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# Does freer trade really lead to productivity growth? Evidence from Sub-Saharan Africa[1]

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**Abstract**

Manufacturing is intensive in the use of reproducible factors and exhibits greater technological dynamism than primary production. As such its growth is central to long-run development in low-income countries. Sub-Saharan African countries are latecomers to industrialization, and barriers to manufacturing growth, including those that limit trade, have been slow to come down. What factors contribute most to increases in output and productivity growth in their manufacturing sectors? Recent trade-IO theory suggests that trade liberalization should raise average total factor productivity (TFP) among manufacturing firms (Melitz 2003), but these predictions are conditional on maintained assumptions about the nature of industries, factor markets and trade patterns that may be less suitable in a developing-country setting.

Manufacturing firms are heterogeneous, so the analysis demands disaggregated data. We use firm-level data from the World Bank's Regional Program on Enterprise Development (RPED) covering Ghana, Kenya, Nigeria, and Tanzania, 1991-2003. Among other things, the data distinguish exports by destination (Africa and the rest of the world), which is important due to the spread of intra-Africa regional trade agreements (RTAs). Econometric results confirm well-known relationships, such as a positive association between export intensity and TFP that implies selection into exporting by more productive firms. However, we also find the destination of exports to be important. Many exporters have experienced declining TFP growth rates, and this has occurred at different rates depending on the country and the export destination. The evidence for "learning by exporting" is thus mixed. These results add a new dimension to controversies over the development implications of trade liberalization and the promotion of intra-Africa RTAs.

JEL Codes: F14, O14, O33

## 1 INTRODUCTION

Economic theory and empirics confirm the aggregate benefits of international trade to countries that participate in it. But with any competition there are winners and losers, and trade is no exception. Changes at the extensive margin – the appearance or disappearance of industries – are standard occurrences. At the intensive margin, recent research has shown that within an industry, the lowering of trade barriers has differential effects on firm profitability and activity depending on the distribution of firm-specific assets. A large literature beginning with Melitz (2003) explores the idea that firms with differing levels of total factor productivity within an industry respond to a trade liberalization shock either by specializing in exports, producing for domestic markets only, or exiting the industry (Chaney 2008; Eaton et al. 2011).

Theories and empirical work elaborating on this idea have been developed principally with rich-country cases in mind. In this paper, we consider the interactions of trade and productivity in sub-Saharan African economies. We find that in the African data, the response of manufacturing firms to trade shocks aligns broadly with standard theory, but also diverges in some important and interesting ways. As expected, export status is an activity that is positively and significantly correlated with firm productivity, that is, exporters are more productive than firms producing only for the domestic market. However, productivity trends over time among exporting firms are generally negative, a finding that contrasts with theories of "learning by exporting" and other less formal narratives of endogenous productivity growth associated with participation in trade. These results lead to additional policy questions as East African countries, among others, are now actively implementing regional trade agreements and customs unions. These measures might have implications for trade diversion, as often postulated; we find that they may also have effects on firm and industry productivity growth.

This paper is structured as follows. In section 2 we motivate the study and review relevant literature. In section 3we move to the data, highlighting special features of African economies that are likely to be relevant to empirical analysis. In section 4 we propose an econometric model to test for links

between trade orientation and firm productivity. In light of our findings, the paper concludes in section 5 with a review of current economic development and trade policies.

## 2 EXPORTS, TRADE SHOCKS AND PRODUCTIVITY GROWTH

There is strong evidence that export-oriented economic strategies have positive growth benefits (Krugman 1987; Rodrik 1988, 1991; Grossman and Helpman 1991).[2] Exporting expands market access for domestic producers and can lead to productivity and knowledge spillovers from the interaction with foreign markets. Many empirical studies demonstrate positive links between firm productivity and export status (Hallward-Driemeier *et al*. 2002; Bernard and Jensen 2004; Bernard 1995; Isgust 2001; Alvarez and Lopez 2005). This empirical literature tends to support the notion of self-selection of more efficient firms into the export market as the cause for the productivity difference between exporting and non-exporting firms (Clerides *et al.* 1998; Bernard and Jensen 1999; Granér 2002); evidence on endogenous productivity growth at firm level caused by moving into the export market, or "learning by exporting", is more mixed. A smaller empirical literature addresses these questions with specifically Africa data, once again with mixed findings (Biggs *et al*. 1995, Bigsten *et al*. 1999, Rankin 2001, Bigsten *et al.* 2004, Mengistae and Pattillo 2004, Granér and Isaksson 2009).

Another recent strand of the trade-development literature argues that productivity is also affected by the composition of exported goods and trading partners. Hausmann, Huang and Rodrik (2007) assert ex ante that "not all goods are alike in their consequences for economic performance" and provide evidence in support of this claim from a selection of countries. In their analysis, baskets of export goods with higher quality (based on the authors' evaluation system) produce better economic performance. To date, few studies have explored these ideas with African data. Mengistae and Pattillo (2004), using a dataset that overlaps with ours, study the productivity effects of exporting, and the effects of exporting outside Africa versus exporting within the region. They find not only that exporters have higher

[2] See empirical support from (among others) Haddad (1993), Harrison (1994), and Aw and Hwang (1995).

productivity, but also that African firms exporting to the rest of the world are significantly more productive than those exporting only within the continent. Granér and Isaksson (2009) use Kenyan data from the same source as this paper, but for a shorter time period. They also find evidence that the destination of a country's exports has positive productivity effects. Surprisingly, however, they find that it is exports *within* Africa, rather than those to the rest of the world, that contribute the greatest share of "learning by exporting" productivity gains. The reason for this, the authors conclude, may be that technologies in other African countries are better suited than those of other continents, notably industrialized countries.

The findings of these studies display wide variation despite their reliance on subsets of a common database. One reason is that some subsets are for specific countries, and those countries' experiences may in some way be idiosyncratic. Another is that the 1990s was a period during which a great deal of change took place in African trade policies and in global trade policies affecting Africa. These may have had different effects on exporting and thus on productivity. We explore this idea in the following paragraphs.

In Melitz (2003), increasing exposure to trade raises average TFP in manufacturing through the exit of least productive firms and the reallocation of labor to new, more productive firms. This within-industry restructuring comes about due to competition from imports into the domestic market (which, in this theory, drives out the least productive domestic firms) and opportunities for expansion among those firms that are competitive in the world market. In this theory, the resulting rise in average manufacturing sector TFP is a source of welfare growth over and above the gains from specialization and trade identified in neoclassical trade theory.

Of course, the Melitz model is highly stylized. Importantly, it maintains an exclusive focus on manufacturing industries. This ensures that following a trade shock, resources freed up by the exit of the least productive firms will be reassigned, under full employment, to more productive manufacturing firms. In reality, in low-income economies the manufacturing sector coexists with a large non-manufacturing economy. Mobility of labor and other factors among sectors makes it just as likely that resources given up by firms that exit from manufacturing will instead migrate to non-manufacturing

employment, whether in agriculture and natural resource extraction, or in non-traded industries (transportation, domestic trade and warehousing, construction, etc.) servicing these sectors. This likelihood is greater in countries whose comparative advantage lies in farming or mining, as is the case for most of sub-Saharan Africa.

A second stylization in Melitz is that by assumption, every firm produces only one good. Changes in the product mix thus necessitate entry or exit by firms. The real world, however, is densely populated with multiproduct firms. In these cases changes in relative prices—caused, for example, by a trade shock—may result in resource reallocation within firms rather than (or in addition to) that among firms. Besides the changes in extensive and intensive margins identified by the Melitz model, this is an additional margin at which adjustment may occur. It may appear in the data as a lower rate of firm entry and exit than would be expected under the assumption of single-product firms.

Finally, in Melitz' model firms are assumed to sell to one of just two homogeneous markets, domestic or foreign. In Africa, a continent with high overall trade costs and many landlocked countries, there are (at least) three market types: domestic, non-domestic intra-Africa, and rest of the world (ROW). The data also suggest that there are large fixed costs to "moving up" in terms of markets, whether from domestic to intra-African markets, or to ROW. In our data, which span more than a decade, almost no firms are recorded as *entering* either of the two types of export market after initially selling only in the domestic market. However, the distribution of their sales among markets does change over time.[3]

One possible reason for changes in the allocation of sales across markets is trade policy reform. During the 1990s there were three broad types of policy-related changes in trade conditions for African economies. Each is likely to have had distinct *ceteris paribus* effects on average productivity and welfare.

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[3] Unfortunately, the aggregation level of the data makes it impossible to know whether these are identical products going to different markets, or differentiated products produced by multiproduct firms for different markets. This remains a subject for research with new data.

1. Lowering of own-country manufacturing tariffs. This should have some Melitz-type effects: if import competition increases and the least productive domestic firms exit, then average productivity among the remaining firms should rise. However, it is not necessary that we would also see expansion or exporting by the most productive firms. Resources given up by manufacturing firms that exit can also be reassigned into other industries, specifically commercial agriculture, natural resource extraction, and the service industries that support them.

2. Liberalization of foreign (especially ROW) export markets for manufactures. Examples are multilateral trade liberalization in the Uruguay Round/World Trade Organization, the U.S. African Growth and Opportunity Act, the EU's Everything-But Arms agreement, and their successors). These liberalization policies should be expected to *lower* the average productivity of exporting firms, since the marginal African firm able to break even by exporting now has lower TFP than before. The downward shift in average TFP could be offset by endogenous productivity growth ("learning by exporting"), but as noted, the empirical evidence on this effect is mixed.

3. Creation or expansion of African regional trade agreements (RTAs). *Ceteris paribus,* RTAs have differential effects on their member economies, depending on the average productivity of the respective economies' manufacturing sectors. For countries with relatively low average productivity, the RTA has Melitz-type effects as they face stronger competition from abroad (in this case, from an RTA partner). But for the more productive countries, the margin between producing for their own domestic market and for export within the RTA moves down, bringing lower-productivity firms into export markets (or, in a model with multiproduct firms, increasing the share of output exported by less productive firms). If the latter effect dominates, then average manufacturing sector productivity may fall, with a more pronounced TFP decline observed among those firms exporting to less-productive RTA partners.

These three trade liberalization measures have contradictory effects on domestic industry. Therefore, their relative magnitudes also matter. In general, African import tariffs have fallen by less than have ROW tariffs applied to African exporters. Progress on within-Africa RTAs has been slow and

uneven. Among the effects of these three broad types of trade liberalization, if the ROW tariff effect is dominant, then average TFP among African exporters should *decline*. When economies also participate in an RTA, then the least-productive members of the RTA could see significant loss of industrial manufacturing capacity, with only the most efficient and productive firms surviving. In the more productive RTA partners, the combination of lower ROW tariffs and lower tariffs within the RTA could cause average firm productivity to fall. In short, and in contrast with Melitz (2003), there is no uniform prediction for trade-productivity interactions. Whether trade increases average TFP among manufacturing firms or reduces it is an empirical question.

## 3 DATA AND ANALYSIS

### 3.1 Data

We use a panel of firm-level data from the World Bank African Regional Program on Enterprise Development (RPED). RPED has up to 12 consecutive years of firm-level data from a random selection of privately-held manufacturing firms. The industries covered are: food and bakery, furniture, machinery, chemicals, and metals, textiles, garments, and wood products. The firms can be either formally registered or informal. The countries covered are Ghana, Kenya, Nigeria and Tanzania (RPED also contains data from South Africa, but they are insufficient for panel data analysis).

The dataset has information on production, inputs, and sales, including whether sales are to the domestic market or, if exported, to markets within Africa or beyond. Characteristics of the firm, including age, foreign ownership, output per worker, number of employees, and other features are also included. There is also more specific information on resource use and outputs such as profit-to-capital ratios, materials per worker, and average education and age of workers. Table 1 provides definitions of the most important variables.

Table 2 and Table 3 describe the main variables of interest by economy. Note in Table 3 that the number of firms and observations for ownership and export status are not directly correlated; there are nearly a third more foreign-owned non-exporting firms than exporters, and 80 more domestically-owned

than foreign-owned exporting firms. The average number of employees is larger for foreign-owned firms than for domestically-owned firms.

Despite the number of firms and the length of the data series, there is almost no instance of firms making the transition from wholly domestic sales to exporting, nor of corresponding transitions from exporting to wholly domestic sales. The kinds of firm-level responses to trade shocks predicted by the Melitz model are thus not visible in the African data. What we do see, however, is changes at firm level in the mix of sales by market, a trend more consistent with the existence of multiproduct firms.

The data form an unbalanced panel. Countries were observed for different time periods. Some firms exit or enter during the observation period, and others can either not be traced in some years or previously interviewed firms declined to be interviewed again. Very frequently, firms are absent from the data for a few years, and then reappear. For example, a firm might enter the dataset at age 25, report for an additional year and then stop reporting for the remainder of the dataset. There are cases in which well-established firms, older than 40 years, report for only one year, and others in which relatively new firms, less than 10 years old, enter and report for the remainder of the series. When this happens, variables describing the firm are typically consistent and very similar to the values in their previous reporting session. Nevertheless, unexplained exit and entry of firms has the potential to cause selection bias if, for example, firms that exit have different characteristics to those that survive.

A typical pattern is for firms to report for a few years, fail to report for several years, resume reporting, and then fail to report again, depending on the duration of the data series. Therefore, it is unclear whether they have actually ceased operations or are simply failing to report. With regard to firm entry, the number of firms entering the dataset midstream is a negligible fraction of the total observations.

We know of only one other study using the full dataset applied in this paper. Rankin *et al.* (2006) investigate what they describe as the poor export performance of SSA firms. They find only weak evidence for self-selection into exporting based on efficiency and firm size, and conclude rather that it is firm-specific factors such as skills and foreign ownership that are predominant. As noted above, earlier

versions of this dataset with fewer observations have been used in several studies (Granér and Isaksson, 2009; Van Biesebroeck, 2005; Bigsten *et al.*, 2004; Söderbom and Teal, 2003).

### 3.2 Empirical analysis

#### 3.2.1 Production function estimates

In this section we examine relationships between firm characteristics such as ownership, trade orientation, and total factor productivity growth. Our starting point is a basic production function from which we recover estimates of TFP levels and changes over time, for the dataset as a whole and for a variety of relevant subsets. For any firm, denote output per worker $Y$ as a function of inputs of capital, material inputs and other inputs per worker, all measured in constant US dollars and denoted by $K$, $M$, and $O$ respectively. Suppressing subscripts, we have:

$$Y = A\, f(K, M, O), \tag{1}$$

where $A$ is a measure of TFP.

We are interested in differential productivity and productivity growth across firms, industries and countries, and among firms with different characteristics including foreign ownership, which is represented by a binomial variable $F$, and destination of exports, $X$. We hypothesize that each of these, along with time, $T$, could affect overall productivity levels, implying that in equation (1), $A = A(X,F,T)$. We assume Cobb-Douglas technology, which gives the function:

$$Y = A^{\alpha+(1+\rho T)(1+\gamma F+\eta X)} K^{\beta_1} M^{\beta_2} O^{\beta_3}. \tag{2}$$

In this expression, unconditional initial TFP is equal to $A^{1+\alpha}$. TFP evolve in linear fashion with time at the rate $\rho$. The influence of foreign ownership and export status on TFP are captured by $\gamma$ and $\eta$ respectively. These influences may also evolve over time, at rates $\rho\gamma$ and $\rho\eta$ respectively. Effects on output per worker of increases in capital, material and other inputs are given by the respective $\beta$ terms. Under constant returns, the marginal product of labor is equal to $(1-\beta_1-\beta_2-\beta_3)$.

Taking the logarithm of (2) and choosing productivity units such that ln$A$ = 1, indexing firms by $i$ and time by $t$, and writing this in the form of an empirical model, the resulting basic equation is:

$$\ln Y = \alpha + \rho T_t + (1+\rho T_t)*(\gamma F_{it} + \eta X_{it}) + \sum_k \beta_k \ln Z_{it}^k + \delta' \mathbf{D} + \mu_i + \varepsilon_{it}, \quad (3)$$

in which $Z$ = ($K$, $M$, $O$) and $\boldsymbol{\delta'D}$ is the product of a vector of industry and country dummy variables **D** and their associated coefficient vector $\boldsymbol{\delta}$; $\mu_i$ is a random effect at the firm level, and $e_{it}$ is an i.i.d. error term.

While equation (3) represents a standard Solow-type TFP estimation, improvements in TFP are likely to be known and anticipated by firm managers. That would potentially make observations of inputs (for example capital investments) endogenous to changes in TFP known by firm managers but unobserved by econometricians. Olley and Pakes (1996) propose using capital investment as a proxy for increases in TFP, but their method relies on observing firm exit and non-zero investments, which does not conform to our data. Levinsohn and Petrin (2003) propose a more tractable method using intermediate inputs as a proxy for capital investments. In their approach, demand for intermediate inputs by firm $i$ in period $t$ is a function of both capital $K_{it}$ and of TFP, $\omega_{t\tau}$, such that $M_{it} = M_{it}(K_{it}, \omega_{it})$. As long as this function exhibits monotonicity, we can invert it to obtain $\omega_{it} = g^{-1}(K_{it}, M_{it})$. We estimates this from our data using Levinsohn and Petrin's revenue-based GMM estimator as described by Petrin, Poi, and Levinsohn (2004). This is:

$$\begin{aligned} Y_{it} &= \alpha + \beta_O O_{it} + \beta_k K_{it} + \beta_m M_{it} + \omega_{it} + e_{it} \\ &= \beta_O O_{it} + \varphi_{it}(K_{it}, M_{it}) + e_{it} \end{aligned} \quad (4)$$

where now $\varphi_{it}(K_{it}, M_{it}) = \beta_0 + \beta_k K_{it} + \beta_m M_{it} + g^{-1}(K_{it}, M_{it})$. This equation is estimated using OLS with a third-order polynomial approximation in $K_{it}$ and $M_{it}$ taking the place of $\varphi_{it}(K_{it}, M_{it})$. The estimation procedure then makes use of moment conditions on the relationship between previous period's error terms as described by Petrin, Poi, and Levinsohn (2004), and uses bootstrapped standard errors. The estimates of TFP, $\omega_{it}$, are calculated from (4) as follows:

$$\omega_{it} = exp(y_{it} - \beta_O O_{it} - \beta_k K_{it} - \beta_m M_{it}) . \quad (5)$$

We then conduct a second stage estimation of how TFP, measured as $ln(\omega_{it})$, changes with the variables of interest related to firm export status and ownership. This represents a similar random effects model to equation (3) but we now have TFP as our dependent variable and have already controlled for inputs, so they no longer appear. The estimating equation is as follows:

$$ln\ \omega_{it} = \alpha + \rho T_t + (1 + \rho T_t)*(\gamma F_{it} + \eta^{r\prime}\mathbf{X}_{itr}) + \delta'\mathbf{D} + \mu_i + \varepsilon_{it}\ , \qquad (6)$$

where we have allowed for separate productivity effects from exports to more than one destination $r$, each denoted by an element of the vector $\mathbf{X}_{itr}$ with marginal productivity effect $\eta^r$, as well as a vector of control variables in **D**. The control variable vector includes industry dummy variables. It also includes a measure of the real effective exchange rate (REER) for each country and year. The REER captures macroeconomic forces that are expected to have an effect on tradable sector profitability. A high value of REER indicates an overvalued nominal exchange rate, typically (though not always) the result of inflation at a rate persistently higher than in a country's trading partners. It indicates diminished international competitiveness of domestic production.[4] Null hypotheses based on this model are:

(a) $\rho = 0$: secular TFP growth is zero;

(b) $\gamma = 0$: foreign ownership has no effect on TFP levels;

(c) $\rho\gamma = 0$: foreign ownership has no effect on TFP trends;

(d) $\eta^r = 0$: firms that export to destination $r$ have no difference in TFP levels;

(e) $\rho\eta^r = 0$: firms that export to destination $r$ have no difference in TFP trends.

Note that acceptance of hypothesis (d) is evidence against the idea that more productive firms select into exporting, while acceptance of hypothesis (e) is evidence that there are no "learning by exporting" productivity effects. These are the main foci of our estimation work.

[4] REER data are obtained from http://www.bruegel.org/publications/publication-detail/publication/716-real-effective-exchange-rates-for-178-countries-a-new-database/, accessed 24 May, 2012.

**3.3 Results**

Summary statistics of key variables used in regressions are shown in Table 4. The Levinson-Petrin production function estimates are in Table 5; these display expected signs and magnitudes (cf. Yasar and Morrison-Paul 2007) and have strong statistical significance. For comparison, appendix tables show the results of OLS estimates of Cobb-Douglas production functions (under the assumption of exogenous capital) with controls for firm type, export orientation and industry. Finally we fit the TFP model of equation (6) with a random effects specification. The results are shown in Table 6, which reports estimates for all countries pooled as well as for individual countries.

The results contain several surprises. First, the secular trend of TFP is significantly negative in Kenya and Ghana, but positive (and large) in Tanzania, while in Nigeria there is no trend.

Second, firms that export have generally higher TFP levels than those which do not, but the difference is significant only in the case of Ghanaian and Nigerian exports to the rest of the world, and Kenyan exports to Africa. In these cases alone can we claim, through rejection of hypothesis (d), that there is any support for the claim that more productive firms self-select into exporting.

Third, in spite of higher TFP levels, firms that export display no evidence of learning by exporting (the only exception of a positive effect is for Ghanaian exporters to non-African destinations). In fact, West African exporters to non-African destinations show *negative* TFP growth rates of -3% (Ghana, $p<0.05$) and -6% (Nigeria $p<0.15$). Sinilarly, Kenyan firms exporting to *African* destinations have negative TFP growth rates of -5% ($p<0.05$).

Fourth, after controlling for other sources of variation, foreign ownership appears to be significantly associated with TFP growth in only one country, Tanzania.

These results are robust to specification tests including the effects of behind-the-border transport and marketing margins represented by dummy variables for industry location by city, and by dummies for location in the capital city or the main port. They are unaffected by inclusion or exclusion of the REER (which has the expected negative sign in most cases but significantly so in Ghana alone). They are unaffected by division of the sample between small and large firms (the dividing point being 10

employees), although the results for small firms are much weaker, due to smaller sample sizes and (plausibly) higher degrees of measurement error.[5] The results of the TFP estimates are also found in estimates of the Cobb-Douglas production functions (see Appendix).

**3.4 Interpreting the estimation results**

In our earlier discussion we concluded that in the presence of multiple-product firms, non-manufacturing sectors, and multiple export destinations, and with more than one possible source of a trade liberalization shock, firm-level trade-TFP relationships might vary by country. Unfortunately we lack the data required for precise and direct tests of the influences of trade and trade policy shocks on firm-level productivity. Thus the inferences we draw are necessarily speculative. Nevertheless our results are sufficiently different from many previous findings, and sufficiently robust with respect to model specification, that some discussion is warranted.

In our data set the two West African countries, Ghana and Nigeria, are engaged in trade with both ROW and their African neighbors. Both are partners in ECOWAS, a West African RTA. However, ECOWAS, while large, has essentially failed to evolve in that there has been very little change in intra-RTA trade policies. For these countries, then, most trade liberalization has been in the form of reduced foreign tariffs applied to their exports, with smaller reductions in their own import tariffs. From 1997-2004, the simple average applied Most Favored Nation tariffs of Sub-Saharan African countries fell by one-fifth, from 21.6% to 17.2%. Tariffs in ECOWAS countries, which include Ghana and Nigeria, fell by less -- about one-sixth. Over the same period, tariffs imposed by industrial countries fell by more than one-third, from 8.7% to 5.7% (Yang and Gupta 2005, Table 2). From section 2 above, we can predict that when foreign tariff reductions are the dominant form of trade liberalization, the margin of productivity at which exports are profitable moves down, with the result that average TFP among exporters to ROW should decline. We observe this in the cases of Ghana and Nigeria.

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[5] Complete tables of robustness checks are available from the authors.

In the two West African countries, initial TFP is much higher among firms that export outside Africa—by 29% in Ghana and 9.6% in Nigeria—than among firms that do not. The rate of TFP growth among firms selling into domestic or African markets is zero, while that for exporters to ROW is significantly negative, at -2.5% per year in Ghana and a massive -8.1% in Nigeria. These estimates are strongly consistent with the prediction that when foreign tariff reductions dominate trade liberalization, average productivity among exporters will fall as the lower productivity margin compatible with profitability in exporting to ROW declines (see section 2). The data do not show evidence of entry into exporting by new firms, however. Rather, the result presumably comes from the diversion of sales from domestic and/or African markets to ROW by existing exporters. Within these firms, it is likely that lower-technology products (simpler types of garments or furniture, perhaps) can now be profitably exported to ROW, whereas in the past they had been sold only within the domestic and African markets. To check on this trend, however, requires data at a finer level of product disaggregation than the RPED dataset makes available.

In East Africa, by contrast, the 1990s saw significant steps toward revitalization of a regional economic grouping, which by 1999 had evolved into the East African Community (EAC). The original members of this grouping are Kenya, Tanzania and Uganda. All three share a common history of British colonialism and had constituted a common economic area during the colonial period.[6] On average, 14.2% of Kenya's exports went to other African countries (almost all to its two EAC neighbors) in 1970-97. Intra-EAC trade grew very sharply through the 1990s, however, resulting in regional trade intensities much higher than in any other developing-country trading bloc (Kirkpatrick and Watanabe 2005, Table 3 and Figure 1). By 2004, 10% of Kenyan exports went to Uganda and another 6.9% to Tanzania. In contrast, in the same year only 7% of Tanzania's exports and 14% of Uganda's exports went to their EAC partners (Kirkpatrick and Watanabe 2005). Meanwhile the EAC as a whole moved toward formation of a

[6] The three countries were previously linked through several agreements, including the East African Community (1967-77). East African Cooperation was agreed on in 1993 and launched in 1996. Continuing negotiations led to the formation of the East African Community in 1999 (source: http://www.eac.int/about-eac/eac-history.html, accessed 4 January 2012). Kenya, Tanzania and Uganda are also members of COMESA, the Common Market for Eastern and Southern Africa, established in 1993.

customs union. Kenyan and Tanzanian import tariffs were reduced somewhat, although (as in West Africa) by proportionally less than the reductions in ROW tariffs applied to their exports outside Africa. During the 1990s, therefore, intra-EAC liberalization was arguably the most important source of trade shocks for Kenya and Tanzania.

In Section 2 we argued that the *ceteris paribus* effects of an RTA would depend on where each country lay in relation to productivity among its RTA partners. Countries with lower average productivity should see intensified competition from outside, leading to exit of their least productive firms and a rise in average TFP. In contrast, to the more productive economies, lower tariffs within the RTA are equivalent to lower tariffs from any external source; firms which were formerly unable to make a profit exporting will now be able to do so (at least to their neighbors). At the margin between selling to domestic and African markets, less productive firms will shift into exports (or, in multiproduct firms, less productive lines produced within diversified firms will now be exported).

These are exactly the results shown in Table 6. In Tanzania, average productivity is initially somewhat lower than in Kenya. During the period covered by the data, average manufacturing sector TFP in Tanzania rises by over 8% per year. There is no difference in TFP growth rates between exporters and non-exporters. This is consistent with the prediction of a general decline in Tanzanian manufacturing activity, led by the least productive firms, with the resources so released migrating out of the sector and into agriculture or services.

In Kenya, unlike Tanzania, firms that export to Africa are significantly more productive (by 44%) than other firms. But while average TFP growth among *all* Kenyan firms is zero, that among Kenya's exporters to Africa declined by almost 4% per year. Again, this finding is consistent with the predictions from a model in which lower barriers to intra-RTA trade dominate the effects of other forms of trade liberalization, permitting less productive firms to remain competitive in export markets from which they would otherwise be excluded. Unlike the other economies in our sample, the share of Kenya's manufacturing output exported within Africa increased during the 1990s – substantially, from 4% to over 7.5%. Among Kenyan exporting firms, total output on average did not grow in real terms through the

1990s. But that of Kenya's exporters to other African countries did, by a statistically significant margin over other firms.

To reiterate, limitations in the data set mean that we lack direct evidence of changes in firm behavior. We can say only that the estimation results are consistent with our *ex ante* postulates. It is worth reiterating also that our findings for Kenya contradict those of Granér and Isaksson (2009), who found that learning-by-exporting effects among Kenyan manufacturing firms are strongest from trade within Africa, where they (presumably) have a comparative advantage in skills and capital, rather than from exports to the rest of the world, where Kenya's comparative advantage is in low-skill products. A strict comparison of these two sets of results is part of an agenda for ongoing research.

## 4 CONCLUSIONS

The economies of sub-Saharan Africa have historically grown very slowly in spite of constant attention from international financial institutions and the donor community. It is well known that manufacturing sector growth is a key to sustained economic growth in the aggregate, and moreover that productivity growth is the key to long-run growth in manufacturing industries. In the African context, structural constraints to manufacturing sector productivity growth are acknowledged to be important elements in the overall growth experience.

Using data on four African countries, we tested for relationships between manufacturing productivity growth and trade at firm level. As expected, firms that export are (in most cases) significantly more productive, by a TFP measure, than firms selling only into domestic markets. However, secular TFP growth rates are found to be zero in one country (Nigeria), and negative in two others (Ghana and Kenya). Moreover, TFP growth rates among some types of exporters in some countries are found to be significantly negative. We argue that the observed pattern of TFP levels and growth rates is consistent with predictions about trade policy shocks experienced by these countries. The key to the observed patterns appears to lie in a model allowing for multiple export destinations, differential types and rates of trade policy liberalization, multiproduct firms, and the existence of a

sizeable non-manufacturing component to employment of domestic factors of production. All of these phenomena are well-documented characteristics of African firms and economies.

The results yield some interesting thoughts on prospects for the growth of African manufacturing. Foreign ownership may in the past have been a significant source of productivity growth, although the direction of causation between foreign ownership and higher TFP at the firm or industry level remains unproven. More can be said from our data about the influence of trade. In Africa, post-independence import-substitution policies have been slow to break down. At the same time domestic markets have remained small, limiting the scope for the kinds of endogenous productivity gains (whether within or between firms) that are associated elsewhere with expanded manufacturing sector activity. Africa's export markets have become more open, but this by itself has not helped to increase TFP in African manufacturing. In fact, as we see, it has contributed to a lowering of TFP growth as the margin of profitable exporting moves down. Similarly, the expansion of intra-African RTAs seems to have had mixed effects. For firms in the least productive economies, RTAs mean intensified competition from within-RTA imports. Average TFP in manufacturing has risen due to the exit of less productive firms. However, more productive firms have not necessarily appeared, because of factor market competition from agriculture and services. Meanwhile the more productive RTA members have also experienced declining average productivity as the effective size of the "domestic" (i.e. intra-RTA) market grows.

The results of our analysis are robust, but additional data could help strengthen and generalize them. A longer and richer dataset could also help answer more questions. With the current dataset we can only examine the changes in productivity among exporting and non-exporting firms, but more detailed information on firm entry and exit would allow us to provide more definitive results.

**REFERENCES**

Álvarez, R. and R. Lopez (2005), "Exporting and performance: Evidence from Chilean plants," *Canadian Journal of Economics* 38 (4) pp.1384-1400.

Aw, B. and A. Hwang (1995), "Productivity and the export market: A firm-level analysis," *Journal of Development Economics* 47 (2) pp. 313-32.

Bernard, A. and J. Jensen (1999), "Exceptional exporter performance: Cause, effect, or both?" *Journal of International Economics* 47 (1) pp. 1-25.

Bernard, A., J. Jensen, P. Schott (2003), "Falling trade costs, heterogeneous firms, and industry dynamics," NBER Working Paper No. W9639.

Bernard, A. and J. Jensen (2004), "Why some firms export," *Rev. Econ. & Statistics* 86 (2) pp.561-569.

Bernard, A., J. Jensen, S. Redding, P. Schott (2007), "Firms in international trade," *Journal of Economic Perspectives* 21 (3) pp. 105-130.

Biggs, T., M. Shah, and P. Srivastava (1995), "Training, technology and firm efficiency in Sub-Saharan Africa," RPED Discussion Paper, World Bank.

Bigsten, A., P. Collier, S. Dercon, B. Gauthier, J. Gunning, J. Habarurema, A. Isaksson, A. Oduro, R. Oostendorp, C. Pattillo, M. Soderbom, F. Teal, A. Zeufack (1999), "Exports of African manufacturers: Macro policy and firm behavior," *J. Internat. Trade & Development* 6 (1) pp. 53-71.

Bigsten, A., P. Collier, S. Dercon, M. Fafchamps, B. Gauthier, J. Gunning, A. Oduro, R. Oostendorp, C. Pattillo, M. Soderbom, F. Teal, A. Zeufack (2004), "Do African manufacturing firms learn from exporting," *Journal of Development Studies* 40 (3) pp. 115-141.

Bresnahan, L., I. Coxhead, and T. Mogues (2011). "Trade, foreign ownership and productivity growth in African manufacturing." Paper submitted to the CGIAR-Canada USAID Linkage Fund Programme.

Chaney, T. (2008). "Distorted gravity: heterogeneous firms, market structure, and the geography of international trade." *American Economic Review* 98, 1707-1721.

Clerides, S., S. Lach, and J. Tybout (1998), "Is learning-by-exporting important? Micro-dynamic evidence from Colombia, Mexico and Morocco," *Quarterly Journal of Economics* 113 (3) pp. 903-47.

Eaton, J., S. Kortum, and F. Kramarz, (2011). "An anatomy of international trade: evidence form French firms." *Econometrica* 79(5), pp. 1453-1498.

Granér, M. (2002), "Export-led efficiency or efficiency-led exports: Evidence from the Chilean manufacturing sector," In *Essays on trade and productivity: Case studies of manufacturing in Chile and Kenya*, Göteborg University.

Granér, M. and A. Isaksson (2009), "Firm efficiency and the destination of exports: Evidence from Kenyan plant-level data," *The Developing Economies* 47 (3) pp. 279-306.

Grossman, G. and E. Helpman (1991), "Innovation and growth in the global economy," MIT Press.

Haddad, M. (1993), "How trade liberalization affected productivity in Morocco," Policy Research Working Paper, Vol. 1096, World Bank.

Hallward-Driemeier, M., G. Iarossi, R. Sokoloff (2002), "Exports and manufacturing productivity in East Asia: A comparative analysis with firm-level data," NBER Working Paper No. W8894.

Harrison, A. (1994), "Productivity, imperfect competition, and trade reform: theory and evidence," *Journal of International Economics*, Vol. 36 (1-2) pp. 53-73.

Hausmann, R., J. Hwang, and D. Rodrik (2007), "What you export matters," *Journal of Economic Growth* 12 (1) pp. 1-25.

Kirkpatrick, C., and M. Watanabe (2005). "Regional trade in sub-Saharan Africa: an analysis of East African Trade Cooperation 1970-2004." *The Manchester School* 73(2): 141-164.

Krugman, P. (1987), "The narrow moving bank, The Dutch disease and the competitive consequences of Mrs. Thatcher: Notes on Trade in the presence of dynamic scale economies," *Journal of Development Economics* 27 (1-2) pp.41-55.

Levinsohn, J. and A. Petrin. 2003a. Estimating production functions using inputs to control for unobservables. *Review of Economic Studies* 70(2): 317–342.

Melitz, M. (2003), "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica* 71 (6) pp. 1695-1725.

Mengistae, T. and C. Pattillo (2004), "Export orientation and productivity in sub-Saharan Africa," *IMF Staff Papers* 51 (2).

Olley, G. S. and A. Pakes. 1996. The dynamics of productivity in the telecommunications equipment industry. *Econometrica* 64: 1263–1297.

Petrin, A., B. Poi, and J. Levinsohn. 2004. "Production function estimation in Stata using inputs to control for unobservables." *The Stata Journal* 4, No. 2, pp. 113–123.

Rankin, N. (2001), "Specialization, efficiency and exports: Some preliminary results from South African manufacturing firms," Presented at "New Industrial Realities and Firm Behavior in Africa," Oxford.

Rodrik, D. (1988), "Imperfect competition, scale economies and trade policy in developing countries," in R. Baldwin (ed.) *Trade policy issues and empirical analysis*, University of Chicago Press.

Rodrik, D. (1991), "Closing the technology gap: Does trade liberalization really help?," in G. Helleiner (ed.) *Trade policy, Industrialization and Development*: *New Perspectives*, Oxford Clarendon Press.

Söderbom, M. and F. Teal (2003), "Are manufacturing exports the key to economic success in Africa?" *Journal of African Economies* 12 (1) pp.1-29.

Van Biesebroeck, J. (2005), "Exporting raises productivity in sub-Saharan African manufacturing firms," *Journal of International Economics* 67 (2) pp. 373-391.

Yang, Y., and S. Gupta (2005). "Regional trade agreements in Africa: Past performance and the way forward." IMF Working Papers No. IMF/05/36.

Yasar, M., and C. Morrison-Paul (2007). "International linkages and productivity at the plant level: Foreign direct investment, exports, imports and licensing." *Journal of International Economics* 71 (2): 373-388.

Table 1: Definition of Variables

| VARIABLES | Definition |
|---|---|
| Firm age | Age of firm |
| Any foreign ownership | Dummy variable if firm has any foreign ownership |
| % foreign ownership in industry | Percentage of firms in an industry that have any foreign ownership |
| Output | Production output of firm, measured in real USD |
| Capital | Capital of firm, measured in real USD |
| Material inputs | Material inputs used, measured in real USD |
| Other inputs | Other inputs used, measured in real USD |
| Workers | Number of employees |
| Export | Dummy variable if firm exports |
| Export in Africa | Dummy variable if firm exports within Africa |
| Export outside Africa | Dummy variable if firm exports outside Africa |
| % of output exported | Percent of output exported |
| % of output exported in Africa | Percent of output exported within Africa |
| % of output exported outside Africa | Percent of output exported outside Africa |

←

Table 2: Span and Size of Data

| Observations: | Ghana | Kenya | Nigeria | Tanzania |
|---|---|---|---|---|
| Number of firms | 273 | 405 | 180 | 375 |
| Years covered | 1991-2002 | 1992-1999 | 1998-2003 | 1992-2000 |
| Total observations | 2,291 | 1,475 | 700 | 1,290 |
| Any foreign ownership | 427 | 242 | 131 | 182 |
| Exporters | 309 | 340 | 62 | 152 |
| Exporters within Africa | 218 | 85 | 34 | 40 |
| Exporters outside Africa | 160 | 261 | 51 | 65 |

Note: Values reported are number of observations except for the variable 'number of firms'.

←

Table 3: Sample size, by ownership, firm size and export status

| | | Non-Exporter | Exporter |
|---|---|---|---|
| *Domestically owned* | | | |
| Number of observations | | 3,371 | 540 |
| Number of firms | | 905 | 187 |
| Number of employees | Avg. | 35 | 199 |
| | Min. | 1 | 3 |
| | Max. | 2,103 | 2,598 |
| *Any foreign ownership* | | | |
| Number of observations | | 515 | 319 |
| Number of firms | | 146 | 99 |
| Number of employees | Avg. | 119 | 300 |
| | Min. | 1 | 5 |
| | Max. | 1,742 | 4,000 |

←

Table 4: Summary statistics of regression variables

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Real output per worker, USD (log) | 5,210 | 8.5966 | 1.4593 | 2.6744 | 13.7082 |
| Real other inputs per worker, USD (log) | 5,133 | 6.0879 | 1.6780 | -0.4656 | 13.2039 |
| Real capital per worker, USD (log) | 5,239 | 7.7930 | 2.1078 | 0.5184 | 13.3451 |
| Real material inputs per worker, USD (log) | 5,082 | 7.8221 | 1.6304 | -0.5591 | 13.6402 |
| Any foreign ownership | 10,102 | 0.1751 | 0.3801 | 0 | 1 |
| Exporter | 5,181 | 0.2187 | 0.4134 | 0 | 1 |
| Export to ROW | 4,253 | 0.1258 | 0.3317 | 0 | 1 |
| Export to Africa | 4,256 | 0.1816 | 0.3856 | 0 | 1 |
| Textiles | 10359 | 0.0626 | 0.2422 | 0 | 1 |
| Garments | 10359 | 0.1681 | 0.3739 | 0 | 1 |
| Wood products | 10359 | 0.0754 | 0.2640 | 0 | 1 |
| Furniture | 10359 | 0.1757 | 0.3806 | 0 | 1 |
| Processed foods | 10359 | 0.2187 | 0.4134 | 0 | 1 |
| Metals & machinery | 10359 | 0.2977 | 0.4573 | 0 | 1 |

←

Table 5: Levinsohn-Petrin production function estimates

| Dependent var (ln real output/worker) | |
|---|---|
| VARIABLES | All Countries[+] |
| ln real US$ other inputs per worker | 0.156*** |
| | (0.00969) |
| ln real US$ K:L ratio | 0.178*** |
| | (0.0608) |
| ln real US$ materials per worker | 0.367** |
| | (0.164) |
| Observations | 4502 |

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Table 6: TFP Regressions

| Dependent var = ln(TFP) | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Variables | All Countries | Ken & Tan | Kenya | Tanzania | Ghana | Nigeria |
| Time Trend | -0.0132*** | -0.00584 | -0.0360** | 0.0857*** | -0.0235*** | -0.0126 |
| | (0.00323) | (0.00866) | (0.0152) | (0.0131) | (0.00413) | (0.0103) |
| Trend*exports outside Africa | -0.0276*** | -0.0312 | -0.0268 | -0.0213 | -0.0308** | -0.0653 |
| | (0.01000) | (0.0220) | (0.0298) | (0.0485) | (0.0123) | (0.0451) |
| Trend*exports within Africa | -0.0102 | -0.0552*** | -0.0485** | -0.0139 | 0.0234* | 0.00336 |
| | (0.00909) | (0.0153) | (0.0200) | (0.0377) | (0.0139) | (0.0377) |
| Any foreign ownership = 1 | 0.110** | 0.140** | 0.0927 | 0.185** | 0.00934 | 0.0172 |
| | (0.0459) | (0.0636) | (0.0952) | (0.0761) | (0.0846) | (0.0913) |
| Exports within Africa = 1 | 0.116 | 0.480*** | 0.445*** | 0.240 | -0.171 | 0.0886 |
| | (0.0741) | (0.116) | (0.143) | (0.320) | (0.111) | (0.416) |
| Exports outside Africa =1 | 0.249*** | 0.214 | 0.220 | 0.0756 | 0.260*** | 0.986** |
| | (0.0816) | (0.168) | (0.207) | (0.416) | (0.0982) | (0.494) |
| Real eff. exchange rate | -0.000330* | -0.000513 | 0.00329 | -0.00399 | -0.00203*** | -0.000107 |
| | (0.000173) | (0.000599) | (0.00317) | (0.00260) | (0.000607) | (0.000188) |
| Constant | 3.481*** | 3.275*** | 3.184*** | 3.054*** | 3.871*** | 3.667*** |
| | (0.0478) | (0.0765) | (0.176) | (0.376) | (0.105) | (0.137) |
| Observations | 3,459 | 1,300 | 753 | 547 | 1,477 | 682 |
| Number of firms | 944 | 555 | 339 | 216 | 214 | 175 |

Industry controls included but not reported. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table A-1: Production function estimates from the full dataset

| Dependent: ln output/worker | (1)<br>All countries | (2)<br>Exporters | (3)<br>Export destination | (4)<br>Foreign ownership |
|---|---|---|---|---|
| ln *K* (ln capital/worker) | 0.0547*** | 0.0552*** | 0.0588*** | 0.0552*** |
| | (0.00621) | (0.00620) | (0.00724) | (0.00620) |
| ln *M* (ln mat. inputs/worker) | 0.638*** | 0.637*** | 0.656*** | 0.637*** |
| | (0.00653) | (0.00653) | (0.00731) | (0.00653) |
| ln *O* (ln other inputs/worker) | 0.142*** | 0.143*** | 0.119*** | 0.143*** |
| | (0.00696) | (0.00695) | (0.00773) | (0.00696) |
| *F* (any foreign ownership=1) | 0.0798*** | 0.0793** | 0.0858** | 0.0794 |
| | (0.0309) | (0.0308) | (0.0357) | (0.0483) |
| *X* (exporter = 1) | 0.0637*** | 0.178*** | | 0.178*** |
| | (0.0223) | (0.0404) | | (0.0413) |
| *T* (time) | -0.00175 | 0.00122 | -0.00145 | 0.00123 |
| | (0.00207) | (0.00225) | (0.00281) | (0.00234) |
| $T \times X$ | | -0.0179*** | | -0.0179*** |
| | | (0.00528) | | (0.00544) |
| $T \times F$ | | | | -6.01e-06 |
| | | | | (0.00551) |
| Export to Africa = 1 | | | 0.132** | |
| | | | (0.0610) | |
| Export to ROW =1 | | | 0.267*** | |
| | | | (0.0674) | |
| $T \times$ Export to Africa | | | -0.0146* | |
| | | | (0.00748) | |
| $T \times$ Export to ROW | | | -0.0256*** | |
| | | | (0.00828) | |
| Kenya | -0.164*** | -0.157*** | -0.191*** | -0.157*** |
| | (0.0367) | (0.0367) | (0.0406) | (0.0367) |
| Ghana | -0.110*** | -0.101*** | -0.126*** | -0.101*** |
| | (0.0386) | (0.0387) | (0.0430) | (0.0387) |
| Tanzania | -0.265*** | -0.259*** | -0.234*** | -0.259*** |
| | (0.0370) | (0.0370) | (0.0431) | (0.0370) |
| Constant | 2.389*** | 2.357*** | 2.371*** | 2.357*** |
| | (0.0712) | (0.0717) | (0.0825) | (0.0719) |
| Observations | 4,280 | 4,280 | 3,459 | 4,280 |
| Number of firms | 1,139 | 1,139 | 944 | 1,139 |

Dependent variable is log of real output per worker. Industry controls included but not reported. Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Appendix Table A-2: Production function estimates by country

| Dependent var: ln real output/worker | (1) Kenya | (2) Tanzania | (3) Kenya & Tanzania | (4) Ghana | (5) Nigeria |
|---|---|---|---|---|---|
| ln *K* (ln capital/worker) | 0.0908*** | 0.0247** | 0.0685*** | 0.0501*** | 0.0720*** |
| | (0.0181) | (0.00990) | (0.0113) | (0.0111) | (0.0168) |
| ln *M* (ln mat. inputs/worker) | 0.649*** | 0.678*** | 0.661*** | 0.667*** | 0.642*** |
| | (0.0203) | (0.0135) | (0.0137) | (0.0100) | (0.0163) |
| ln *O* (ln other inputs/worker) | 0.0820*** | 0.160*** | 0.105*** | 0.146*** | 0.0892*** |
| | (0.0262) | (0.0163) | (0.0174) | (0.0105) | (0.0137) |
| *F* (any for. ownership=1) | 0.102 | 0.0211 | 0.0866* | 0.130** | -0.0208 |
| | (0.0771) | (0.0466) | (0.0493) | (0.0576) | (0.0773) |
| *T* | -0.00780 | 0.0406*** | -0.00252 | -0.00227 | -0.00749 |
| | (0.00951) | (0.00809) | (0.00622) | (0.00335) | (0.00738) |
| Export to Africa = 1 | 0.319** | 0.125 | 0.340*** | -0.116 | -0.183 |
| | (0.131) | (0.219) | (0.101) | (0.0882) | (0.348) |
| Export to ROW =1 | 0.265 | 0.305 | 0.266* | 0.289*** | 0.960** |
| | (0.186) | (0.284) | (0.145) | (0.0775) | (0.424) |
| *T* × Export to Africa | -0.0394** | -0.0104 | -0.040*** | 0.0144 | 0.0206 |
| | (0.0184) | (0.0257) | (0.0133) | (0.0110) | (0.0316) |
| *T* × Export to ROW | -0.0300 | -0.0376 | -0.0316* | -0.0249** | -0.0806** |
| | (0.0273) | (0.0330) | (0.0191) | (0.00974) | (0.0387) |
| Constant | 2.217*** | 1.637*** | 2.133*** | 2.131*** | 2.615*** |
| | (0.194) | (0.108) | (0.120) | (0.105) | (0.190) |
| Observations | 753 | 547 | 1,300 | 1,477 | 682 |
| Number of firms | 339 | 216 | 555 | 214 | 175 |

Dependent variable is log of real output per worker. Industry controls included but not reported. Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.