AGRODEP Working Paper 0025

April 2016

Decision to Export among Ghanaian Manufacturing Firms: Does Export Destination Influence the Entry Sunk Cost?

Francis M. Mulangu
Luke O. Olarinde

About the Authors

Francis M. Mulangu is an agricultural economist at the African Center for Economic Transformation, Accra, Ghana.

Luke O. Olarinde is Professor at the department of Agricultural Economics, Ladoke Akintola University of Technology, Oyo State, Nigeria.

Acknowledgments

This paper benefited from a 2015 seed grant from the African Growth and Development Policy Modeling Consortium (AGRODEP). The authors are also grateful to Professor Christopher Parameter who provided guidance in the inception and advanced versions of this paper.

This research was undertaken as part of, and partially funded by, the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by IFPRI and funded by the CGIAR Fund Donors. This paper has gone through AGRODEP's peer-review procedure. The opinions expressed here belong to the authors, and do not necessarily reflect those of AGRODEP, IFPRI, PIM or CGIAR.

Table of Contents

Abstract

Two nonexclusive hypotheses have been put forward to explain why exporters enjoy higher productivity than do non-exporters: self-selection and learning-by-exporting. In the case of a small economy such as Ghana's, we suspect that self-selection to export is less prevalent because of the high sunk cost of export market entry. While this sunk cost is considered high in the case of developing countries, its magnitude and persistence will vary by the export destination. The present paper evaluates how export destination influences export entry sunk cost. We use a dynamic probit model that corrects for the correlation between the error term and the lagged dependent variable and find African destinations to be associated with both lower and less persistent sunk costs of exporting relative to other export destinations.

Résumé

Deux hypothèses non exclusives (l'auto-sélection et l'apprentissage en exportant) ont été avancées pour expliquer pourquoi les firmes exportatrices bénéficient d'une productivité plus élevée que les firmes non-exportatrices. Dans le cas d'une petite économie comme celle du Ghana, nous pensons que la pratique de l'auto-sélection est moins répandue en raison du coût élevé d'investissement à l'accès au marché d'exportation. Bien que ce coût d'investissement soit élevé dans les pays en développement ; son ampleur et sa persistance varient selon la destination d'exportation. Le présent document évalue la façon dont la destination d'exportation influence le cout d'investissement. Nous avons utilisé un modèle dynamique de probit qui permet de corriger la corrélation entre le terme d'erreur et la variable dépendante décalée et de trouver des destinations africaines associées à la fois à des coûts d'investissement inférieurs et moins persistants par rapport à d'autres destinations d'exportation.

1. Introduction

It is a very well-documented fact that exporting firms are very different from non-exporting firms. Since the evidence was introduced in the seminal works by Bernard and Jensen (1995, 1999) and Bernard and Wagner (1997), several papers have confirmed a positive correlation between exporting and firm productivity in both developed and developing countries. Within the literature, two nonexclusive hypotheses have been put forward to explain such export productivity premiums: self-selection and learning-by-exporting. An evaluation of more than 100 publications, conducted by Brambilla, Depetris-Chauvin, and Porto (2014), describes how empirical evidence tends to support the self-selection theory better than the learning-by-exporting theory. While it is clear that productive firms become exporters, it is less clear that exporters remain significantly more productive than non-exporters.

An important starting point for documenting this evidence is found in the work of Álvarez and López (2005), who test the two theories using plant-level data from Chile. They find that plants that enter international markets show superior initial performance compared with non-exporters, which is consistent with self-selection theory. They also observe increases in productivity after plants begin to export, which is consistent with learning-by-exporting theory. In Sweden, support for both theories is reported by Hansson and Lundin (2004). In the U.K. chemical industry, Greenaway and Yu (2004) find that exporters are more productive than non-exporters, due to both self-selection and learning-by-exporting effects.

The evidence has not always favored the two theories simultaneously. Mixed evidence is reported by Isgut (2001) in Colombia, where exporters are clearly more productive than non-exporters, as the self-selection theory predicts. After entry into international markets, sales and employment keep growing significantly faster for exporters, but growth in labor productivity and capital intensity is indistinguishable between exporters and non-exporters. This is partly consistent with the learning-by-exporting hypothesis. Studying Spanish firms, Delgado et al (2002) use Kolmogorov-Smirnov nonparametric tests to provide strong evidence supporting the self-selection of more productive firms in the export market. Their evidence in favor of learning-by-exporting is rather weak, and limited to younger exporters only. Similarly, Fryges and Wagner (2008) find that firms' export activities have an effect on labor productivity growth; however, exporting improves labor productivity growth only within a sub-interval of the range of firms' export–sales ratios.

Among Sub-Saharan Africa countries, Milner and Tandrayen (2004) use employer-employee matched data for manufacturing firms in six African countries and find a positive association between individual earnings and the export status of the firm. As in Brambilla et al. (2012), the skill wage premium in exporting firms is significantly higher. In terms of productivity in Africa, Mengistae and Pattillo (2004) show that export manufacturers have an average total factor productivity premium of 17 percent. African exporters also enjoy productivity growth that is 10 percent faster than among non-exporters. Fatou and Choi (2013) found evidence of both self-selection and learning-by-exporting for the case of Senegalese manufacturing firms. Using firm-level data for the manufacturing sector in Cameroon, Ghana, Kenya and Zimbabwe, Bigsten et al (2004) estimate significant efficiency gains from exporting, which can be interpreted as learning by exporting. Van Biesebroeck (2005) reports similar results for a panel of manufacturing firms in nine African countries. The results indicate that exporters in these countries are more productive and, more importantly, that exporters increase their productivity advantage after entry into the export market (which is consistent with both self-selection and with learning-by-exporting).

In the case of a small economy, especially those recently opened to the global trade market, such as Ghana, we suspect that self-selection is less probable than learning-by-exporting. This is because exporting requires prior investments in plants, machinery, or equipment, and/or adoption and mastery of export compliance processes. As investment in plants and equipment is expensive for most firms operating in developing countries, mastery of export compliance processes remains the only option available. It must be noted, however, that even mastery of new practices does not come cheaply, and firms can find themselves facing a high sunk cost for capacity building. Firms operating in developing countries are known to be caught in a technology transfer trap: the further away these firms are from the technological frontier, the higher the costs and risks of learning (Lall and Pietrobelli, 2002). The required sunk cost to get out of the trap is particularly high in sub-Saharan African (SSA) countries because of their low technological capabilities compared to the rest of the world (Lall 1992). This sunk cost presents a near-insurmountable barrier to entry, such that firms lucky enough to enter the export market display a strong desire to remain exporters, or hysteresis to export, as this is called by Roberts and Tybout (1997).

One important determinant of export market entry sunk cost is export destination. Brambilla, Lederman, and Porto (2012) argue that there are differences across export destinations in quality valuation and in the service activities required for exportation, implying heterogeneity in returns on exports. For developing countries, exporting to high-income countries requires mastery of new skills and practices. This is because firms need to increase product quality, as argued by Verhoogen (2008), and because firms need to use skilled labor during the export process, as argued by Matsuyama (2007). However, evidence of export-related sunk cost relative to export destination for Africa-based firms is scant. The present paper seeks to fill this gap, using the case of Ghanaian manufacturing firms.

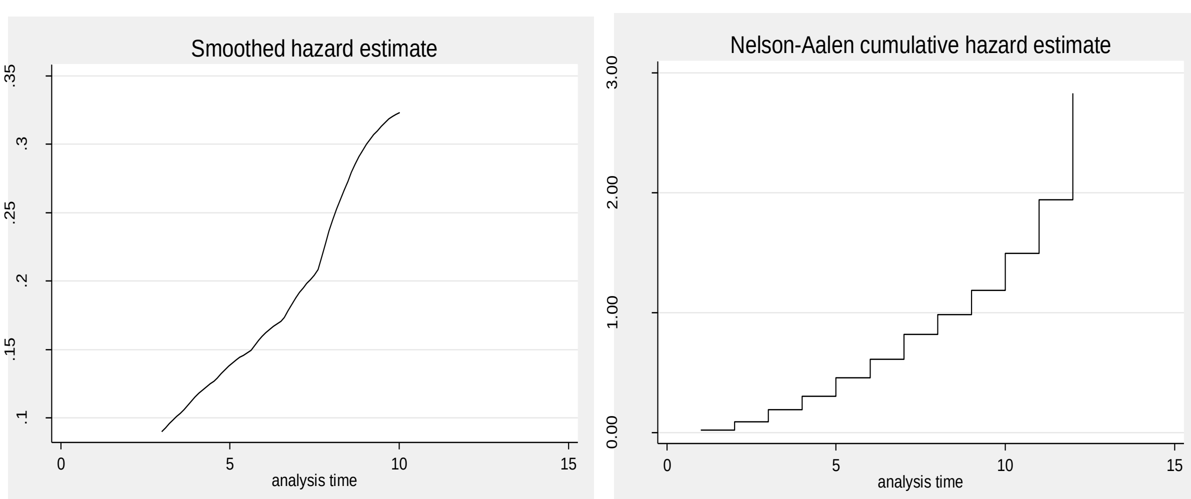
The objective of this paper is to provide evidence of both weak self-selection and strong hysteresis to export, as presented by Roberts and Tybout (1997), among Ghanaian manufacturing firms. However, unlike Roberts and Tybout (1997), we (1) test both the self-selection and learning-by-exporting theories for a small economy that has just entered the international scene, using Kolmogorov-Smirnov nonparametric tests following Delgado et al (2002); (2) provide useful insights on firms' transition rates in the export market as it varies across exporting destinations; and (3) use Wooldridge's (2005) dynamic probit approach to handle correlation between the error term and the lagged dependent variable and control for firm covariates and present evidence of export destination dependent sunk cost to exporting.

2. Analyses

2.1 Data

This study employs an extensive firm and worker data set from the Regional Project on Enterprise Development & Ghana Manufacturing Enterprise Survey (RPED/GMES), supported by the World Bank. These data, made available by the Centre for the Study of African Economies at the University of Oxford, record the activity of more than 280 manufacturing firms and an average of more than 1,000 workers per round. The data cover the period between 1991 and 2002 and were gathered from four of the major cities in Ghana, namely, Accra, Kumasi, Cape Coast, and Takoradi. However, only Accra and Takoradi have exporting harbors. The firms constituted a panel intended to be broadly representative of the size distribution of firms across the major sectors of Ghana's manufacturing industry, which include food processing, textiles and garments, wood products and furniture, metal products, and machinery. The firm-level variables captured in this survey can be divided into 10 groups: output, physical capital, number of workers, employee mobility, human capital, location, ownership and firm structure, export and import, unionization, and prices. The summary statistics of the variables used in the analysis are discussed in the appendix.

Figure 1: Hazard ratio and cumulative hazard ratio



Source: Author's calculation based on survey data

The hazard ratio presented in the left panel of Figure 1 shows that firms are more likely to export as time elapses. In other words, while the probability of exporting is about 0.13 after a five-year period of no exporting, this changes to about 0.31 after a 10-year period of no exporting. The hazard ratio is the rate of firms exporting at time *t*, conditional on survival. A high hazard ratio implies that firms have a high rate of exporting at a given time. The graph in the right panel of Figure 3 shows the accumulation of the hazard ratio.

2.2 Testing

a. Self-selection or learning-by-exporting?

We test whether Ghanaian firms self-select to export or learn by exporting. To organize the empirical test so as to replicate the Kolmogorov-Smirnov test in Delgado et al (2002) for the case of Ghana, we undertake three tests:

1) To test for self-selection at entry, we compare the productivity distribution between exporting and non-exporting firms before their entry into the export market.
2) To test for self-selection at exit, we compare the productivity distribution between continuing exporters and exiting exporters.
3) To test for learning-by-exporting, we compare the distribution of productivity growth rates between entering exporters and non-exporting firms.

We first estimate Total Factor Productivity (TFP) after estimating a production function using the model specification developed by Levinsohn and Petrin (2003). To get a better understanding of how the algorithm in Levinsohn and Petrin (2003) works, let us consider a typical production function such that:

$$pr_{it} = \theta_0 + \theta_k k_{it} + \theta_l l_{it} + \theta_m m_{it} + \nu_{it} + u_{it}^q \quad (1)$$

where $A_{it} = \theta_0 + \nu_{it}$ represents firm-level productivity and u_{it}^q is an *i.i.d.* component, representing unexpected deviations from the mean due to measurement errors. Typically, empirical researchers estimate (1) and solve for A_{it}. Estimated productivity can then be calculated as follows:

$$\hat{A}_{it} = \hat{\theta}_0 + \hat{\nu}_{it} = y_{it} - \hat{\theta}_k k_{it} + \hat{\theta}_l l_{it} + \hat{\theta}_m m_{it} \quad (2)$$

It follows that estimating (1) using OLS leads to biased productivity estimates, caused by the endogeneity of input choices and selection bias. Moreover, in the presence of imperfect competition in output and/or input markets, an omitted-variable bias will arise in standard TFP estimation if data on physical inputs and output and their corresponding firm-level prices are unavailable. Finally, if firms produce multiple products, potentially differing in their production technology, failure to estimate the production function at the appropriate product level, rather than at the firm level, will introduce additional methodological issues.

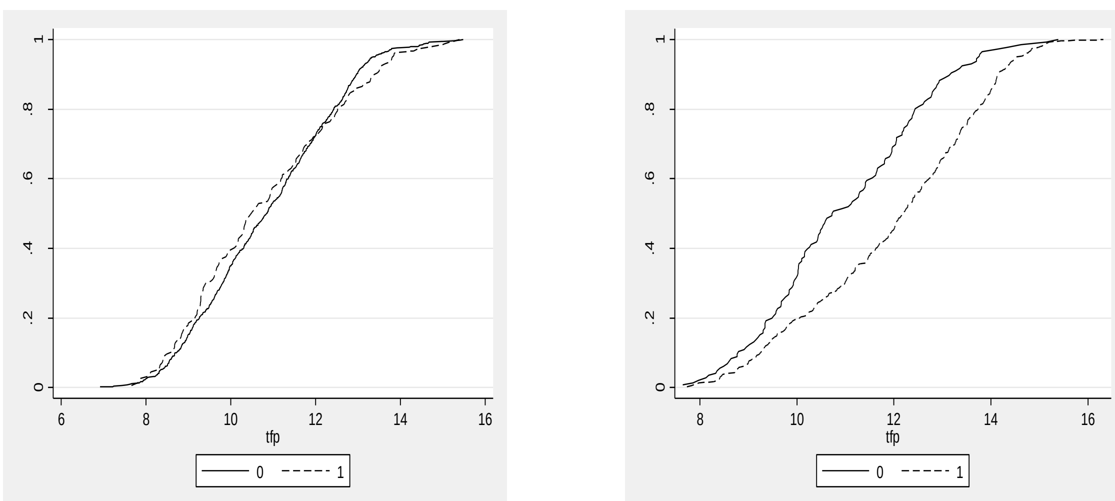
Levinsohn and Petrin (2003) propose an algorithm that uses intermediate inputs to proxy for unobserved productivity, rather than investment, as proposed by Olley and Pakes (1996). This implies that intermediate inputs (materials, in this case) are expressed as a function of capital and productivity, i.e., $m_{it} = m_t(k_{it}, \omega_{it})$, where $s_{it}(.) = m_t^{-1}(.)$. Using this expression, it is possible to rewrite (1) as:

$$pr_{it} = \theta_0 + \theta_k k_{it} + \theta_l l_{it} + \theta_m m_{it} + s_{it}(k_{it}, m_{it}) + u_{it}^q \quad (3)$$

where the coefficient on the proxy variable (i.e., materials) is now recovered only in the second stage of the estimation algorithm.

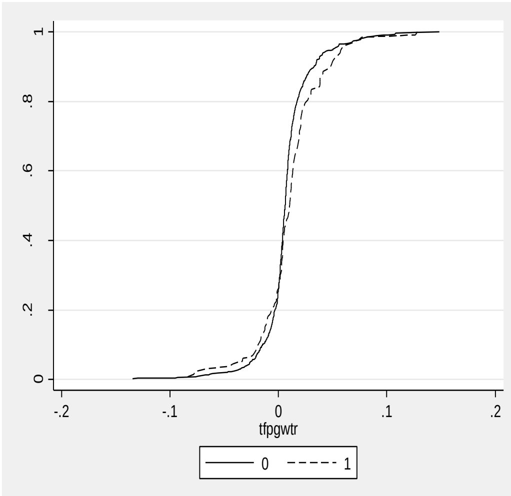
We derived the TFP for each firm in each year using material inputs as the unobserved productivity variable, in line with Levinsohn and Petrin (2003). We could not replicate the similar approach used by Delgado et al (2002) to estimate their TFP because our data set does not report cost shares. Despite this difference in TFP estimation, both of our procedures preserve the transitiveness of the TFP, which was the main objective of the TFP estimation procedure used by Delgado et al (2002). In addition, the approach taken by Levinsohn and Petrin (2003) corrects for correlation between the error term and inputs if firms' prior beliefs about the error term influenced its choice of inputs.

Figure 2: TFP level before export (left panel) and TFP level at exit (right panel) (exporters = 1; non-exporters = 0)



Source: Author's calculation based on survey data

Figure 3: Growth rate of TFP (exporters = 1; non-exporters = 0)



Source: Author's calculation based on survey data?

The graphs presented in Figures 2 and 3 illustrate aggregate results of a graphical Kolmogorov-Smirnov test. This aggregate test assumes that there is only one year of observation and that all firms are distinct. We plotted the average productivity distribution of exporters and that of non-exporters across the years and conducted tests of equality using a t-value, which was obtained by evaluating the asymptotic limiting distribution. Self-selection was found only in the case of exiting firms. The distribution of productivity of exiting firms is stochastically dominated by that of continuously exporting firms. However, we did not find statistically significant evidence that the distribution of entering firms' TFP stochastically dominates that of firms that did not enter. At the same time, we did find strong evidence of learning-by-exporting. We noted that the distribution of TFP growth rate of firms entering the export market stochastically dominates that of non-exporting firms. These results were no different when we considered only exports to Africa. While the evidence of self-selection to export is limited to exiting firms only, the evidence of learning-by-exporting is strong for African destinations.

We next disaggregated the previous results by conducting a Kolmogorov-Smirnov test for each year, as shown in Table 1. Because all firms exported in 1994, 1995, and 2001 and those years therefore lacked variation, we did not conduct the tests for those years. Some years also included instances in which there was no distinction between continuing exporters and exiting exporters because of attrition. In those cases, we could not perform the tests because of data limitations and marked these "NA." On a year-to-year basis, the evidence is weak across all three tests. In aggregate, however, we noted strong evidence of learning-by-exporting, regardless of export destination, and weak evidence of self-selection to export, which is limited to only exiting firms.

Table 1: Productivity level differences between exporters and non-exporters; hypotheses test statistics

Year	Self-selection at entry				Self-selection at exit				Learning-by-exporting			
	Number of observation		Differences favorable to exporters		Number of observation		Differences favorable to exporters		Number of observation		Differences favorable to exporters	
	Exporters	Non-exporters	Difference in TFP	P-value	Exporters	Non-exporters	Difference in TFP	P-value	Exporters	Non-exporters	Difference in TFP	P-value
1992	6	117	0.34	0.27	8	7	0.36	0.39	3	91	0.35	0.49
1993	8	106	0.42*	0.07	11	1	0.91	0.22	8	97	0.059	0.94
1994	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	32	114	0.55***	0.00	NA	NA	NA	NA
1997	7	128	0.73***	0.00	32	1	0.78	0.31	7	124	0.41	0.10
1998	12	57	0.47***	0.01	25	10	0.32	0.23	10	53	0.45**	0.03
1999	NA	NA	NA	NA	42	2	0.78*	0.09	NA	NA	NA	NA
2000	7	69	0.39	0.15	17	11	0.21	0.54	6	62	0.10	0.89
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	1	80	0.81	0.27	NA	NA	NA	NA	1	79	0.85	0.24
All	157	747	0.073	0.25	405	146	0.25***	0.00	133	656	0.18***	0.00
Africa Only	158	750	0.06	0.42	157	395	0.35***	0.00	128	665	0.16***	0.004

Note: ***=significant at 1%, **=significant at 5% and *=significant at 10%
Source: Author's calculation based on survey data

b. Entry into and exit from the export market

One potential reason for the weak self-selection evidence is the high sunk cost of entering the exporting market. Roberts and Tybout (1997) argue that a combination of sunk cost and uncertainty should induce persistence in firms' exporting status. Firms that have already paid the sunk start-up costs in the past should be relatively likely to export in the current period. The probabilities of exporting in a given year, conditional on having exported in the previous year, are used here to proxy for the sunk cost of entering the export market. We first present this evidence by estimating the transition rate into and out of the export market, conditional on the previous year's exporting status, in line with Roberts and Tybout (1997). This transition rate is a good proxy for whether or not a firm is willing to pay the sunk cost associated with moving from one status to another. The first column in Table 2 below presents the export status in time, *t*, and the second column shows the export status in time *t + 1*.

Table 2: Firms' transition rates in the export market, 1991–2002

Year *t* status	**Year (*t*+*1*) status**	**1991 – 1992**	**1992 – 1993**	**1993 – 1994**	**1994 – 1995**	**1995 – 1996**	**1996 – 1997**	**1997 – 1998**	**1998 – 1999**	**1999 – 2000**	**2000 – 2001**	**2001 – 2002**	**Average, 1991–2002**
No exports	No exports	0.95	0.91	0	0	0.94	0.86	0.88	0.89	0.89	0.83	0.9	0.72
	Exports	0.04	0.09	1	1	0.06	0.14	0.12	0.11	0.11	0.17	0.1	0.28
Exports	No exports	0.82	0.72	0	0	0.7	0.54	0.51	0.58	0.54	0.45	0.53	0.56
	Exports	0.18	0.28	1	1	0.3	0.46	0.49	0.42	0.46	0.55	0.47	0.44

Source: Author's calculation based on survey data

As illustrated in Table 2, firms that did not export in year *t* are on average less likely to export in year *t + 1* compared to a firm that exported in year *t*. In addition, firms that did not export in year *t* are more likely to not export than firms that exported in year *t*. These transition rates are true not only on average but also across the years. Except in the case of 1993–1994 and 1994–1995, when all firms exported, firms that incurred the sunk start-up cost by exporting in a given year are more likely to export in the future than those that did not incur that cost.

We noted earlier that Ghanaian firms also export within the African continent. We repeated the same exercise of calculating the firms' transition rates in the African export market and present the results in Table 3. We again noted that a firm is more likely to export in Africa if it has a history of exporting in Africa compared to a firm that has no such history. A firm is also more likely to remain a non-exporter to Africa if it never previously exported to Africa, compared to a firm that exported to Africa in the past.

Table 3: Firms' transition rates in the African export market, 1991–2002

Year *t* status	Year (*t+1*) status	1991 – 1992	1992 – 1993	1993 – 1994	1994 – 1995	1995 – 1996	1996 – 1997	1997 – 1998	1998 – 1999	1999 – 2000	2000 – 2001	2001 – 2002	Average, 1991–2002
No exports	No exports	1.00	0.54	0.61	0.57	0.64	0.62	0.63	0.67	0.77	0.68	0.68	0.64
	Exports	0.00	0.46	0.40	0.43	0.37	0.38	0.37	0.33	0.23	0.32	0.32	0.36
Exports	No exports	0.41	0.29	0.11	0.14	0.16	0.17	0.14	0.18	0.23	0.21	0.21	0.27
	Exports	0.59	0.71	0.89	0.86	0.84	0.83	0.86	0.82	0.77	0.79	0.79	0.74

Source: Author's calculation based on survey data

One important point to mention here when comparing the transition rates presented in Tables 2 and 3 is that the transition rate into exporting, regardless of the previous year's exporting status, is higher for the case of the Africa market than for the case of exporting in general. However, the transition rate into non-exporting status is higher for the case of exporting in general. This means that the sunk cost associated with exporting in Africa is much lower than that associated with exporting in general. We believe that this is because exporting outside Africa is often associated with stricter requirements that take longer to master than those involved when exporting within Africa.

c. Dynamic probit specifications and export sunk cost identification

While the transition rates derived in Tables 2 and 3 give us a good idea of the relative size of sunk cost across export destinations, they may be limited because they do not account for other firm-specific covariates and are silent about the persistence of the sunk cost. To address this limitation, Roberts and Tybout (1997) developed a dynamic discrete choice model of export participation with sunk costs for a profit-maximizing firm. Their model argues that exports involve large sunk costs, which include modifying domestic products for foreign consumption, market searches, forming new distribution networks, and transportation. The existence of sunk costs in exporting has two interrelated implications. First, it creates a barrier to entry. Firms that enter into export markets must have profits sufficient to cover the fixed costs; it is therefore the more productive firms that self-select into export markets. Second, high sunk costs imply high exit costs when reentry is possible. When firms stop exporting, knowledge about export markets diminishes rapidly, and any expertise gained is lost. This is especially true today, as exporting rules change every year. Hence, those that have already incurred start-up costs should be relatively likely to export in the current period. The combination of sunk costs and uncertainty should induce hysteresis of a firm's exporting status. The sunk cost is formally modeled as a lagged export variable. Roberts and Tybout (1997) provide the following econometric framework for modeling export decisions:

$$Pr(y_{it} = 1) = \varphi(\sum_{j=1}^{J} \gamma A_{i,t-j} + \sum_{j=1}^{J} \beta y_{i,t-j} + \sum \alpha Z_{it} + \varepsilon_{it}) \qquad (4)$$

where y_{it} is the export participation dummy, equal to 1 if firm i has any export in year t, and 0 otherwise. The lagged export participation dummy is represented by y_{it-j}, while $A_{i,t-j}$ is the lagged productivity, Z_{it} is a vector of other control variables, ε_{it} is the normally distributed error term, and φ is the pdf. A positive and significant coefficient of the lagged productivity, γ, indicates self-selection into the export market. A positive and significant coefficient of prior export status (β), on the other hand, shows hysteresis in export. The higher the evidence of hysteresis in export, the higher the sunk cost of entry. Firms' managers are more likely to insist on staying in the export market when it cost them a fortune to enter the export market in the first place.

Before estimating equation (4), we first attempted to correct for the attrition problem that appeared to be endemic in the data, as just about 39% of the firms that existed in the first wave of the data had gone out of business by the 12th wave. We first tried to determine if attrition was random by comparing common characteristics between firms that survived and those that died before the 12th wave. A number of tests have been proposed to determine whether attrition in a panel is random, including attrition probits (Fitzgerald et al, 1998) and pooling tests, in which coefficients from the baseline sample with and without attritors are equal (Becketti et al, 1988). We implemented both of these tests here and found that the baseline variables explained only about 7% of panel attrition between 1991 and 2002. We later conducted the pooled test to see if the firms' characteristics were different from zero and failed to reject the null hypothesis, implying that attrition is random and will not bias our results.

Model (4) is generally called the lagged dependent variable model. In the past, the approach has been used to study the dynamics of unemployment in Arulampalam, Booth, and Taylor (2000), while Stewart (2007) and Cappellari and Jenkins (2008) used it to evaluate the dynamics of social assistance receipt in the United Kingdom. Biewen (2004) also used the approach, and extensions of it, to study poverty dynamics. To solve it, let

$$p_{it}^{*} = \gamma' Z_{it} + \beta y_{it-1} + \tau_i + \zeta_{it}; t = 2, \dots, T_i \tag{5}$$

describe the latent probability of exporting in each year of the sequence of Ti years for which a firm in the panel is observed, excluding the first year (t= 1). A firm is observed to export, y_{it}= 1, in year t if $p_{it}^{*} > 0$, and $y_{it} = 0$ otherwise.

The larger and more positive β is, the greater the probability of an exporting firm to retain its exporting status. Unobserved firms' heterogeneity is characterized by a fixed firm-specific component (τ_i) and a white noise error component (ζ_{it}), where the error terms are uncorrelated with each other and with the explanatory variables included in Z_{it}. The errors are each assumed to have a mean zero and be normally distributed, with the variance of ε_{it} normalized to be 1 and variance of τ_i estimated from the data.

The standard random effects model assumes that the unobserved firm-specific components are uncorrelated with the observed explanatory variables. We follow Cappellari and Jenkins (2008) in allowing for correlations between u_i and Z_{it} by supposing that

$$\tau_i = \zeta' \bar{Z}_i + u_i \qquad (6)$$

where u_i is distributed $N(0, \sigma_u^2)$ and is assumed independent of Z_{it} and ζ_{it} for all firms and time periods. The $\bar{Z}_i$ may be defined in several ways; we follow the common practice of defining it as the longitudinal average for each firm of each characteristic within the sector Z_{it}. Intuitively, differences in longitudinal averaged characteristics are informative about underlying firm specifics, so that the firm differences that are left (u_i) may be more plausibly supposed to be independent of observed characteristics. For brevity in notation, we subsume the time-averaged variables into the vector Z_{it} henceforth.

The model assumes that the correlation between the composite errors from any two years $t$and $s, t \neq s$, is the same for any $t, t = 2, \dots, T_i$.

$$\rho = corr(u_i + \zeta_{it}, u_i + \zeta_{is}) = \sigma_u^2 / (1 + \sigma_u^2) \qquad (7)$$

As we can see from (7), there is an issue for estimation concerning the "initial conditions" of the sequence of observations for each firm whether y_{it} is independent of u_i. If exporting in the initial year is correlated with the time-invariant firm-specific effect, a correlation is induced between the error term and the lagged dependent variable in (5), leading to bias in parameter estimates.

Many approaches have been suggested to address this bias problem. One increasingly used approach is the conditional maximum likelihood estimator proposed by Wooldridge (2005). Rather than model the joint distribution of the sequence of binary export indicators from the initial one to the final one, conditioning on the set of explanatory variables, Wooldridge (2005) suggested modeling the distribution of the binary receipt indicator from $t = 2, \dots, T_i$ and conditioning on the set of explanatory variables and the binary export indicator for the initial year. Wooldridge proposed modeling the distribution of τ_i conditional on y_{i1} and either $Z_i = (Z_{i1,} Z_{i2,} \dots, Z_{iT})$ or $\bar{Z}_\iota$. His model for the firm-specific component can be written as

$$\tau_i = a_0 + a_1 y_{i1} + u_i + \zeta_{it} \qquad (8)$$

so that the dynamic equation becomes

$$p_{it}^* = \gamma' Z_{it} + \beta y_{it-1} + \zeta' \bar{Z}_\iota + a_0 + a_1 y_{i1} + u_i + \zeta_{it}; t = 2, \dots, T_i \qquad (9)$$

By contrast, with the Orme (2001) approaches, the initial state is not modeled.

Wooldridge's (2005) estimator was developed assuming a balanced panel. However, it may be applied to unbalanced panels assuming that sample dropout is ignorable. Cappellari and Jenkins (2008) found evidence that the impact of this attrition can be ignorable.

The independent variables we considered here are TFP, a dummy variable that equates 1 if a firm imported, firm age, number of skilled workers, a city fixed effect to control for proximity to ports, a sector fixed effect, and a year fixed effect. All of these variables were lagged. To evaluate the sunk cost, we took the first, second, and third lag terms of export, following Roberts and Tybout (1997), to measure both its magnitude and its persistence.

Table 4: Dynamic probit model

	Everywhere		**Africa Only**	
Variables	**Coef.**	**P-Val**	**Coef.**	**P-Val**
$Export_{t-1}$	3.11***	0.00	2.02***	0.00
$Export_{t-2}$	-1.38***	0.00	-0.31	0.12
$Export_{t-3}$	1.31***	0.00	0.30**	0.06
TFP_{t-1}	0.11	0.37	0.12	0.20
$Wage_{t-1}$	-0.03	0.73	-0.04	0.59
$FirmAge_{t-1}$	0.00	0.63	0.00	0.87
$Price_{t-1}$	0.00	0.67	0.00	0.99
$Import_{t-1}$	0.00	0.78	0.00	0.85
Sk_worker_{t-1}	0.08	0.61	-0.02	0.87
$Export_{93}$	0.30	0.23	-0.06	0.70
$Export_{92}$	0.89**	0.02		
$Export_{91}$	-1.16***	0.00		
$Constant$	-3.31***	0.02	-2.52***	0.01
$Sector\ FE$	Yes			
$Year\ FE$	Yes			
$City\ FE$	Yes			

Note: *** = significant at 1%; ** = significant at 5%
Source: Author's calculation based on survey data

First, as expected, we did not find evidence of self-selection to export where firms with higher TFP are more likely to enter the export market the following year. TFP is positively correlated with exporting, but not statistically significant. This is evident here because of the high entry cost reflected in strong hysteresis to export, in turn reflected by the high and statistically significant export lagged term across the export destinations.

We have also noted that sunk cost is sensitive to export destination, as hypothesized. Exporting within Africa is associated with lower sunk cost compared to exporting everywhere. In addition, the sunk cost is less persistent for the case of African destinations than for all other destinations.

Table 5: Falsification tests

Chow Tests Null Hypothesis	Chi Square	P-Value
Everywhere Export_(t-1) = Africa Export_(t-1)	14.23***	0.0002
Everywhere Export_(t-2) = Africa Export_(t-2)	10.47***	0.0012
Everywhere Export_(t-3) = Africa Export_(t-3)	16.22***	0.0001

Note: *** = significant at 1%; ** = significant at 5%; * = significant at 10%
Source: Author's calculation based on survey data

Last, in an attempt to conduct a falsification test to verify whether African destinations are in fact associated with lower sunk costs, we conducted a Chow test for the null hypothesis that the lagged export coefficients are the same across exporting destinations. We found evidence at 99% confidence intervals that export lagged coefficients are different across destinations, supporting the argument of export destination–dependent sunk cost and a relatively less persistent sunk cost for African destinations.

We believe that the differences in sunk costs across export destinations are due to the quality requirements imposed by buyers in the importing countries. African destinations are most likely associated with lower demand for sophisticated products and therefore require lower export entry costs. It is therefore important for policymakers to provide appropriate export incentives for firms exporting to sophisticated destinations. Provision of training and subsidized interest rate loans to facilitate firms' acquisition of the skills and technologies required to effectively compete in sophisticated non-African markets are among the incentives that small economies such as Ghana should consider to help overcome the high and persistent sunk cost associated with non-African exporting.

3. Conclusion

Export competitiveness of manufacturing products has reemerged as a key determinant of economic transformation in a number of African countries. This reemergence is especially prominent among SSA countries and regional institutions—such as the African Development Bank, the UN's Sustainable Development Goals (SDGs), and the African Union— who have echoed the need for economic transformation and industrialization. However, following the two contentious theories that explain why exporting firms are different from non-exporting ones, the sunk cost of entering the export market appears to be a key determinant for small economies. The case of Ghana is no different. Using a dynamic probit model à la Wooldridge (2005) to correct for the correlation between the error term and the lagged dependent variable, we found African destinations to be associated with both lower and less persistent sunk costs of exporting relative to all export destinations. This justifies the argument we advanced earlier that firms operating in developing countries face important barriers to entry. However, this barrier to entry varies by export destination. It is less significant for African destinations than for other destinations because non-African destinations require more sophisticated products, necessitating more technology to produce.

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Appendix

Table 6: Summary statistics

VARIABLES		MEAN	MIN	MAX
Number of workers		86.07	1	1800
Replacement value of capital (in local currency)		7.04E+09	0	4.00E+11
Exporting firm		0.25	0	1
Firm age (in years)		19.5	0	76
Number of unskilled workers		76	0	1593
Number of skilled workers		16	1	253
Real value of output (in local currency)		8.71e+08	0	1.18e+11
Real value of capital (in local currency)		7.04e+09	0	4.00e+11
Imports		0.53	0	1
Union		0.50	0	1
Efficiency		0.46	0.003	0.82
Human capital (in		10.32	0	23
Location dummies				
	Accra	0.59	0	1
	Cape Coast	0.04	0	1
	Kumasi	0.31	0	1
	Takoradi	0.06	0	1
Subsector dummies				
	Drink processing	0.02	0	1
	Food processing	0.13	0	1
	Small-scale resource-intensive	0.01	0	1
	Chemical	0.05	0	1
	Machines	0.03	0	1
	Metal	0.19	0	1
	Furniture	0.18	0	1
	Wood	0.08	0	1
	Textile	0.04	0	1
	Garment	0.19	0	1
	Others	0.08	0	1
Number of firms in survey		297		
Number of waves		12		

Source: RPED/GMES

The summary statistics suggest that 25% of firms were involved in exports. However, this value varied substantially by location. Of the firms located in Takoradi, 51% were involved in export activities, while only 24% of those located in Kumasi were. The reason for this difference is obvious, given the proximity of Takoradi to a major port. Furthermore, 60% of the exporting firms exported outside of Africa to more sophisticated markets, which was equivalent to approximately 14% of all manufacturing firms.

Manufacturing firms in Ghana appear to remain in business for long periods of time. The average age of the firms surveyed was 19.5 years, with a maximum of 76 and a minimum of 0. The oldest firms were located in Cape Coast, while the youngest were in Kumasi. This is understandable, as Cape Coast is considered the oldest city in the country, and Kumasi recently became the economic capital of Ghana.

The average number of unskilled workers per firm was 76, with a minimum of 0 and a maximum of 1,593. Generally, unskilled workers were more attractive to firms located in Takoradi and least attractive to those in Kumasi. This is because Takoradi is home to a number of low-skill manufacturing firms due to its proximity to the port, while Kumasi attracts businessmen involved in activities that require a certain minimum skill level.

The real value of firms' output and input costs averaged to approximately 871 million and 360 million Ghana cedis (GH₵), respectively. For both of these variables, the textile firms experienced the highest output and input values, and firms in the small-scale resource-intensive subsector saw the lowest. Firms located in Takoradi had the highest output values and input costs, and those located in Cape Coast had the lowest.

On average, firms had approximately 16 skilled workers. Those with the highest number of skilled workers were located in Takoradi, and those with the lowest number were located in Kumasi. However, the average number of unskilled workers was 76, such that firms located in Takoradi had the highest average number of unskilled workers, and those in Cape Coast had the lowest. Looking at subsector differences, the textile subsector had the most skilled and unskilled workers, while the small-scale resource-intensive subsector had the fewest.

The average real value of capital was GH₵7 billion, with the textile subsector having the highest value and the small-scale resource-intensive subsector the lowest. Furthermore, firms located in Takoradi had the highest capital values, and those in Kumasi had the lowest. Nearly half of the firms imported and had workers who were registered with a union. The firms that imported the most were in the drink processing subsector, and those that imported the least were in the wood subsector. The chemical subsector had the largest number of firms registered with a union, while the small-scale resource-intensive subsector had the fewest unionized firms.

Efficiency was measured using Greene's (2005) true fixed effects approach. Most of the firms in this sample operated below the optimal efficiency level, with an average technical efficiency level of 0.58, a maximum of 0.93, and a minimum of 0.0002. The most efficient firms operated in the food processing subsector and the least efficient ones in the bakery subsector. This ratio was the highest in the food subsector and the lowest in the small-scale resource-intensive subsector. Approximately 4% of the surveyed firms were state-owned. While 21% of these firms were in the drink processing subsector, 2% were in the metal subsector. Furthermore, most of the state-owned firms were located in Takoradi, while Accra had the fewest.

We estimated human capital by estimating the weighted firm average of education and obtained an average value of 10.32 and a maximum of 23. The subsector with the highest human capital value was the chemical subsector, and the subsector with the lowest was the small-scale resource-intensive subsector. The average ratio of managers to the total number of workers per firm was 3.27, with a maximum of 50 and a minimum of 0; this simply means that for every manager, there were 3.27 non-managerial workers in a firm. The natural logarithm of the real pre-tax, per-hour wage is 4.6, with a maximum of 9.6. The subsectors that paid the highest wages were the drink and chemical subsectors, and the subsector offering the least attractive remuneration was the small-scale resource-intensive subsector. Between 1991 and 2002, real wages grew by an average rate of 1.3%.

The average worker's age was 33, with a maximum of 82 and a minimum of 14. Age differences across sector and location were not statistically significant. Overall, 80% of workers were male, and only the small-scale resource-intensive subsector was dominated by female workers, who represented 92% of all workers in this subsector. The average worker had 10.8 years of education, with a maximum of 27 and a minimum of 0. Surprisingly, years of education did not show statistically significant variance across gender. On average, 31% of workers were considered skilled, and skilled workers had four more years of education than unskilled workers. The average tenure of a worker was seven years, with a maximum of 52 and a minimum of 0. Worker turnover appeared to be highest among unskilled workers, who on average remained in a job for three fewer years than skilled workers. Workers in the garment industry remained in a position for two fewer years on average than in other subsectors.

For approximately half of the original sample, the data were obtained in all 12 years. The remaining half was subject to gradual attrition over the course of the 12 years. The original sample size was about 280 firms. The attrition rate was at 30% in 1993, 12.4% in 1994–95, 14.4% in 1996–97, and 27.5% in 1998–99. The sample size remained at 133 for the remaining years of the survey, 2000–2002. In addition, not all firms started to export in the first year. The accumulated number of years before entry into the export market varied across firms.

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