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Article

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Abstract: This paper establishes the determinants of the export durability of agriculture products in Zambia with specific attention to maize, sugar, cotton, and tobacco between 1996 and 2019. We find that approximately 39% of Zambia's agricultural products were exported beyond the first year of trading and less than 10% lasted up to 6 years of trading. The mean and median duration of exporting agricultural products in Zambia was 1.7 years and 1 year, respectively. Among the products, maize had the highest export duration after the first year of trading, followed by sugar, tobacco, and cotton. Results of the discrete-time logit and probit models with random effects revealed that the duration of total agricultural products was significantly impacted by common colony, contiguity, partner's gross domestic product (GDP), Zambia's GDP, initial exports, and total exports. Of these factors, colonial history and Zambia's GDP reduced export duration, while contiguity, partner's GDP, initial exports, and total exports increased the durability of exports in Zambia. The effect of Zambia's GDP was uniform across all individual agricultural products. Total exports also significantly impacted all other agriculture products in a similar manner except for maize. Export durability for cotton was significantly impacted by the Regional Trade Agreements (RTAs), while the export durability of tobacco was significantly impacted by distance, contiguity, and partner's GDP. To increase the duration of agriculture exports, we propose the exporting of finished agriculture products (and not just raw materials), which have a higher market value and duration probability. Farmers also need support with export subsidies, increased foreign market access (especially to economies with higher buying power), and negotiated favorable trade terms in the region and around the globe.

Keywords: agriculture; export duration; export survival; discrete-time models; Zambia

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1. Introduction

The last two centuries witnessed an enormous spike in international trade. The world merchandise trade was 19.48 trillion USD in 2018, a 10% rise from 2017 [1]. As posited by Ossa [2] and trade-led growth models [3], trade boosts economic growth rates of countries. For this reason, both developed and developing countries trade beyond their borders.

This study focuses on Zambia, a developing country in Africa. Zambia is endowed with natural resources, particularly minerals such as copper [4]. However, there is a growing need for economic diversification, and the country is projected to grow faster by improving the agricultural sector [5]. Furthermore, contemporary challenges such as climatic change and the economic hardship caused by the COVID-19 pandemic have awakened Zambia and the entire globe to the need for food security. This is essential as

840 million people are expected to go hungry by the year 2030 [6]. Thus, it is paramount for Zambia to not only expand the product scope by partaking in international trade but to also enhance durability of its agricultural exports. Doing so requires an understanding of factors that affect the durability of exports, especially in the importing countries. Therefore, our task is to describe the trend of export duration of agricultural products in Zambia alongside establishing its determinants.

Trade duration is a relatively new concept in international trade literature. It was first applied by Besedeš and Prusa [7,8] and Sabuhoro et al. [9] in the context of international trade. Besedeš and Prusa [7,8] analyzed the duration of imports in the United States of America (USA), while Sabuhoro et al. [9] assessed export duration in Canada. Both studies found that trade relationships are short-lived, a stylized fact that has been confirmed in other countries, e.g., Germany by Nitsch [10], Turkey by Türkcan and Saygılı [11], and developing countries by Brenton et al. [12] and Carrère and Strauss-Kahn [13]. Briefly, export duration is the likelihood that a product will be exported to a specific destination nonstop for a certain period of time (usually months or years). It is important to improve export duration as it deepens existing trade relationships and enhances long-term export growth [12,14–17].

According to our knowledge, this subject has only been addressed by Banda and Simumba [18] in Zambia. The authors researched channels of export growth, through export margins, in Zambia using customs transaction data ranging from 1999 to 2011. Export duration was briefly described using Kaplan–Meier survival, whereby the average duration of Zambia's exports was found to be about 2 years. The determinants of export duration were not established, as the study largely concentrated on explaining the role of extensive and intensive margins on export growth in Zambia. The extensive margin assesses export growth that arises from trading in new markets and new products, while the intensive margin evaluates export growth from trading in existing markets and products. Trade margins are related to export duration as they both assess the channels of export growth; however, trade margins illustrate the static part of export growth, while export duration explains the dynamic part [19].

Failure to establish the determinates of export duration by Banda and Simumba [18] is a deficiency that we address in this study. In addition, Banda and Simumba [18] did not describe export duration by product categories, yet sectors such as agriculture exhibit potential for Zambia's export growth in the future [5]. It is these two research gaps that this paper fills. To do so, we use macrolevel data ranging from 1996 to 2019. We establish export duration of overall agricultural products and disaggregated categories—maize, sugar, tobacco, and cotton—which are among the country's major agriculture exports, of which the sector constitutes 23.1% of Zambia's non-mineral exports [20].

We find that about 39% of Zambia's agricultural exports survive beyond the first year of trading. The duration rate in the second year of exporting is 24%, and it is less than 10% after six years of trading. Among products, maize has the highest duration rate after the first year of trading, followed by sugar, tobacco, and cotton. Nonetheless, tobacco overtakes sugar after 7 years of trading, signifying the effect of experience. The duration of total agricultural exports from Zambia is determined by colonial history, contiguity, partner's gross domestic product (GDP), Zambia's GDP, initial exports, and total exports. These factors have a heterogenous effect on categories of agricultural products.

The remainder of this article is organized as follows: Section 2 presents the literature review, Section 3 describes the empirical model, Section 4 provides the data and presents the preliminary results, Section 5 discusses the empirical results, and Section 6 concludes the article and makes policy recommendations.

2. Literature Review

2.1. Theoretical Literature

Mainstream trade theory is founded on three major theories: the absolute advantage, the comparative advantage, and the Heckscher–Ohlin. These theories explain why and how countries trade, but they do not explain the duration of trade relationships between countries. Instead, trade duration is explained through theoretical models such as the product life cycle, sunk-cost model, and search-cost model.

The product life cycle (PLC) by Vernon [21] explains how the production and competitiveness of a product transition from a developed country to a developing country. A product is initially produced in a developed country due to the advanced level of skilled labor. With mass acceptance and imitation, production of the product shifts to a developing country which has cheaper and less skilled labor. The developing country acquires a comparative advantage in production and export of the respective product, leaving the developed counterpart to either stop production of that product or develop a better version of the product. This process entails death and birth of the product, which describes its trade duration.

The sunk-cost model [22–24] and the search-cost model [25] also explain the duration of exports. The sunk-cost model suggests that, once a firm pays its sunk costs, it prefers to stay on the foreign market so as to recover its previous losses and make profits despite its initial temporary losses. That is one of the reasons why firms persist on the foreign market [26,27]. Conversely, the search-cost model entails buyers on the foreign market buying products from exporters on a trial basis. This has an impeding effect on the duration of exports as importers are usually uncertain about the exporter's abilities to deliver products. The sunk-cost and the search-cost models cannot fully explain the shorter duration of exports [7,8,10,28] However, they lay a basis for which the empirical literature builds on to study export duration.

2.2. Empirical Literature

Besedeš and Prusa [7] presented a pioneer study on trade duration in the context of international trade. The authors analyzed a Cox proportional hazard model [29] on import data in the United States (US) spanning the period of 1972 to 2001, and they found that the median export period to the US is between 2 and 4 years. This has so far been revised to 1 year by Hess and Persson [30] who applied discrete-time duration models (probit, logit, and complementary log–log) to the same data. Other scholars found a similar outcome in other countries. For instance, the median export duration in Germany is 2 years [10], while it is 1 year in Turkey [11], and 2 years for developing countries [13]. Studies on African countries also affirmed the short lifespan of exports, e.g., Kamuganga [31] for 49 African countries, Cadot et al. [32] for Mali, Malawi, Tanzania, and Senegal, Lemessa et al. [33] for Ethiopia, Mohammed [34] for Ghana, Zaki et al. [35] for Egypt, and Majune et al. [36] for Kenya.

Nonetheless, the overall trajectory of duration studies after Besedeš and Prusa [7] has been twofold. First, most studies apply discrete-time models in their analysis following the recommendation of Hess and Persson [30] that discrete-time models are superior to the continuous-time Cox model. The key reasons are discussed in the next section. Second, studies increasingly apply firm-level data due to the budding availability of microlevel data such as the customs transaction data. Some examples of firm-level duration studies are Békés and Muraközy [37], Fu and Wu [38], Lejour [39], Zhu, Liu, and Wei [40], Anwar et al. [41], and Kostevc and Kejžar [42]. Nevertheless, we focus on macrolevel studies since our study applies country-level data. Our study is aligned with the literature on export duration of agricultural and food products given that it is our subject matter.

We reckon that a few studies assessed the export duration of agricultural and food products. Some notable examples include Wang et al. [43], who studied the duration of seafood exports from the Association of Southeast Asian Nations (ASEAN). The authors applied Cox, logit, and complementary log–log (Cloglog) models in their analysis for data spanning 1996 to 2014. They found that the mean duration of seafood exports is 4.42 years. This was determined by the GDP of importers and exporters, initial and total export indicators, importer and exporter population, and Regional Trade Agreements

(RTA), all having an incremental probability for the duration of trade, while distance had the reverse effect.

Peterson et al. [44] studied the duration of fresh fruit and vegetable exports to the US between 1996 and 2018. The authors applied three sets of discrete-time models—probit, logit and Cloglog—in their analysis. They found that the prices in the USA and the exporter GDP had the highest impact on duration, with it being enhanced by proper treatment of fruits and vegetables, while exporter experience was on the lower end of the effect.

Asche et al. [45] found that at least 45% of Norwegian cod exports fail after the first year of trading. Using a Cox model, the authors concluded that distance, GDP, GDP per capita, firm size, and the number of shipments significantly influence the duration of cod exports. A few studies studied the duration of agricultural exports in New Zealand. Luo and Bano [46] followed this line of research by establish the duration and determinants of dairy products in New Zealand. The mean duration of exporting dairy products was found to be 2 years, and it is majorly determined by the GDP of the importer, the domestic GDP, population, and distance. This study applied logit and Cloglog models.

A study was conducted ascertaining the fishery trade patters between major importers and exporters among the Organization for Economic Co-operation and Development (OECD) countries [47]. Its conclusion was that intra-industry duration was much higher than inter-industry duration, with the former having a higher duration rate in horizontal with respect to vertical integrated products. Additionally, the duration of trade was impacted by gravity variables such as common boarder, language, and colonial experience, which had a positive effect on the probability of duration using the Cox proportional hazard model. Concerning the duration of shrimp exports from China, a higher probability of the hazard rate was noted, especially in Special Economic Zones, with the significant aspect culminating from partner GDP, distance, prices, and initial exports [48]. Concerning the exportation of seafood from developing countries to the European Union (EU), Zhang and Tveterås [49] using the Cox model concluded that the Generalized Scheme Preference (GSP) impacted the export performance with Preferential Trade Agreements (PTAs) and product types playing a role, particularly for processed foods coming from the developing world, where prices, GDP, and distance had higher hazard rates and were significant for that effect with a median of under 3 years.

Concerning export duration of maize, few studies were conducted [50–52]. The USA has, over the years, been the number one exporter of maize and maize products. Mostly, nations export less maize products, due to increased transportation and production costs, as well as the fact that maize is used for domestic consumption, including as food for livestock [51,52]. Lately, an increase in demand for the use of maize as an alternative energy input had contributed to its escalating need on the global platform. In addition to agreeing with the aforementioned statements, Ferto and Szerb [50] using the probit, logit, and Cloglog models observed that gravity variables, namely, partner population and GDP, significantly reduced the hazard rate, while the reverse was significantly noted in the case of distance with maize having a median duration of 2 years, with over 72% of Hungarian exports ceasing within 3 years. In most cases, the duration, impact, and direction of the flow of agriculture products was affected by trade policy, which has a consequential impact on agriculture trade duration [53]. With regard to agriculture policy, state policies in supporting agriculture entrepreneur education and innovation can pave the way for increased exports through its increased value addition [54–56], and higher market share value [57]. Furthermore, improved technology can enable increased water capacity, which is a catalyst for healthy, arable, and pastoral growth, making it possible for nations to export agriculture products which are of international standards [56,58].

3. Empirical Model

We apply a discrete-time model in our study. These models have three advantages over continuous-time models as per Hess and Persson [30]. That is, they efficiently deal with ties in duration, control for unobserved heterogeneity, and do not assume a proportional hazard, meaning that the assumption of the hazard rate depending on the covariate and constant over time is not made [13,43].

To conceptualize discrete-time duration models, we start with a life table estimator duration function as follows:

$$\hat{S}(j) = Pr(T > j) = \prod_{m=1}^{j}\left(1 - \frac{d_m}{r_m}\right) = \prod_{m=1}^{j}(1 - h_m), \tag{1}$$

where T is the number of consecutive years a product is exported between countries (spell). The failure (hazard) rate is h_m which occurs after a spell has ended. d_m is the time interval of a spell, whereby $d_m = (t_m, t_{m+1})$, for $m = 1, \ldots, j$. t_m and t_{m+1} are the start and end of the time interval. r_m is the adjusted number of spells at risk of failure at the midpoint of the time interval. It is written as $r_m = R_m - \frac{c_m}{2}$, where R_m is the number of relationships likely to fail at the beginning of the interval. Estimating Equation (1) allows establishing the duration rate of an exporting firm beyond year j. To assess the impact of covariates on the failure rate of exporting a product, we define the hazard function as follows:

$$h(x_{im}) = Pr(T_i < t_{m+1} | T_i > t_m) = F\left(x'_{im}\delta + \gamma_m + v_i\right), \tag{2}$$

where $h(x_{im})$ is the hazard rate, x_{im} is a vector of time-varying covariates defined in Table A1 (Appendix A), δ is the vector of coefficients to be estimated, and γ_m is the baseline hazard rate that is a function of (interval) time that allows the hazard rate to vary across periods. It is presented as a number of dummy variables which vary according to the length of spells. Frailty (unobserved heterogeneity) is addressed by v_i which follows a Gaussian distribution. $F(.)$ is an appropriate distribution function which can be estimated by maximizing the following log-likelihood function:

$$ln\ L = \sum_{i=1}^{n}\sum_{m=1}^{j}[y_{im}log(h_{im}) + (1 - y_{im})log(1 - h_{im})], \tag{3}$$

where L is an expression of likelihood for the whole sample, i.e., countries from i = 1, . . . , n. m represents the time interval of the spell from m = 1, . . . , j. y_{im} is a binary dependent variable, which takes the value 1 if spell i is observed to cease in year m and 0 otherwise. h_{im} is the hazard rate which is specified in Equation (2).

To estimate Equation (3), the functional form of the hazard rate (h_{im}) must be specified. In our case, we considered the logit and probit models, which are the most commonly used specifications for models with a binary dependent variable [59].

We overcame the problem of left-censoring by excluding trading relations in 1996, which was taken as our first of year trading. The main reason is the lack of clarification on whether the trade relationship began in 1996 or earlier. The last year of trading, 2019, was taken as the right-censoring, as done in related studies [45,48,49]. Multiple spells were included as a dummy, in line with similar studies [7,36]. Multiple spells arose when an export relationship stopped and then recurred during the study period.

4. Data and Preliminary Results

This study uses annual country–product–destination data from the World Integrated Trade Solution (WITS) database on exports from Zambia to 107 countries between 1996 and 2019 (for the list of countries, see Table A2, Appendix A). The data are at the six-digit level classification of the harmonized system (HS). The HS two-digit codes for the respective products are 17 for sugar, 52 for cotton, and 24 for tobacco. The HS four-digit code for maize is 1005. To guarantee credibility of our data, we used the import records of destination countries instead of Zambia's export records because import records are more reliable, especially if the exporter is a developing country [12].

Descriptive statistics of our trade data are presented in Table 1. The average value of all four agricultural products is about 1.8 million USD with the highest value being approximately 264 million USD. Maize has the highest mean in terms of products (4.27 million USD), followed by tobacco (2.319 million USD), sugar (1.745 million USD), and cotton (0.965 million USD). The descriptive statistics for all variables are presented in Table A3 (Appendix A).

Table 1. Descriptive statistics of exports.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Total Agricultural Products	4022	1.812	8.012	0	263.779
Maize	344	4.273	19.175	0	263.779
Sugar	636	1.745	4.541	0	39.857
Cotton	1732	0.965	3.953	0	64.132
Tobacco	1310	2.319	8.209	0	133.131

Source: Author's computation (2020).

Next, we use Kaplan–Meier graphs to describe the export duration of agricultural products in Zambia. The horizontal axis of these graphs plots the duration (survival time period) in years, while the vertical axis represents the observations whose spell of service exceeds a certain period (this interpretation applies for Figures 1 and 2). Figure 1 shows that 39% of agricultural exports from Zambia exceed the first year of exportation. This is equivalent to the duration rate of exports from Kenya [36] but is generally above the average of all African exports [31]. The duration rate in the second year of exporting is 24%, while it is less than 10% after 6 years of trading. Roughly 2% of agricultural exports survive to the 24th year, which is the end period of our sample. We also note that the mean and median duration of exporting agricultural products in Zambia is 1.7 years and 1 year, respectively. This is within the range of export duration of most African and developing countries [13,14,31].

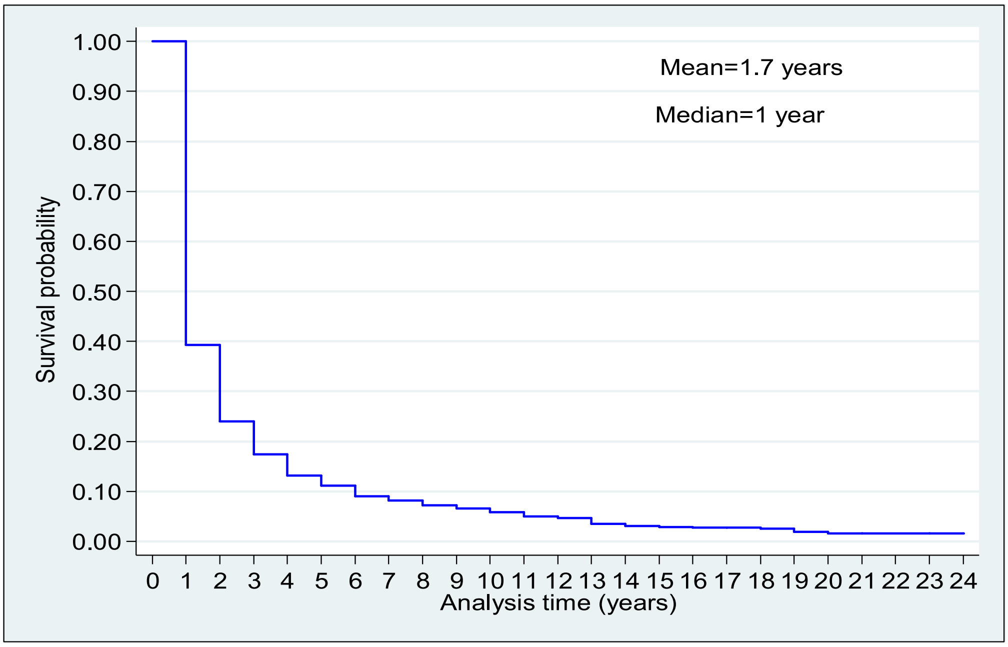

Figure 1. Export duration of total agricultural products. Source: Author's computation (2020).

Figure 2 displays the duration analysis of agriculture by product. Maize has the highest export duration rates (59%), followed by sugar, tobacco, and cotton at 48%, 37%, and 36%, respectively. The first-year duration rate of maize exports in Hungary is about 90% [50], meaning that it is higher than the survival in Zambia. Overall, the duration rate of most agricultural and fruit products in other countries was higher than that of Zambia.

For instance, Norwegian salmon exports had a rate of 76% [45], while it was 75% for fish to OECD countries [47], and shrimp from China had a rate of approximately 35% when frozen, while prepared, frozen paid, and fresh shrimp had a rate of just over 45% [48].

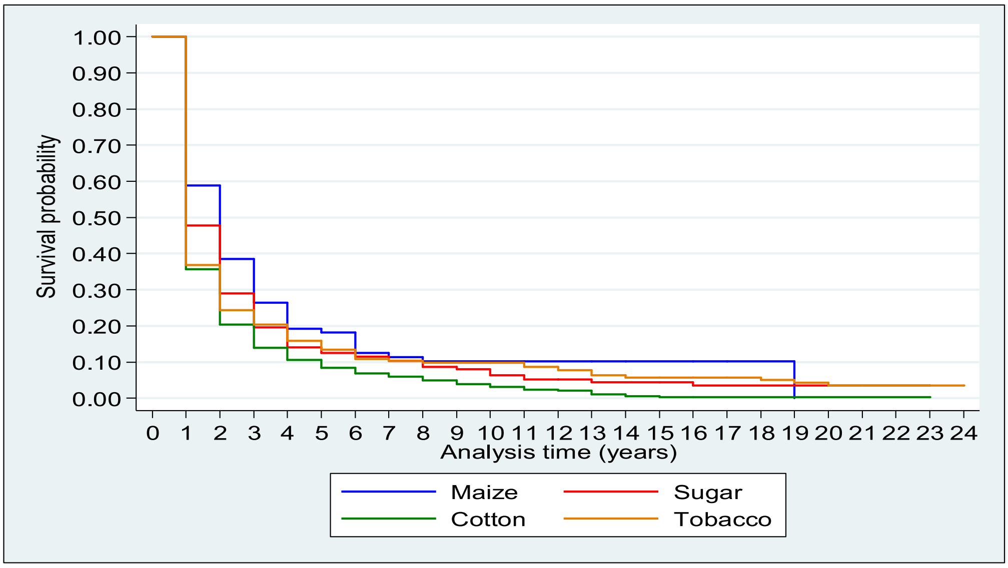

Figure 2. Export duration of agricultural products by category. Source: Author's computation (2020).

Figure 2 also shows that maize exports maintained their top spot as the highest surviving products throughout the period of our analysis. The duration of sugar exports was bypassed by that of tobacco after 2 years of trading. This pattern was maintained to the end of our sample period, implying that the duration of tobacco products improves with experience. Cotton exports had the lowest duration rate for the entire period of study. The mean and median duration of maize exports was 3.4 years and 2 years, respectively. The median export duration for other products was 1 year. The mean export duration for sugar, cotton, and tobacco was 2.5 years, 2.1 years, and 2.7 years, respectively. This can be compared to 2 years for Hungarian maize exports [50], 4 years for Norwegian salmon exports [45], 4.42 years for seafood exports from ASEAN countries [43], 2 years for New Zealand's dairy exports [46] and OECD countries' fish exports, 2 to 4 years for fruit and vegetable exports to the USA [44], 2 to 4 years for fish exports to OECD countries [47], 2 years for Malaysian food products, with beverages lasting up to 7 years [60], and under 3 years for fish exports from developing countries to the European Union (EU) [49].

5. Empirical Results

The logit and probit regression results are presented in Table 2. The probit model was used for robustness analysis in this study. The dependent variable, likelihood of a trade relationship ending, was regressed on a set of country-specific variables (see description in Table A1, Appendix A) along with other control variables. The dependent was a dummy variable with 1 indicating failure of a trade relationship in a specific year and 0 otherwise. A positive sign on a coefficient indicates failure of an export relationship (increase in the hazard rate), while a negative coefficient signifies an increase in duration of an export relationship (decrease in the hazard rate). Year fixed effects, spell fixed effects, and period and destination fixed effects were included to account for possible unobserved heterogeneity, as done by related studies [11,36]. Year and period fixed effects control for time trends, and spell fixed effects control for the presence of multiple spells, while destination fixed effects control for importer characteristics. Failure to control for these sources of heterogeneity likely leads to understatement of a positive duration dependence and overstatement of a negative duration dependence [46].

Table 2. Regression results for agricultural products (total and categories). GDP, gross domestic product; RTA, Regional Trade Agreement.

	Logit					Probit				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
	Total	**Maize**	**Sugar**	**Cotton**	**Tobacco**	**Total**	**Maize**	**Sugar**	**Cotton**	**Tobacco**
Distance	0.131	−0.568	2.267	−0.288	0.690 *	0.079	−0.339	1.307	−0.154	0.407 *
	(0.179)	(1.511)	(1.866)	(0.294)	(0.383)	(0.105)	(0.862)	(1.130)	(0.172)	(0.224)
Common language	−0.269	0.191	−0.176	−0.642	0.307	−0.166	0.103	−0.065	−0.379	0.172
	(0.206)	(1.393)	(2.978)	(0.401)	(0.367)	(0.122)	(0.796)	(1.784)	(0.236)	(0.217)
Colony	0.648 *	-	0.830	0.623	−0.238	0.391 *	-	0.451	0.374	−0.134
	(0.385)	-	(2.999)	(0.570)	(0.853)	(0.228)	-	(1.782)	(0.334)	(0.497)
Contiguity	−0.576 **	−0.711	0.455	−0.537	−1.337 **	−0.344 **	−0.415	0.245	−0.290	−0.820 **
	(0.239)	(1.600)	(1.333)	(0.453)	(0.668)	(0.141)	(0.914)	(0.812)	(0.265)	(0.390)
Partner’s GDP	−0.157 ***	0.394	−0.893	−0.096	−0.423 ***	−0.093 ***	0.230	−0.516	−0.056	−0.251 ***
	(0.052)	(0.528)	(0.924)	(0.087)	(0.103)	(0.031)	(0.300)	(0.554)	(0.051)	(0.060)
Zambia’s GDP	1.320 ***	6.575 ***	2.009 *	0.899 *	1.455 **	0.777 ***	3.767 ***	1.203 *	0.544 *	0.861 **
	(0.250)	(2.190)	(1.083)	(0.502)	(0.634)	(0.148)	(1.213)	(0.630)	(0.280)	(0.383)
Real exchange rate	−0.007	−0.073	−0.098	−0.044	0.029	−0.004	−0.043	−0.061	−0.024	0.016
	(0.024)	(0.159)	(0.088)	(0.040)	(0.048)	(0.014)	(0.091)	(0.053)	(0.024)	(0.028)
RTA	−0.325	−0.166	0.964	−1.065 **	0.276	−0.180	−0.096	0.575	−0.606 **	0.187
	(0.276)	(1.737)	(1.061)	(0.525)	(0.513)	(0.161)	(0.998)	(0.597)	(0.302)	(0.299)
Initial export value	−0.050 **	−0.155	−0.072	−0.017	−0.057	−0.029 **	−0.090	−0.044	−0.009	−0.035
	(0.022)	(0.105)	(0.054)	(0.051)	(0.039)	(0.013)	(0.059)	(0.032)	(0.030)	(0.023)
Total exports	−0.153 ***	−0.099	−0.088 *	−0.166 ***	−0.195 ***	−0.091 ***	−0.053	−0.052 *	−0.097 ***	−0.114 ***
	(0.022)	(0.295)	(0.050)	(0.043)	(0.050)	(0.013)	(0.164)	(0.030)	(0.025)	(0.029)
Constant	−24.728 ***	−152.295 ***	−39.840 *	−12.970	−26.046 *	−14.557 ***	−87.277 ***	−23.917 *	−8.136	−15.388 *
	(5.984)	(50.771)	(22.453)	(11.596)	(15.218)	(3.546)	(28.157)	(13.058)	(6.566)	(9.203)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spell effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination effects	No	No	Yes	No	No	No	No	Yes	No	No
Observations	2589	212	400	966	832	2589	212	400	966	832
Log-likelihood ratio	−1392.932	−101.631	−213.859	−523.881	−417.44681	−1392.626	−101.315	−213.675	−523.915	−417.543

Note: Standard errors are shown in parentheses. Asterisks (*) represent the level of significance, whereby * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$. Some models lack destination fixed effects to avoid the incidental parameter problem.

Results in Model 1 (Table 2) reveal that the duration of total agricultural products from Zambia is significantly determined by colonial history, contiguity, partner's GDP, Zambia's GDP, initial export value, and total exports. These results are confirmed by Model 6, which follows the probit model. Having a colonial relationship with a trading partner reduces the chances of export duration in Zambia. Contiguity increases the export duration of agricultural products in Zambia, implying that countries which share a border or are geographically close have low trade costs. Our results differ from those of Lee et al. [47] but concur with those of Wang et al. [43]. An increase in a partner's GDP increases export duration as it increases the market diversity and demand for Zambia's agricultural products. This result is in line with related studies [46–48,50]. Exporter's GDP, which in our case implied a decrease in the chances of continued duration and increased the probability of failure, was similar to Fertő and Szerb [50] but in contrast to Wang et al. [43] and Luo and Bano [46]. This possibly implies that growth in Zambia's GDP improves the production capacity of other sectors of the economy, away from agriculture. Initial export value was included to evaluate the existence of ex ante trust between trading partners, which is expected to reduce the export hazard [25]. We found that initial export increases export duration in Zambia, confirming our hypothesis. Wang et al. [60] found similar results but Asche et al. [45] and Yang et al. [48] found contrary results. The total export value of a product was included in the analysis to account for the effects of Zambia's experience on duration. We found that total exports enhance export duration; thus, experience enhances the duration of Zambia's agricultural exports.

Concerning the individual components of agriculture, Zambia's GDP significantly affected the export duration of all products, as shown by both logit and probit models (Models 2 to 5 and Models 7 to 10). Nonetheless, this effect is contrary to expectation as an improvement in Zambia's GDP reduces the duration of categories of agricultural exports. The result for maize may be influenced by the fact that it is the country's stable food. The result for other products means that their production is substituted for other sectors when Zambia's GDP increases.

The export duration of sugar products was also affected by total exports. We specifically found that a rise in total exports increased the export duration of sugar products. Hence, Zambia's experience of exporting sugar also improves the duration of sugar products. Exporting under a Regional Trade Agreement (RTA) increases the duration of cotton exports from Zambia. RTAs reduce market entry costs and have been found to raise export duration by studies such as Türkcan and Saygılı [11]. The duration of sugar exports is also enhanced by total exports, suggesting that experience is important in exporting sugar products. Sharing a common border, a rise in importer's GDP, and total exports significantly enhance the duration of tobacco exports. Distance, which signifies the cost of trading in the gravity literature [36], reduces the export duration of tobacco.

6. Conclusions and Recommendations

This study emphasized the agriculture sector as a catalyst for enabling adequate food security, employment creation, and sustained trade and economic development. An understanding of the factors affecting agriculture exports highlighted trade and market logistics in both importer and exporter countries, as alluded to in the previous section. To our knowledge, this study is the first to examine the duration of the agriculture products in Zambia. We applied discrete-time logit and probit models with random effects to assess the duration of total agricultural products at HS-6 codes alongside the duration of maize, sugar, cotton, and tobacco exports from Zambia between 1996 and 2019. Our bilateral data involved 107 partners.

We found that about 39% of Zambia's agricultural exports go beyond the first year of trading. The duration rate in the second year of exporting is 24%, while it is less than 10% after 6 years of trading. In general, the mean and median duration of exporting agricultural products in Zambia is 1.7 years and 1 year, respectively. Among products, maize has the highest duration rate after the first year of trading, followed by sugar, tobacco, and cotton. Nonetheless, tobacco overtakes sugar after 7 years of trading, signifying the effect of experience.

Concerning the empirical effects of factors that affect the export duration of total agricultural products, we found that colonial history, contiguity, partner's GDP, Zambia's GDP, initial exports, and total exports had a significant effect. Surprisingly, Zambia's GDP reduced the export duration of agricultural products, implying a deviation effect in terms of domestic capacity as a growth in GDP shifts production to other sectors of the economy. This result was uniform across all categories of agriculture products. Other factors had a heterogeneous effect on export duration of categories of agricultural products. For instance, maize was only affected by Zambia's GDP, sugar was affected by Zambia's GDP and total exports, cotton was affected by Zambia's GDP, RTA, and total exports, and tobacco was affected by distance, contiguity, partner's GDP, Zambia's GDP, and total exports. In order to ensure sustainable food security and agriculture production, ultimately accelerating sustained agriculture logistics (which is necessary for improved trade and sustainable agriculture and economic growth), this article concludes by making the recommendations below.

Having noted how the domestic economy's GDP significantly increases the hazard rate of all the four agriculture products, there is a need to increase the economy's production capacity to export more, including improving on the terms of RTAs, which increase the durability rate [47]. This was noted in the case of tobacco, which significantly increases the durability.

Zambia can emphasize the processing of more agriculture products to export finished products (instead of mostly raw materials). Some studies have shown that other economies successfully did that [43–45]. To this effect, the Zambian government can promote the production and exportation of complete clothes, cigarettes, medicines, canned sugar, maize products, etc. This is because they command a higher market value but, most importantly, last longer. This could impact the duration as both Zambia and partner countries could benefit from a prolonged trade relationship. This will also benefit and support the country's newly lanced eighth National Development Plan (NDP), which seeks to diversify the economy with agriculture amongst its pillars.

With the size of the partner's economy exhibiting a potential for increased export durability across all agricultural products as indicated by the results in Table 2, the Ministries of Agriculture and Commerce, Trade, and Industry can accelerate and improve on the promotion of agriculture by increasing market access to countries with stronger buying power, including offering export subsidies to farmers, as well as negotiate proper trade terms with regional blocs, the Commonwealth states, and the globe.

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Appendix A

Table A1. Variable description and source of data. WITS, World Integrated Trade Solution.

Variable	Description	Sources (Database)
Distance	Log of simple distance between the exporter and partner capitals	CEPII database
Contiguity	Dummy, 1 for contiguity and 0 otherwise	CEPII database
Common language	Dummy. 1 if the partner has the same common official language	CEPII database
Colony	Dummy, 1 if pairs ever in a colonial relationship and 0 otherwise	CEPII database
Zambia's GDP	Log of real GDP for Zambia	World Development Indicators
Partner's GDP	Log of real GDP of the partner country	World Development Indicators
Real exchange rate	Real exchange rate	World Development Indicators
Initial export value	Log of value of export for the previous year	WITS
Total exports	Log of total value of exports per product and destination	WITS
RTA	Dummy if a country is in a similar RTA with a Zambia	Baier and Bergstrand's website: www.nd.edu/jbergstr and WTO's RTA-IS database.

Table A2. List of countries.

Algeria	**Ghana**	**Norway**
Angola	Greece	Pakistan
Argentina	Guatemala	Philippines
Armenia	Honduras	Poland
Australia	Hong Kong	Portugal
Austria	Hungary	Romania
Azerbaijan	India	Russian Federation
Bahrain	Indonesia	Rwanda
Bangladesh	Iran	Saudi Arabia
Belarus	Ireland	Senegal
Belgium	Israel	Serbia and Montenegro
Bosnia and Herzegovina	Italy	Seychelles
Botswana	Japan	Singapore
Brazil	Jordan	Slovak Republic
Bulgaria	Kenya	Slovenia
Burkina Faso	Korea	South Africa
Burundi	Kuwait	Spain
Cambodia	Kyrgyzstan	Sri Lanka
Cameroon	Lao PDR	Sudan
Canada	Latvia	Swaziland
Chile	Lesotho	Sweden
China	Lithuania	Switzerland
Colombia	Luxembourg	Tanzania
Cote d'Ivoire	Madagascar	Thailand
Croatia	Malawi	Tunisia
Cyprus	Malaysia	Turkey
Czech Republic	Mauritius	Uganda
Denmark	Mexico	Ukraine
Dominican Republic	Moldova	United Arab Emirates
Egypt	Morocco	United Kingdom
Estonia	Mozambique	United States
Ethiopia	Namibia	Uruguay
Finland	Netherlands	Vietnam
France	New Caledonia	Yemen
Georgia	New Zealand	Zimbabwe
Germany	Nigeria	

Table A3. Summary of statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Dependent variable (failure rate)	3596	0.411	0.492	0	1
Distance	3596	8.032	0.994	6.370	9.592
Common language	3596	0.540	0.498	0	1
Colony	3596	0.029	0.168	0	1
Contiguity	3596	0.313	0.464	0	1
Partner's GDP	3595	25.208	2.194	20.032	30.655
Zambia's GDP	3596	23.274	0.753	21.947	24.059
Real Exchange rate	2690	3.079	2.782	−3.113	22.629
RTA	3596	0.484	0.500	0	1
Initial export value	3595	3.001	3.625	−6.908	10.524
Total exports	3596	7.267	4.308	−6.908	12.628

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