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Intermediated Trade and Credit Constraints: The Case of Firm's Imports

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Abstract

Growing evidence suggests that a large share of international trade transactions are made through intermediaries and that whether firms use them or not depends on different factors. In this paper, we investigate whether credit constraints introduce a degree of difference among firms in their mode of importing. To begin, we develop a simple analytical framework highlighting the possible links between credit constraints and reliance on import intermediaries, and then use firm-level data from 66 developing and developed countries to test the model's predictions. The results show that credit-constrained firms exhibit a higher probability of importing their inputs using an intermediary, while unconstrained firms are more likely to import directly. Our results also establish that the impact of credit constraints on the probability of indirect importing is amplified for firms with a higher distance from their international sourcing network. Moreover, if firms face other types of frictions to imports, then the probability that credit-constrained firms rely on intermediaries is estimated to be higher. The frictions we consider relate to the degree of regulatory burden and the extent of documentary compliance, time to import and other costs involved in import activities.

JEL classifications: F10; F14; F36; G20.
Keywords: Firms' Import Mode; Trade Intermediaries; Financial Constraints.

1 Introduction

A large body of literature has emphasized the role of trade intermediaries in supporting firms engaged in foreign transactions (see e.g., Antràs and Costinot, 2011; Ahn et al., 2011). Growing evidence suggests that a substantial share of trade flows are conducted through wholesalers, retailers or trading companies rather than through a direct interaction between firms and foreign suppliers or firms and foreign consumers. For example, Bernard et al. (2010) document that 35 per cent of U.S. exporters are wholesalers and they account for 10 per cent of the value of country's exports, while, according to Blum et al. (2010), intermediaries handle about 35 per cent of Chilean imports. Ahn et al. (2011) report that in 2005 Chinese exports through intermediaries represented 22 per cent of the country's total exports, whilst Abel-Koch (2013) cites evidence from Jones (1998) that in the 1990s trading companies in Japan exported more than 40 per cent and imported more than 70 per cent of the country's products.

When deciding whether to conduct import and export activities directly or indirectly, each firm faces a trade-off. Under a direct internationalization mode, firms incur a variety of fixed costs specific to foreign activities, such as those for collecting information on foreign suppliers and destination markets, or establishing and maintaining international source and distribution networks. By contrast, under an indirect mode, a large part of these costs are borne by trade intermediaries, who charge higher variable costs per unit of output in exchange for their services (see e.g., Bai et al., 2017; Akerman, 2018).

With few exceptions, such as Grazzi and Tomasi (2016), Bernard et al. (2010) and Blum et al. (2010), existing contributions on the role of intermediaries in facilitating international trade have focused exclusively on export activities, thus ignoring imports. This is surprising for two reasons. Firstly, there is a high incidence of firms who rely on imported inputs and, among them, many resort to trade intermediaries, as noted above. Second of all, an extensive literature has analyzed the beneficial effects of import market participation on numerous aspects of a firm's performance.[1]

In analysing the factors that prompt firms to rely on trade intermediaries, almost all contributions focus on productivity as the key dimension along which firms sort into alternative

[1] For example, Amiti and Konings (2007), Kugler and Verhoogen (2009) and Halpern et al. (2015) document how importing intermediate inputs enables firms to increase their productivity. Similarly, a study by Goldberg et al. (2010) shows that firms' reliance on imported inputs results in an expansion of their domestic product scope via the introduction of new product varieties, leading to dynamic gains from trade.

internationalization modes.[2] In spite of the impact financial constraints have in impeding firms' participation to international trade, to the best of our knowledge there is only one contribution which analyses how credit constraints influence the self-selection of heterogeneous firms into alternative trade modes.[3] In particular, a recent paper by Chan (2019) documents that, when engaged in export activities, credit-constrained firms are more likely to rely on trade intermediaries compared to unconstrained ones. In his study, however, firms' import activities are not taken into consideration.

The aim of this paper is to investigate whether and how financial constraints affect a firm's mode of participation to import markets. To the best of our knowledge, our contribution is the first to address this issue.

To guide and motivate our empirical analysis, we develop a simple theoretical model which yields testable predictions for data scrutiny. We characterize a firm's trade-off between direct and indirect imports by examining how the interplay of fixed and variable costs contributes to shape the pattern of its profits under each mode of importing. We model the presence of credit constraints in a firm through a positive wedge between the cost of external finance and that of internal finance. We assume that a firm relies on internal funds to pay its costs for imported inputs, but, if these funds are not sufficient, then it relies on bank credit to cover the remaining financial needs. Such external funds, however, require the payment of a premium. The model identifies a set of combinations of fixed costs and variable costs premium where the level of firm profits is the same under both import modes, thus singling out those combinations in which direct importing is more profitable than indirect importing and vice versa. Importantly, the configuration of this set depends on the severity of financial constraints. Our key theoretical prediction is that a credit-constrained firm is expected to import indirectly under a wider set of circumstances compared to an unconstrained firm.

[2] The main finding in theoretical and empirical literature is that the least productive firms are not engaged in international trade; at the same time, among the remaining firms, those that are relatively unproductive are more likely to trade indirectly, whilst relatively productive ones favour direct trade. The rationale for this sorting pattern is intuitive: only high-productivity firms can afford the fixed costs of direct participation to foreign markets ; low-productivity firms resort to intermediaries as a conduit for trade (see e.g., Ahn et al., 2011; Crozet et al., 2013; Abel-Koch, 2013).

[3] The role of access to finance as a dimension along which firms self-select into foreign activities has been largely emphasized in international trade literature (see, e.g., Manova, 2013; Minetti and Zhu, 2011; Muûls, 2015). Indeed, to cover fixed and variable costs associated with participation to international trade, a firm must have routine access to external capital and/or be endowed with sufficient liquidity. Numerous theoretical and empirical contributions have shown that financial constraints restrain firm participation to export and import markets (see e.g., Chaney, 2016; Berman and Héricourt, 2010), as well as affecting the impact of exchange rate fluctuations on international trade (see e.g., Li et al., 2020; Dai et al., 2021).

In analyzing how the ability to have access to finance affects firms' import modes, we rely on a large sample of establishment-level data for 66 countries, drawn from the World Bank Enterprise Surveys (hereby WBES). These data contain information on whether any of the material inputs or supplies purchased by a firm were imported directly in a given year. Moreover, the database provides valuable information to detect the presence of credit constraints in each firm. In particular, in the WBES, each firm is asked a number of questions regarding its ability to have access to credit. The responses provide a comprehensive self-assessment on the matter.

In our empirical analysis we provide robust evidence of a statistically significant effect of credit constraints on the firm's decision whether to import directly or indirectly. In particular, we show that unconstrained firms tend to directly source in international markets, whilst firms with financial restraints are more likely to acquire imported inputs through an intermediary. In the estimation on firm-level data we rely on methodologies based on instrumental variables, which allow us to bypass the endogeneity problems which may have otherwise plagued our results. In particular, we control for potential reverse causation in the relationship between financial constraints and the mode of imports – for example if a direct participation in import markets signalled high product quality and productivity – inducing a softening of credit restraints. In addition, this allows to control for common omitted factors, such as unobservable features which may affect both the firm's ability to access credit and its decision on the mode of importing. In light of these aspects, we believe that our estimation approach enables us to properly identify causal effects and establish more directly how financial constraints impact the mode of import participation.

We also analyze whether the effect of credit constraints on the likelihood of importing indirectly is amplified for firms facing other types of frictions to imports. In this respect, we first consider the geographical distance of the firm from its international sourcing network. In particular, we combine information on imported intermediates across different source countries with that on bilateral distance between the capital cities of any pair of countries. We then derive, for the industry to which a firm belongs, a country-specific measure of the weighted average distance between the firm's country and the countries of the foreign sources of its intermediate inputs. A higher geographical distance is found to reduce the likelihood of importing directly and to enhance the role of financial constraints in the firm's decision to import directly or through an intermediary. In case of a higher distance from the international sourcing network, the estimated effect of credit constraints on the likelihood of importing indirectly is magnified. We also allow for other frictions in importing activities by using information on the degree of regulatory burden and other fixed costs to imports.

We rely on a number of indicators at the country level: a) the extent of the documentary compliance, b) the amount of time to import and c) the costs involved in import activities. We show that, if these obstacles to trade are more severe, the effect of credit constraints on the probability of a firm sourcing its foreign inputs through an intermediary is higher.

The rest of the paper is organized as follows. Section 2 presents some background literature. Section 3 illustrates a simple theoretical framework providing motivation for the empirical analysis. Section 4 focuses on econometric methodology, data and descriptive statistics. Section 5 presents the empirical findings of the baseline specification, while Section 6 deals with extensions and robustness checks. Section 7 draws concluding remarks.

2 Background literature

Although, to the best of our knowledge, this is the first contribution that investigates the effect of credit constraints on firms' sorting into different import modes, it is important to frame the issue in the context of various strands of literature to which our paper is related.

In general, to understand the reasons why resorting to a trade intermediary can be convenient for a firm engaged in international trade, one must recall that participation in export and import markets implies specific fixed and variable costs which, in general, must be paid upfront (Melitz, 2003). These extra costs result, for example, from: a) establishing and maintaining international source and distribution networks, b) collecting information on the reputation of foreign suppliers, the quality and technological features of their products (in the case of imports) as well as on local tastes in the foreign destination markets (in the case of exports); c) the regulatory burden on product standards and custom compliance and d) the difficulties in enforcing international contractual agreements (Manova, 2013; Nucci et al., 2020).

From a theoretical perspective, an insightful theory of intermediation in international trade has been proposed by Antràs and Costinot (2011), who develop a dynamic general equilibrium model where the role of intermediaries originates from the presence of search frictions. Their analysis shows how intermediaries contribute in generating gains from international trade and in affecting their distribution. Against this backdrop, resorting to a trade intermediary can be beneficial, as they are able to pool the fixed costs of exporting and/or importing and spread them across firms, product varieties and source and destination markets.[4]

[4] Hessels and Terjesen (2010) provide an overview of the roles that intermediaries perform in international

The literature has emphasized how international trade through an intermediary implies a saving in fixed costs compared to direct trade, but also higher variable costs. As elucidated by Akerman (2018) for the case of exports, such higher variable costs reflect the fact that a trade intermediary introduces a markup between the procurement price of the good and what it charges the final consumer in the foreign country. For the case of imports, of course, the markup would be between the procurement price of the foreign input and the price charged to the firm that imports the inputs through a wholesaler. This trade-off between lower fixed costs and higher variable costs induces firms to partition into different trade modes according to some of their characteristics. In general, sounder firms (according to a number of characteristics described below) are more likely to be able to afford the payment of the fixed costs of participation in export and import markets, and are therefore more likely to engage directly in foreign activities. Weaker firms, on the contrary, tend to rely on trade intermediaries.

Many contributions establish, both theoretically and empirically, that firms endogenously select into specific modes of trading internationally based on their productivity. In particular, firms with no international exposure are less productive than those that rely on a trade intermediary, while the latter firms are in turn less productive than direct exporters and/or importers. Ahn et al. (2011) develop a theoretical model whose main prediction is that more productive firms are able to access foreign consumers directly, while less productive firms prefer to rely on intermediaries. Using firm-level Chinese data, they confirm this sorting pattern at the empirical level. Akerman (2018) proposes a theoretical framework that, as regards the choice of export mode, predicts a sorting based on productivity: the most productive firms tend to export directly, firms with intermediate productivity tend to export via wholesalers and the least productive firms serve only the domestic market. Moreover, if fixed costs increase, more products are exported through intermediaries because of their ability to generate economies of scope by spreading the extra costs of trade across many goods. Akerman (2018) also provides empirical support to this latter prediction by using information on Swedish firms.

Békés and Muraközy (2018) also propose a model in which more productive firms self-select into trade modes that, whilst imposing higher fixed costs, imply lower marginal costs. Using survey data of EFIGE project (European Firms in a Global Economy), they show that firms with a higher total factor productivity are more likely to trade directly (see, also, for similar

trade. Chen and Li (2014) highlight a number of interesting findings regarding the role of intermediaries in China's exports from 2000 to 2006.

theoretical frameworks and empirical results, Fujii et al., 2017; Lu et al., 2017).[5] Crozet et al. (2013) adds one dimension to this picture, proposing a theoretical model which also accounts for the accessibility of foreign markets in terms of trade costs and market size. Within this framework, they show both theoretically and empirically (using French firm-level customs data) how intermediaries support the least productive firms in accessing overseas markets – the more so for those located in more distant and smaller countries. A related result is that of Abel-Koch (2013), who emphasizes the role of firm's size in the choice of export mode and documents how larger firms prefer to export their products directly, while smaller firms tend to reach overseas markets through an intermediary. Interestingly, Yaşar (2015) finds a positive effect of exporting on productivity only for firms which export directly, and not for those that use an intermediary.

The study by Grazzi and Tomasi (2016) is one of the few that focus not only on exports but also on imports. Remarkably, it also lends empirical support to the hypothesis of productivity sorting, based on survey data at firm level from the World Bank Business Environment Enterprise Performance Survey (BEEPS). Differently from other studies, in their empirical framework firm productivity is used as dependent variable, while dummy variables for the export or import modes are included as regressors (see, e.g., Davies and Jeppesen, 2015). This provides further support to the view that causality may run in both directions: from the level of productivity to the choice of international trade mode and vice versa (as suggested by the results of Yaşar, 2015).

A different perspective is taken by Dasgupta and Mondria (2018), who argue that, since uncertainty on product quality is widespread in international trade, intermediaries perform the important role of screening the quality of products and revealing it to consumers. Using a model with trade intermediation and incomplete information about product quality, they show that firms with the highest levels of quality find it optimal to export directly, while those with intermediate quality tend to export through intermediaries, and firms with the lowest levels of quality do not serve foreign markets (see also, Tang and Zhang, 2012).[6]

[5] Some contributions focus on learning-by-exporting mechanisms and show that they largely differ across export mode. According to Bai et al. (2017), for example, direct exporters learn more than indirect exporters as productivity and demand evolve more favorably under direct exporting. Defever et al. (2020) use Chinese data and find that productivity of both direct and indirect importers increases following a trade liberalization, but this effect is stronger for firms involved in direct importing. Toshimitsu (2019) provides theoretical and empirical support to the view that indirect exporters learn how to enter foreign markets and eventually become direct exporters.

[6] There are other factors that affect the endogenous sorting into alternative trade modes. In China, having political connections, as shown by Zhang et al. (2020), significantly increases the probability of being direct exporters. Bernard et al. (2015) find that a weaker quality of governance and contracting increases the degree

Blum et al. (2010) study transaction-level data on Chilean imports between 2004 and 2008, uncovering two interesting and stylized facts. First, intermediaries achieve economies of scale by specializing in imports of large volumes of few specific products from a limited number of countries. Second, imports to Chile from countries with the lowest total export value are typically made by large Chilean firms, many of which are intermediaries.

The study by Chan (2019) is especially relevant for our purposes, as it analyses the role of credit frictions in the firm's decision on the mode of export. He shows theoretically and empirically that firms facing credit constraints are more likely to pursue intermediated export compared to unconstrained firms.

As emerges from this overview section, the literature on the role of intermediaries in international trade has focused almost exclusively on export activities (exceptions include Bernard et al., 2010; Blum et al., 2010; Grazzi and Tomasi, 2016). We also recall that an array of literature has focused on credit constraints as an important characteristic severely impeding firm's participation to foreign markets. A large number of theoretical and empirical contributions have shown that firms with access to credit are more likely to enter export and import markets compared to credit-constrained firms and, in the pool of importing and/or exporting firms, unconstrained firms tend to be engaged in these foreign activities more intensively (see, e.g., Berman and Héricourt, 2010; Manova, 2013; Minetti and Zhu, 2011; Muûls, 2015; Chaney, 2016; Pietrovito and Pozzolo, 2019). Against this background, it is surprising that, with the sole exception of Chan (2019), there are no studies that attempt to investigate the impact of financial constraints on the mode of participation to international trade. Our contribution seeks to fill this gap.

Whilst our paper relates closely to the work by Chan (2019), there are three essential differences. First, we focus on imports while he analyses exports. Second, we also investigate whether the effect of credit constraints on the probability of importing indirectly is amplified when a firm faces other types of frictions to imports – such as market distance, the extent of regulatory burden, and other fixed costs. Third, we adopt a different approach in computing the main measure of financial constraints, as we rely on a comprehensive self-assessment by each firm of its ability to have access to credit.

Before presenting the empirical results, to provide neater motivation and guidance for the empirical analysis, we first propose a simple theoretical model, to which we now turn.

of reliance on trade intermediation. A similar effect has been uncovered by Felbermayr and Jung (2011) in case of more severe country-specific expropriation risks.

3 A simple theoretical framework

In the simple model presented in this section, the choice between importing directly or indirectly (i.e. through an intermediary) depends on three factors: a) the fixed costs of acquiring foreign inputs directly, b) a variable cost premium to be paid in the case of indirect importing, to reward the activity of the intermediary, and c) the credit constraints faced by the firm, which affect its ability to pay ex-ante the fixed costs of importing directly.

As in Melitz (2003), we assume that each firm $i \in [1, N]$ produces a single variety of a differentiated product. Without loss of generality, and to focus only on our object of interest (imported inputs), we make the hypothesis that manufacturing one unit of good requires a firm-level expenditure of ca_i, where c denotes the cost of a bundle of imported inputs that are necessary to produce one unit of output, and a_i is the inverse of the firm's productivity level $(1/a_i)$. Following the literature, we assume that a_i is drawn from a distribution $G(a)$ that is common among all firms and has a support in the interval $[a_L, a_H]$. To source its inputs abroad, the firm must pay an up-front fixed cost, which is equal to F_i^D if it imports directly and to F_i^I if it acquires them through an intermediary.

Crucially, we assume that intermediaries allow firms to access import markets with smaller fixed costs compared to direct importing, i.e. $F_i^D > F_i^I$. However, to reward the activity of the intermediary, the firm must pay ex-ante a variable cost premium, $\gamma_i > 1$.

Each firm pays up-front costs using its available liquid assets, L_i. However, if these funds are insufficient, then it must recur to external sources, which are more costly than the internally generated funds because of financial market imperfections. We thus assume that a financial premium ($\phi_i > 0$) relative to the cost of internal funds (which, for simplicity, is set equal to zero) has to be paid on external resources. The premium on external financing is firm-specific and reflects the severity of credit constraints faced by the firm.[7]

A firm chooses its price and quantity to maximize profit (we drop the index i to streamline the exposition):

$$\pi(p, q, \gamma, F^j) = pq - q\gamma ca - F^j - (q\gamma ca + F^j - L)\phi, \tag{1}$$

where $F^j = F^D$ if the firm imports its inputs directly and $F^j = F^I$ if, instead, it relies on

[7] Whilst simple, this way of modeling financial constraints is in line with the approach by Kaplan and Zingales (1997), who classify firms as credit constrained if they face a wedge between the internal and external costs of funds; a firm is considered more financially constrained if this wedge is higher.

an intermediary.

Assuming that consumers have preferences over the set of goods produced, as in Melitz (2003), each firm faces the following demand function for its product:

$$q(p) = \frac{p^{-\epsilon} Y \theta}{P^{1-\epsilon}} \tag{2}$$

where: $q(p)$ is the quantity demanded of a specific variety, p is its price, $\epsilon > 1$ is the elasticity of substitution between goods in the representative consumer's utility function, Y is total expenditure in the economy and $P = \sum_{i=1}^{N} p_i^{\frac{\epsilon}{\epsilon-1}}$ is the aggregate price level.

Maximizing Equation (1) subject to the consumers' demand function (Eq. (2)), we obtain the following expressions for the optimal price and quantity produced by each firm:

$$p = \frac{\epsilon}{\epsilon - 1}(1+\phi)\gamma c a, \tag{3}$$

$$q = \left[\frac{\epsilon}{\epsilon - 1}(1+\phi)\gamma c a\right]^{-\epsilon} \frac{\theta Y}{P^{1-\epsilon}}. \tag{4}$$

Note that, in previous expressions, $\gamma > 1$ if the firm uses inputs imported through an intermediary and $\gamma = 1$ if the firm is importing directly.

Substituting Eqs. (3) and (4) into Eq. (1) yields the following profit function:

$$\Pi(\gamma, F^j) = [\mu(1+\phi)\gamma c a]^{-\epsilon} \frac{\theta Y}{P^{1-\epsilon}}(\mu - 1)(1+\phi)\gamma c a - (1+\phi)F^j + \phi L, \tag{5}$$

where: μ is the firm's price mark-up (i.e. $\mu = \frac{\epsilon}{\epsilon-1} > 1$), and $F^j = F^D$ and $\gamma = 1$ if the firm imports directly and $F^j = F^I$ if the firm uses an intermediary.

A firm must decide whether to import its inputs directly or rely instead on an intermediary. From Eq. (5) it imports directly if $\Pi(1, F^D) > \Pi(\gamma, F^I)$, it imports indirectly if the opposite holds true and it is indifferent between the two alternatives if $\Pi(1, F^D) = \Pi(\gamma, F^I)$. From the latter condition we can thus solve for the threshold level of γ (we call it γ^*) that makes a firm indifferent among the two import modes:

$$\gamma^* = \left[1 - A a^{\epsilon-1}(1+\phi)^{\epsilon}(F^D - F^I)\right]^{\frac{1}{1-\epsilon}}, \tag{6}$$

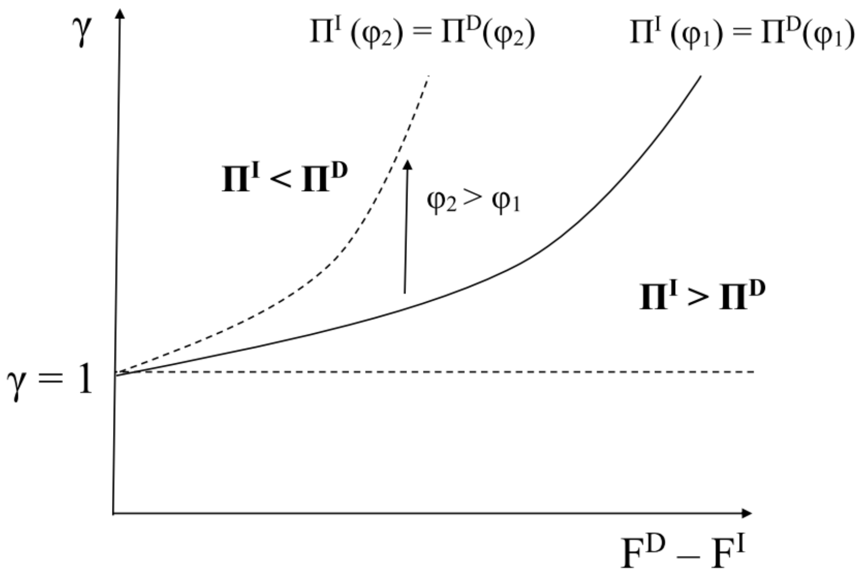

Figure 1

where $A = \frac{c\mu^{\epsilon}}{\mu-1}\frac{P^{1-\epsilon}}{\theta Y} > 0$.[8]

We first establish from the above expression that $\frac{\partial\gamma^*}{\partial(F^D - F^I)} > 0$. In other words, when the fixed costs under direct importing, F^D, increase compared to those under indirect importing, F^I, the threshold variable costs premium that the firm is willing to accept without switching to direct importing, γ^*, is higher. That is, as $(F^D - F^I)$ rises, under a larger set of circumstances it is convenient for the firm to rely on intermediated, rather than direct, trade. We also establish that $\frac{\partial\gamma^*}{\partial\phi} > 0$, implying that, *ceteris paribus*, firms facing more severe credit constraints are less likely to import directly. Using Eq. (6), the curve in Figure 1 represents the set of values of γ and $(F^D - F^I)$ at which profits are the same under direct and indirect import modes: $\Pi^I(\phi_1) = \Pi^D(\phi_1)$. At any combination of γ and $F^D - F^I$ which lies above (below) that curve it is convenient to import directly (indirectly). Crucially, as credit constraints become stronger $(\phi_2 > \phi_1)$, it is more likely that a firm finds it profitable to import indirectly.

Equating to zero the profit function in Eq. (5), it is also possible to determine the threshold

[8]It is worth emphasizing that $\gamma^* > 1$, because the term in square brackets is likely to be bounded between 0 and 1 (for plausible values of Y at the denominator of the expression for A), and, as for its exponent, $\frac{1}{1-\epsilon}$, it is negative and the absolute value of it is lower than unity.

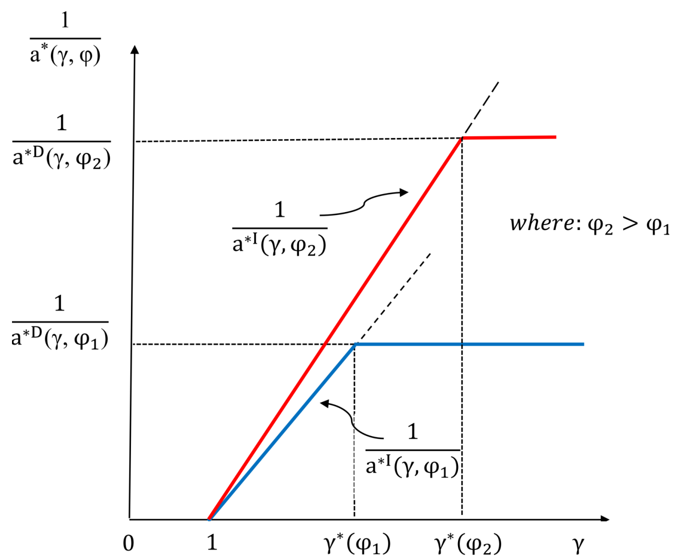

Figure 2

level of productivity, $\frac{1}{a^*}$, below which a firm does not produce because it would incur a loss:

$$\frac{1}{a^*} = \left[\frac{(1+\phi)F^j - \phi L}{\theta Y(\mu - 1)}\right]^{\frac{1}{\epsilon-1}} \frac{\mu^\mu(1+\phi)\gamma c}{P}, \tag{7}$$

where, as above, $\gamma = 1$ if the firm is importing directly, and $\gamma > 1$ if it uses an intermediary.

The threshold productivity value $\frac{1}{a^*}$ is an increasing function of γ. However, this cannot be directly inferred from equation (7), because there might be a discontinuity in when the firm switches from using an intermediary to importing directly, i.e., when the expression switches from $F^j = F^I$ and $\gamma > 1$ to $F^j = F^D$ and $\gamma = 1$.

Figure 2 represents the relationship between $\frac{1}{a^*}$ and γ, showing that the threshold productivity level, $\frac{1}{a^*(\gamma,\phi)}$ is an increasing function of γ for $\gamma < \gamma^*(\phi)$, but it is constant at $\frac{1}{a^{*D}(\gamma,\phi)}$ for $\gamma \geq \gamma^*(\phi)$. This is because if the firm imports directly, it pays higher fixed costs but no variable costs, so that $\frac{1}{a^*}$ is independent of γ.[9] Since for any level of productivity, including at the threshold level $\frac{1}{a^*}$, γ^* is the value of the variable costs premium which makes it indifferent for the firm to import directly or through an intermediary, it descends that

[9]The threshold level of productivity under direct importing is defined as $\frac{1}{a^{*D}}$.

$\frac{1}{a^{*I}(\gamma^*)} = \frac{1}{a^{*D}}$ (where $\frac{1}{a^{*I}(\gamma)}$ is the threshold level of productivity under indirect importing). Figure 2 also shows that if a firm faces more severe credit constraints (i.e., $\phi_2 > \phi_1$), then the likelihood for it to rely on intermediaries increases.[10]

The simple model outlined above predicts that an increase in the variable costs premium makes it more likely for firm to switch to direct imports; the opposite is true for an increase in the difference between the fixed costs of importing directly and those of importing indirectly. Moreover, the model establishes that firms facing stronger credit constraints are more likely to use an intermediary. In the following, we will put these predictions under empirical scrutiny.

4 The Empirical Framework

4.1 Firm-Level Methodology

This section describes the empirical models adopted to test the hypotheses originated from our theoretical framework. The first is based on the following binomial specification, where firms are indexed by i, industries by k, countries by c and time by t:

$$\begin{aligned} Pr\left(indirect\_import_{ikct} = 1\right) &= \alpha + \beta CR_{ikct} + \gamma Z_{ikct} + \nu_k + \lambda_c + \eta_t + \epsilon_{ikct} \\ &= Pr\left(\alpha + \beta CR_{ikct} + \gamma Z_{ikct} + \nu_k + \lambda_c + \eta_t + \epsilon_{ikct} > 0\right) \\ &= \Phi\left(\beta CR_{ikct} + \gamma Z_{ikct} + \nu_k + \lambda_c + \eta_t + \epsilon_{ikct}\right). \end{aligned} \tag{8}$$

The dependent variable is a dummy variable, $indirect\_import_{ikct}$, that takes the value of one if the firm uses an intermediary to import its inputs, and zero otherwise. The main explanatory variable is a dummy that takes the value of one if the firm is credit-rationed, and zero otherwise, CR_{ikct} (in Section 4.2 we discuss in detail how we identify credit-constrained firms).[11] The explanatory variables include a set of firm characteristics, Z_{ikct}, such as number of employees, age, productivity, capacity utilization, the share of skilled and temporary workers, foreign ownership, the relevance of domestic market, and the export status (the entire set is described in detail in Section 4.2). To control for potential omitted variables in

[10] A symmetric analysis can be conducted with respect to F^j, treating γ as fixed.

[11] It is worth emphasizing that our analysis is based on a pooled cross-section and not on a panel data set, because very few firms are observed in consecutive years.

this specification, we include fixed effects that account for: (i) the time-invariant industry characteristics, to capture for example the level of upstreamness or downstreamness (ν_k); (ii) the time-invariant country-level characteristics, that control for aspects such as the stance of trade policy (λ_c); and (iii) the time effects, accounting for the fact that our sample period spans from before to after the financial crisis (η_t).

First we estimate a Linear Probability Model (LMP) which considers our dichotomous dependent variable ($indirect\_import_{ikct}$) as continuous. While this is not the most efficient estimator, it is consistent and robust to potential mispecification errors (Chiburis et al., 2012). Its main shortcoming is that it may yield predicted probabilities that lay outside the $[0, 1]$ interval (Caudill et al., 1988). For this reason, we then estimate equation (8) adopting a probit model, accounting for the constraints that the predicted probability must lie between zero and one.

From an econometric perspective, a crucial problem to assess the causal impact of the presence of credit constraints on a firm's choice of import mode is that such a relationship may suffer from at least two major endogeneity problems. First, unobserved firm-level characteristics might influence both their ability to access external finance and their mode of participation to import markets. For instance, if a firm faces a negative shock that induces a contraction in its level of economic activities, this would determine a drop in external financing, making it more likely for the firm to be credit-constrained and inducing a decrease in the firm's imports. The incidence of the fixed costs of importing would thus increase and the benefits of operating directly in international markets would drop, making it more likely for the importing firm to use an intermediary. Or, more simply, firms whose managers are members of an established international network might be better able to access both external finance and foreign suppliers. Second, the relationship of interest may be characterized by reverse causation, as firm's access to foreign markets might be seen as a positive signal that makes it easier to obtain external funding, reducing the extent of credit rationing.

Since both the dependent variable and the proxy for credit constraints are dichotomous, we address the endogeneity problem estimating a bivariate probit model, which includes two equations: the first estimates the probability that the firm is credit-constrained and the second estimates the probability of importing through an intermediary, conditional on being credit-rationed. Intuitively, this method replicates an instrumental variable (IV) approach, where the first stage estimates the probability that a firm is credit constrained. The identification of the first equation in the bi-probit model is made possible by the inclusion of some explanatory variables not included in the second equation, which play the same role of the instruments in a standard IV estimation (see e.g., Minetti and Zhu, 2011; Minetti et al., 2019). We use two such instruments. The first is a dummy variable that takes the value of one if the firm's financial statement is checked and certified by an external auditor, and zero otherwise. The second is a measure of limited availability of internal sources of funds, constructed as a dummy variable that takes the value of one for firms with a share of payment inflows after delivery higher than 90% and zero otherwise, interacted with four firm size dummies corresponding to the quartiles of the distribution of firms by employment size. We allow the impact of late payments (i.e., commercial credits granted by the firm) to vary depending on firm size, since abundant evidence highlights significant differences between large and small firms in their policies on late payments. As we consider the quartiles of the distribution of firm size, we include four interactions as instrumental variables.[12]

The second equation of the bi-probit model is identical to equation (8), while the first equation is the following:

$$\begin{aligned} Pr\left(CR_{ikct}=1\right) &= \delta I_{ikct} + \lambda Z_{ikct} + \nu_k + \lambda_c + \eta_t + \mu_{ikct} \\ &= Pr\left(\delta I_{ikct} + \lambda Z_{ikct} + \nu_k + \lambda_c + \eta_t + \mu_{ikct} > 0\right) \\ &= \Phi\left(\delta I_{ikct} + \lambda Z_{ikct} + \nu_k + \lambda_c + \eta_t + \mu_{ikct}\right) \end{aligned} \tag{9}$$

where I_{ikct} is the set of instrumental variables, excluded from equation (8). The set of control variables, Z_{ikct}, and the three sets of fixed effects are the same as those in equation (8). The bivariate probit model controls for endogeneity by allowing the error terms ϵ_{ikct} and μ_{ikct} of equation (8) and equation (9) to be correlated. The baseline bi-probit model is estimated including the three sets of fixed effects mentioned above; additionally we provide results including the interaction of year, country and sector fixed effects (*year*country*sector*).

One of the main characteristics for an instrumental variable is its exogeneity. In our specification, instruments should affect the import mode only through our measure of credit constraints; they should not directly affect our dependent variable. In other terms, our instruments should prove not to be correlated with some omitted variables that might affect both the likelihood of importing with an intermediary and that of being credit constrained. To verify the validity of our instruments, we provide two different tests, obtained by estimating the companion second stage regression (8) with a linear model and instrumenting credit rationing with the instruments mentioned above. The first is the Hansen test of overidentifying restrictions, verifying the joint null hypothesis that the instruments are valid, i.e., uncorrelated with the error term, and that the instruments in equation (9) are correctly ex-

[12]The choice of these instruments is consistent with the literature on the determinants of credit constraints (see, for example, Drakos and Giannakopoulos, 2011; Nucci et al., 2020).

cluded from the estimated equation (8). The second is the Kleibergen-Paap statistic, which tests the hypothesis that the included instruments are weakly correlated with the endogenous regressors.

The models are estimated on the sub-sample of importing firms, distinguishing between those importing indirectly and those that import directly. To control for the possible bias caused by the selection of only those firms which import at least some of their inputs, we also estimate an Heckman selection model (with instrumental variables). To this end, we jointly estimate the likelihood that a firm: (i) is an importer, (ii) is credit-constrained, and (iii) uses an import intermediary. Identification of the first equation is obtained by including a variable related to the firm's perception of the influence of political instability on its business operations (which is excluded from the other two equations). Identification of the second equation is obtained as in the bi-probit model, excluding from the third equation the dummy variable indicating whether the firm's financial statement is checked and certified by an external auditor as well as the measure of limited availability of internal sources of funds.[13]

4.2 Data and sources

To test the predictions of the model, we analyze a pooled cross-section sample retrieved from the WBES, including 13,515 private firms from 66 countries, mostly emerging and developing, in years 2003 and 2006-2014. Firms belong to 22 manufacturing industries, classified according to the 2 digit level of ISIC.

These data contain information not only on the origin of material inputs and supplies used in the production process (domestic or foreign), but also on the mode of sourcing inputs from abroad: directly or through an intermediary.

To measure credit constraints, our key explanatory variable in the empirical model – we use specific questions included in the WBES. A large strand of empirical research identifies credit-constrained firms based on characteristics ranging from measures of firms' risk (see, for instance, Muûls, 2015; Wagner, 2015) to leverage and liquidity ratios (see, e.g., Bas and Berthou, 2012; Fauceglia, 2015). However, since several concerns have been raised on the ability of these indicators to identify credit-constrained firms (see, for instance, Farre-Mensa and Ljungqvist, 2016), we prefer to exploit the firm's self-assessment available in WBES and define as credit-constrained those firms that obtained a credit denial or characterize

[13]Estimation are conducted using the CMP routine for Stata made available by Roodman (2011).

themselves as discouraged borrowers. This approach was pioneered by Jappelli (1990) and adopted in several papers on credit constraints and international trade (see, for instance, Drakos and Giannakopoulos, 2011; Nucci et al., 2020).

In practice, we define a firm as credit-constrained, and identify it with a dummy variable taking the value of one if it either: (i) applied for a loan or a credit line but did not obtain it for reasons related to the credit rationing policy of the financial intermediary, or (ii) it self-excluded from the credit market, not applying for a loan because of the complexity of the application procedures, the expected unfavorable conditions on interest rates, collateral, size, duration, among others, or the expectation that the application would be rejected. All firms that, at the time of the survey, have a loan or a credit line or state that they do not need a loan are considered as unconstrained.

Information on importing activities and credit rationing is supplemented with other firm characteristics, used as control variables in our econometric specification to reduce the potential omitted variables bias (see, for instance, Grazzi and Tomasi, 2016). In particular, we assume that the mode of import may be affected by structural characteristics of the firm, such as: size, measured by the number of permanent full-time employees; labor productivity, approximated by the ratio of total sales to the number of employees; the share of skilled workers over the number of permanent full-time employees; age, measured by the number of years since its foundation; the share of temporary employees over total employees; a self-reported measure of capacity utilization; the incidence of foreign shareholders, on the grounds that foreign ownership of a firm may affect the propensity to access international markets (Grazzi and Tomasi, 2016). Finally, since the empirical literature has provided ample evidence of interconnection and complementarity between exporting and importing (Castellani et al., 2010; Muûls and Pisu, 2009), we also control for the firm's exporting status, with a dummy that takes the value of one if the firm sells its products to foreign markets and zero otherwise, and for the relevance of its domestic market, with a dummy taking the value of one if the firm states that the main market for its leading product is national and zero otherwise.

4.3 Summary statistics

Table 1 presents the descriptive statistics, showing that 46% of the firms in our sample import using an intermediary, and slightly less than 20% are credit-constrained. Interestingly, the share of constrained firms is larger for indirect importers (26%) than for direct importers (14%), and the difference is statistically significant at the 1% level, as shown by the t-test in the last column of the table. Similar differences are shown for “Access to finance”, our alternative measure of credit rationing.

Firm structure shows a high degree of heterogeneity within our sample, with size ranging for example from 5 employees at the $5th$ percentile to 550 employees at the $95th$ percentile. Firms that import indirectly show: (i) a lower probability of exporting (26%) than firms importing directly (60%), and (ii) a lower share of foreign ownership (4%) than firms importing directly (15%). This may be explained by the fact that exporting and foreign-owned firms face lower costs to import directly, because of their better knowledge of how to trade internationally. Firms importing indirectly are smaller, less productive and younger than firms importing directly.

Table 2 presents the correlations between variables. Reassuringly, our dependent variable is positively correlated with both measures of credit rationing, suggesting that credit-rationed firms are more likely to import through an intermediary than directly. In the following, we will show that this finding is consistent with more rigorous econometric analysis.

5 Baseline Empirical Results

Table 3 presents the estimation results of equation (8) and (9), obtained using a linear probability model (LPM, column 1), a probit specification (column 2), and two bi-probit specifications with different sets of dummy variables (columns 3-6). To make the results comparable, while using different estimation methods, columns 2-6 report the values of the marginal effects calculated at the sample values.

Consistent with the predictions of our theoretical framework, firms that are credit rationed are significantly more likely to acquire imported inputs through an intermediary. The estimated marginal effects – which coincide with the estimated coefficient only in the case of the LPM – are very similar using the three different estimation methods, and they are in all cases statistically significant at the 1% level. Since in the following we will present results solely obtained using binomial models, we will consider the results in column 2 as our baseline specification. The estimated marginal effect of credit rationing is in this case 0.075, with a very small standard error of 0.009. Since the unconditional share of firms which use import intermediaries is 46% (see Table 1), the effect of credit constraints is to increase the probability of using intermediaries by 16% – a sizable economic impact.

The estimated impact of the other control variables is as expected. The marginal effect of the logarithm of the total number of employees is estimated to be -0.089, and it is statistically significant at the 1% level. Larger firms are thus less likely to use import intermediaries, as predicted by the theoretical model. Firms with better access to foreign markets, such as exporters and local subsidiaries of multinational firms, are also less likely to import inputs using an intermediary. The estimated marginal effect of the dummies for exporting firms and for foreign owned firms are both negative, respectively -0.144 and -0.001, and also statistically significant at the 1% level. In general, firms which are more productive and employ a more skilled labor force are less likely to use import intermediaries. This is shown by the negative and statistically significant estimated marginal effects of labor productivity (-0.054, statistically significant at the 1% level), the degree of competition faced in the domestic market (-0.044, significant a the 1% level) and the degree of capacity utilization (-0.052, significant a the 1% level), and by the positive estimated marginal effect of the share of temporary workers (0.043, significant at the 5% level). If one assumes that skilled workers are better at handling complicated import procedures, thus reducing the need to employ an intermediary, the positive estimated marginal effect of the share of skilled workers (0.102, also statistically significant at the 1% level) is admittedly less intuitive. Arguably, firms with a high share of skilled workers are likely to import sophisticated inputs which they would rather have thoroughly screened by specialized import intermediaries.

As argued in section 4.1, the presence of financial constraints and the choice to use an intermediary to acquire imported inputs may be affected by an endogeneity bias. Estimates using a bi-probit specification allow to control for this possiblity.[14] As discussed in 4.1, the identification of the equation for the event that a firm is credit constrained is obtained by including five additional variables. The results obtained estimating equation (8) using the bi-probit specification, reported in column 3, show that we cannot reject the hypothesis that the dummy for credit-constrained firms is endogenous with respect to the use of import intermediaries. Column 4 reports the results of the estimation of equation (9) within the bi-probit specification. Aside from the estimated marginal effects of the characteristics included in equations (8) and (9) – which are not the focus of the current analysis, and all have the expected sign – it is reassuring that the five regressors included for identification are highly jointly statistically significant, and four of them are also individually significant at the 1% level.

The negative correlation coefficient between the estimated error terms of the two equations of the bi-probit specification, $Corr(\epsilon_{ikct}, \mu_{ikct})$, is statistically significant at the 5% level. It

[14] As we already discussed in section 4.1, this mimics an instrumental variable approach in a binomial specification setting.

implies that, after controlling for observable characteristics, credit-rationed firms are less likely to use import intermediaries. Thus, the endogeneity bias works against finding a significant effect of credit rationing on the import mode, as confirmed by the fact that, in this case, the estimated marginal effect of the dummy for credit rationing is 0.338 (also statistically significant at the 1% level) – about four times larger than that estimated using the probit specification. Reassuringly, the marginal effects of the other firm characteristics are broadly comparable to those obtained with the LMP and the probit specifications (with the only exception of the effect of the degree of capacity utilization, which diminishes in absolute value and becomes statistically insignificant).

The IV least-squares estimates of the companion model provide indirect evidence that our specification is robust. The Kleibergen-Paap first stage F-statistic has a value of 6.06, which allows to reject at the 1% level the hypothesis that the instruments have jointly zero significance in the first stage regression. The Hansen test of overidentifying restrictions has a value of 3.81, with an associated p-value of 0.43, which does not allow to reject the joint null hypothesis that instruments are valid (i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the second-stage equation).

The results presented in columns 3 and 4 refer to a bi-probit specification including year, country and sector fixed effects. In columns 5 and 6 we present the results of the estimates of an alternative specification, which includes a larger set of dummies, obtained from the interaction of year, country and sector fixed effects (*year*country*sector*). Adopting this specification amounts to comparing rationed and non-rationed firms within the same sector, country and year, significantly reducing the total variability, and absorbing large degrees of freedom. Nonetheless, the estimated marginal effect of credit rationing is 0.239 and it remains statistically significant at the 1% level. This provides support to our previous findings. According to our estimates, all else being equal, credit rationed firms are about 20% to 30% more likely to use import intermediaries. Also in this case, the Kleibergen-Paap and Hansen tests confirm the soundness of the econometric specification.

6 Extensions and Robustness Analysis

6.1 Controlling for Sample Selection Bias

The results reported in Table 3 are obtained estimating equation (8) on the sample of importing firms. As such, they cannot be used to infer the behavior of a non-importing firm that decides to begin acquiring foreign inputs. To address this issue, we have estimated equation (8) using a two-stage Heckman correction model on all 21,498 firms in our sample.[15] Columns 1-3 of Table 4 report the estimated marginal effects. Column 1 refers to the equation where the dependent variable is a dummy indicating the firm's import status (importer or non importer). In that column, the measure of perceived political instability, the included regressor used to identify the equation, is statistically significant at the 1% level. Column 2 refers to the equation where the dependent variable is a dummy indicating whether the firm has access to credit (credit-constrained or unconstrained firms). The estimated results in that column show that, also in this case, the five additional controls included in the estimation of equation (9) are jointly statistical significant at the 1% level, confirming the validity of our specification.

Column 3 refers to the equation in which the dependent variable is a dummy indicating the mode of import of each firm (direct or indirect). Our results corroborate the findings of the bi-probit specification. The estimated marginal effect of credit rationing is 0.33, almost identical to that reported in column 3 of Table 3. All other estimated effects are also very similar to those obtained with the bi-probit specification. We therefore provide more generality to our findings, by establishing that they also apply to firms that are not using foreign inputs, but decide to begin acquiring them.

6.2 Alternative Definition of Credit Rationing

In our baseline specification, firms are classified as credit-rationed if they either: (i) applied for a loan, but did not obtain it; or (ii) did not apply for a loan because they were discouraged from doing so. To check the robustness of our results in relation to this measure, we made use of another question in the WBES survey, in which firms are asked whether access to finance is an obstacle to their current operations.[16] We defined as credit-rationed all firms which answered that access to finance is a moderate, major or very severe obstacle to their operations. Table 5 presents the results obtained estimating the bi-probit model defined by equations (8) and (9) using this alternative definition. Since they are obtained using an identical specification, these results are fully comparable with those of columns 3 and 4 of

[15] As explained above, we have estimated an instrumental variables Heckman correction model using the CMP routine developed by Roodman (2011); also in this case this allows us to control for the endogeneity of credit rationing with respect to the choice of import mode.

[16] The specific question is the following: "Is access to finance, which includes availability and cost, interest rates, fees and collateral requirements, no obstacle, a minor obstacle, a moderate obstacle, a major obstacle, or a very severe obstacle to the current operations of this establishment?".

Table 3. Reassuringly, the estimated marginal effect of the dummy for credit rationed firms is 0.396 – even larger in absolute value than that in column 3 of table 3 (0.338) – and also in this case it is statistically significant at the 1% level. All other controls have comparable effects. As in the previous cases, the five additional controls included in the estimation of equation (9) are jointly statistical significant, confirming the soundness of our specification.

6.3 Geographical Distance

Abundant empirical literature focussed on gravity equations has provided evidence that geographical distance has a first-order effect on international trade flows. Typically, distance creates a host of physical, administrative and informational barriers, which increase costs and hamper the amount of bilateral trade among country pairs. Physical and information barriers are also likely to impact differently on direct and indirect importers, because intermediaries can spread the fixed costs component of importing across a larger volume of imports. This leads to two testable implications. First, firms importing inputs from more distant countries are more likely to use intermediaries. Second, since credit-constrained firms are less able to sustain fixed costs, the impact of rationing on the probability that a firm uses an intermediary is higher if it imports from more distant countries.

To test this hypothesis, we need a measure of the distance of the countries from which the firms import their inputs. Since WBES does not include such information, we compute a weighted distance indicator combining country- and sector-specific information on imported inputs from the International Use tables in the WIOD with data on the geographical distance between pairs of countries from the *Centre d'Études Prospectives et d'Informations Internationales* (CEPII).[17] The Use WIOD tables are product-by-industry type tables, including 35 industries covering the overall economy and roughly corresponding to the two-digit ISIC rev.4 level (Timmer et al., 2015). They report the values of foreign purchases of each product, distinguishing whether it is used: as an intermediate input by domestic industries, to satisfy domestic final demand, or for re-exporting. For the purpose of this paper, we focus on the value of imports used as intermediate inputs by domestic industries. Taking a country c, for each country pair $c - j$ and for each industry k, we sum imports of inputs from all sectors to obtain total imports in country c of firms belonging to industry k ($imports_{kc}$). We then compute the share of imports by firms in industry k in country c from source country

[17] The use tables are the core statistical sources from which statistical institutes derive national input-output tables. Data are accessible at: http://www.wiod.org/database/int_suts16; data on distance are accessible at: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=6.

j ($imports_{kcj}$) over total imports of firms in country c operating in sector k. After selecting 22 sectors and 66 countries included in our sample for each importing industry k in country c, we construct the following weighted average distance measure ($weighted\_distance_{kc}$):

$$weighted\_distance_{kc} = \sum_{j=1}^{N} distance_{cj} \frac{imports_{kcj}}{imports_{kc}}, \tag{10}$$

where $distance_{cj}$ is the distance between capitals cities of countries c and j. The weighted distance is then associated to each firm operating in industry k of country c.

Table 6 presents the results controlling for the average distance of the countries from which firms import in a given sector. Unfortunately, data from International Use tables produced by WIOD allow to build the indicator only for 15 of the countries included in our original data set, causing a reduction in our sample size from 13,808 to 3,229 observations. Column (1) of Table 6 reports the results of the estimation of equation (8), using the same bi-probit model adopted to obtain the baseline results reported in columns 3 and 4 of Table 3.[18] The only difference in the specification is that, in both equations of the bi-probit model, among the regressors we also include the logarithm of the weighted average distance from the countries from which inputs are imported. Reassuringly, despite the reduction in the size of the sample, the coefficient of the dummy for credit rationed firms is 0.299 – very similar to the 0.338 estimated from the baseline bi-probit specification (column 3 of Table 3) – and also in this case it is statistically significant at the 1% level. Consistent with our hypothesis, the coefficient of the logarithm of the weighted distance is positive (0.167) and it is statistically significant at the 1% level. The distance from the countries from which inputs are imported has therefore a significant positive impact on the probability that a firm uses an intermediary. However, omitting to control for this feature does not seem to introduce a sizable bias in our estimates.

Columns 2 and 3 of Table 6 report the estimates obtained splitting the sample depending on whether the distance of the importers from the countries where the imported inputs are produced is above or below the sample median (calculated across sectors and countries). Consistent with our hypothesis, credit-constrained firms that are on average more distant from the countries where their imported inputs are produced are more likely to rely on import intermediaries. This is shown by the coefficient of 0.389, which is larger than that estimated on the entire sample, and is statistically significant at the 1% level (column 3). For firms that

[18] Results of the estimation of the other equation of the bi-probit model are omitted for space reasons, but are available from the authors upon request.

are closer to the countries where their imports are produced, the effect of credit rationing is instead statistically insignificant (column 2). All other estimated coefficients, including that of distance, are broadly similar in the two specifications (with the only exception of that of the share of temporary workers).

6.4 Other Frictions to Imports

Sourcing inputs from abroad and, in general, conducting international trade is subject to a variety of obstacles other than distance, which can impact on a firm's choice of import mode, and possibly magnify the effect of credit constraints on the probability of importing indirectly. To investigate this issue, we use a number of indicators on impediments to imports drawn from the World Bank Doing Business project. These indicators appraise, at the country level, the time and costs associated with three steps in the overall process of importing a shipment of products: documentary compliance, border compliance and domestic transport.[19] The first proxy for frictions to imports that we adopt is the number of documents per import shipment that are required by public authorities (including government ministries, customs, port authorities and other control agencies) and by banks for the issuance of a letter of credit. The second measure refers to the costs, expressed in deflated US dollars, associated with importing a container of goods by sea transport through four predefined stages: document preparation, customs clearance and inspections, inland transport and handling, port and terminal handling. These expenditures include, but are not limited to, costs for documents, administrative fees for customs clearance and inspection, customs broker fees, port-related charges and inland transport costs. The third measure is the time associated with importing a container by sea transport through the three above-mentioned predefined stages. For each of the three indicators, we construct the average value over the period 2004-2014. In addition, since all three indexes proxy for the degree of frictions to imports, we also construct a synthetic index calculating their first principal component (i.e., the one explaining the highest variance). We estimate our baseline equation separately for different sub-samples, each defined on the basis of the value of each of these indexes, and of their first principal component. For each indicator, the sample is split using the median as threshold value.

Table 7 reports the results of the estimates of the equation for the probability that a firm imports using an intermediary (Eq. (8)), obtained from the bi-probit specification. The columns labeled with an odd number refer to the sample of countries with lower frictions to

[19] Data are accessible at: https://www.doingbusiness.org/en/data/exploretopics/trading-across-borders/what-measured.

imports – that is, those with the value of the corresponding index below the sample median; those labeled with an even number refer to countries with higher frictions.

Results confirm that credit rationing has a stronger impact on a firm's likelihood to use an intermediary in countries where frictions to imports are higher.[20] The marginal effect of being credit rationed is always statistically significant at the 1% level; it is higher for firms in countries with higher indexes of documentary compliance (0.421 vs. 0.305), time to import (0.413 vs. 0.259), costs of importing (0.364 vs. 0.354), and with a higher level of the principal component of the three measures (0.408 vs. 0.316).

Overall, these additional findings are consistent with those obtained splitting the sample according to geographical distance, strengthening our interpretation that credit constrains have a higher impact on forcing firms to use intermediaries when the fixed costs of importing are more substantial.

7 Concluding Remarks

A large literature has established that, to conduct international trade and pay the associated fixed costs, firms must own sufficient liquidity or have access to external finance. Growing evidence suggests that a substantial share of trade transactions are made indirectly, i.e. through wholesalers or retailers. The latter are able to pool the fixed costs of trade across several firms, allowing producers who rely on intermediaries to avoid these extra expenses. Against this backdrop, we show both theoretically and empirically that credit constraints have a first order effect on a firms' mode of participation to import markets, and that credit-constrained firms exhibit a higher likelihood of importing their inputs through a trade intermediary. Moreover, the impact of credit constraints on the mode of import is amplified for firms that face stronger frictions to importing, such as a higher geographical distance from their foreign sources and longer and costly administrative procedures.

Our results have two relevant policy implications. First, they uncover an additional channel through which credit constraints can negatively impact on a firm's performance, by increasing the indirect costs that it needs to pay to acquire foreign inputs. Second, they show that reducing the frictions affecting import activities can be comparatively more beneficial for firms which are credit constrained than for their unconstrained counterparts.

[20] These specifications do not include the level of friction index in each country because, in absence of information on its sector variability, it would be perfectly collinear with the country fixed effects.

Our analysis also uncovers some directions for future research, to better understand the extent and characteristics of the impact of credit constraints on import mode. Better quality data, often available at the country level, may allow to investigate the heterogenous impact of credit constraints on the intensive margin of import, depending on the type of product varieties and input providers.

Table 1: Descriptive Statistics

	All sample					Indirect importers					Direct importers					
Variables	mean	p5	p50	p95	s.d.	mean	p5	p50	p95	s.d.	mean	p5	p50	p95	s.d.	t-test
Indirect imports	0.458	0.000	0.000	1.000	0.498											
Credit rationing	0.194	0.000	0.000	1.000	0.396	0.263	0.000	0.000	1.000	0.440	0.136	0.000	0.000	1.000	0.343	-18.720 ***
Access to finance	0.087	0.000	0.000	1.000	0.282	0.127	0.000	0.000	1.000	0.333	0.053	0.000	0.000	1.000	0.224	-14.938 ***
Export status	0.442	0.000	0.000	1.000	0.497	0.257	0.000	0.000	1.000	0.437	0.599	0.000	1.000	1.000	0.490	43.401 ***
Foreign ownership	0.100	0.000	0.000	1.000	0.279	0.039	0.000	0.000	0.250	0.175	0.151	0.000	0.000	1.000	0.335	25.153 ***
Employees	143.628	5.000	34.000	550.000	435.085	65.041	4.000	18.000	250.000	209.185	210.112	6.000	62.000	800.000	550.273	21.072 ***
Labour productivity	42,202	408	21,026	163,319	60,298	27,484	357	14,500	95,378	42,231	54,652	482	30,147	199,561	69,750	28.138 ***
Age	23.055	5.000	17.000	60.000	18.873	20.083	5.000	16.000	52.000	15.944	25.570	5.000	19.000	65.000	20.706	17.573 ***
Share of temporary workers	0.108	0.000	0.000	0.583	0.203	0.118	0.000	0.000	0.600	0.220	0.099	0.000	0.000	0.500	0.186	-5.275 ***
Share of skilled workers	0.475	0.042	0.500	0.889	0.271	0.502	0.015	0.518	0.900	0.273	0.451	0.049	0.455	0.868	0.267	-10.980 ***
National competition	0.483	0.000	0.000	1.000	0.500	0.440	0.000	0.000	1.000	0.496	0.520	0.000	1.000	1.000	0.500	9.338 ***
Capacity utilization	0.724	0.300	0.750	1.000	0.215	0.704	0.300	0.700	1.000	0.224	0.742	0.300	0.800	1.000	0.206	10.338 ***
Certification	0.554	0.000	1.000	1.000	0.497	0.421	0.000	0.000	1.000	0.494	0.666	0.000	1.000	1.000	0.472	29.662 ***
Late payments	0.580	0.000	0.680	1.000	0.374	0.525	0.000	0.500	1.000	0.376	0.627	0.000	0.750	1.000	0.366	16.144 ***
No. observations			13,808					6,328					7,480			

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Table 2: Pairwise Correlations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)	Indirect imports	1													
(2)	Credit rationing	0.161	1												
(3)	Access to finance	0.130	0.628	1											
(4)	Export status	-0.344	-0.131	-0.113	1										
(5)	Foreign ownership	-0.200	-0.035	-0.037	0.184	1									
(6)	Employees	-0.166	-0.080	-0.062	0.207	0.126	1								
(7)	Labour productivity	-0.225	-0.108	-0.095	0.194	0.164	0.077	1							
(8)	Age	-0.145	-0.070	-0.055	0.140	0.026	0.188	0.148	1						
(9)	Share of temporary workers	0.046	0.031	0.015	-0.030	-0.002	-0.049	0.013	-0.016	1					
(10)	Share of skilled workers	0.093	0.062	0.036	0.004	-0.026	0.022	-0.089	-0.090	-0.062	1				
(11)	National competition	-0.079	-0.018	-0.017	-0.022	-0.017	0.018	0.093	0.063	-0.032	-0.030	1			
(12)	Capacity utilization	-0.088	-0.078	-0.074	0.085	0.047	0.088	0.086	-0.028	-0.052	0.075	0.025	1		
(13)	Certification	-0.246	-0.095	-0.080	0.194	0.151	0.176	0.158	0.171	0.004	-0.053	0.071	0.068	1	
(14)	Late payments	-0.136	-0.108	-0.085	0.166	0.055	0.022	0.186	0.117	-0.040	-0.116	0.065	0.005	0.108	1

Table 3: Credit Constraints and Import Mode: The Baseline Estimates

	OLS	Probit	bi-probit			
			Indirect importing	Credit rationing	Indirect importing	Credit rationing
	(1)	(2)	(3)	(4)	(5)	(6)
Credit rationing	0.080***	0.075***	0.338***		0.239***	
	(0.010)	(0.009)	(0.049)		(0.050)	
Export status	-0.168***	-0.144***	-0.127***	-0.015*	-0.127***	-0.015*
	(0.019)	(0.016)	(0.023)	(0.008)	(0.016)	(0.009)
Foreign ownership	-0.001***	-0.001***	-0.001***	0.000	-0.001***	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employees (log)	-0.092***	-0.089***	-0.071***	-0.029***	-0.070***	-0.030***
	(0.005)	(0.005)	(0.009)	(0.004)	(0.005)	(0.004)
Labor productivity (log)	-0.056***	-0.054***	-0.043***	-0.017***	-0.054***	-0.017***
	(0.004)	(0.003)	(0.006)	(0.002)	(0.002)	(0.003)
Age (log)	-0.001	-0.001	0.002	-0.007**	-0.001	-0.011***
	(0.009)	(0.008)	(0.007)	(0.003)	(0.008)	(0.003)
Share of temporary workers	0.046*	0.043**	0.038**	-0.001	0.027	-0.010
	(0.022)	(0.021)	(0.018)	(0.011)	(0.021)	(0.009)
Share of skilled workers	0.112***	0.102***	0.076***	0.049***	0.063***	0.047***
	(0.023)	(0.023)	(0.025)	(0.015)	(0.024)	(0.014)
National competition	-0.043***	-0.044***	-0.041***	0.006	-0.039***	0.005
	(0.015)	(0.013)	(0.013)	(0.007)	(0.012)	(0.006)
Capacity utilization	-0.054**	-0.052***	-0.016	-0.099***	-0.031	-0.100***
	(0.021)	(0.019)	(0.020)	(0.014)	(0.025)	(0.016)
Balance sheet certification				-0.038***		-0.030***
				(0.008)		(0.009)
Late payments * 1st qt.				0.028***		0.031***
				(0.011)		(0.010)
Late payments * 2st qt.				-0.010		-0.008
				(0.010)		(0.012)
Late payments * 3st qt.				-0.038***		-0.038***
				(0.012)		(0.011)
Late payments * 4st qt.				-0.038**		-0.031*
				(0.015)		(0.016)
Year fixed effects	X	X	X	X		
Country fixed effects	X	X	X	X		
Industry fixed effects	X	X	X	X		
Year*Country*Sector fixed effects					X	X
Corr(ϵ, μ)			-0.556**		-0.420**	
			(0.066)		(0.123)	
Kleibergen-Paap first stage F-statistic (p-value)			6.06 (0.001)		6.629 (0.001)	
Overidentifying restrictions statistic (p-value)			3.806 (0.433)		5.747 (0.219)	
Observations	13,808	13,808	13,808		13,808	

Notes: In columns (1) – (3) and (5) the dependent variable is a dummy which takes the value of one if the firm imports through and intermediary and zero if it imports directly; in columns (4) and (6) the dependent variable is a dummy that takes the value of one if the firm declares to be credit rationed and zero otherwise. $corr(\epsilon, \mu)$ is the correlation coefficient (ρ) between the unobserved determinants of the import participation decision (ϵ) and those of rationing (μ). The Kleibergen-Paap first stage F-statistic (p-value) is the value of the F statistic (with the p-value) for the hypothesis that instruments have jointly zero coefficients in the first stage regression. The over-identifying restrictions statistic (p-value) is the value of the Hansen statistic (and p-value). Kleibergen-Paap first stage F-statistic (p-value) and overidentifying restrictions statistic (p-value) are obtained from the two-stage least-squares estimation of the companion specification for the extensive margin of imports, where credit rationing is instrumented using our instruments. Standard errors, clustered at the sector level, are reported in parenthesis; *** denotes significance at the 1% confidence level; ** at the 5% confidence level and * at the 10% level.

Table 4: Controlling for Sample Selection

		Heckman IV	
	Importing	Credit rationing	Indirect importing
	(1)	(2)	(3)
Credit rationing			0.330***
			(0.029)
Export status	0.142***	-0.021***	-0.123***
	(0.018)	(0.007)	(0.020)
Foreign ownership	0.001***	0.000	-0.001***
	(0.000)	(0.000)	(0.000)
Employees (log)	0.044***	-0.029***	-0.072***
	(0.005)	(0.004)	(0.004)
Labor productivity (log)	0.029***	-0.018***	-0.043***
	(0.003)	(0.002)	(0.004)
Age (log)	-0.003	-0.009**	0.002
	(0.006)	(0.003)	(0.007)
Share of temporary workers	0.019	0.006	0.037*
	(0.021)	(0.009)	(0.020)
Share of skilled workers	-0.050**	0.043***	0.079***
	(0.020)	(0.014)	(0.022)
National competition	0.056***	0.000	-0.038***
	(0.014)	(0.006)	(0.012)
Capacity utilization	-0.083***	-0.088***	-0.026
	(0.019)	(0.009)	(0.021)
Political instability	0.008***		
	(0.003)		
Balance sheet certification	0.031***	-0.042***	
	(0.007)	(0.006)	
Late payments * 1st qt.	0.002	0.027***	
	(0.016)	(0.009)	
Late payments * 2st qt.	0.007	-0.013	
	(0.010)	(0.013)	
Late payments * 3st qt.	0.020	-0.027***	
	(0.014)	(0.009)	
Late payments * 4st qt.	0.044***	-0.037**	
	(0.015)	(0.016)	
Corr[(1),(2)] =	0.086 (0.213)		
Corr[(2),(3)] =	−0.534 (0.065)		
Corr[(1),(3)] =	−0.042 (0.016)		
Observations		21,498	

Notes: Results refer to a system sample selection model with instrumental variables, estimated using the CMP procedure of Roodman (2011). In column (1) the dependent variable is a dummy which takes the value of one if the firm is an importer and zero otherwise; in column (2) the dependent variable is a dummy that takes the value of one if the firm declares to be credit rationed and zero otherwise; in column (3) the dependent variable is a dummy which takes the value of one if the firm imports through an intermediary and zero if it imports directly. $corr[(1),(2)]$ is the correlation coefficient (ρ) between the unobserved determinants in equations (1) and (2); $corr[(2),(3)]$ and $corr[(1),(3)]$ between those in equations (2) and (3) and (1) and (3). All specifications include year, country and industry fixed effects. Standard errors, clustered at the industry level, are reported in parenthesis.*** denotes significance at the 1% confidence level; ** at the 5% confidence level and * at the 10% level.

Table 5: Alternative Measure of Credit Rationing

	bi-probit	
	Indirect importing	Access to finance
	(1)	(2)
Access to finance	0.396***	
(Alternative measure of credit rationing)	(0.078)	
Export status	-0.131***	-0.017***
	(0.027)	(0.005)
Foreign ownership	-0.001***	-0.000
	(0.000)	(0.000)
Employees (log)	-0.081***	-0.012***
	(0.014)	(0.002)
Labor productivity (log)	-0.047***	-0.011***
	(0.008)	(0.001)
Age (log)	0.001	-0.005
	(0.008)	(0.003)
Share of temporary workers	0.046**	-0.015
	(0.023)	(0.011)
Share of skilled workers	0.094***	0.012
	(0.027)	(0.009)
National competition	-0.041***	0.003
	(0.014)	(0.007)
Capacity utilization	-0.026	-0.069***
	(0.019)	(0.010)
Balance sheet certification		-0.023***
		(0.006)
Late payments * 1st qt.		0.013**
		(0.005)
Late payments * 2st qt.		-0.004
		(0.006)
Late payments * 3st qt.		-0.004
		(0.007)
Late payments * 4st qt.		-0.031***
		(0.009)
Corr(ϵ, μ)	-0.592***	
	(0.091)	
Kleibergen-Paap first stage F-statistic (p value)	2.398 (0.072)	
Overidentifying restrictions statistic (p value)	4.704 (0.319)	
Observations	13,808	

Notes: In column (1) the dependent variable is a dummy which takes the value of one if the firm imports through and intermediary and zero if it imports directly; in column (2) the dependent variable is a dummy that takes the value of one if the firm declares that access to finance is a "moderate obstacle", "major obstacle" or "very severe obstacle" to its current operations and equal to zero if the firm's perception about access to finance is one of the following "no obstacle" or "minor obstacle" to its operations, and zero otherwise. $corr(\epsilon, \mu)$ is the correlation coefficient (ρ) between the unobserved determinants of the import participation decision (ϵ) and those of rationing (μ). The Kleibergen-Paap first stage F-statistic (p-value) is the value of the F statistic (with the p-value) for the hypothesis that instruments have jointly zero coefficients in the first stage regression. The over-identifying restrictions statistic (p-value) is the value of the Hansen statistic (and p-value). Kleibergen-Paap first stage F-statistic (p-value) and overidentifying restrictions statistic (p-value) are obtained from the two-stage least-squares estimation of the companion specification for the extensive margin of imports, where credit rationing is instrumented using our instruments. All specifications include year, country and industry fixed effects. Standard errors, clustered at the sector level, are reported in parenthesis; *** denotes significance at the 1% confidence level; ** at the 5% confidence level and * at the 10% level.

Table 6: Geographical Distance

	bi-probit Indirect importing Full sample (1)	 Low distance (2)	 High distance (3)
Credit rationing	0.299***	-0.048	0.389***
	(0.098)	(0.435)	(0.104)
Distance (log)	0.167***	0.214**	0.194***
	(0.053)	(0.086)	(0.062)
Export status	-0.142***	-0.156***	-0.121***
	(0.019)	(0.026)	(0.021)
Foreign ownership	-0.001**	-0.001*	-0.001
	(0.000)	(0.000)	(0.001)
Employees (log)	-0.050***	-0.061***	-0.048***
	(0.009)	(0.014)	(0.011)
Labor productivity (log)	-0.037***	-0.039***	-0.040***
	(0.006)	(0.014)	(0.011)
Age (log)	-0.009	0.000	-0.019
	(0.012)	(0.021)	(0.014)
Share of temporary workers	0.078***	0.119**	0.034
	(0.025)	(0.052)	(0.045)
Share of skilled workers	0.083**	0.126*	0.063**
	(0.037)	(0.067)	(0.026)
National competition	-0.015	-0.024	-0.018
	(0.011)	(0.016)	(0.022)
Capacity utilization	-0.090*	-0.083	-0.099
	(0.054)	(0.071)	(0.063)
Corr(ϵ, μ)	-0.528**	0.488	-0.654**
	(0.205)	(0.862)	(0.223)
Kleibergen-Paap first stage F-statistic (p-value)	0.969 (0.460)	1.175 (0.356)	1.346 (0.302)
Overidentifying restrictions statistic (p-value)	3.536 (0.472)	6.796 (0.147)	7.830 (0.098)
Observations	3,229	1,620	1,609

Notes: The dependent variable is a dummy which takes the value of one if the firm imports through and intermediary and zero if it imports directly. Results are obtained using a bi-probit specification similar to that of columns (3) and (4) of table 3, but the estimates for the credit rationing equation are not reported. The weighted distance indicator has been constructed adopting the International Use tables produced by WIOD. $corr(\epsilon, \mu)$ is the correlation coefficient (ρ) between the unobserved determinants of the import participation decision (ϵ) and those of rationing (μ). The Kleibergen-Paap first stage F-statistic (p-value) is the value of the F statistic (with the p-value) for the hypothesis that instruments have jointly zero coefficients in the first stage regression. The over-identifying restrictions statistic (p-value) is the value of the Hansen statistic (and p-value). Kleibergen-Paap first stage F-statistic (p-value) and overidentifying restrictions statistic (p-value) are obtained from the two-stage least-squares estimation of the companion specification for the extensive margin of imports, where credit rationing is instrumented using our instruments. All specifications include year, country and industry fixed effects. All specifications include year, country and industry fixed effects. Standard errors, clustered at the sector level, are reported in parenthesis; *** denotes significance at the 1% confidence level; ** at the 5% confidence level and * at the 10% level.

Table 7: Other Frictions to Imports

	Documentary compliance		Time to import		Costs of importing		Principal component	
	low	high	low	high	low	high	low	high
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit rationing	0.305***	0.421***	0.259***	0.413***	0.354***	0.364***	0.316***	0.408***
	(0.040)	(0.023)	(0.061)	(0.029)	(0.031)	(0.038)	(0.037)	(0.028)
Export status	-0.143***	-0.077***	-0.149***	-0.099***	-0.124***	-0.128***	-0.153***	-0.088***
	(0.018)	(0.023)	(0.018)	(0.019)	(0.023)	(0.015)	(0.019)	(0.019)
Foreign ownership	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.002***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Employees (log)	-0.079***	-0.045***	-0.073***	-0.070***	-0.078***	-0.064***	-0.076***	-0.063***
	(0.006)	(0.007)	(0.005)	(0.006)	(0.005)	(0.008)	(0.006)	(0.004)
Labor productivity (log)	-0.050***	-0.035***	-0.051***	-0.028***	-0.047***	-0.026***	-0.054***	-0.021***
	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)
Age (log)	-0.004	0.022***	-0.006	0.014	-0.011	0.010	-0.010	0.015**
	(0.009)	(0.007)	(0.007)	(0.009)	(0.009)	(0.010)	(0.009)	(0.007)
Share of temporary workers	0.076***	-0.079***	0.085***	-0.000	0.080**	0.004	0.091***	-0.007
	(0.016)	(0.030)	(0.021)	(0.019)	(0.036)	(0.019)	(0.019)	(0.023)
Share of skilled workers	0.070***	0.098***	0.087***	0.074***	0.097***	0.069***	0.079***	0.082***
	(0.027)	(0.024)	(0.026)	(0.024)	(0.022)	(0.026)	(0.026)	(0.020)
National competition	-0.038***	-0.030**	-0.035***	-0.037**	-0.039***	-0.043***	-0.038***	-0.037***
	(0.013)	(0.013)	(0.009)	(0.017)	(0.015)	(0.015)	(0.013)	(0.013)
Capacity utilization	-0.035	-0.009	-0.045	0.020	-0.029	-0.005	-0.055	0.026
	(0.026)	(0.027)	(0.035)	(0.014)	(0.035)	(0.015)	(0.039)	(0.022)
$corr(\epsilon, \mu)$	-0.483***	-0.748***	-0.405***	-0.705***	-0.611***	-0.592***	-0.521***	-0.705***
	(0.092)	(0.051)	(0.125)	(0.073)	(0.061)	(0.089)	(0.086)	(0.065)
Kleibergen-Paap first stage F-statistic (p-value)	5.66 (0.002)	4.305 (0.008)	2.191 (0.094)	12.059 (0.000)	2.901 (0.038)	11.443 (0.000)	3.448 (0.020)	4.318 (0.007)
Overidentifying restrictions statistic (p-value)	3.300 (0.509)	2.888 (0.577)	6.792 (0.147)	3.192 (0.526)	7.528(0.110)	3.817 (0.431)	0.847 (0.932)	2.512 (0.643)
Observations	9,208	4,600	8,360	5,448	6,859	6,949	7,274	6,534

Notes: The dependent variable is a dummy which takes the value of one if the firm imports through and intermediary and zero if it imports directly. Results are obtained using bi-probit specifications similar to that of columns (3) and (4) of table 3, but the estimates for the credit rationing equation are not reported. $corr(\epsilon, \mu)$ is the correlation coefficient (ρ) between the unobserved determinants of the import participation decision (ϵ) and those of rationing (μ). All specifications include year, country and industry fixed effects. Standard errors, clustered at the sector level, are reported in parenthesis; *** denotes significance at the 1% confidence level; ** at the 5% confidence level and * at the 10% level.

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