Journal of Industrial and Business Economics
https://doi.org/10.1007/s40812-020-00156-9

Investments, export entry and export intensity in small manufacturing firms

Stephen Esaku[1]

Received: 4 October 2019 / Revised: 27 March 2020 / Accepted: 14 April 2020

Abstract

We analyze the effect of investment in physical capital on the firm's choice to enter the export market and increase export intensity. We specifically examine the hypothesis that firm-level investment facilitates small firms to initiate exporting and increase their export intensity. Using propensity score matching techniques, the results we find are remarkable. First, we find that firm-level investments in physical capital significantly increase the probability of export market entry among small firms. Second, we show that small firms that investment significantly increase the probability of expanding their exports, as observed in the high export intensity. This implies that firm-level investment is a substantial component in the firm's choice to export and may be another channel through which small firms can access export markets despite the presence of sunk entry costs that act as a barrier to entry. Third, we show that firms that invest above the industry average investment level stand the highest probability of entering the export market and expanding their export sales. Moreover, we also find that exporting experience significantly influences the firm's choice to invest, probably as a measure of upgrading production technology. At the policy level, we observe that export subsidies should be directed at addressing capacity and technology related constraints as these have hampered export entry and export intensity among small firms.

Keywords Treatment effects model · Investments · Exports · Firm performance · SMEs

JEL Classification C21 · E22 · F1 · L25 · L26

✉ Stephen Esaku
esaku_stephen@yahoo.com; sesaku@cavendish.ac.ug

[1] Department of Business and Management, Cavendish University Uganda, Box 810, Soroti, Kampala, Uganda

Published online: 30 April 2020

1 Introduction

There is a growing body of theoretical literature examining the behavior of heterogeneous firms that trade. The Melitz (2003) model establishes that participating in foreign trade generates high export entry rates among the large and more productive firms while at the same time lowering the probability of entry for the less productive ones. Consequently, any additional exposure to trade for the whole industry would induce further intra and inter-firm reallocation of resources towards the most productive firms. Relative to the more productive firms, the less productive ones remain to serve the domestic markets and those that venture into the export markets find themselves unable to survive longer in these markets (Melitz 2003; Roberts and Tybout 1997). This is a clear indication that firm-level efficiency is an important element in the firm's decision to enter and exit international markets. Following the intuitive study by Bernard and Jensen (1999), several empirical studies confirm this central thesis (see Haidar 2012; Serti and Tomasi 2008) and show that export participation leads to improvements in the firm's efficiency level (Eliasson et al. 2012; Fernandes and Isgut 2015). The above arguments imply that firms must first acquire high efficiency levels before entry and improve it further thereafter (suggesting self-selection and learning-by-exporting patterns).

Contrary to the above line of thinking, Eaton et al. (2008) using firm-level data study the behavior of Colombian exporters and suggest that the above narrative might not necessarily hold for firms in developing countries. They show that small manufacturing firms enter nearby foreign markets yearly vending small quantities of their products. A large number of them do not survive beyond one year, and those that survive grow and expand their sales to more distant foreign markets. This contradicts the much established strand of literature showing that prospective exporters possess all the desired features (in terms of productivity, size, capital intensity among others) years before they start to export. However, what then explains the observed export entry pattern of these small and less productive firms in the foreign markets as documented in Eaton et al. (2008)? How can we reconcile this observed pattern with the conventional wisdom of the Melitz's (2003) model and numerous other empirical studies supporting the self-selection assumption? This study will try to show that there might be a missing link that could provide answers to this observed puzzle in the firm-level data.

Recently, some authors have also argued for the presence of a missing link that provides a better justification for the observed empirical patterns among Colombian manufacturing firms. Several studies have examined the possible contribution of firm-level investments in research and development (R&D) to the probability of exporting (see Aw et al. 2011). As ably shown by Esteve-Pérez and Rodríguez (2012), firms that engage in R&D have high probability of exporting while simultaneously raising their likelihood of engaging in R&D. Similarly, Falk (2012) examines firms in Austria and finds that intensity in R&D creates a positive and statistically significant effect on the growth of sales and employment. Moreover, firms engaging in R&D increase sales as their products stimulate increased demand among potential customers. Correspondingly, Hölzl (2009) studies the R&D behavior of firms in 16 countries and finds that R&D is central to the growth and performance of high-growth SMEs in economies where technology is not distant. Accordingly, some studies have followed a different strand of literature on international trade that examines the effect of firm-level innovations on the success of export entry and participation. For example, Colombelli et al. (2016) note that export entry alone without innovation may not sustain the survival and performance of firms. Firms should engage in innovation, both process and product, to succeed in exporting and increase their chances of survival in the foreign markets. However, their study examines only innovative start-ups while neglecting firms that have attained maturity in the market.

Relatedly, Rochina-Barrachina et al. (2008) study how process innovations affect the firm's total factor productivity growth and note that the former increases productivity of firms. Moreover, these authors confirm that successful innovations foster the efficiency of firms over time. In the same vein, various empirical studies using firm-level data present similar conclusions (see Baffour et al. 2018; Caldera 2010; Hall et al. 2009; Lileeva and Trefler 2010; Segarra and Teruel 2014). Accordingly, Bustos (2011) demonstrates that the scaling down of trade barriers reinforces trade integration which in turn stimulates firms to upgrade their production technology (Alvarez and López 2005) and the quality of the product (Iacovone and Javorcik 2012) even before export market entry. Taken together, there is a growing body of literature examining the effect of R&D, innovation, and technology upgrading on exporting. Conversely, few studies examine the relationship between firm-level investment in physical capital and the behavior of exports. We define investments in physical capital as any firm-level investment in physical capital—equipment and machinery, designed to upgrade the technology of the firm. We view investments in physical capital as a form of technology upgrading that can help firms grow their productive capacity and attain economies of scale.

Accordingly, researchers have begun to develop theoretical models to test the implications of investments in physical capital on firm-level export decisions. Rho and Rodrigue (2016) present a structural model to study how firm-level investments affect export dynamics among Indonesian manufacturing firms. They show that small firms that accumulate enough capital generate capacity that makes them productive over time, and survive longer in the export markets. Moreover, Rho and Rodrigue (2015) assert that new exporters have high rates of investments than non-exporters and suggest that the productivity differences and export behavior between non-exporters and exporters may be explained by differences in firm-level investment. On the empirical side, Peluffo (2016) studies the behavior of Uruguayan manufacturing firms to understand whether increased firm-level investment in total physical assets induces firms to sell products in foreign markets. Conclusions from this study reveal that investments induce increased levels of exports and export orientation among Uruguayan manufacturing firms.

We follow the recent strand of trade literature examineing the implications of firm-level investment on the decision to export. More specifically, this study's objective is to examine the effect of investments in physical capital[1] on the probability of export market entry, export intensity, on one hand, and the effect of exporting experience on investment on the other, on small manufacturing firms. Our interest is to examine whether new firm-level investment in physical capital explains export entry patterns of small firms. If this is the case, we should expect to see small firms that invest in physical capital increase their probability of switching status, from non-exporter to exporter, better than firms that have not invested. We assess the following specific research questions: (1) Do new firm-level investments increase small firms' probability of switching status—from non-exporter to exporter, thus explaining the entry patterns among small exporters? (2) Do small firms that invest increase the probability of increasing export intensity? (3) Does exporting experience increase small firms' probability of investing in physical capital?

While some studies have examined the impact of R&D investments, innovation and technology upgrading, this study differs from previous literature in four major ways: First, we examine the effect of firm-level investment on the probability of export entry among small firms. The uniqueness of our data allows us to explicitly study the effect of firm-level investment on the size class of firms. This is a gray area that has received limited treatment in the international trade literature. Second, relative to previous literature that examined the effect of investments on manufacturing firms in developed countries, we exclusively focus on Africa. This region has not received adequate studies on the subject matter. This study will help shed more light on the behavior of firms that engage in investments. Third, we make a novel policy contribution to the literature on effect of firm-level investments on export entry and export intensity. Most African countries would want to promote exports to earn the much needed foreign exchange. Our study will highlight policy implications of investments on the success of export entry and export intensity among small firms. To the best of our knowledge, this study is the first to analyze the impact of firm-level investment in capital on the decision to export, with focus on small firms in Africa. We use unique data that cover a relatively long period, from 1991–2002, ideal for studying the behavior of firms. Furthermore, our data includes key information on physical investments, employment, and data necessary for estimating total factor productivity. We implement our econometric analysis using propensity score matching estimation methods.

We find complementary evidence suggesting that investment in physical capital may help small firms to initiate exporting and increase export intensity. This implies that as firms invest in capital, they upgrade their production technology that helps them cut-down on the variable costs of production. Recently, Ahn and McQuoid (2012) suggested that a number of new exporters face increasing marginal costs of production due to difficulty in accessing capital financing when they start to sell in foreign markets. Since finance is a binding constraint, our evidence proves that firms

[1] We use physical capital, capital or capital stock interchangeably. In this study, they have the same meaning.

that invest are likely to access export markets compared to non-investing firms. Consistent with the findings of Hall et al. (2009), our results seem to suggest that new exporters may face stiff competition that requires them to invest in some form of technology upgrade to circumvent the competition.

The rest of the paper is structured as follows; Sect. 2 presents the literature review. Section 3 describes the data used to conduct empirical exercises, while Sect. 4 presents the methodology. Section 5 reports and discusses the results, while Sect. 6 concludes.

2 Literature review

Recent theoretical and empirical literature on international trade emphasizes the complementary relationship between firm-level investment and export growth. Recently, Rho and Rodrigue (2015) have shown that export market entry increases the investment behavior of exporters by 37%. They find that new exporters engage in accumulating capital holding during the first year of entry and continue doing so up to 3 years after export market entry. Moreover, their findings also suggest persistent differences in the investment behavior between foreign and domestically owned firms, with foreign owned firms investing in physical capital faster than their domestic counterparts. This suggests that exposure to international trade makes firms to face intense competition that may require them to upgrade their production technology (Bustos 2011), to improve the quality of their products to meet international standards (Iacovone and Javorcik 2012).

As Rho and Rodrigue (2016) findings show, firm-level investment in physical capital allows new exporters to grow into the export markets faster. Investments in physical capital helps firms expand their capacity to produce and utilize the production inputs to meet their market demands. In this case, new firms can mitigate their exposure to demand disturbances across markets as they attain the requisite resources to address these demand shocks. On the empirical front, Peluffo (2016) examines the hypothesis that investments facilitate export market entry and finds evidence to support this assumption. When investment is taken as the treatment variable, there is evidence that it raises the level of exports and increases export propensity among firms. Moreover, the findings from the above study confirm that productivity is important for any firm to engage in investment. Examining the implications of the above study, we note that firms make a deliberate effort to build their capacity and productivity by engaging in investments to enter into the export markets as shown by Rho and Rodrigue (2015).

However, as noted by Roberts and Tybout (1997), exporting is expensive because new entrants will have to pay sunk costs, in addition to other variable costs of production. Sunk costs of entry may be related to establishing distribution channels, research on market demand and customer preferences, upgrading the quality of products to match international levels, among others. These costs are substantial and may not be recovered even if the firm decides not to enter the export markets, as such can only be covered by large and more productive firms. Indeed if sunk costs are important, small firms may find it hard to access international markets unless they possess high enough productivity or have accumulated enough capital, carried out significant innovations or R&D that helps them upgrade their production technologies. This implies that investments form an important component in the decision to export and play an important role in helping firms to build enough capacity. As demonstrated by Yang et al. (2004), technology is important for all firm size classes and raises the likelihood of export market entry implying that firms that invest in technology may access foreign markets faster than non-investing firms.

To conclude, a number of studies show how firm-level initiatives, like investment in research and development influence the firm's decision to export (Aw et al. 2011; Constantini and Melitz 2008; Esaku and Krugell 2020), while others study the effect of firm innovation on productivity and export dynamics (Cassiman and Golovko 2011; Damijan et al. 2010) and importance of technology on input choices (Yeaple 2005). However, studies that examine how firm-level investment in physical capital shapes the firm's choices of entry and productivity dynamics after entry are so limited. Peluffo (2016), Rho and Rodrigue (2015, 2016) and Wu and Miranda (2015) are some of the few studies that have attempted to assess the relationship between physical capital and entry dynamics, but all these studies examine firms outside of Africa. This study will provide a clear understanding of this relationship in the African context using firm size class as a testing framework.

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. We choose the countries because of one main reason; availability of data that span a relatively long period suitable for conducting firm-level analyses. The data are made available by the Centre for the study of African Economies (CSAE)[2] at the University of Oxford and its use is not exclusive. The dataset has comprehensive data extracted from a panel survey of manufacturing firms operating in these countries in the following industries, textile, wood, furniture, garment, metal and machinery, and food and bakery (Esaku 2019). The data on Ghana manufacturing firms cover a period of 12 years collected over seven rounds, from 1991 to 2002 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 Center for the study of African Economies (CSAE)[3] based at the University of Oxford, using stratified sampling strategies within each country and firm size. This dataset is unique in having comprehensive information on firm-level employment, value added, labor productivity, capital intensity, real monthly wages, weighted

[2] The data can be download from https://www.csae.ox.ac.uk/data.

[3] We thank the Center for the study of African Economies for making the data available for download for free to researchers. We are grateful to you for this assistance without which, it would not have been possible to conduct this study.

Table 1 Variable description and summary statistics

Variable	Description	Observ.	Mean	S. Dev.	Minimum	Maximum
TFP	Total factor productivity calculated using the ACF method	3811	2.094	2.289	−16.893	13.983
Labor productivity	Log of real output per worker in US$	4633	5.415	3.982	0	13.002
Capital intensity	Log of real US$ capital to labor ratio (K:L)	4620	4.797	3.794	−1.149	15.744
Wages	Log of real monthly wages in US$	2713	3.483	1.192	−3.965	11.673
Materials	Log of real US$ materials per worker	4633	4.860	3.680	−0.560	12.011
Employment	Log of the number of workers in the firm (both skilled and unskilled)	4861	2.072	1.881	0	7.863
Export intensity	Ratio of export sales to total sales	5625	0.039	0.170	0	1
Firm age	Firm's year since it first started operations	4262	17.502	12.450	0	102
Ownership	Dummy variable equal one if the firm has some percentage of foreign ownership	5573	0.191	0.393	0	1

Source: Author's calculations from CSAE data

Table 2 Percentage of firms by their investment status from 1991–2002

Firms	Size class	Non-exporters (%)	Exporters (%)
Do not engage in firm-level investment (%)	Micro (Emp < 10)	30.7	6.1
	Small (Emp >= 10&emp < 50)	28.8	18.6
	Medium (Emp >= 50&emp < 249)	6.4	8.4
	Large (Emp >= 250)	5.3	19.1
	Sub-sample of non-investing firms	71.2	52.2
Engage in firm-level investment (%)	Micro (Emp < 10)	7.1	2.6
	Small (Emp >= 10&emp < 50)	12.6	14.3
	Medium (Emp >= 50&emp < 249)	4.4	5.6
	Large (Emp >= 250)	4.7	25.3
	Sub-sample of investing firms	28.8	47.8
All firms (%)	Total	100	100

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

average education and tenure, investment in equipment, land and buildings and other variables.

3.1 Variable description and summary statistics

We present the summary of descriptive statistics in Table 1.

3.2 Percentage investment shares by exporting and non-exporting firms

In this section, we report percentage shares of investment levels by exporting and non-exporting firms, according to firm size classification. The results are presented in Table 2. We exploit the uniqueness of our data in providing size classes of firms. Consequently, we use European Union revised classification[4] of firm size classes and classify firms into four size classes; (1) micro firms—being those that employ less than 10 workers (emp 1–9), (2) small firms—employ from 10–49 workers (emp 10–49), (3) medium firms—employ 50–249 workers (emp 50–249), (4) large firm, employ 250 and more workers, (emp 250+). We note that 71.2% of non-exporters do not engage in any form of firm-level investment, while 28.8% of them engage in firm-level investment. Correspondingly, 52.2% of exporters do not engage in firm-level investment while 47.8% of them have invested. We observe that investment is a rare activity among African manufacturing firms. These results suggest that firm-level investment may be costly and may only be undertaken by more established firms as can be seen from the number of firms that engage in it. This might also be

[4] Downloaded from https://ec.europa.eu/regional_policy/sources/conferences/state-aid/sme/smedefinitionguide_en.pdf.

associated to the capacity and financial constraints firms face to acquire the necessary production technologies.

4 Methodology

4.1 Econometric strategy

In this section, we detail out the propensity score matching (PSM) econometric methodology which enables us to study the causal effects of investment (treatment) on the firm's decision to enter the export market and the growth of exports—export intensity (measured by the ratio of value of output exported to total sales). Moreover we also assess the causal effects of exporting experience on the probability of investing in capital. We carry out the analysis on the premise that different firm size classes are differently affected by the treatment variable (investment). Therefore, we evaluate the impact of firm-level investment in physical capital on the probability of switching firm export status, from non-exporter to exporter. Consequently, our treatment variable takes five forms; (1) invest—which is a firm's investment status in period t; (2) invest $t-1$—defined as the variable equal to one if the firm invested in physical capital in period $t-1$ and zero otherwise; (3) invest $t-2$ defined as the variable equal to one if the firm invested in physical capital in the previous two periods and zero otherwise; (4) db—which is a generated dummy variable equal to one if firm *i*'s investment in physical capital is below the average of industry investment and zero otherwise, and finally; (5) da—dummy variable equal to one if the firm's investment in physical capital is above the industry average, and zero otherwise. To enable us generate dummy variables, (db) and (da), we first established the industry average investment for all firms following the approach of Peluffo (2016).

We also assess whether exporting induces firms to engage in firm-level investment. We assume that, 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 product *x* switches exporter status $i = 1$, it incurs a one-time sunk cost and marginal costs of exporting each unit of product *x*, incurring increasing marginal costs of production and investment. These costs may become export constraints to small 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 firm-level investment in capital and have built larger capital stocks grow into export markets, survive longer and face lower marginal costs as shown by Rho and Rodrigue (2016). Using propensity score matching, we analyze the effect of the treatment on the outcome variable. We examine three assumptions: (1) firm-level investment 'causes' export entry and export intensity, (2) firms that invest below industry investment average face low probability of export entry and intensity, (3) firms investing above industry average have higher probability of export entry and intensity, and (4) exporting experience 'causes' firm-level investment.

Denote the export status of firm *i* by $exp_{it} \in \{0,\ 1\}$ the dummy variable equal one if firm *i* enters the export market in time *t*, and zero otherwise. Denote investment in physical capital as (invest) where $invest_{it} \in \{0, 1\}$ represents a dummy variable equal one if the firm invested (the treatment) so that $\exp^1_{it+n}$ is the outcome at $t+n$, following the treatment. Analogously, we can denote the outcome of firm *i* had it not received the treated by $\exp^0_{it+n}$. We can then infer that the causal effect of the firm's treatment in year $(t+n)$ is expressed as:

$$\exp^1_{it+n} - \exp^0_{it+n} \tag{1}$$

Given the above expression, we now face a fundamental issue of causal inference, leading to a counterfactual situation, where we only observe $\exp^1_{it+n}$, while $\exp^0_{it+n}$ is unobservable. The analysis of causal inference depends on the creation of the counterfactual—the average outcome that a firm would have obtained had it not invested in physical capital. To overcome this counterfactual, we select a valid control group in such a way that every treated unit (firm that invested) is matched to an untreated unit (which did not invest) with the same characteristics at the time before the treatment. Consequently, we use *propensity score matching* method and apply it as follows: for all firms, we analyze the likelihood of investing in physical capital, or more specifically, th*e propensity score* by means of a logit model. For example, firm *i* that is a member of the control group with similar propensity scores to another firm that has received treatment are identified as matches. To implement the estimation of the effect of the treatment (investment), we use a number of covariates, in logs and lagged one period, namely: total factor productivity (TFP), capital intensity (K:L), firm size (measured by the log of number of employees), ownership status of the firm (any for), monthly average wages (wages) and a firm's age. The latter variable is not in logs. We also test whether treatment balance is achieved.

We then use the *teffects* suite of Becker and Ichino (2002) and match our units using nearest-neighbor matching. We then select a non-exporter firm that is "closest" to the ultimate exporter in terms of its propensity score. More formally though, for the individual new entrant firm *i,* exporting to country *f*, a non-exporter firm *j* can be selected such that:

$$|p^f_{it} - p^f_{jt}| = \min_{k \in \{\exp=0\}} \left\{ p^f_{it} - p^f_{jt} \right\} \tag{2}$$

This method of matching has the advantage of being easy to implement and less likely to be affected by selection bias. Moreover, the nearest neighbor matching nearly estimates the average treatment effect (ATE) always because it matches control individuals to the treated group and discards controls that are not selected as matches.

4.2 Measuring total factor productivity (TFP)

In this section, we show how we measure TFP. As shown by recent studies, the common approach in correctly estimating a production function lies in how the problem of unobservable determinants of production is handled (Ackerberg et al. 2015). This implies that the unobservable determinants of production may be known to the firm but unobserved by the econometrician, and it's the residual of the production function that correlates with other variable inputs that may create the simultaneity problem. Some approaches have been advanced to handle the simultaneity issue (see, Ackerberg et al. 2006 (henceforth, ACF); Levinsohn and Petrin 2003 (henceforth, LP); Olley and Pakes 1996 (henceforth, OP); Woodridge 2009). These methods involve dividing the residual into two components; (1) productivity of the firm which is known to the manager, denoted by, ω, and (2) ε, taken to be the residual. Consider a Cobb–Douglas function of the form in logs:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \varepsilon_{it} \tag{3}$$

where k_{it} is the log of capital input, l_{it} is the log of labor input, ω_{it} is the TFP component that influences the firm's decisions on the right combination of inputs to produce maximum output, and ε_{it} is the error component. Given that capital and labor input choices rely on the productivity term, ω_{it}, it implies that k_{it} and l_{it} are endogenous, thereby generating endogeneity problem. Consequently, LP and OP introduced novel ways of addressing this problem by proposing the use of a proxy variable that inverts out the productivity term, ω_{it}. For example, LP use intermediate materials, while OP propose the use of the firm's investment to proxy the unobserved productivity.

Although Olley and Pakes (1996) and Levinsohn and Petrin (2003) provide novel approaches of dealing with endogeneity issues, Ackerberg et al. (2006, 2015) point out strong reservations in using these methods due to collinearity in the first stage of estimating the production function.Consequently, ACF (2015), propose to estimate the value added production function of the form:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \varepsilon_{it} \tag{4}$$

where l_{it} represents the labor input of firm i at period t, k_{it} is the capital input, ω_{it} denotes the unobservable state variable (productivity) that influences the firm's input choices and the level of production, and ε_{it} is the error term. ACF assume that firms accumulate capital according to the following:

$$k_{it} = \kappa(k_{it-1}, +i_{it-1}) \tag{5}$$

where i_{it-1} denotes the investment chosen in the previous year, $t-1$, while labor input l_{it} is chosen at year t, year $t-1$ or year $t-c$ (with $0 < c < 1$). Because of the timing of these assumptions, firm *i's* material input demand at period t now depends on l_{it} chosen prior to it (Ackerberg et al. 2006), so that:

$$m_{it} = f_t(\omega_{it}, l_{it}, k_{it}) \tag{6}$$

where $f_t(\omega_{it}, l_{it}, k_{it},)$ is monotonically increasing in ω_{it} for all (l_{it}, k_{it}) to get the inverted intermediate input demand, $\omega_{it} = h_t^{-1}(m_{it}, l_{it}, k_{it})$. This expression enables l_{it} to be identified before all or some of ω_{it} is achieved at period t. When we substitute the above expression into the production function, we obtain

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + h_t^{-1}(m_{it}, l_{it}, k_{it}) + \varepsilon_{it} = \hat{\Gamma}_t(m_{it}, l_{it}, k_{it}) + \varepsilon_{it} \tag{7}$$

If h_t^{-1} is considered non-parametric, ACF (2015) shows that terms; β_0, $\beta_l l_{it}$, and $\beta_k k_{it}$ are not identified and are subsumed to $\hat{\Gamma}_t(m_{it}, l_{it}, k_{it}) = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it}$, thereby giving the first stage moment condition as follows:

$$E[\varepsilon_{it}|I_{it}] = E[y_{it} - \hat{\Gamma}_t(m_{it}, l_{it}, k_{it})I_{it}] = 0 \tag{8}$$

In the above expression, it is difficult to estimate β_l in the first stage as in Levinsohn and Petrin (2003). ACF (2015) propose estimating β_l in the second stage of the estimation along with the other production parameters, using the second stage conditional moment given as:

$$\begin{aligned} &E[\zeta_{it} + \varepsilon_{it}|I_{it-1}] \\ &\quad = E[y_{it} - \beta_0 - \beta_l l_{it} - \beta_k k_{it} - g(\hat{\Gamma}_{t-1}(m_{it-1}, l_{it-1}, k_{it-1}) - \beta_0 - \beta_l l_{it-1} - \beta_k k_{it-1})|I_{it}] = 0 \end{aligned} \tag{9}$$

where I_{it-1} is the firm's information at period t − 1 and with $\hat{\Gamma}_{t-1}$ replaced by its estimate from stage one. In the first stage, ACF (2015) present trial values of parameters β_l and β_k by first constructing an estimate for $\beta_0 + \omega_{it}$ as follows:

$$\beta_0 + \hat{\omega}_{it}(\beta_l, \beta_k) = \hat{\Gamma}_t(m_{it}, l_{it}, k_{it}) - \beta_l l_{it} - \beta_k k_{it} \tag{10}$$

where $\hat{\Gamma}_t(m_{it}, l_{it}, k_{it})$ is derived in the first stage. Then in the second stage, ACF (2015) estimate the AR (1) process by regressing $\beta_0 + \hat{\omega}_{it}(\beta_l, \beta_k)$ on its lagged variable $\beta_0 + \hat{\omega}_{it-1}(\beta_l, \beta_k)$ to get the regression residual $\hat{\omega}_{it}(\beta_l, \beta_k)$. Then as a final stage, ACF (2015) estimate β_l and β_k applying the following concentrated moment condition:

$$E\left[\hat{\zeta}_{it}(\beta_l, \beta_k)X\begin{pmatrix} l_{it-1} \\ k_{it-1} \end{pmatrix}\right] = 0 \tag{11}$$

We rely on ACF (2015) procedure and use the *Stata* command *acfest* to estimate a Cobb–Douglas production function of the form:

$$y_{it} = \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \omega_{it} + \varepsilon_{it} \tag{12}$$

where all variables are in logs; y_{it} denotes the value added, l_{it} is the labor input, m_{it} is the materials, and k_{it} is the capital input, ω_{it} represents the productivity shock that impacts the firm's input decisions, and ε_{it} denotes the error term.

Consequently, Eq. (12) gives a valid process of estimating TFP, where its residual is the TFP of the firm retrieved from the coefficients. Thus we have;

$$TFP_{it} = y_{it} - \tilde{\beta}_l l_{it} - \tilde{\beta}_m m_{it} - \tilde{\beta}_k k_{it} \tag{13}$$

Table 3 Average treatment effect for the binary treatment (invest, invest t − 1, invest t − 2, db and da) on probability of export entry

Treatment	Outcome				
	Entry into exports				
	Firm size class				
	All	Micro	Small	Medium	Large
Invest	0.119 (0.000)***	− 0.014 (0.627)	0.088 (0.035)***	− 0.008 (0.905)	− 0.026 (0.859)
$Invest_{t-1}$	0.124 (0.000)***	0.038 (0.366)	0.127 (0.002)***	0.078 (0.267)	0.027 (0.829)
$Invest_{t-2}$	0.084 (0.002)***	0.023 (0.471)	0.097 (0.021)**	− 0.005 (0.952)	0.107 (0.458)
db-Investment below industry average	0.036 (0.237)	− 0.012 (0.696)	0.033 (0.437)	− 0.116 (0.102)**	0.026 (0.903)
da-Investment above industry average	0.369 (0.001)***	–	0.675 (0.076)*	0.186 (0.080)*	− 0.051 (0.668)
N	1595	427	535	258	152

Analysis of effect of investment above industry average on micro firms not done because few observations to conduct the matching

Estimator: nearest-neighbor matching

Outcome model: matching

Distance metric: Mahalanobis

**Significance: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

5 Estimation results and discussion

5.1 Binary treatment effects of investment on export market entry

In this section, we present the results of the analysis of the treatment (investment) effect on the probability of export market entry (outcome) in period *t*. We focus our discussion on the effect of the treatment on the outcome of interest, according to firm size class. We classify our firms as outlined earlier (micro, small, medium and large) and try the various forms of treatment (as shown in the methodology), that is, firms that invest in period t, period t − 1, period t − 2, invest below the industry average, and those that invest above industry average. We determine the average investment levels (below and above industry average) by following the approach of Peluffo (2016). We calculate the average investment for each industry and use this to group investment levels as either below or above industry average.

We report our results in Table 3. From Table 3, we can observe that investment has a positive and statistically significant effect on the firm's decision to enter export markets. To note two examples; first, previous investment in period t − 1 increases the probability of initiating exporting by 12.7% among small firms. When we analyze the effect of different levels of investment on the probability of export entry, we observe a positive and statistically significant effect on firms that invest above the industry average investment level. Second, we note that investment levels that are above the industry average, increases the firm's likelihood of initiating exporting by 67.5%. The implication of these results is that firm-level investment is a substantial component in the firm's choice of initiating exporting.

We turn to the results that highlight the objective of this study. Theoretical and empirical advances in international trade literature point to the observed patterns where relatively large and productive firms self-select into the export markets. As shown by Bernard and Jensen (1999) using U.S. data, plants that export are large (in terms of sales volumes and employment), more productive and pay higher wages. Moreover, Bernard et al. (2003) show that exporters are a small fraction of the entire population of U.S. firms and ship small quantities of their products to the export markets. To reconcile these facts, the self-selection and a small fraction of exporters, Melitz (2003) develops a tractable theoretical model that captures these facts, and shows that exporting is expensive and involves fixed costs. As shown in the work of Roberts and Tybout (1997), there is empirical evidence supporting the existence of sunk costs of exporting. These costs include market research, establishing distribution and sales channels, adjusting the products to international standards, information costs and others. These costs are substantial and act as a barrier to export entry against small firms. We test these facts in our analysis. We hypothesize that, while sunk costs are substantial and act as a barrier to export market entry against small firms, as shown by previous studies; investing in physical capital could enable small firms attain the required productivity that induces entry into the export market. If this is true, we should see positive and statistically significant effect of the treatment (investment) on the outcome (export market entry) among small firms.

Table 3, column 4, reports the results of the treatment on small firms. We clearly see that investments facilitate export market entry for small firms. We note that, investment in period *t* significantly increases the probability of export market entry for small firms by 8.8%. Similarly, investment in period t − 1 significantly raises the probability of entry further, by 12.7%. Correspondingly, we observe the most pronounced effect among small firms that invest above the industry average. In column 4, second last row, we see that small firms that invest above industry average have a higher probability, 67.5%, of initiating exporting activities. This effect is positive and statistically significant at 10%. These results imply that investing in physical capital is an important activity that may promote export-led growth in developing countries in Africa. However, our findings emphasize that small firms stand higher chances to export only when their investment level is above the average industry investment level. Firms that cannot reach this investment threshold may take time to gain the required productivity level that can propel them into the export markets.

Our findings seem to provide an explanation for the existence of small firms in the export markets, as shown by Eaton et al. (2008), despite being small (in terms

Table 4 Balancing test for firms that invest in physical capital

Variable	Mean			T test	
	Treated	Control	% Bias	T	P > t
Firm's size	1.7843	1.7868	−0.4	−0.04	0.972
Total factor productivity	2.8845	2.5681	0.102	0.50	0.2421
Capital intensity	5.693	5.7453	−2.9	−0.24	0.807
Wages	3.560	3.324	−0.237	1.93	0.0540
Firm's age	13.025	12.78	2.4	0.25	0.806
Ownership	0.02516	0.03774	−6.9	0.522	0.7740

Source: Author's calculations from the data: Note that Firm's age, total factor productivity, capital intensity and wages are in logs; except firm's age and foreign ownership

Table 5 Average treatment effect for the binary treatment on export intensity

Treatment	Outcome				
	Export intensity				
	Firm size class				
	All	Micro	Small	Medium	Large
Invest	0.047 (0.000)***	−0.002 (0.181)	0.060 (0.001)***	−0.003 (0.935)	−0.099 (0.366)
$Invest_{t-1}$	0.046 (0.000)***	−0.002 (0.180)	0.061 (0.001)***	0.045 (0.228)	−0.023 (0.720)
$Invest_{t-2}$	0.037 (0.001)***	−0.001 (0.316)	0.046 (0.014)**	0.017 (0.694)	−0.013 (0.870)
db	−0.008 (0.478)	−0.002 (0.181)	0.021 (0.274)	−0.123 (0.000)***	−0.012 (0.911)
Da	0.139 (0.001)***	–	0.533 (0.000)***	0.222 (0.007)***	0.001 (0.990)
N	1593	433	534	259	78

Estimator: nearest-neighbor matching

Outcome model: matching

Distance metric: Mahalanobis

**Significance: ***p < 0.01; **p < 0.05; *p < 0.1

of employment and sales). We argue that, though the presence of sunk costs of export entry provides an explanation to the rareness of exporting, we also show an important channel through which small firms can access the export markets. This finding is important for policy. Export-led policies, like export subsidies, without proper understanding of export market constraints that small firms face might not grow exports. As shown by Bernard and Jensen (2004), state subsidies tailored at promoting exports have no significant effect on the probability of export market entry. However, entry to export markets may be promoted if policies are geared towards providing subsidies to help small firms acquire production technologies, or upgrade technologies or replace outdated equipment (Bustos 2011). This has a substantial effect on entry into the export markets, similar to effect of innovation on exporting (Caldera 2010), Research and Development on

Table 6 Balancing test of export intensity

Variable	Mean			*T* test	
	Treated	Control	% Bias	T	P > t
Firm's size	2.727	3.121	0.394	5.87	0.0000
Ownership status	0.162	0.102	−0.060	2.23	0.0264
Firm's age	17.138	16.824	−0.315	0.37	0.7084
Capital intensity	6.379	7.008	0.629	3.45	0.0006
Wages	3.560	3.324	−0.237	1.93	0.0540
Productivity	2.549	2.747	0.197	1.20	0.2317

Source: Author's calculations from the data. Note that Firm's age, total factor productivity, capital intensity and wages are in logs; except firm's age and foreign ownership

exporting (Aw et al. 2007, 2011). Consequently, these firms are able to restructure their production processes by improving the production technology, which in turn raises production efficiency and lowers average marginal costs of production (Table 4).

5.2 Binary treatment effects of investment on export intensity

Bernard et al. (2003) present one stylized fact 'the low export intensity among U.S. exporters.' Analyzing the 1992 U.S. census of manufacturing plants, the authors show that about 65% of the firms sold a small fraction, less than 10%, of their products abroad. This finding seems to suggest that exporting indeed is an expensive activity that is costly for less established firms. We test whether small firms that invest in physical capital increase their export intensity. We report our results in Table 5. We exclude micro firms and those with investment level that is above the industry average because of small number of observations. In Table 5, column 3, we report the results of our interest—effect of the treatment (invest, invest t − 1, invest t − 2, db and da) on the outcome (export intensity). We find that current period's investment significantly increases export intensity by 6.0% among small firms. This effect is positive and significantly higher in period t − 1; that is, 6.1%. We observe that investment is crucial for the growth of exports (measured by export intensity). As shown by Ahn and Mcquoid (2012), small firms face a number of constraints like capacity related issues, financial and organizational constraints. So with limited capacity, these firms may find it costly to engage in international trade and to grow their exports. However, one possible avenue through which some of these constraints may be overcome, may point to investment in physical capital to build and improve the capacity of these firms. As pointed above, export promotion policies per se without associated subsidies to enable small firms accumulate physical capital to improve their production technologies may not yield fruitful results. Consistent with the findings of Peluffo

Table 7 Average treatment effect for the binary treatment on probability of investing in physical capital

Treatment	Outcome				
	Probability of investing in physical capital				
	Firm size class				
	All	Micro	Small	Medium	Large
$Exports_t$	0.120 (0.001)***	0.090 (0.000)***	0.201 (0.003)***	0.007 (0.915)	−0.070 (0.424)
$Exports_{t-1}$	0.066 (0..062)*	−0.033 (0.618)	0.173 (0.013)***	0.011 (0.859)	−0.015 (0.876)
$Exports_{t-2}$	0.038 (0.290)	−0.101 (0.195)	0.163 (0.051)***	−0.124 (0.089)*	0.119 (0.238)
$Exports_{t-3}$	0.309 (0.000)***	–	0.259 (0.001)***	−0.087 (0.282)	−0.015 (0.884)
$Exports_{t-4}$	0.364 (0.000)***	–	0.298 (0.000)***	0.036 (0.714)	−0.310 (0.054)*
$Exports_{t-5}$	0.211 (0.000)***	–	0.369 (0.000)***	0.157 (0.117)	−0.274 (0.189)
$Exports_{t-6}$	0.189 (0.000)***	–	0.315 (0.000)***	0.008 (0.946)	−0.216 (0.043)**
N	1502	330	535	257	100

Estimator: nearest-neighbor matching

Outcome model: matching

Distance metric: Mahalanobis

**Significance: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

(2016), firm-level investment enables firms to grow their exports and reap the benefits of international trade (Table 6).

5.3 Average treatment effect for the binary treatment (exporting in periods t, t − 1, t − 2, t − 3, t − 4, t − 5) on the outcome (engaging in investment)

Firms that start to export have the advantage of raising their productivity (De Loecker 2007). But they also face fierce competition as they venture into the international markets requiring these firms to adjust production technologies to upgrade their products to meet international standards. If this is the case, we should expect firms that export to be engaged in technology upgrades in the form of investment in physical capital. Moreover, small firms that already have a technological disadvantage over other firm size classes should significantly accumulate physical capital, higher than other firms. We test this hypothesis in the data and report the results in Table 7. In Table 7, column 4, we find evidence that small firms that export also engage in investment activities. We observe that, in the current period of exporting, small firms have a high probability of investing in physical capital. Moreover, we observe that export experience of 5

Table 8 Transition rates in the export markets, 1991–2002

Year	Year t + 1 status			
	Exporters (%)		Non-exporters (%)	
	Exports	No export	Exports	No exports
1991–1992	85.19	14.81	0.74	99.26
1992–1993	84.00	16.00	2.83	97.17
1993–1994	92.98	7.02	8.33	91.67
1994–1995	89.23	10.77	4.74	95.26
1995–1996	85.19	14.81	7.82	92.18
1996–1997	82.76	17.24	2.51	97.49
1997–1998	72.22	27.78	3.24	96.76
1998–1999	79.52	20.48	4.05	95.95
1999–2000	85.07	14.93	4.28	95.72
2000–2001	86.36	13.64	3.16	96.84
2001–2002	88.10	11.90	2.75	97.25
Average 1991–2002	75.22	24.78	3.90	96.10

Source: Author's calculations from CSAE data

and 6 years increases the probability of small firms investing in physical capital by 36.9% and 31.5% respectively. One remarkable finding of our results is that exporting experience significantly influences the firm's probability of engaging in technology upgrades in the form of investment in physical capital. This finding is robust across time periods and may imply that firms invest to try to cope with the market pressures and competition from rival exporters. Second, small firms may invest because of the learning mechanisms associated with learning-by-exporting so as to appear at per with rival firms. Overall, our findings show the importance of exporting experience on the probability of investing in physical capital, a measure that immensely benefits small firms.

5.4 The transitions, in and out, of the export market

To understand the churning that takes place in the export markets, we provide a transition probability matrix in Table 8. From Table 8 columns 2 and 3, we note that transition rates on average for exporters, stand at 75.22% and 24.78% for the whole sample period. This implies that, on average, 75.22% of exporters persist to sell in the export market despite the churning in these export markets. Further, an average of 24.78% of exporters that sell products in the export markets exit these markets. Correspondingly, from columns 4 and 5, we observe that on average 3.90% and 96.10% of non-exporters transition into export markets and remain non-exporters respectively. In column 4, we note that on average, 3.90% of non-exporters enter the export market, representing a low transition rate compared to exporters who exit these markets. Further, on average, 96.10% of non-exporters do not transition into the export markets. These firms continue to sell to domestic customers.

6 Conclusion

In this study, we analyzed the effect of the binary treatment (invest, invest t − 1, invest t − 2, db and da) on the outcome variables (export entry and export intensity) for small firms. We use data from Tanzania and Ghana for the period 1991–2002 covering firms from all firm size classes. Our analysis reveals remarkable findings. First, we find that firm-level investment in physical investment has a positive and statistically significant effect on the probability of export market entry. We show that firms that accumulate physical capital above the industry average level of investment have higher probability of initiating exporting activities. This implies that firm-level investment is a substantial component of the firm's decision to export. Secondly, our results also show that investment significantly facilitates export market entry among small firms that would otherwise find it costly to do so. We reveal that firm-level investment could be another channel through which small firms access the international markets, and might explain why exporting is a scarce activity. Moreover, we also find that investment significantly impacts on export intensity. We show that small firms that carry out firm-level investment significantly increase their probability of expanding their exports, which might hold the key to growing exports in African countries. At the policy level, any export-led policy that does not address the constraints faced by small firms might not boost exports in African countries. Our findings could signal that small firms may increase the level of entry into the export markets if they are facilitated with technological capabilities. Subsiding exporters without addressing capacity and technological constraints might not grow exports among capacity and technologically constrained firms as is the case with small firms. However, the limitations of our data do not allow us to verify the subsidy angle of policy. Moreover, investments could impact the level of exports and export intensity only if it is above the industry average. Consistent with previous studies, we establish that investment enables firms to grow their exports and reap the benefits of international trade.

Compliance with ethical standards

Conflict of interest In accordance with Journal of Industrial and Business Economics and my ethical obligation as a researcher, we report that we have no financial and/or business interests that have arisen from the direct application of this research.

References

Ackerberg, D. A., Caves, K., & Frazer, G. (2006). Structural identification of production functions. http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=C3CABBD31DAD631A092A43ABF56735AB?doi=10.1.1.421.2599&rep=rep1&type=pdf.

Ackerberg, D. A., Caves, K., & Frazer, G. (2015). Identification properties of recent production functions estimators. *Econometrica, 83*(6), 2411–2415. https://doi.org/10.3982/ECTA13408.

Ahn, J., & Mcquoid, A. F. (2012). Capacity constrained exporters : Micro evidence and macro implications capacity constrained exporters : micro evidence and macro implications. Economics Research Working Paper Series 2.

Alvarez, R., & López, R. A. (2005). Exporting and performance: Evidence from Chilean plants. *The Canadian Journal of Economics/Revue canadienne d'Economique, 38*(4), 1384–1400. https://doi.org/10.1111/j.0008-4085.2005.00329.x.

Aw, B. Y., Roberts, M. J., & Winston, T. (2007). Export market participation, investments in R&D and worker training, and the evolution of firm productivity. *The World Economy, 30,* 83–104. https://doi.org/10.1111/j.1467-9701.2007.00873.x.

Aw, B. Y., Roberts, M. J., & Xu, D. Y. (2011). R&D investment, exporting, and productivity dynamics. *The American Economic Review, 101*(4), 1312–1344. https://doi.org/10.1257/aer.101.4.1312.

Baffour, P. T., Ebo Turkson, F., Gyeke-Dako, A., Oduro, A. D., & Abbey, E. N. (2018). Innovation and employment in manufacturing and service firms in Ghana. *Small Business Economics*. https://doi.org/10.1007/s11187-018-0120-7.

Becker, S. O., & Ichino, A. (2002). Estimation of average treatment effects based on propensity scores. *The Stata Journal, 2*(4), 358–377.

Bernard, A. B., Eaton, J., Jensen, J. B., & Kortum, S. (2003). Plants and productivity in international trade. *The American Economic Review, 93*(4), 1268–1290. https://doi.org/10.1257/000282803769206296.

Bernard, A. B., & Jensen, J. B. (1999). Exceptional exporter performance: Cause, effect, or both? *Journal of International Economics, 47,* 1–25. https://doi.org/10.1016/s0022-1996(98)00027-0.

Bernard, A. B., & Jensen, J. B. (2004). Why some firms export? *The Review of Economics and Statistics, 86*(2), 561–569. https://doi.org/10.1162/003465304323031111.

Bustos, B. P. (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinian firms. *The American Economic Review, 101*(1), 304–340. https://doi.org/10.1257/aer.101.1.304.

Caldera, A. (2010). Innovation and exporting: evidence from Spanish manufacturing firms. *Review of World Economics, 146*(4), 657–689. https://doi.org/10.1007/s10290-010-0065-7.

Cassiman, B., & Golovko, E. (2011). Innovation and internationalization through exports. *Journal of International Business Studies, 42*(1), 56–75. https://doi.org/10.1057/jibs.2010.36.

Colombelli, A., Krafft, J., & Vivarelli, M. (2016). To be born is not enough: the key role of innovative start-ups. *Small Business Economics, 47*(2), 277–291. https://doi.org/10.1007/s11187-016-9716-y.

Constantini, J., & Melitz, M. (2008). The dynamics of firm-level adjustmnt to trade liberalization. The organization of firms in a global economy (pp. 107–141). Boston: Havard University Press. http://www.jstor.org/stable/j.ctt13x0gdj.

Damijan, J. P., Kostevc, C., & Polanec, S. (2010). From innovation to exporting or vice versa? *The World Economy, 33,* 374–398. https://doi.org/10.1111/j.1467-9701.2010.01260.x.

De Loecker, J. (2007). Do exports generate higher productivity? Evidence from Slovenia. *Journal of International Economics, 73*(1), 69–98. https://doi.org/10.1016/j.jinteco.2007.03.003.

Eaton, J., Eslava, M., Kugler, M., & Tybout, J. (2008). The margins of entry into export markets: Evidence from Colombia. In E. Helpman, D. Marin, & T. Verdier (Eds.), *The organization of firms in a global economy* (pp. 231–272). Boston: Harvard University Press.

Eliasson, K., Hansson, P., & Lindvert, M. (2012). Do firms learn by exporting or learn to export? Evidence from small and medium-sized enterprises. *Small Business Economics, 39*(2), 453–472. https://doi.org/10.1007/s11187-010-9314-3.

Esaku, S. (2019). Export markets and firm productivity in Sub-Saharan Africa. *Journal of African Business*. https://doi.org/10.1080/15228916.2019.1695190.

Esaku, S., & Krugell, W. (2020). Firm-level investment and exporting: New empirical evidence from Ghana and Tanzania. *International Economic Journal, 34*(1), 125–143. https://doi.org/10.1080/10168737.2019.1663440.

Esteve-Pérez, S., & Rodríguez, D. (2012). The dynamics of exports and R&D in SMEs. *Small Business Economics, 41*(1), 219–240. https://doi.org/10.1007/s11187-012-9421-4.

Falk, M. (2012). Quantile estimates of the impact of R&D intensity on firm performance. *Small Business Economics, 39*(1), 19–37. https://doi.org/10.1007/s11187-010-9290-7.

Fernandes, A. M., & Isgut, A. E. (2015). Learning-by-exporting effects: Are they for real? *Emerging Markets Finance and Trade, 51*(1), 65–89. https://doi.org/10.1080/1540496x.2015.998073.

Haidar, J. I. (2012). Trade and productivity: Self-selection or learning-by-exporting in India. *Economic Modelling, 29*(5), 1766–1773. https://doi.org/10.1016/j.econmod.2012.05.005.

Hall, B. H., Lotti, F., & Mairesse, J. (2009). Innovation and productivity in SMEs: Empirical evidence for Italy. *Small Business Economics, 33,* 13–33. https://doi.org/10.1007/s11187-009-9184-8.

Hölzl, W. (2009). Is the R&D behaviour of fast-growing SMEs different? Evidence from CIS III data for 16 countries. *Small Business Economics, 33*(1), 59–75. https://doi.org/10.1007/s11187-009-9182-x.

Iacovone, L., & Javorcik, B. S. (2012). Getting ready: Preparation for exporting. http://users.ox.ac.uk/~econ0247/Tequila.pdf.

Levinsohn, J., & Petrin, A. (2003). Estimating production functions using inputs to control for unobservables estimating production functions using inputs to control for unobservables. *Review of Economic Studies, 70*(70), 317–341. https://doi.org/10.1111/1467-937X.00246.

Lileeva, A., & Trefler, D. (2010). Improved access to foreign markets raises plant-level productivity … for some plants. *The Quarterly Journal of Economics, 125*(3), 1051–1099. https://doi.org/10.1162/qjec.2010.125.3.1051.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica, 71*(6), 1695–1725. https://doi.org/10.1111/1468-0262.00467.

Olley, G. S., & Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica, 64*(6), 1263–1297. https://doi.org/10.2307/2171831.

Peluffo, A. (2016). The role of investments in export growth. *Small Business Economics, 47*(1), 115–137. https://doi.org/10.1007/s11187-016-9714-0.

Rho, Y., & Rodrigue, J. (2015). Growing into export markets: The impact of exporting on firm-level investment in Indonesia. *Review of International Economics, 23*(1), 62–85. https://doi.org/10.1111/roie.12156.

Rho, Y., & Rodrigue, J. (2016). Firm-level investment and export dynamics. *International Economic Review, 57*(1), 271–304.

Roberts, M. J., & Tybout, J. R. (1997). The decision to export in Colombia: An empirical model of entry with sunk costs. *The American Economic Review, 87*(4), 545–564.

Rochina-Barrachina, M. E., Mañez, J. A., & Sanchis-Llopis, J. A. (2008). Process innovations and firm productivity growth. *Small Business Economics, 34*(2), 147–166. https://doi.org/10.1007/s11187-008-9110-5.

Segarra, A., & Teruel, M. (2014). High-growth firms and innovation: An empirical analysis for Spanish firms. *Small Business Economics, 43*(4), 805–821. https://doi.org/10.1007/s11187-014-9563-7.

Serti, F., & Tomasi, C. (2008). Self-selection and post-entry effects of exports: Evidence from italian manufacturing firms. *Review of World Economics, 144*(4), 660–694. https://doi.org/10.1007/s10290-008-0165-9.

Wu, R., & Miranda, M. J. (2015). Exports, investment and production growth: A dynamic heterogeneous firm model with learning and entry costs. *The Journal of International Trade and Economic Development, 24*(8), 1037–1053. https://doi.org/10.1080/09638199.2014.998856.

Yang, C.-H., Chen, J.-R., & Chuang, W.-B. (2004). Technology and export decision. *Small Business Economics, 22,* 349–364. https://doi.org/10.1023/b:sbej.0000022213.61143.37.

Yeaple, S. R. (2005). A simple model of firm heterogeneity, international trade, and wages. *Journal of International Economics, 65*(1), 1–20. https://doi.org/10.1016/j.jinteco.2004.01.001.