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Financial Development and Survival of African Agri-food Exports*

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Abstract

This paper investigates the link between export survival of agri-food products and financial development. Our hypothesis is that financial developement differentially affects the survival of exports across products based on their need of external finance. We propose a test for the role of financial development by examining whether exports of products that are relatively more reliant on external capital survive longer when initiated in more financially developped countries. Our results suggest that agri-food products that require more external finance indeed sustain longer in foreign markets when exported from more financially developed countries.

Keywords: Financial Development, External Finance Dependence, Agri-food trade, SPS regulation, Product Risk Index Duration of trade

JEL classification: G1 F10 C41

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1 Introduction

Surviving in the export market is not just about entering into, but also about not exiting from foreign markets. The rapidly growing literature on international trade at the level of individual firms has mainly focused on the role of fixed costs and firms' characteristics–productivity and financial constraints–on exporting status (Melitz, 2003, Eaton et al., 2004; Bernard and Jensen, 2004; Chaney, 2005; Manova, 2008, Eaton et al., 2009). Yet, empirical evidence on the relevance of these determinants on firms' ability to sustain once they entered is rather scarce. This is surprising given that sustained trade relationships are the driving force of firms' export performances and subsequent economic growth (Besedes and Prusa, 2006a; Brenton and Newfarmer, 2007; Brenton et al., 2009). In countries as different as Columbia or China, higher export performances are to be expected from the securing (survival) and deepening of existing trade flows rather than the creation of new ones (Eaton et al., 2008; Manova and Zhang, 2009).

In this paper we try to fill this void of the literature and investigate the role of financial development in promoting export survival of agri-food export sensitive to food safety regulations of destination markets. The focus on the agri-food sector is dictated by the availability of a measure of financing needs at the product level. We rely on a measure of product sanitary risk developed by Jaud et al., (2009a). Additionally, the agri-food sector is particularly relevant to developing countries. International trade in high-value food products–including fresh and processed fruits and vegetables, fish, live animals and meat, nuts, and spices–from developing countries has expanded enormously over the last two decades offering opportunities for development. However, trade in agri-food is governed by a growing array of standards. Evolving Sanitary and Phytosanitary Standards (SPS) and technical regulations as well as changes in importers supply chain requirements impose additional sunk, fixed and operating costs along the firms' export life. These costs may not only affect the decision of firms to start exporting but also affect survival of the firms "pricing out" producers that cannot comply with the SPS regulations.

The existence of these costs suggests a potential role of credit constraints in shaping the duration of trade relationships on foreign markets. Well-developed financial markets by facilitating firms access to finance would allow them to survive demand shocks in foreign markets and maintain long-standing trade relationships. The more so for products with higher financing needs. We empirically test this prediction by examining the export survival of different agri-food products from firms operating in five African countries to the world. We build on the seminal work of Rajan and Zingales (1998) and use a difference in differences approach. To capture the differentiated effect of financial development across industries, they interact the country level of financial development with the industry level of external finance dependence and control for industry and country fixed effects. The measure of external finance dependence is computed using US firm level data and reflects the industry technological demand for external finance.

As a proxy for financing needs of agri-food products, a measure of sanitary risk computed at the 8-digit level of the HS classification (Jaud et al., 2009a). The Sanitary Risk Index (SRI) reflects the propensity of products to fail health and safety controls on the European Union (EU) market. Thus, it captures the need for investments to comply with the EU food safety requirements. Several studies in the standard and trade literature, suggest high costs of compliance, both variable and fixed, for firms exporting high-value food products (Garcia-Martinez and Poole, 2006; Maskus et al., 2005). Our proxy captures the need for financing associated with exporting to stringent developed countries market. Since our focus is on African firms ability to sustain in the export markets, capturing the differentiated effect of financial development requires an export based measure rather than production based measure.

The paper contributes to three strands of literature. First, it contributes to a literature on credit constraints and patterns of trade. This rapidly growing line of research highlights the role of finance for credit constrained firms to fund both short term and longer term needs. A number of papers have provided evidence on the positive effect of the supply of external finance to firms on trade performances (Manova, 2008; Beck, 2003; Svaleryd and Vlachos 2005; Berman and Hericourt forth, Bugamelli et al. 2008; Görg and Spaliara 2009). More recently, several papers have looked into the effects of liquidity shortages following banking crisis on the performances of firms already engaged in exporting (Amiti and Weinstein, 2010; Bricogne et al., 2010). Crucially, the negative effects of credit constraints vary with the industry dependence on external finance (Rajan and Zingales, 1998). Finance helps especially exports of those firms with needs for greater external capital. An innovation of our paper with respect to the previous related literature is its reliance on the index of sanitary risk to capture the need for financing of agri-food firms to support their exports to high income destination markets. Additionally, we address the issue of export survival. The existing literature on finance and trade usually focuses on the short-term year-to-year changes in the export status of products or firms (Manova 2008, Berman and Héricourt forth). An exception is the recent paper of Jaud et al. (2009b), who show that financial development promotes export survival for financially vulnerable industries requiring a higher external financing to maintain their operations. Relying on the tools of survival analysis arguably enables us to better capture the medium and long run survival of exporters. This distinction is not innocuous. The majority of export relationships die within two years and the bulk of export growth in successful developing countries comes from the long-term survivors. Second, it contributes to the burgeoning trade literature using survival analysis (Besedes and Prusa 2006a, 2006b; Nitsch, 2009; Brenton et al., 2009). The literature has so far examined how different country characteristics contribute to longer survival of domestic firms on foreign markets. The main problems of using country characteristics as regressors are the potential endogeneity and omitted variables bias. When trying to identify the causal effect of financial development, it is impossible to control for all other country characteristics that are correlated with finance and also might affect the survival

of exporting firms. We address this issue by incorporating the methodology of Rajan and Zingales (1998) into the framework of survival analysis. This enables us to look for a specific channel through which financial development promotes export survival while controlling for country, firm and product fixed effects.
Third, we contribute to the food safety standards and trade literature. Most of the works have focused on the quantitative assessment of the effects of standards on trade essentially by including standards–count of notifications–as explanatory variables in gravity equations (Otsuki et al. 2001, Moenius 2006, Disdier et al. 2008). We distinguish ourselves from this literature relying on an innovative measure of product sanitary risk. Our measure captures the need at the product level for finance to comply with the food safety regulation.

The remainder of the paper is organized as follows. The next section briefly discusses some key features of the data that motivated our empirical framework. Section 3 introduces the empirical strategy. Section 4 presents our African firm-level data and gives some descriptive statistics. Section 5 reports the main estimation results. Section 6 shows some robustness checks. And finally, section 7 concludes.

2 Motivation

2.1 Access to Finance and Trade Duration

The theoretical literature shapes a role for finance on trade mainly at the time of entry, when access to financing is the most critical (Das et al., 2007; Berman and Hericourt forth). The prominence of firms entry and subsequent exit from export markets suggests that initial entry costs are not as high as theoretical models predict. The high proportion of failures in trade relationships, past the first two years of exporting, can be explained by the high costs of sustaining in the export market (Besedes 2007). This calls for a role of access to finance along the life of trade relationships. Long lasting trade relations depend on a well-functioning financial system both in the origin and destination country. In 2006, the average ratio of private credit to GDP was 110 percent in the OECD, 31 percent in Latin America–notoriously under-banked–and only 20 percent in Africa. The latter is most certainly biased upwards since a large number of African countries do not report any data. Additionally, the majority of firms located in these five countries are small and medium sized firms, for which the lack of technical qualifications and necessary capital investments constrain their ability to remain and expand on foreign export markets.
We use firm-level survey data to further show the relevance of access to finance for firms export survival.[1] We use answers from surveyed exporters in Ghana, Mali, Malawi,

[1] The survey data –100 responding companies– serves as anecdotal evidence. It highlights the importance of access to finance for exporting activity. It is by no means a representative sample of all

Senegal and Tanzania. The data comes from the World Bank International Trade Department. In each country around 100 firms provided answers to the questions. The questions are designed such that each firm can give multiple answers to each of the questions. Therefore percentage do not add up to 100. The first question investigates what are the main supply constraints to the expansion of the company exports. Among current exporters one answer largely dominates. 34% of current exporters cite the lack of finance as a main obstacle for the expansion of the company production to the larger scale. And 34% of current exporters cite the lack of finance as a main obstacle for improving the quality of the company's products. Among past exporters–that at the time of the interview had ceased activities–47% cite the lack of finance as a main obstacle for surviving in the exporting activity. The second question further considers the costs relating to exporting as potential constraints to the company sales expansion abroad. Once more, the answer that dominated among companies operating in agriculture is the costs related to complying with SPS regulation (25% of the respondents). These results highlight the large dependency of firms on external finance to support both their working capital and longer term investment needs.

2.2 Standards, Cost of Compliance and Trade Duration

In recent years, developing countries exports in high-value food products to developed-country markets have expanded considerably in response to changing consumer tastes and with the support of advances in production, transport, and other supply chain technologies. Characterized by relatively high income elasticities of demand and lower price volatility than many traditional developing country export commodities, high-value food products have emerged as a potentially major source of export growth for many African countries. Still, trade in such products is governed by a growing array of standards. Not only are food standards stringent, they are increasingly so. Standards relate to the products themselves and to the processes by which they are produced and handled.

To enter foreign markets African agri-food exports have to satisfy both stringent public and private standards. The EU being the main destination for sub-Saharan African agricultural exports (see Appendix 8.*A*), the EU legislation remains of primary importance to these countries. The EU new comprehensive food safety policy (EC R 178/2002) involves the adoption of an integrated approach covering all aspects of the food chain. Traceability implies that EU food companies have to document from/to whom they are buying/selling produce such that products can be traced back to their origin in case of food safety problems. While, they are limited to a "one step forward, one step back" principle within the EU, with no obligations to keep records in third countries, in practise, however, EU buyers are going beyond the strict legal requirements. Complete

African firms.

traceability throughout the chain up to the level of overseas producers forms parts of many private standards, including the GlobalGAP.
As a result, exporting adequate quality products requires producers to invest in production infrastructure, revise their practises through staff training and implement traceability systems. A significant body of literature provides evidence that these compliance costs are non trivial and may be sufficient to disrupt firms trade relationships. Maskus et al., (2005) use firm-level data from 16 developing countries in the World Bank Technical Barriers to Trade (TBT) Survey Database. Their findings indicate that standards do increase short-run production costs by requiring additional inputs of labor and capital. They show that a one percent increase in investment to meet compliance costs in importing countries raises variable production costs by between 0.06 and 0.13 percent in the exporting country. Additionally, they find that the fixed costs of compliance are significant and amount approximately $425,000 per firm, or about 4.7 percent of value added on average. Other attempts to quantify the compliance costs include the recent study by UNCTAD (2005). The costs of compliance with SPS for tropical fruits in three sub-Saharan African countries–including United Republic of Tanzania, Mozambique and Guinea–are estimated using the GlobalGAP protocol as a case study[2]. Appendix 8.B reports results for Tanzania. These findings illustrate the importance of both recurring operating and fixed investment costs, suggesting that compliance is both a costly and lengthy process. While these costs may be born publicly, in practise, the lack of technical and administrative capacities in developing countries implies that the cost burden fall onto individual firms. Their ability to secure sufficient liquidity to insure ongoing production as well as to make the necessary investments is essential to their profitably remaining on the market. In this manner, the relative under-development of financial systems in sub-Saharan African countries may constrain firms access to capital and subsequent export survival. The next two sections present our choice of empirical strategy and the data.

3 Empirical Strategy

Our hypothesis is that financial development differentially affects the survival of exports across products based on 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.

This differential effect calls for a difference-in-difference approach initially proposed by Rajan and Zingales (1998). Their seminal paper emphasizes the beneficial implications of financial development for industries dependent on external finance. To capture

[2]The GlobalGAP was designed to accommodate the requirements set out by international standards as well as EU regulations. For these reasons, it is a good proxy to estimate the necessary costs of complying with standards and providing safe – non rejected – products.

the differential effect of financial development across industries, they interact the country level of financial development with the industry level of external finance dependence and control for industry and country fixed effects. This allows to isolate the impact of financial development on industry growth after controlling for cross-country and within-country differences as well as omitted variable bias. Industry-level measures of external capital dependence are based on U.S. firms financial data. The indicator of a sector's reliance on outside finance is defined as the ratio of capital expenditures minus cash flow from operations to capital expenditures for the median firm in each industry taking the average across years. Thus, the measure of external finance dependence captures technological demand for financing for each industry and is assumed to be similar across countries.
The paper relies on the Rajan and Zingales estimation strategy to isolate a channel through which financial development may promote export survival. We do not build on Rajan and Zingales to compute our risk measure. Crucially, our proxy for financing needs of agri-food products is a measure of their sanitary risk. It is an export based rather than a production based measure, computed using rejections of exports at the EU borders. Thus, our proxy captures the need for financing associated with exporting to stringent developed countries market. Since our focus is on African firms ability to sustain in the export markets, capturing the differentiated effect of financial development requires an export based measure of financing needs.

3.1 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:

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

where ε_{ck} is an error term. For a product k and an exporter c, the dependent variable is the combined count of notifications from all EU member states between 2001 and 2008[3]. The unit of observation is an exporter $\times$ product pair and the regression is cross-sectional. To avoid picking up on any particularities generated by exporting countries'

[3] There is indeed, 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 account of 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.

exports volume, protectionist agenda or limited competition a set of control variables are included: exporter c share 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 EU's MFN tariff on product k, ($tariff_k$)[4], a dummy variable indicating whether product k is affected by a quota during the sample period ($quota_k$), 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 exporter c is affected by a ban on product k during the sample period controls for decreases in the incidence of notifications resulting from reduced imports rather than reduced risk (ban_{ck}). The initial value of EU imports of product k in the year 2000 ($totimport_k^{2000}$) is included, as products imported in large volumes are likely to be inspected–and therefore, fail inspections–more often than others. Finally, the inclusion of a country fixed effect δ_c, controls for all supplier's characteristics that may affect the quality of the product–including overall economic development.[5] Because the number of notifications is a count, estimation is by Negative Binomial–alternatively Poisson.[6]
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 standard 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, laying far away from the standard, leaves firms with two options, either conform or drop the market. As shown in section 2.2, compliance is a lengthy and costly process. Thus, for complying firms, the risk index captures the need for capital to conform with EU markets food safety requirements, and acts as a proxy for product financing needs. 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[7]. As explained in

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

[5] Even though we control for a potential protectionist agenda of the destination markets and for the exporting country time invariant characteristics, our index may still suffer from omitted variable bias. The limited time span of our data on alerts does not allow us to estimate the risk index controlling for time invariant sectorial characteristics specific to the exporting country.

[6] A Poisson would 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.

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

details above, the number of alerts *per se,* as a measure of financing needs, is a very noisy proxy 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 practise. 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 on the costs of compliance at the product level, which would be the best proxy for capital needs, is available (section 2.2). The correlations between our risk index and those alternative measures are reported in Appendix 8.C. All coefficients are below 0.35. The correlation between the number of public SPS notifications and the measure of sanitary risk is low. 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 SRI.

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 the case in practise. However we verify that the ranking of agri-food sectors based on rejection occurrences is persistent over time[8].

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 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 and process based, they are developed to correct market failures, and therefore, tend to play a dominant role in preventing fraud and ensuring minimum standards for largely homogenous agricultural products. While, 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 arise because of public regulations. Our risk measure while not accounting for private standard 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–high income countries mostly. Besides, the EU is a major destination market for our African countries' export. It makes sense to account for requirements in this destination market. All together, this substantially supports our

[8] Although not optimal, this gives us some insight on how risk may evolve across sectors over time. The number of alerts at the product level is correlated at 75% across all years between 2001 and 2008.

claim that the risk index is the best available proxy for financing needs at the product level.[9]

Appendix 8.D provides a list of the CN2 agri-food sector associated with the highest sanitary risk indices, both according to the number of "risky" products–product 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, as well as the most frequent reason for rejection. Not surprisingly, fishery products, spices emerge as the most "risky" sectors, and thus, the sectors that use the most external finance. 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 authorised threshold in inspected products.

3.2 Trade Duration and Difference in Difference Approach

Our empirical strategy consists of incorporating the Rajan and Zingales (1998) methodology into the survival analysis framework. Our focus is on the long run survival of products in foreign markets. We depart from previous works on finance and trade, where the focus is on the short-term year-to-year changes in export status of products or firms (Manova, 2008; Berman and Héricourt forth). Survival analysis is probably the most suitable tool to study the impact of financial development on the longer-term exporting status of trade relationships. While our data is initially a 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 and not to enter in the market.

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 (CPHM). We assume that the duration of exports of product k from firm i operating

[9] 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. All together 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.

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 country and sector fixed effects, an interaction term between our measure of risk with the level of financial development, a set of controls and the unobserved effects. In the Cox PH model (Appendix 8.J), the inclusion of fixed effects, result 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–HS8-digit–by fitting a stratified Cox PH model. Stratification according to the product indicator variable η_k with 698 the number of 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.
Thus, the empirical model we estimate is as follows:

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

where FD_c is the level of financial development of country c, $sanitary\_risk_k$ the risk index of product k, δ_i is a firm fixed effect, δ_j is a destination country fixed effect, Δ is an exporter $\times$ HS2 sector fixed effect[10], and ε_{cikj} is an unobserved effect. To capture the differential effect of financial development across products, we interact the country level of financial development with the product level of financing needs ($FD_c \times sanitary\_risk_k$) and control for product and country fixed effects. This allows 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[11]. That is the year we first have export data. All other explanatory variables take value at the initiation of the trade relationship. Our vector of $Controls$ includes various product and firm characteristics as well as traditional bilateral gravity variables. The 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 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 in country c with product k in the initial year of the trade relationship, $NDestinations_{cik}$, in log terms. This allows to control for the experience the firm has in supplying the world market with product k. We control for the degree of export

[10] Sector is defined at HS2 level.

[11] We do this due to the short time span of our sample, and the poor reliability of the data for African countries. Additionally, we 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.

diversification for a given firm, incorporating the number of products exported by firm i to the world market in the initial year of the trade relationship, $NProducts_{ci}$. Transport costs are proxied with bilateral distance between origin country c and destination country j in logs, $Distance_{cj}$.[12]. We also include a dummy variable that equals one if importing and exporting countries share a border, $Contiguity_{cj}$. Bilateral trade can be fostered by countries' cultural proximity. Similarity in culture can indeed 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 $8.E$ provides summary statistics of 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–to avoid biasing the standard errors downwards–in all tables we report robust standard errors clustered at the exporter-sub-sector (HS4) level. 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 problem of right-censoring is accounted for in the Cox estimation procedures[13]. Left-censoring presents a more serious problem. 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[14].

4 Data

4.1 African Firm 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[15]. The dataset combines firm level export data collected by customs authorities in five African reporting countries–Ghana, Mali, Malawi, Senegal and Tanzania. The dataset

[12] 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.

[13] Stata incudes a dummy variable taking vaue one if the spell is still existing the last year of the sample.

[14] Results not reported, available upon request.

[15] We thank Denisse Pierola and Paul Brenton.

provides trade flows for more than 5,000 HS 8-digit products[16] to 253 countries, between 2000-2008[17]. 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). Among reporting firms almost 50% only appear once in the dataset. That is, they export only one product to one destination one year. As such observations are likely to be mis-reports, we exclude them from the analysis. 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. 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[18]. Finally, the data show that 3.5% of export flows are realised by trading companies. Since our analysis focuses on agri-food products, for which changing food safety regulation may impose additional production and or transaction costs, we are concerned about producing firms. In a robustness test we drop observations from trading companies and estimate the sensitivity of our results to the exclusion of these observations.

4.2 Additional Data Sources

The data on financial development is 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 private credit to GDP as a proxy for country's financial depth. The variable ranges from 0.21 for Senegal in 2008 to 0.052 for Malawi in 2004. The annual data for GDP per capita is taken from the World Development Indicator report 2006, and is reported in constant 2000 US dollars. Financial development and GDP per capita are correlated at 78% in our sample.

Additionally, we use the level of outstanding short-term credit (TC_c) and trade credit insurance (IC_c) as reported in the Global Development Finance (GDF) as a share of GDP, as proxies for trade financing. Finally, as an alternative control for the country's quality of financial systems, we use the Getting Credit Index (EGC_c) from the World Bank Doing Business Survey (WBDBS) data for the year 2004[19]. The index ranks countries according to the strength of legal rights and the depth of credit information.

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

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

[18] Including these exporters, results hold in a similar way. Results are available upon request.

[19] This is the only available year.

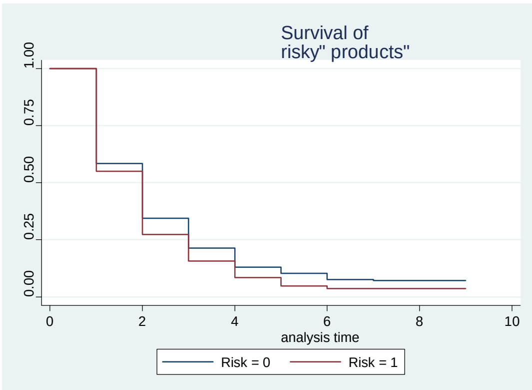
We control for additional country characteristics. We use the Ease of Doing Business index (EDB_c) and the Trading Across Borders index (TAB_c) to control for the quality of the business environment in the exporting country. A country's ranking on the former is based on the average of ten subindices–including starting a business, dealing with licenses, hiring and firing workers. More specifically, 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 is taken from the WBDBS. We use the Logistics Performance Index as a proxy for exporting country's capacity to efficiently move goods and connect with international markets (LPI_c). 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, 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 comes from the World Bank Logistic Performance Indicator database for the year 2007[16] .
Product wise, we use a perishability index, to insure 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, 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.

4.3 Descriptive Statistics

Appendix 8.F reports some statistics at the firm level for each exporting country. "Risky" products account for an important share of firms total exports in all five countries. Additionally, "risky" 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 8.G and 8.H 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 greater than 1'000'000 dollars. Dropping all spells with initial trade value inferior to 10'000 dollars (100'000, or 1'000'000 dollars) increase (even more) 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).

We now move on to characterize the duration of trade relationships non parametrically, by estimating the survival function using the Kaplan-Meier estimator (see Appendix 8.I for technical details). We consider all countries and split products into two groups according to their risk: agri-food products in the top 25th percentile of the risk index distribution, the most "risky" products, and the rest of the product, the less "risky" ones[20]. The survival functions for both products categories are presented in Figure 1.

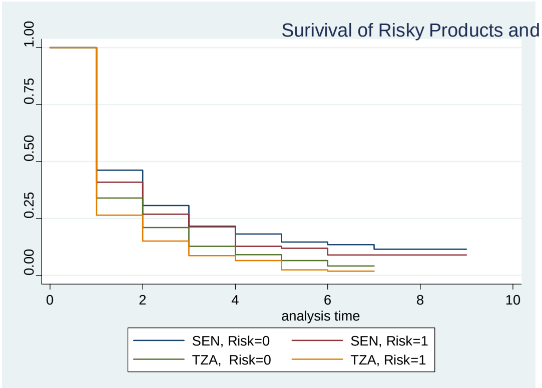
Figure 1: Survival of "Risky" versus "non Risky" Products, All Countries.



As expected, the less "risky" products (risk=0) survive longer than the riskier ones (risk=1). Tests on the equality of the survival functions reject the null hypothesis at a 1% level of significance (Appendix 8.I). The pattern remains unchanged if we consider each country individually (not reported). Finally, we plot survival functions of each risk category for Senegal and Tanzania, the countries with the highest and lowest level of financial development–measured as the ratio of private credit to GDP–in our sample (Figure 2). Results suggest that "risky" products survive longer in Senegal where financial markets are relatively better developed, yielding support to our hypothesis.

[20]The split is dictated by the high proportion of zero risk products.

Figure 2: Survival of "Risky" Products and Financial Development.



5 Empirical Results

5.1 Trade Survival and Financial Development

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 from firm i operating in country c. Our main variable of interest is the interaction term between the Sanitary Risk Index and the ratio of bank credits to GDP. The coefficient on the interaction term $(FD_c \times sanitary\_risk_k)$ captures the differentiated effect of financial development across products based on their need for external finance. In column (1) we estimate the direct effect of risk $(sanitary\_risk_k)$ and financial development (FD_c) on the probability to exit 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 all trade relationships. We find that "risky" products survive significantly less than non "risky" ones. The level of financial development in country c has a positive effect on firms' survival. Both coefficients enter statistically significant at the 1% level.

Table 1: Financial Development and Trade Survival.

The dependent variable is the hazard rate of trade relationships for product k of firm i operating in country c to 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 ($\text{sanitary\_risk}_{\text{k}}$) and its interaction with financial development in country c (FD_{c}*$\text{sanitary\_risk}_{\text{k}}$). The control variables include financial development of country c (FD_{c}), initial export value ($\text{initial\_export}_{\text{ickj}}$), number of products exported by firm i to the world market ($\text{NProducts}_{\text{ci}}$), number of destination service by firm i with product k ($\text{NDestinations}_{\text{cik}}$), gravity variables ($\text{Contiguity}_{\text{cj}}$,$\text{Com\_language}_{\text{cj}}$,$\text{Colony}_{\text{cj}}$, $\text{Distance}_{\text{cj}}$). 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
destination x exporter fe	no	yes	no	no
year fe	yes	yes	yes	yes
HS4 fe	yes	no	no	no
HS2 x exporting country fe	no	yes	yes	yes
HS8 strata	no	no	yes	no
HS8 x destination strata	no	no	no	yes
Observations	14870	14870	14870	14870

Our variable of interest is negative and significant at the 5% level, suggesting that financial development helps disproportionately more "risky" products to survive. In column (2) we add firm fixed effects controlling for unobserved time invariant firm characteristics. We stratify by HS2 $\times$ exporter and allow the baseline hazard function to vary across HS2-exporting country pair (69 pairs). In this way, we control for cross country differences in specialisation patterns. We further control for possible bilateral aid to trade programs that may influence the survival of trade relationships, including importer $\times$ exporter fixed effects. The effect of financial development alone is absorbed. The coefficient on the risk index remains positive and statistically significant. The coefficient on the interaction term is negative and significant at the 10%. In column (3) we include a product (HS 8-digit) fixed effect to control for any product time invariant characteristics. The coefficient on risk alone is absorbed. The coefficient on our interaction term remains negative and strongly significant. This specification is the closest to the original Rajan and Zingales methodology, and therefore, our preferred. We use it for all subsequent robustness checks unless specified otherwise. Finally, in the last column of Table 1, we estimate an even more rigorous specification, including HS8 $\times$ destination fixed effects. The inclusion of HS8 x destination effects controls for unobservable protectionist measures that may impact the ability of firms to survive. 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 is negative and significant at the 10% level.

Moving to our control variables, the value of export ($initial\_export_{cikj}$), and the total number of product to all destination markets ($NProducts_{ci}$) and the total number of destination 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 company has experience with exporting and with placing the products in other markets as well. Distance as a proxy for trade costs increases the hazard rate. While sharing a common border, colonial links and a common language decrease the hazard rate. All in all, the coefficient on our variable of interest ($FD_c \times sanitary\_risk_k$) is negative and significant for all specifications, suggesting that domestic financial development increases survival 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 -0.45, when controlling for HS8 $\times$ destination country fixed effects, to -0.10 when controlling for HS2 $\times$ origin country fixed effects. 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%, 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 -0.264 in our preferred specification. Therefore, if Tanzania's level of financial development reached Senegal's, then the hazard rate of shrimps exports would decrease by $\beta * Risk * \Delta FinDev = -0.264 * 2.97 * (0.145 - 0.051) \approx 7\%$.

6 Robustness Checks

6.1 Alternative Measures of Financial Development

In Table 2 we report results using alternative measures of risk (column 2) and financial development (column 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) using a Poisson model instead of a Negative Binomial. Results remain qualitatively the same[21]. Column (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 increases survival of "risky" products in foreign markets.

[21] Alternatively, we use the count of notifications per product at the HS 6-digit level, as a measure of financing needs. The data is taken from Didiers and 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 2: Robustness I, Survival and Alternative Measures of Financial Development.

The dependent variable is the hazard rate of trade relationships for product k of firm i operating in country c to 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 ($\text{alt\_sanitary\_risk}_\text{k}$, see Jaud et al.,2009a). We use as alternative measures of financial development proxied by trade credit over GDP in country c (TC_c), by trade credit insurance over GDP in country c (IC_c) and by 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)				
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)
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)
Observations	14870	14870	14870	14870	14870

6.2 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 variable potentially correlated with financial development and that may impact the survival of products differentially. 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 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 3. The coefficient on our main variable ($FD_c \times sanitary\_risk_k$) has expected sign and remains significant in all specifications. The coefficient of the interaction term between the Sanitary Risk Index and GPD per capita , is positive and significant at the 5% level. This, most probably, signals a colinearity problem between both interaction terms (column 1)[22]. In column (2) we interact the Ease of Doing Business index with the risk index ($EDB_c \times sanitary\_risk_k$), controling for favourable business conditions in the exporting country that may positively influence exports survival. The coefficient is positive but not significant. Column (3), (4) and (5) report results when controlling for respectively, Logistic Performance Index ($LPI_c \times sanitary\_risk_k$), the quality of the trading infrastructure ($Infrustructure_c \times sanitary\_risk_k$), and the complexity of trading procedures in the exporting country ($TAB_c \times sanitary\_risk_k$). Coefficients on all three interaction terms have expected signs but fail to be statistically significant, while the coefficient on the interaction of FC_c with $sanitary\_risk_k$ remains negative and significant[23]. All in all, after controlling for overall economic development, quality of the business and trading environment, the positive effect of access to finance on firms exports survival remains. These findings yield further support to our hypothesis.

[22] We run a regression with the interaction term of GDP per capita with risk alone. The coefficient is negative and significant at the 5% level. This suggests that the overall level of economic development act in a similar way as financial development.

[23] Running separate regressions with the interaction term of each of these variables with risk alone, the coefficients are of expected sign and statistically significant.

Table 3: Robustness II, Survival and Institutional Development.

The dependent variable is the hazard rate of trade relationships for product k of firm i operating in country c to 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_cx $sanitary\_risk_c$), country c Logistic Performance index (LPI_cx $sanitary\_risk_c$), country c level of infrastructure ($Infrustructure_c$x $sanitary\_risk_c$), and country c level of trade related infrustructure (TAB_cx $sanitary\_risk_c$). 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_cx $sanitary\_risk_k$	-0.590**	-0.257**	-0.291**	-0.169*	-0.345***
	(0.243)	(0.099)	(0.146)	(0.101)	(0.130)
$initial\_export_{cikj}$	-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)
$GDPpc_c$ 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)
Observations	14870	14870	14870	14870	14870

6.3 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 only (Table 4). 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 (column (3) in Table 1). Destination markets are: non European countries only (column 1-2), high income countries only (column 3-4), low income countries only (column 5-6), and finally African countries only (column 7-8). First, results indicate that the risk index is not specific to the EU market. The coefficient on our interaction term ($FD_c \times sanitary\_risk_k$) is negative and significant at the 1% level when excluding EU countries from the sample (column 1-2). Second, the coefficients on risk and its interaction with financial development are not significant when considering low income or African countries only as destination markets. Suggesting that food safety matters solely for developed countries, restricting the role of financial development for those markets only. Precisely, it reflects the stronger concerns of developed economies 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–quality being measured by unit values.

6.4 Survival and Firms' Type

Among exporting firms 17% export to African markets only. Obviously, such firms face very different food safety requirements in comparison to firms servicing developed countries. We re-estimate our main specification considering firms that export only to Africa. The level of financial development does not seem to matter for firms that only export to the African region (column 1 in Table 5). 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 (from to -0.26 to -0.46). Additionally, 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. Additionally, large trading companies may enjoy facilitated access to trade credit. To insure our results are not driven by multinationals or large trading companies[24], we alternatively drop them from our sample and re-estimate our preferred specification. Results are reported in column (3) and (4) and show that this is not the case. Finally, firms exhibiting multiple-spell trade relationships[25] may spread the investment and operating costs, to come to compliance with food safety requirements, over different spells. We drop observations corresponding to higher order spells from our sample. Column (5) show that our results remain the same.

6.5 Perishable versus "Risky" Products

Lastly, to insure that the risk index is not picking up on other product characteristics that may affect their survival, we include as a control variable, a perishability index ($perishable_k$). We expect perishable products–that 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 in place of our main interaction term. Column (1) and (2) in Table 6, report results controlling for firm destination and year fixed effects and stratifying across HS4. In column (3) and (4) we stratify across HS8. Perishable products survive less (column 1). However, the level of financial development does not seem to matter. After controlling for the perishable nature of product, the coefficients on risk and risk interacted with financial development remain significant and of expected signs[26].

[24] We identify multinational companies based on their names; for example "NESTLE", or "COLGATE" are identified as multinationals. Trading companies are identified using search for keywords in the firm names; for example "EXPORT TRADING CO. LTD."

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

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

Table 4: Robustness III, Survival and Destination Markets.

The dependent variable is the hazard rate of trade relationships for product k of firm i operating in country c to 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) $\times$ HS4 sector level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) non EU countries	(2) non EU countries	(3) High Inc countries	(4) High Inc countries	(5) Low Inc countries	(6) Low Inc countries	(7) AF countries	(8) 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

Table 5: Robustness IV, Survival and Firms' Type.

The dependent variable is the hazard rate of trade relationships for product k of firm i operating in country c to 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. Sample description: firms only exporting to African countries (column 1), total sample excuding firms only exporting to African countries (column 2), total sample excuding trading and international companies (columns 3-4), and total sample excuding higher order spells (column 7). 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)
	Firms exporting to Africa only	Firms exporting to different regions	No international companies	No trading companies	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 6: Robustness V, Survival Sanitary Risk and Product Perishability.

The dependent variable is the hazard rate of trade relationships for product k of firm i operating in country c to 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). We control for alternative product characteristics, their perishability (perishability_k). We interact the level of financial development in country c with tthe perishability index ($\text{FD}_c \times \text{perishability}_k$). In addition we include number of non EU partners to control for altrenative 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

7 Concluding Remarks

This paper documents the importance of access to finance in determining the survival of agri-food products sensitive to food safety regulations in destination markets. We combine the econometric framework of survival analysis with the methodology introduced by Rajan and Zingales (1998). Our novelty stands in the use of a measure of product sanitary risk (Jaud et al., 2009a) as a proxy for the reliance of agri-food exportrs on external financing. The Sanitary Risk Index (Jaud et al., 2009a) is computed at the 8-digit level of the CN classification. It reflects the propensity of products to fail safety and health controls, and thus, captures the demand for financing to comply with food safety regulations at the product level.

Our paper provides strong evidence for a selective role of finance in promoting exports survival. The increased availability of finance helps disproportionately more exports of food products that require financing to keep up with food safety regulations. A well-developed financial market can thus promotes export survival of high-value food products. Additionally, our results suggest that food safety mostly matters for developed countries, restricting the role of financial development to those markets.

These findings are particularly relevant for developing countries for whom access to international markets for high-value food products is a mean to achieve higher economic growth. Policy makers may focus on addressing credit failures and enabling financial development to allow for higher export performances. In addition, our results point out an alternative route for firms unable to cope with stringent developed markets regulations. The less stringent requirements that rule regional trade offer an opportunity for firms to expand and grow stronger before they make the investments needed to service the EU or US markets.

8 Appendices

8.A 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

8.B 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

8.C 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

8.D 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,	38	2.07	934	Composition
mate and spices				Mycotoxins
Preparations of meat & 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	5	0.49	221	Food additives
and sugar Co				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.

8.E 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

8.F 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.

8.G 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

8.H 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

8.I Kaplan-Meier Estimates of Survival Functions.

In discrete time, the survivor function is defined as the probability that an individual survives at least to time t:

$$S(t) = P(T \geq t) \quad t = 1, 2, ...$$

The Kaplan-Meier estimator of the survivor function at time t is defined as:

$$\hat{S}(t) = \prod_{t_i \leq t} [n_i - d_i/n_i]$$

where t_i, $i = 1, 2...$ is the ordered failure times, n_i denotes the number of spells alive (at risk) just before time t_i, including those who will die at time t_i. Let d_i denote the number of failures (deaths) at time t_i[27].

Test on Equality of Survival Functions	Chi2 (1)	Pr>chi2	Null Hypothesis on Equality Survival Functions
Cox regression-based test	24.87	0	rejected at 1%
Wilcoxon (Breslow) test	28.28	0	rejected at 1%
Tarone-Ware test	34.3	0	rejected at 1%
Log-rank test	47.87	0	rejected at 1%

8.J 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 times,

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

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 $X = \{x_1, x_2, ...x_j, ..x_n\}$:

[27] The conditional probability that a spell dies in the time interval from $t_i - \Delta$ to t_i, given survival up to time $t_i - \Delta$, is estimated as $\frac{d_i}{n_i}$. The conditional probability that a spell survives beyond $t_i - \Delta$, given survival up to time $t_i - \Delta$, is estimated as $\frac{n_i - d_i}{n_i}$. In the limit as $\Delta \to 0, \frac{n_i - d_i}{n_i}$ becomes an estimate of the conditional probability of surviving beyond t_i given survival up to t_i.

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

is defined as the product of a baseline hazard function, $h_0(t)$, common to all observations and a parametrised 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, only. 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, affect the hazard function by a factor of $exp(\beta_j)$ at all points in time it 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.