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Exporters, importers and credit constraints ☆

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ABSTRACT

This paper analyzes the interaction between credit constraints and trading behavior, decomposing trade in extensive and intensive margins. I construct a unique dataset containing firm-level trade transaction data, balance sheets and credit scores from an independent credit insurance company for Belgian manufacturing firms between 1999 and 2007. Firms are more likely to be exporting or importing if they enjoy lower credit constraints. Also, firms that have better credit rating export and import more. Importing and exporting behaviors differ in how both the level and growth of the various margins of trade are related to credit constraints in one important dimension. In the case of exports, it is the intensive and extensive margins of exports in terms of *both product and destinations* that are significantly associated with credit constraints whereas for imports it is the extensive margin in terms of *products only*.

1. Introduction

When the economy enters a recession and a credit crunch shakes the financial sector, or simply when they suffer other types of shocks, firms might find it harder to access credit. This is likely to affect their operations, the investments and R&D they conduct and the way they develop and expand. There is however little empirical evidence on how important financial considerations are for the international expansion and activities of firms and on how they adjust their trading activities.

This paper considers the determinants of firm trading patterns by matching firm-level trade transaction data with individual, time-varying credit ratings. In particular, it seeks to analyze the interactions between financial or credit constraints on the one hand and exports and imports margins on the other. While the analysis of firm-level trade has mostly focused on the relationship between trade and productivity, this paper contributes to a recent literature studying another critical determinant of trading decisions: the financial situation of the firm, and in particular the credit constraints it faces. On the one hand, a bad financial situation might make its suppliers based abroad less willing to risk trading with the firm, hence affecting its imports. On the other hand, being credit-constrained would prevent the firm from overcoming any fixed costs associated with either exporting or importing.

Based on a unique and detailed dataset, I find that firms that enjoy lower credit constraints and bankruptcy risk are more likely to be exporting. Firms that have better credit rating also export more. They have higher extensive margins: they export more products to more destinations. Their intensive margin, the average export value per firm-product-country observation for all combinations with positive exports, is higher too. The same patterns hold for imports except that the country extensive margin and the import intensive margin, are not correlated with credit constraints. Finally, most of these results are shown to hold over time, when estimated with the growth of the various trade margins. This brings novel insights on the differences between import and export choices, and these correlations are useful to guide future theoretical work.

The detail of the datasets used is particularly suitable for the questions addressed. First, the trade and balance sheet data cover the full sample of Belgian manufacturing, at the firm level, with detailed

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information on trade participation, but also on the destinations or origins and products traded. This allows for a full decomposition of trade flows into the intensive margin as well as firm, country and product extensive margins and the density of trade. Using firm-level analysis in this paper allows a better understanding of how firms vary within a given sector. Second, the measure of credit constraints used is unique in its kind: a yearly measure of the creditworthiness of firms established by an institution external to the firm. By assessing financial constraints with a continuous credit rating rather than single and extreme default payment episodes implies that the effects identified do not only hold in the case of extreme credit constraints. The paper's main contribution is to be using a measure of credit constraint that exhibits sufficient within-firm variation over time to relate it to the firms' importing and exporting outcomes after controlling for firm fixed effects.

This paper contributes to two related areas of the literature. First, the relation between liquidity constraints and exports has been studied both in theory models and empirically. The next section will discuss relevant theoretical papers. Empirically, the question has also been studied using different datasets. Several papers use the sector-level Rajan and Zingales (1998) measure of "external finance dependence" to examine how it affects exports. Manova (2008) shows how financial frictions and credit market development explain cross-country patterns of trade at the sector level. Export growth is proven to be slower in external finance dependent sectors in Iacovone and Zavacka (2009). Considering Belgian exporters as in this paper, Behrens et al. (2013) find that imports fell more during the recent recession for firms with above median reliance on external finance. Analyzing transaction-level data and the financing terms used by firms, Antràs and Foley (2015) show how trade finance, and hence financial constraints, influence the impact of macroeconomic and financial crises. Analyzing monthly US imports from countries with varying degrees of credit market tightness, Chor and Manova (2012) demonstrate that exports are less sensitive to the cost of external capital in industries relying less on external finance or less financially-vulnerable according to other measures, and that this sensitivity rose during the financial crisis.[1] Albornoz et al. (2012) analyze the sequential pattern of exports expansion by successful new exporters for Argentina and find that credit constraints do not explain these patterns.[2] The firm-level dimension of the dataset I use allows me to go beyond this type of sectoral analysis and exploit intra-sector variations. Others have used firm-level measures to capture credit constraints. Minetti and Zhu (2011) analyze a cross-sectional survey of Italian manufacturers and find that "credit rationed" firms are less likely to export and are likely to export less. They focus on the firm extensive margin of exports. Berman and Héricourt (2010) find similar results for developing countries, using financial ratios as measures of constraints. They find that financial constraints are not correlated with export values or export survival in those countries. Other authors also explore these questions by deriving measures of financial health and constraints from balance sheet financial ratios. Greenaway et al. (2007) find no ex-ante effect on the probability of becoming an exporter while Bellone et al. (2010) do. Askenazy et al. (2011) find that credit constraints negatively affect the entry into a new destination and increase the probability of exiting a market.[3] Exploiting data available from the international firm-level data from the World Bank Enterprise Surveys, Wang (2011) reports that the probability of exporting and the export volume increase with age, which is consistent with the hypothesis that firms need to accumulate sufficient collateral before they can borrow enough funds to profitably export. This paper extends this literature by analyzing the extensive margins at the level of destinations and products as well as considering financial constraints as a continuous measure.

A second area of the trade literature has empirically analyzed firm-level imports. The fact that the import of new varieties leads to higher productivity and growth has been shown empirically both at the country level (Broda and Weinstein, 2006) and at the firm level, with imports of intermediates or reductions in input tariffs being associated with productivity gains or higher productivity levels (see Antràs et al. (2014); Amiti and Konings (2007); Kasahara and Rodrigue (2008) or Goldberg et al. (2010)). While my results do not contradict these findings, the question I address is whether financial constraints might prevent some firms from reaping the benefits of importing intermediates. Although it may appear surprising that financial constraints shape the country-level extensive margin differently on the export side and on the import side, these results are consistent with the findings of Antràs et al. (2014). These authors show that the determination of the country-level extensive margin of importing is much more complicated than in models of selection into exporting, mainly because the marginal increase in profits from adding a country to a firm's set of potential sourcing locations depends on the number and characteristics of other countries in the set. Imports and exports have often been compared in the recent analysis of firm-level trade data. Descriptive evidence by Bernard et al. (2007), Muûls and Pisu (2009) or Halpern et al. (2005) shows that importing firms share many attributes with exporters: they are both larger and more productive and product and country-level patterns of trade at the firm level are similar for both. Based on a theoretical model estimated with Chilean data, Kasahara and Lapham (2013) analyze the complementarities of exports and imports for the productivity and welfare gains of trade. This paper shows that imports and exports are different in some important dimensions when put in relation with credit constraints.

The remainder of the paper is organized as follows. Section 2 presents the conceptual framework of how financial constraints can affect exporting and importing patterns. Section 3 describes the data, and demonstrates in particular why the Coface score is an appropriate measure of credit constraints. Section 4 contains the empirical analysis of the links between export and import patterns and credit constraints at a given point in time, while Section 5 takes a closer look at trade growth. Section 6 concludes.

2. Conceptual framework

Why are credit constraints analyzed here specifically in relation to trade transactions and not both domestic and international activities? External finance is indeed used by firms to finance investments in capital, product development and R&D or advertising among others. However, in addition, trading firms face incremental fixed and variable expenses thus needing even more access to external capital. In order to frame the empirical analysis below, one can decompose total trade flows.

At a first level, total exports or imports of a country can be separated between the total number of trading firms and the average values of trade by these firms. In the following equation where $V_{j=x,m}$ represents total exports (x) or imports (m),

$$V_{j=x,m} = f_j \times v_j \tag{1}$$

f_j is the firm extensive margin of exports or imports, reflecting the number of firms having entered exporting or importing activities, whereas v_j stands for the overall intensive margin of trade, the average exports or imports per firm. This is the type of margins decomposition that arose first in the literature, but with increasing availability of

[1] An important literature has studied the impact of financial crises on exports. The collapse in trade relative to GDP during the 2008 crisis was larger than predicted by standard econometric models. Ahn et al. (2011) describe how important financial factors and trade finance were to explain this episode. Other authors studying the crisis include Iacovone and Zavacka (2009), Levchenko et al. (2010) and Paravisini et al. (2011). Amiti and Weinstein (2011) study past financial crises in Japan.

[2] There are also several papers on financial institutions and trade that show that export volumes from financially-vulnerable sectors are higher in financially-developed countries such as Beck (2002), Svaleryd and Vlachos (2005) and Hur et al. (2006).

[3] Other authors using financial ratios to study the correlations between exports and financial constraints include Campa and Shaver (2002) and Stiebale (2011).

firm-level data, a finer decomposition has been proposed, such as in Bernard et al. (2009). In this way, we have

$$v_{j=x,m} = \frac{1}{f_j}\sum_{i=1}^{f_j} v_{j_i} = \frac{1}{f_j}\sum_{i=1}^{f_j}\left[c_{j_i} p_{j_i} d_{j_i} \overline{u}_{j_i}\right] \quad (2)$$

with individual firms indexed as i. Two additional extensive margins are identified as the number of products (p_{j_i}) exported ($j = x$) or imported ($j = m$) and the number of markets served or imported from (c_{j_i}). The density term d_{j_i} equals the ratio of the product of active (non-zero) country and product combinations relative to the total number of possible country and product combinations ($o_{j_i}/\left(c_{j_i} p_{j_i}\right)$). The intensive margin $\overline{u}_{j_i}$ would in such a case be the firm-country-product-level average value per observation with positive trade (v_{j_i}/o_{j_i}). Each firm's exports or imports can thus be decomposed as:

$$ln\, v_{j_i} = ln\, c_{j_i} + ln\, p_{j_i} + ln\, d_{j_i} + ln\, \overline{u}_{j_i} \quad (3)$$

For *exporters*, sunk costs can be incurred in relation to both the country and product extensive margins. With regards to c_{x_i}, these could include, for example, making market-specific investments in production capacity or developing a distribution network within new countries.[4] As for p_{x_i}, fixed costs could for instance be incurred to make existing domestic products compliant to international regulations. Some of these costs might be borne for both products and destinations. The fixed costs to be incurred for exporting the first product to the first country will also determine whether a firm is an exporter or not, and hence influence the firm extensive margin of exports, f_x. Variable trade costs might also be incurred in relation to $\overline{u}_{x_i}$: a higher level of average exports per active product-country would entail increased insurance, shipping costs or customs, excise duties or other export taxes. Not only would these costs be encountered before export revenues are realized, but in comparison to domestic sales, international shipping and delivery would increase this gap in time by up to 90 days (Djankov et al., 2010). Firms are likely to rely on more external financing to meet these higher liquidity needs and will usually negotiate trade credit from their suppliers or access trade finance from banks and other financial institutions. As will be described in Section 3.2 when describing the credit score used in the empirical analysis, trade insurance is also widely used by exporting firms.

What are the impacts of credit constraints on these different export margins that are predicted by the existing models? Focussing mainly on a framework with only a firm level extensive margin as in Eq. (1), Chaney (2013) and Manova (2013) introduce credit constraints in a theoretical model of trade with heterogeneous firms à la Melitz (2003) and yield several predictions on the equilibrium relationships between productivity, credit constraints, exports and export margins. In both models, firms must pay up-front a fixed cost of entry into foreign markets and hence need sufficient liquidity to do so. In Chaney's model, firms finance these costs with cash flows from their domestic operations. Once a firm has entered foreign markets, financial constraints do not impact the marginal cost of exporting: the firm will finance an increase in the scale of its exports through its internal cash-flow and foreign trade credit. In equilibrium, financial constraints impact the extensive but not the intensive margin of exports. In Manova (2013), firms need to borrow to cover both the fixed and the variable costs of exporting. This follows from the imperfect enforceability of international transaction contracts together with imperfect information on the potential returns from foreign markets. In equilibrium, total exports will increase with lower credit constraints. More productive firms and less credit-constrained firms will be more likely to export. Credit constraints will decrease the firm extensive margin and the overall intensive margin v_t (average exports per firm). To summarize, these models illustrate that in equilibrium, credit constraints affect the intensive (respectively, extensive) margins of exports if financial constraints are assumed to affect the variable (respectively, fixed) costs of exporting.

There is to the best of my knowledge no model that explicitly considers firm exporting decisions in relation to credit constraints with a distinction of export margins according to Eqs. (2) and (3).[5] In a stylized dynamic model, Besedeš et al. (2014) focus on changes in the intensive margin and show that credit constraints can have an important role in the start of exporting activity, but not on the growth of exports in later stages. There is also limited empirical firm-level evidence on these issues, with existing studies focussing on export margins as defined by Eq. (1), or considering whether or not the firm exports to more than one market as in Minetti and Zhu (2011). By illustrating the correlations between these constraints on the one side and the different extensive margins and the intensive margin of exports on the other, the results of the empirical analysis below should serve as a motivation for future theoretical work in this area.

For *importers*, it is also true that firms face fixed costs in regards to both the country and product extensive margins. Relating to c_{m_i}, the country extensive margin, there could be a cost to finding a suitable supplier in a new country. Similarly, shifting the sourcing of an additional input from home to abroad, the product extensive margin p_{m_i}, would involve for example fixed expenditures to verify regulation and technological issues. As in the case of exports, the combination of these sunk costs would also determine the firm extensive margin, f_m. Variable costs affecting $\overline{u}_{m_i}$ could include delivery expenses, duties or insurance. Hopefully, the empirical analysis that follows in this paper will guide the development of theoretical frameworks to analyze the relations between import margins and credit constraints.

3. Data

3.1. The Belgian balance sheet and trade transaction data

This dataset provided by the National Bank of Belgium has been used in several papers analyzing export and import patterns and behavior (see Muûls and Pisu (2009); Behrens et al. (2013) and Araujo et al. (2012) among others). It merges firm-level balance sheet and trade data for Belgium. The balance sheet part of the BBSTTD is used to extract firm-level annual characteristics, including employment, value added, profitability, sector of activity and to compute total factor productivity. The trade data includes the value, destinations and origins as well as products at the 8-digit Combined Nomenclature (or CN8) level of the EU.[6]

Manufacturing firms only are selected as belonging to sectors 15 to 36 of the NACE-BEL classification.[7] The data is then merged into the Coface database, described in the following subsection. Only firms for which a Coface score is given for each year a balance sheet was available are included in the dataset. All observations are kept in the resulting dataset, which is described in Table 3.

[4] Moxnes (2010) shows that fixed costs of exporting are to some extent market specific.

[5] More recently, Kohn et al. (2014) introduce financial constraints into a standard trade model in order to capture new exporter dynamics. The dynamic model of Caggese and Cunat (2013) shows how the link between financial constraints and exports can affect the gains from trade liberalization. In Impullitti et al. (2013), the costs of exporting include a sunk component which implies hysteresis in firm export participation. Arkolakis and Muendler (2010) develop a theoretical model focussing on product level margins.

[6] Given the difference of threshold for data to be available when a firm exports within the EU and outside the EU (see Muûls and Pisu (2009)), we do not consider as exporters or importers for a given year firms that trade only outside the EU and whose annual total of imports and exports is lower than 250,000 Euros.

[7] Note that in the BBSTTD, observations with a negative value-added or with less than one employee are dropped. Also, firms from sector 232 (refined petroleum products) are excluded as their total factor productivity (TFP) measures are strong outliers.

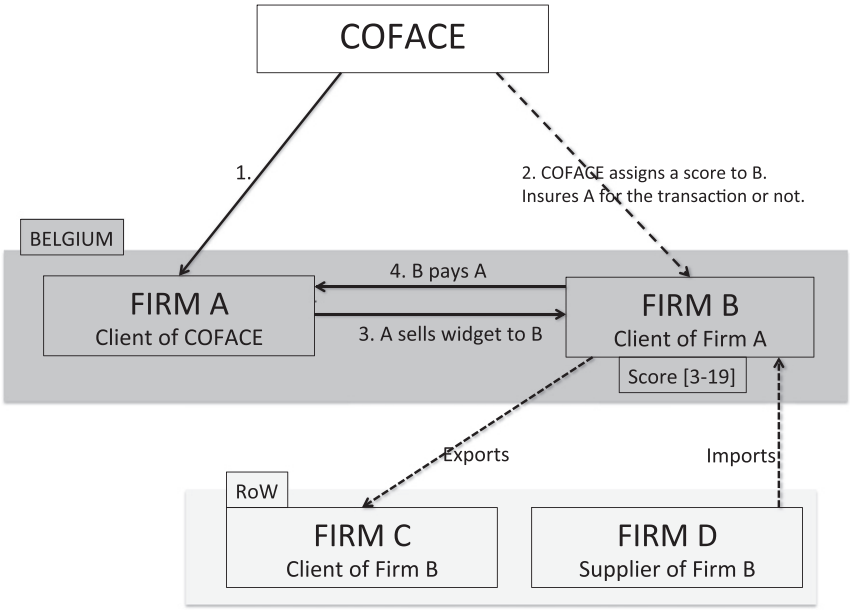

Fig. 1. Credit insurance.

3.2. Measuring credit constraints: the Coface score

3.2.1. The Coface score

As a measure of credit constraints, I use the Coface Services Belgium Global Score for more than 9000 Belgian manufacturing firms between 1999 and 2007. Credit insurance firms offer insurance policies to businesses that wish to protect their accounts receivable from loss due to commercial and political credit risks such as protracted default, overdue accounts, insolvency or bankruptcy. Established in France in 1945 as a credit insurance company, Coface is now an international firm, providing a range of services to facilitate business-to-business trade. Among these, it also provides credit worthiness information: through a worldwide network of credit information entities, it has constructed an international buyer's risk database on 44 million companies. Data from public and private sources are added to Coface's internal data in order to manage each company's rating and Coface's risk exposure on a continuous basis. Fig. 1 provides an example of who the parties would be in a credit insurance contract. Belgian firm A is a client of Coface. It wants to sell a product to Belgian firm B and protects itself against the risk that B might default on paying for that product. As it would do for any transaction, it asks Coface whether it will be covered. Coface, if it hasn't already done so, will compute a score for B, and if it is high enough will insure the transaction. A will send the product to B in exchange for payment. If B defaults, Coface will pay A and seek to recover the amount from B. Imagine that Belgian firm B also exports goods to firm C and imports inputs from firm D. Neither B, C nor D are clients of Coface, but because of its transaction with firm A, the credit rating score of firm B will be in the dataset.

There is a large academic literature on bankruptcy prediction models such as that used to construct Coface's score (see for example the review by Balcaen and Ooghe (2006)). However, privately-computed probability of default or credit scores such as Coface's are naturally less well-known. Various datasets are compiled to construct the Coface score: the firm's financial statements (leverage, liquidity, profitability, size, etc.), its legal form, age and life cycle, location and information on its commercial premises as well as industry specific information. Data on payment incidents both with other firms and to the social security (ONSS) are also used. Finally, legal judgments and the board structure are taken into account. For example, if a firm goes bankrupt it will negatively affect the score of all companies that have common board members. These various inputs are combined using several statistical methods and trial-and-error. The result is a score ranging from 3/20 to 19/20. Although the model predicts continuous scores they are rounded to unity in the obtained data. The score therefore contains information about the firm's quality, performance and productivity. However, two firms with equally valuable projects, and identical profitability and productivity can be very different in terms of financial health, board structure, and other elements that will determine their score and their access to credit. The empirical analysis will therefore control for a number of variables that could potentially influence both the Coface score and the trading activity, such as size, profitability and productivity of firms.[8] A firm's score varies from year to year: the average yearly change is 2 points (or 12.5% of the largest possible variation from 3/20 to 19/20) with a standard deviation of 2. The average difference between a firm's largest score over the time sample and its lowest is 6 points. It is this variation that I exploit in my analysis below.

Importantly for the purpose of this paper, Coface's score does not include in its determination model any information on the firm's exports or imports. Firm-level trade data is not public information in Belgium and even if Coface would have such information for some firms through it's network of international clients, it does not enter directly in the computation of the score. However, trade performance might affect the score indirectly, through its impact on profitability for example or other variables that are included in the construction of the score. While it does not remove all potential endogeneity in the Coface score, great care is taken in the remainder of the paper to include crucial firm-level controls and to exploit the panel dimension of the data. Constructed as a bankruptcy risk measure, the score is highly correlated with how credit-constrained a firm is, reflecting the same type of information that a bank would use to decide whether it lends to a firm. Being determined independently by a private firm, it is unusual for such data to be available and has a great advantage on measures of credit constraints used in the literature so far: it is firm-specific, varies through time on a yearly basis[9] and allows for a continuous measure of the

[8] Also, only 200 firms out of more than 13,000 manufacturing firms present in the BBSTD are not included in the Coface sample. Given these are mostly very small firms, controlling for these variables will avoid potential selection bias.

[9] Although the score is updated by Coface on a continuous basis, the data provided by the company for this paper only reports the score of each firm on December 31st.

degree of credit constraint rather than classifying firms between two constrained or unconstrained categories. Compared to datasets on payment incidents that would identify a small subset of firms as being credit-constrained,[10] the Coface score ranks firms along the whole spectrum of ratings. Payment incidents would only be one of the elements affecting the score, in combination with many others.

Overall, the Coface score is a well-suited direct measure of creditworthiness used by other firms and by banks when extending loans, and I therefore use it in my empirical analysis to measure how credit-constrained firms are.

3.2.2. External validation

This section presents the correlation between the score and firm fundamentals. It also relates it to the important literature on credit constraints, in particular in corporate finance.

Given the methodology used to construct the score is not available publicly, it is shown here how correlated the score is with the firm's financial situation and productivity. A selection of financial ratios[11] measures each firm's solvency and investment.

Table 1 shows how strongly the Coface score is correlated with the financial situation of the company, in particular its solvency and investment intensity. Firm and year fixed effects are included in the OLS regression, thus also controlling for possible differences in, for example, risk premie across industries and years which might affect the Coface score and other financial measures differentially. Solvency is measured with two ratios: financial independence and coverage of borrowings by cash flow. The strong correlation between these and the score shows that firms that are more able to meet their short- and long-term financial liabilities have a higher score. Financial independence, the ratio between equity capital and total liabilities, reflects how independent the firm is of borrowings. The coverage of borrowings by cash flow measures the firm's repayment capability, and its converse specifies the number of years it would take to repay its debts assuming that its cash flow was constant. Higher scores are also associated with larger investment ratios, the acquisitions of tangible fixed assets over value added.

EBITDA (Earnings before Interests, Taxes, Depreciation and Amortization) is a commonly used financial measure of the operational profitability and performance of the firm. It appears as being positively associated with the Coface score. I will include it as a control in the regression analysis below, in order to control for the effects of the profitability of a company. Productivity has been shown to be an important determinant of trade patterns. It is measured here as in Levinsohn and Petrin (2003).[12]

Column (5) of Table 1 reports a positive but not perfect correlation of the Coface score with productivity, confirming that credit constraints and productivity are two different issues to be considered when analyzing export behavior.

The effects of financial constraints on firm behavior are an important area of research in corporate finance. Compared with the existing literature, the Coface score provides many advantages, as described above. One of the many approaches in the literature consists of sorting firms into financially-constrained and unconstrained types on a yearly basis by ranking firms according to different measures. In Almeida et al. (2004), firms in the top three deciles of their payout dividend ratio would be considered as less financially-constrained than firms in the bottom three. Allayannis and Mozumdar (2004) use total assets. I test in Table 2 whether the score is consistent with such classifications. The mean Coface score, its standard error, maximum and minimum observations are reported separately for constrained and unconstrained firms. Firms whose dividend payout is in the top 30 percentiles are considered as financially unconstrained, whereas those in the bottom 30 percentiles are financially constrained. The same is done with total assets. The mean test is passed, meaning that constrained firms have a lower score than unconstrained firms, in both criteria. It is robust to using only one cross-section of the data, or taking out observations within the top and bottom percentiles of each measure. This confirms that the Coface score offers a creditworthiness measure that is consistent with other measures used in the literature.

Table 1
The correlation between the score and financial ratios and productivity.

	Score				
	(1)	(2)	(3)	(4)	(5)
Financial independence	4.970***				
	(0.080)				
Borrowings coverage		0.448***			
		(0.029)			
EBITDA (Ln)			0.0717**		
			(0.027)		
Investment ratio				0.530***	
				(0.028)	
Productivity					0.0650**
					(0.023)
Employment	0.529***	0.468***	0.422***	0.554***	0.465***
	(0.024)	(0.026)	(0.028)	(0.025)	(0.026)
Observations	129,541	129,515	129,542	130,848	129,471
Number of firms	19,932	20,030	19,968	20,091	19,868
R-squared	0.08	0.01	0.01	0.01	0.01
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes

Notes: Fixed-effect OLS regression ("Within" estimator). The dataset is an unbalanced panel of Belgian manufacturing firms from the BBSTTD with Coface score available and includes an average of 14,698 firms per year in 100 three-digit sectors over the period 1999 to 2007. Robust standard errors in parentheses; * denotes statistical significance at the 10% level; ** denotes statistical significance at the 5% level; *** denotes statistical significance at the 1% level. Includes constant and year dummies, not reported. The ratios are defined as follows: Financial independence = Equity capital/Total liabilities; Coverage of borrowings by cash flow = Cash flow/(Debt + Reserves + Deferred tax); EBITDA (Ln) = ln [Earnings before interest, taxes, depreciation, and amortization]; Investment ratio = Acquisitions of tangible fixed assets/Value added. The extreme observations (top and bottom percentile) for each ratio across all years are removed for the corresponding regression. Total Factor Productivity is measured according to Levinsohn and Petrin's (2003) method. Employment is in logarithm. The dependent variable is the credit rating score constructed for each year and each firm by Coface and ranges from 3 to 19. The variation in the number of observations is due to firms not reporting some of the variables used in the calculation of a given ratio in their balance sheet.

Table 2
Score of financially-constrained and unconstrained firms according to dividend payout ratio and total assets.

Score	Mean	SE	Max	Min	N
Dividend payout					
Constrained	13.31	0.05	19	3	3808
Unconstrained	13.92	0.04	19	3	3808
Total assets					
Constrained	9.88	0.02	19	3	29,687
Unconstrained	12.59	0.02	19	3	29,687

Notes: See notes to Table 1. The mean Coface score, its standard error, maximum and minimum observations are reported for the different categories defined. Firms whose dividend payout is in the top 30 percentiles are considered as financially unconstrained, whereas those in the bottom 30 percentiles are financially constrained. The same is done with total assets. The mean test is passed, meaning that constrained firms have a lower score than unconstrained firms, in both criteria. This is robust to using only one cross-section of the data, or taking out observations within the top and bottom percentiles of each measure.

[10] Bricongne et al. (2012) report that 4.7% of French exporters experienced a payment incident between January and April 2007.

[11] For examples of ratio computations using Belgian balance sheet formats, see Lagneaux and Vivet (2006).

[12] TFP is computed in this approach by using materials as a proxy rather than investment, thus reducing the number of zero-observations often noted in the data for investment compared to materials. The results presented below are robust to using alternative measures of Total Factor Productivity or the logarithm of labour productivity measured by value added per employee, rather than TFP.

Table 3
Descriptive statistics.

	Non-traders				Exporters				Importers			
	Mean	sd	Obs.	se	Mean	sd	Obs.	se	Mean	sd	Obs.	se
Score	10.6	3.77	81,832	0.01	12.4	3.80	36,956	0.02	12.5	3.74	39,940	0.02
Employment	7.95	18.90	81,832	0.07	103.3	332.13	36,956	1.7	99.2	320.73	39,940	1.6
Productivity	10.2	1.11	79,890	0.004	11.0	1.63	36,770	0.009	11.0	1.63	39,745	0.008
Operational profitability	450.9	1276.33	81,832	4.5	8567.8	41,484.97	36,956	215.8	8248.7	40,213.06	39,940	201.2
Wage	31.0	24.49	81,832	0.09	39.8	18.58	36,956	0.10	39.7	15.62	39,940	0.08
Age	15.6	12.05	81,827	0.04	23.5	16.73	36,954	0.09	23.5	16.58	39,938	0.08
Multinational	0.0026	0.05	81,832	0.0002	0.087	0.28	36,956	0.001	0.082	0.28	39,940	0.001
Investment ratio	0.24	0.40	81,829	0.001	0.18	0.27	36,949	0.001	0.18	0.28	39,933	0.001
Borrowings coverage ratio	0.38	0.42	81,831	0.001	0.37	0.40	36,956	0.002	0.37	0.41	39,940	0.002
Financial independence	0.32	0.28	81,831	0.0010	0.34	0.24	36,956	0.001	0.35	0.24	39,940	0.001
Number of countries					13.7	16.97	36,956		7.61	5.89	39,940	
Number of products					14.5	23.93	36,956		39.2	55.20	39,940	
Total export/import value					19.2	113.31	36,956		10.5	68.37	39,940	

Notes: The dataset is an unbalanced panel of Belgian manufacturing firms from the BBSTTD with Coface score available and includes an average of 14,686 firms per year in 100 three-digit sectors over the period 1999 to 2007. Observations are at the firm-year level. The credit rating score constructed for each year and each firm by Coface ranges from 3 to 19. The multinational dummy (0/1) is derived from the Survey on Foreign Direct Investment. Productivity is measured as Total Factor Productivity according to Levinsohn and Petrin's (2003) method. Operational profitability is measured by EBITDA and is reported in thousand of Euros. Wage is reported in thousand Euros. Total export value is reported in million Euros. See Table 1 for the definition of the ratios. The means, standard deviations, numbers of observations and standard errors of means are reported. Exporters/Importers are firms that were exporting/importing a positive amount in that year. Non-traders were trading zero in that year.

4. Credit constraints and trade levels

4.1. Export or import status

I begin the empirical analysis by exploring the variation in credit scores between exporters and importers on the one hand and non-traders on the other. It appears that less credit-constrained firms are more likely to be trading. This is shown at first in the descriptive statistics presented in Table 3: on average, traders are not only significantly larger and more productive, they also have a significantly higher score, meaning they are more creditworthy and less liquidity-constrained.

This is confirmed when estimating the effects of different firm characteristics on the probability of exporting or importing in a given year with the following two separate specifications for importers or exporters:

$$Ex/Importer(0/1)_{i,t} = \alpha + \beta_1 CS_{i,t-1} + \sum_{j=2} \beta_j FirmChar(j)_{i,t-1} + \{FE\} + \varepsilon_{i,t} \quad (4)$$

Where $Ex/Importer(0/1)_{i,t}$ is a dummy that takes the value 1 if firm i is an exporter/importer at time t and zero otherwise. $CS_{i,t-1}$ is the Coface credit score[13] for firm i at time $t-1$ and additional firm characteristics are added: productivity, operational profitability, wage, age, employment, MNE status and financial ratios proxying firm access to finance. Of course, many other factors might affect a firm's export status such as the current economic situation, and other characteristics of the firm. Other potential factors such as exchange rates, factor endowments, factor prices or industry demand will be common to all exporters of a sector in a given year. This is why I include firm and sector-year fixed effects in my specifications, denoted by {FE}, thus eliminating any bias that they could cause. The results are also presented with an alternative set of fixed effects – year and sector – for comparability with the previous literature. Each firm only belongs to one sector so in the specification where firm fixed effects are not included, sector fixed effects are used to control for non-time-varying sector-specific idiosyncrasies. Including fixed effects, controlling for firm-level observables and given the composition of the score described above, the residual effect of the Coface score is a good measure of credit constraints faced by a firm.

Given the number of fixed effects to be included in the specification, using a linear probability model in levels addresses the incidental parameter problem that affects non-linear fixed effect estimates. This specification is used in Bernard and Jensen (2004) for a very similar binary choice problem despite the problems this might provoke (e.g. predicted probabilities outside the 0–1 range). The first four columns of Table 4 only include sector and year fixed effects, as in Bernard and Jensen (2004). In columns (5) and (6), the full set of sector-year and firm fixed effects are included. Finally, as a robustness check, the results using a conditional logit estimator with year and firm fixed effects are presented in column (7). Other firm characteristics are also included as controls in columns (3) to (7): operational profitability, wage levels, age of the firm, multinational status and the financial ratios presented in Table (1). As would be expected, the Table shows that more productive firms are more likely to export, although the coefficient becomes insignificant once firm and sector-year fixed effects are included. The coefficient on the lagged credit score is positive and significant in all specifications, confirming that firms which are less credit-constrained have a higher probability of being exporters. In column (2), the coefficient on productivity is not reduced compared to the first column, indicating that the score captures the additional effect of credit constraints. Column (3) shows that the effect of productivity decreases while that of the credit score increases when more controls are added. When including the lagged export status variable, as in Bernard and Jensen (2004), the coefficients on TFP and the Coface score are strongly reduced as shown in column (4). Columns (6) and (7) show that the sign and significance of the score coefficient remain robust to including firm as well as sector-year fixed effects. Conditional logit with firm and year fixed effects yields similar results although the significance of the coefficient on the Coface score is lower, as shown in Column (7). These results are consistent with the literature showing that the firm extensive margin of exports (f_m in Eq. (1)) is positively correlated with lower credit constraints.

Very similar results are obtained when estimating the effect of the Coface score on import status using exactly the same specifications. As shown in Table 5, one notable difference with export status is that the positive effect of productivity on the probability of being an importer remains strong and significant across the different specifications. Less financially-constrained firms have a higher probability of being importers. Also, the strongly significant coefficient on the Coface score is robust to including sector-year and firm fixed effects as well as the

[13] As a robustness check, available from the author at request, the square of the score was included as explanatory variable. The results remain qualitatively similar.

Table 4
Linear probability model on exporter status.

Dependent variable:	0/1 Dummy non-exporter/exporter						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	LIN PROB	LIN PROB	LIN PROB	LIN PROB	LIN PROB	LIN PROB	COND LOG
Score		0.027***	0.048***	0.012***	0.009***	0.007**	0.156*
ln(Score (t-1))		(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.080)
Productivity	0.101***	0.099***	0.026***	0.006***	0.006	0.004	0.238**
ln(TFP Lev-Pet (t-1))	(0.002)	(0.002)	(0.004)	(0.002)	(0.004)	(0.004)	(0.097)
Operational profitability			0.115***	0.025***	0.036***	0.028***	0.643***
ln(EBITDA (t-1))			(0.003)	(0.002)	(0.005)	(0.005)	(0.100)
Wage			−0.016***	−0.008***	−0.008*	−0.007*	−0.033
ln(Wage (t-1))			(0.003)	(0.002)	(0.004)	(0.004)	(0.111)
Age			0.009***	−0.007***	0.024***	0.012***	0.327**
ln(Age)			(0.001)	(0.001)	(0.005)	(0.005)	(0.141)
Foreign			0.001	0.002	0.003	−0.000	0.471
Dummy for MNE(t-1)			(0.006)	(0.003)	(0.011)	(0.010)	(0.424)
Existing exporter				0.800***		0.247***	0.915***
Exporter/non-exporter (t-1)				(0.003)		(0.009)	(0.044)
Employment	0.125***	0.124***	0.038***	0.006***	0.026***	0.019***	0.856***
ln(Employment (t-1))	(0.001)	(0.001)	(0.003)	(0.002)	(0.004)	(0.004)	(0.097)
Investment ratio			0.000	0.000*	0.000	0.000	−0.002
			(0.000)	(0.000)	(0.000)	(0.000)	(0.008)
Borrowings coverage ratio			−0.025***	−0.004*	−0.003	−0.002	−0.052
			(0.003)	(0.002)	(0.002)	(0.002)	(0.056)
Financial independence ratio			−0.052***	−0.017***	−0.011	−0.009	−0.371**
			(0.005)	(0.003)	(0.007)	(0.006)	(0.173)
Observations	107,994	107,994	103,516	103,516	103,516	103,516	17,304
Number of firms					18,740	18,740	2512
R-squared	0.42	0.42	0.43	0.80	0.86	0.87	
Firm fixed effects	No	No	No	No	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	No	No	Yes
Sector-Year fixed effects	No	No	No	No	Yes	Yes	No

Notes: See notes to Table 3. Robust standard errors in parentheses; Stars denotes statistical significance at the 10% (*), 5% (**) or 1% (***) level. Includes constant and 3-digit sector and year dummies or sector-year dummies, not reported. The dependent variable is a dummy indicating whether the firm exports or not in that year. (t-1) indicates the explanatory variable has been lagged by one year. Ln (x) is the natural logarithm of variable x. The Foreign dummy variable takes the value 1 if the firm is part of a multinational, 0 otherwise. It is obtained from the Survey on Foreign Direct Investment conducted by the National Bank of Belgium.

lagged importer status in the linear probability model as shown in column (6) or the conditional logit specification in column (7). The coefficient of the credit constraint score is larger than in the case of exports. Import and export status, and hence the firm extensive margins for both trade flows, are therefore correlated to credit worthiness in a very similar way. These first results show that there are factors of credit worthiness that the Coface score integrates, over and above the observed balance sheet firm-level variables that are included as controls and to which the score is correlated. The regressions here and in the next sections are highlighting the effects of these additional elements of credit worthiness.

4.2. Value, destinations, origins and products

Conditional on being a trader, it is also of interest to understand how credit constraints might be related to the total value of exports or imports. Also, how might the number of countries being served or imported from and the number of products being traded be related to credit constraints? In other words, how strong is the association between credit constraints and each of the margins identified in Eq. (3)? This is explored by specifying for each of the margins:

$$ln(y)_{i,t} = \alpha + \beta_1 CS_{i,t-1} + \sum_{j=2} \beta_j FirmChar(j)_{i,t-1} + \delta_i + \delta_{st} + \varepsilon_{i,t} \qquad (5)$$

where y is either the total exports or imports value per firm (v_{j_i}), the number of destinations (c_{x_i}), the number of origins (c_{m_i}), the number of products (p_{j_i}), the density (d_{j_i}) or the average exports/imports per observation with positive trade ($\overline{u}_{j_i}$). δ_i and δ_{st} are respectively firm and sector-year fixed effects. In contrast to Tables 4 and 5 where different combinations of fixed effects are presented, I here include sector-year and firm fixed effects in all cases. I also control for firm characteristics: EBITDA, wages, age, MNE status, employment and three financial ratios presented above, as proxies of a company's access to finance: the investment ratio, the borrowing coverage ratio and the financial independence ratio. The result of such an OLS regression for each dependent variable is reported in Table 6, where it appears that in the case of exports the lagged score is positively and significantly correlated with total exports. This supports the result of Manova's model in which credit constraints would reduce firm-level exports. In addition, I find that the score is positively associated with each of the firm-level extensive margins as well as the intensive margin. It is negatively associated with the density. The evidence in Table 6 thus suggests that credit constraints are positively correlated with both the fixed costs of exporting – reflected in the extensive margins – and the variable costs that affect the intensive margin. It also suggests that the Coface score has explanatory power for export patterns beyond other measures of a company's access to external finance that are the financial ratios included as controls.

In order to obtain a sense of the magnitude of these effects, one can compute that a one standard deviation increase in the log of the credit score corresponds to a 4.4%[14] increase in total exports. This can be compared to the average annual increase in total Belgian exports between 1995 and 2008 which was 5.4% (Baugnet et al., 2010). Comparing the different margins, a 10% increase in the score (and not the logarithm of the score) would correspond to a 0.4% increase of both the number of products exported and destinations served and a 0.45% increase of the intensive margin. This is a small figure in the case of products given that the mean annual increase in the number of products

[14] This is calculated using the coefficient in column (1) in combination with the standard deviation of the logarithm of the score (0.414): exp(0.414*0.104)-1 = 4.39%.

Table 5
Linear probability model on importer status.

Dependent variable:	0/1 Dummy non-importer/importer						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	LIN PROB	LIN PROB	LIN PROB	LIN PROB	LIN PROB	LIN PROB	COND LOG
Score		0.040***	0.061***	0.018***	0.018***	0.016***	0.474***
ln(Score (t-1))		(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.083)
Productivity	0.109***	0.106***	0.025***	0.010***	0.010**	0.011**	0.398***
ln(TFP Lev-Pet (t-1))	(0.002)	(0.002)	(0.004)	(0.002)	(0.004)	(0.004)	(0.104)
Operational profitability			0.129***	0.024***	0.031***	0.021***	0.495***
ln(EBITDA (t-1))			(0.004)	(0.002)	(0.005)	(0.005)	(0.103)
Wage			−0.017***	−0.010***	−0.012***	−0.011***	−0.204*
ln(Wage (t-1))			(0.003)	(0.002)	(0.004)	(0.004)	(0.114)
Age			0.010***	−0.007***	0.019***	0.008*	0.699***
ln(Age)			(0.001)	(0.001)	(0.005)	(0.004)	(0.150)
Foreign			−0.053***	−0.013***	0.000	0.000	0.897
Dummy for MNE(t-1)			(0.006)	(0.003)	(0.009)	(0.008)	(0.606)
Existing importer				0.809***		0.236***	0.934***
Importer/non-imp. (t-1)				(0.003)		(0.009)	(0.043)
Employment	0.131***	0.130***	0.035***	0.007***	0.027***	0.021***	0.890***
ln(Employment (t-1))	(0.001)	(0.001)	(0.003)	(0.002)	(0.004)	(0.004)	(0.099)
Investment ratio			0.000*	0.000*	−0.000	−0.000	0.000
			(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Borrowings coverage			−0.029***	−0.006***	−0.004*	−0.003	−0.066
			(0.003)	(0.001)	(0.002)	(0.002)	(0.062)
Financial independence			−0.044***	−0.018***	−0.019***	−0.018***	−0.770***
			(0.005)	(0.003)	(0.007)	(0.006)	(0.200)
Observations	107,994	107,994	103,516	103,516	103,516	103,516	16,049
Number of firms					18,352	18,352	2341
R-squared	0.45	0.45	0.46	0.81	0.88	0.88	
Firm fixed effects	No	No	No	No	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	No	No	Yes
Sector-year fixed effects	No	No	No	No	Yes	Yes	No

Notes: See notes to Tables 1 and 3. Robust standard errors in parentheses; Stars denotes statistical significance at the 10% (*), 5% (**) or 1% (***) level. Includes constant and 3-digit sector and year dummies or sector-year dummies, not reported. The dependent variable is a dummy indicating whether the firm imports or not in that year. (t-1) indicates the explanatory variable has been lagged by one year. Ln (x) is the natural logarithm of variable x.

exported by a firm in the dataset is 6.5%. It is however a much larger result for countries given that on average firms do not increase the number of countries they export to.

In the case of imports, the lagged score is positively and significantly associated with total imports as well as the number of products imported, the product extensive margin. But in contrast with the corresponding result for exports, the coefficient on the number of origins is insignificant. A potential explanation behind this result is that firms rarely source goods from multiple countries. The mean number of countries from which a firm imports a given product, whether defined at the 8-digit or 6-digit level, is 1.5, while it is 3.68 countries per exported CN8 product. This has also been found using U.S. data in Antràs et al. (2014) and it could be due to the fixed cost of expanding on the product extensive margin of imports being smaller than the fixed cost of expanding on the country extensive margin. The fact that the country-level extensive margin of imports is not significantly shaped by the credit score is also consistent with the model in Antràs et al. (2014). Another channel to take into account is that if a firm does not have a good financial health, foreign firms will be less willing to risk a payment default, limiting the range of inputs it can import from abroad. There appears to be no relationship between the import intensive margin and credit constraints, which would indicate that variable costs for imports are less related to the access to external finance. One standard deviation increase in the logarithm of the score would correspond to a 3.4% increase in total imports, suggesting that access to credit matters less than in the case of exports on aggregate, although the coefficient for the product extensive margin is slightly higher than for exports. These various results will be analyzed in their growth dimension in Section 5.

It is also interesting to note that for exports, only total value and the intensive margin are positively related to productivity while for imports, it is also the case of the number of origins. A higher EBITDA is positively associated with all margins for both imports and exports. This suggests that firms that reach a certain maturity make bigger margins on their products thus obtaining higher profitability and exports. A higher EBITDA might also reflect lower input costs which could be the result of a more intense importing behavior. The negative and significant coefficients for the financial independence ratio that appear in most specifications of Tables 6 and 7 could be due to the fact that a higher ratio at $t-1$ will facilitate the firm's potential to increase its liabilities which in itself will decrease the ratio at t. This decrease has a negative impact on trade values and its margins. Finally, the strongly significant and large coefficient for the employment variable in the case of the extensive margins confirms that it is important to control for firm size when considering the trading decisions of firms.

These results clearly establish the relationship that exists between credit constraints and exporting and importing patterns, even if once productivity, size, profitability, access to finance and other firm characteristics are controlled for.

5. The effects of credit constraints over time

This section shows how credit constraints relate to changes in trade levels and their margins. Policy makers are usually keen to understand the determinants of trade growth. Given the openness of the Belgian economy and its size, the number of firms starting to export within the sample is too low to lead to meaningful results. I therefore focus on understanding the impact of credit constraints on the growth in total imports and exports, decomposing them through the product and country extensive margins as well as the densities and intensive margins of exporters and importers through time. Defining $\Delta v_{j,t_i} = v_{j,t_i}/v_{j,t-1_i}$ as the change in the total value of

Table 6
Total exports, destinations and products.

Dependent variable:	Exports					Imports				
	Total value	Destinations	Products	Density	Av. value	Total value	Origins	Products	Density	Av. value
	ln (Total exports value)	ln (Number of dest.)	ln (Number of products)	ln(active prod.-dest. per total potential)	ln(Av. Value per active prod.-dest.)	ln (Total imports value)	ln (Number of origins)	ln (Number of products)	ln(active prod.-orig. per total potential)	ln(Av. Value per active prod.-orig.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Score	0.104***	0.039***	0.040**	−0.020**	0.045**	0.080***	0.016	0.047***	−0.009	0.026
ln(Score (t-1))	(0.031)	(0.013)	(0.017)	(0.010)	(0.021)	(0.027)	(0.012)	(0.017)	(0.009)	(0.018)
Productivity	0.143***	0.017	−0.002	0.011	0.117***	0.098***	0.018*	0.023	−0.018**	0.075***
ln(TFP Lev-Pet (t-1))	(0.034)	(0.014)	(0.021)	(0.015)	(0.023)	(0.027)	(0.010)	(0.016)	(0.008)	(0.019)
Operational prof.	0.173***	0.050***	0.066***	−0.038***	0.095***	0.203***	0.052***	0.098***	−0.047***	0.099***
ln(EBITDA (t-1))	(0.036)	(0.015)	(0.019)	(0.012)	(0.024)	(0.036)	(0.012)	(0.018)	(0.010)	(0.025)
Wage	−0.108**	−0.003	0.020	−0.007	−0.118***	−0.100*	0.011	−0.017	−0.005	−0.090**
ln(Wage (t-1))	(0.052)	(0.022)	(0.030)	(0.017)	(0.034)	(0.051)	(0.021)	(0.029)	(0.016)	(0.035)
Age	−0.005	0.053	−0.019	−0.025	−0.014	0.013	−0.014	−0.040	0.025	0.042
ln(Age)	(0.076)	(0.036)	(0.041)	(0.025)	(0.049)	(0.073)	(0.030)	(0.046)	(0.024)	(0.047)
Foreign	0.182**	0.092***	0.120***	−0.076***	0.047	0.032	0.018	0.027	−0.012	−0.001
0–1 dummy	(0.073)	(0.031)	(0.036)	(0.020)	(0.043)	(0.048)	(0.016)	(0.027)	(0.014)	(0.038)
Employment	0.418***	0.208***	0.258***	−0.169***	0.122***	0.410***	0.206***	0.315***	−0.179***	0.068**
ln(Employment (t-1))	(0.049)	(0.021)	(0.029)	(0.016)	(0.032)	(0.052)	(0.022)	(0.032)	(0.017)	(0.033)
Investment ratio	0.004	0.003**	0.005	−0.003	−0.001	−0.002	−0.002	0.001	0.001	−0.002
	(0.004)	(0.002)	(0.004)	(0.002)	(0.002)	(0.006)	(0.003)	(0.003)	(0.002)	(0.003)
Borrowings cov.	0.007	−0.003	−0.015	0.002	0.022	0.019	0.007	−0.009	−0.001	0.022
	(0.026)	(0.013)	(0.015)	(0.009)	(0.017)	(0.017)	(0.010)	(0.012)	(0.008)	(0.017)
Financial independ.	−0.328***	−0.097**	−0.204***	0.121***	−0.148**	−0.319***	−0.081**	−0.091*	0.047*	−0.194***
	(0.099)	(0.040)	(0.047)	(0.028)	(0.067)	(0.077)	(0.033)	(0.048)	(0.027)	(0.056)
Observations	31,344	31,344	31,344	31,344	31,344	27,392	27,392	27,392	27,392	27,392
Number of firms	6239	6239	6239	6239	6239	5552	5552	5552	5552	5552
R-squared	0.90	0.92	0.88	0.85	0.87	0.91	0.88	0.91	0.87	0.88
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See notes to Table 4. Fixed-effect ("Within") regressions. Robust standard errors in parentheses; Stars denote statistical significance at the 10% (*), 5% (**) or 1% (***) level. Includes constant and sector-year dummies, not reported.
The dataset is an unbalanced panel of Belgian manufacturing firms from the BBSTTD with Coface score available or each year they file in a balance sheet over the period and includes an average of 14,686 firms per year in 100 three-digit sectors over the period 1999 to 2007.
Ln (x) is the natural logarithm of variable x. (t-1) indicates the explanatory variable has been lagged by one year. The credit rating score, constructed for each year and each firm by Coface ranges from 3 to 19. TFP Lev-Pet is a measure of Total Factor Productivity calculated according to Levinsohn and Petrin's (2003) method. The Foreign dummy variable takes the value 1 if the firm is part of a multinational, 0 otherwise. It is obtained from the Survey on Foreign Direct Investment conducted by the National Bank of Belgium.

each firm i's exports or imports between $t-1$ and t and applying the first difference operator to Eq. (3), it can be decomposed as:

$$\Delta v_{j,t_i} = \Delta\left(ln\, c_{jt_i}\right) + \Delta\left(ln\, p_{jt_i}\right) + \Delta\left(ln\, d_{jt_i}\right) + \Delta\left(ln\, \overline{u}_{jt_i}\right) \quad (6)$$

where $\Delta\left(lnc_{jt_i}\right)$ reflects the change in the country extensive margin, $\Delta\left(lnp_{jt_i}\right)$ the change in the product extensive margin, $\Delta\left(lnd_{jt_i}\right)$ the change in density and $\Delta\left(ln\overline{u}_{jt_i}\right)$ the change in the average value exported/imported per active country-product pair, which is the intensive margin.

5.1. Extensive and intensive margin for exports

I found in Section 4.2 that firms with a higher credit score are also likely to display higher values of total exports, to be exporting more products, serving more destinations and to have larger average exports per non-zero product-country. This result also applies to the growth in total exports and its components, except for the intensive margin. In this section, I run the same specification as in Eq. (5), but taking as dependent variables the various elements of Eq. (6). I include firm fixed effects, sector-year dummies and control for firm characteristics in an OLS specification as above. Levels of the dependent variable in the previous year are included as explanatory variable in each case, to capture together with the firm's age the existing exporting activity level effects on each margin, although the results are robust to excluding them from the regression. The first column of Table 7 shows that the increase in total exports relative to the previous year is positively related to creditworthiness. One standard deviation increase in the logarithm of the score can be associated with a 2.5% increase in the growth of exports. This can be decomposed into a positive relation with the increase in the number of destinations served as shown in column (2) and the increase in the number of products (column (3)). It confirms that credit constraints can be associated with the fixed costs of exporting to more countries or more products. Variations in the intensive margin of trade, the dependent variable of column (5), are not correlated with credit constraints.

The coefficients on productivity are not significant when considering the product and destination extensive margins suggesting that when looking at changes over time, it is important to also consider other determinants of trading patterns. Besides, being part of a multinational is positively associated to the increase in the number of destinations and products exported but not the intensive margin. Finally, the export levels, whether in value, products or destinations in t-1 are correlated to the total growth as well as to all three margins negatively: firms are less likely to grow in all dimensions if they are already strong exporters.

5.2. Extensive and intensive margin for imports

Identical specifications are run for imports. There is a strong statistical relationship between the growth of imports and the Coface score at t-1: an increase of one standard deviation in the logarithm of the score is associated with a 2.6% increase in the growth of imports, a figure very

Table 7
Extensive and intensive margins.

	Exports					Imports				
Dependent variable	Growth	Destination extensive margin	Product extensive margin	Density	Intensive	Growth	Origen extensive margin	Product extensive margin	Density	Intensive margin
	Δ ln (total value of exports)	Δ ln (number of destinations)	Δ ln (number of products)	Δ ln (active prod.-dest. per total potential)	Δ ln (mean value per active prod.-dest.)	Δ ln (total value of imports)	Δ ln (number of origins)	Δ ln (number of products)	Δ ln (active prod.-orig. per total potential)	Δ ln (mean value per active prod.-orig.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Score	0.059**	0.028**	0.029*	−0.020*	0.020	0.062***	0.014	0.035**	−0.014	0.023
ln(Score (t-1))	(0.026)	(0.011)	(0.015)	(0.011)	(0.020)	(0.023)	(0.010)	(0.014)	(0.009)	(0.017)
Productivity	0.115***	0.016	0.010	−0.005	0.068***	0.064***	0.010	0.013	−0.022***	0.031**
ln(TFP Lev-Pet (t-1))	(0.030)	(0.012)	(0.018)	(0.013)	(0.021)	(0.021)	(0.009)	(0.012)	(0.007)	(0.016)
Operational prof.	0.061**	0.027**	0.044***	−0.026**	0.012	0.142***	0.039***	0.070***	−0.023***	0.077***
ln(EBITDA (t-1))	(0.029)	(0.013)	(0.016)	(0.012)	(0.022)	(0.025)	(0.010)	(0.013)	(0.008)	(0.020)
Wage	−0.106**	−0.019	0.010	0.037*	−0.033	−0.072*	0.008	−0.021	0.014	−0.032
ln(Wage (t-1))	(0.049)	(0.021)	(0.029)	(0.019)	(0.034)	(0.042)	(0.017)	(0.024)	(0.015)	(0.032)
Age	−0.144**	−0.011	−0.067*	0.064***	−0.007	−0.155***	−0.051**	−0.105***	0.074***	0.000
ln(Age)	(0.061)	(0.031)	(0.036)	(0.022)	(0.042)	(0.052)	(0.024)	(0.033)	(0.019)	(0.036)
Foreign	0.076	0.053**	0.076***	0.004	0.041	0.025	0.020	0.027	−0.009	0.010
Dummy for MNE(t-1)	(0.051)	(0.022)	(0.028)	(0.016)	(0.033)	(0.036)	(0.013)	(0.021)	(0.011)	(0.027)
Total value at t-1	−0.609***			0.066***	−0.421***	−0.701***			0.097***	−0.465***
ln(imp./exp. (t-1))	(0.019)			(0.005)	(0.014)	(0.020)			(0.006)	(0.014)
Countries at t-1		−0.669***					−0.760***			
ln(# of dest./orig.(t-1))		(0.014)					(0.013)			
Products at t-1			−0.713***					−0.685***		
ln(# products (t-1))			(0.013)					(0.014)		
Employment	0.264***	0.148***	0.201***	−0.036**	0.182***	0.298***	0.151***	0.219***	−0.040***	0.208***
ln(employment (t-1))	(0.042)	(0.020)	(0.026)	(0.015)	(0.029)	(0.040)	(0.016)	(0.023)	(0.012)	(0.028)
Investment ratio	0.021**	0.008**	0.021***	−0.007***	0.006	−0.002	0.000	0.001	−0.001**	−0.003***
	(0.009)	(0.003)	(0.005)	(0.003)	(0.005)	(0.002)	(0.000)	(0.001)	(0.000)	(0.001)
Borrowings cov.	−0.021	−0.000	−0.009	−0.003	−0.023	0.001	0.003	−0.016	0.001	0.000
	(0.021)	(0.012)	(0.014)	(0.008)	(0.015)	(0.014)	(0.008)	(0.010)	(0.007)	(0.013)
Financial indep.	−0.166**	−0.058*	−0.149***	0.058**	−0.103*	−0.170***	−0.041	−0.028	0.018	−0.114**
	(0.082)	(0.034)	(0.041)	(0.026)	(0.060)	(0.063)	(0.027)	(0.041)	(0.023)	(0.045)
Observations	29,000	29,000	29,000	29,000	29,000	31,545	31,545	31,545	31,545	31,545
Number of firms	5584	5584	5584	5584	5584	5970	5970	5970	5970	5970
R-squared	0.47	0.46	0.46	0.16	0.39	0.51	0.49	0.49	0.16	0.39
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See notes to Table 4. Firm fixed effect regressions ("Within" estimator). Robust standard errors in parentheses; Stars denotes statistical significance at the 10% (*), 5% (**) or 1% (***) level. Includes constant, not reported. Only observations in which the firm is exporting (columns 1–5) or importing (columns 6–10) are kept. Δ indicates the value of a variable at time t minus its value at time t-1.
Based on ImportsExportsDynamic_JIErev2_withcontr.

similar as that for exports. However, in contrast with the results for exports when decomposing into different margins, credit worthiness appears to be strongly significantly correlated with the imported product extensive margin but not with the growth in the number of countries imported from, as shown in columns (7) and (8) of Table 7. This suggests that liquidity is not correlated with importing from more origins, but is positively so with expanding the range of imported inputs. As discussed above, this correlation suggests the presence of sunk costs of importing an additional product from abroad. In addition, it could also be related to the default risk reflected in the score: foreign companies will be less willing to take this risk if the importer has a lower credit rating. As in the case of exports, changes in average import values per active product-country are uncorrelated with credit constraints. The coefficients on operational profitability are positive and significant across all import margins, including the intensive one. It is also noteworthy that MNE status is not correlated with import margins.

The results in Table 7 reinforce the findings from Section 4.2 that considered the levels of the trade margins. The lack of association between number of countries imported from and credit constraints could reflect the fact that contrary to exports where more destinations imply larger markets, the primary rationale for imports is the necessity to source inputs that are either not available domestically, or not at the same levels of price or quality. The novel finding is that at the firm level, the relationship between credit constraints and the country extensive margin is different for imports and exports.

6. Conclusion

In this paper, I show that credit constraints are related to export and import volumes and patterns. A precise and complete dataset on trade transactions at the firm level for the Belgian manufacturing sector is combined to a unique and very useful yearly measure of credit constraints faced by firms, a creditworthiness score constructed independently by a credit insurance company. These allow me to examine the relationship between credit constraints and trade in a new way. My main contribution is to show that credit constraints are important across the spectrum, not only in cases of payment defaults and that they are correlated differently with export and import margins.

It is shown that firms which are less credit-constrained, more productive and profitable have a higher probability of being exporters or importers. Such firms are also likely to report larger total trade values. While credit constraints are positively associated with both the country and product extensive margins and the intensive margin of exports, this is not true in the case of imports where it is only the case for the product extensive margin of imports.

Finally, this result also holds when decomposing the growth of exports and imports. I find that the growth in the number of products

exported and destinations served is positively correlated with the Coface score measure. This supports the hypothesis that entering a new market or exporting a new product imply fixed costs for exporters. On the other hand, for imports, a rise in its credit score is associated with an increase in the number of inputs imported by a firm. This might reflect the impact of the firm's financial situation on both a firm's potential to pay the fixed cost of sourcing an additional input from abroad, as well as the willingness of its potential suppliers to take the risk it might default. Related to the fact that a firm rarely imports a good from multiple countries, I find that a decrease in credit constraints is not positively associated with an increase in the number of countries that a firm sources its imports from.

These results confirm the link between credit constraints and export and import margins. They also highlight the potential role of government agencies in reducing the fixed costs of entry to new markets or of importing new inputs. Exploring further the relationship between financial constraints and trading behavior, by using firm level information on specific products' domestic sales versus exports, could shed further light on the links between the dynamics of trade and financial constraints.

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References

Ahn, J.B., Amiti, M., Weinstein, D.E., 2011. Trade finance and the great trade collapse. Am. Econ. Rev. 101, 298–302.
Albornoz, F., Pardo, H.A.F., Corcos, G., Ornelas, E., 2012. Sequential exporting. J. Int. Econ. 88, 17–31.
Allayannis, G., Mozumdar, A., 2004. The impact of negative cash flow and influential observations on investment—cash flow sensitivity estimates. J. Bank. Financ. 28, 901–930.
Almeida, H., Campello, M., Weisbach, M.S., 2004. The cash flow sensitivity of cash. J. Financ. 59, 1777–1804.
Amiti, M., Konings, J., 2007. Trade liberalization, intermediate inputs, and productivity: evidence from Indonesia. Am. Econ. Rev. 97, 1611–1638.
Amiti, M., Weinstein, D.E., 2011. Exports and financial shocks. Q. J. Econ. 126, 1841–1877.
Antràs, P., Foley, C.F., 2015. Poultry in motion: a study of international trade finance practices. J. Polit. Econ. http://dx.doi.org/10.3386/w17091.
Antràs, P., Fort, T.C., Tintelnot, F., 2014. The margins of global sourcing: theory and evidence from U.S. firms. Technical Report. Harvard University.
Araujo, L., Mion, G., Ornelas, E., 2012. Institutions and export dynamics. CEP Discussion Paper 1118. London School of Economics, London, UK.
Arkolakis, C., Muendler, M.A., 2010. The extensive margin of exporting products: a firm-level analysis. CESifo Working Paper Series 3309. CESifo Group Munich.
Askenazy, P., Caldera, A., Gaulier, G., Irac, D., 2011. Financial constraints and foreign market entries or exits: firm-level evidence from France. CEPREMAP Working Papers.
Balcaen, S., Ooghe, H., 2006. 35 years of studies on business failure: an overview of the classic statistical methodologies and their related problems. Br. Account. Rev. 38, 63–93.
Baugnet, V., Burggraeve, K., Dresse, L., Piette, Ch., Vuidar, B., 2010. Place de la Belgique dans le commerce mondial. Econ. Rev. 29–56.
Beck, T., 2002. Financial development and international trade: is there a link? J. Int. Econ. 57, 107–131.
Behrens, K., Corcos, G., Mion, G., 2013. Trade crisis? What trade crisis? Rev. Econ. Stat. 95, 702–709.
Bellone, F., Musso, P., Nesta, L., Schiavo, S., 2010. Financial constraints and firm export behaviour. World Econ. 33, 347–373.
Berman, N., Héricourt, J., 2010. Financial factors and the margins of trade: evidence from cross-country firm-level data. J. Dev. Econ. 93, 206–217.
Bernard, A.B., Jensen, J.B., 2004. Why some firms export. Rev. Econ. Stat. 86, 561–569.
Bernard, A.B., Jensen, J.B., Redding, S.J., Schott, P.K., 2007. Firms in international trade. J. Econ. Perspect. 21, 105–130.
Bernard, A.B., Jensen, J.B., Redding, S.J., Schott, P.K., 2009. The margins of us trade. Am. Econ. Rev. 99, 487–493.
Besedeš, T., Kim, B.C., Lugovskyy, V., 2014. Export growth and credit constraints. Eur. Econ. Rev. 70, 350–370.
Bricongne, J.C., Fontagné, L., Gaulier, G., Taglioni, D., Vicard, V., 2012. Firms and the global crisis: French exports in the turmoil. J. Int. Econ. 87, 134–146.
Broda, C., Weinstein, D.E., 2006. Globalization and the gains from variety. Q. J. Econ. 121, 541–585.
Caggese, A., Cunat, V., 2013. Financing constraints, firm dynamics, export decisions, and aggregate productivity. Rev. Econ. Dyn. 16, 177–193.
Campa, J.M., Shaver, J.M., 2002. Exporting and capital investment: on the strategic behavior of exporters. Discussion Paper n469. IESE Business School, University of Navarra.
Chaney, T., 2013. Liquidity constrained exporters. NBER Working Paper 19170.
Chor, D., Manova, K., 2012. Off the cliff and back? Credit conditions and international trade during the global financial crisis. J. Int. Econ. 87, 117–133.
Djankov, S., Freund, C., Pham, C.S., 2010. Trading on time. Rev. Econ. Stat. 92, 166–173.
Goldberg, P.K., Khandelwal, A.K., Pavcnik, N., Topalova, P., 2010. Imported intermediate inputs and domestic product growth: evidence from India. Q. J. Econ. 125, 1727–1767.
Greenaway, D., Guariglia, A., Kneller, R., 2007. Financial factors and exporting decisions. J. Int. Econ. 73, 377–395.
Halpern, L., Koren, M., Szeidl, A., 2005. Imports and productivity. C.E.P.R. Discussion Papers n5139.
Hur, J., Raj, M., Riyanto, Y.E., 2006. Finance and trade: a cross-country empirical analysis on the impact of financial development and asset tangibility on international trade. World Dev. 34, 1728–1741.
Iacovone, L., Zavacka, V., 2009. Banking crises and exports: lessons from the past. Policy Research Working Paper Series 5016. The World Bank.
Impullitti, G., Irarrazabal, A.A., Opromolla, L.D., 2013. A theory of entry into and exit from export markets. J. Int. Econ. 90, 75–90.
Kasahara, H., Lapham, B., 2013. Productivity and the decision to import and export: theory and evidence. J. Int. Econ. 89, 297–316.
Kasahara, H., Rodrigue, J., 2008. Does the use of imported intermediates increase productivity? Plant-level evidence. J. Dev. Econ. 87, 106–118.
Kohn, D., Leibovici, F., Szkup, M., 2014. Financial frictions and new exporter dynamics. York University, mimeo.
Lagneaux, F., Vivet, D., 2006. Trend in the financial structure and results of firms in 2005. Econ. Rev. 2006 (3), 31–56.
Levchenko, A., Lewis, L., Tesar, L., 2010. The role of financial factors in the great trade collapse: A skeptic's view. University of Michigan, mimeo.
Levinsohn, J., Petrin, A., 2003. Estimating production functions using inputs to control for unobservables. Rev. Econ. Stud. 70, 317–341.
Manova, K., 2008. Credit constraints, equity market liberalizations and international trade. J. Int. Econ. 76, 33–47.
Manova, K., 2013. Credit constraints, heterogeneous firms, and international trade. Rev. Econ. Stud. 80, 711–744.
Melitz, M., 2003. The impact of trade on aggregate industry productivity and intra-industry reallocations. Econometrica 71, 1695–1725.
Minetti, R., Zhu, S.C., 2011. Credit constraints and firm export: microeconomic evidence from Italy. J. Int. Econ. 83, 109–125.
Moxnes, A., 2010. Are sunk costs in exporting country specific? Can. J. Econ. 43, 467–493.
Muûls, M., 2008. Exporters and credit constraints. A firm-level approach. National Bank of Belgium Working Paper n139.
Muûls, M., Pisu, M., 2009. Imports and exports at the level of the firm: evidence from Belgium. World Econ. 32, 692–734.
Paravisini, D., Rappoport, V., Schnabl, P., Wolfenzon, D., 2011. Dissecting the effect of credit supply on trade: evidence from matched credit-export data. National Bureau of Economic Research Working paper n16975.
Rajan, R.G., Zingales, L., 1998. Financial dependence and growth. Am. Econ. Rev. 88, 559–586.
Stiebale, J., 2011. Do financial constraints matter for foreign market entry? A firm-level examination. World Econ. 34, 123–153.
Svaleryd, H., Vlachos, J., 2005. Financial markets, the pattern of industrial specialization and comparative advantage: evidence from OECD countries. Eur. Econ. Rev. 49, 113–144.
Wang, X., 2011. Financial constraints and exports. University of Wisconsin, mimeo.