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Firm-Level Investment and Exporting: New Empirical Evidence from Ghana and Tanzania

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ABSTRACT

Using firm-level data from two selected African countries, we examine whether firm-level investment in physical capital is a possible channel through which less productive firms gain entry into export markets. Our findings reveal that non-exporters who invest in physical capital increase their probability of switching status, from non-exporter to exporter, and we provide evidence that firm-level investment is correlated with increased productivity growth among exporters. Consequently, we emphasize that firm-level investment in physical capital enables non-exporters to increase their odds of entry to export markets and provides opportunity for young exporters to grow rapidly and persist long in export markets. Although firm productivity differences can be explained by self-selection factors as one channel, firm-level investment in physical capital provides another explanation as to why less productive firms gain entry into the export markets. We establish that when firms invest in physical capital, they improve their productive capacity thereby raising their productivity in the process. Export promotion policies should target providing support to firms that seek to upgrade or expand their production technology as this would stimulate the probability of export market entry hence promoting exports.

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1. Introduction

How do we explain the fact that, relatively small and less productive firms enter export markets yearly, selling small quantities of their products to a nearby country? How do we reconcile this fact with the view that only the large and more productive firms engage in exporting activity? Studies show that export market entry is costly and involves incurring sunk costs besides the per-unit costs of selling products in the export market, such that only the large and more productive firms sell products in the foreign markets (Melitz, 2003). Moreover, international trade literature has invaluable documented how crucial firm-level differences in productivity, export status, ownership structure, size and other firm characteristics are in the decision to initiate exporting. Consequently, the large and more productive firms do participate in international trade while the least productive ones sell in the home market. In this way, firm export participation is a rare activity. Moreover,

firms that initiate engagements in international markets and survive their first year of exporting, continue to export the subsequent years even when they face negative demand shocks (Timoshenko, 2015). Empirical evidence shows that firms that engage in international trade (both exporters and importers) constitute a small proportion of firms in many developed and developing countries. Accordingly, an expansive trade literature documents that export participation is influenced by the existence of sunk export entry costs. Firms that intend to engage in international markets must first incur costs related to researching the tastes and preferences of their customers, understanding regulations related to the target market, setting up sales and distribution channels, upgrading their products to suite international standards and other costs. These costs may never be recovered even if the firm resolves not to sell its products in the international market. Thus firms export as a consequence of improved firm efficiency and productive capacity, inducing the firm to reach out to the international markets.

A number of papers have recently started to add a new feature to the study of export engagements and productivity relationship: firm-level investment in activities that upgrade the productivity of the firm. These activities include research and development (R&D) as shown by Aw, Roberts, and Xu (2011), Constantini and Melitz (2008), among others. More recently though, another dimension was added to this study: firm-level investment in physical capital (Rho & Rodrigue, 2015, 2016; Riaño, 2011; Wu & Miranda, 2015). The observed patterns in exporting firms have motivated economists to provide some explanations as to why exporters and non-exporters vary and what explains this variability. Empirical studies document large productivity premium for exporters compared to non-exporting firms. Consequently, the decision to enter export markets is influenced by factors that shape the firms' productivity prior to export market entry. Theoretical models of trade and firm dynamics, as presented by Jovanovic (1982) and Hopenhayn (1992), demonstrate how a firm's productivity is derived from a common distribution. Extending the novel work of Jovanovic (1982) and Hopenhayn (1992), Melitz (2003) model gives evidence to confirm that firm i 's productivity in period t can be assigned to it by luck of the draw from a common distribution. Once the firm makes a low productivity draw, it becomes difficult for it to change its future productivity. The above models of firm dynamics do not present conclusive examination of firm heterogeneity and why small, sometimes, less productive exporters venture into the export markets.

Moreover, Eaton, Eslava, Kugler, and Tybout (2008) study of Colombian exporters confirms that domestic firms enter the export market every year and that these new exporters are small. Their findings show that new export entrants begin by vending small quantities to neighbouring countries to gain experience of targeting other more distant and advanced markets. Considering that sunk costs are important and that only the large and more productive firms undertake export activity, what would explain the entry of small and less productive exporters into the export markets and how can we reconcile this pattern with the self-selection hypothesis? Conversely, some studies have attempted to use endogenous growth theory to model firm productivity and link it to firm-level productivity enhancing activities like innovation, firm-level investment in physical capital, investment in research and development (R&D), technology upgrading, or investment in workers' training to give a possible explanation of their importance in export market entry (see Aw, Roberts, & Winston, 2007; Aw et al., 2011; Bustos, 2011; Cassiman & Golovko, 2011; Rho & Rodrigue, 2016; Wu & Miranda, 2015).

In this study, we develop an analytical framework that may account for the entry patterns of low productivity firms and small exporters in the international markets. The insights gained from the above framework guide our empirical work and evaluation of the research question ‘whether firm-level investment in physical capital explains export entry patterns of small and less productive firms’. This research question is broken into three specific questions: (i) Does firm-level investment in physical capital boost non-exporters’ probability of switching status- from non-exporter to exporter, thus explaining the entry patterns among exporters? (ii) Do exporters that invest increase their productivity than those that do not? (iii) Do exporters that invest generate higher productivity growth rates? We view firm-level investment as a productivity enhancing activity that builds a firm’s capability to improve the technology of production. Our definition of firm-level investment in physical capital involves a firm’s investment expenditures in plant and equipment, which we consider productivity enhancing investments. Our view is that investment in productivity enhancing activities upgrades the firm’s technology of production thereby expanding its productivity frontier. This study is important because it provides a crucial explanation to firm heterogeneity and another possible channel that explains productivity differences between exporting and non-exporting firms. Most importantly, we focus the analysis on two Sub-Saharan African countries (Ghana and Tanzania) because of data availability. These countries have reformed their economies and advocated for export promotion strategies, at the expense of import substitution, to strengthen export growth.

We implement our econometric analysis in a regression framework, for the first part of the research question, and using propensity score matching and difference-in-differences estimation methods, for the second part of the research question. We find that non-exporters that invest in physical capital increase their probability of export market entry and grow further their productivity when they initiate exporting. This implies that non-exporting firms that engage in firm-level investment improve their probability of switching status, from non-exporter to exporter. Moreover, this form of investment is correlated with increased productivity growth among exporters. Consequently, we argue that, although firm productivity differences can be explained by self-selection factors as one channel, firm-level investment in physical capital provides another channel through which self-selection and learning-by-exporting can occur and a possible explanation to why firms with low productivity, venture into the export markets, as was shown by Eaton et al. (2008). We establish that when firms invest in physical capital, especially plant and equipment, they improve their productive capacity, because the more productive firms produce more output at lower unit costs as postulated in our theoretical model. Therefore, export promotion policies should target providing support to firms that seek to expand their productive capacity. Firms would benefit greatly if they receive support in form of technology and capacity improvements as this would stimulate the probability of export market entry hence promoting exports.

This study contributes to the literature on firm heterogeneity and industry dynamics. This is an important element of the literature on international economics and firm dynamics that continues to stimulate a lot of research and debate. Moreover, this study adds another dimension to the literature on firm selection and growth in new markets, first suggested by Luttmer (2007) and recently extended by Arkolakis (2016) who presents an analytical framework for studying firm and export growth. To the best of our knowledge,

this study is the first to analyse the impact of investment in physical capital on performance of exporters in Africa.

The rest of the paper is organized as follows: Section 2 presents the review of related literature. Section 3 provides an overview of the data. Section 4 presents theoretical and empirical framework and econometric methods. Section 5 reports and discusses the results. Section 6 concludes.

2. Literature Review

Recent empirical work on firm dynamics and export behaviour of firms documents various empirical regularities and shows how engaging in international trade generates considerable benefits for exporters (Bernard, Eaton, Jensen, & Kortum, 2003; Melitz, 2003). It is established that engaging in trade influences only the more productive firms to initiate selling their products in the international markets relegating firms with low productivity to continue serving the home market. The observed pattern among exporters has motivated economists to provide more explanations on why exporters and non-exporters differ in almost all characteristics and their contribution to the economy. Recent studies on firm differences have presented controversial findings on the observed pattern and behaviour of firms: relative to non-exporters, exporting firms are large, more productive, pay higher remunerations and employ more people, hence self-select into foreign markets because of their productivity (Bernard & Jensen, 1999). Additionally, sunk costs are shown to be a major source of export-market persistence (Roberts & Tybout, 1997).

However, Eaton et al. (2008) study of Colombian exporting firms indicates that domestic firms enter the export market every year and that these new exporters are small. Their findings show how new exporters begin by selling small quantities to neighbouring countries to gain experience of targeting other more distant and advanced markets. Given that sunk costs are important and that only the large and more productive firms undertake export engagements, we have to explain the existence of small export entrants in export markets and reconcile this entry pattern with the self-selection hypothesis. This finding contradicts the much documented facts about exporters. Furthermore, exporting activity presents a firm with more benefits when firms engage in international trade through the opportunity to sell in a large market and learning-by-exporting mechanism. Other studies have suggested that firm heterogeneity arises from endogenous factors, that is, factors internal to the firm play a crucial role in export market entry and performance rather than exogenous factors (see Greenaway & Kneller, 2007). These internal factors are attitudinal characteristics and individual capabilities (i.e. commitment to export activity, marketing of the product, networking with other exporters among others), decisions on technology of production and other factors internal to the firm, play a significant part in the internationalization of firms (Nazar & Saleem, 2009).

Although consistent with observed trends in exporting firms, the evidence presented on self-selection hypothesis and considerable persistence of exporting engagement among exporter firms (Bernard & Jensen, 1999; Roberts & Tybout, 1997) does not provide a convincing explanation to show reasons for the firms' decision to enter export markets and how export market engagement affects their productivity. It is plausible to think that there is a missing link that provides an explanation to export market entry and participation. This missing link might be firm-level productivity enhancing activities like acquiring

physical capital to expand production, product and process innovation, research and development, capacity utilization or capacity building programs. Consequently, one may posit that some firms are initially more productive than others because of their differences in firm-level investment efforts, such as acquiring the capital crucial for production process, innovating products, processes, research and development, or upgrading production technology-through acquisitions. In this case, there must be a connection between a firm's investment effort and its overall productivity which prompts it to initiate export activity or a link from exporting performance to increase in investment effort. Accordingly, Dzhumashev, Mishra, and Smyth (2016) find evidence to show that investment and export participation are complementary activities. This implies that firms that simultaneously engage in these activities may survive longer in the export markets.

Consequently, Rho and Rodrigue (2016) study firm-level investment and export dynamics among Indonesian manufacturing firms and observe that firm-level investment in physical capital allows new exporters to grow into the export markets. Once firms make enough firm-level investment in physical capital, they expand their capacity to produce and utilize the production inputs to meet their market demands. Similarly, new firms that make enough firm-level investments in physical capital are capable of mitigating their exposure to demand disturbances across markets as they have adequate capacity to respond to these demand shocks. Consequently, new firms that have adequate investment in physical capital realize higher investment rates in the year of initiating exporting activity and continue till fourth year, making these new exporters gain the ability to survive longer in the export markets (Rho & Rodrigue, 2015, 2016). Likewise, Ahn and Mcquoid (2012) study capacity constrained exporters and present micro and macro evidence to show that exporters face financial and capacity constraints, which leads to increasing marginal costs among exporters. If exporters address the issue of financial and physical capacity constraints, they can adequately respond to market demand shocks and reduce aggregate output volatility.

Recently, Rho and Rodrigue (2015) study the investment patterns among Indonesian manufacturing firms and provide evidence showing differences in the investment behaviour between foreign and domestic firms. Their study suggests that foreign owned firms have high access to financing compared with domestic ones. This implies that better access to financing helps firms access the export market and realize better export market performance outcomes. Moreover, new exporters require finance to acquire the much needed production technology and expand production. However, financial access for African firms remains a challenge due limited access to finance (Collier, 2009) with lending institutions insisting on firms being formal (registered) and more established (Quartey, Turkson, Abor, & Iddrisu, 2017). The implication of this is that access to financing might be a key determinant to differences in investment patterns among exporters. As shown by Rho and Rodrigue (2015), credit constrained exporters have a low probability of starting exporting activities. Better access to finance facilitates firm-level investment in physical capital thereby improving production technology, output and export growth. Additionally, Bustos (2011) finds that falling tariffs induce firms to upgrade their production technology. The author shows that the observed firm heterogeneity cannot be completely explained by self-selection hypothesis but also by technology upgrades as well. This suggests that trade policies that facilitate export market entry can stimulate firms to develop mechanisms of improving firm-level productivity hence stimulating international market engagements. Further, Riño (2011) presents a dynamic model of risk-averse producers and suggests

that firms face costs of export market entry and participation hence must make investments that are irreversible to reduce on volatility of their sales as a result of export market participation.

Relatedly, Aw et al. (2007) show that exporters that invest in research and development or training of workers improve their future productivity levels than firms that do not engage in any investment activity. Besides firms that invest or incur expenditure on training workers, benefit from these investments because of the presence of statistically significant relationship between productivity and export market entry. Similarly, Constantini and Melitz (2008) emphasize the implication of firm-level investments as a possible channel for productivity enhancing effects of trade. They conclude that when firms anticipate liberalization in the industry, they will be stimulated to engage in productivity enhancing activities, like innovation, ahead of export market entry to maximize the benefits that might accrue from export market entry and participation. Equally, Girma, Görg, and Hanley (2008) present arguments to suggest that exporting experience enhances innovation capability of firms thereby improving the performance and survival of firms. When firms innovate, they improve their productivity and chances of entering export markets as suggested by Constantini and Melitz (2008) model and as was first emphasized by Licandro, Maroto, and Puch (2003). Furthermore, Doraszelski and Jaumandreu (2011) find that research and development expenditures are a key determinant of differences in firm productivity and a possible reflection of how firm-level productivity evolves over time. In the same vein, Damijan and Kostevc (2015) find that there is learning that exporting firms receive as the result of export market participation which enhances the firms' ability to innovate products.

3. The Data and Descriptive Statistics

To facilitate the empirical analysis in this study, we use firm-level data of two African countries; Ghana and Tanzania. The data are from a panel survey of firms operating in manufacturing sectors of the two countries, namely, textile, wood, furniture, garment, metal and machinery, and food and bakery. The data on Ghana manufacturing firms cover a period of 12 years collected over seven rounds, from 1992 to 2003 while for Tanzania, the data were collected over four waves between 1992 and 1999. The data were collected under the Regional Program on Enterprise Development (RPED) organized by the World Bank, jointly with the Centre for the study of African Economies (CSAE) and the University of Oxford, using stratified sampling strategies within each country and firm size.

3.1. Description of Manufacturing Firms Per Country

In Table 1, we present an overview of manufacturing firms in each individual country under the study. Column 1 is the country, columns 2–6 are number of firms, percentage of firms, number of observations, average exports, average domestic sales, and export destinations (categorized into destinations to African countries and destinations outside of Africa). From Table 1, we note that exporting is a rare activity among firms, in the two countries: with exports averaging 17% and 7% in Ghana and Tanzania, respectively. We observe that most firms (83%) in Ghana sell their products in the domestic market, a feature which can also be seen with the Tanzanian firms, where 93% of these firms serve the

Table 1. Summary of manufacturing firms per country.

Country	No. of firms	% of firms	No. of obs.	Average exports	Average domestic sales	Export destinations	
						Africa	Outside Africa
Ghana	311	43.44%	3564	0.17	0.83	0.10	0.07
Tanzania	405	56.56%	2068	0.07	0.93	0.04	0.03

Source: Calculations using Centre for the study of African Economies (CSAE) dataset.

Table 2. Percentage of firms by their investment status.

Firms	Non-exporting firms (%)	Exporting firms (%)	All firms (%)
Do not engage in firm-level investment (%)	72.79	8.04	80.83
Engage in firm-level investment (%)	13.87	5.30	19.17
All firms (%)	86.66	13.34	100.00

Source: Calculations from the data. The percentages should sum up to 100%.

local market. A majority of the exports (10% for Ghana and 4% for Tanzania) are sold in markets across Africa, while a small percentage of exports (7% for Ghana and 3% for Tanzania) go to markets outside of Africa.

3.2. Percentage Investment Shares by Exporting and Non-Exporting Firms

In Table 2, we note that 72.79% of non-exporting firms do not engage in any form of firm-level investment in physical capital, while 13.86% of them do. Conversely, 8.05% of exporting firms do not engage in any firm-level investment activity whereas 5.30% of them have incurred investment expenditures. We can suggest that firm-level investment is a costly venture that may be undertaken mostly by established firms as can be seen from the number of firms that engage in it.

4. Theoretical Model and Empirical Strategy

4.1. Theoretical Framework

To guide the econometric analysis, we rely on the theoretical and empirical model on firm's profit maximizing behaviour in a dynamic framework as in Erickson and Pakes (1995) and insights from Wu and Miranda (2015) and Rho and Rodrigue (2016). In this dynamic framework, the firm faces a business environment characterized by harsh competition coming from within and outside of the industry. To succeed, the firm has to take risks and invest to increase its chances of growth and survival, otherwise it faces a fall in its profitability and eventual shut down. In this setting, the goal of the firm is to maximize profits given expectations about industry competition. In each period, a firm decides on its business status, either to serve the domestic market as a domestic supplier or to engage in the export market as an exporter. As in Wu and Miranda (2015), a firm i starts each period t_0 either as an exporting firm $i = 1$ or non-exporting firm $i = 0$ with a predetermined investment in capital stock $k \geq 0$. In this set up, the firm operates in a competitive market environment and takes exporter price P_1 and non-exporter price P_0 as given. In this set up, firm i that has intentions to enter the export market will then choose to increase its

investment in capital stock with the aim of increasing firm efficiency, decrease marginal costs and consequently initiate export activity. We express the firm's capital stock in the following period as given by

$$k_{it} = (1 - \eta)k_{it-1} + \psi_{it-1}, \quad (1)$$

where k_{it} is the current capital stock holding, $\eta \in (0, 1)$ is the per-period rate of capital depreciation, ψ_{it-1} is the sum of the firm's investment in physical capital in period $t-1$. Each year a firm is faced with some decisions, whether to invest and serve the domestic market or to invest and serve the export market. Each of these decisions involves incurring some costs. If the firm decides to invest in order to engage in the export market, it has to decide how much investment will lead to the production of optimum output for the export market, in this case, $\psi \geq 0$. Similarly, in each period, a firm producing good x , that is non-exporter choosing to become an exporter incurs a switching cost $s_x > 0$ which is sunk in nature and irrecoverable should the firm decide to exit the export market (Melitz, 2003).

The switching costs can then be expressed as

$$\varphi_{it} = \begin{cases} s_x, & \text{if } i = 0, m = 1, \\ 0, & \text{otherwise,} \end{cases}$$

where φ_{it} are the total fixed capital and all other costs associated with export market entry and conditional on the firm selecting export status m in the current period, when it starts with export status i .

When firms choose to either export and or invest they incur additional costs. If they choose to invest, we follow Rho and Rodrigue (2015) and express the investment cost function $C(i_{it}, k_{it}, \gamma_t)$ as follows:

$$C(i_{it}, k_{it}, \gamma_t) = c(i_{it}, k_{it}, \gamma_t) + F_{it}^{\gamma_t} \mathbf{1}(i_{it} > 0), \quad (2)$$

where γ_t is the dummy variable showing the ownership status of the firm, set equal to 1 if firm has foreign ownership and 0 otherwise. Assuming the convexity of investment costs, that is $c(0, k_{it}, \gamma_{it}) = 0$, $c_1 = \frac{\partial C}{\partial i_{it}} > 0$, $c_2 = \frac{\partial C}{\partial k_{it}} < 0$, $c_{11} = \frac{\partial^2 C}{\partial i_{it}^2} > 0$, $c_{22} = \frac{\partial^2 C}{\partial k_{it}^2} > 0$. The above suggests that firms may have to cover investment costs that are fixed, F_{it} to invest in physical capital. Moreover starting to export means additional fixed entry costs which we denote by $C(d_{it}, d_{it-1}, \gamma_t)$ which is assumed to be determined by the exporting experience, so that

$$C(d_{it}, d_{it-1}, \gamma_t) = F_{it}^{\gamma_t} d_{it} d_{it-1} + S_{it}^{\gamma_t} d_{it} (1 - d_{it-1}), \quad (3)$$

where d_{it} is the dummy variable equal to 1 if firm i exports in period t and 0 otherwise.

Given that rational firms will be driven by profit maximization motive, the profit function to be maximized before incurring investment costs can be expressed as $\pi_{it} = \pi_t(k_{it}, \varpi_{it}, d_{it} d_{it-1}, Z, Z^*)$ with Z and Z^* denoting demand shifters specific to the market. The firm's dynamic decision problem can be shown by the Bellman equation given below:

$$V_{it}(k_{it}) = \max \pi_{it}(k_{it}, d_{it}) - C(i_{it}, k_{it}, \gamma_t) - C(d_{it}, d_{it-1}, \gamma_t) + \beta E_t V_{it+1}(k_{it+1}), \quad (4)$$

where $E_t V_{it+1}(k_{it+1}) = \int_{\omega'} V_{it+1}(k') dF(\omega' | \omega_{it})$. This implies that not investing results into a drop in the firm's capital stock thereby raising the firm's marginal costs of production

given the same output level. However, investing in capital stock implies that capital stock in year $t + 1$ will rise thereby reducing the firm's marginal costs of production. Therefore, the investment choice for either non-exporter or exporter can be expressed as

$$C(i_{it}, k_{it}, \gamma_t) = \beta E_t \frac{\partial V_{it+1}(k_{it+1})}{\partial i_{it}}, \quad (5)$$

where $C(i_{it}, k_{it}, \gamma_t)$ is the adjusted marginal costs that are free from the firm's export choice or history, while the remaining component on the right-hand side of the equation is the expected additional benefit or gain. Consequently, we express the net gain or benefit associated with exporting dependent on the firm's investment choice as follows:

$$MBE_{it} = \frac{\pi_{it}(k_{it}, d_{it} = 1) - \pi_{it}(k_{it}, d_{it} = 0) - C(d_{it}, d_{it-1}, \gamma_t)}{\text{Gain/loss at the start}} + \frac{\beta E_t \{V_{it+1}(k_{it+1}, d_{it} = 1) - V_{it+1}(k_{it+1}, d_{it} = 0)\}}{\text{Gain/loss for the future}}. \quad (6)$$

Equation (6) shows that current period's investment choices vary with firm-level differences in capital stock, productivity level of the firm and ownership. The model predicts that any additional gains from the decision to invest are related to the export choice of the firm. Sunk costs of export entry implies that increases the propensity to continue exporting which raises the marginal value of capital thereby inducing greater investment level. If this is the case, then firms that export also raise their probability of investing as well, upon entry into the export markets. Moreover, investment should increase the probability of entry into the export markets and generate productivity premium for the exporters.

4.2. Empirical Strategy

Our empirical analysis follows the insight developed and discussed in the theoretical model. As in Wu and Miranda (2015) and Rho and Rodrigue (2016), in each period, non-exporters that change their status to exporters must incur a switching cost $S_x > 0$ which is sunk. When firm i , producing good x assumes the exporter status $i = 1$, it incurs a one-time sunk cost and marginal costs of exporting each unit of good x , and the firm incurs rising marginal costs of production and investment. These costs may become export constraints to less productive firms with constrained production capacity unless these firms possess higher productivity to minimize the cost constraint. However, relative to firms with smaller capital stocks, firms that have made new investments in physical capital and have built larger capital stocks have a high probability of entering export markets, survive longer and face lower marginal costs (Rho & Rodrigue, 2016). Once firms make enough firm-level investment in physical capital, they expand their capability to produce and utilize the production inputs to meet their market demands. Using propensity score matching techniques, we analyse the effect of the treatment (firm-level investment) on the outcome variable export entry (exp). The literature on international trade also suggests that firms that export have also a high probability of investing, once they start to export, than non-exporter (Lileeva & Trefler, 2010). Similarly, Kimura and Kiyota (2006) show that the most productive firms simultaneously engage in exporting and foreign direct investments while

the less productive remain to serve the domestic market. We test the view that exporting induces firm to invest as well using firm-level data from a different context. We then examine the effect the treatment variable (exporting) on the outcome (investment) as well.

Denote the export status of firm i by $\text{Exp}_{it} \in \{0, 1\}$ the dummy variable equal to 1 if firm i entered the international market in time t , and 0 otherwise. Similarly, denote investment (invest) so that $\text{invest}_{it} \in \{0, 1\}$ represents the dummy variable equal to 1 if the firm invests and 0 otherwise. In this case, $\text{exp}_{it+\nu}^1$ denotes the results in period $t + \nu$, after the treatment and $\text{exp}_{it+\nu}^0$ denotes the result of the firm had not received the treatment (investment). The effect of the treatment is the estimated difference-in-difference in the outcome variable (exp) between the firms that are treated (firms with investment status equal one) and the control group (firms that have not invested). The effect of exporting (treatment) on investment (outcome) is defined analogously.

Given the above, the causal effect of treatment (investment) on firm i in year $t + \nu$ can be expressed as

$$\Delta \text{exp}_{it} = \text{exp}_{it+\nu}^1 - \text{exp}_{it+\nu}^0 \quad (7)$$

Naturally, the critical challenge of causal inference is the fact that, for each firm, we can see only $\text{exp}_{it+\nu}^1$ but not $\text{exp}_{it+\nu}^0$ because each firm at a certain point in time gets either treatment or will be in control group, but not both (Holland, 1986). Conversely, it is difficult to identify what would have happened to the firm had it not invested or exported in the future. To overcome this counterfactual, we create a control group in such a way that every treated unit is matched to an untreated unit with same characteristics at the time before the treatment. The calculated differences between the two matched groups based on observable measures can then be assigned to the effect of the treatment (Heckman, LaLonde, & Smith, 1999). This then means that firms can be assigned into two groups: the treated group that received the treatment and the control group that did not get the treatment.

Specifically, the treatment does not affect the control group, and for observational studies, the outcomes are unconnected to the treatment, subject to X , that is:

$$\omega^0, \omega^1 \perp D \mid X \quad (8)$$

Denote $\text{exp}_{it} \in \{1, 0\}$ as indicator variable showing whether firm i entered the international market for the first time at period t , we can estimate the average treatment effect, such that

$$\begin{aligned} \text{ATT} &= E\{\text{exp}_{it+\nu}^1 - \text{exp}_{it+\nu}^0 \mid \text{invest}_{it} = 1\} = E\{\text{exp}_{it+\nu}^1 \mid \text{invest}_{it} = 1\} \\ &\quad - E\{\text{exp}_{it+\nu}^0 \mid \text{invest}_{it} = 0\} \end{aligned} \quad (9)$$

and

$$\begin{aligned} \text{ATT} &= E\{\text{invest}_{it+\nu}^1 - \text{invest}_{it+\nu}^0 \mid \text{exp}_{it} = 1\} = E\{\text{invest}_{it+\nu}^1 \mid \text{exp}_{it} = 1\} \\ &\quad - E\{\text{invest}_{it+\nu}^0 \mid \text{exp}_{it} = 1\} \end{aligned} \quad (10)$$

Equations (9) and (10) are helpful in the estimation of the observed outcome $E\{\text{exp}_{it+\nu}^1 \mid \text{invest}_{it} = 1\}$ and $\{\text{invest}_{it+\nu}^1 \mid \text{exp}_{it} = 1\}$, however, the causal inference will be meaningful if proper construction of the counterfactual for the unobserved portion of equations (9) and (10); $E\{\text{exp}_{it+\nu}^0 \mid \text{invest}_{it} = 0\}$ and $E\{\text{invest}_{it+\nu}^0 \mid \text{exp}_{it} = 1\}$, which are the

average outcomes entrants would have received had they not invested; or initiated export activity. To estimate $E\{\text{invest}_{it+v}^0|\text{exp}_{it} = 1\}$, we analyse a corresponding average value of never exporters such that

$$E\{\text{exp}_{it+v}^0|\text{invest}_{it} = 0\} \quad (11)$$

and

$$E\{\text{invest}_{it+v}^0|\text{exp}_{it} = 0\} \quad (12)$$

We can then specify a valid control group based on the observable characteristics and pre-entry level value of the outcome variable exp_{it-1} . Based on our knowledge of determinants of export entry, we then estimate the export probability function using a probit model. As in Rosenbaum and Rubin (1983), we use propensity score matching approach, as follows:

$$P(\text{exp}_{it} = 1) = G(\text{invest}_{it-1}, X_{it}), \quad (13)$$

where invest_{it} , denotes the lagged firm-level innovation status, while X_{it} , is the outcome variables of interest, including the control variables (size, firm age, ownership status, sector, year and country). Based on the propensity score, we can match firms that invested against those that did not in period $t-1$ and examine the effects of lagged firm-level investment on the probability of export entry in period t . Similarly, we match exporters and non-exporter firms hinging on their probability to invest and test whether the two cohorts are different in their investment ability. Formally, we specify the firm's probability of being an exporter as

$$P(\text{invest}_{it} = 1) = G(\text{Exp}_{it-1}, X_{it}), \quad (14)$$

where Exp_{it-1} represents the lagged firm-level exporting status, while X_{it} is the outcome variables of interest, including the control variables (size, firm age, ownership status, sector, year and country).

Consequently, Equations (13) and (14) indicate the probability that a firm invests or initiates export activity based on function G , $\text{invest}_{it} = 1$ or $\text{Exp}_{it} = 1$ denotes the predicted probability of investing or exporting at t for firm i . We then use the `psmatch2` suite of Leuven and Sianesi (2003) nearest-neighbour matching method with common support and then select a non-exporter firm that is 'closest' to ultimate exporter in terms of its propensity score. More formally though, for an individual new entrant firm i , exporting to country f , a non-exporter firm j can be selected such that

$$|p_{it}^f - p_{jt}^f| = \min_{k \in \{\text{exp} = 0\}} \{p_{it}^f - p_{jt}^f\}. \quad (15)$$

This method of matching has the advantage of being easy to implement and less likely to be affected by selection bias. Moreover, the nearest neighbour matching nearly estimates the Average Treatment of the Treated (ATT) always because it matches control individuals to the treated group and discards controls that are not selected as matches. Additionally, common support condition in the matching algorithm requires discarding entrants whose propensity score is not stable in the control group. We then estimate Equations (9) and (10) using difference-in-differences method to enhance the reliability of our outcomes. Blundell and Dias (2000) observe that integrating matching and difference-in-differences

(DID) substantially improve the quality of non-experimental evaluation studies. Using DID, we estimate the causal effect of the treatment (investment) on the outcome (export performance).

Formally, the DID estimation can be written as

$$\Delta\omega_1 = (\omega_{11} - \omega_{10}) - (\omega_{01} - \omega_{00}), \quad (16)$$

where $\Delta\omega_1$ represents the impact or outcome variable, $(\omega_{11} - \omega_{10})$ is the outcome for the treated group and $(\omega_{01} - \omega_{00})$ denotes the outcome for the control group.

Therefore, we write down our DID equations for investment and exporting based on the sample of matched firms as

$$\Delta\omega_{it} = \alpha\omega_{it-1} + \beta X_{it-1} + \sum_{v=-1}^2 \lambda_v \text{invest}_{it-v} + D_{jkt} + \varepsilon_{it}, \quad (17)$$

and

$$\Delta\omega_{it} = \alpha\omega_{it-1} + \beta X_{it-1} + \sum_{v=-1}^2 \lambda_v \text{Exp}_{it-v} + D_{jkt} + \varepsilon_{it}, \quad (18)$$

where $\Delta\omega$ denotes the change in the outcome variables (total factor productivity, labour productivity, employment or wages), i , t , j and k index firms, time periods, sectors/industries and countries respectively, while D denotes the full set of industry, regions and time dummies. X is a vector of control variables, and invest_{it} and Exp_{it} are dummy variables equal to 1 if firm i made firm level investments or switches to exporting, at point t , and 0 otherwise. To evaluate the impact of investment on exporting and exporting on investment, we also use an indicator to predate investment (invest_{it-2}) and exporting (Exp_{it-2}); estimating Equations (17) and (18), and use an indicator to predate investment (invest_{it-1}), to further control for any relationships in pre-periods not captured by matching process.

4.3. Estimating Total Factor Productivity (TFP)

In order to evaluate the effect of the treatment (investment) on the export market performance of exporters, we derive the measure of export performance. Our measure of export market performance is TFP which we derive using Levinsohn and Petrin (2003), also referred to as LP method. The fundamental issue in the estimation of production function is the fact that firms simultaneously choose inputs and outputs, which then causes inputs to be correlated with unobservable productivity. Consequently, the estimation of the production function using Ordinary Least Squares (OLS) method is not feasible and leads to inconsistent estimates of the production function. We therefore generate consistent estimates of the production function using the LP, method by help of the ‘levpet’ STATA command, which uses intermediate inputs as proxy for unpredicted productivity shocks.

We consider firm that produces good, x , using a Cobb–Douglas production functions in logs:

$$v_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_i im_{it} + \omega_{it} + \varepsilon_{it}, \quad (19)$$

where v_{it} is the value added (the difference between gross output and intermediate inputs), k_{it} is the log of capital input, l_{it} is the log of labour input, im_{it} is the intermediate inputs, ω_{it} is the TFP component and ε_{it} is the error component.

Using LP, we can recover the predicted firm-level productivity estimates and generate an index of the firm's TFP, thus

$$\bar{\omega}_{it} = TFP_{it} = v_{it} - \bar{\beta}_1 k_{it} - \bar{\beta}_2 l_{it} - \bar{\beta}_3 im_{it}, \quad (20)$$

where ω_{it} is the predicted TFP, v_{it} is the value added, k_{it} , l_{it} , im_{it} denote the recovered estimates from capital, labour and intermediate materials.

Overall, we present the results in some chronological order. First, we present the export and investment premia; second, we report the results of average treatment effects on the treated, estimates of the DID; third we report the results of the effect of firm-level investment on export participation, and finally report the results of firm-level investment on post-entry productivity growth rates exporters.

5. Estimation Results and Discussion

5.1. Does Firm-level Investment Stimulate Export Market Entry?

It has been argued that prior firm-level investments may induce entry to the export market and past export experience stimulates further firm-level investments. To examine this argument, we use Equation (13) to match non-exporting firms that engage in firm-level investment with non-exporting firms that do not in period $t-2$ to estimate average treatment effects on the treated. Specifically, we want to know whether previously non-exporting firms that engage in firm-level investment are more likely to become exporters in period t than non-exporters who do not engage. Analogously, we estimate Equation (14) by matching exporters and non-exporters in period $t-2$ and evaluate whether previous exporters that do not engage in firm-level investment activities are more likely, than non-exporters who do not, to engage in firm-level investment. Using propensity matching and difference-in-differences methods, our two cohorts are matched using the nearest neighbour and we report estimates without covariates and with covariates. Panel (a) reports estimates when the treatment is investment and export entry as the outcome variable of interest. Similarly, panel (b) presents estimates when we take exporting as the treatment and investment as the outcome. Table 3, column 2 shows that non-exporters who invest in physical capital have high probability of switching status to being exporters. We find evidence that previous investment (2 years ago) increases the firm's probability of becoming an exporter by 36.2%, while a 1-year investment decreases its probability by 19.8%. Similarly, when we include covariates (column 5), the probability increases significantly, to 39.3% – for a 2-year lag. We note that the returns from firm-level investments may not be realized immediately but takes time to cause effect, which may explain low probability of switching status to exporter, when we have a 1-year lag in firm-level investment.

Correspondingly, we also find evidence that exporting experience is associated with the probability that a firm will engage in firm-level investment (column 5, rows 4–5). We can observe that a 2-year exporting experience increases the probability of a firm engaging in firm-level investment by 8.7%, while a 1 year exporting experience boosts its chances of investing in capital stock by 13% higher than non-exporters. The evidence presented in this section is consistent with other findings that show that firms who engage in any productivity enhancing activities like innovation, Research and Development or technology upgrading at the firm-level receive a stream of benefits that accrue from such investment.

Table 3. Effects of firm-level investments (exporting experience) on probability of exporting (investing).

Treatment	Outcome					
	Export entry					
	Without covariates			With covariates		
	ATT	R ²	Obs.	ATT	R ²	Obs.
Panel (a) investment						
Invest(t-2)	0.362 (0.206)	0.03	891(3097)	0.393 (0.085*)	0.18	784(1950)
Invest(t-1)	-0.198 (0.000***)	0.04	855(3386)	-0.070 (0.139)	0.19	781(2199)
Panel (b) exporting						
Exports(t-2)	-0.338 (0.000***)	0.03	563(3109)	0.087 (0.576)	0.18	424(2117)
Exports(t-1)	-0.306 (0.000***)	0.04	630(3610)	0.130 (0.541)	0.17	493(2486)

Note: We report bootstrapped standard errors (50 replications) with the number of the matched controls and the number of the treated on the common support; values are estimated using DID. *P*-values in parenthesis where significance levels are at: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Consequently, these firms are able to restructure their production processes by upgrading the production technology, which in turn raises production efficiency and lowering average marginal costs of production; raising performance of firms (Aw et al., 2007; Bustos, 2011; Caldera, 2010; Damijan, Kostevc, & Polanec, 2010; Jorgenson, 2011).

5.2. The Effect of Firm-level Investment on Export Market Performance

Next, we consider the view that firm-level investment improves the firm's productivity in the export market. We view firm-level investment in capital stock as a catalyst that expands a firm's production capacity thus improving production efficiency. If the firm cuts down on its marginal costs of production, it will sell in the international markets at a reduced cost compared to firms whose marginal costs of production are still high. If this is the case, we should be able to see a firm increase its performance once it begins to sell in the export market thus increasing its productivity levels. We estimate Equation (17), using DID. We present the results of DID, with covariates and without covariates in Table 4.

Our findings confirm the view that firm-level investment is another channel that might explain the large productivity differences between exporters and non-exporters. In column 2, we find evidence that exporters who engage in firm-level investment have higher TFP, 47.7%, and labour productivity, 5.5%, than non-exporters. We note that, though the other firm characteristics seem to be lower, our interest is to understand whether firms that invested in physical capital improve their productivity once they start exporting activities. We can see in column 5, where we report results with covariates, that TFP and labour productivity is still higher, at 2.5% and 40.9% respectively. We also note that capital intensity and wages are also higher, at 46.5% and 5.8% respectively. We observe that firm-level investment in capital does not only facilitate firm entry into the export markets, but also increases TFP and labour productivity among new exporters.

The evidence presented in this section confirms that firm-level investment is the another crucial channel for productivity enhancing effects of trade, implying that firms that invest in physical capital strengthen their ability to improve productivity and performance in export markets (Constantini & Melitz, 2008). Furthermore, these findings are consistent

Table 4. The effect of firm-level investment on export market performance.

Firm characteristics	Without covariates			With covariates		
	ATT	R ²	Obs.	ATT	R ²	Obs.
Total factor productivity (TFP)	0.477 (0.090*)	0.00	815(2004)	0.025 (0.943)	0.04	774(1565)
Labour productivity	0.055 (0.879)	0.11	847(2736)	0.409 (0.232)	0.30	866(2597)
Capital intensity	-0.103 (0.773)	0.11	846(2731)	0.465 (0.199)	0.38	774(1595)
Real monthly wages	-0.103 (0.730)	0.00	446(1558)	0.058 (0.833)	0.04	459(1445)
Education (skills)	-1.082 (0.008***)	0.05	753(1550)	-0.744 (0.021**)	0.16	728(1473)
Employment	-0.607 (0.002***)	0.15	786(1958)	-1.161 (0.000***)	0.21	781(2200)

Note: We report bootstrapped standard errors (50 replications) with the number of the matched controls and the number of the treated on the common support; values are estimated using DID. *P*-values in parenthesis where significance levels are at ****p* < 0.01; ***p* < 0.05; **p* < 0.1.

with evidence presented by Yeaple (2005). He emphasizes the view that heterogeneous differences between exporters and non-exporters arise because of differences in production technology. Firms that endogenously improve production technology of producing good *x* improve their efficiency and reduce the marginal costs of producing additional units of that good. Firm-level investment in capital is analogous with improving the firm's technology and productive capacity, thus increasing firm production efficiency.

5.3. Firm-level Investment and Growth Rates of Exporters

In this section, we report the estimates of exporters who have carried out firm-level investment in the past one year. We estimate an equation of the following type:

$$\Delta\omega_{it} = \frac{1}{\omega_{it-1}}(\omega_{it} - \omega_{it-1}) = \alpha_{it} + \beta X_{it} + \sum_{v=-1}^2 \lambda_v \text{Exp}_{it-v} + D_{jkt} + \varepsilon_{it}, \quad (21)$$

where $\Delta\omega$ denotes the change in the outcome variables (total factor productivity, labour productivity, employment or wages), and the rest of the terms are labelled as before; *i*, *t*, *j* and *k* denote index firms, time periods, sectors/industries and countries respectively, while *D* denotes the full set of industry, regions and time dummies. *X* is a vector of control variables and *Exp_{it}* is dummy variables set to 1 if firm *i* is an exporter, at point *t*, and zero otherwise.

We present the estimation results in Table 5. From Table 5 column 2, we note that TFP, labour productivity and capital intensity growth rates for new exporters that invest are 11.4%, 3% and 1.1% respectively. These growth rates are positive and statistically significant at 1% and 5% levels, implying that exporters that invest in capital stock have significant TFP, labour productivity and capital intensity growth rates. When we include covariates in our estimation, we observe almost similar results. In column 5, we see that TFP growth rate is now at 15%, labour productivity is at 3.2% and capital intensity is at 0.8%. We can also see that all the other performance measures have positive growth rates – real monthly wages are at 1.4%, skills at 0.2% and employment is at 1.4%. Therefore, the main message of Table

Table 5. Firm-level investment and growth rates of exporters.

Firm measures	Without covariates			With covariates		
	ATT	R ²	Obs.	ATT	R ²	Obs.
Total Factor Productivity (TFP)	0.114 (0.001***)	0.00	800(1327)	0.150 (0.000***)	0.00	765(1261)
Labour productivity	0.030 (0.022**)	0.00	819(1355)	0.032 (0.005***)	0.30	760(1260)
Capital intensity	0.011 (0.000***)	0.00	846(2731)	0.008 (0.000***)	0.00	761(1289)
Real monthly wages	-0.003 (0.912)	0.00	370(1246)	0.014 (0.630)	0.00	345(810)
Education	0.007 (0.000***)	0.00	753(1550)	0.002 (0.000***)	0.00	707(1299)
Employment	0.011 (0.000***)	0.00	809(1498)	0.014 (0.000***)	0.00	772 (1410)

Note: We report bootstrapped standard errors (50 replications) with the number of the matched controls and the number of the treated on the common support; Values are estimated at the 0.5 Quantile. *P*-values in parenthesis where significance levels are at: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

5 is that firm-level investment is a key catalyst of productivity growth among new exporters. Thus exporters who have upgraded their technologies receive higher productivity premia which further drives productivity differences between exporters and non-exporters (Bustos, 2011). We observe that, although productivity differences between exporters and non-exporters may be explained by self-selection and learning-by-exporting, firm-level investments in capital stock may also be another channel that further explains these differences. Though we did not test for the time it takes to start and survive in the export markets, our results may suggest that firm-level investments help less productive firms increase their productivity, expand faster and persist in the international markets, generating increased profitability and productivity in the process as shown by Rho and Rodrigue (2016).

6. Conclusion

In this study, we analysed the effect of firm-level investment in capital on export entry and productivity growth of new exporters. Using firm-level data from two selected Sub-Saharan African countries, we show that non-exporters who engage in firm-level investment in capital stock have higher probability of switching status, from non-exporter to exporter. This establishes the fact that although firm productivity differences can be explained by self-selection factors as one channel, firm-level investment may be another possible channel that provides explanation to why firms with low productivity, venture into the export market. This study establishes a clear indication that when firms invest in physical capital, especially plant and equipment, they gain capacity to produce effectively and so more productive firms produce more output at lower unit costs as postulated in our theoretical model.

Relatedly, we evaluate whether firm-level investment in capita stock provides superior advantages to exporters when they initiate exporting. We apply matching together with DID methods to test whether firm-level investment stimulates better performance among exporters. We find evidence that firms that invest in physical capital receive a positive, statistically significant premium when they engage in the international markets. Our findings

suggest that firm-level investment in capital is associated with better export market performance outcomes. Therefore, policies aimed at promoting exports should target providing support to firms that seek to invest to expand their productive capacity. Firms can benefit greatly if they receive support in form of technology and capacity improvements as this would stimulate the probability of export market entry hence promoting exports.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Data Availability

The data associated with the results of the paper were downloaded from website of Centre for the Study of African Economies at Oxford, available at <https://www.csae.ox.ac.uk/data>.

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