Agricultural R&D and export survival in ECOWAS countries

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Introduction

Since the seminal work of Besedeš and Prusa (2006a) who found that the median duration of US imports is very short, many researches are focused on the analysis of trade survival across countries. This growing interest on trade duration is explained by Hess and Persson (2012) who argued that short duration in trade flows is detrimental to export growth. At firm level, ensuring long trade relationship is very important. As argued by Alessandria and Choi (2007), firms face important sunk costs for entering export market. Thus, stopping exports after a short period decreases greatly the probability to recover these sunk costs. This problematic raises an important interest on the determinants of trade survival in the recent literature. Indeed, several authors tried to explain the short duration of trade relationship by questioning its determinants at firm, product and country levels. The main determinants of trade duration found in the literature are transport costs (Hess and Persson, 2012; Besedes and Blyde, 2010; Besedeš and Prusa, 2006b; Brenton et al., 2010), GDP of destination countries and membership of a free trade area (Shao et al., 2012).

Another possible determinant of trade duration that is not sufficiently examined is research and development. Indeed, even if several studies found that R&D is an important factor for firm entry in foreign market and for export growth, few are questioning its impact on export survival especially in agricultural sector. Researches focused on agricultural export survival at country level did not examine specifically the role of R&D. The main issue largely analyzed is the implication of trade liberalization on export survival as in Bojnec and Fertő (2012) who found that European Union enlargement implies larger duration of trade for new member states. The similar results are found by Kamuganga (2012) for Intra-Africa Regional Trade Cooperation.

In this study we addressed the issue of investments in agricultural R&D in Economic Community of West African States (ECOWAS) and their possible effects on agricultural export survival. This issue is important at four levels.

First, agriculture is the main economic activity in African countries. Indeed, it contribute to about 35% in GDP and employs more than 60% of available workforce. Ensuring the survival of agricultural exports in international markets is one of the key strategies for economic development.

Second, in many ECOWAS countries, all scenarios of climate prediction suggest a reduction in the production of crops

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and livestock (Pereira, 2017). Agricultural R&D can thus lead to more resilient practices that can ensure sustainability and growth of production, and export.

Thirdly, investments in the agricultural sector seem to be very low in African countries in general and particularly in the ECOWAS countries. Indeed, since the *Maputo Declaration*[1], several studies point out that the commitment was not kept for all countries (Benin, 2012). Finally, as international standards seems to have a negative impact on trade for developing countries which are not able to meet theses standards (Czubala et al., 2009), investing in R&D is an important way to develop innovative practices and production processes to meet theses standards.

Methodology and data

Cox proportional hazard proposed by Cox (1972) is widely used in literature because of its simplicity and the fact that it is not necessary to impose a functional form for the baseline hazard. It also gives the possibility to include other covariates in the model in order to capture their effects on the hazard rate. Despite its advantages, the Cox proportional hazard has drawbacks particularly for international trade data analysis. Hess and Persson (2012) identified three of them. First, Cox proportional hazard method assumes continuous-time specification whereas trade data are observed yearly. Second, including unobserved heterogeneity in the model, makes the estimation difficult or impossible. In trade data, we do not observe all characteristics of countries or products. Estimating the Cox proportional hazard function without taking into account unobserved heterogeneity leads to biased parameters and survival function (Hess and Persson, 2012). Finally the authors argued that the Cox model assumes that the effects of explanatory variables are constant over time. If this assumption does not hold, the model will produce misleading estimates of the covariates effects. Given these disadvantages of Cox model to analyze trade data Hess and Persson (2012) recommended the use of discrete-time duration models. We then used Cloglog as our benchmark model which allows us to control for countries heterogeneity and we use Cox proportional hazard method to compare the results. In practice, we estimated in each method an equation that explain the hazard rate of trade relationship by R&D investments and others control variables.

For the empirical implementation, we used data from three sources. The first data set is trade data collected on United Nations Commodity Trade Statistics Database (UN ComTrade) that contains exports of all 15 ECOWAS countries to 76 destinations from 1993 to 2014[2]. The second data set comes from Centre d'Études Prospectives et d'Informations Internationales (CEPII) and contains gravity variables as countries GDP, distance, contiguity, ect. The third data set records data on agricultural R&D. Theses data are collected from Agricultural Science and Technology Indicators (ASTI) which is an open-access data and analysis on agricultural research investment capacity in low and middle-income countries provided by the Consultative Group for International Agricultural Research (CGIAR). It contains several measures of agricultural R&D indicators including total expenditure, total expenditure in percentage of agricultural GDP, etc. We estimated the model using agricultural R&D share in agricultural GDP and the sum of five last year total R&D expenditures. We also controlled for the characteristics of countries.

1 In 2003 at Maputo, African Heads of States and Government taken the important decision to allocate at least 10% of national budgetary to agriculture
2 Trade data are available until year 2017 but our R&D data are available until 2014

Results and discussion

We first present a non parametric estimation of trade survival function using Kaplan-Meier survival rate and then the results of the Cloglog model. Kaplan-Meier method estimates the probability of trade survival overtime. This probability can be estimated by the values of some dummy variables. In figure 1 we estimated trade survival function according to some political, geographic and trade policy variables which have potential impact on trade survival. Thus, trade between partners with colonial link between, trade agreement seems to have more survival rate. As expected, countries sharing the same border have lower death rate of trade relationship. We also found that trade between ECOWAS countries in general have more survival rate than trade between others countries. Recall that the estimation method is non parametric and does not imply that there is a causal effect relation between the two variables.

Fig. 1 Estimated Kaplan-Meier survival rate

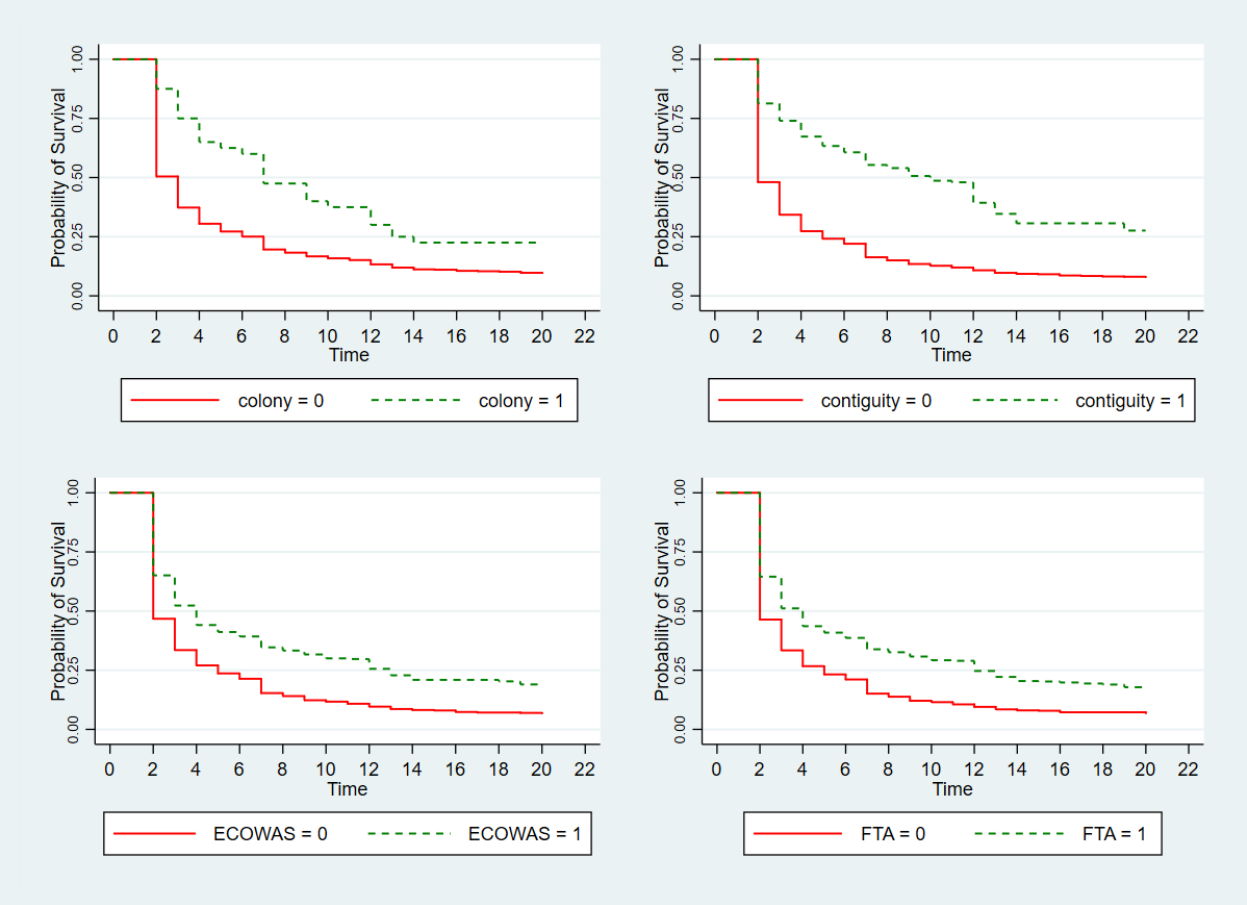

Table 1 shows the results of Cloglog and Cox proportional hazard estimations of the impact of R&D on export survival rate by controlling for other covariates namely, traditional gravity variables. For each method, we used two measures of R&D including the share of R&D in agricultural GDP and the total of last five years of R&D investment in agriculture. The last measure is motivated by the fact that R&D can be perceived as a stock and not

a flow. Indeed, knowledge created through R&D is accumulated over year. Theses knowledge can then continue to impact trade survival during many years.

As we have estimated the hazard rate, the coefficients must be interpreted in comparison with 1. Thus, if the coefficient is greater (lower) than one, the increase in the given variable increases (reduces) the hazard rate and, then decreases (increases) the probability of trade survival.

For both methods (Cox proportional an Cloglog), country investing more in agricultural R&D have higher export survival rate. As already said, we will interpret the results of Cloglog model. Thus, a 1% increase in the share of agricultural R&D decreases the hazard rate by 31.3 (1-0.687) percentage points. This decrease is 11.2 percentage points for 1% increase in the total of the five last years investments in R&D. This support our presumptions that R&D is a stock and not a flow. R&D expenditures in agricultural sector in developing countries are most often devoted to researches on improved seeds development, and new practices more climate-resilient and their diffusion to producers. This could results in increase of production of agricultural products and then increase the probability of country to maintain its trade relationships.

Table 1 Results - Impact of R&D on export survival

	Coefficients			
	Cox		Cloglog	
	(1)	(2)	(3)	(4)
Log of R&D (in % of agricultural GDP)	0.755***		0.687***	
	(0.029)		(0.026)	
Log of R&D (5 last years)		0.864***		0.888***
		(0.030)		(0.032)
Observations	14 579	14 482	14 579	14 482
Chi^2	495.03	463.37	842.30	732.32
$Prob > Chi^2$	0.00	0.00	0.00	0.00

$***$, $**$, $*$: significant at 1%, 5% and 10% respectively

Conclusion

Short duration of trade relationship is detrimental for export growth. Few researches focus on the determinants of agricultural trade survival in developing countries despite the importance of this sectors in the economies of these countries. This research tried to fill this gap by analyzing the impact of agricultural R&D on a agricultural export survival of ECOWAS counties. Our results show that investing in R&D in agriculture increase export survival rate. As agricultural export growth is an important factor for the economic development it important for ECOWAS countries, R&D must be at the heart of agricultural policies. The Maputo Declaration must therefore be renewed with particular emphasis on the orientation of public expenditures, in particular by subsidizing research projects with high potential impact on new technologies adoption by producers.

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