Do Firms Self-Select to Export or Learn-by-Exporting? Evidence from Ghanaian Manufacturing Firms

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VERY PRELIMINARY

Abstract

Numerous studies have documented that exporters enjoy higher productivity than do non-exporters within the same industry, controlling for observed factors that may affect productivity. In the literature, two non-exclusive explanations have been put forward to explain such export productivity premia: self-selection and learning-by-exporting. Early 1990's Ghana, a then small recently open economy under structural adjustment policies, provides us with an interesting natural experiment environment for testing the two theories. While self-selection to export is found to be weak, we found learning-by-exporting to be largest among sub-section of firms that entered the exporting scene late but quitted early.

Introduction

It is a very well-documented fact that exporting firms are very different from non-exporting firms. Since the evidence were brought out 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 developed countries, developing countries, as well as in African countries. An evaluation of more than 100 publications conducted by Brambilla, Depetris-Chauvin, and Porto (2014) describe how the conflict between the two leading theories is yet to settle. One argues that firms self-select into exporting; implying that firm managers make conscious decision to become productive in order to start exporting. The other theory suggests that firms become exporters and later become more productive, the "learning-by-exporting" theory. Empirical evidence, however, tend to support the self-selection theory; while it is clear that productive firms become exporters, it is less clear that exporters remain significantly productive than non-exporters.

An important starting point for documenting this evidence is found in the work of Alvarez and Lopez (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, 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, both because of self-selection and learning-by-exporting effects.

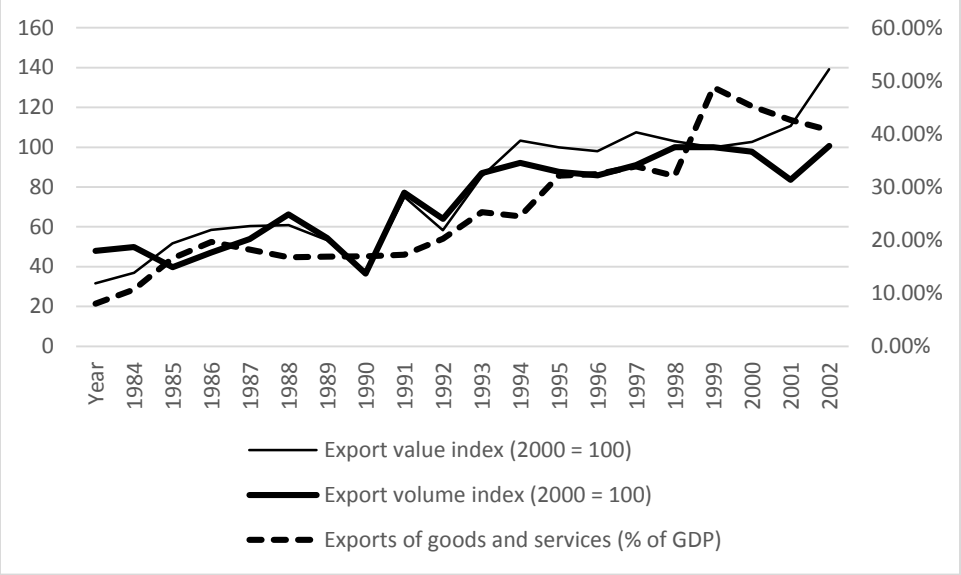
The evidence have not always been in favor of the two theories simultaneously. Mixed evidence is reported by Isgut (2001) in Colombia where exporters are clearly better than non-exporters, as the self-selection theory predicts. After entry, sales and employment keep growing significantly faster for exporters, but the growth of labor productivity and capital intensity is indistinguishable for exporters and non-exporters. This is partly consistent with the learning-by-exporting hypothesis. For Spanish firms, Delgado, Farinas and Ruano (2002) use non-parametric techniques to provide strong evidence supporting the self-selection of more productive firms in the export market. The evidence in favor of learning-by-exporting is rather weak, and limited to younger exporters only. Similarly, Fryges and Wagner (2008) find effects of firms' export activities on labor productivity growth. However, exporting improves labor productivity growth only within a sub-interval of the range of firms' export-sales ratios.

For the case of a small economy such as 1990s Ghana that recently opened to the global trade market, we suspect that leaning-by-exporting to be more prevalent than self-selection to export. This is expected because Ghana opened up to the world in the 1980's under conditionalities of both the International Monetary Fund (IMF) and the World Bank which have increased exports. By the beginning of the 1980s, severe balance-of-payments problems had made the state import substitution strategy difficult to sustain in almost all of the SSA countries that employed it, and country after country, including Ghana, turned to the International Monetary Fund (IMF) and the World Bank for help. This help was often contingent on the countries' entrance into macroeconomic stabilization programs with the IMF and programs of structural reform with the World Bank. These programs, often jointly referred to as "Structural Adjustment Programs" (SAPs), typically shared the following features: fiscal adjustment (to reduce fiscal deficits); exchange rate devaluation; trade (particularly import) liberalization; privatization of state-owned enterprises; and reduction of government involvement in production or support to select economic activities and actors. While the results of Ghana SAPs program has been disappointing, it is responsible for the high export growth Ghana experienced during the 1990's.

As illustrated in Figure 1 below, export value grew by an average rate of 4.42% between 1984 and 1991 but grew by an average annual rate of 16.92% between 1992 and 2000. We observe the same situation for export quantity which grew by an average rate of -1.55% between 1984 and 1991, and by an average rate of 14.27% between 1992 and 2000. Last, we have also noted that exports of goods and services grew by an annual rate of 15.46% between 1984 and 1991, but this growth average to about 32.92% between 1992 and 2000.

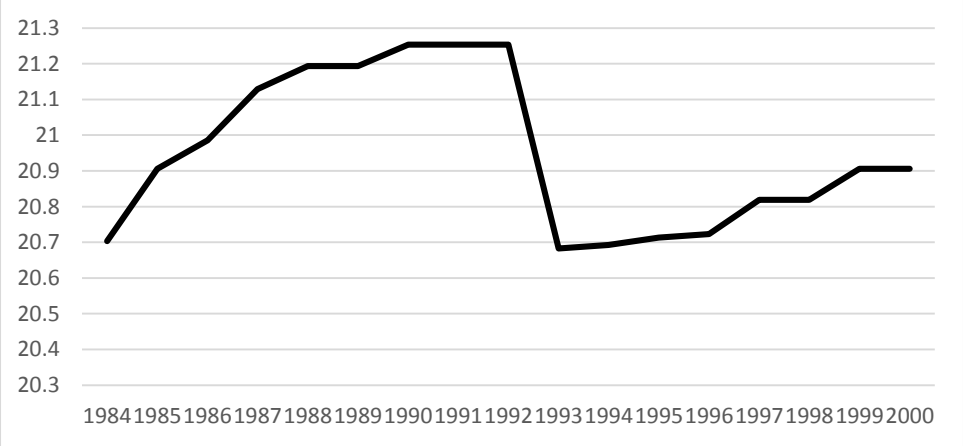
While SAP may have created a conducive environment for firms to export, it may not have positively impacted productivity. In fact, we note in Figure 2 that manufacturing value added, an important measurement for productivity followed a different and lower trajectory after the SAP. While manufacturing added value grew by an average rate of 0.38% between 1984 and 1991, it grew by an average rate of -0.18% between 1992 and 2000.

Figure 1: Export volume, value, and growth in Ghana



Source: World Development Indicator Online

Figure 2: Log of manufacturing value added in Ghana



Source: World Development Indicator Online

We are fortunate to have in our hands salient data from Ghanaian manufacturing firms for the 12 years after the end of the SAP program. This is important for two reasons. First, this period

ushered in the country's departure from the post-colonial socialist economic system to a more market economy. Second, 1992 was the year Ghana adopted its new constitution which laid the ground work for the current stable democratic political economy it is currently enjoying. Coming out of SAP with lower productivity, but rapid export growth, we hypothesize learning-by-exporting to be more relevant among Ghanaian manufacturing firms operation in the 1990s than self-selection as productivity just experienced a sharp drop from a growing trajectory in 1992.

The objective of this paper is to provide robust causality evidence of both "self-selection" and "learning-by-exporting" theories using the case of Ghanaian manufacturing firms. Unlike previous papers, we are using the case of a small open economy that suddenly opened to the world through the SAP program with initially low productivity. We further present firm-level heterogeneous evidence of the impact of exporting within the context of learning-by-exporting using non-parametric regressions.

Data

The study employs an extensive firm and worker data set from the Regional Project on Enterprise Development & Ghana Manufacturing Enterprise Survey (EDGMES) supported by the World Bank and made available by the Centre for the Study of African Economics at the University of Oxford. These data tracked more than 280 manufacturing firms and an average of more than 1000 workers per round between 1991 and 2002 from four of the major cities in Ghana, namely, Accra, Kumasi, Cape Coast, and Takoradi. 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. These sectors include food processing, textiles and garments, wood products and furniture, metal products and machinery. Table 1 below provides an overview of the summary statistics. These values are averages across firms and years.

Table 1: Summary statistics

VARIABLES	MEAN	MIN	MAX
Number of workers	86.07	1	1800
Replacement value of capital	7.04E+09	0	4.00E+11
Exporting firm	0.25	0	1
Firm age	19.5	0	76
Number of unskilled workers	76	0	1593
Number of skilled workers	16	1	253

Real value of output		8.71e+08	0	1.18e+11
Real value of capital		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		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
Sub-sector 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: EDGMES

The summary statistics suggest that 25 per cent of firms are involved in exports. However, this value varies substantially by location. Of the firms located in Takoradi, 51 per cent are involved in export activities, while only 24 per cent of those located in Kumasi are. This difference is obvious given the proximity of Takoradi to the port. Furthermore, 60 per cent of the exporting firms export outside of Africa to more sophisticated markets; and this is equivalent to approximately 14 per cent of all manufacturing firms.

Manufacturing firms in Ghana appear to remain in business for long periods. The average age of firms is 19.5 years with a maximum of 76 and a minimum of 0. The oldest firms are located in Cape Coast, while the youngest are 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 is 76 with a minimum of 0 and a maximum of 1593. Generally, unskilled workers are more attractive to firms located in Takoradi and least attractive to those in Kumasi. This is because Takoradi hosts a number of low-skill manufacturing firms due to its proximity to the port, while Kumasi attracts businessmen involved in activities that require a minimum skill level.

The real value of firms' output and input costs average to approximately 871 million and 360 million Ghana Cedis, respectively. For both of these variables, the textile firms experience the highest output and input values and firms in the small-scale, resource intensive sub-sector the lowest. In terms of location, firms located in Takoradi have the highest output values and input costs and those located in Cape Coast have the lowest.

On average, firms have approximately 16 skilled workers. Those with the highest number of skilled workers are located in Takoradi, and those with the lowest number are located in Kumasi. However, the average number of unskilled workers is 76, such that firms located in Takorai have the highest average number of unskilled workers and those in Cape Coast have the lowest. In terms of sub-sector differences, the textile sub-sector has the most skilled and unskilled workers, while the small-scale, resource intensive sub-sector has the fewest.

The average real value of capital is 7 billion Ghana Cedis, and the textile sub-sector has the highest value and the small-scale, resource intensive sub-sector the lowest. Furthermore, firms located in Takoradi have the highest capital values and those in Kumasi the lowest. Nearly half of the firms import and have workers who are registered with a union. The firms that import the most are in the drink sub-sector, and those that import the least are in the wood sub-sector. With respect to unions, the chemical sub-sector has largest number of firms registered with a union. The small-scale, resource intensive sub-sector has the fewest unionized firms.

Efficiency is measured using Greene (2005) True Fixed Effect approach. Most of the firms in this sample operate 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 operate in the food processing sub-sector and the least efficient ones in the bakery sub-sector. This ratio is the highest in the food sub-sector and the lowest in the small-scale, resource intensive sub-sector. Approximately 4 per cent of the surveyed firms are state owned. While 21 per cent of these firms are in the drink sub-sector, 2 per cent are in the metal sub-sector. Furthermore, most the state owned firms are located in Takoradi, while Accra has the fewest.

We estimated human capital by estimating the weighted firm average of education and obtain an average value of 10.32 and a maximum of 23. The sub-sector with the highest human capital value is the chemical sub-sector, and that with the least is the small-scale, resource intensive sub-sector. The average ratio of managers to the total number of workers per firm is 3.27 with a maximum of 50 and a minimum of 0. This simply means that for every manager, there are 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 sectors that pay the highest wages are the drink and chemical sectors, and the least attractive in terms of remuneration is the small-scale, resource intensive sector. Between 1991 and 2002, real wages have grown by an average rate of 1.3 per cent.

The average worker's age is 33 with a maximum of 82 and a minimum of 14. Age differences across sector and location are not statistically significant. Overall, 80 per cent of workers are male, and only the small-scale, resource intensive sector is dominated by female workers, who represent 92 per cent of all workers in this sector. The average worker has 10.8 years of education with a maximum of 27 and a minimum of 0. Surprisingly, years of education do not statistically significantly difference across gender. On average, 31 per cent of workers are considered skilled, and skilled workers have four more years of education than unskilled workers. The average tenure of a worker is seven years with a maximum of 52 and a minimum of 0. Worker turnover appears to be highest among unskilled workers, who on average remain in a job for three fewer years than skilled workers, and workers in the garment industry on average remain in a position for two fewer years than in other sectors.

For approximately half of the original sample, the data was obtained in all 12 years. The remaining half is subject of 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 remains at 133 for the remaining years, 2000-2002, of the survey. In addition, not all firms started to export in the first year. There is a variation across firms in the accumulated number of years before starting to export.

Empirical Approach

Testing for Self-Selection to Export

a. Model Specification

Roberts and Tybout (1997) developed a dynamic discrete choice model of export participation with sunk costs for a profit-maximizing firm. They argue that exports involve a large sunk cost that includes modifying domestic products for foreign consumption, market searches, 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 should have sufficient profits 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 re-entry is possible. When firms stop exporting, knowledge about export markets diminishes rapidly and the expertise gained is lost. Hence, those who 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 persistency (hysteresis) in exporting status. Roberts and Tybout (1997) provide the following econometric framework for modelling export decisions.

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

where y_{it} is the export participation dummy equal to one if firm *i* has any export in year *t* and zero otherwise. y_{it-j} is the lagged export participation dummy. $A_{i,t-j}$ is the lagged productivity, z_{it} a vector of other control variables and ε_{it} is the normally distributed error term. 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.

Before estimating equation (1), we leverage on the dynamic nature of our data to derive a few stylized facts. This is done by deriving both the hazard ratio and the survival function in figures 1 and 2. The hazard ratio is the probability that a firm in year t exports during that year, assuming that it has not exported up to that year. It is the rate of firms exporting at year *t* conditional on survival. The hazard ratios presented in the left panel of Figure 1 first states that probabilities of exporting is quiet low among Ghanaian firms. Despite this, we note some heterogeneity as firms

are more likely to export as time elapses. While the probabilities of exporting is at about 0.14 after a five years period of no exporting, this changes to about 0.32 after 10 years period of no exporting. The graph in the right panel of figure 1 is just the accumulation of the hazard ratio.

Figure 1: Hazard ratio and cumulative hazard ratio

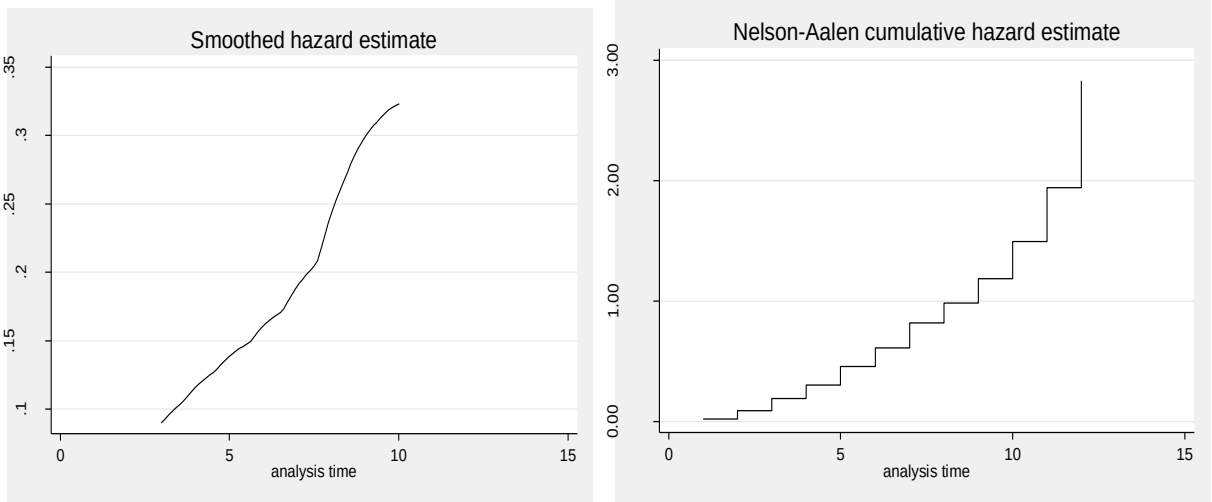
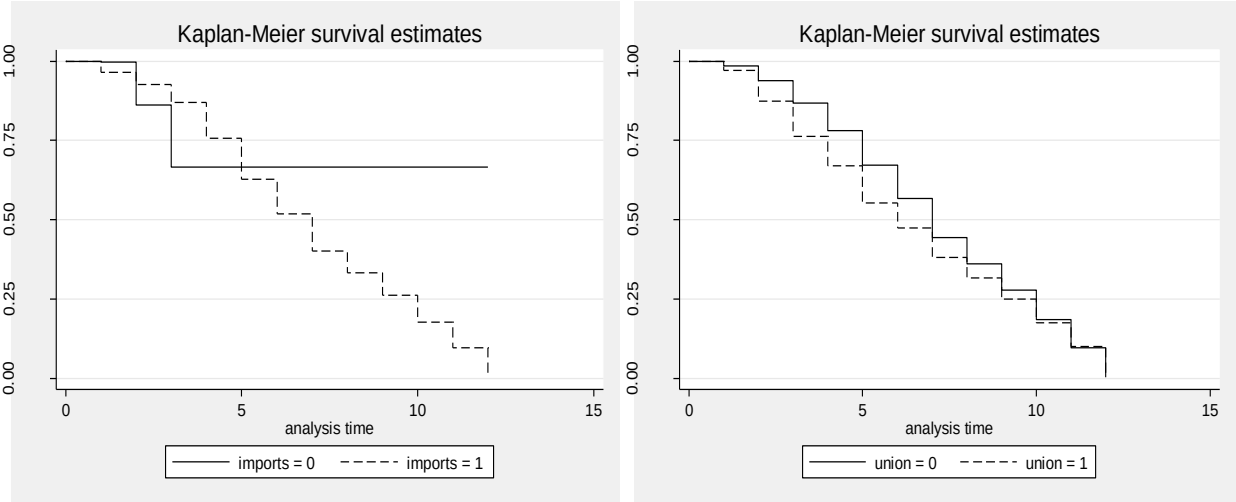


Figure 2 present the survival function. The graph in the left panel presents the difference between importing and non-importing firms and that on the right presents the difference between firms whose workers are union members to those whose workers are not. As expected, the survival function starts with 1 in the first period and gradually move toward zero. The graph states that the difference between survival rate of importing and non-importing firms depends on the analysis time. Before year five, importing firms have higher survival rate than non-importing ones. However, after year five, the tide shifts in favor of importing firms supporting evidence in Verhgroon (2008). Importing firms have higher probabilities of exporting only after operating for more than five years. The graph in the right panel of Figure 2 is relatively less conflicting than the one on the left panel. It states that unionized firms are less likely to survive than non-unionized firms. However, as time elapses, this difference becomes negligible.

Figure 2: Survival functions



b. Results

Before estimating equation (1), 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 dropped by the 12th wave. We tried to first determine if attrition was random by comparing common characteristics between firms that survived against those that died before the 12th wave. A number of tests have been proposed for whether attrition in a panel is random, including attrition Probits (Gottschalk et al., 1998) and pooling tests, in which the equality of coefficients from the baseline sample with and without attritors are equal (Becketti et al., 1988). We implement both of these tests here and found that the baseline variables to explain only about 7% of panel attrition between 1991 and 2002. We later conducted the pooled test for testing if the firms' characteristics are different than zero and fail to reject the Chi-square statistic, implying that attrition is random and will not bias our results.

We estimate equation (1) in four models illustrated in table 2 to see how controlling for sector and year fixed effects affect the results. Our variable of interest here is the previous year TFP which has a statistically significant coefficient for three out of the four model specifications. Its significance drops in model four when we control simultaneously for sector and year fixed effect. Firms that exported in the previous year are more likely to export tomorrow. Therefore, we conclude that self-selection to export is rather weak for the case of Ghana as anticipated.

Table 2: Fixed effect Probit model for testing the "self-selection to export" theory

	Model 1		Model 2		Model 3		Model 4	
Variables	Coeff	Std. Err	Coeff	Std. Err	Coeff	Std. Err	Coeff	Std. Err
Firm age	-0.015*	0.008	-0.011	0.008	-0.011	0.013	0.016	0.013
Firm age squared	0.000	0.000	0.000	0.000	0.000	0.000	0.0003*	0.000
Last yr TFP	0.023**	0.008	0.025*	0.009	0.032*	0.017	0.039	0.027
Last yr Export	1.411***	0.074	1.31***	0.076	2.216***	0.124	2.013***	0.131
Union	0.312***	0.075	0.086	0.092	0.486***	0.100	0.138	0.123
Import	0.156**	0.072	0.227***	0.076	0.053	0.098	0.167	0.106
Avg edu of firm mgmt	-0.026**	0.013	-0.019	0.013	-0.027	0.033	-0.021	0.033
Avg age of firm mgmt	-0.006	0.007	-0.010	0.007	-0.005	0.010	-0.010	0.010
Constant	-0.261	0.369	-0.051	0.291	-1.091	0.665	-0.767	0.679
Sector FE	No		Yes		Yes		Yes	
Year FE	No		No		No		Yes	

Testing for Learning by Exporting

a. Model Specification

To test the learning by exporting theory we started with the approach used by Alvarez and Lopez (2005). The model specification is such that:

$$TFP_{final} = \delta_o + \delta_1 TFP_{initial} + \boldsymbol{\Delta Ex} + \delta_2 \mu_{i1} + \varepsilon_{it} \quad (2)$$

In addition to the initial TFP, the independent variables of equation (2) include the vector $\boldsymbol{Ex}$ which is a vector of types of exporters, and transient inefficiency. Adding more continuous independent variables triggers the curse of dimensionality problem and makes the analysis intractable. We divide the firms into five groups based on the possible exporting patterns. These groups include: permanent, quitters, late entrant stayers, late entrant quitters, and no exporters. The features of these groups are such that permanents are those who engaged in exporting activities for the entire survey. Quitters are firms that entered the exporting scene early (before or in year 2) but quitted before the last wave. Late entrant stayers are firms that entered the export market late (after year 2) and stayed until the end of the study. The late entrant quitters are firms that entered late (after year 2) and quitted before the last year of the survey, and the no exporters are those who never engaged in exporting activities.

One criticism of this division is that we implicitly assume that firms started to exist in the first wave and any information prior to 1991 is less useful. For the case of Ghana, this assumption turns out to be less harmful since as mentioned early 1991-1992 are important years that are considered as the beginning of politically and economically modern Ghana.

Transient efficiency is used here to control for firm level operational heterogeneities. We derive it using the specification below:

$$y_{it} = \xi_o + x_{it}\xi + \mu_i - \gamma_i + v_{it} - \mu_{it} \quad (3)$$

In model (3), unlike conventional approaches, the error term is split into four components to take into account different factors affecting productivity, given the inputs. The first component captures firms' latent heterogeneity which has to be disentangled from inefficiency; the second component captures short-run (time-varying) inefficiency. The third component captures persistent or time-invariant inefficiency while the last component captures random shocks. This specification is the true fixed-effects (TFE) model developed by Greene (2005), in which both time-invariant unmeasured heterogeneity and time-varying firm inefficiency are considered. By splitting these two inefficiencies, we acquire an unbiased time-variant inefficiency term which is used as covariate for equation 2 because unlike the conventional efficiency terms, transient

inefficiency excludes the permanent inefficiency which for our case will be correlated with both initial and final TFP.

We mentioned earlier that Ghanaian firms have erratic exporting patterns which varies across firms. This heterogeneity in exporting behaviors will lead to heterogeneous impact of exporting and this cannot be captured using conventional OLS specifications. We use here non-parametric regression specification to derive heterogeneous results from evaluating equation (2).

Results

A key empirical issue is how one choses to relate the heterogeneous information derived from the non-parametric regression. Calculation of either the estimated surface or the respective gradients (marginal effects) offers an array of choices when presenting results. In a univariate context it is relatively straightforward to present a plot of the estimated relationship (both the function and its slope) against the data to highlight nonlinearities. However, in multivariate settings this is not typically possible, especially for the estimated slopes since these slopes are observation-specific and more than likely will depend on the values of other covariates (Henderson, Kumbhakar and Parameter, 2012).

The common practice in multivariate settings is to select a variable of interest, hold the remaining variables fixed at some value (usually the mean) and present either partial mean or partial slope functions. The key issue with this presentation is that the results are dependent upon where the remaining variables are held fixed. While holding variables fixed at the mean may appear innocuous, it is well known that as the dimensionality of the data increases, the distance of any data point from the overall mean is increasing. Thus, it is quite likely that even in settings with two or three covariates, many of the actual observations will not be close to the mean.

Henderson, Kumbhakar and Parameter (2012) introduced a novel approach to visualize slope estimates from any nonlinear model which are valid for any dimension, easily constructed and presented. This approach allows for two-dimensional figures which do not require that we fix covariates at specific values.

To visualize multivariate gradient estimates Henderson, Kumbhakar and Parameter (2012) introduce the 45 degree plot. This figure plots the estimated gradients against themselves, along with either bootstrap or asymptotic confidence bands. Next, the horizontal and vertical axes are plotted. These plots will easily allow us to distinguish where a bulk of the effects lie, which effects are significant and which effects are insignificant. These plots can help to clarify the nature of the heterogeneity that exists in estimates stemming from nonlinear models.

We use the 45 degree plot approach to present the heterogeneous relationship between TFP and exporting in the context of evaluating the learning-by-exporting theory. The 45 degree plot presents the relative relationship between each exporters both within and without their group and productivity. The observations are in back and the upper and lower bounds are in red and green respectively.

Figure 4: 45 degree plot of Initial TFP

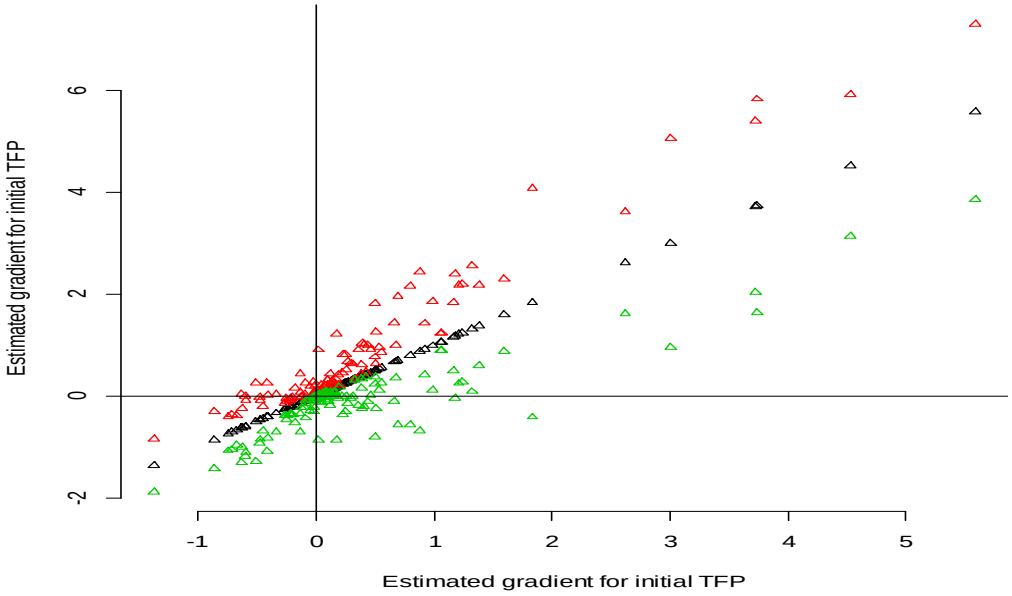


Figure 5: 45 degress plots for late quitters

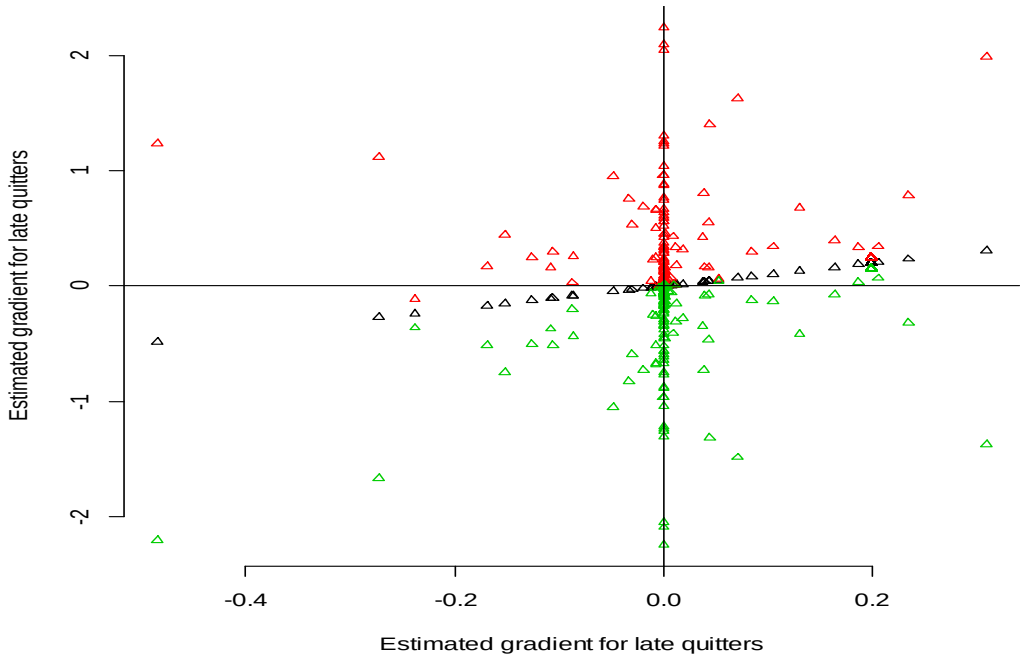


Figure 6: 45 degress plots for quitters

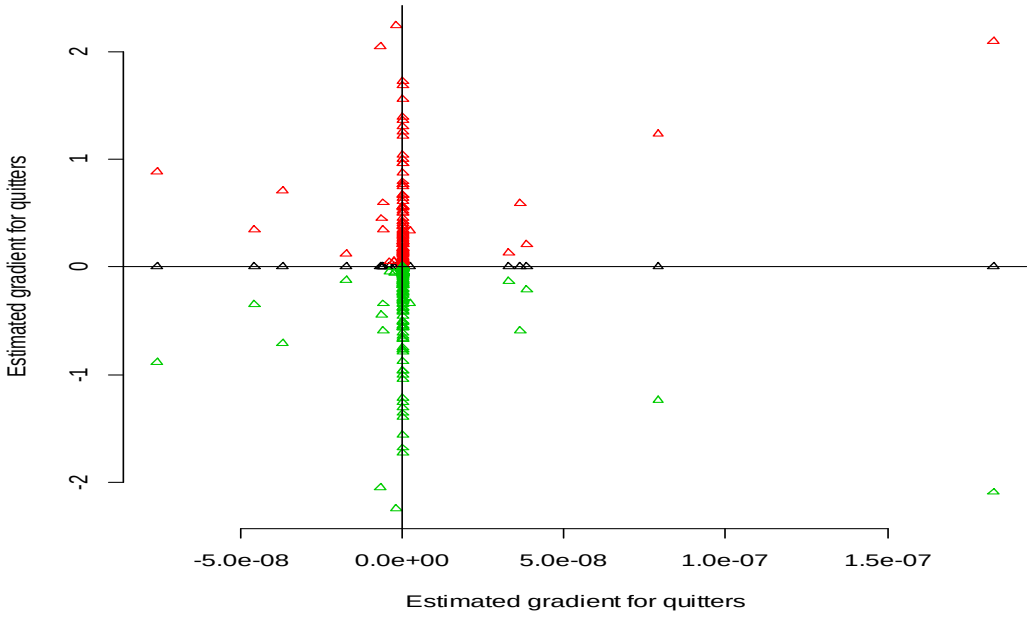


Figure 7: 45 degree plot for late entrant stayers

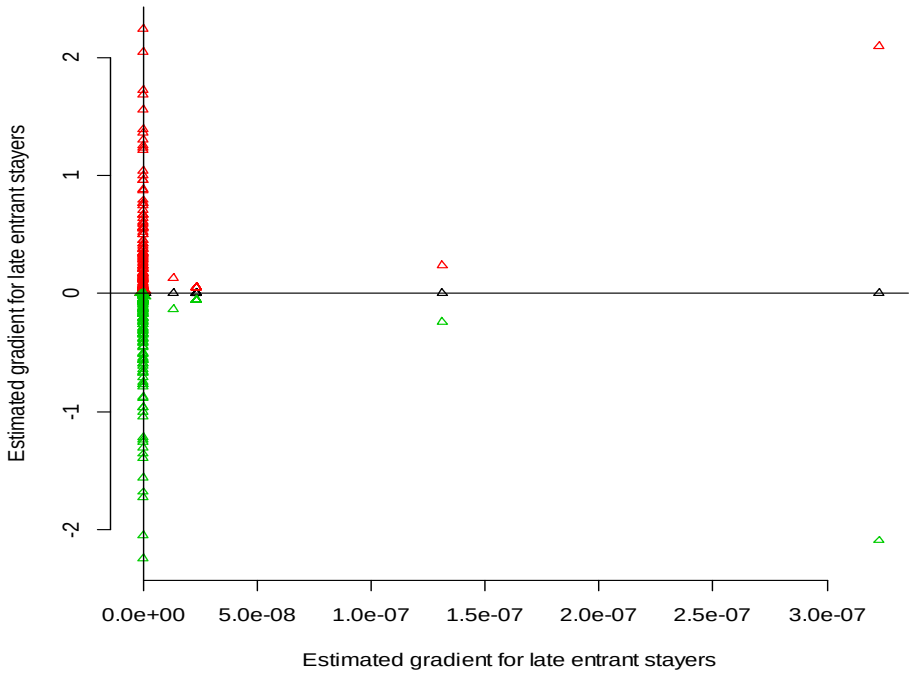


Figure 8: 45 degree plot for permanents

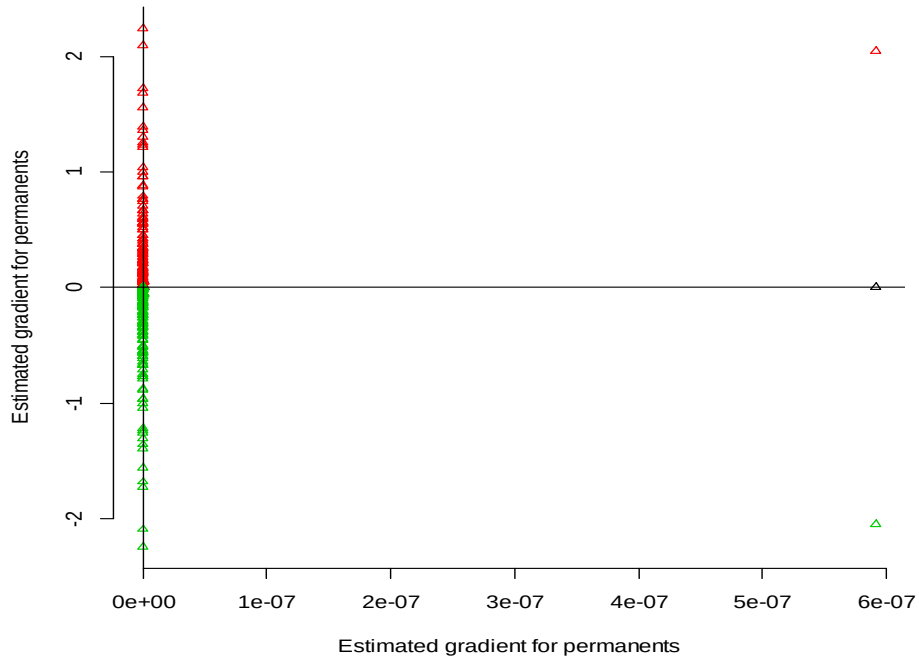


Figure 4 tells us that the relationship between initial TFP and final TFP is mostly positive, although a few firms are in the third quadrant expressing a negative relationship. This is a reflection of the economic period that Ghana experienced during the time frame of our data. While the period immediately following the Economic Recovery Programs (ERP) initiated by both the World Bank and IMF during the early 80's in Ghana showed dramatic improvement in manufacturing growth with output averaging 12.7% between 1984 and 1988 and up to the early 1990's, the remaining of the 1990's was associated with a sharp decline in manufacturing productivity as illustrated in Figure 2. Growth rate averaged 2.3% between 1989 and 1993 and 3.3% between 1994 and 2000. With the exception of 1990 and 1997, growth rate has not reached 5% in any year up to 2000. The decline in the growth rate since 1988 has been attributed to the pace of trade liberalization (Asante, 2002). According to Lall (1995), "the low level of capabilities in Ghana have meant that rapid liberalization, unaccompanied by supply-side measures to develop skills, capabilities and technical support, led to significant and costly de-industrialization".

Next, we compare permanent, quitters, late entrant quitters, and late entrant stayers against no exporters in terms of their impact on productivity. The 45 degree plot presents the location of relative types of exporters against other exporters within the same group in their relationship with final TFP against firms that do not export. We note that exporters in general regardless of the group they fall in experience higher productivity. However, the average impact and its range varies by exporter group. First, we note that late entrant quitters and quitters are the only groups that have firms falling in both the first and third quadrants. It is hard to tell whether these firms quitted because they were less productive or left because they could not gain more in terms of productivity. Firms that stayed until the end of the survey are the only ones that experienced a positive impact across all firms although very small. The impact are very low as they vary between 3e-7 and 6e-7. We note higher impact only among the firms that entered late and quitted before the end of the survey, although there is an almost equal variation between firms in the first and third quadrant, late entrant quitters reflect stronger evidence of learning-by-exporting.

Conclusion

We found rather weak evidence of self-selection and limited evidence of learning by exporting among Ghanaian manufacturing firms. Self-selection to export's robustness drops as we add both year and sector fixed effect in the analyses, implying a rather unreliable statistical significance. We produced heterogeneous evidence of learning-by-exporting by non-parametrically evaluating it and found exporters to experience higher productivity after exporting although with variations across exporter types. While the impact on productivity is fairly small for all groups, firms that entered later but quitted before the last wave seem to experience higher productivity impact although with almost equal number of firms experiencing positive and negative impacts.

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