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Abstract

Using data on 2380 firms from nine emerging countries, this paper shows that there is a positive and significant relationship between financial health and the intensive margin of trade. The magnitude of this positive relationship is shown to depend on several firm characteristics, where the effects of financial health on firm-level exports are larger for firms with higher levels of export, bigger size (measured by assets), higher productivity (measured by value added per worker), and moderate levels of financial health (measured by cash flow over total assets). The results are robust to the consideration of foreign ownership and country characteristics as well as industry and time fixed effects.

JEL Classification: D24, F10, F14

Key Words: Financial Health; Intensive Margin of Trade; Threshold Analysis; Emerging Markets

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1 Introduction

International exporting at the firm level is subject to fixed costs, especially the costs related to finance; e.g., up to 90% of world trade has been estimated to rely on some form of trade finance (Auboin (2009)). However, whether these costs are paid for one time (e.g., sunk costs at the time of entry into international markets)[1] or each time (i.e., financial costs paid any time exported, such as costs of shipping, duties and freight insurance before export revenues are realized)[2] is a subject of debate. While the former is connected to the role of finance in the extensive margin of trade, the latter is associated with the role of finance in the intensive margin of trade.[3] The existing literature agree upon the role of finance on the extensive margin of trade.[4] However, evidence for the role of finance on the intensive margin of trade is limited.[5]

Within this picture, this paper investigates the relationship between financial health and the intensive margin of trade. Since financially more vulnerable firms may have alternative necessities for finance as shown by studies such as by Manova (2012) and Manova et al. (2015), we also consider possible nonlinearities arising from the determinants of financial vulnerability, such as *size*, *productivity* and *foreign ownership*, by employing parametric threshold and nonparametric estimation models.[6] The Enterprise Surveys of the World Bank are used,

[1] According to Manova (2012), sunk and fixed costs of international trade include learning about the profitability of potential export markets; making market-specific investments in capacity, product customization and regulatory compliance; and setting up and maintaining foreign distribution networks.

[2] According to Djankov et al. (2010), cross-border shipping and delivery usually take 30-90 days longer to complete than domestic orders

[3] In the literature focusing on cross-firm analyses, the extensive margin of trade is connected to the export decision of firms or the number of exporters, while the intensive margin of trade is connected to the level of exports; e.g., see Berman and Héricourt (2010). Accordingly, when the extensive margin of trade is considered, cross-firm studies attempt to understand why certain firms export, while others do not at a given point in time. Similarly, when the intensive margin of trade is considered, cross-firm studies attempt to understand why certain firms export more or less than others.

[4] See Espanol (2007), Castagnino et al. (2013), Egger and Kesina (2013), Manole and Spatareanu (2010), Kiendrebeogo and Minea (2012), Ito and Terada-Hagiwara (2011), Forlani (2010), Cole et al. (2010), Wang (2010).

[5] Studies such as by Li and Yu (2009), Buch et al. (2009), Muûls (2008), Berman and Héricourt (2010), and Hasan et al. (2013) have found rather weak or limited evidence, while studies such as by Manova (2012) have shown that two thirds of the trade-specific effect of financial frictions are due to the intensive margin of trade

[6] Nonparametric estimation methodology is a useful tool and widely applied in many areas of economics. The following are studies that apply nonparametric estimation techniques, among many others: Henderson and Millimet (2005) estimate the impact of environmental policy on state-level output. Henderson and Kumbhakar (2006) estimate the returns on public and private capital. Gyimah-Brempong and Racine (2006) investigate the relationship between alcohol availability and crime. Henderson and Millimet (2007) assess the impact of U.S. state-level pollution abatement costs on the spatial distribution of FDI inflows. Eren and Henderson (2008) evaluate the role of homework on academic achievement. Zhu (2011) analyzes the individual level differences in returns to education in urban China. Wheelock and Wilson (2012) estimate the returns to scale for all U.S. banks over the period 1984-2006. Finally, Mastromarco and Simar (2015)

where the data include observations from 2380 firms across nine emerging countries. Exports are measured in U.S. dollars, financial health is measured by the lagged value of cash flow over total assets, size is measured by the lagged value of log assets measured in U.S. dollars, and productivity is measured by the lagged ratio of value added (measured in U.S. dollars) over the number of workers, where using lagged values on the right hand side is important to control for any potential endogeneity problem. In order to have a healthy comparison with the existing literature, we use the version of the data set used in Berman and Héricourt (2010).

The empirical results show that financial health is a significant factor in explaining the intensive margin of trade for many firms in our sample, although the magnitude of the effect changes across firms. When we search for a systematic explanation, we show that there are significant nonlinearities in the relationship between finance and the level of exports: financial health leads to higher levels of exports for highly-exporting, large, productive or domestically owned firms, after controlling for all else. Therefore, the role of finance on the intensive margin of trade is subject to nonlinearities in explanatory variables as suggested by the theoretical literature (which is discussed in details in the next section).[7]

When we search for specific firm characteristics that are consistent with financial health being effective on the level of exports, we find through parametric threshold analyses that financial health is positively and statistically significant more for firms with sizes (measured by assets) higher than about $1,794,075\,(=\exp(14.4))$ U.S. dollars, with productivities higher than 8.05 U.S. dollars of value added per worker, and with cash flow over total asset measures more than 0.15. Despite their nonlinear structure, since parametric threshold models are still restrictive due to their piecewise linear structure on the financial health function, for robustness, when we continue our investigation using a nonparametric model, we show that the results are qualitatively the same and quantitatively very similar to the parametric threshold analysis. In particular, financial health is positively and statistically significant mostly for firms with median export values higher than about $80,000\,(\approx\exp(11.3))$ U.S. dollars (corresponding to about 33% of the observations in our sample), with median sizes (measured by assets) higher than about $180,000\,(=\exp(12.1))$ U.S. dollars (corresponding to about 50% of the observations in our sample), with median productivities higher than 7.12 U.S. dollars of value added per worker (corresponding to about 46% of the observations

use a nonparametric production frontier model and analyze the channels through which external factors may affect the economic performance of production unit.

[7]Since we employ the same data set as in Berman and Héricourt (2010), who show that the role of finance on the intensive margin of trade is weak, we can safely claim that the results in this paper are due to considering nonlinearities in the relationship between finance and trade (rather than any potential differences in data sets used).

in our sample), and with median cash flow over total asset measures between 0.04 and 1.02 (corresponding to about 68% of the observations in our sample).

Hence, we provide clues for policy makers regarding which firms are more beneficial to subsidize in order to achieve higher export volumes that would support an export-oriented growth strategy. These results are robust to the consideration of the nationality of firms and country-industry-time fixed effects which are important to control for the effects of finance across emerging countries with potentially heterogenous characteristics where banks may be different or some firms may have export promotion agencies whilst others may not.

Compared to the literature, this is not the first paper showing the relationship between finance and the level of exports (i.e., intensive margin of trade). For instance, using a 30 year aggregate-data panel of 65 countries, Beck (2002) shows that financial development exerts a large impact on the level of exports. Similarly, using data on U.K. firms over the period 1993-2003, Greenaway et al. (2007) find that exporters exhibit better financial health than non-exporters, and when they differentiate between continuous exporters and starters, they see that this is driven by the intensive margin of trade. In another study, Paravisini et al. (2015) find that credit shocks affect the intensive margin of exports. Likewise, Hur et al. (2006) find that economies with higher levels of financial development have higher export shares, which is another evidence for the relationship between finance and the intensive margin of trade. Finally, Minetti and Zhu (2011) report that credit rationing reduce foreign sales using survey data from Italian firms, and Manova et al. (2015) use Chinese firm level data to show that foreign affiliates and joint ventures have better export performance than private domestic firms in financially more vulnerable sectors. However, none of these papers have considered a cross-country firm-level data coming from emerging countries to study the relationship between finance and the intensive margin of trade, which is important to depict a systematic approach for emerging countries to grow faster through international trade. Moreover, these mentioned studies do not consider nonlinearities in the relationship between finance and the intensive margin of trade through distinguishing between the size, productivity and export share of firms either, which have been shown to be important for the effects of finance on firm-level exports in the theoretical literature. This paper bridges such gaps.

The rest of the paper is organized as follows. The next section discusses the mechanisms through which finance can affect firm-level exports. We present and discuss our empirical methodology in Section 3. Section 4 describes the data and the corresponding descriptive statistics. Section 5 reveals the estimation results. Section 6 concludes.

2 Motivation and Theoretical Background

We have two motivations in this paper regarding the effects of finance on the intensive margin of trade. First, exporting firms are believed to be more dependent on finance compared to firms selling to their domestic markets. Second, the effects of finance on trade are believed to depend on the financial vulnerability of the firm. We discuss each of them below by referring to the corresponding literature.

According to the model introduced by Feenstra et al. (2014) where banks do not observe firms' productivities, there are three reasons behind exporting firms depending more on finance compared to firms selling to their domestic markets. First, entering foreign markets entails additional expenses for each time firms exports. This is mostly due to the variable trade costs consisting of transportation, duties, and freight insurance, since export revenues are not realized before the delivery is completed. Second, international delivery usually takes 30-90 days longer to complete than domestic orders according to Djankov et al. (2010); therefore, for each time export is achieved, exporting firms are required to finance their production costs for a longer period of time compared to domestic sellers. Third, due to the greater risk involved in international transactions, exporter firms are required to obtain trade insurance for each time that they export; e.g., according to Auboin (2009), up to 90% of world trade requires some form of trade finance. Hence, the literature has agreed upon the dependency of exporter firms on finance regarding the intensive margin of trade.

Regarding the theoretical background for the effects of finance on the intensive margin of trade, we follow Manova et al. (2015) by summarizing the predictions of a model that incorporates the role of finance in a heterogeneous-firm framework based on Melitz (2003) and Manova (2012). First, productive firms can earn bigger revenues and offer lenders a higher (and more secure) return in case of repayment of their debt. Since more productive firms are associated with larger firm sizes and higher firm-level exports, finance may be more effective for firms that have higher productivities, larger sizes, and higher export volumes. Second, since more productive firms can enter into more destination markets with a wider range of products, finance may again be more effective for firms with higher productivities, larger sizes, and higher export volumes. Third, finance can affect the intensive margin of trade through firms' investments in productivity and product quality, which can further affect the intensive margin of trade. Fourth, although finance is important for all sectors through indicators such as their cash flow, certain sectors may be financially more vulnerable due to their requirement for external capital; accordingly, regarding firms' alternative levels of current financial health, the effects of finance on the intensive margin of trade may be mixed (i.e., depending on the sector that the firm belongs to).

In sum, the existing literature on theory suggests that the positive effects of finance on the intensive margin of trade are larger for firms with higher productivities, larger sizes, and higher export volumes, while the effects based on alternative current financial health of firms are uncertain. Since financial depth is further connected the development of countries (e.g., see Rousseau and Yilmazkuday (2009), Yilmazkuday (2011)), the effects discussed so far are even more important for emerging markets. Accordingly, by using firm-level data on exports, productivity, size, and financial health, we consider the theoretical background discussed in this section for our nonlinear investigation, below.

3 Empirical Methodology

We would like to understand how financial health affects the intensive margin of trade (measured by the log of exports) across firms, conditional on the firms participating in the export market. Since we do not know the exact form of the relationship between financial health and intensive margin of trade, there are only few choices in terms of empirical modeling. To provide a complete assessment of this relationship, we consider linear and nonlinear parametric models as well as a nonparametric model that does not impose any restrictive functional form assumptions on the relationship between financial health and exports.

3.1 Linear Model

One approach is to assume that the true model is linear as the existing literature (introduced above) has done. The most popular regression model in the literature is the linear parametric model

$$y_i = \alpha + \beta_1 x_i + \beta_2 Fin_i + u_i \qquad i = 1, \ldots, NT$$

where y_i represents log of exports, x_i is vector of regressors which include size, productivity, foreign ownership, country dummies, industry dummies and time dummies. As a measure of financial health, Fin_i, we employ the ratio of cash flow over total assets. α, β_1 and β_2 are unknown parameters to be estimated and u_i is the disturbance term. This specification serves as a baseline by providing an estimate of the average predicted change in the level of exports regardless of the level of financial health.

3.2 Threshold Model

We are concerned about possible nonlinearities in the relationship between finance and firm-level exports, because it is possible that the true relationship between the dependent variable

and the regressors is nonlinear. Accordingly, the second alternative specification for the functional form of financial health is the (parametric) threshold model that imposes a piecewise linear functional form:

$$y_i = \alpha + \beta_1 x_i + \sum_{j=1}^{2} I(\tau_{j-1} < Fin_i \leq \tau_j)\gamma_j Fin_i + u_i$$

where $I(\cdot)$ is the indicator function, $\{\tau_j\}_{j=0}^{2}$ are the thresholds such that $\tau_0 = -\infty$ and $\tau_2 = +\infty$, and there are two regimes. This specification permits us to empirically investigate a tipping point beyond which the effects of financial health becomes useful (harmful) for the intensive margin of trade. The two-states can be interpreted as a system consisting of low and high financial health regime. In addition to searching a tipping point in financial health, we also investigate a tipping point in size and productivity beyond which financial health has asymmetric effects on the intensive margin of trade.

The threshold model can be estimated by conditional least squares, where the model is estimated by simple least squares conditional on a given threshold value. In particular,

$$\widehat{\tau}_1 = \arg\min_{\tau_1} \sum_i \widehat{u}_i^2,$$

where $\tau_1 \in \mathbb{R}_0$; i.e $\mathbb{R}_0$ is a bounded subset of the real line. Following the usual practice, we perform a grid search on financial health by trimming a certain portion of observations from top and bottom of its distribution (see Hansen (2000)).[8] We first estimate the threshold value, then model parameters are estimated by least squares conditional on the estimated threshold.

Asymptotic distribution of the threshold estimate $\widehat{\tau}_1$ is not nuisance parameter free. Moreover, the threshold parameter is not identified under the null hypothesis of linearity. Therefore, standard testing techniques are not applicable to conduct inference for the threshold parameter. However, if τ_1 is known with certainty, conventional normal approximations can be used for testing the null hypothesis that the coefficients are identical in two regimes (for a detailed discussion see Hansen (2000)). So, after we estimate the threshold parameter, we implement an F-test to test the equality of the regime coefficients.

[8] We trim 10% of observations from top and bottom. We also produce results by trimming 5% and 15% of observations and find that threshold estimate is robust to trimming percentage.

3.3 Nonparametric Regression

In addition to the parametric nonlinear models discussed above, for robustness, we also employ a nonparametric approach that lets the data speak and tell us the form of the relationship. Such a nonparametric approach will also let us distinguish the effects of finance on exports among firms based on their observable characteristics such as size, productivity, and foreign ownership.

We consider the intensive margin of trade taking the unknown form

$$y_i = m(x_i) + u_i, \qquad i = 1, \ldots, NT \tag{1}$$

where y_i represents log of exports, $m(x_i)$ is the unknown smooth function with $x_i = [x_i^c, x_i^u, x_i^o]$, x_i^c is a vector of continuous regressors (financial health, size, productivity), x_i^u is a vector of regressors that indicate unordered discrete values (foreign ownership, country effects, industry effects), x_i^o is a vector of regressors that indicate ordered discrete values (time effects), u_i is the error term, N is the number of cross-sections, T is the number of time periods. The nonparametric model does not assume that the variables enter in linearly or they are separable from one another.[9]

Nonparametric kernel regression uses the idea of local averaging, where the values of the left-hand-side variable are estimated by regressors' values that are neighbor to a target value. As more observations being used in the neighborhood, the fitted curve will be a straight line. Conversely, if only the nearest observations are used, then the fitted curve will be less smooth. The smoothness of the regression function is controlled by optimally selecting a smoothing parameter which is called window-width (bandwidth). The unknown function is estimated by connecting the (locally averaged) point estimates over a range of x. We give a detailed discussion of our nonparametric estimation and bandwidth selection in Appendix.[10]

In this study, two usual sources of endogeneity are of a particular concern: omitted variable bias and reverse causality. Regarding the former, it is undeniable that there could be other sources of omitted variables that may stop us from making definite causal inference

[9] In this paper we implement a fully nonparametric approach, which includes all continuous and discrete regressors within the unknown function. We do not model unobserved heterogeneity (firm specific individual effects) within the function $m(.)$ because it causes some issues regarding the identification of the nonparametric function. Moreover, computing the estimate of $m(.)$ and its derivative is quite involved in this case. For more details see Matzkin (2003). Additionally, each firm in our data set has at most three time series observations. We use the lagged variables as the regressors due to simultaneity and lose one more time series observation for each firm. This results in two time series observations for each firm at the maximum. We believe that we do not lose much information by pooling the data and implementing the kernel regression, since time series dimension of the data set is at most two for each firm.

[10] We use asymptotic normal approximations for inference in all models. Standard errors for the model parameters and the nonparametric function are estimated by taking into account the possible heteroskedastic nature of the residuals.

from our findings. One might consider using an instrumental variable approach. However, finding a valid instrument is crucial but challenging at the same time. Moreover, tackling the endogeneity problem within the nonparametric framework is quite complicated. Few estimators that have been proposed in the literature are generally difficult to implement. Given these concerns, we believe that our approach is beneficial in this context because it relaxes the functional form assumptions while addressing the type of the omitted variable bias that is considered to be particularly important in this literature. For the latter, as indicated in studies such as by Durlauf et al. (2005), Rajan and Subramanian (2008), Bazzi and Clemens (2013), we consider the lagged values of the right hand side variables to address causality through the time dimension, since it is difficult to find a valid instrument and implement it within the nonparametric framework.

4 Data and Descriptive Statistics

The data set includes firm-level information on the value of exports (i.e., the intensive margin of trade), financial health, size, productivity and nationality, together with country, industry and time, obtained from The Enterprise Surveys, which is an ongoing World Bank project.[11] In order to have a healthy comparison with the existing literature, we employ the version of this data set used in Berman and Héricourt (2010), where the value of exports is in U.S. dollars, financial health is measured by the lagged value of cash flow over total assets, size is measured by the lagged value of log assets measured in U.S. dollars, productivity is measured by the lagged ratio of value added (measured in U.S. dollars) over the number of workers, and nationality (i.e., foreign) is measured as a binary variable that takes the value of 1 if the foreign participation in its capital is at least 49%.[12]

The data include 3966 observations of 2380 firms from the time period that lies between 1998 and 2004 across nine emerging countries, although the time period covered changes across countries.[13] In order to control for the factors other than the explanatory variables introduced above, categorical variables (country-industry-time fixed effects) are also used in the estimations. Categorical variables pick up country-specific heterogeneity, industry-

[11] Visit www.enterprisesurveys.org for more details.

[12] Although there is another measure of financial health in the data set used by Berman and Héricourt (2010), namely total assets over total debt, when we filter the data regarding firms with positive exports and the usage of the first lag of financial health, size and productivity as regressors to avoid the simultaneity bias, together with the requirement of having a large sample in nonparametric regressions due to the so-called "curse of dimensionality" in the literature, we only consider cash flow over the total assets as the measure of financial health in the estimation process.

[13] The countries and time-periods are: Bangladesh (2000–2002), China (1998–2000, 2000–2002), India (1999–2001), Indonesia (2000–2002), Morocco (2000–2002), Philippines (2000–2002), South Africa (2000–2002), Thailand (2000–2002), and Vietnam (2002–2004).

specific heterogeneity, and time variation. In a linear regression setting, these variables would be the dummy variables. The benefit of the nonparametric methodology is that it allows our categorical variables not only shift intercepts but also interact with our continuous regressors.

Descriptive statistics are provided in Table 1, where the average value is about $13,629$ ($= \exp(9.52)$) U.S. dollars for exports, 0.39 for cash flow over total assets, $33,860$ ($\exp(10.95)$) U.S. dollars for size, and 5.23 for productivity. In relative terms, cash flow over total assets has the largest coefficient of variation, suggesting that firms are more heterogenous in terms of their financial health compared to their size, productivity, or exports. Exports are highly correlated with the size and productivity of firms; however, financial health is negatively correlated with exports, size and productivity, although the correlation coefficients are very low. These low correlation coefficients are also in line with the regression results in Berman and Héricourt (2010), where the evidence for the effects of financial health (measured by cash flow over total assets) on the log of exports is quite weak (i.e., not stable across alternative estimation strategies). We claim that this weak relationship between exports and financial health may be due to the restricting assumption of linearity when the correlation coefficients are calculated or linear regressions are employed. Accordingly, for comparison purposes, we consider the results based on both linear and nonlinearities in the relationship between exports and financial health in the next section.

5 Estimation Results

For our empirical investigation, we use the data set of Berman and Héricourt (2010) but we do not have the same number of sample observations. This is due to the fact that we use lagged variables as the regressor to account for the reverse causality. Even though we do not expect to exactly obtain the same results in Berman and Héricourt (2010) quantitatively, we still expect to obtain parallel estimates qualitatively. We initially discuss our findings from the parametric models (linear, and threshold), and then from the nonparametric model.

Table 2 displays the coefficient estimates and standard errors for the linear and non-linear parametric models under study. Column (1) and (2) exhibit the coefficient estimates for the linear regression model. From column (1), we observe that the marginal effect of financial health on intensive margin of trade is positive and statistically significant. If cash flow over total assets increases by 0.01, then the predicted increase of exports would be 0.328%. In addition, size and productivity also have positive and significant effect on firm-level exports. These coefficient estimates are qualitatively parallel to the point estimates reported by Berman and Héricourt (2010). Column (2) displays the results for the linear model when foreign-owned companies are controlled for. We find that foreign-ownership has

a positive and significant impact on exports; all other regressors have roughly the same effect on exports as in column (1).

We then model financial health with a piecewise linear function and estimate a threshold regression. Columns (3) and (4) show the estimated coefficients, where the threshold variable is financial health. The threshold value of financial health is estimated to be 0.15. Below the threshold, the partial effect of cash flow over total assets is negative (-1.204) and statistically significant. Once the threshold is breached, the partial effect of financial health on exports changes to 0.406. This is very interesting in the sense that threshold regression is able to pick up the critical level of financial health for the firm-level of exports. We further find that the effects of financial health on the intensive margin of trade in two regimes are statistically different from each other.

It is also possible that the threshold variable could be another variable other than the financial health. Thus, we additionally consider size and productivity as other threshold variables. Columns (5) and (6) show the estimated coefficients, where the threshold variable is size. We estimate the threshold value of size to be 14.40. Below the threshold, the partial effect of size on the intensive margin of trade is 0.271 and significant, above the threshold the partial effect is 2.076. Our results indicate that the effect of financial health becomes higher in magnitude for firms in size larger than 14.40. Even though the partial effects of financial health do not alternate in signs, they are indicating an asymmetric behavior. We test the difference in coefficients between the two regimes and find that they are significantly different.

Columns (7) and (8) display our final findings from the threshold model, where we consider productivity as our threshold variable. The tipping point is estimated to be 8.05. Below the tipping point, the effect of financial health is 0.286 and significant, above the tipping point it is 1.031. Similar to our previous results, the effect of financial health becomes more pronounced in the second regime, which implies that the return to financial health is higher for more productive firms. Even though threshold regression produced results that are useful for modeling, it is still too restrictive because it imposes a piecewise linear structure on the financial health function. Therefore, we move to the discussion of our empirical findings from the nonparametric regression next.

Nonparametric regression allows us to estimate the partial effects and the corresponding standard errors for each observation in our sample. A partial effect estimate of a variable is equivalent to a slope coefficient estimated at a single data point. Accordingly, our estimation strategy produces 3966 coefficient estimates (partial effects) and standard errors, where 3966 is the sample size. Table 3 provides the mean and the quartiles of these estimated coefficients for each continuous variable, along with the estimates of bandwidth, where we have considered

two cases (i.e., Case #1 and Case #2), namely the nonparametric regressions without and with the dummy for nationality (i.e., foreign), respectively.

As is evident, financial health enters the regressions positively and significantly for the median coefficient; in terms of the magnitude, when cash flow over total assets increases by 0.01, on average, it corresponds to about 0.63% of an increase in exports. Similarly, size enters the regressions positively and significantly for the quartiles depicted. Productivity enters the regressions insignificantly for most of the observations. The inclusion of the foreign dummy does not seem to change the results significantly, and the explanatory power of the regressions are pretty high. The main point of the results in Table 3 is that there is empirical evidence for nonlinearity in the partial effect, which cannot be modeled with linear regression models.

In this paper, we are particularly interested in the coefficient (i.e., partial effects) of finance on exports. One evidence in Table 3 is that the partial effects of finance on exports change significantly across firm-level observations. The next obvious step is to investigate whether there is any systematic explanation for the magnitude of these coefficients. Based on our motivation and theoretical background discussed above, we would like to know whether the effects of finance change with respect to firm characteristics such as size and productivity. Similarly, as in Manova et al. (2015), we would like to investigate the connection between foreign ownership and the effects of finance on exports.

The corresponding results are given Table 4, where the effects of finance on exports depend on firm characteristics. As is evident, finance has a bigger (and significant) effect on exports for firms that have higher values of export, productivity, size or finance; the effects are also higher for domestic firms. Therefore, the role of finance on the intensive margin of trade is not only positive and significant but also depends on firm characteristics such as size or productivity as suggested by the theoretical literature.

Although the results in Table 4 provide evidence for a nonlinear relationship between finance and exports, they do not say anything regarding specific thresholds. Specifically, is there any specific threshold for variables such as size or productivity above which finance becomes a significant factor in explaining firm-level exports? In order to answer this question, we consider thresholds in the variables included in the regression analysis. In particular, for each threshold variable, (i) we rank the data and the estimated coefficients (partial effects) with respect to that variable, (ii) we consider moving windows with a length of 100, and (iii) we calculate the corresponding median values within each window.[14]

[14]We also consider various moving windows lengths and find that results are not sensitive to the choice of the moving window length.

The results are given in Figure 1 and Figure 2 for Case #1 and Case #2, respectively. We find that the effects of financial health on firm-level exports are positive and significant for higher levels of exports, higher values of size, higher values of productivity, and moderate levels of financial health. In terms of the actual thresholds, the effects of financial health on firm-level exports mostly become positive and significant for median export values higher than about $80,000$ ($\approx \exp(11.3)$) U.S. dollars (corresponding to about 33% of the observations in our sample), for median sizes (measured by assets) higher than about $180,000$ ($= \exp(12.1)$) U.S. dollars (corresponding to about 50% of the observations in our sample), for median productivities higher than 7.12 U.S. dollars of value added per worker (corresponding to about 46% of the observations in our sample), and for median cash flow over total asset measures between 0.04 and 1.02 (corresponding to about 68% of the observations in our sample). Hence, there are significant nonlinearities in the relationship between exports and financial health when nonparametric regressions are considered; financial health leads to higher levels of exports for highly-exporting, large and productive firms, after controlling for all else.

Different countries in our sample also have different observation percentiles for which the effects of finance on trade is positive and significant at the 1% level when the dummy for nationality included (i.e., Case#2 is considered); the corresponding results are given in Table 5. As is evident, the positive effects of finance on trade is mostly driven by countries such as by Thailand, Morocco, Bangladesh and South Africa, while effects in other countries are either weak (for Indonesia and Vietnam) or none (for China and India). It is implied that while certain countries have firm-level characteristics above the threshold values found above, the firm-level characteristics are below such values in other countries. In any case, having such a heterogeneity across countries further supports the usage of our nonparametric methodology through considering nonlinearities in the effects of finance on trade.

The overall results are in line with our theoretical discussion/motivation, above. In particular, firms with higher productivity levels, which also correspond to firms with higher volumes of exports and larger sizes, may be benefiting more from finance due to (i) their higher and more secure returns to their lenders, (ii) their wider range of products, and (iii) higher investments in productivity and quality. Nevertheless, since the effects of finance may also depend on the financial vulnerability of the sector that the firm belongs to, such effects may change according to the firms' current financial health based on the sector. Therefore, our empirical results based on nonparametric kernel regression methods confirm the expectations implied by the recent theoretical literature.

6 Conclusion

The existing empirical literature has focused on the role of financial health mostly on the extensive rather than on the intensive margin of trade, where the latter is shown to be positive and significant in this paper. We show that this positive relationship between financial health and the intensive margin of trade is also robust to the consideration of possible non-linearities. In particular, the corresponding results suggest that the effects of financial health on the intensive margin of trade depend on the financial vulnerability of firms measured by their size, productivity and ownership. The effects of financial health on firm-level exports mostly become positive and significant for median export values corresponding to about the upper 33 percentile of the observations in our sample, for median sizes (measured by assets) corresponding to about the upper 50 percentile of the observations, and for median productivities corresponding to about the upper 46 percentile of the observations in our sample. Since the data are from nine emerging markets, the results also provide clues for policy makers regarding which firms are more beneficial to subsidize in order to achieve higher export volumes that would support an export-oriented growth strategy.

Appendix

Generalized Kernel Estimation

In this section, we discuss Li-Racine Generalized Kernel estimation which is used to estimate partial effects in our model. We employ local-linear least squares, which performs weighted least squares regression around a point x with weights determined by kernel function and bandwidth vector. Recall that $x_i = [x_i^c, x_i^u, x_i^o]$, x_i^c is a vector of continuous regressors, x_i^u is a vector of regressors that indicate unordered discrete values, x_i^o is a vector of regressors that indicate ordered discrete values, u_i is the error term

Taking a first order Taylor series expansion of (1) around x yields

$$y_i \approx m(x) + (x_i^c - x_j^c)\beta(x_j) + u_i$$

where $\beta(x_j)$ is the partial derivative of $m(x_j)$ with respect to x^c. The local-linear least squares estimator $\delta(x) \equiv \begin{pmatrix} m(x_j) \\ \beta(x_j) \end{pmatrix}$ is given by

$$\widehat{\delta}(x_j) = (X'K(x)X)^{-1}X'K(x)y$$

where $K_{\widehat{h}}(x) = \prod_{s=1}^{q} \widehat{h}_s^{-1} w(\frac{x_{si}^c - x_{sj}^c}{\widehat{h}_s}) \prod_{s=1}^{r} l^u(x_{si}^u, x_{sj}^u, \widehat{\lambda^u}_s) \prod_{s=1}^{p} l^o(x_{si}^o, x_{sj}^o, \widehat{\lambda^o}_s)$. K_h is the product kernel, where w is the Gaussian kernel function with bandwidth h_s associated with the s^{th} component of x^c. l^u is a variation of Aitchison and Aitken (1976)'s kernel function which equals one if $x_{si}^u = x_{sj}^u$ and λ_s^u otherwise, and l^o is the Wang and Van Ryzin (1981) kernel function which equals one if $x_{si}^o = x_{sj}^o$ and $(\lambda_s^o)^{|x_{si}^o - x_{sj}^o|}$ otherwise. For further details see Li and Racine (2007).

Bandwidth selection

Choice of the bandwidths $(h, \lambda^u, \lambda^o)$ is an important issue in nonparametric analysis, reflecting a bias-variance trade-off. Choosing a very small (large) bandwidth may generate an under-smoothed (over-smoothed) estimator. This is a well-known trade-off in applied nonparametric econometrics, and automated determination procedures are generally utilized to estimate the bandwidths. There are many procedures for selecting the optimal smoothing parameter in practice. We implement Hurvich et al. (1998)'s Expected Kullback Leibler (AIC_c) criteria. This procedure selects the bandwidth using an improved version of a criterion based on the Akaike Information Criteria. It has been shown that AIC_c is a robust procedure and avoids the tendency to undersmooth as frequently happens under other approaches such as Least-Squares Cross-Validation. The bandwidths are picked to minimize

$$AIC_c = \log(\widehat{\sigma}^2) + \frac{1 + tr(H)/NT}{1 - [tr(H) + 2]/NT}$$

where $tr(H)$ is the trace of H, H is $NT \times NT$ matrix of kernel weights, and

$$\widehat{\sigma}^2 = \frac{1}{NT} \sum_{j=1}^{NT} (y_j - \widehat{m}_{-j}(x_j))^2$$

where $\widehat{m}_{-j}(x_j)$ the leave-one-out estimator of $m(x)$.

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Table 1 - Descriptive Statistics

	Log of Exports	Cash Flow over Total Assets	Size	Productivity
Mean	9.52	0.39	10.43	5.23
Minimum	0.00	-1.48	0.45	0.00
First Quartile	6.43	0.08	7.34	2.45
Second Quartile	8.44	0.26	9.41	3.74
Third Quartile	13.06	0.57	14.02	9.07
Maximum	20.83	6.12	19.87	13.50
Standard Deviation	4.06	0.60	3.86	3.41
Coefficient of Variation	0.43	1.54	0.37	0.65
Correlations				
Log of Exports	1.00			
Cash Flow over Total Assets	-0.07	1.00		
Size	0.90	-0.12	1.00	
Productivity	0.87	-0.03	0.90	1.00

Notes: The sample size is 3966, while the number of firms is 2380.

Table 2 - Summary of Parametric Estimation Results

	Dependent Variable: Log(Exports)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(Cash Flow/Total Assets)$_{t-1}$	0.328***	0.323***						
	(0.052)	(0.051)						
(Cash Flow/Total Assets)$_{t-1}$<0.15			-1.204***	-1.077***				
			(0.180)	(0.174)				
(Cash Flow/Total Assets)$_{t-1}$>=0.15			0.406***	0.395***				
			(0.054)	(0.052)				
(Cash Flow/Total Assets)$_{t-1}$ I(Size<14.40)					0.271***	0.270***		
					(0.053)	(0.051)		
(Cash Flow/Total Assets)$_{t-1}$ I(Size>=14.40)					2.076***	1.941***		
					(0.179)	(0.173)		
(Cash Flow/Total Assets)$_{t-1}$ I(Productivity<8.05)							0.286***	0.279***
							(0.054)	(0.052)
(Cash Flow/Total Assets)$_{t-1}$ I(Productivity>=8.05)							1.031***	1.054***
							(0.250)	(0.263)
Size$_{t-1}$	0.724***	0.710***	0.744***	0.729***	0.689***	0.678***	0.729***	0.715***
	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)	(0.018)	(0.018)	(0.018)
Productivity$_{t-1}$	0.323***	0.298***	0.307***	0.284***	0.313***	0.290***	0.307***	0.281***
	(0.031)	(0.030)	(0.030)	(0.030)	(0.030)	(0.029)	(0.031)	(0.030)
Foreign dummy		0.819***		0.800***		0.795***		0.823***
		(0.061)		(0.060)		(0.060)		(0.060)
F-stat			72.63	65.23	101.32	91.6	8.65	8.480
Prob(F)			0.000	0.000	0.000	0.000	0.003	0.004
R^2	0.87	0.87	0.87	0.87	0.87	0.88	0.87	0.87

Notes: *, ** and *** represent significance at the 10%, 5% and 1% levels. This table represents the point estimates and the standard errors for the parametric models considered in the paper. Standard errors are in parenthesis below each estimate. In models (1) and (2) financial health (Cash Flow/Total Assets) enters the regression in linear form, for models (3), (4), (5) and (6) in a piece-wise linear form. F-stat indicates the test statistic for the null hypothesis that two regimes are identical in the threshold model. Prob(F) is the corresponding probability value. All regressions include country-industry-time fixed effects. Foreign stands for the dummy capturing foreign-owned companies. The sample size is 3966, while the number of firms is 2380.

Table 3 – Summary of Nonparametric Estimation Results

	Dependent Variable: Log(Exports)			
	Partial Effects		Bandwidth	
	Case #1	Case #2	Case #1	Case #2
(Cash Flow/Total Assets) $_{t-1}$			1.33	0.91
Mean	0.629**	0.646*		
	(0.285)	(0.381)		
First Quartile	0.110	0.087		
	(0.150)	(0.482)		
Second Quartile	0.684***	0.737**		
	(0.040)	(0.349)		
Third Quartile	1.172***	1.229*		
	(0.121)	(0.525)		
(Size) $_{t-1}$			0.93	1.52
Mean	0.783***	0.785***		
	(0.181)	(0.196)		
First Quartile	0.559***	0.585***		
	(0.135)	(0.103)		
Second Quartile	0.830***	0.848***		
	(0.185)	(0.098)		
Third Quartile	0.993***	0.982***		
	(0.136)	(0.108)		
(Productivity) $_{t-1}$			1.11	0.63
Mean	0.225**	0.188		
	(0.114)	(0.245)		
First Quartile	-0.126	-0.161		
	(0.373)	(0.278)		
Second Quartile	0.250	0.197		
	(0.237)	(0.458)		
Third Quartile	0.542***	0.522**		
	(0.159)	(0.245)		
Foreign Dummy	No	Yes		0.06
R-Squared	0.92	0.94		

Notes: *, ** and *** represent significance at the 10%, 5% and 1% levels. Partial effects are presented as the estimated derivatives from the local-linear regression using the bandwidths that are computed using the Expected Kullback Leibler (AICc) criteria. This table represents the mean, median, first and third quartile of the vector of partial effects for the particular continuous regressor. The standard error for each estimated coefficient is given in parenthesis. All regressions include country-industry-time fixed effects. Foreign stands for the dummy capturing foreign-owned companies. The sample size is 3966, while the number of firms is 2380.

Table 4 – Partial Effects of Cash Flow over Total Assets on the Intensive Margin of Trade

	Dependent Variable: Log(Exports)	
	Partial Effects of Cash Flow over Total Assets	
	Case #1	**Case #2**
Log(Exports)		
Low (Below Median)	0.480***	0.528
	(0.057)	(0.335)
High (Above Median)	1.052***	1.014***
	(0.145)	(0.140)
Size $_{t-1}$		
Low (Below Median)	0.537***	0.545
	(0.124)	(0.361)
High (Above Median)	1.042***	0.998***
	(0.132)	(0.262)
Productivity $_{t-1}$		
Low (Below Median)	0.480**	0.551*
	(0.178)	(0.314)
High (Above Median)	1.048***	0.999***
	(0.095)	(0.130)
(Cash Flow/Total Assets) $_{t-1}$		
Low (Below Median)	0.573**	0.561**
	(0.289)	(0.243)
High (Above Median)	0.787***	0.867***
	(0.129)	(0.188)
Ownership		
Foreign	0.429***	0.258
	(0.052)	(0.586)
Domestic	0.743***	0.857***
	(0.100)	(0.176)

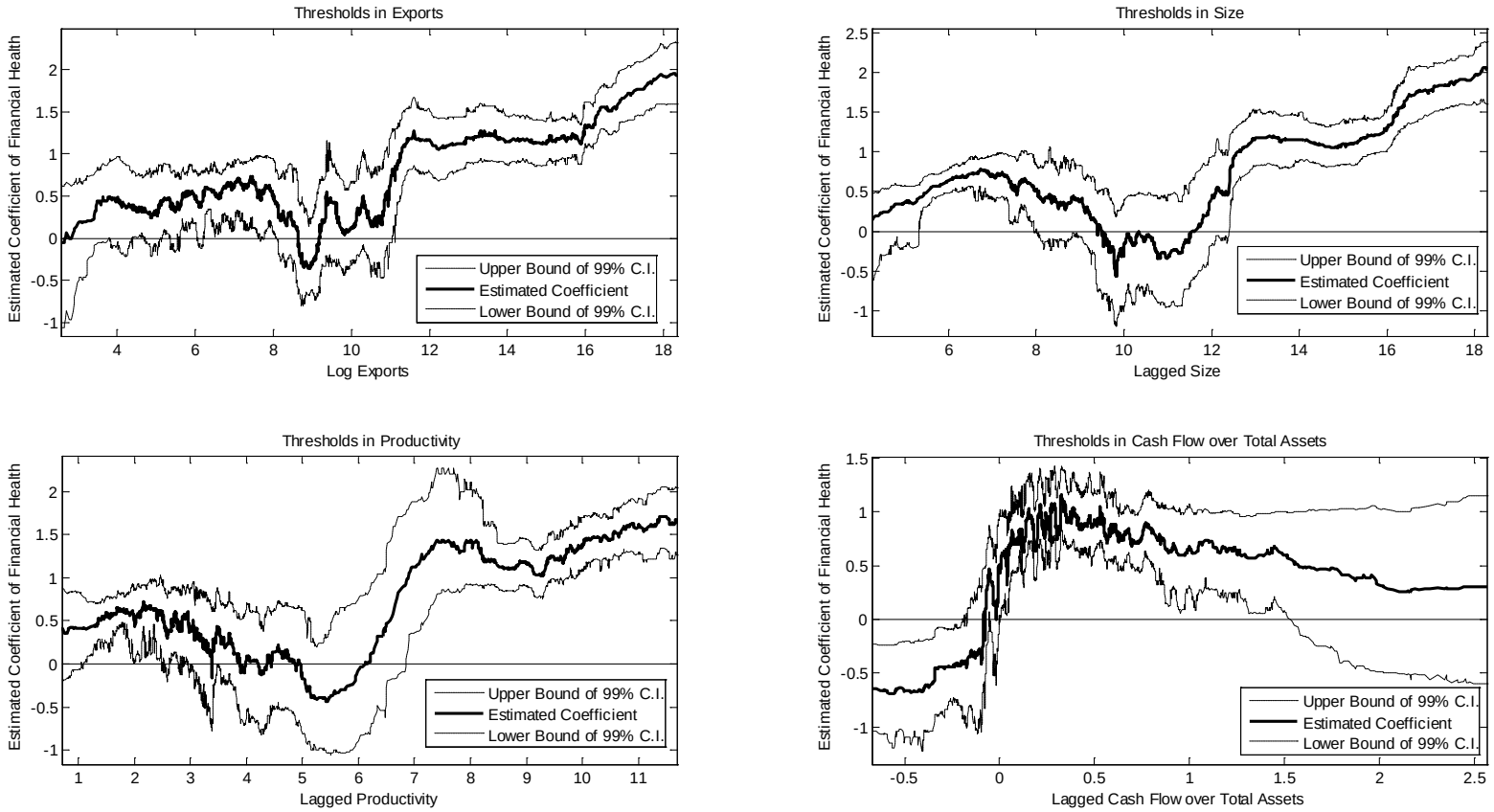
Notes: *, ** and *** represent significance at the 10%, 5% and 1% levels. The numbers in this table represent the median estimates for below or above the median of the corresponding variables. Partial effects are presented as the estimated derivatives from the local-linear regression using the bandwidths that are computed using the Expected Kullback Leibler (AICc) criteria. The standard errors are given in parenthesis. All regressions include country-industry-time fixed effects. Foreign stands for the dummy capturing foreign-owned companies. The sample size is 3966, while the number of firms is 2380.

Table 5 – Country-Specific Results

Country (Sample Period)	Sample Size	Percentile of Observations with Positive Effects of Finance on Trade for the Threshold Variable of:			
		Exports	Size	Productivity	Financial Health
Bangladesh (2000-2002)	24	58.33	4.17	0.00	83.33
China (1998-2000, 2000-2002)	803	0.00	0.00	0.00	0.00
Indonesia (2000-2002)	199	2.51	2.01	1.51	0.00
India (1999-2001)	27	0.00	0.00	0.00	0.00
Morocco (2000-2002)	800	89.00	80.25	76.50	99.50
Philippines (2000-2002)	349	0.00	0.00	0.00	0.00
Thailand (2000-2002)	1338	100.00	100.00	99.55	100.00
Vietnam (2002-2004)	135	2.96	11.85	8.89	4.44
South Africa (2000-2002)	291	20.27	20.27	2.41	1.72
Pooled Sample	3966	33.34	50.23	46.02	68.21

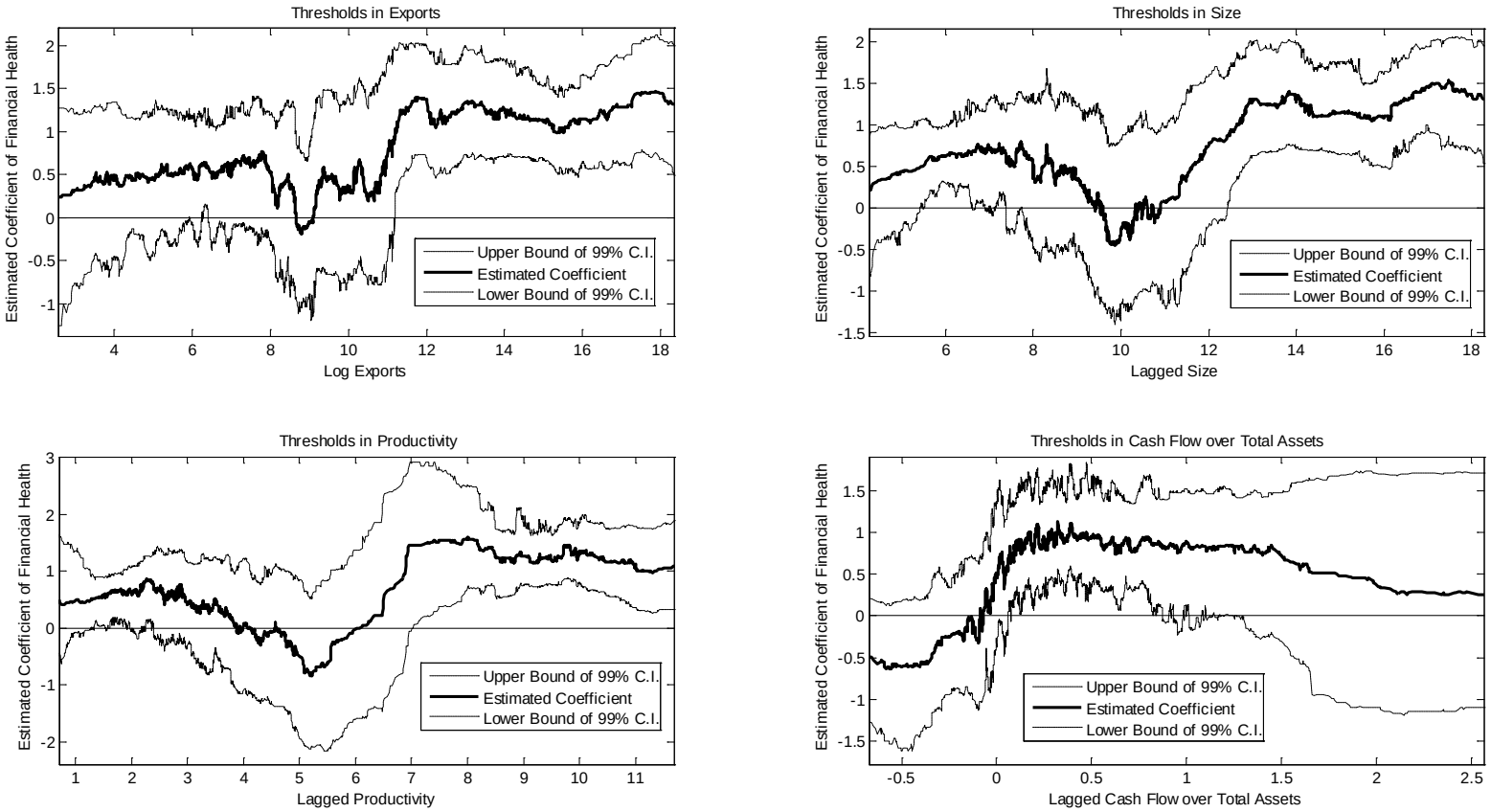
Notes: For each country, the percentile of observations with positive effects of finance on trade represent the observations for which the effects of finance on trade is positive and significant at the 1% level, when the dummy for nationality is included.

Figure 1 – Nonlinear Effects of Cash Flow over Total Assets on the Intensive Margin of Trade - Case #1



Notes: The solid lines show the coefficient estimates of financial health, while the dashed lines represent the 99% confidence interval. Median values are shown that have been calculated using a window size of 100.

Figure 2 – Nonlinear Effects of Cash Flow over Total Assets on the Intensive Margin of Trade - Case #2



Notes: The solid lines show the coefficient estimates of financial health, while the dashed lines represent the 99% confidence interval. Median values are shown that have been calculated using a window size of 100.