma}}{z_{ij}^{\alpha k}}. \quad (4)$$

## 2.3 | Credit constraints

We introduce credit constraints in the firm's profit maximisation problem as in Fan et al. (2015). Following Melitz and Ottaviano (2008), we assume that the firm maximises profits in the two markets

<sup>7</sup>The iceberg cost is equal to one plus the ad-valorem cost.

<sup>8</sup>The firm has to invest  $x_{ij}^k$  units of input in its technology to start producing an output with quality  $z_{ij}^k$  for market  $k$ . This investment is equal for all firms exporting to  $k$  and does not depend on firm's productivity but only on the effectiveness of technology,  $1/\gamma$ . Moxnes (2010) confirms that the fixed cost of exporting can be market specific.



independently and then solve for optimal quality of exported and domestic products subject to credit availability.

Firms cannot borrow more than a fraction  $\theta \in [0, 1]$  of their cash flow in market  $k$  to finance the fixed cost of producing a good with quality  $z_{ij}^k$ . As a consequence,  $\theta$  indicates credit availability to the firm.

The firm finances the total amount of the fixed cost with bank credit.<sup>9</sup> Therefore, when  $\theta$  decreases, less credit is available to the firm. The budget constraint takes the following form:

$$\theta \left\{ \left[ P_{ij}^k - \tau_i^k \frac{(c_{ij}(z_{ij}^k, w_i) + T_i^k)}{z_{ij}^{\alpha^k}} \right] Q_i^k \right\} \geq f^k \frac{w_i (z_{ij}^k)^{\frac{1}{\gamma}}}{z_{ij}^{\alpha^k}}. \tag{5}$$

The profit maximisation problem reads as follows:

$$\max_{P_{ij}^k, z_{ij}^k} \left\{ \left[ P_{ij}^k - \tau_i^k \frac{(c_{ij}(z_{ij}^k, w_i) + T_i^k)}{z_{ij}^{\alpha^k}} \right] Q_i^k - f^k \frac{w_i (z_{ij}^k)^{\frac{1}{\gamma}}}{z_{ij}^{\alpha^k}} \right\}, \tag{6}$$

subject to (5). Using the definition for the marginal cost of production,  $c_{ij}(z_{ij}^k, w_i)$ , and introducing  $\lambda$  to represent the Lagrange multiplier, the first-order condition with respect to  $z_{ij}^k$  leads us to find optimal quality for the foreign market:<sup>10</sup>

$$(z_{ij}^k)^{1/\gamma} = \frac{\alpha^k \tau_i^k T_i^k Q_i^k}{\left(\frac{1}{\gamma} - \alpha^k\right) w_i \left[ \frac{\tau_i^k}{\varphi_{ij}} Q_i^k + \frac{(1+\lambda)}{(1+\lambda\theta)} f^k \right]}. \tag{7}$$

Optimal quality supplied to market  $k$  is increasing in the specific per-unit trade cost,  $T_i^k$ , in firm's productivity,  $\varphi_{ij}$ , and decreasing in the term  $\left(\frac{1+\lambda}{1+\lambda\theta}\right)$ , representing the distortion in output quality due to credit constraints. Moreover, per-capita income in the importing country, which influences the term  $\alpha^k$ , is positively associated with export quality, as in Hallak (2006). The first-order condition with respect to  $P_{ij}^k$ , the quality-adjusted c.i.f price, shows that the firm charges a price equal to a mark-up over marginal costs and specific trade costs:  $P_{ij}^k = \left(\frac{\sigma}{\sigma-1}\right) \tau_i^k \frac{(c_{ij}(z_{ij}^k, w_i) + T_i^k)}{z_{ij}^{\alpha^k}}$ . It is important to notice that the solution for the quality-adjusted price does not directly depend on credit availability, which affects  $P_{ij}^k$  only through  $z_{ij}^{*k}$  and  $c_{ij}(z_{ij}^{*k}, w_i)$ .

There exists a cut-off level of credit availability,  $\theta$ , such that the budget constraint (5) is binding for  $\theta^* < \theta$ . Using (the inverse of)  $\theta$  as a proxy for a firm's credit availability (constraint) and imposing that the budget constraint is binding, it is possible to solve for the distortion in output quality due to

<sup>9</sup>It is possible to solve the model allowing the firm to finance a fraction  $d \in [0, 1]$  of the fixed cost, as in Fan et al. (2015), obtaining results in line with those presented here. Derivations for this extension are available upon request. Here, we assume  $d = 1$  to simplify our exposition.

<sup>10</sup>Derivations are reported in Appendix A, available online.



credit constraints. Substituting the solution for  $\frac{1+\lambda}{1+\lambda\theta}$  in (7), we obtain optimal output quality supplied to market  $k$  when the budget constraint is binding:

$$z_{ij}^k = \left[ \frac{\varphi_{ij} \tau_i^k T_i^k Q_i^k}{w_i \left( f^k \varphi_{ij} \left( \frac{\sigma-1}{\theta} \right) - \tau_i^k Q_i^k \right)} \right]^\gamma \tag{8}$$

Notice that export quality depends on quality-adjusted demand, which represents demanded quantity for a given level of product quality,  $Q_i^k = \frac{\partial E^k}{\partial p_i^k}$ .

We now assume that the exporting firm produces also for the domestic market. Our aim is to find the optimal solution for output quality in the domestic market assuming that firm  $j$  maximises its profits in the two markets,  $i$  and  $k$ , independently. We solve the profit maximisation problem for firm  $j$  in

the domestic market  $i$  assuming that it faces a quality-adjusted fixed cost  $\frac{F_{ij}^i}{z_{ij}^{\sigma i}} \equiv f^i \frac{w_i (z_{ij}^i)^{\frac{1}{\gamma}}}{z_{ij}^{\sigma i}}$ . When producing for the domestic market, the firm does not pay any ad-valorem trade cost:  $\tau_i^i$  is equal to one. Moreover, we assume that the specific unitary trade cost,  $T_i^i$ , is also equal to one.<sup>11</sup> Our firm finances the total amount of the fixed cost obtaining a fraction,  $\theta \in [0, 1]$ , of its cash flow in the domestic market  $i$  as credit. When  $\theta$  decreases, the firm has less credit available and it is more likely to be credit rationed.

Using the same solution method adopted to find optimal quality in the foreign market, we can derive optimal output quality supplied to the domestic market when the budget constraint is binding:

$z_{ij}^i = \left[ \frac{\varphi_{ij} Q_i^i}{w_i \left( f^i \varphi_{ij} \left( \frac{\sigma-1}{\theta} \right) - Q_i^i \right)} \right]^\gamma$ . It is now possible to obtain the ratio between output quality supplied to the foreign and the domestic market,  $Z_j^{ki}$ :

$$Z_j^{ki} = \left( \frac{z_{ij}^k}{z_{ij}^i} \right)^{\frac{1}{\gamma}} = \left( \frac{Q_i^k}{Q_i^i} \right) \frac{\tau_i^k T_i^k \left[ f^i \varphi_{ij} (\sigma-1) \theta^{-1} - Q_i^i \right]}{\left[ f^k \varphi_{ij} (\sigma-1) \theta^{-1} - \tau_i^k Q_i^k \right]} \tag{9}$$

Equation (9) shows that the ratio between quality for the foreign and the domestic market depends, among others, on the specific unitary trade cost to the destination market, on quality-adjusted demand in the two markets and on credit availability. This equation leads us to obtain two theoretical predictions that we bring to the data:

**Proposition 1** Under a binding budget constraint, when credit availability ( $\theta$ ) decreases, the ratio between output quality supplied to the foreign and the domestic market decreases if  $\frac{Q_i^k}{Q_i^i} \tau_i^k > \frac{f^k}{f^i}$ .

**Proposition 2** If  $\frac{Q_i^k}{Q_i^i} \tau_i^k > \frac{f^k}{f^i}$ , when  $T_i^k$ , the specific unitary cost to ship a product to the foreign market  $k$ , increases, the ratio between output quality supplied to the foreign and the domestic market augments,  $\frac{z_{ij}^k}{z_{ij}^i}$ , when  $\theta$  increases. Since  $T_i^k$  is increasing in distance between the two markets, credit availability affects more output quality differentiation by firms exporting to distant markets.

<sup>11</sup>This assumption is consistent with Feenstra and Romalis (2014).



The first proposition states that as credit availability (rationing) is reduced (increases), the firm is less likely to increase the quality content of exported products with respect to the quality of products sold in the domestic market. Since the firm requires external funding to finance the fixed cost of production, a reduction in credit availability reduces quality differentiation when the budget constraint is binding.

This result holds as long as the ratio between the quality-adjusted quantities supplied to two markets, multiplied by the iceberg trade cost, is larger than the ratio between the constant terms in the fixed cost for the foreign and the domestic market.<sup>12</sup> This finding is consistent with Fan et al. (2015) who show that optimal quality for the foreign market is decreasing in credit rationing when the firm needs external finance to pay the fixed cost of quality differentiation.<sup>13</sup>

The second proposition states that a reduction in credit availability has a stronger impact on the quality ratio for firms exporting to markets reporting a higher  $T_i^k$ . According to the original interpretation of Feenstra and Romalis (2014),  $T_i^k$  is proportional to distance to the destination market. Therefore, credit constraints have a stronger negative impact on quality differentiation when firms serve distant markets. Notice that  $\alpha^k$  does not enter Equation (12): when the budget constraint is binding, per-capita income does not influence the quality ratio.

### 3 | DATA

The empirical analysis is based on data from the "VIIIth UniCredit Survey on Italian SMEs" ran in the summer of 2011. The sample was designed according to a stratified selection procedure so that findings are representative for the Italian economy. Interviewers collected data on a group of 6,025 firms reporting revenues below 5 million euro (small) and a group of 1,408 firms reporting revenues between 5 and 50 million euro (medium). Computer-assisted telephone interviews (CATI) were held to firms distributed on the whole national territory following a scheme which respects the original firms' population and using information for the period 2009–11. In particular, the sample of small firms was selected on the basis of province-level quotas and after that, within each province, the sample of interviewed firms was determined on the basis of firms' frequency distributions for each sector and legal form. In order to guarantee comparability within the sample, the group of medium-sized firms was selected on a regional basis. On average, 8% of firms are exporters within the group of firms reporting revenue below 5 million euro, while 62% of firms reporting a revenue between 5 and 50 million Euro are exporters. Firms employing less than 50 individuals represent more than 50% of firms included in the database.

The sample size of the survey consists of 7,433 non-financial firms, and among these, 1,057 are manufacturing firms. Given our research question, we focus on data from manufacturing firms, which account for more than 1% of Italian manufacturing firms in terms of employees.

The main strength of this database is the very detailed information it collects on individual firms. In particular, the 2011 wave features information regarding firms': (a) main characteristics; (b) innovation strategies; (c) financial structure and bank–firm relationship; (d) credit availability; (e) production characteristics; (f) collaboration and cooperation agreements; and (g) internationalisation strategies.

<sup>12</sup>The constant component of the fixed cost is larger in the export market  $k$ . For example, costs associated with setting up a new distribution channel are higher in the foreign market, leading to  $f^k > f^i$ . Moreover, the iceberg cost is larger than one:  $\tau_i^k$  units have to be shipped from  $i$  in order for one unit to reach  $k$ .

<sup>13</sup>The effect of credit rationing on quality differentiation can also be studied assuming that credit availability hampers the firm-level decision to increase product quality once entering the foreign market. When the firm has to pay costs upfront, credit availability can affect quality differentiation.

We also have access to annual balance sheet data for all firms involved in the survey for the period 2002–10. Along with firms' balance sheets, firms' credit scores from CeBi ("Centrale Bilanci") are at our disposal.

### 3.1 | Main Variables

#### 3.1.1 | High-quality out

Our dependent variable is a dummy equal to one if the firm answers "higher" to the following survey question: "How would you define the quality of your exported output compared to the one you sell in the domestic market?" Respondents are asked to compare the quality of exported output with the one sold in the domestic market. This question gives us the possibility to rely on a direct measure of quality differentiation. Moreover, it is included in the section of the survey dedicated to internationalisation strategies, where firms are asked a number of detailed questions which require the respondent to be well-informed on product characteristics and on the performance of the firm in the foreign markets.

When answering this question, firms can also declare that they export products of lower or equal quality with respect to the one produced for the domestic market. In our main specifications, we investigate whether credit constraints differently affect firms declaring to export a product of higher quality than those supplying products of equal quality to the two markets.<sup>14</sup> This setting enables us to directly assess how credit availability affects quality differentiation. The fact that the group supplying equal quality to the two markets includes firms producing high (low) quality for both markets does not affect our identification as long as we can control for determinants of product quality usually considered in the literature, such as labour productivity and firm size.

#### 3.1.2 | Measures of credit rationing

Following our theoretical framework, we should employ a firm-level proxy for credit constraints, an observable variable representing the inverse of  $\theta$ . When  $\theta$  decreases, accessing to bank credit becomes more costly to the firm that, as a consequence, cannot differentiate the quality content of its exported output. In the survey, firm managers are asked the following questions: (a) "In 2010 would the firm have liked to obtain more credit at the market interest rate?" and (b) "In 2010 did the firm demand more credit than it actually obtained?". In case of positive answer to both questions, the firm is defined as "strongly rationed", while in case of positive answer only to the first question, the firm is labelled as "weakly rationed". Minetti and Zhu (2011) rely on this variable as a proxy for credit rationing. Yet, this proxy for credit rationing suffers from two important shortcomings: (i) it is available only for year 2010; (ii) it does not give any information on the extent to which credit rationing differently affects firms.

#### 3.1.3 | External credit score

The firm's external credit score is an index spanning from 1 (firms in good financial/economic conditions) to 9 (firms with a very high risk of default), and it is computed by CeBi-CERVED analysing

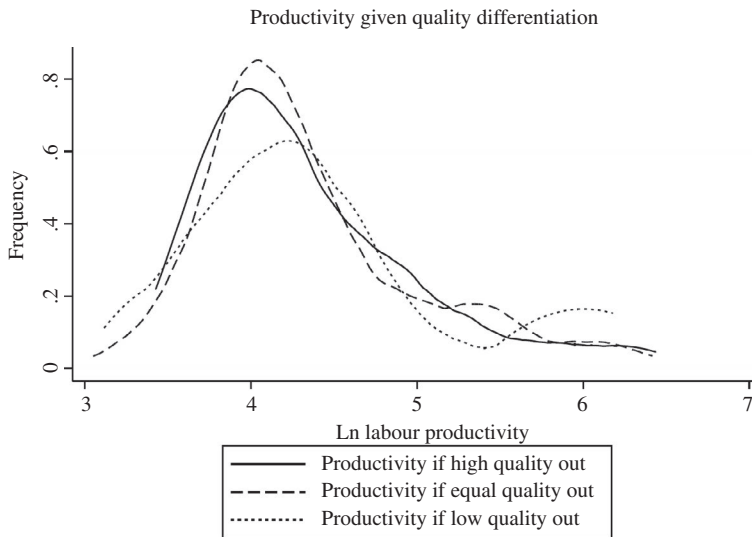
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<sup>14</sup>Firms declaring to export goods of lower quality represent 3% of exporting firms. We take these firms into consideration when assessing the robustness of our findings.

firm-level financial ratios with proprietary statistical models (Altman, 1968).<sup>15</sup> This is the most important and trusted rating used by Italian banks to assess the credit risk of Italian SMEs (Rodano, Serrano-Velarde, & Tarantino, 2016). Similarly to Muùls (2015), we consider this variable as a reliable proxy for credit constraints. Using Italian firm-level data for 2004, Rodano et al. (2016) find that the credit score is positively correlated with the interest rate charged by banks to firms. In their sample, the best score is associated with a loan interest rate of 4%, while the worst score category pays an interest rate slightly below 5%. Panetta, Schivardi, and Shum (2009) confirm that the score is an accurate predictor of actual default incidence among Italian firms.<sup>16</sup>

### 3.1.4 | Firm-level data

We consider a number of variables that can affect a firm's decision to change the quality of exported output and its access to credit. Large firms often produce for the foreign market and, since revenues are correlated with firm size, could have more funds available to invest in quality differentiation.<sup>17</sup> Our proxy for firm's size is the number of employees. Firm productivity is considered in the empirical trade literature, as well as in our framework, to be significantly associated with output quality.<sup>18</sup> Following Greenaway, Guariglia, and Kneller (2007) and Minetti and Zhu (2011), we measure labour productivity as the ratio between total value-added and the number of employees in each year. Quality differentiation could be associated with systematic differences in productivity across exporting firms. Figure 1 reports the distribution of labour productivity in 2010 for firms exporting products of higher, lower or equal



**FIGURE 1** Labour productivity in 2010 given quality differentiation across exporters

<sup>15</sup>This index is sometimes labelled Z-Score in the literature. This is the score classification: 1, highly safe, 2, safe, 3, highly solvent, 4, solvent, 5, vulnerable, 6, highly vulnerable, 7, at risk of default, 8, high risk of default, 9, very high risk of default.

<sup>16</sup>Refer to Appendix B, available online, for an empirical validation of this variable as a proxy for credit rationing.

<sup>17</sup>See Bernard et al. (2007) and Minetti and Zhu (2011).

<sup>18</sup>See Verhoogen (2008) and Crinò and Epifani (2012), among others.

quality than the one supplied to the domestic market. At a first sight, quality differentiation does not appear to be associated with substantial heterogeneity in productivity across exporters. In particular, the frequency distribution for firms increasing quality for the export market is not skewed with respect to the distribution of firms supplying goods of equal quality to the domestic market and the foreign market. The Kolmogorov–Smirnov test confirms that the two distributions are not statistically different.

We also rely on variables representing the amount of financial resources generated by the firm and its access to external funds. In particular, we use data on (i) firm's leverage ratio, defined by firm's total liabilities over equity; (ii) liquidity ratio, obtained dividing current assets less current liabilities by total assets; (iii) cash flow, equal to net revenues over total equity; and (iv) Ebitda, earnings before interest, taxes, depreciation and amortisation. We also consider capital intensity, measured by the ratio between total fixed assets and the number of employees to account for the role of firm-level capital needs in determining the impact of credit rationing on quality differentiation.

Variables (i) to (iii) have often been used in the literature as proxies for credit rationing.<sup>19</sup> In some of our specifications, these measures are used as control variables since we want to assess the explanatory power of the credit score as a proxy for credit rationing. It is important to stress that a firm's leverage ratio would give us information on the amount of credit received by the firm with respect to the resources generated internally; however, the amount of external funds obtained by a firm is the result of its production technologies, investment decisions and business cycles, and, as such, it gives partial information on how difficult and costly accessing to external finance might be for the firm. The external score is instead known by all banking institutions across Italy. It is probably the first indicator checked by a Bank's manager when asked to increase the upper limit or to open a new credit line for a firm, and it drives her/his decision on whether to finance a firm.

### 3.1.5 | Other survey data

Relying on survey data, it is possible to introduce variables correlated with a firm's decision to differentiate the quality of its exported output. Firms are asked to state the percentage of University graduates in their labour force, whether they innovate and which type of innovation they introduced, when the firm was founded, whether they are part of a business group, a corporation or a consortium and if they are located in the centre, the south or the north of Italy. Firms employing a skilled labour force and those active for several years are often found to be more productive and to supply high-quality products.<sup>20</sup> Being part of a corporation or a business group might give incentives to invest in innovation and in quality upgrading practices, while reducing the need of external capital. Moreover, given the peculiar features of the Italian economy and the fragmentation of its credit market, it is crucial to consider the geographical location of the firm since this is likely to affect the characteristics of its labour force as well as its access to external finance.

### 3.1.6 | Province-level variables

To this rich database, we add information on the economic activity at the province level: we introduce data on provincial value added from 1998 to 2008, both in levels and growth rates, obtained from the Italian National Statistical Office, ISTAT. This enables us to consider the role of local economic

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<sup>19</sup>See Greenaway et al. (2007) and Bernini et al. (2015).

<sup>20</sup>Wang (2016) finds that the probability of exporting and the volume of exports are higher for older firms.



conditions for product quality differentiation across markets (Minetti & Zhu, 2011). In order to obtain a proxy for credit supply at the local level, we consider the average number of bank branches per 1,000 inhabitants in each Italian province during the period 1991–98, available from the Bank of Italy.

### 3.2 | Summary statistics

Table 1 reports summary statistics on these variables for exporting manufacturing firms under observation.

Almost 12% of firms declare to export products of higher quality to the foreign market, 3% export goods of lower quality, while 85% supply products of equal quality to the two markets. Firms exporting goods of lower quality with respect to the ones supplied domestically mainly target EU markets. More than 55% of interviewed firms introduced either product or process innovation during the three years preceding the survey. Moreover, 78% of these firms introduced innovations for the main destination market. Interestingly, the majority of firms belonging to this group also declares to export goods of higher quality. The median number of employees is 49. Firms below 50 employees are well represented in our database as they account for more than half of firms. On average, exporting manufacturing firms are 32 years old and are mainly located in the north of Italy.<sup>21</sup> The percentage of the labour force holding a university degree is slightly higher than 10%. The median credit score is relatively low and equal to 4, suggesting that the majority of firms were considered as being not likely to default by the external rating agency in 2010. Nevertheless, 26% of firms define themselves as weakly rationed. The share of strongly rationed firms in our database, 13.3%, is similar to the share of Italian enterprises that were rejected a loan or had to refuse a loan because its costs would have been too high, amounting to 13.8% in the SAFE survey run in the same year (ECB, 2011). We can compare these numbers with Minetti and Zhu (2011), who also use data from a similar survey on Italian firms ran in 2001. In their sample, only 4.4% of exporting firms define themselves as strongly rationed and 18.5% weakly rationed. The sizeable increase in these percentages from 2001 to 2011 is concomitant with the credit crunch experienced by Italian SMEs during the Great Recession (Albaretto & Finaldi Russo, 2012).

## 4 | RESULTS: INCREASING QUALITY FOR THE FOREIGN MARKET

In this section, we empirically test predictions obtained in the framework presented in section 2. Our dependent variable is the dummy  $\Gamma_j^{ki}$  which is equal to 1 for firms exporting output of higher quality with respect to the one sold domestically and equal to 0 for firms not changing product quality across markets. Proposition 1 predicts that quality differentiation is decreasing in credit rationing:  $\partial \Pr(\Gamma_j^{ki} = 1) / \partial C_j < 0$ , where,  $C_j$ , represents credit rationing at the firm level. We rely on the following econometric specification:

$$\Pr(\Gamma_j^{ki} = 1) = \text{prob}(\alpha + \zeta_{ind} + \beta C_j + \omega X_j + \chi T_p + \varepsilon_j > 0). \quad (10)$$

<sup>21</sup>74.2% is located in the north, 15.5% in the centre and 10.1% in the south of Italy.

**TABLE 1** Descriptive statistics, 2010

	Mean	Median	SE-Mean	Min	Max	p5	p95	Obs.
High quality out (d)	0.119	0	0.013	0	1	0	1	621
Low quality out (d)	0.030	0	0.007	0	1	0	0	621
Equal quality out (d)	0.851	1	0.014	0	1	0	1	621
Strongly rationed (d)	0.133	0	0.013	0	1	0	1	622
Weakly rationed (d)	0.260	0	0.018	0	1	0	1	626
Innovation (d)	0.551	1	0.019	0	1	0	1	642
Innovation for the main market (d)	0.781	1	0.018	0	1	0	1	499
Corporation (d)	0.704	0	0.018	0	1	0	1	642
Consortium (d)	0.026	0	0.006	0	1	0	0	642
Business group (d)	0.336	0	0.018	0	1	0	1	642
North (d)	0.742	0	0.17	0	1	0	1	642
Centre (d)	0.155	0	0.014	0	1	0	1	642
South (d)	0.101	0	0.012	0	1	0	1	642
External score	4.380	4	0.084	1	9	1	7	513
Firm size	76.042	49	4.368	5	1,387	14	208	513
Ln labour productivity	4.113	4.122	0.024	0.356	6.722	3.330	4.926	505
Ln capital intensity	4.260	4.375	0.045	0.676	7.657	2.598	5.829	513
Ln cash flow	1.062	0.971	0.023	0.011	7.025	0.458	1.856	513
Leverage ratio	1.890	0.928	0.401	-111.143	80.803	0	7.609	513
Liquidity ratio	0.174	0.154	0.009	-0.628	0.810	-0.139	0.543	513
Labour skill	10.805	5	0.648	0	100	0	40	592
Firm age	32.663	29	0.964	1	179	5	69	607

*Notes:* This table reports descriptive statistics on our variables of interest. Data here reported refer only to exporting manufacturing firms. High quality out is a dummy equal to one for those firms that declare to produce output of higher quality for the foreign market. Low quality out is a dummy equal to one for those firms declaring to produce output of lower quality for the foreign market. Equal quality out is a dummy for those firms declaring to supply products of equal quality to the two markets. A firm is strongly rationed if it receives less external funds than what demanded in 2010 and if it would have accepted to obtain more credit at the current market interest rate. A firm is defined as weakly rationed if it answers positively only to the first question. Innovation is a dummy variable identifying firms that introduced a process or product innovation in the three years preceding the survey. Innovation for the main market indicates whether this innovation was introduced on products for the main destination market. Corporation, consortium and business group are dummy variables indicating whether a firm is a corporation, belongs to a consortium or to a business group. North, centre and south indicate in which part of the Italian territory the firm is headquartered. External score is the score received by the firm from the external rating agency in 2010, and it ranges from 1 to 9. The higher the score, the more likely to default is considered the firm. The number of employees is our proxy for firm's size. Labour productivity is measured as value added per employee. Fixed assets/employment measures capital intensity. Cash flow is computed as profits net of tax expenditures plus depreciation and is normalised by total assets. The leverage ratio is computed as firm's total liabilities over total equity. Liquidity ratio is defined as firm's current assets minus current liabilities over total assets. The number of years since the foundation is the proxy for firm age.

The term (d) indicates a dummy variable

The probability that firm  $j$  exports goods of higher quality with respect to the one supplied in the domestic market,  $\Gamma_j^{ki} = 1$ , depends on the explanatory variable,  $C_j$ , representing credit rationing at the firm level, proxied by the average of the credit score in the period 2008–10. The higher the external credit score and more rationed the firm is, the less likely it is to differentiate quality for the foreign



market. We control for firm-level variables correlated with firm's credit availability and with the possibility of a firm to upgrade the quality of its exported output,  $X_j$ . This vector of variables includes firm's size, labour productivity, cash flow, liquidity ratio, capital intensity, labour skill and firm's age. Following Minetti and Zhu (2011), variables representing economic development in the province where the firm has the headquarter, such as provincial value-added growth in the period 1998–2008, the average of provincial value added in the same period and the number of bank branches per 1,000 inhabitants in each province, are included in the vector  $T_p$ . In these specifications, we introduce an intercept and use industry dummies,  $\zeta_{ind}$ , in order to account for other sources of comparative advantage and for demand patterns within industries.<sup>22</sup> Standard errors are clustered at the province level in all of the following regressions. Panel A of Table 2 reports our first set of results.

We start by introducing our explanatory variable, the average of the credit score in the period 2008–10 together with industry-level dummies, and insert control variables group by group in the following Probit regressions. The external score reports in column (1a) a negative marginal effect equal to  $-0.025$ , significant at the 1% level. We add firm-level controls from specification (2a) onwards. Results confirm that large firms are more likely to report a quality differential between exported and domestically supplied products: this coefficient is positive and significant in all our regressions. The credit score remains significant when considering productivity differences across firms. If only high (low) productivity firms differentiate product quality, this variable should significantly reduce the explanatory power of the credit score: this is not the case. In specification (3a), we insert cash flow, liquidity ratio, leverage ratio and capital intensity. These variables report non-significant coefficients, yet, being correlated with the external score, influence the magnitude of this coefficient. We then control for the percentage of skilled labour force in the firm, for a dummy equal to one in case the firm introduced a product/process innovation in the year before the interview from specification (4a) onwards. These two variables report non-significant coefficients. In the same regression, we control for firm's age and for dummies representing the organisational structure of the firm. Firms belonging to a business group are less likely to differentiate product quality between the foreign market and the domestic market, while the other variables report non-significant coefficients. Our preferred specification, (5a), considers the whole set of controls, including provincial value-added growth and the number of bank branches at the province level. Firms located in provinces that experienced a positive growth in value added from 1998 to 2008 are less likely to differentiate quality for the export market. This finding suggests that firms located in richer provinces have less incentives to vary the quality of exported output given that regional demand, and the supposedly high level of competition, most likely already selects those firms producing an output quality closer to the one requested in the foreign markets. In specification (6a), we consider the level of provincial value added: results do not change and this variable reports a non-significant coefficient.

Turning to the main explanatory variable, this first set of regressions shows that the marginal effect of our proxy for credit constraint is negative and significant. Interestingly, the magnitude of the marginal effect for this variable remains quite stable across all specifications, ranging from  $-0.019$  to  $-0.030$ . Relying on the marginal effect obtained in specification (5a), a standard deviation higher external score is associated with a 36% reduction in the probability of quality differentiation.<sup>23</sup>

Referring to the estimates reported in panel B of Table 2, it is possible to compare results obtained in specification (5a) with those obtained estimating a linear probability model for the same specification, in (1b) and (2b), respectively. Results confirm that a worse credit score is associated with a lower

<sup>22</sup>Using the Italian Ateco two-digit classification, firms in our sample belong to 16 different industries.

<sup>23</sup>We obtain this estimate multiplying the average marginal effect of this variable, as obtained in specification (5a), 0.030, by its standard deviation in the estimation sample, 1.82. We then divide the result by the share of firms that upgrade quality in the estimation sample: 15%.



TABLE 2 Quality differentiation, determinants, probit

	Panel A					
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
	High quality out	High quality out	High quality out	High quality out	High quality out	High quality out
External score - av.	-0.025*** (0.008)	-0.019** (0.008)	-0.030** (0.015)	-0.026* (0.014)	-0.030** (0.014)	-0.029** (0.014)
Ln firm size - av.		0.044** (0.022)	0.039* (0.022)	0.049** (0.024)	0.047** (0.024)	0.047** (0.024)
Ln labour productivity - av.		0.045 (0.028)	0.058* (0.030)	0.060* (0.032)	0.052 (0.033)	0.052 (0.033)
Ln capital intensity - av.			-0.017 (0.020)	-0.014 (0.021)	-0.011 (0.021)	-0.011 (0.021)
Ln cash flow - av.			-0.027 (0.021)	-0.023 (0.023)	-0.033 (0.023)	-0.033 (0.023)
Leverage ratio - av.			-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Liquidity ratio - av.			-0.137 (0.137)	-0.101 (0.136)	-0.123 (0.134)	-0.120 (0.136)
Innovation (d)				-0.029 (0.033)	-0.024 (0.032)	-0.024 (0.032)
Labour skill				0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Firm age				0.012 (0.022)	0.011 (0.020)	0.011 (0.020)
Corporation (d)				-0.009 (0.033)	-0.008 (0.035)	-0.008 (0.035)
Consortium (d)				-0.120 (0.105)	-0.103 (0.102)	-0.100 (0.100)
Business group (d)				-0.099** (0.044)	-0.094** (0.041)	-0.093** (0.041)
Center (d)					-0.022 (0.036)	-0.025 (0.037)
South (d)					-0.019 (0.056)	-0.045 (0.086)
Provincial value-added growth, 98–08					-0.066*** (0.018)	-0.070*** (0.019)
N. branches per 1,000 inhab.					-0.002 (0.001)	-0.002 (0.001)
Provincial value added - av.						-0.055 (0.127)

(Continues)

TABLE 2 (Continued)

Panel A						
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
	High quality out	High quality out	High quality out	High quality out	High quality out	High quality out
Observations	428	428	428	428	428	428
Per cent correctly predicted	84.35	84.58	84.81	84.81	84.81	84.81
Log-pseudolikelihood	-172.67	-170.84	-170.28	-166.66	-162.15	-162.10
Pseudo $R^2$	0.052	0.063	0.066	0.085	0.110	0.110
Panel B						
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
	High q. out-probit	High q. out-ols	High q. out-probit	Quality-ordered probit	Equal q. out-probit	Low q. out-probit
External score—av.	-0.030** (0.014)	-0.026* (0.014)		-0.026** (0.012)	0.029** (0.014)	-0.006 (0.012)
Negative av. score, d			-0.078* (0.043)			
Firm size—av..	0.047** (0.024)	0.047* (0.025)	0.054** (0.023)	0.041** (0.020)	-0.047** (0.024)	0.017 (0.019)
Labour productivity—av.	0.052 (0.033)	0.045 (0.031)	0.053 (0.033)	0.045 (0.029)	-0.052 (0.033)	0.052 (0.032)
All controls	Y	Y	Y	Y	Y	Y
Observations	428	428	428	495	428	278
Per cent correctly predicted	84.81		84.81	84.81	82.04	91.91
Log-pseudolikelihood	-162.15		-162.53	-162.15	-194.97	-43.73
Pseudo $R^2$ or $R^2$	0.110	0.087	0.108	0.157	0.088	0.283

Notes: This table studies the relation between the proxy for credit constraint, "external score—av. .", and the probability that a firm declares to produce higher quality for the foreign market (High Quality Out) in panel A. Panel B investigates the relation between the proxy for credit constraint, "external score—av.", and the probability that a firm declares to produce higher, equal or lower quality for the foreign market. We report estimates obtained using the probit model (1b) reported in specification (5a) of panel A and a linear probability model in (2b). In (3b), the main explanatory variable is a dummy for firms reporting an average score higher or equal to 5 in the period between 2008 and 2010. In (4b), we also consider firms that declare to export an output of lower quality with respect to the one sold domestically,  $Z_{i,j} > Z_{k,j}$ , using an ordered probit model. For this specification, we report marginal effects for the sub-sample of firms declaring to produce a higher quality for the export market. Column (5b) reports estimates obtained when focusing on firms that supply products of equal quality to the two markets. Column (6b) shows the effect of the explanatory variables on the probability that a firm exports goods of lower quality than the one supplied domestically,  $Z_{i,j} > Z_{k,j}$ . Average marginal effects are reported for all specifications, except (2b). "All controls" indicates the full set of variables employed in specification (5a). All specifications include industry-level dummies and a constant term. Variables indicated with - av. are averages for the period 2008–10. All regressions cluster standard errors, reported in parentheses, at the province level. \*, \*\* and \*\*\*Significance at the 10%, 5% and 1% levels, respectively.

The term (d) indicates a dummy variable

probability of quality differentiation. Column (3b) reports coefficients obtained changing the explanatory variable. We use a dummy for firms reporting an average score higher than 5 in the years between 2008 and 2010. Results show that firms reporting a worse (i.e., higher) credit score during this period were less likely to differentiate the quality of exported products. In specification (4b), we change the dependent variable to "Quality". This variable takes three different values: it is equal to 0 if a firm declares to export output of lower quality with respect to the one supplied to the domestic market, equal to 1 if the firm states that the quality of products supplied in the two markets does not differ and equal to 2 if the firm declares to produce output of higher quality for the export market. We estimate an ordered probit model using our main explanatory variable and the set of controls employed in (5a) as regressors. Results for this last specification are in line with those previously described. The average marginal effect of the score on quality differentiation is  $-0.026$ , and it is significant at the 5% level.

Estimates reported in columns (5b) and (6b) show that the probability of a firm supplying a product of the same quality to the domestic and the foreign market is positively associated with the credit score (5b), while the probability of producing goods of lower quality for the export market is not significantly correlated with the score (6b).<sup>24</sup> Rationed exporters are less likely to differentiate product quality across markets, while the decision on whether to supply goods of lower quality abroad does not seem to be determined by credit availability.

## 5 | EXPORT DESTINATION AND CREDIT CONSTRAINTS

Hummels and Skiba (2004), Martin (2012), and Mayneris and Martin (2015) show that distance to export destination and the quality of exported products are positively associated. These studies, mainly employing unit value as a proxy for output quality, find that firms supply high-quality products to more distant markets. Bourgeon and Bricongne (2016) show that the negative effect of financial frictions on export revenue is stronger for French exporters serving distant markets. Our theoretical framework suggests that firms exporting to distant markets should be more affected by a worsening in credit rationing when setting the quality difference between exported and domestic products.

In the survey, firms are asked to declare which markets they were serving in 2010.<sup>25</sup> Markets are identified in terms of geographic macro-areas: North America, Latin America, Africa, Mediterranean countries, Asia, China and India, Oceania, European main markets for Italian exporters, European secondary markets for Italian exporters and Eastern European countries.<sup>26</sup> Given this information, we set a dummy equal to 1 for firms exporting outside the European area (EU).<sup>27</sup> Firms exporting outside

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<sup>24</sup>We also created an alternative proxy for quality differentiation which is equal to one if the firm exports higher quality abroad and equal to zero when the firm exports either the same quality produced for the domestic market or lower quality. Results obtained estimating a probit specification show that the average marginal effect of external score on this new outcome variable is equal to  $-0.027$  and it is significant at the 5% level. Results for this specification are available on request.

<sup>25</sup>Given that we do not have detailed information from firms on export destinations and revenues in each destination, we cannot employ usual distance data currently employed in the literature.

<sup>26</sup>Mediterranean countries include all countries in North Africa and in the Middle East. Asia includes destinations in Asia as well as countries in the Arabic peninsula. The main markets for Italian exporters in the EU are Germany, France, UK and Spain. European secondary markets for Italian exporters are Switzerland, Sweden, Belgium and the Netherlands. East-European destinations include EU member countries in Eastern Europe, Balkan countries and Russia.

<sup>27</sup>We identify as exporters to the European area firms declaring to export in European main markets, European secondary markets and East European countries. We refer to the EU as a geographical area and not as a political-economic entity. Moreover, we do not consider observations from firms whose most distant export market outside the EU is in the Middle East or in North Africa.



the European area should face, on average, higher per-unit transportation costs with respect to firms exporting only to European destinations. We investigate the role of credit constraints on these firms interacting this dummy variable with the main explanatory variable: the average score in the period 2008–10. Equation (11) shows the econometric model estimated in Table 3:

$$\Pr(\Gamma_j^{ki} = 1) = \text{prob}(\alpha + \zeta_{ind} + \beta C_j + \lambda \text{OutEu}_j + \delta \text{OutEu}_j \times C_j + \omega X_j + \chi T_p + \varepsilon_j > 0). \quad (11)$$

We test the following prediction: the probability of quality differentiation should be decreasing in the term interacting the proxy for credit rationing and export destination,  $\frac{\partial \Pr(\Gamma_j^{ki}=1)}{\partial (C_j \times \text{OutEu}_j)} < 0$ . Panel A of Table 3, reporting estimated coefficients, shows an interesting result: firms exporting outside the EU are more affected by credit rationing.

A standard deviation higher score has a 28% larger effect on firms exporting to destinations outside Europe.<sup>28</sup>

This finding indirectly confirms that credit constraints have a larger negative effect on quality differentiation for firms exporting to distant markets. Coefficients reported in Table 3 also confirm that more productive and large firms are capable of differentiating product quality between the foreign market and the domestic market. Figure 2, based on results obtained in specification (6a), shows changes in the predicted probability of quality differentiation for firms exporting outside Europe (*Y*-axis) at different values of the credit score (*X*-axis).<sup>29</sup> An increase in the score is associated with a reduction in the probability of quality differentiation. The magnitude of this effect is negative and significant for firms exporting outside the EU and reporting a score higher than 4.

Considering all export destinations as equally affecting quality differentiation might be considered as a strong assumption. In order to further investigate this, we employ an alternative estimation strategy. We focus on the sub-sample of firms exporting to the main European markets for Italian exporters: France, Germany, UK and Spain. Among these firms, we select those exporting to North America. The United States is the largest market for Italian manufacturing firms after the European: many Italian SMEs export to this market on top of exporting to one or more EU destinations. A dummy equal to one for firms exporting to North America is then interacted with the credit score. Results, reported in specification (1b) and (2b) of Table 3, strongly confirm findings previously described. Among exporters to the main European destinations, firms exporting to North America are relatively more affected by a worsening in the score. Interestingly, the coefficient for the dummy variable is positive and significant: for very low values of the score, exporting to North America is positively associated with quality differentiation.

## 5.1 | Average income and distance

Recent studies show that export quality is positively correlated with average income in the importing country (Dingel, 2016; Fieler, 2013; Flach, 2016; Hallak, 2006; Manova & Zhang, 2012; Simonovska, 2015). Firms target consumers in richer destinations supplying goods of higher quality given their higher willingness to pay. SMEs in our sample might then differentiate the quality of exported products to target markets where the potential pool of customers for high-quality goods is larger. This

<sup>28</sup>To obtain this number, we compute the average marginal effect of the interaction term, as in Karaca-Mandic et al. (2012).

<sup>29</sup>We rely on the methodology proposed in Norton et al. (2004) to compute marginal effects for interaction terms in non-linear models.

**TABLE 3** Quality differentiation and exporting outside EU, determinants

	Panel A					
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
	High q. out	High q. out	High q.out	High q.out	High q. out	High q. out
External score—av.	−0.048 (0.040)	−0.030 (0.043)	−0.074 (0.074)	−0.062 (0.073)	−0.062 (0.072)	−0.081 (0.077)
Outside eu (d)	1.422** (0.642)	1.355** (0.630)	1.357** (0.616)	1.267** (0.622)	1.226** (0.622)	1.289** (0.642)
Outside eu (d) × external score—av.	−0.503*** (0.149)	−0.476*** (0.143)	−0.476*** (0.138)	−0.458*** (0.140)	−0.446*** (0.140)	−0.457*** (0.145)
Ln firm size—av.		0.173* (0.104)	0.150 (0.104)	0.192* (0.114)	0.199* (0.114)	0.194* (0.115)
Ln labour productivity—av.		0.180 (0.127)	0.237* (0.139)	0.242 (0.151)	0.258 (0.157)	0.223 (0.164)
Firm-level financial controls	N	N	Y	Y	Y	Y
Other firm-level controls	N	N	N	Y	Y	Y
Firm region dummies	N	N	N	N	Y	Y
Province-level controls	N	N	N	N	N	Y
Observations	428	428	428	428	428	428
Per cent correctly predicted	83.88	84.58	84.81	84.11	84.11	84.11
Log-pseudolikelihood	−165.99	−164.68	−164.21	−161.04	−160.88	−156.63
Pseudo $R^2$	0.090	0.097	0.099	0.116	0.117	0.141
	Panel B					
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
	High q. out	High q. out	High q. out	High q. out	High q. out	High q. out
External score - av.	−0.190* (0.098)	−0.215** (0.097)	−0.218** (0.102)	−0.244** (0.104)	−0.262* (0.141)	−0.278* (0.147)
North America (d)	1.142** (0.473)	1.164** (0.483)				
North America (d) × external score - av.	−0.297*** (0.112)	−0.294*** (0.110)				
South America (d)			0.697 (0.446)	0.652 (0.467)		
South America (d) × external score - av.			−0.241** (0.103)	−0.229** (0.108)		
East eu (d)					0.085 (0.607)	0.238 (0.642)

(Continues)

TABLE 3 (Continued)

	Panel B					
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
	High q. out	High q. out	High q. out	High q. out	High q. out	High q. out
East eu (d) × external score - av.					-0.035 (0.139)	-0.057 (0.148)
Ln firm size - av.	0.093 (0.129)	0.087 (0.133)	0.088 (0.126)	0.083 (0.132)	0.091 (0.130)	0.072 (0.134)
Ln labour productivity - av.	0.155 (0.249)	0.124 (0.247)	0.173 (0.237)	0.145 (0.237)	0.169 (0.242)	0.125 (0.241)
Firm-level financial controls	Y	Y	Y	Y	Y	Y
Other firm-level controls	Y	Y	Y	Y	Y	Y
Firm region dummies	Y	Y	Y	Y	Y	Y
Province-level controls	N	Y	N	Y	N	Y
Observations	291	291	291	291	291	291
Per cent correctly predicted	86.60	87.97	85.91	86.94	86.25	86.94
Log-pseudolikelihood	-95.30	-93.13	-95.89	-93.85	-97.50	-95.26
Pseudo R <sup>2</sup>	0.169	0.188	0.164	0.181	0.150	0.170

Notes: This table studies the relation between the proxy for credit constraint, "external score—av.", interacted with different dummy variables indicating the destination market of firm's exports, and the probability that the firm declares to produce higher quality for the foreign market. Estimated coefficients are reported. "Firm-level financial controls" include ln capital intensity, ln cash flow, leverage ratio and liquidity ratio; "other firm-level controls" include innovation, labour skill, firm age, corporation, consortium and business group, "firm region dummies" include south and centre; and "province-level controls" include provincial value-added growth, n. branches per 1,000 inhabitants and provincial value added. All specifications include industry-level dummies. Variables indicated with - av. are averages for the period 2008–10. All regressions include a constant term and cluster standard errors, reported in parentheses, at the province level. The term (d) indicates a dummy variable. \*, \*\* and \*\*\*Significance at the 10%, 5% and 1% levels, respectively.

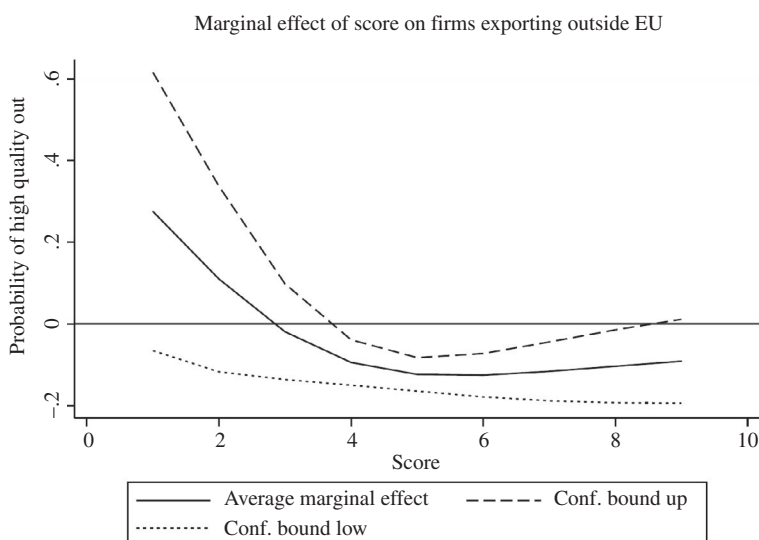


FIGURE 2 Score, effect on "high quality out" for firms exporting outside EU

effect might play a role for estimates presented in specification (1b) and (2b). Indeed, North America has a higher average income than most EU destinations. In order to address this issue, we run specification (3b) and (4b) where we repeat the same exercise considering firms exporting to South America on top of exporting to EU main destinations. Since distance from the EU to North America and South America is comparable, while average income in the two destinations is different, we expect to find similar results in the two specifications if average income in the destination market does not play a major role for the impact of credit constraints on quality differentiation. Results confirm that the effect of credit rationing on quality differentiation is similar to firms exporting to South America. Firms with a better (i.e., lower) credit score are more likely to export goods of higher quality when exporting to North America rather than to South America; yet, any further increase in the score is associated with a lower probability of quality differentiation for both destinations. To further confirm this result, specifications (5b) and (6b) show that credit availability does not differently affect firms exporting to Eastern European countries with respect to those serving only the most important EU markets. Since Eastern European destinations are closer to the EU than other possible destinations, we do not obtain a significant effect for the interaction term between the score and the East EU dummy. These findings confirm that credit constraints have a stronger impact on firms exporting to distant markets and that this effect is not hampered by income differences across destinations.

## 6 | ROBUSTNESS

Endogeneity of the main explanatory variable might bias estimates discussed in the previous sections. First of all, even if a firm's credit score is determined by the external agency after analysing its economic performance, this measure might be influenced by the recent economic crisis. Credit supply and credit demand factors may jointly affect credit availability and quality differentiation, giving rise to a simultaneity bias. Evidence confirms that during the recent economic crisis, Italian credit institutions decreased the amount of loans and strongly reduced the number of loans to risky debtors (Albareto & Finaldi Russo, 2012). We try to isolate the supply-side shock of the recent economic downturn on Italian SMEs' credit score. We first retrieve the amount of variation in the score explained by firm-level determinants of credit demand. For example, we can take into consideration how the reduction in the cash flow due to the economic crisis affects the credit score. We then consider as supply-constrained those firms whose score was affected during the crisis more than indicators of their economic and financial performance would predict.<sup>30</sup>

Furthermore, we do not have explicit information on how the external rating agency sets the score: it is computed using a proprietary algorithm on balance sheet data. Yet, if the rating agency gives better (i.e., lower) scores to those firms that are capable to differentiate the quality of exported output with respect to the output sold domestically, we face a reverse causality problem. Lastly, even if we are controlling for a good number of factors correlated with the explanatory variable, there might be unobservables, such as managers' connections with the banking sector, that might be negatively correlated with both the firm's score<sup>31</sup> and the quality differentiation, leading us to find upward biased estimates.<sup>32</sup> Marginal effects commented in the previous section would then be an upper bound of the

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<sup>30</sup>We underline that estimates obtained using this strategy might be affected if firm-level variables at our disposal do not entirely capture the direct impact of the economic crisis on firm performance.

<sup>31</sup>Managers more connected with the banking sector might be able to obtain better (i.e., lower) scores.

<sup>32</sup>Firms producing high-quality products, both for the domestic market and for the foreign market, might also employ managers more capable of maintaining close linkages with the banking sector.



unbiased marginal effect. We take into consideration the possible endogeneity of our explicative variable due to omitted variables employing instrumental variable estimation.

The cross-sectional nature of our data also prevents specifications discussed in this section from taking into account firm-level unobserved factors not varying over time which might determine the effect of the external score on quality differentiation. Therefore, the results reported in the following paragraphs should be considered as additional checks on the direction of the correlation between our proxy for credit constraints and quality differentiation for the export market.

## 6.1 | The great recession: a shock to credit availability

We now study the effect of the recent economic crisis on credit constraints at the firm level. Our aim is to consider the great recession as an external shock to the credit score of Italian SMEs. The recession started at the end of 2007 with a financial crisis in the United States and then spread across other developed economies through a significant fall in the demand for durable goods and a credit crunch.<sup>33</sup> This shock affected the economic and financial performance of Italian firms both reducing revenues and affecting their credit availability. Bricongne et al. (2012) show that exports of firms operating in high financial dependence sectors were mostly negatively affected by credit constraints during the crisis. As long as we are able to control for indicators of firm performance determining the credit score during the crisis period, we can consider the crisis as a shock affecting the supply of credit to the firm through its impact on the score. In specification (Equation 12), we estimate the correlation between a dummy for the crisis' years, *After 2007<sub>t</sub>*, and our explanatory variable, the credit score, controlling for time fixed effects,  $\gamma_t$ , firm fixed effects,  $\rho_j$ , and for time-varying indicators of a firm's economic and financial performance,  $X_{jt}$ : Ln Labour Productivity, Ln Firm Size, Ln Capital Intensity, Ln Cash Flow, Leverage Ratio and Liquidity Ratio. The dummy variable, *After 2007<sub>t</sub>*, identifies the average effect of the crisis on the score during the crisis period. We estimate the following model:

$$C_{jt} = \alpha + \gamma_t + \rho_j + \lambda \text{After } 2007_t + \omega X_{jt} + \varepsilon_{jt}. \quad (12)$$

Coefficients reported in column (1) of Table 4 show that the firm's credit score is not only significantly correlated with firm-level financial and economic variables, but also positively and significantly correlated with the *After 2007<sub>t</sub>* dummy. During the years of the crisis, Italian SMEs experienced a worsening (i.e., increase) in their credit score which was not entirely due to their economic performance.

Given this finding, we proceed to the following step and run specification (Equation 13) on two different sub-samples. We separately employ observations before and after the crisis to estimate:

$$C_{jt} = \alpha + \gamma_t + \rho_j + \omega X_{jt} + \varepsilon_{jt}. \quad (13)$$

After obtaining firm-level time-varying residuals,  $\hat{\varepsilon}_{jt}$ , from (Equation 13), we regress  $\hat{\varepsilon}_{jt}$  on our dummy for the crisis period, *After 2007<sub>t</sub>*, for each firm,  $j$ :

$$\hat{\varepsilon}_{jt} = \alpha + \beta_j \text{After } 2007_t + \mu_{jt}. \quad (14)$$

<sup>33</sup>According to the NBER, the US recession began in December 2007 and finished in June 2009. World trade declined by 29% from September 2008 to January 2009. Italy was in a recession from Q2-2008 to Q2-2009.

**TABLE 4** Productivity and external score, impact of crisis

	(1)	(2)	(3)	(4)	(5)	(6)
	External score	High q. out	High q.out	High q.out	High q. out	High q. out
After 2007 (d)	0.139*** (0.028)					
Ln firm size	-0.448*** (0.093)					
Ln labour productivity	-0.284*** (0.080)					
Ln cash flow	-0.562*** (0.043)					
Ln capital intensity	-0.195*** (0.048)					
Leverage ratio	0.000 (0.000)					
Liquidity ratio	-4.614*** (0.151)					
Impact of crisis		1.081** (0.492)	1.086** (0.508)	1.238** (0.569)	1.185** (0.591)	1.299** (0.616)
Ln labour productivity - av.		0.087 (0.068)	0.274** (0.107)	0.304** (0.141)	0.327** (0.146)	0.290* (0.161)
Impact of crisis × Ln labour productivity - av.		-0.253** (0.110)	-0.248** (0.112)	-0.269** (0.123)	-0.259** (0.127)	-0.283** (0.133)
Ln firm size - av.			0.210** (0.093)	0.257** (0.124)	0.270** (0.117)	0.263** (0.117)
Firm-level financial controls	N	N	N	Y	Y	Y
Other firm-level controls	N	N	N	Y	Y	Y
Firm region dummies	N	N	N	N	Y	Y
Province-level controls	N	N	N	N	N	Y
Observations	9,188	428	428	428	428	428
R <sup>2</sup> or Pseudo R <sup>2</sup>	0.848	0.015	0.027	0.055	0.058	0.081

*Notes:* In specification (1) of this table, we study the impact of the recent economic crisis on "external score", and we control for firm fixed effects, time fixed effects, and consider the usual firm-level indicators of economic and financial performance. From specification (2) onwards, we use a firm-level variable representing the impact of the crisis on the external score as a proxy for credit rationing. "Firm-level financial controls" include Ln capital intensity, Ln cash flow, leverage ratio and liquidity ratio; "other firm-level controls" include innovation, labour skill, firm age, corporation, consortium and business group; "firm region dummies" include south and centre; and "province-level controls" include provincial value-added growth, n. branches per 1,000 inhabitants and provincial value added. In these specifications, we cluster and bootstrap (500 replications) standard errors, reported in parentheses, at the province level and introduce industry-level dummies. Variables indicated with —av. are averages for the period 2008–10. Estimated coefficients are reported. \*, \*\* and \*\*\*Significance at the 10%, 5% and 1% levels, respectively. The term (d) indicates a dummy variable.



Using the coefficients  $\hat{\beta}_j$ , estimated in this last specification, we create the variable (*Impact of Crisis*)<sub>*j*</sub> to capture the magnitude of the increase in the score due to the economic crisis. In particular, this variable accounts for the change in the credit score due to those factors not explained by the firm-level variables available to us and included in specification (Equation (13)). Among these factors, this coefficient captures the credit supply shock of the economic crisis experienced by each firm through the variation in its credit score in the years after 2007.

It is now possible to employ this firm-level variable to assess the impact of credit rationing on quality differentiation. This identification strategy relies on assuming that, after controlling for firm-specific, time-varying determinants, it is possible to capture the exogenous effect of the crisis on firm's credit access through the variation in its credit score.

We run the following specification to compare, for a given labour productivity, firms reporting different variations in their score due to the recent economic crisis, conditioning on the set of controls previously employed:

$$\Pr(\Gamma_j^{ki} = 1) = \text{prob}(\alpha + \zeta_{ind} + \beta \text{Crisis}_j + \lambda \text{Lab}P_j + \delta \text{Lab}P_j \times \text{Crisis}_j + \omega X_j + \chi T_p + \varepsilon_j > 0). \quad (15)$$

The variable representing the effect of the crisis on a firm's external score, *Crisis*<sub>*j*</sub>, is then interacted with labour productivity, *LabP*<sub>*j*</sub>.<sup>34</sup> Results show that among two equally productive firms, the one whose score was affected by the crisis is less likely to differentiate quality for the export market. Findings are confirmed when controlling for the time trend of economic and financial variables in Equation (13).

The size of the shock due to the economic crisis may be affected by firm-level attributes, like export market exposure, which also affect quality differentiation. In order to address this point, we run specification (Equation 15) controlling for firm export market exposure, represented by the ratio between export revenue and total revenue. Findings are in line with those reported in Table 4.<sup>35</sup>

Relying on coefficients obtained in specification (6) of Table 4, we report, in the following Table (5), marginal effects of *Crisis*<sub>*j*</sub> on the outcome variable for different levels of labour productivity. Estimates show that the effect credit rationing on quality differentiation is larger for more productive firms in our sample.

Considering the crisis as an external shock to the credit score, we find that firms whose score increased (i.e., worsened) during the recent economic crisis are less likely to export goods of higher quality with respect to those sold domestically. Credit rationing due to recent economic crisis is associated with a lower probability of quality differentiation for the foreign market.

## 6.2 | Instrumental variable approach

In order to partially address the endogeneity of our explicative variable due to omitted variable bias, we rely on instrumental variable estimation. In the first specification reported in part A of Table 6, we instrument the average score in the period 2008–10 with the difference between the firm's score in 2002 and the contemporaneous average score in the province in which the firm is located. We employ this variable assuming that the score assigned to the firm nine years before the survey is not influenced

<sup>34</sup>We bootstrap standard errors (500 replications) to take into account that the variable *Crisis*<sub>*j*</sub> is a firm-level coefficient estimated in Equation (14).

<sup>35</sup>Results available on request.

**TABLE 5** Productivity and impact of crisis, marginal effects

Ln labour productivity - av.	High q. out
1.0	0.087 (0.084)
1.5	0.084 (0.074)
2	0.081 (0.063)
2.5	0.075 (0.052)
3	0.066 (0.041)
3.5	0.053* (0.031)
4	0.033 (0.024)
4.5	0.005 (0.021)
5	-0.031 (0.030)
5.5	-0.074 (0.047)
6	-0.121* (0.065)
6.5	-0.166** (0.080)
7	-0.209** (0.089)
7.5	-0.246*** (0.095)
8	-0.276*** (0.099)
Observations	428

*Notes:* This table reports the marginal effect of "impact of crisis" for different levels of "Ln labour productivity - av.". In order to compute marginal effects, we employ the last specification of the previous Table. Bootstrapped standard errors (500 replications) are reported in parentheses. \*, \*\* and \*\*\*Significance at the 10%, 5% and 1% levels, respectively.

by the fact that a firm declares to produce a product of higher quality for the foreign market in 2010. Moreover, by taking the difference with respect to the average score at the province level, it is possible to account for the role of local economic factors in determining the score. Identification based on this instrument might be less reliable if quality differentiation is the result of investment decisions made in 2002 or before. Yet, descriptive evidence shows that among firms obtaining more than 50% of their revenues from exports, those adopting an innovation for the export market in the period 2007–10

**TABLE 6** Quality differentiation, instrumental variable estimation

	Part A			Part B		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
	Ext. score - av.	High q. out	Marginal effects	Ext. score - av.	High q. out	Marginal effects
	First stage			First stage		
External score - av.		-0.458** (0.186)	-0.108** (0.050)		-0.434** (0.183)	-0.101** (0.048)
Firm size - av.	-0.463*** (0.082)	0.044 (0.148)	0.006 (0.035)	-0.470*** (0.081)	0.057 (0.145)	0.009 (0.035)
Labour productivity - av.	-0.341*** (0.107)	0.074 (0.179)	0.019 (0.041)	-0.352*** (0.109)	0.082 (0.179)	0.021 (0.040)
Firm-level financial controls	Y	Y	Y	Y	Y	Y
Other firm-level controls	Y	Y	Y	Y	Y	Y
Firm region dummies	Y	Y	Y	Y	Y	Y
Province-level controls	Y	Y	Y	Y	Y	Y
Instrumental variables						
Diff. with respect to Provincial Score, 2002	0.265*** (0.049)			0.265*** (0.049)		
Share of branches belonging to local banks, 1936				1.160** (0.520)		
Observations	341	341	341	341	341	341
Per cent correctly predicted		83.28			83.58	
Log-pseudolikelihood		-604.72			-603.10	
Wald test of exogeneity, Prob. > Chi <sup>2</sup>		0.044			0.054	
F Test of excluded instruments		26.19			13.73	
Cragg-Donald Wald F-statistic		50.64			27.10	
Stock-Yogo weak ID c. v., 10%		16.38			19.93	
Hansen J. Stat., Prob. > Chi <sup>2</sup>					0.416	

*Notes:* This table studies the impact of our proxy for credit constraint, "external score - av.", on the probability that a firm declares to produce higher quality for the foreign market using an IV strategy. Our IVs for "external score - av." are (1) the difference between the firm External Score in 2002 and the average score at the province level in the same year, and (2) the share of bank branches belonging to local banks at the regional level in 1936. All specifications include industry-level dummies. "Firm-level financial controls" include ln capital intensity, ln cash flow, leverage ratio and liquidity ratio; "other firm-level controls" include innovation, labour skill, firm age, corporation, consortium and business group; "firm region dummies" include south and centre; and "province-level controls" include provincial value-added growth, no. branches per 1,000 inhabitants and provincial value added. Variables indicated - av. are averages for the period 2008–10. All specifications include a constant term and cluster standard errors, reported in parentheses, at the province level. \*, \*\* and \*\*\*Significance at the 10%, 5% and 1% levels, respectively.

actually export products of higher quality than those supplied domestically.<sup>36</sup> Therefore, it is reasonable to infer that a large part of firms under observation introduced changes on exported products in the years after 2007. Once controlling for the full set of covariates, we expect the instrument to be related to the dependent variable only through the instrumented variable.

Part A of Table 6 reports the first- and the second-stage estimates for our specifications. From the first stage of this specification, reported in column (1a), it is possible to observe that this instrument is not weak, since it is highly and significantly correlated with the endogenous variable. The larger is the difference between the score in 2002 and the province average, the higher is the score in 2008–10.

Marginal effects, reported in (3a), confirm that constrained firms are less likely to upgrade the quality of exported output. The magnitude of the estimates confirms that the omitted variable bias affects coefficients estimated in the main specification. The marginal effect for the variable of interest is equal to  $-0.108$ .<sup>37</sup> This specification enables us to review a series of important statistical tests. First of all, results for the Wald test of exogeneity lead us to reject the null hypothesis of exogeneity of the instrumented variable, findings obtained instrumenting are statistically different with respect to those obtained without instrumenting. The  $F$  test of excluded instruments reports an  $F$ -statistic higher than 20, suggesting that excluded instruments are irrelevant. The Cragg–Donald Wald test  $F$ -statistic is well above the Stock–Yogo weak ID critical value.

We complete this section introducing a second instrument for the average score in the period 2008–10. Other studies in the field dealt with the endogeneity of the main explanatory variable while working on data sets and research questions similar to ours. Minetti and Zhu (2011) and Secchi, Tamagni, and Tomasi (2016), among others, use province-level variables representing credit supply at the local level as instruments for credit rationing at the firm level. As a consequence, the second instrumental variable introduced in part B of Table 6 is the share of bank branches owned by local banks at the regional level in 1936. This variable was first employed by Guiso, Sapienza, and Zingales (2004) and Guiso, Sapienza, and Zingales (2006) as an instrument for local financial development.

After the 1930–31 banking crisis, the Fascist Government introduced a law aimed at stabilising the banking system in 1936. This law, which was not abolished after World War II, introduced a strict regulation to bank entry: local banks (cooperative, commercial and savings banks) faced a less stringent regulation on the opening of new branches than national banks that were allowed to open new branches only in the major cities. Between 1936 and 1985, local banks had the possibility to expand more than national banks: branches belonging to savings banks and cooperatives grew on average 138%, while large national banks grew only 70% (Guiso et al., 2006). The law introduced a random shock to the Italian credit market since the regional diffusion of the different types of banks was the result of the various waves of bank creation and of the Italian unification process. Restrictions imposed by this law were in place until the end of the 1980s and, consequently, had a strong long-lasting effect on the local configuration of the Italian banking sector. An accidental outcome of the law was a different degree of competition across Italian provinces and regions due to the conditions preceding the 1936 law. When introducing this variable in part B, we observe that this is positively and significantly correlated with the variable of interest. The larger the presence of local banks in 1936, the higher the average credit score, the more constrained is the firm in the period 2008–10. A larger presence of local banks is indeed associated with long-lasting relations between local banks and

<sup>36</sup>A variable on innovation for the main market is available in the section of the survey in which firms are asked to describe the type of innovations pursued during the three years before the survey. We find that almost 20% of firms adopting an innovation for the main market, in the period 2007–2010, declare to export a product of higher quality to the foreign market.

<sup>37</sup>According to Heckman and Vytlacil (2007), this marginal effect, estimated using IV, can be considered as a weighted average of the marginal treatment effect in case of heterogeneous returns across units in the estimation sample.



SMEs. As a consequence, a local bank might be more likely to provide credit to a firm even when the credit score of the firm worsens. Guiso et al. (2006) confirm that bad loans are more likely to be found in regions with a larger presence of local banks.<sup>38</sup> Marginal effects for this specifications, reported in column (3b), confirm the negative relation between credit constraint and quality differentiation. The estimated effect is slightly smaller than the one reported in (3a); nevertheless, it remains higher in magnitude than the one obtained without instrumenting. The  $F$  test of excluded instruments reports an  $F$ -statistic higher than 10, showing us that excluded instruments are irrelevant. The Cragg–Donald Wald test  $F$ -statistic is well above the Stock-Yogo weak ID critical value, while the endogeneity test confirms that results obtained instrumenting are statistically different with respect to those obtained without instrumenting. For this specification, we also report the Hansen  $J$  statistic of the over-identification test. Since it is possible to reject the null hypothesis for this test, we conclude that the two instruments are valid.

Results discussed in this section confirm that credit constraints are associated with a lower probability of quality differentiation at the firm level. We first find that, conditional on having the same labour productivity, the firm whose credit availability was negatively affected by the crisis is less likely to differentiate quality for the foreign market. Moreover, using IV, we observe that the magnitude of the correlation between credit rationing and quality differentiation is negative and larger in magnitude than the one reported in the main estimations. This last finding confirms that omitted variables might lead us to obtain upward biased coefficients in specifications reported in Table 2.

## 6.3 | Additional robustness checks

### 6.3.1 | Strongly rationed exporters

The variable indicating strongly rationed firms is a reliable measure of credit rationing since it is an information directly provided by the firm on the difficulties in obtaining the desired amount of credit in the year preceding the survey. We introduce this dummy variable in specification (1a) of Table 7 as an alternative proxy for credit constraint.

Interestingly, this dummy variable enters the first regression with a negative, significant marginal effect. Rationed exporters are less likely to supply goods of higher quality to the foreign market. We proceed by introducing, in specification (2a), the main explanatory variable, the external score, jointly with the "strongly rationed" dummy. Interestingly, when we consider both variables, only the score is significantly and negatively associated with the dependent variable. In specification (3a), we introduce an interaction term between the dummy variable and the external score to assess whether our results are driven by firms reporting a higher average score and declaring to be rationed in the survey. This interaction is an important test for our analysis since it uses the external measure of credit rationing jointly with a proxy for credit rationing assessed at the firm level and accounting for the mismatch between credit demand and supply in 2010. Results confirm that strongly rationed firms reporting a worse (i.e., high) external score are less likely to supply goods of higher quality to the foreign market with respect to the one of products sold domestically. The negative relation between the score and quality differentiation holds also for firms that actually did not declare to be strongly rationed in the survey.

<sup>38</sup>See also Beck et al. (2003).



**TABLE 7** Additional checks I: Other indicators of credit rationing

	<b>Panel A</b>		
	<b>(1a)</b>	<b>(2a)</b>	<b>(3a)</b>
	<b>High quality out</b>	<b>High quality out</b>	<b>High quality out</b>
External score - av.		-0.037** (0.018)	-0.039** (0.018)
Strongly rationed	-0.090* (0.054)	-0.070 (0.055)	0.053 (0.110)
Strongly rationed (d) × External score - av.			-0.119** (0.061)
Firm size - av.	0.068*** (0.023)	0.052** (0.023)	0.051** (0.024)
Labour productivity - av.	0.048 (0.033)	0.042 (0.034)	0.037 (0.035)
Observations	385	385	385
Per cent correctly predicted	83.90	84.42	84.16
Log-pseudolikelihood	-150.65	-148.56	-147.21
Pseudo $R^2$	0.105	0.117	0.125
	<b>Panel B</b>		
	<b>(1b)</b>	<b>(2b)</b>	<b>(3b)</b>
	<b>High quality out</b>	<b>High quality out</b>	<b>High quality out</b>
External score - av.		-0.035** (0.014)	-0.034** (0.014)
Industry fin. dependence	0.073 (0.051)	0.064 (0.053)	0.064 (0.051)
Industry fin. dependence × External score - av.			0.077 (0.055)
Ln firm size - av.	0.064*** (0.022)	0.050** (0.022)	0.050** (0.022)
Ln labour productivity - av.	0.052 (0.033)	0.048 (0.035)	0.047 (0.035)
Observations	415	415	415
Per cent correctly predicted	85.06	85.06	85.06
Log-pseudolikelihood	-156.76	-154.42	-154.27
Pseudo $R^2$	0.104	0.117	0.118

(Continues)

TABLE 7 (Continued)

	Panel C		
	(1c)	(2c)	(3c)
	High quality out	High quality out	High quality out
External score - av.	-0.028* (0.014)	-0.030** (0.014)	-0.028* (0.014)
Ebitda - av.	0.002** (0.001)		0.002** (0.001)
Debt/ebitda - av.		-0.013 (0.031)	-0.012 (0.036)
Ln firm size - av.	0.005 (0.029)	0.048** (0.024)	0.006 (0.029)
Ln labour productivity - av.	0.010 (0.035)	0.053 (0.034)	0.011 (0.035)
Observations	428	428	428
Per cent correctly predicted	85.05	84.81	85.05
Log-pseudolikelihood	-160.15	-162.11	-160.12
Pseudo $R^2$	0.121	0.110	0.132
Firm-level financial controls	Y	Y	Y
Other firm-level controls	Y	Y	Y
Firm region dummies	Y	Y	Y
Province-level controls	Y	Y	Y

*Notes:* This table studies the relation between the proxy for credit constraint, "external score—av.", and the probability that a firm declares to produce higher quality for the foreign market. We check the robustness of previous results controlling for the "strongly rationed" dummy in panel A of the table, for "industry finance dependence" in panel B and for Ebitda in panel C. Firms with more than 10 employees are considered in panel A. Marginal effects are reported. Specifications in panels A and C include industry-level dummies. The marginal effect for the interaction term reported in specification (3b) is obtained computing the marginal impact of "industry finance dependence" when the External Score is equal to 4, the discrete value closer to the mean of this variable in our sample. "Firm-level financial controls" include ln capital intensity, ln cash flow, leverage ratio and liquidity ratio; "other firm-level controls" include innovation, labour skill, firm age, corporation, consortium and business group; "firm region dummies" include south and centre; and "province-level controls" include provincial value-added growth, n. branches per 1,000 inhabitants and provincial value added. Variables indicated with - av. are averages for the period 2008–10. All regressions include a constant term and cluster standard errors, reported in parentheses, at the province level. \*, \*\* and \*\*\*Significance at the 10%, 5% and 1% levels, respectively. The term (d) indicates a dummy variable

### 6.3.2 | External finance dependence

Manova (2013) followed by Fan et al. (2015) employs an indicator of external finance dependence at the industry level as a proxy for credit rationing.<sup>39</sup> The rationale behind this choice being that a firm operating in a specific industry needs, on average, a determined amount of external funds given the

<sup>39</sup>This industry-level indicator of finance dependence was introduced by Rajan and Zingales (1998), and it is based on US data.

inherent characteristics of the production technology employed in that industry. The ranking of finance dependence across industries tends to be quite similar across countries and, being based on US data, should not be influenced by financial markets' imperfections. We introduce this variable to assess whether the effect of credit rationing on quality differentiation is affected by industry-level determinants of external finance dependence. Specifications reported in panel B of Table 7 show that industry finance dependence reports a non-significant marginal effect. Interestingly, the credit score enters specifications (2b) and (3b) with a negative and significant coefficient.

### 6.3.3 | Ebitda and debt/Ebitda

In panel C of Table 7, we introduce an alternative indicator for the economic and financial performance of the firm. The Ebitda index (earnings before interest, taxes, depreciation and amortisation) available from balance sheet data is often used to analyse and compare profitability across companies. The other variable considered in these regressions is the ratio between firm's debt and Ebitda, computed as the ratio between firm's total outstanding debt with banks and financial institutions and the Ebitda. This last variable is a strong predictor for a firm's ability to repay its outstanding debt given its earnings. As a consequence, this is one of the measures that might significantly reduce the variation in quality differentiation explained by our preferred explanatory variable. Nevertheless, estimates strongly confirm the negative relation between the score and quality differentiation. As expected, Ebitda reports a positive significant marginal effect, while Debt/Ebitda is never significant. Our explicative variable retains its explanatory power above and beyond the role of other direct indicators of firm's access to external finance.

### 6.3.4 | Export revenues

As reported in Equation (9) of the theoretical framework, the ratio between quality of exported output and the quality of output sold domestically depends positively on the ratio between  $Q_i^k$  and  $Q_i^i$ . A higher quality-adjusted demand in the export market,  $Q_i^k$ , raises incentives for a firm to supply goods of higher quality to the foreign market. We do not have direct information on this variable; yet from our data, it is possible to recover information on total turnover in the foreign market and on revenues both in the foreign market and in the domestic market, as of 2010. Therefore, we are able to assess whether the effect of credit rationing on quality differentiation depends on export market exposure. We create a dummy variable for firms declaring to obtain more than 75% of their turnover abroad and the other two variables to compute the ratio between revenues in the export market and total revenues. Following implications discussed above, we expect to find a positive correlation between these additional controls and the probability of producing an output of higher quality for the export market. Evidence reported in panel A of Table 8 confirms that this is indeed the case.

In specifications (1a) and (2a), we find that firms obtaining more than 75% of their turnover in the export market are more likely to ship products of higher quality to the foreign market with respect to the one of products supplied domestically. The marginal effect at the means of reporting a high turnover in the foreign market is positive and equal to 0.067, significant at the 10% level. This result is confirmed when introducing the credit score, which now reports a marginal effect equal to  $-0.044$ , significant at the 5% level. Controlling for the ratio between revenues obtained in the export market and revenues obtained in the domestic market, in (3a) and (4a), does not affect our main finding.

**TABLE 8** Additional checks II: Export performance and alternative province level indicators

	<b>Panel A</b>			
	<b>(1a)</b>	<b>(2a)</b>	<b>(3a)</b>	<b>(4a)</b>
	<b>High quality out</b>	<b>High quality out</b>	<b>High quality out</b>	<b>High quality out</b>
External score - av.		-0.044** (0.019)		-0.035** (0.016)
High exp. turnover	0.067* (0.039)	0.064* (0.038)		
Rev. Exp./tot. rev.			0.106* (0.058)	0.109* (0.061)
Ln firm size - av.	0.026 (0.021)	0.007 (0.024)	0.057** (0.024)	0.042* (0.024)
Ln labour productivity - av.	0.019 (0.035)	0.008 (0.038)	0.050 (0.035)	0.041 (0.037)
Observations	322	322	380	380
Per cent correctly predicted	86.34	87.27	84.74	85.26
Log-pseudolikelihood	-109.58	-106.42	-145.35	-143.34
Pseudo $R^2$	0.121	0.146	0.114	0.126
	<b>Panel B</b>			
	<b>(1b)</b>	<b>(2b)</b>	<b>(3b)</b>	<b>(4b)</b>
	<b>High quality out</b>	<b>High quality out</b>	<b>High quality out</b>	<b>High quality out</b>
External score - av.	-0.030** (0.014)	-0.027* (0.014)	-0.026* (0.014)	-0.027* (0.014)
Ln pop. province, 2009	-0.021 (0.022)			
VA per inhab., 2009		0.005 (0.004)		
Share total credit province, 2010			0.274 (0.387)	
Total credit province, 2010				0.018 (0.015)
Firm size - av.	0.045* (0.024)	0.049** (0.023)	0.051** (0.024)	0.050** (0.024)
Labour productivity - av.	0.053 (0.033)	0.060* (0.033)	0.061* (0.033)	0.061* (0.033)
Observations	428	428	428	428
Per cent correctly predicted	84.58	84.81	84.81	84.81
Log-pseudolikelihood	-161.71	-165.75	-166.12	-165.76

(Continues)

TABLE 8 (Continued)

	Panel B			
	(1b)	(2b)	(3b)	(4b)
	High quality out	High quality out	High quality out	High quality out
Pseudo $R^2$	0.112	0.090	0.088	0.090
Firm-level financial controls	Y	Y	Y	Y
Other firm-level controls	Y	Y	Y	Y
Firm region dummies	Y	Y	Y	Y
Province-level controls	Y	Y	Y	Y

*Notes:* This table studies the relation between the proxy for credit constraints, "external score - av.", and the probability that a firm declares to produce higher quality for the foreign market. We check the robustness of our previous results controlling for proxies for firm's revenues in the foreign market and for alternative province-level control variables. Average marginal effects are reported. "Firm-level financial controls" include ln capital intensity, ln cash flow, leverage ratio and liquidity ratio; "other firm-level controls" include innovation, labour skill, firm age, corporation, consortium and business group; "firm region dummies" include south and centre; and "province-level controls" include provincial value-added growth, no. branches per 1,000 inhabitants and provincial value added. All specifications include industry-level dummies, and variables indicated with - av. are averages for the period 2008–10. Standard errors, reported in parentheses, are clustered at the province level, \*, \*\* and \*\*\*Significance at the 10%, 5% and 1% levels, respectively.

### 6.3.5 | Alternative province-level indicators

In panel (B) of Table 8, we introduce alternative indicators for market size, economic performance and credit availability at the province level. In specifications (1b) and (2b), we control for the logarithm of population and value added per inhabitant in each province for year 2009 which are available from the Italian National Statistical Office (ISTAT). Moreover, we control for the amount of credit to private firms in each province as a share of the nation's total for year 2010 (3b), and for the logarithm of total credit to private firms in the same year at the provincial level (4b), which are available from the Bank of Italy. Estimates show that the coefficient for "external score—av." is marginally lower in size, while its standard error remains similar to the one reported in Table 2. The negative relation between our proxy for credit rationing and quality differentiation is confirmed, while all additional province-level controls report non-significant coefficients.

## 7 | CONCLUSION

Using data on Italian manufacturing SMEs, we investigated the effect of credit constraints on quality differentiation across markets. Ameliorating the quality of exported output with respect to products supplied in the domestic market is an activity that requires significant external resources for firms, yet crucial to be successful in the foreign market. Our findings show that the more binding credit constraints are, the less likely a firm is to differentiate quality across markets. Firms reporting a standard deviation worse credit score are 36% less likely to export goods of higher quality relative to their domestically sold output. As predicted by the theoretical framework, we find that the negative relation between credit rationing and quality differentiation is stronger on those firms having higher incentives to pursue it, that is those exporting to distant markets. Moreover, we observe that the effect of distance to the importing market on quality differentiation is robust to considering differences in average income across destinations.



We employ two different strategies in order to partially account for the possible endogeneity of our explanatory variable, and results confirm the negative correlation between credit constraints and quality differentiation for the export market.

Our findings suggest that exporting SMEs willing to differentiate output quality for the foreign market might suffer from credit rationing. Interestingly, these firms could sustain domestic demand during economic downturns by obtaining higher revenues in the foreign market. Therefore, targeting exporting SMEs with policies aimed at giving them access to alternative sources of external capital could improve the resilience of the domestic manufacturing sector to negative shocks.

## DATA AVAILABILITY STATEMENT

Firm-level data is available upon request to UniCredit Group. Other data employed is available from publicly available sources indicated in the manuscript.

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