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Financial Development and Sustainable Exports: Evidence from Firm-Product Data

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Abstract

We combine a novel measure of export-related financial needs at the product level with a unique database of firm-product export data (including names of the exporting firms) from five developing countries. Using the tools of survival analysis and taking into account firms' and products' heterogeneity, we then examine the impact of financial development on the long-term trade. Finance matters for sustainable export performance, as goods with higher export-related financial needs disproportionately benefit from better financial development. Our results complement existing literature on finance and trade, which has relied on production-based measures of financial dependence at the industry or firm level.

JEL-Code: F100, G100, O160.

Keywords: finance and trade, export survival, agri-food trade, SPS regulation.

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1. INTRODUCTION

Does domestic financial development promote export performance? A booming literature at the intersection of finance and trade attempts to address this question (Beck, 2003; Svaleryd and Vlachos 2005; Chaney, 2005; Manova, 2008; Bugamelli et al. 2008; Görg and Spaliara 2009; Berman and Hericourt forth). The main empirical challenge in this emerging field is the identification of exports that are most likely to benefit from a strong domestic financial system. So far, the existing scholarly work mainly adopted two sets of production-based measures of financial needs from the finance-growth literature. The first set of measures focuses on industries that are reliant on external finance, following the idea pioneered in the seminal paper by Rajan and Zingales (1998). The second set of empirical proxies attempts to identify the financial constraints at the level of exporting firms.

Our paper departs from this literature and uses a novel *export-based* measure of *financial needs at the product level.* We use the fact that an important part of financial costs related to agricultural exports originates in the compliance with the Sanitary and Phytosanitary Standards (SPS). Following Jaud et al. (2009a), we identify variations in the SPS compliance costs at the product level and use them to construct a proxy for export-related financing needs.

We then combine this measure with product-firm export data collected by custom authorities in five developing countries. The firm-product character of this unique database allows us to control simultaneously for firm and product fixed effects, as well as for time-varying export-related variables on the product level. Moreover, the data contain names rather than just anonymized identification numbers of the exporting firms. This allows us to conduct a thorough cleaning of the data and also look more deeply into the effect of firm heterogeneity (e.g., examining to which extent are our results driven by the presence of multinational corporations and trading companies among exporters). Using the tools of survival analysis, we show that financial development disproportionately promotes export survival of goods with high costs of SPS compliance. The result is robust and supports the notion that finance plays an important role in the long-term export success, even when one simultaneously controls for both firm and product heterogeneity.

Our empirical strategy complements the existing work on finance and trade in two important aspects. First, relying on production-based measures of financial needs from the finance-growth literature implicitly assumes that exporting is mostly an extension of domestic production activities. By contrast, our measure is directly linked to financing costs of the exporting activities. The SPS standards are enforced by the official authorities of the importing countries. The SPS compliance expenses therefore occur only for the exporters. As an internal survey by World Bank International Trade Department shows, this compliance is an important component of export-related costs. When asked about exporting costs as potential constraints to sales expansion abroad, 25 per cent among the surveyed agricultural exporters cite the costs related to complying with the SPS. This is the most frequent answer in this group of firms. In addition to the qualitative survey evidence, UNCTAD (2005) documents also quantitatively the importance of SPS compliance costs for tropical fruits.[5] Maskus et al. (2005) does the same for a broader set of compliance costs and products including both agricultural and non-agricultural goods.

Second, the standard production-based proxies for dependence on external finance or financial constraints are measured either at the industry or firm level. Instead, we measure financial needs at the product level. As agriculture products are homogenous goods, we can be reasonably confident about using a product-level measure in examining the importance of financial factors in exporting activities. Indeed, one of the reasons why existing literature has relied on measures of financial vulnerability at industry or firm level might be the prevailing focus on trade in manufactured goods. Due to their intrinsically differentiated character, it is not easy to come up with a technological measure of financing needs in manufacturing at the product level.

The paper also contributes to two other strands of literature on international trade – trade survival and trade in agri-food products. Firstly, we focus on the long-term export survival that is crucial for the sustainable success in the international trade (Besedes and Prusa, 2006a; 2006b). There are only a few papers that look how financial factors affect long-term survival of trade flows. Jaud et al. (2009b) and Besedes et al. (2011) use the traditional measures of financial needs and show that finance promotes export survival. Jaud et al. (2012) show that finance disproportionately benefits the export survival of products that correspond to the comparative advantage of the exporting countries. Secondly, we examine agricultural exports from developing countries. This is an important and rather under-researched topic in the trade literature. Agri-food exports have recently emerged as an important source of export growth for many low-income countries. One example are the agri-food imports of the European Union, where the share

[5] The costs of compliance with SPS for tropical fruits in three sub-Saharan African countries – United Republic of Tanzania, Mozambique and Guinea – are estimated using the GlobalGAP protocol as a case study. Appendix $A.2$ reports results for Tanzania.

of developing countries increased from 66% in 1988 to 70% in 2001, reaching 75% in 2005 (EUROSTAT data cited by Jaud et al., 2009a).

The remainder of the paper is organized as follows. The next section explains our empirical strategy. Section 3 introduces the data and some summary statistics. Section 4 reports the main empirical results, and Section 5 reports several robustness checks. Section 6 concludes.

2. EMPIRICAL STRATEGY

Our hypothesis is that the impact of financial development on export survival varies across products according to their sensitivity to SPS regulations. A measure of sanitary risk at the product level (Jaud et al., 2009a) serves as a proxy for financing needs of agri-food products. It is an export-based rather than a production-based measure. The measure is computed on the product level, using rejections of exports at the EU borders. For the agricultural exports in our sample, the EU is the main destination among highly developed markets (see Appendix A.1). Moreover, the estimation results in Subsection 4c confirm that our proxy captures the need for financing associated with exporting to the stringent markets of developed countries in general, not just to the EU alone.

a. The Sanitary Risk Index

This section details the construction of the Sanitary Risk Index and motivates its use as a measure of financing needs at the product level. The risk index is computed using data from the EU Rapid Alert System for Food and Feed (RASFF). The RASFF database reports all agri-food shipments to the EU between 2001 and 2008 that have suffered rejection due to food safety reasons. The database provides rejections by product, exporting country, importing country (EU member state), and year. The index is the coefficient on the product dummy (δ_k) in the following regression:

$$Alert_{ck} = f(\beta ImpShare_{ck}^{EU} + \gamma Controls_k + \ \delta_c + \delta_k + \varepsilon_{ck}), \qquad (1)$$

where ε_{ck} is an error term. For a product k exported from country c, the dependent variable is the combined count of notifications from all EU member states between 2001 and 2008.[6] The unit of observation is exporting country × product pair and the regression is cross-sectional. To avoid picking up on any particularities generated by exporting countries' exports volume, protectionist agenda or limited competition, a set of control variables are included: share of exporting country c in EU imports of product k in the year 2000 (one year before the sample start) ($Imp\_share_{ck}^{EU}$), the ad-valorem equivalent of the MFN (most favoured nation) tariff imposed by the EU on product k, ($tariff_k$),[7] a dummy variable indicating whether product k is affected by a quota during the sample period ($quota_k$), and a dummy variable indicating whether product k has been the object of a dispute at the WTO between the EU and any other country ($dispute_k$). Including a dummy variable indicating whether exporting country c is affected by a ban on product k during the sample period (ban_{ck}) controls for decreases in the incidence of notifications resulting from reduced imports rather than reduced risk. The initial value of EU imports of product k in the year 2000 ($totimport_k^{2000}$) is also included, as products imported in large volumes are likely to be inspected – and thus likely to fail inspections – more often than others. Finally, the inclusion of exporting country fixed effect (δ_c) controls for all supplier's characteristics that may affect the quality of the product, including the overall economic development.[8] Because the number of notifications is a count, estimation is by Negative Binomial or by Poisson.[9]

In this set up, the product dummy captures the share of alerts due to product characteristics, after controlling for exporters' characteristics and other variables that may affect the probability of being rejected. A high risk index reflects a high sensitivity to food safety regulations. Since rejection occurs when a product does not comply with food safety requirements as set in the regulation, the index can be interpreted as the gap between stan-

[6] Indeed, there are consistent differences in the number of notifications among notifying EU states. In an average year, Germany with 20% of notifications is among the top notifying countries, while Ireland only accounts for 0.21% of notifications. Aggregating the number of notifications, across all importing (notifying) countries and all years, smooths temporal fluctuations and reduces the effects of outliers.

[7] We take tariffs data for the year 2005.

[8] The limited time span of our data on alerts does not allow us to include country-sector fixed effects.

[9] Most of the presented estimations use Negative Binomial with Poisson serving as a robustness check in one specification. The Poisson and Negative Binomial should give similar results, as the consistency of second-stage estimates does not depend on the correct specification of the first-stage equation. In addition, we have over-dispersion and little excess of zeros in the sample. The Negative Binomial is to a reasonable extent adequate in tackling both problems. However, estimation using Zero-inflated Negative Binomial could be a good alternative.

dard and actual product quality. "Risky" products are products far away from the standard. The gap deepens if the regulation is changing and/or if current production technologies do not allow to reach adequate quality. As a consequence, being far away from the standard leaves firms with two options: conform or exit the market. As argued before, compliance is a costly process. For complying firms, the risk index thus captures the need for capital to conform with EU markets food safety requirements and acts as a proxy for financing needs related to the exporting of a product. In the remainder of the paper, we refer to our measure of financing needs as the risk index. Here, risk should be understood as the risk of suffering alerts.

We now briefly discuss some important features of the index. First, to our knowledge, there is no available measure of financing needs at the product level.[10] The number of alerts *per se,* as a measure of financing needs, would be a very noisy proxy for capturing both product and country characteristics. In a similar manner, the occurrence of notifications at the product level – count of existing SPS regulations – is poorly informative. It is an *ex-ante* measure that does not reflect how the regulations are being managed in practice. By contrast, we consider the effective product risk based on real food alerts at the EU border. The risk index measures how food safety regulations translate into inspections and rejections of non-compliant shipments and thus how costly it may be to comply. In addition, no data are available on the costs of compliance at the product level, which would be the best proxy for capital needs. The correlations between our risk index and those alternative measures are reported in Appendix A.3. All coefficients are below 0.35. The correlation between the number of public SPS notifications and the measure of sanitary risk is low.[11]

Second, it is worth noting that our measure of risk, and therefore the need for financing, is time invariant. Most probably this will not be absolutely true in practice. However, we verify that the ranking of agri-food sectors based on rejection occurrences is persistent over time.[12]

Finally, we ask the question whether the risk index computed using the EU market food safety requirements as a benchmark is relevant. The focus of the analysis is on public standards since the food alert database only

[10] In Bricogne et al. (2010), the authors compute an external finance dependence measure – akin to Rajan and Zingales (1998) – at the HS2-digit industry level.

[11] However, this may be explained by the fact that the number of notifications is taken from Disdier et al. (2008) and is computed at the HS6 level, while our measure of risk is computed at the HS8 level. In addition, a lot of products have at least one notification, while few products have a positive sanitary risk index (SRI).

[12] The number of alerts at the product level is correlated at 75% across all years between 2001 and 2008.

reports shipments non-compliant with the EU food safety regulation, and due to data limitations it was not possible to account for private standards in the empirical analysis. Private protocols play an increasingly important role in the governance of food supply chains. Public standards are becoming more performance-based and process-based. They are developed to correct market failures and thus tend to play a dominant role in preventing fraud and ensuring minimum standards for largely homogenous agricultural products. In many cases, private standards build on the existing public standard infrastructure to provide an element of competition through quality differentiation, as well as to facilitate effective coordination in supply chains. Thus, a large share of the cost of compliance arises because of public regulations. Our risk measure, while not accounting for private standards, still captures the need for financing to maintain access to developed countries' market. In addition, the EU regulation is in line with requirements set out by international standards as well as other domestic regulations of the (mostly) high income countries. Besides, the EU is a major destination market for our African countries' export. It makes thus sense to focus on the requirements in this destination market.[13]

Appendix *A*.4 provides a list of the CN2 agri-food sector associated with the highest sanitary risk indices, both according to the number of "risky" products (i.e., products with a positive Sanitary Risk Index) and the average sanitary risk. The table also gives the total number of alerts for each sector between 2001 and 2005 and the most frequent reason for rejection. Fishery products and spices emerge as the most "risky" sectors, and thus, the sectors with the highest SPS compliance expenses that are necessary to sustain their exports. All together, 373 CN8 codes out of 2146 have a non zero risk index. In most cases, rejections are due to contamination level above the authorized threshold in inspected products.

b. Trade Duration as a Function of the Sanitary Risk Index

Much of the previous work on finance and trade has focused on the entry into exporting and neglected the export survival. Papers addressing the issue of sustaining in foreign markets usually look into the short-term year-to-year changes in export status of products or firms (Manova, 2008; Berman and

[13]Since four of the five African countries used in our analysis are also present in the food alert database, this may introduce an endogeneity bias. Ghana, Mali, Malawi and Senegal account for 2.6 percent of the food alerts, when an average exporter suffers around 90 alerts and an average African exporter gets rejected 12 times on average. We re-estimated the risk index dropping those four countries from the food alert database. The level of correlation between the actual and newly computed risk index is 0.9.

Héricourt, 2010). Our focus is instead on the long run survival of products in foreign markets. As we argued elsewhere (Jaud et al., 2009b), survival analysis is probably the most suitable tool to study the impact of financial development on the longer-term export performance.[14]

While our data are initially four-dimensional panel data (we observe export by firm-destination country-product over time), we reduce the panel dimensions to three, to study the length of trade relationships. This highly detailed level of information is particularly suitable for survival analysis as aggregation may introduce considerable bias, essentially hiding failures. A trade relationship is defined as a firm-product-destination triplet, and the duration of a trade relationship is defined as the time (in years) a triplet has been in existence without interruption. Our variable of interest is the survival-time of firm's export relationships – the time until a trade relationship ends – across products in five African countries. Then, firms in our sample are already surviving firms. They already incurred sunk entry costs. As a result, our focus is on the determinants of their ability to continuously remain on the market rather than to enter it.

Ordinary Least Squares (OLS) are not suitable for duration data, essentially because survival-times are restricted to be positive, and thus, have a skewed distribution. Therefore, we model the survival of trade relationships using a Cox Proportional Hazard Model (Cox PH model, CPHM). We assume that the duration of exports of product k from firm i operating in country c to destination country j depends upon a set of variables X_{cikj}. Specifically, we model the hazard function of a trade relationship as a multiplicative function between an unspecified time-dependent baseline hazard function and an exponential function of explanatory variables. These variables include an interaction term between our measure of risk with the level of financial development, a set of controls, country and sector fixed effects, and unobserved effects (error term).

In the Cox PH model, the inclusion of fixed effects results in a shift of the baseline hazard function. We further allow for the shape of the baseline hazard function $h(t)$ to vary across products (at the level of HS8-digit disaggregation), by fitting a stratified Cox PH model. Stratification according to the product indicator variable η_k, in a sample with 698 agri-food products, adds more flexibility to the model and allows to estimate the effect of the X_{cikj} on the hazard rate within-product. In other words, the specification allows for a different underlying hazard rate for each of the 698 products. Appendix $A.9$ provides further methodological details about the Cox PH

[14] Besedes et al. (2011) and Jaud et al. (2012) also look at the long-term impact of finance on international trade.

model.

Thus, we estimate the following empirical model:

$$h(t|X_{cikj}, \eta_k = k) = h_k(t)\exp[\alpha FD_c \times sanitary\_risk_k + \gamma\beta Controls_{ckt_0} + \delta_i + \delta_j + \Delta + \delta_{t_0} + \varepsilon_{cikjt_0}], \quad (2)$$

where FD_c is the level of financial development in the exporting country c, $sanitary\_risk_k$ is the risk index of product k, δ_i is a firm fixed effect, δ_j is a destination country fixed effect, Δ is an exporting country $\times$ HS2 sector fixed effect[15], and ε_{cikj} is an unobserved effect. The time fixed effects (δ_{t_0}) control for the possibility that the initial conditions in the first year of exports (t_0) influence the products' chances for subsequent survival. The stratification at the product level ($\eta_k = k$) and the described set of fixed effects ($\delta_i, \delta_j, \Delta, \delta_{t_0}$) relate to our main specification, as reported in column (3) in Table 1. In other estimations, we also experiment with different sets of fixed effects and stratification levels.

To capture how financial development shapes export success across products, we interact the financial development at the country level with the financing needs at the product level ($FD_c \times sanitary\_risk_k$), while at the same time controlling for stratification at the product level ($\eta_k = k$) and for the exporting country $\times$ industry fixed effects (Δ). This allows us to isolate the impact of financial development on product survival after controlling for omitted variable bias at the country and product level. The level of financial development is taken at the initiation of the sample period for each exporting country, i.e. in the earliest year for which we have export data from given country. We have also used the average level of financial development over the sample period for each country and financial development measured at the beginning of each spell. Results remain qualitatively the same. All other explanatory variables take value at the initiation of the trade relationship t_0. Our vector of $Controls$ includes various product and firm characteristics as well as traditional bilateral gravity variables.

Product-related variables include the value of export in US dollars in the initial year of the trade relationship in logs ($initial\_export_{cikj}$). This reflects the level of confidence that importers have in the profitability of their trading partner (Rauch and Watson, 2003; Albornoz et al., 2010). Additionally, we include the total number of destination markets served by firm i from exporting country c with product k in the initial year of the trade relationship

[15] These interacted fixed effects control for the possibility that specific exporting countries might possess comparative advantage in specific industries.

in log terms ($NDestinations_{cik}$). This allows us to control for the experience the firm has in supplying the world market with product k. We control for the degree of export diversification of a given firm, incorporating the number of products exported by firm i to the world market in the initial year of the trade relationship ($NProducts_{ci}$).

Bilateral country-level variables include transport costs, which are proxied with bilateral distance between exporting country c and destination country j in logs ($Distance_{cj}$).[16] We also include a dummy variable that equals one if exporting and destination country share a border ($Contiguity_{cj}$). Bilateral trade can be fostered by countries' cultural proximity. Similarity in culture can increase the quality of the match between varieties produced in exporting country and tastes of consumers in the destination country. We control for this proximity by introducing two dummies, respectively equal to one if a language is spoken by at least 9% of the population in both countries ($Com\_language_{cj}$) or if both partners have had a colonial relationship ($Colony_{cj}$). Appendix $A.5$ provides summary statistics for the main variables used in our analysis.

Equation (2) is estimated under partial likelihood (Cox, 1972). Since there may be unobserved variation across exporter-sector pairs, we report robust standard errors clustered at the exporter-subsector (HS4) level in all tables. This avoids biasing the standard errors downwards. The coefficients can be interpreted as semi-elasticities, as they measure the percentage point change in the hazard rate as a result of a unit change in the right-hand side variables.

A common feature of survival data is censoring. First, we observe flows in the first year of our sample but do not know how long they have been in existence. Second, we observe flows in the final year of our sample but do no know how long they will continue to exist. The latter problem called right-censoring is accounted for in the Cox estimation procedures.[17] The former problem of left-censoring presents a more serious issue. Given the short time span, our approach is simply to ignore left censoring in our main estimations. As a robustness test, we drop all observations which are left-censored and determine the sensitivity of our results to left-censoring.[18]

[16] Distances are calculated as the sum of the distances between the biggest cities of both countries, weighted by the share of the population living in each city.

[17] Stata includes a dummy variable taking value one if the spell is still existing in the last year of the sample.

[18] Results not reported, available upon request.

3. DATA

a. Firm-Product Export Data

Our analysis relies on a novel dataset collected within the frame of the Export Survival Project, implemented by the International Trade Department of the World Bank.[19] The dataset combines export data at the firm-product level that were collected by customs authorities in five African reporting countries – Ghana, Mali, Malawi, Senegal, and Tanzania. The dataset provides trade flows for more than 5,000 HS 8-digit products[20] to 253 countries, in the time span from 2000 to 2008.[21] In the following, we consider only exports of agri-food products excluding beverages, animal feed, and tobacco. This corresponds to chapters 1 to 21 of the HS classification and restricts our sample to 845 product lines. Exports flows are reported annually in values (US dollars) and quantities (tons).

The fact that our product-firm database includes also the names of the firms allows us to conduct a more thorough cleaning of the data than it would be possible in a database with only anonymized identification numbers of exporters. For example, almost 50% of the reporting firms appear only once in the dataset. That would imply that they only export one product to one destination in one year. Among these observations, we find a large proportion of individuals, for example, "MR. OMART FRANCOIS KOUBLANOU", "MR. JOHN AMEFU", or inconsistent exports such as "AIRLINES GHANA LTD." exporting wood logs. We thus conclude that such observations are likely to be mis-reports and exclude them from the analysis. Additionally, we exclude from the analysis exports flows from international organizations and embassies (3% of the observations) since such exports are not driven by profit motives and might bias our results.[22] Finally, the data show that 3.5% of export flows are realized by trading companies. Our analysis focuses on agri-food products, for which changing food safety regulation may impose additional production and/or transaction costs. We are thus primarily interested in producing firms. In Subsection 4b, we examine the sensitivity of our results to the exclusion of these observations.

[19] We thank Denisse Pierola and Paul Brenton.

[20] Since HS 8-digit product classifications are country-specific, we first had to harmonise the classifications among all countries. Then we matched it with the CN 8-digit Eurostat classification, for which the risk index is computed.

[21] Senegal reports data from 2000 to 2008, Mali from 2005 to 2008, Malawi and Ghana from 2004 to 2008, and Tanzania from 2003 to 2009.

[22] When we include these exporters, the results (available upon request) hold in a similar way.

b. Additional Data Sources

The data on financial development are taken from the Beck, Demirguc-Kunt, and Levine (2006) database, which contains various indicators of financial development across countries and over time. We use the ratio of private credit (i.e., bank credit to private sector) to GDP as a proxy for country's financial depth. The variable, which we call financial development, ranges from 0.052 for Malawi in 2004 to 0.21 for Senegal in 2008. As mentioned in Section 2b, we report estimations with financial development that is measured at the beginning of sample period and thus time-invariant within countries. We feel that this approach best addresses possible endogeneity concerns. The results are robust when using the time-varying version of financial development instead. The annual data for GDP per capita are taken from the World Development Indicator Report 2006 and are reported in constant 2000 US dollars. Financial development and GDP per capita are correlated at 78% in our sample.

We use two proxies for trade financing: the level of outstanding short-term credit (TC_c) and trade credit insurance (IC_c), reported in the Global Development Finance (GDF) as a share of GDP. Finally, as an alternative control for the country's quality of financial system, we use the Getting Credit Index (EGC_c) from the World Bank Doing Business Survey (WBDBS) data for the year 2004.[23] The index ranks countries according to the strength of legal rights and the depth of credit information.

We control for additional country characteristics. We use the Ease of Doing Business index (EDB_c) and the Trading Across Borders index (TAB_c) to control for the quality of the business environment in the exporting country. A country's ranking on the Ease of Doing Business index is based on the average of ten subindices, including starting a business, dealing with licenses, or hiring and firing workers. The Trading Across Borders index captures the complexity of customs procedures faced by exporters. It accounts for the number of documents, the number of signatures, and time necessary to export and import. The data for both indices are taken from the WBDBS. We use the Logistics Performance Index (LPI_c) as a proxy for exporting country's capacity to efficiently move goods and connect with international markets. The index is a weighted average of country scores on six key dimensions, including efficiency of the clearance process, competence and quality of logistics services, and ease of arranging competitively priced shipments. Additionally, we control for the quality of trade and transport infrastructures using the Infrastructure Index, which enters the overall LPI index. The data

[23] This is the only available year.

come from the World Bank Logistic Performance Indicator database for the year 2007.

Product-wise, we use a perishability index, to make sure that our risk measure is not picking up on other product characteristics that may affect their survival. The index takes value one if the product cannot be stored without refrigerator facilities and zero otherwise. Perishable products typically include meat, fishery products, fruits, and vegetables. Correlation between our risk index and the perishability index is 0.15. Finally, data for the gravity variables come from the CEPII database.

c. Descriptive Statistics

Appendix $A.6$ reports some statistics at the firm level for each exporting country. "Risky" products account for an important share of total agricultural exports in all five countries. Additionally, "risky" firms (i.e., firms exporting at least one "risky" product) represent around half of the total firm population in all five countries. "Non-risky" firms are firms that export no "risky" products at all. Appendices $A.7$ and $A.8$ report some statistics for our survival data. Considering firms in all countries, the average spell duration is about one year and four months and the median duration is only one year. Almost 40% of the spells are right censored and 17% are left censored. Considering each country individually, Senegal exhibits the highest average spell duration and Ghana the lowest. A large proportion of spells (56%) start with trade values lower than 10'000 dollars, 13% are initiated with trade values higher than 100'000 dollars, and only 3% start with initial trade values higher than 1'000'000 dollars. Dropping all spells with initial trade value lower than 10'000 dollars (100'000, or 1'000'000 dollars) progressively increases the average and median spell duration. The higher the initial trade value, the higher the probability to survive. These results are in line with findings in previous empirical studies (Besedes and Prusa, 2006a, 2006b).

4. MAIN EMPIRICAL RESULTS

a. Baseline Results

Table 1 reports the effect of financial development on export survival for our baseline specification incorporating various combinations of fixed effects. The dependent variable is the probability of exiting destination country j

for product k exported by firm i from country c. Our main variable of interest is the interaction term between financial development (measured as the ratio of bank credits to GDP) and the Sanitary Risk Index. The coefficient on this interaction term ($FD_c \times sanitary\_risk_k$) captures how the effect of financial development on export success varies across products according to their export-related need for finance. In column (1), we also estimate the direct effects of risk ($sanitary\_risk_k$) and financial development (FD_c) on the probability of exiting the foreign markets. We stratify by HS4 to allow the hazard function to vary across sub-sectors. In addition, we include destination market fixed effects as the ability to survive may vary from one destination market to another. Year fixed effects account for global shocks affecting survival chances of all trade relationships.

Our main variable of interest is negative and significant at the 5% level, suggesting that financial development helps disproportionately more "risky" products to survive. The two coefficients capturing the direct effects of finance and riskiness are also statistically significant. "Risky" products survive significantly less than non "risky" ones, and the financial development in exporting country c (FD_c) has a positive effect on firms' survival (i.e., it decreases the hazard rate). In column (2), we add firm fixed effects controlling for unobserved time-invariant firm characteristics. We also control for cross-country differences in specialization patterns, by adding HS2 $\times$ exporting country fixed effects (69 pairs). Furthermore, we allow the baseline hazard function to vary across destination country $\times$ exporting country pairs. This controls for possible bilateral aid to trade programs that may influence the survival of trade relationships. The direct effect of financial development is absorbed by these fixed and strata effects. The coefficient on the risk index ($sanitary\_risk_k$) remains positive and statistically significant. The coefficient on the interaction term ($FD_c \times sanitary\_risk_k$) is negative and significant at the 10%. In column (3), we include a product (HS 8-digit) strata effect to control for any product time-invariant characteristics. The direct effect of sanitary risk is now also absorbed by these strata effects. The coefficient on our interaction term remains negative and strongly significant. This specification is our preferred. We use it for all subsequent estimations unless specified otherwise. Finally, in the last column of Table 1, we estimate an even more rigorous specification, including HS8 $\times$ destination strata effects. Stratification of the estimation according to HS8 $\times$ destination controls for unobservable protectionist measures that may affect the ability of exports to survive in a given destination market. Additionally, it controls for the market structure for a given product in a given destination that may influence the survival of risky agri-food products. The coefficient on our main variable ($FD_c \times sanitary\_risk_k$) is negative and significant at the 10% level.

Moving to our control variables, the value of export ($initial\_export_{cikj}$), the total number of products exported by given firm to all its destination market ($NProducts_{ci}$), and the total number of destinations served with product k ($NDestinations_{cik}$) in the initial year of export spell all decrease the hazard rate. Intuitively, products survive longer on the export market when the importers are willing to accept a higher initial shipment and when the exporting firm has experience with exporting many products and with placing a given product in many markets. Distance between exporting and destination country ($Distance_{cj}$) - serving as a proxy for trade costs - increases the hazard rate. Sharing a common border ($Contiguity_{cj}$) and a common language ($Com\_language_{cj}$) decrease the hazard rate. Colonial links ($Colony_{cj}$) decrease the hazard rate in the main specification (column 3) and also in the estimations reported in the subsequent tables. The coefficient on our main variable of interest ($FD_c \times sanitary\_risk_k$) is negative and significant in all specifications, suggesting that domestic financial development disproportionately increases survival (decreases hazard rate) of "risky" products in foreign markets. The magnitude and significance on the interaction term is affected by the choice of fixed effects and stratification variable. The coefficient varies from -0.458, when stratifying the Cox PH model at the HS8 $\times$ destination country level, to -0.109 when stratifying at the destination country $\times$ exporting country level. One way to get a sense of the magnitude of the effect is as follows. In 2003, Senegal's ratio of private credit to GDP is about 0.145% and Tanzania's ratio of private credit to GDP is about 0.051%. We consider "Shrimps" with an associated risk index of 2.97. The coefficient of the interaction term between financial development and our risk index is -0.263 in our preferred specification. Therefore, if Tanzania's level of financial development reached Senegal's, then the hazard rate of its shrimps exports would decrease relative to the hazard rate of its "non-risky" exports by 7% ($\beta * Risk * \Delta FinDev = -0.263 * 2.97 * (0.145 - 0.051) \approx -7\%$).

b. Survival and Firms' Type

After establishing statistical and economic significance of our main result, we examine how the firm heterogeneity affects the working of the channel examined in this paper.

To start with, 17% among exporting firms in our sample export to African markets only. These firms might face very different food safety requirements in comparison to firms servicing also developed countries. We re-estimate our main specification considering firms that export only to Africa. The level of

Table 1: Financial Development and Trade Survival.

The dependent variable is the hazard rate of trade relationships for product k exported by firm i from country c into destination country j. All regressions are estimated using the Cox Proportional Hazard Model and account for various stratification variables and fixed effects. (See details for each column). The main variables of interest are sanitary risk of product k (sanitary_risk_k) and its interaction with financial development in country c (FD_c*sanitary_risk_k). Financial development is measured as a ratio of private credit (i.e., bank credit from banks to private sector) over GDP. The control variables include the direct effect of financial development of country c (FD_c), initial export value ($\text{initial\_export}_{ickj}$), number of products exported by firm i to the world market (NProducts_{ci}), number of destinations serviced by firm i with product k ($\text{NDestinations}_{cik}$), gravity variables ($\text{Contiguity}_{cj}$,$\text{Com\_language}_{cj}$,$\text{Colony}_{cj}$, Distance_{cj}). Robust standard errors clustered at (exporting country) × HS4 sector level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
FD_c x $sanitary\_risk_k$	-0.141**	-0.109*	-0.263**	-0.458*
	(0.069)	(0.066)	(0.107)	(0.252)
$sanitary\_risk_k$	0.018***	0.015**		
	(0.007)	(0.006)		
FD_c	-3.557***			
	(0.726)			
$initial\_export_{cikj}$	-0.075***	-0.094***	-0.088***	-0.096***
	(0.007)	(0.006)	(0.007)	(0.010)
$NProducts_{ci}$	-0.003***	-0.003	-0.004**	-0.009**
	(0.001)	(0.002)	(0.002)	(0.004)
$NDestinations_{cik}$	-0.024***	-0.060***	-0.057***	-0.065***
	(0.004)	(0.008)	(0.009)	(0.014)
$Contiguity_{cj}$	-0.087		-0.150	-0.190
	(0.090)		(0.105)	(0.251)
$Com\_language_{cj}$	-0.249***		-0.126***	-0.123
	(0.040)		(0.040)	(0.101)
$Colony_{cj}$	0.123		-0.086	0.122
	(0.089)		(0.084)	(0.197)
$Distance_{cj}$	0.095**		0.090*	0.319**
	(0.044)		(0.049)	(0.147)
firm fe	no	yes	yes	yes
destination fe	yes	no	yes	no
year fe	yes	yes	yes	yes
HS2 x exporting country fe	no	yes	yes	yes
destination x exporting country strata	no	yes	no	no
HS4 strata	yes	no	no	no
HS8 strata	no	no	yes	no
HS8 x destination strata	no	no	no	yes
Observations	14870	14870	14870	14870

financial development does not seem to matter for firms that only export to the African region (column 1 in Table 2). Yet, it does for firms that export to other regions. In column (2), we rerun estimation dropping firms that export only to Africa from the total firms sample. The coefficient on our interaction term after dropping the "only-Africa" exporters increases nearly twofold in magnitude compared to estimation on the whole sample reported in column 3 of Table 1 (from -0.263 to -0.461). A possible explanation for these results would be a laxer enforcement of food safety standards in the developing countries in Africa. Stricter SPS controls on the borders of developed countries would imply higher costs of compliance and thus higher dependence on external finance for firms exporting to developed markets. Section 4c looks into this issue in more detail.

Next, we use the unique character of our firm-product database that contains the names of exporting firms. This allows to examine whether our results are not driven by the presence of multinational companies or trading companies in the sample. There is evidence of capital flows from multinational firm to affiliates as potential channels to overcome imperfections in local capital markets (Desai, Folay and Hines, 2009). Yet, our index does not account for trade financing associated with intra-firm trade by multinational corporations or trade related to foreign direct investment. To make sure that our results are not driven by multinationals, we drop them from our sample and re-estimate our preferred specification. We identify multinational companies based on their names; for example "NESTLE" or "COLGATE" are identified as multinationals. Results are reported in column (3) and demonstrate the robustness of our main result. Similarly, large trading companies may enjoy easier access to trade credit. We identify trading companies, using search for keywords in the firm names; for example "EXPORT TRADING CO. LTD." Estimation reported in column (4) confirms that our main result holds in the subsample that excludes trading companies. Unfortunately, the high data requirements of the formal survival analysis do not allow us to separately run estimations containing only multinational corporations or trading companies. We plan to come back to this issue in future work where we want to look at export entry, export exit, and trade volume as dependent variables. These estimations do not put such high requirements on the number of observations.

Finally, firms exhibiting multiple-spell trade relationships[24] may spread the investment and operating costs related to compliance with food safety requirements over different spells. We drop observations corresponding to

[24] If a firm-destination-product triplet enters more than once in the dataset, we say that it exhibits multiple spells of service.

higher order spells from our sample. Column (5) shows that our results remain the same.

c. Destination Markets' Demand for Quality

In this section, we provide evidence that the risk index, while computed using the EU food safety regulations as a benchmark, does not capture specificities of the EU market alone (Table 3). Columns with odd numbers report results when controlling for firm destination and year fixed effects and stratifying across HS4. This allows us to recover the main effect of the risk index. Columns with even numbers report results under our preferred specification (introduced in column 3 in Table 1). Destination markets are: non European countries only (columns 1 and 2), high income countries only (columns 3 and 4), low income countries only (columns 5 and 6), and African countries only (columns 7 and 8). First, results indicate that the risk index is not specific to the EU market. When excluding EU countries from the sample (columns 1 and 2), the coefficient on our main variable ($FD_c \times sanitary\_risk_k$) is negative and becomes significant once we apply the more stringent stratification that controls for potentially different baseline hazard across HS8 products (column 2). Second, the coefficients on risk ($sanitary\_risk_k$) and its interaction with financial development ($FD_c \times sanitary\_risk_k$) are significant in case of exports into high income countries. However, they are not significant when considering low income or African countries as destination markets. This suggests that food safety matters primarily for developed countries, causing SPS compliance to be particularly costly, and funding especially important, for exports to those markets. This could reflect the stronger concerns in developed countries for human health and food safety issues. Such results find support in the trade and quality literature. Hallak (2006) finds some evidence that richer countries have relatively greater demand for high-quality goods, when measuring quality by the unit values.

Table 2: Survival and Firms' Type.

The dependent variable is the hazard rate of trade relationships for product k exported by firm i from country c into destination country j. All regressions are estimated using the Cox Proportional Hazard Model. We control for destination country, year, firm and exporting country x HS2 fixed effects, and allow the baseline hazard to vary across HS8. The variables of interest are defined in Table 1. Sample description: firms only exporting to African countries (column 1), total sample excluding firms only exporting to African countries (column 2), total sample excluding multinational and trading companies (columns 3 and 4), and total sample excluding higher order spells (column 5). Robust standard errors clustered at (exporting country) × HS4 sector level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) Firms exporting to Africa only	(2) Firms exporting to different regions	(3) No international companies	(4) No trading companies	(5) First spell only
FD_c x $sanitary\_risk_k$	0.018	-0.461***	-0.243**	-0.235**	-0.237**
	(0.142)	(0.151)	(0.108)	(0.107)	(0.118)
$initial\_export_{cikj}$	-0.087***	-0.094***	-0.089***	-0.089***	-0.093***
	(0.015)	(0.008)	(0.007)	(0.008)	(0.007)
$NProducts_{ci}$	0.010***	-0.016***	-0.004	-0.002	-0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$NDestinations_{cik}$	-0.033***	-0.046***	-0.057***	-0.060***	-0.055***
	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)
$Contiguity_{cj}$	-0.085	-0.204	-0.086	-0.152	-0.110
	(0.155)	(0.170)	(0.125)	(0.109)	(0.102)
$Com\_language_{cj}$	-0.225***	-0.074	-0.072	-0.124***	-0.113***
	(0.065)	(0.048)	(0.045)	(0.044)	(0.043)
$Colony_{cj}$		-0.123	-0.166**	-0.076	-0.103
		(0.088)	(0.083)	(0.085)	(0.104)
$Distance_{cj}$	0.109	0.066	0.141***	0.085*	0.121***
	(0.084)	(0.064)	(0.052)	(0.050)	(0.047)
Observations	2494	12376	14163	13522	13191

Table 3: Survival and Destination Markets.

The dependent variable is the hazard rate of trade relationships for product k exported by firm i from country c into destination country j. All regressions are estimated using the Cox Proportional Hazard Model. We control for destination country, year, firm and exporting country x HS2 fixed effects, and allow the baseline hazard to vary across HS4 subsectors (odd numbered columns) and across HS8 product (even numbered columns). The variables of interest are defined in Table 1. Sample description: Destination markets considered are: non EU countries (columns 1-2), high income countries (columns 3-4), low income countries (columns 5-6), and African countries (columns 7-8). Robust standard errors clustered at (exporting country) × HS4 sector level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	non EU countries	non EU countries	High Inc countries	High Inc countries	Low Inc countries	Low Inc countries	AF countries	AF countries
FD_c x $sanitary\_risk_k$	-0.104	-0.267**	-0.294*	-0.381**	0.021	0.026	0.017	0.003
	(0.076)	(0.116)	(0.174)	(0.167)	(0.098)	(0.130)	(0.092)	(0.117)
$sanitary\_risk_k$	0.012*		0.039**		-0.0001		0.001	
	(0.007)		(0.019)		(0.009)		(0.008)	
$initial\_export_{cikj}$	-0.086***	-0.084***	-0.098***	-0.092***	-0.090***	-0.099***	-0.084***	-0.087***
	(0.007)	(0.007)	(0.009)	(0.011)	(0.011)	(0.011)	(0.009)	(0.010)
$NProducts_{ci}$	-0.002	-0.002	-0.010***	-0.011***	0.006***	0.007***	0.002	0.004*
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
$NDestinations_{cik}$	-0.049***	-0.047***	-0.051***	-0.055***	-0.038***	-0.033***	-0.039***	-0.031***
	(0.008)	(0.009)	(0.007)	(0.010)	(0.008)	(0.010)	(0.007)	(0.009)
$Contiguity_{cj}$	-0.120	-0.113			-0.192	-0.163	-0.095	-0.097
	(0.100)	(0.108)			(0.127)	(0.133)	(0.108)	(0.119)
$Com\_language_{cj}$	-0.096**	-0.105*	-0.044	-0.065	-0.218***	-0.284***	-0.200***	-0.236***
	(0.048)	(0.054)	(0.062)	(0.063)	(0.052)	(0.058)	(0.048)	(0.053)
$Colony_{cj}$			-0.184**	-0.158*				
			(0.090)	(0.094)				
$Distance_{cj}$	0.088*	0.116**	0.212***	0.233**	0.019	0.070	0.097*	0.122*
	(0.048)	(0.056)	(0.075)	(0.095)	(0.066)	(0.067)	(0.055)	(0.064)
Observations	7831	7831	10220	10220	3010	3010	3690	3690

5. ROBUSTNESS CHECKS

a. *Alternative Measures of Risk and Financial Development*

In Table 4, we report results using alternative measures of risk (column 2) and financial development (columns 3 to 5). Column (1) reports our preferred baseline specification for the sake of comparison. In column (2), we use an alternative measure of risk ($alt\_sanitary\_risk_k$), constructed by Jaud and al. (2009a) and using a Poisson model instead of a Negative Binomial. Results remain qualitatively the same.[25]

Columns (3) and (4) report results using alternative measures of access to financing. Local financial markets are not the only source of finance for exporters. Firms operating in countries with poorly developed financial markets may rely on trade financing provided by institutions in the destination country. The interaction term between our risk index and the measure of short-term credit from the BIS banks (TC_c) is negative and statistically significant at the 10% level. The coefficient is negative but not significant when using the ratio of trade insurance to GDP (IC_c) interacted with risk.

Column (5) reports results when using the Ease of Getting Credit index (EGC_c). The coefficient on the interaction term with the risk index comes out negative and significant at the 5% level, suggesting that the quality of domestic financial institution disproportionately helps the survival of "risky" products in foreign markets.

b. *Controlling for Alternative Channels*

As in standard OLS, the identification of our main coefficient relies on the assumption of orthogonality between the interaction term and the residual. We are concerned with variables that are potentially correlated with financial development and at the same time their impact on export survival might vary across products. Financial development may be correlated with other country characteristics, such as the quality of the infrastructure, the complexity of the customs procedures, the business regulations, etc. In order to control

[25] Alternatively, we use the count of notifications per product at the HS 6-digit level, as a measure of financing needs. The data are taken from Didiers et al. (2008). The correlation between our measure of risk and this alternative measure is 0.05. Coefficients on both the count of notifications and its interaction with the level of financial development are of expected sign but not significant.

Table 4: Survival and Alternative Measures of Risk and Financial Development.

The dependent variable is the hazard rate of trade relationships for product k exported by firm i from country c into destination country j. All regressions are estimated using the Cox Proportional Hazard Model. We control for destination country, year, firm and exporting country x HS2 fixed effects, and allow the baseline hazard to vary across HS8 product (strata). The variables of interest are defined in Table 1. Additional controls include an alternative measure of sanitary risk, the sanitary risk index computed using Poisson regression (alt_sanitary_risk$_k$, see Jaud et al., 2009a). We use as alternative measures of financial development trade credit over GDP in country c (TC$_c$), trade credit insurance over GDP in country c (IC$_c$), and the Ease of Getting Credit index (EGC$_c$). Robust standard errors clustered at (exporting country) × HS4 sector level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
FD$_c$ x sanitary_risk$_k$	-0.263**				
	(0.106)				
FD$_c$ x alt_sanitary_risk$_k$		-0.202**			
		(0.088)			
TC$_c$ x sanitary_risk$_k$			-0.118*		
			(0.062)		
IC$_c$ x sanitary_risk$_k$				-0.138	
				(0.120)	
EGC$_c$ x sanitary_risk$_k$					-0.0003**
					(0.0001)
initial_export$_{cikj}$	-0.088***	-0.088***	-0.088***	-0.089***	-0.089***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
NProducts$_{ci}$	-0.004**	-0.004**	-0.004**	-0.004**	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
NDestinations$_{cik}$	-0.057***	-0.057***	-0.057***	-0.057***	-0.056***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Contiguity$_{cj}$	-0.150	-0.151	-0.147	-0.147	-0.150
	(0.104)	(0.104)	(0.104)	(0.105)	(0.104)
Com_language$_{cj}$	-0.126***	-0.126***	-0.126***	-0.126***	-0.126***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
Colony$_{cj}$	-0.086	-0.086	-0.093	-0.094	-0.086
	(0.084)	(0.084)	(0.085)	(0.085)	(0.084)
Distance$_{cj}$	0.090*	0.089*	0.092*	0.090*	0.089*
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
Observations	14870	14870	14870	14870	14870

for these alternative channels, we interact each of these country variables with the risk index and include them as additional regressors in our baseline specification (column 3 in Table 1). Results are reported in Table 5. The coefficient on our main variable ($FD_c \times sanitary\_risk_k$) has expected sign and remains significant in all specifications. The coefficient on the interaction term between the Sanitary Risk Index and GDP per capita is positive and significant at the 5% level (column 1). This, most probably, signals a colinearity problem between both interaction terms.[26] In column (2), we interact the Ease of Doing Business index with the risk index ($EDB_c \times sanitary\_risk_k$), controlling for favorable business conditions in the exporting country that may positively influence exports survival. The coefficient is positive but not significant. Columns (3), (4), and (5) report results when controlling for Logistic Performance Index ($LPI_c \times sanitary\_risk_k$), the quality of the trading infrastructure ($Infrastructure_c \times sanitary\_risk_k$), and the complexity of trading procedures in the exporting country ($TAB_c \times sanitary\_risk_k$), respectively. Coefficients on all three interaction terms have expected signs but fail to be statistically significant, while the coefficient on our main variable ($FD_c \times sanitary\_risk_k$) remains negative and significant.[27] All in all, after controlling for overall economic development and quality of the business and trading environment, the positive effect of access to finance on export survival remains. These findings yield further support to our hypothesis.

c. Perishable versus "Risky" Products

Finally, to ensure that the risk index is not picking up on other product characteristics that may affect their survival, we include a perishability index ($perishable_k$) as a control variable. We expect perishable products - which cannot be stored without refrigerator facilities - to survive less. We interact financial development with the perishability index ($FD_c \times perishable_k$) and include it instead of our main interaction term. Columns (1) and (2) in Table 6 report results controlling for firm destination and year fixed effects and stratifying across HS4. In columns (3) and (4), we stratify across HS8. Perishable products have a higher hazard rate and thus survive less (column 1). However, the level of financial development does not seem to matter

[26] We run a regression with the interaction term of GDP per capita with risk alone (i.e., dropping our main interaction term). The coefficient is of the expected negative sign and significant at the 5% level.

[27] When running separate regressions that only include the interaction term of each of these variables with sanitary risk (i.e., not including our main interaction term), the coefficients are of expected sign and statistically significant.

Table 5: Survival and Institutional Development.

The dependent variable is the hazard rate of trade relationships for product k exported by firm i from country c into destination country j. All regressions are estimated using the Cox Proportional Hazard Model. We control for destination country, year, firm and exporting country x HS2 fixed effects, and allow the baseline hazard to vary across HS8 product (strata). The variables of interest are defined in Table 1. Additional controls include the interaction between the sanitary risk and: country c overall economic development ($GDPpc_c$ x $sanitary\_risk_c$), country c Ease of Doing Business index (EDB_c x $sanitary\_risk_c$), country c Logistic Performance index (LPI_c x $sanitary\_risk_c$), country c level of infrastructure ($Infrastructure_c$ x $sanitary\_risk_c$), and country c level of trade related infrustructure (TAB_c x $sanitary\_risk_c$). Robust standard errors clustered at (exporting country) × HS4 sector level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
FD_c x $sanitary\_risk_k$	-0.590**	-0.257**	-0.291**	-0.169*	-0.345***
	(0.243)	(0.099)	(0.146)	(0.101)	(0.130)
$GDPpc_c$ x $sanitary\_risk_k$	0.00016*				
	(0.0001)				
EDB_c x $sanitary\_risk_k$		0.0001			
		(0.0001)			
LPI_c x $sanitary\_risk_k$			0.0120		
			(0.036)		
$Infrastructure_c$ x $sanitary\_risk_k$				-0.052	
				(0.033)	
TAB_c x $sanitary\_risk_k$					-0.0007
					(0.0005)
$initial\_export_{cikj}$	-0.088***	-0.088***	-0.088***	-0.088***	-0.088***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
$NProducts_{ci}$	-0.004*	-0.004**	-0.004**	-0.004*	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$NDestinations_{cik}$	-0.057***	-0.057***	-0.056***	-0.057***	-0.057***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$Contiguity_{cj}$	-0.150	-0.149	-0.150	-0.148	-0.151
	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)
$Com\_language_{cj}$	-0.125***	-0.126***	-0.126***	-0.125***	-0.125***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.040)
$Colony_{cj}$	-0.089	-0.088	-0.086	-0.089	-0.087
	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
$Distance_{cj}$	0.090*	0.091*	0.090*	0.091*	0.089*
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
Observations	14870	14870	14870	14870	14870

Table 6: Survival Sanitary Risk and Product Perishability.

The dependent variable is the hazard rate of trade relationships for product k exported by firm i from country c into destination country j. All regressions are estimated using the Cox Proportional Hazard Model. We control for destination country, year, firm and exporting country x HS2 fixed effects, and allow the baseline hazard to vary across HS4 (columns 1-2) and across HS8 (columns 3-4). The variables of interest are defined in Table 1. We control for perishability ($\mathrm{perishability_k}$) as an alternative product characteristic. We interact the level of financial development in country c with the perishability index ($\mathrm{FD_c} \times \mathrm{perishability_k}$). In addition, we include number of non-EU partners to control for alternative markets where exporters can sell their products. Robust standard errors clustered at (exporting country) × HS4 sector level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
FD_c x sanitary_risk$_k$		-0.154**		-0.263**
		(0.073)		(0.108)
FD_c x perishable$_k$	-0.537	-0.321	0.703	0.978
	(0.897)	(0.890)	(0.927)	(0.915)
sanitary_risk$_k$		0.020***		
		(0.007)		
perishable$_k$	0.296**	0.279**		
	(0.135)	(0.131)		
initial_export$_{cikj}$	-0.094***	-0.094***	-0.089***	-0.088***
	(0.007)	(0.007)	(0.007)	(0.007)
NProducts$_i$	-0.003	-0.003	-0.004**	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
NDestinations$_{cik}$	-0.057***	-0.057***	-0.056***	-0.056***
	(0.008)	(0.008)	(0.009)	(0.009)
NPartn_nonEU$_{cik}$	-0.168395*	-0.172531*	-0.148588	-0.150
	(0.098)	(0.098)	(0.104)	(0.103)
Com_language$_{cj}$	-0.115***	-0.114***	-0.129***	-0.129***
	(0.040)	(0.040)	(0.040)	(0.040)
Colony$_{cj}$	-0.151*	-0.148*	-0.088	-0.083
	(0.083)	(0.083)	(0.085)	(0.084)
Distance$_{cj}$	0.043	0.043	0.090*	0.091*
	(0.043)	(0.044)	(0.048)	(0.048)
Observations	14870	14870	14870	14870

for these products. After controlling for the perishable nature of product, the coefficients on risk ($sanitary\_risk_k$) and risk interacted with financial development ($FD_c \times sanitary\_risk_k$) remain significant and of expected signs (columns 2 and 4).[28]

6. CONCLUSIONS

Using a novel measure of export-related financial needs at the product level and a unique firm-product database, this paper examines the impact of financial development on the long-term export performance. In particular, we combine the Sanitary Risk Index (Jaud et al., 2009b) with firm-product data on agricultural exports from five developing countries: Ghana, Mali, Malawi, Senegal, and Tanzania. Sanitary Risk Index (SRI) is computed at the 8-digit level of the CN classification and reflects the propensity of agricultural products to fail safety and health control at the border of the European Union. Sustainable exports of such products thus require a costly compliance with the import regulation in the major destination market of the exporting countries in our sample. This makes SRI a fitting proxy for financial needs that are directly related to exporting activities.

We exploit the tools of the survival analysis and also use the fact that our firm-product database allows inclusion of both firm and product fixed effects. The presence of firm names in our database enables us a further look into firm heterogeneity. That includes examining the possibility whether our results are driven by the presence of multinational corporations or trade companies among the exporting firms. We find that financial development disproportionately promotes the long-term export survival of the goods with high export-related financial needs. The result is robust to alternative measures of financial development and remains significant after controlling for various alternative channels that could affect the sustainable success at the foreign markets. Financial development is especially important for long-term export survival if the destination markets are developed countries. These results contribute to three emerging fields that have only recently caught the attention of trade scholars: finance and trade, long-term survival of exports, and agri-food trade.

[28] The correlation between our risk measure and the perishability index is 0.13.

A APPENDIX

A.1 Average Export Share by Region (% in an average year).

Variables	Ghana	Mali	Malawi	Senegal	Tanzania
Africa	2	71	51	52	19
America	15	0	4	1	4
Asia	15	6	8	3	34
Europe	72	24	34	46	43
Pacific	0	0	0	0	1

A.2 Micro Costs of Global GAP Compliance–Tanzania.

	GlobalGAP Requirements	Set Up Costs (US$)	On Going Costs (US$)
1	Traceability	4’300	100
2	Record keeping and self-inspection	6’000	3’600
3	Site management	900	0
4	Risk assessments	1’500	300
5	Technical services	0	2’000
6	Laboratory analysis	0	3’000
7	Soil and substrate management	1’000	100
8	Fertilizer use	2’500	750
9	Crop protection	10’400	1’250
10	Irrigation/fertilization	600	0
11	Harvesting	9’800	200
12	Produce handling	11’300	100
13	Waste & pollution management	800	50
14	Worker health, safety and welfare	47’490	4’250
15	Environmental issues	1’100	200
16	Certification costs	1’000	2’000
17	GlobalGAP procedures	0	2’600
	Total costs	98’690	20’500

A.3 Correlation Matrix.

	Alerts	Sanitary Risk Index	SPS Notifications
Alerts*	1		
Sanitary Risk Index	0.2347	1	
SPS Notifications*	0.0113	0.0123	1

*Total number over the period 2001-2005

A.4 The Sanitary Risk Index (SRI), at the CN2 level.

Description	# "risky" products	Sanitary Risk Index (SRI)*	# Alerts 2001-05	Most frequent cause for rejection
Coffee, tea, mate and spices	38	2.07	934	Composition/ Mycotoxins
Preparations of meat and fish	32	1.29	309	Residues drugs
Oil seeds and oleaginous fruits	25	1.04	1491	Mycotoxins
Fish, crustaceans & molluscs	108	0.95	2641	Residues drugs
Miscellaneous edible preparations	7	0.85	185	Food additives
Edible fruit and nuts	53	0.71	3210	Mycotoxins
Edible vegetables	27	0.65	441	Pesticide residues
Cocoa and cocoa prep.	4	0.57	20	Allergens
Preparations of vegetables, fruit or nuts	44	0.54	677	Mycotoxins
Sugars and sugar Co	5	0.49	221	Food additives/ Mycotoxins
Products of animal origin, nes	3	0.48	40	Residues drugs
Meat and edible meat offal	17	0.24	498	Pathogens
Animal or vegetable fats and oils	7	0.18	247	Composition
Preparations of cereals	2	0.16	167	Radiation
Dairy produce	0	0.03	367	Residues drugs
Live animals	0	0	1	Heavy metals
Live trees and other plants	0	0	3	
Cereals	0	0	158	GMO/Mycotoxins
Products of the milling industry	0	0	36	Food additives
Lac	0	0	1	Food additives
Vegetable plaiting materials	1	0	1	Labelling incorrect

"Risky" products are products with a positive Sanitary Risk Index. Out of a total of 2146 CN8 products, 373 are "risky" products. In column (3) we compute the Sanitary Risk Index at the CN2 level, taking the average over all CN8 product in each CN2 sector. Column (4) reports the total number of alerts per CN2 sector, over the period 2001-2005. The last column details the most frequent cause for an alert.

A.5 Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Nber of product	14870	28.1	31.6	1	137
Nber of dest	14870	14.3	12.6	1	54
Distance	14870	8.3	0.89	5.04	9.6
Fin_Dev	14870	0.09	0.03	0.04	0.18
GDPpc	14870	369.7	59.1	194.4	510
Insured_credit	14870	0.11	0.027	0.033	0.13
Trade_credit	14870	0.18	0.06	0.055	0.23
Risk	14870	2.71	4.24	0	21.6
LPI	14870	2.16	0.08	2.08	2.42
Infrastructure	14870	2.16	0.11	1.9	2.25
Ease of Doing Business	14870	104.7	23	87	166
Ease of Getting Credit	14870	104.7	16.8	84	145
Trading Across Borders	14870	20.6	4.6	14	45
Fin_Dev × Risk	14870	0.27	0.46	0	3.13
GDPpc × Risk	14870	1027	1669	0	11039
Insured_credit × Risk	14870	0.3	0.48	0	2.78
Trade_credit × Risk	14870	0.5	0.87	0	5.04
LPI × Risk	14870	5.8	9.2	0	51.2
Infrastructure × Risk	14870	5.9	9.3	0	48.6
Ease of Doing Business × Risk	14870	280.6	453.1	0	3222
Ease of Getting Credit × Risk	14870	290.4	472.8	0	3136
Trading_Across_Borders × Risk	14870	54.1	84.2	0	950
Export	14870	8.5	2.9	-6.94	20.21

Descriptive Statistics

A.6 Riskiness of Country's Export.

Country	Average firm in an average year						
	Total nbr products	Nbr "risky" products	Export "risky" products ('000$)	Total Export ('000$)	Share of "risky" exports	Nbr "safe" firms	Nbr "risky" firms
GHA	4	2	276'009	2'663'712	45%	760	581
MLI	2	2	138'172	224'918	61%	46	20
MWI	2	2	254'607	1'025'106	65%	75	36
SEN	3	2	422'751	893'963	65%	122	83
TZA	2	2	692'777	1'931'762	52%	331	145

A safe firm is a firm that export no "risky" products at all. A "risky" firm is a firm exporting at least one "risky" product.

A.7 Survival Database, Spell Duration, All Countries

failure d:died==1					
analysis time$_t$:(spellend-origin)					
origin:time spellbegin					
id:index					
Category	Total	Mean	Min	Median	Max
no. of subjects	14870				
no. of records	14870	1	1	1	1
(first) entry time		0	0	0	0
(final) exit time		1.36	1	1	9
subjects with gap	0				
time on gap if gap	0	.	.	.	.
time at risk	20336	1.36	1	1	9
failures	8479	0.57	0	1	1

A.8 Survival Database, Spell Duration, by County.

Country	Obs	Mean	Std. Dev.	Min	Max
GHA	9074	1.20	0.63	1	5
MLI	63	1.38	0.58	1	3
MWI	301	1.62	1.00	1	4
SEN	1262	1.72	1.42	1	9
TZA	4170	1.60	1.17	1	7

Length of the spell

Initial Export value (USD)	Obs	Mean	Std. Dev.	Min	Max
Export<1'000	4615	1.17	0.56	1	7
1'000 ≤Export <10'000	3723	1.30	0.79	1	9
10'000≤Export<100'000	4107	1.39	0.96	1	9
100'000≤Export<1'000'000	1970	1.71	1.30	1	9
1'000'000 ≤Export	455	2.08	1.63	1	9

A.9 The Cox Proportional Hazard Model

Our approach utilizes a survival-analysis framework, and focuses on the duration of trade relationships. Survival analysis allows to examine the relationship between the survival-times distribution and some covariates of interest. The survival function gives the probability that a trade relationship will survive past time t. Conversely, the hazard function, $h(t)$, assesses the instantaneous risk of demise at time t, conditional on survival till that time. Formally, let $T \geq 0$ denote the survival-time (length) of a trade relationship, with covariates X. Then the hazard rate $h(t)$, is given by:

$$h(t|X) = \lim_{\Delta t \to 0} \frac{\Pr[(t \leq T < t + \Delta t)|T \geq t, X]}{\Delta t}$$

In discrete time:

$$h(t|X) = \Pr(T = t|T \geq t, X), t = 1, 2, ...$$

We estimate the hazard rate for our trade relationships data, using a Cox Proportional Hazard (PH) model (introduced in a seminal paper by Cox, 1972). The Cox PH model is broadly applicable and the most widely used method for survival analysis. The hazard function for a given firm $\times$ destination $\times$ product triplet with covariates $X = \{x_1, x_2, ...x_j, ..x_n\}$ writes:

$$h(t \mid X) = h_0(t) \exp(X.\beta)$$

and is defined as the product of a baseline hazard function, $h_0(t)$, common to all observations and a parametrized function, $\exp(X.\beta)$, with a vector of parameters β. The form of the baseline hazard function characterizes how the hazard changes as a function of time at risk t. The covariates X affect the hazard rate independently of time. The model offers some convenient features. It makes no assumptions about the form of the underlying baseline function. Additionally, the relationship between the covariates and the hazard rate is log-linear, allowing for a straightforward interpretation of the parameters. Increasing x_j by 1, all other covariates held constant, affects the hazard function by a factor of $exp(\beta_j)$ at all points in time. It thus shifts all points of the baseline hazard by the same factor. Parameters estimates in the Cox PH model are obtained by maximizing the partial likelihood as opposed to the likelihood for an entirely specified parametric hazard model (Cox, 1972). Resulting estimates are not as efficient as maximum-likelihood estimates. However, no arbitrary, and possibly incorrect, assumptions about the form of the baseline hazard are made.

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