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Domestic Constraints, Firm Characteristics, and Geographical Diversification of Firm-Level Manufacturing Exports in Africa

Yutaka Yoshino

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Abstract

Using firm-level data on manufacturing sectors in Africa, this paper addresses how domestic supply constraints and other firm characteristics explain the geographical orientation of firms' exports and the overall market diversification of African manufacturing exports. The degree of market diversification, measured by the number of export destinations, is highly correlated with export intensity at the firm level, and both embody strong scale effects. Technological factors, such as new vintage capital and Internet access, which improve production efficiency and lower export costs, show strong effects on the firm-level export intensity. Some qualitative differences exist between Africa's regional exports and exports to the global markets. Foreign ownership is a significant factor in characterizing the intensity of global exports but not regional exports. The technological factors are significant in both cases, but more so in global exports. Public infrastructure constraints, such as inferior power services and customs delays, seem to have more immediate impacts on regional exports in general, implying the relevance of addressing behind-the-border constraints in fostering regional integration in Africa. Customs efficiency does matter for textile exports to the global markets, underscoring the importance of improving trade facilitation in Africa for competitive participation of African producers in global supply chain industries.

This paper—a product of Poverty Reduction and Economic Management, Africa Region—is part of a larger effort in the department to improve understanding of the factors that contribute to successful export diversification and export growth in Sub-Saharan Africa. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org.
The author may be contacted at yyoshino@worldbank.org.

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Yutaka Yoshino*

* Economist, Poverty Reduction & Economic Management, Africa Region, The World Bank. 1818 H Street, N.W., Washington, D.C. 20433, U.S.A. Email: yyoshino@worldbank.org. The author thanks valuable comments from Jorge Arbache, Paul Brenton, George Clarke, Souleymane Coulibaly, John McLaren, Taye Mengistae, Edgar Olsen, John Page, Manju Shah, Marilou Uy, Erik von Uexkull, and participants at the African Economic Conference (November 15-17, 2007, Addis Ababa, Ethiopia) and the University of Oxford CSAE Conference (March 16-18, 2008, Oxford, U.K.). The findings, interpretations, and conclusions expressed in this paper are entirely those of the author. They do not necessarily represent the view of the World Bank, its Executive Directors, or the countries they represent.

1. Introduction

Expanding manufacturing production is often considered a necessary stepping stone for economic growth in low-income countries because manufacturing generates value-adding activities based on the existing economic resources of the country. This is certainly true for African countries, many of which are dependent on only a handful of primary commodities for earning foreign exchange without much value added generated. Manufactured products are not major exports of African countries in general. Only 21 percent of total African exports worldwide are manufactured products (Table 1).[1] For these commodity-dependent African countries, increasing manufacturing exports is the most direct means of diversifying their export structure and reducing their vulnerability to the fluctuations of world commodity prices.

While export diversification in Africa is discussed most often in the context of diversification of product composition (*product diversification*), the question remains whether such product diversification comes with diversification of export markets or *market diversification* of their manufacturing exports. As shown in Table 1, the European Union (EU) is the major destination of African manufactured products, importing more than a half of Africa's manufacturing exports. Recently, some developed countries, such as EU countries and the United States, have provided preferential tariff and non-tariff treatment of the products made by low-income African countries to allow more favorable access to their markets, particularly for manufactured products.[2] These measures have led to considerable growth of African exports in certain sectors such as garment exports to the United States under Africa Growth and Opportunity Act (AGOA). While small in absolute size, exports of manufactured products are a large share of intra-Africa exports (43% of total intra-African trade), compared to exports to other regions. Intra-Africa exports have also grown by almost 20% per annum on average from 2001 to 2005, which is the highest growth for African manufacturing exports among destinations.

While aggregate data show some patterns of market diversification of African manufacturing exports, little has been studied on the geographical orientation of manufacturing exports at the firm level and the patterns of their market diversification. There is only a limited number of papers that look at directions of exports at the firm level across the world. Using Slovenian data, Damijan, Polanice, and Prasnikar (2004) showed that Slovenian exporters to the EU are more productive than exporters to the neighboring countries. Using French micro-data, Eaton, Kortum, and Kramarz (2004) found that most exporters sell to very few markets, whereas a small number sell almost

[1] Manufactured products include machinery and transport equipment, textiles, apparel and footwear, and other manufactured materials.

[2] One notable U.S. example is the Africa Growth and Opportunity Act (AGOA). The European Union also has a similar preferential program called "Everything But Arms" (EBA), as well as the Cotonou Agreement for the African, Caribbean, and Pacific (ACP) countries. The latter will soon be replaced by Economic Partnership Agreements (EPAs) that the EU is currently negotiating with those countries.

everywhere. In the case of Africa, Mengistae and Pattillo (2004) found a higher productivity premium for African exporters exporting outside Africa than for those exporting within Africa.

Contemporary international trade has increasingly deviated from a simple neoclassical comparative advantage model in the following three aspects: (1) relevance of trade cost and distance; (2) disintegration or fragmentation of the production process, which has led to intra-industry trade; and (3) prevalence of increasing return to scale and learning effects.[3] In all three aspects, it is important to understand the *firm-level dynamics* surrounding trade. In particular, with regard to the third aspect, there is already a large body of literature that seeks to identify the micro-level empirical correlation between productivity and export performance.[4] Another implication emanating from these three aspects is that there is an increasing need to understand the factors that influence the *geographical directions of these firm-level exports*, or in other words, with what countries these firms are trading. Locations and types of trading partners are in fact quite relevant to all three aspects. For example, regional and global markets have very different market structures in terms of degree of competition, and they impose different levels of fixed costs associated with market entry, not to mention the difference in distance. Producers in Uganda, for example, who sell their products to Tanzania would incur much less start-up costs and face much less competition than if they sell their products to the Netherlands. Different trading partners also provide different product space in which firms participate in cross-border vertical supply chains. Learning effects may likely differ depending on trading partners with whom firms trade.

The objective of this paper is to explain theoretically and assess empirically how the different characteristics of African manufacturing firms and the various domestic supply constraints they face are related to the pattern of geographical diversification of their manufacturing exports. The empirical analyses is based on the firm-level micro-data collected from the ongoing series of Investment Climate Surveys (ICS) conducted by the World Bank throughout the developing countries in various regions. Using this data set, we conduct some simple econometric analyses on the cross-sectional variation among firms in the dataset in terms of behind-the-border factors and export orientation.

The implications of domestic supply constraints on export enhancement are quite a significant research topic from a policy perspective, particularly in the context of the recent "Aid for

[3] These three points are based on Anthony J. Venables's presentation at a World Bank seminar on trade cost (April 30, 2007).

[4] For example, Bernard and Jensen (1999); Clerides, Lach, and Tybout (1998); Aw, Chung, and Roberts (2000); and, more recently, Bernard, Eaton, Jensen, and Kortum (2003). For African manufacturing firms, Soderbom and Teal (2002), Milner and Tandrayen (2004), and Mengistae and Pattillo (2004), for example, used panel data on three African countries (Ethiopia, Ghana, and Kenya) and estimated significantly higher levels of productivity among exporting firms within the manufacturing firms of these three countries relative to firms selling only domestically.

Trade" initiatives. Yet there is only a handful papers that address domestic and cross-border constraints in export performance of firms. One such paper is Clarke (2005), which uses a similar dataset from ICS to show how behind-the-border, direct constraints on trade (e.g., ports and customs efficiency) affect firm-level export performance in Africa. This paper extends Clarke's research by incorporating the geographical orientation of firms' export performance and the extent of their market diversification in its analysis. Specifically, it differentiates exports to markets outside Africa, such as the EU and U.S., from exports to the regional markets within Africa in addressing the relationship between firms' export performance and the behind-the-border factors. This paper also considers a wider set of behind-the-border domestic factors, including both those directly related to trade and those related to production, which are either public (e.g., public infrastructure service quality) or private (e.g., generator ownership, capital vintage). The paper also examines various firm attributes that help lower trading costs, including both sunk entry cost, such as search cost, as well as variable trading costs (e.g., Internet access).

This study finds that the degree of market diversification in the African manufacturing sector, measured in terms of the number of export destination regions of individual firms, is highly correlated with export intensity of the firms, measured as the ratio of export revenues to the total sales revenues. Similar to the findings of past research that analyzed firms' participation in export markets in Africa, we found a strong scale effect in both export intensity and market diversification. Larger firms export more intensively and to wider geographical areas. In addition, technology factors such as new vintage capital (proportion of new machinery and equipment in firms' total capital stock) and Internet access have strong positive effects on both market diversification and export intensity. These technology factors not only have positive productivity enhancement effects, but they also lower trade-related sunk entry cost. Internet access, for example, reduces the search costs for developing new *clientele* abroad. New machinery and equipment improve product quality to meet product standards set abroad, particularly in high-income markets.

While these factors are significant in explaining firm-level export intensity in general, we found some qualitative differences between regional markets (i.e., intra-African exports) and global markets (i.e., exports outside Africa). These results were based on our analyses of export intensity in regional and global markets using a Tobit model as well as estimation of a multinomial probit model of market orientation. Consistent between these two models, foreign ownership, both foreign African-owned and foreign non-African-owned, was a significant factor in characterizing the intensity of global, but not regional, exports. The technology factors, i.e., new vintage capital and Internet access, are significant in explaining intensities of both types of exports, but more so in the case of global exports. On the other hand, public infrastructure constraints such as inferior power services and customs inefficiency seem to have a more immediate impact on the regional export

intensity in general, implying policy relevance of addressing domestic behind-the-border constraints in fostering regional integration in Africa. For global exports in specific sectors, customs efficiency does matter for textile exports, underscoring the importance of improving trade facilitation in Africa for competitive participation of its domestic industries in global supply chains.

The rest of this paper is organized as follows. The next section provides a basic theoretical framework for understanding how domestic constraints and other firm attributes affect firm-level patterns of market diversification and export intensity. Section 3 documents the data used for the study and highlights the major characteristics of the data by presenting descriptive statistics. Section 4 presents a simple analysis of firm-level patterns of the direction of exports, market diversification, and export intensity based on bivariate statistics. Section 5 presents several econometric models and their estimation results, which show a set of domestic factors, including those private to firms, that help explain firm-level variation in export intensity and market diversification, and how these factors affect export performance differently for regional and global exports. Summary of analyses and conclusions are in Section 6.

2. A Theoretical Model of Firm Heterogeneity, Market Diversification, and Export Intensity

This section provides a stylized theoretical model that illustrates how domestic supply constraints and other firm-specific attributes characterize firms' export propensity and their overall market diversification and export intensity. The domestic constraints considered in the model include those not directly related to trade. These constraints still influence export performance of domestic firms because they lower these firms' production efficiency, which is related to firms' likelihood to export. [5]

Only a partial equilibrium model is derived in order to keep the model simple.

2.1 Basic Setup

There are m countries in the world. In each country, there is a certain number of firms that produce and sell products as well as a certain number of consumers who purchase them. We express the number of firms in Country j as n_j. Each firm produces a *horizontally differentiated* manufactured product in the sense that products are differentiated by *type* rather than *quality*. Each product can be sold in any market, domestic or foreign. Each market is characterized by monopolistic competition among firms. A firm uses one unit of a composite factor which consists of labor and capital to produce one unit of the product. Firms vary in production efficiency, which is exogenously given by the factors explained below. Firms face an identical fixed cost F_j when they operate in Country j.

[5] Some of the key elements of the model follow the models in Melitz (2003) and Helpman, Melitz, and Yeaple (2004).

The presence of the fixed cost makes firms face increasing return to scale (IRS) from production, allowing them to earn non-zero positive profit even in a market of free entry and exit. The cost function for the i th firm in the j th country thus takes the following form:

$$C_{ij} = F_j + \frac{\omega_j}{\delta_{ij}} \sum_{k=1}^{m} Q_{ijk} \quad (1)$$

where Q_{ijk} is total outputs of the firm sold in Country k.[6] The symbol δ_{ij} indicates firm-specific production efficiency level; ω_j represents the composite factor price in Country j.

The firm-level product efficiency is affected by both public and private goods. First, it is affected by domestic business environment factors such as quality of public infrastructure (e.g., road quality, power service quality), which may have varying degrees of impact on firms depending on location, sector, and certain firm-specific characteristics. Second, production efficiency is also affected by individual firms' technological levels including capital intensity, efficiency in machinery and equipment (capital vintage), workers' skill levels, or ownership of a generator to supplement the public grid during power outages.

Turning to the demand side, consumers' preference exhibits a constant-elasticity-of-substitution (CES) utility function over the set of manufactured products produced in all countries. Specifically, the utility function of the consumer located in Country k takes the following form:

$$U_k = \left[\sum_{j=1}^{m} \sum_{i=1}^{n_j} \left(X_{ijk} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad (2)$$

where X_{ijk} is the amount of product produced by the i th firm in Country j and sold in Country k ; σ is the elasticity of substitution among the differentiated products, which is assumed to be greater than 1. Following Dixit and Stiglitz (1977), the consumer utility maximization leads to the consumer demand in Country k for the products produced by the i th firm in Country j to be expressed as:

$$X_{ijk} = \frac{\left(P_{ijk} \right)^{-\sigma}}{\left(\Omega_k \right)^{1-\sigma}} Y_k \quad (3)$$

[6] It represents total domestic sales quantity when $j=k$.

where P_{ijk} is the consumer price in Country k for the product produced by the i^{th} firm in Country j; Y_k is the total expenditure on domestic as well as foreign manufactured products in Country k; and Ω_k is the price index of the manufactured products in Country k expressed as the following:

$$\Omega_k = \left[\sum_{j=1}^{m} \sum_{i=1}^{n_j} \left(P_{ijk} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{4}$$

Trade between any two countries j and k incurs a variable trade cost τ_{jk} which is symmetric in both directions. It takes the form of iceberg trade cost à la Samuelson in the sense that the value of one unit of a product produced in Country j will shrink to $1/\tau_{jk}$ of its original value before it reaches Country k. Transportation cost and ad valorem tariffs are obvious examples of such variable trade cost.

From Dixit and Stiglitz (1977), we know that the firms' profit maximization leads to a producer price set with the markup rate $\sigma/(\sigma-1)$ over the marginal cost:

$$P_{ijk} = \frac{\tau_{jk} \omega_j}{\delta_{ij}} \frac{\sigma}{\sigma - 1} \tag{5}$$

Using equations (3) and (5), we can express the revenue from sales in Country k as:

$$R_{ijk} = P_{ijk} * X_{ijk} = \left(\frac{P_{ijk}}{\Omega_k} \right)^{1-\sigma} Y_k \tag{6}$$

For the moment, assume a firm sells its products only to its domestic markets. The variable profit from production is $1/\sigma$ of the total revenue so that the total profit inclusive of the fixed cost is:

$$\pi_{ijj}^{D} = \frac{1}{\sigma} \left(\frac{P_{ijj}}{\Omega_j} \right)^{1-\sigma} Y_j - F_j \tag{7}$$

Substituting the price index in Country j, which is to be derived analogously to equation (4), for Ω_j in equation (7) and with further algebraic simplification, the profit from serving the domestic market can be rewritten as:

$$\pi_{ijj}^{D} = \frac{Y_j}{\sigma N_j}\left(\frac{\delta_{ij}}{\omega_j}\right)^{\sigma-1} - F_j \tag{8}$$

where $N_j \equiv 1\Big/\sum_{k=1}^{m}\left(\tau_{jk}\omega_k\right)^{\sigma-1}\left(n_k\varepsilon_k\right)^{-1}$ and $\varepsilon_j \equiv n_j^{-1}\sum_i\left(\delta_{ij}\right)^{\sigma-1}$. The latter is the average firm-level production efficiency in Country j.[7] Note that N_j represents *neighborhood competitiveness* for Country j, which is larger when the country is relatively close to countries with higher competitiveness, represented by lower wage, more firms, and higher average efficiency. Note that the marginal profit is zero when $\delta = \delta_j' \equiv \left[\sigma F_j N_j / Y_j\right]^{\frac{1}{\sigma-1}}\omega_j$. Thus, within Country j, only firms whose production is sufficiently efficient so that $\delta_{ij} > \delta_j'$ will operate in the market.

2.2 Export Decision, Market Diversification, and Export Intensity

Now, as per the assumption used in the papers on firm-level export decision, including Roberts and Tybout (1997), Melitz (2003), and Helpman, Melitz, and Yeaple (2004), we assume that there is a sunk entry cost S_j associated with exportation from Country j to each destination. The net profit from exporting to Country k is

$$\pi_{ijk}^{E} = \frac{Y_k}{\sigma N_k}\left(\frac{\delta_{ij}}{\tau_{jk}\omega_j}\right)^{\sigma-1} - S_j \tag{9}$$

The profitability of exporting increases with the market size of the destination and the firm's production efficiency and decreases with the neighbor's competitiveness, variable trade cost, wage level, and with the sunk cost. The marginal profit is zero when $\delta = \delta_{jk}'' \equiv \left[\sigma S_j N_k / Y_k\right]^{\frac{1}{\sigma-1}}\tau_{jk}\omega_j$. Thus, within Country j, only firms whose production process is sufficiently efficient so that $\delta_{ij} > \delta_{jk}''$ will get to export to Country k. Similar to other theoretical models of firm heterogeneity and export propensity, this model also predicts that only efficient firms export. For the moment, let

[7] Note that ε indicates the efficiency level because with the assumption of σ>1, it is inversely related to δ, which is the inefficiency in production.

us assume that the fixed and variable trade costs, i.e., S_j and τ_{jk}, are sufficiently large so that $\delta''_{jk} > \delta'_j$ for any k. This implies that firms serving only domestic markets are necessarily less efficient than firms exporting to any market.

In addition to whether or not firms export, another way of measuring a firm's export performance is the ratio of its export revenue to its total sales revenue (domestic and export), or *export intensity*. For notational simplicity, we define θ_{jk} as the following:

$$\theta_{jk} \equiv Y_k \left(N_k\right)^{-1} \left(\tau_{jk}\right)^{1-\sigma} \tag{10}$$

This can be interpreted as the potential market size of Country k perceived from Country j, net of the neighborhood effect in and the distance to Country k. Then, the revenue for i th firm from its sales in Country k can be expressed as:

$$R_{ijk} = \frac{\theta_{jk}}{\sigma}\left(\frac{\delta_{ij}}{\omega_j}\right)^{\sigma-1} \tag{11}$$

Note that the revenue ratio between any two destinations, for example A and B, is θ_{jA}/θ_{jB}, which is independent of δ_{ij}. Thus, as long as two firms in the *same country* sell their products to the *same set of countries*, including their own country (domestic markets), their export intensity should be identical. This also means that the presence of trade costs, variable as well as fixed entry costs, does not generate any difference in the revenue ratio for firms selling to the same set of countries.[8]

However, firms export to different numbers of countries because of their differences in production efficiency. The more efficient the firm, the more countries it exports to. In other words, improvement in production efficiency allows firms to *diversify* their export markets. To demonstrate this, we order θ_{jk} for exports from Country j to its $m-1$ trading partners according to its size so that $\theta_{j1} \geq \theta_{j2} \geq \theta_{j3} \geq \ldots\ldots \geq \theta_{j(m-2)} \geq \theta_{j(m-1)}$. Since the threshold level of production efficiency for export entrance to Country k can be re-expressed as $\delta''_{jk} = \left[\sigma S_j / \theta_{jk}\right]^{\frac{1}{\sigma-1}} \omega_j$, and therefore $\partial\delta''_{jk}/\partial\theta_{jk} < 0$, the order of θ_{jk}, which represents the size of demand also represents the entry order of $m-1$ foreign markets for firms in Country j along their levels of production efficiency. Suppose the i th firm exports up to Country Z. Then, the export intensity is expressed as:

[8] This holds true as long as we assume both variable and fixed trade costs are invariant among firms. We later relax this assumption.

$$(12) \qquad E_{ij} = \frac{\sum_{k=1}^{Z} R_{ijk}}{R_{ijj} + \sum_{k=1}^{Z} R_{ijk}} = \frac{\theta_{j1} + \theta_{j2} + ... + \theta_{jZ}}{\theta_{jj} + \theta_{j1} + \theta_{j2} + ... + \theta_{jZ}}$$

Since $\partial E_{ij} / \partial Z > 0$, export intensity increases with the number of markets to which firms export, which in turn, increases with the level of production efficiency.

Whether firms are more likely to export regionally or globally depends on the order of the countries in θ as defined in (10) based on the balance among the market size of the destination, the distance or trade cost to reach the destination, and the neighborhood competitiveness effect. Consider a country located in a region where countries, including the country itself, are less competitive than countries in other regions. For such a country, neighboring countries in the same region tend to have higher θ values than those outside the region. Thus, firms in such a country are likely to export regionally rather than globally if they ever export. Only the most efficient firms in the country export globally. Regional integration, which leads to a reduction in intra-regional trade costs, enhances such likelihood. In the same token, firms in such countries could export globally if they benefit from preferential market access given by their trade partners outside the region.

2.3 Sources of Variation in Market Diversification and Export Intensity

To summarize the analysis so far, our model presents the case that production efficiency of firms, affected by public infrastructure quality and the firms' technological level, characterizes their level of export intensity. Firms with higher production efficiency earn higher marginal profits from exporting to individual countries, net of the sunk entry cost, than firms with lower efficiency. These more efficient firms export more intensively because they export to more countries. In our model so far, the variation in production efficiency is the only source of variation in export intensity among firms in the same country because the order of θ in (10) is invariant among firms in the same country.

Now, we relax the earlier assumption that trading costs, both the variable trade cost τ as well as the fixed entry cost for exporting S, are identical among firms in the same country, and we assume that they vary across firms depending on their characteristics. For example, it is likely that foreign-owned firms have their own private mechanisms to lower both variable and fixed trade costs. Internet access also lowers search cost for firms trying to develop new *clientèle* in overseas markets. Then, obviously, firms with lower sunk entry cost export more intensively given their levels of production efficiency because they export to more markets than firms facing higher entry cost. Firms with lower variable trading cost also export more intensively because, in a given export market,

their θ s are higher than those of firms with higher variable trade costs, even though both types of firms serve the same market. Thus, once we allow private characteristics of individual firms to generate variation in variable and fixed trade costs, lowering trade costs also increases the export intensity of individual firms.

3. Data

The empirical part of this study uses the firm-level World Bank Investment Climate Survey (ICS) data from the manufacturing sectors of seven Sub-Saharan African countries: Benin, Ethiopia, Kenya, Madagascar, Senegal, Tanzania, and Uganda.[9] These seven countries were chosen on the basis of availability of detailed information on firm-level export destinations in ICS. The ICS data are collected to prepare Investment Climate Assessments (ICAs), diagnostic reports intended to serve as the basis for policy reforms that will help improve these countries' business environments with the support of the World Bank.[10] The data are collected through firm surveys that include a common set of questions for all countries surveyed, supplemented by country-specific questions to help each country assess its investment climate. The sample is selected by a stratified random sampling method controlling for size, sub-sector, and geographic distribution, based on the company registration records or manufacturing census information available from the government. More than 80 countries have been surveyed since the program started in 2002. The sample size varies, ranging from about 100 firms for some small African countries such as Lesotho to more than 1,000 for countries such as India, China, and Brazil.

The World Bank ICS data are comprehensive in covering firms' business performance (production, sales, raw material purchases); access to and conditions of factor markets (labor, capital); business environments surrounding the firms (administrative barriers, infrastructure problems, informal transactions such as bribes); and participation in various government-sponsored business incentive programs such as tax exemption schemes. The ICS survey data are unique in allowing researchers to link firm-level microeconomics, such as productivity, employment, investment, and supplier relationship, with the institutional aspects of private sector development each industry faces.

According to the ICS data, a relatively limited number of firms in Sub-Saharan Africa actually export their products. Figure 1 shows percentage shares of exporters in the total sample of manufacturing firms (*export participation rate*) in the seven Sub-Saharan African countries in this study, as well as average export values in the total sales (average *export intensity*), shown separately for destination markets. Among 2,039 manufacturing firms in the ICS data of the seven African

[9] The World Bank ICS has been renamed as the World Bank Enterprise Survey. Visit www.enterprisesurvey.org for more information.
[10] ICA reports for Sub-Saharan African countries are available from the World Bank Africa Regional Program on Enterprise Development (RPED) website http://www.worldbank.org/rped).

countries, only 28 percent ever export their products. On average, exports represent 14 percent of total sales per firm in the sample. Among the seven countries, only Benin, Kenya, Madagascar, and Senegal have more than 30 percent of firms exporting products. In terms of average export intensity, Madagascar has an exceptionally high average rate relative to its exporter density.

Among manufacturing sectors, the textile, garment, and leather, and to some extent food and agro-industry sectors, have high export participation rates and average export intensity (Figure 2). Capital-intensive industries such as chemical, paints, and plastic have low export intensity levels relative to their export participation rates, implying that firms in these sectors are less concentrated in exporting. Labor-intensive industries such as textile, on the other hand, are more concentrated or "specialized" in producing products for export rather than domestic markets.

Among many investment climate conditions covered by ICS, efficiency of ports and customs is one of the major factors that directly affect firm-level efficiency in international trade. The ICS data include per-firm average number of days to clear customs for both exports and imports. As shown in Figure 3, the port/customs turnaround time is faster for exports than for imports in all seven countries in the dataset used in the study.

The ICS data also cover a wide range of factors related to the domestic business environment in the countries as experienced by the surveyed firms. This study examined efficiency in infrastructure such as inferior power services and customs delays. Among the seven African countries in the dataset, some cross-country variations are observed in terms of availability and quality of domestic infrastructure services. Figure 4 compares domestic infrastructure service quality across the seven countries in terms of average numbers of days required for a new land telephone line connection and a new electricity connection, and average numbers of days per year for which the surveyed firms experience disruptions in electricity (both power outage and current fluctuation) and in land telephone service.

4. Pattern of Market Diversification of African Manufacturing Sector: Bivariate Analysis

4.1 Geographical Orientation of Exports

Our dataset includes information on the volume of firm exports to specific countries, geographic regions, or country blocs such as "UEMOA countries" or "Asia", organized in a way that allows us to break down the firms' total exports to the following six geographically distinct groups: (1) exports within the same subregion; (2) exports to other African countries outside of the subregions; (3)

exports to Europe; (4) exports to North America; (5) exports to Asia; and (6) exports to other countries outside Africa.[11]

Figure 5 show firms' export participation rates and their average export intensity per destination. Overall, more firms export regionally than globally. A fairly high proportion of firms export to countries within Africa (13.5% within subregions, 10.8% to other African countries).[12] Among destinations outside Africa, exports to Europe are at a relatively high percentage of participation 9.5%) and are significantly more intensive per firm on average than exports to other destinations. On the other hand, exports within Africa are not as intensive. Although intra-Africa exports are relatively pervasive in terms of the number of firms participating in export, these firms do not export as much as exporters to Europe.

Table 2 summarizes destination-specific export intensities by country, sector, nationality, and size of firm. Among the seven countries, firms in Madagascar, and to some extent Ethiopia, have a tendency toward global exports.[13] Intra-Africa exports are intensive in Kenya and Senegal, both of which are regional economic powers in East and West Africa, respectively. The geographical orientation of exports varies among sectors as well, generally reflecting the comparative advantage of African countries vis-à-vis other parts of the world. More capital-intensive sectors—such as chemical, plastics and paints, construction materials, metals and machinery, and paper and pulp—have more regional exports than global exports, whereas labor-intensive products—such as textiles and apparel and agro-processing and food products—are exported more to the markets outside Africa. High export intensities of the textile sector in Europe and North America are presumably driven by preferential market access conditions given to African producers such as Africa Growth and Opportunity Act (AGOA) of the United States and Everything But Arms (EBA) initiative of the EU.

Destination-specific export intensities are also compared across nationality and size of firms. The nationality of a firm is determined by identifying which of the three types of shareholders—domestic, foreigners in other African countries, and foreigners outside Africa—has the largest share. Foreign non-African-owned firms clearly export intensively in global markets, particularly to Europe (19.4%) and North America (8.4%). Firms owned by African foreigners also export intensively to Europe. For all six destinations there is a clear pattern of increasing export intensity with firm size, showing a strong scale factor *within* each market of exports.

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[11] The subregions for the individual seven countries are defined as: UEMOA countries (Benin, Senegal), EAC countries (Kenya, Tanzania, Uganda), Mauritius and Reunion (Madagascar), and geographically contiguous destinations (Ethiopia). "Africa" includes North Africa in our empirical analyses.

[12] Note that informal cross-border exports are not included in these exports within Africa. The data capture only formal trade.

[13] The Malagasy exports outside Africa are almost exclusively driven by firms in export processing zones.

4.2 Market Diversification and Export Intensity

One way to measure the extent of market diversification in firms' exports is the number of export markets they serve. Since the actual numbers of markets are not identified to the level of specific countries for all firms in our data, we count the number of export destinations out of the six regions in which individual firms serve as the "number of export markets."

Table 3 summarizes average numbers of markets among firms by county, sector, and geographical orientation of exports. Firms in Kenya and Senegal have relatively diversified markets, reflecting the presence of leading ports in the subregions (e.g., Mombassa and Dakar), as well as their relative economic sizes vis-à-vis their neighboring countries. Firms in Uganda and Madagascar, on the other hand, have less diversified markets, likely reflecting their geographical characteristics as landlocked and remote island countries, respectively. In terms of sector, food and agro-industry and textile, garment, and leather are the two groups with relatively diversified markets. These two sectors show high export intensity to Europe and other global markets (Table 2). The average number of markets is also calculated for firms grouped for their participation in exports to specific destinations.[14] Firms participating in intra-subregional exports have the least diversified markets, while firms participating in exports to Asia have the most diversified markets. Overall, firms participating in more geographically distant markets have more diversified markets.

Table 4 summarizes how firm characteristics differ among levels of market diversification. On average, the more markets firms serve, the more intensively they export. The positive relationship between number of export destinations and export intensity is also visible when we compare them across sectors (Figure 6). At the same time, as the number of markets increases, the median labor productivity, measured as value-added per worker, also increases. The combination of these two correlated patterns corroborates the theoretical framework presented in Section 2, where more efficient or productive firms export more intensively because they export to a larger number of countries.

There is also a positive correlation between the number of export markets and firm size, implying the presence of a scale effect in market diversification, similar to the case of the scale effect in export intensity mentioned earlier. A similar pattern is observed for manager's education level as well as ownership of generators, given their production capacity. The latter is possibly related to firm size. Larger firms would more likely choose to invest in generators. The level of education of firm managers signifies firm efficiency. At the same time, highly educated managers would have better knowledge or access to information on market opportunities outside of their countries.

[14] Firms grouped for their participation in specific markets can have more than one market because they can simultaneously export to several markets.

There is an interesting difference between exports within Africa and exports to countries outside Africa. Exports within Africa have higher intensity in the middle level of market diversification, i.e., when the number of export markets is 2. On the other hand, exports to countries outside Africa have higher intensity when the number of export markets is 1, but more so when it is large (3 or more export markets).

The observed difference between export intensities within and outside Africa in Table 4 hints at the presence of a qualitative difference between the two types of exports in their market diversification pattern. In fact, a similar difference also exists if we look at export participation rates for these six destinations and how the rates change according to the level of market diversification (Figure 7). The export participation rates for exports within the subregions and to other African countries both peak at 2, while the rates for the exports to the outside of Africa increase monotonically with the number of markets.

Table 5 summarizes conditional average intensities of exports to the six individual markets, conditional on firms' participation in one of these six markets. In other words, the table tells, for example, among firms exporting to countries in the same region, how intensively they simultaneously export to Europe. A quick inspection of the table suggests that there are in fact two types of exporters with distinct patterns of market diversification: one type for firms that sell primarily within Africa and another for firms that sell primarily outside Africa. First, these two types of firms differ in average export intensity, with firms exporting outside Africa tending to export more intensively than those exporting within Africa. The second, and perhaps more interesting, observed pattern is that these two types of firms diversify their markets almost only within each type, segmenting the pattern of market diversification among firms. Export intensity within subregions is high among firms exporting within Africa, including those that export outside the subregions. Subregional markets appear to be the entry point for diversification towards other African markets outside the subregions. On the other hand, exports to Europe have high intensity for firms exporting outside Africa, including those also exporting to North America, Asia, and other countries outside Africa. Firms exporting within Africa export less outside Africa, whereas firms exporting outside Africa export less within Africa. Here, the European markets appear to be the entry point for diversification towards other global markets.

5. Econometric Estimation of Export Intensity, Market Diversification, and Geographical Orientation of Firm-Level Exports

In this section, we formally estimate several reduced-form econometric models that capture the earlier theoretical prediction, that is to say that, given domestic and foreign demand for the products

firms produce, the firm characteristics, including domestic supply constraints and other firm-specific attributes, lead to a variation of export intensity and market diversification at the firm level. We first look at how these factors affect general export intensity and market diversification. Then, we consider exports to specific destinations separately to identify any qualitative difference between exports within Africa (regional exports) and exports outside Africa (global exports) in terms of the way these factors affect firm-level exports.

5.1 Export Intensity

We first estimate how firms' export intensity is characterized by various factors. Export intensity is measured as the ratio of export sales to total sales of the firm, or "export ratio." We estimate the following equation using the two-limit Tobit model (censored below at 0 and above at 1). [15]

$$(13) \qquad XI_{ijk} = \begin{cases} 1 & \text{if} \quad 1 \le \xi_{ijk} \\ \xi_{ijk} & \text{if} \quad 0 < \xi_{ijk} < 1 \\ 0 & \text{if} \quad \xi_{ijk} \le 0 \end{cases} \text{ and}$$

$$(14) \qquad \xi_{ijk} = \alpha + \beta_1 * DC_{ijk} + \beta_2 * X_{ijk} + \beta_3 * Y_j + \beta_4 * Z_k + \varepsilon_{ijk}$$

where the dependent variable XI_{ijk} is the export intensity of Firm i of Sector j in Country k, measured as the ratio of export sales to total sales; DC_{ijk} is a vector of variables indicating behind-the-border domestic constraints as observed at the level of firms; X_{ijk} is a vector of other firm-specific characteristics; and Y_j and Z_k are sector- and country-specific dummies respectively. ε_{ijk} is an error term assumed to be independently and identically distributed (*iid*).[16]

There are two types of behind-the-border domestic constraints considered in this model: the efficiency of customs (number of days of average delay in customs clearance as experienced by the firm during the reporting year) and production-related infrastructure service quality, specifically the quality of public electricity service (frequency of public grid power outage in a year as experienced by the firm during the reporting year). Because a significant number of firms own generators to supplement power from the public grid, the regression incorporates an interaction term between an indicator variable for generator ownership and public grid power outage variable. Note that both

[15] See Maddala (1983) for two-limited Tobit model. Alternatively, one could apply logit transformation to the dependent variable.

[16] All symbols used for this section are non-italicized in order to distinguish them from the symbols used in the theory section.

customs efficiency and public electricity service quality variables used here are based on the actual experiences of individual firms and are thus endogenous to the dependent variable. The nature of the endogeneity of the customs efficiency variable is quite straightforward: the more firms export, the more likely they are to experience problems in their trade-related transactions such as customs clearance. The electricity infrastructure quality variable might also depend on the amount of exports. Firms exporting more must be producing more, and the problems with infrastructure service quality are more likely felt when firms produce more and thus need such services more, compared with firms that are not exporting.

Other firm-specific characteristics in $\mathbf{X}_{ijk}$ include size (number of workers and total sales volume) and age. In addition, capital-labor ratio (value of capital stock per worker), new vintage capital (percentage of machinery and equipment 10 years old or younger in total capital stock in terms of value), skilled labor ratio (ratio of skilled workers to unskilled worker), education level of managers (whether managers have university education), and Internet access are also included. All these variables are assumed to be capturing the level of production efficiency. Some of these variables may also reduce trade costs, including both sunk entry costs and variable trade costs. For example, Internet access reduces firms' search cost in identifying potential overseas customers and collecting other types of information regarding their overseas market opportunities, hence reducing market entry costs. At the same time, it also improves efficiency of various transactions related to shipment, thus reducing variable trading costs.

The inclusion of sector and country dummies is important to capture sector and country variations in unobserved factors in the data such as geographical characteristics of the countries and sectoral comparative advantage based on the countries' factor endowment differences relative to their trading partners.

To account for the endogeneity nature of the variables in $\mathbf{DC}_{ijk}$, we use the Instrumental Variable (IV) Tobit model. Similar to Clarke (2005), we instrument the endogenous regressors by taking region or city × sector averages of those firm-level observations corresponding to the variables in $\mathbf{DC}_{ijk}$.[17] Thus, for the customs efficiency as well as the electricity service quality variables, we use averages in specific regions for specific sectors are used as the instruments of the two endogenous regressors. We allow the model to determine these variables endogenously, using two-step IVTOBIT procedure of STATA.[18]

The coefficient estimates are presented in Table 6. Consistently among the three specifications tested, statistically significant positive coefficients are found for the size factor (either

[17] Each country has about five regions and about ten manufacturing sectors in the dataset.
[18] IVTOBIT procedure is available in STATA 9.

total labor or total sales volume), foreign share (for both foreign African and foreign non-African shares, as well as general foreign ownership), capital-labor ratio, new vintage capital, and Internet access. Customs delay has a negative coefficient in all specifications.

These findings are generally consistent with our predictions. The significance of the size factor is consistent with that in the empirical literature of firm-level export performance in Africa.[19] While the efficiency improvement of the scale effect under IRS and fixed entry cost may be the strong positive size coefficient on firms' export performance, our limitation to cross-sectional analysis does not allow us to effectively disentangle the size factor from other efficiency factors such as capital intensity.[20]

The significance of foreign ownership in firm-level export performance in the African manufacturing sector is also consistent with other studies, including Rankin, Söderbom, and Francis Teal (2006). There are several reasons why the share of foreign ownership matters in particular for firms in low-income countries, such as the ones in the current dataset. First, foreign direct investment brings skills and technologies from source countries that are otherwise not available domestically. And such skills and technologies help improve the physical productivity of firms (*productivity effect*). Another reason is that firms with foreign ownership are more likely to access to established overseas business networks and marketing channels or have their own cross-border corporate networks and channels, including those with the countries of parent companies, which facilitates their exporting activities (*network effect*).[21] The network effect includes not only networks for marketing and sourcing, but also for access to finance, which is very important for overseas transactions.

The positive significant effect of capital intensity (capital-labor ratio), after controlling for sector, implies a technology factor in explaining the level of export intensity. New vintage capital is another technology factor. It particularly affects global export performance because the younger the capital, the higher the quality of products firms can produce and the more efficiently they can produce them.

Consistent with Clarke (2005), customs delay obviously increases the firms' cost to trade, thus reducing export intensity. One day delay of custom clearance on average would shrink the proportion of exports to total sales by more than 20 percentage points. Although not significant, the signs for power outage and the interaction term between power outage and generator ownership are consistent with our prediction.

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[19] For example, Bigsten *et al.* (2004) and Rankin, Söderbom, and Teal (2006) showed that size is a robust determinant of export participation. Clarke (2005) found the significant positive coefficient of size in explaining firms' export intensity.
[20] Using longer panel data, Rankin, Söderbom, and Teal (2006) showed that the size factor in fact is not a proxy for efficiency.
[21] See for example Blömstrom and Kokko (1998) on multinational corporations and their networks.

5.2 Market Diversification

Next, we estimate a market diversification model to see how firm characteristics explain the level of market diversification. Our empirical strategy is to estimate the following Tobit model, regressing the previous set of independent variables used above on the two different measurements of market diversification. The first measurement is simply the number of export markets by region, as used in the bivariate analysis in Section 4. The second measurement is the number of export market regions, each weighted by geographical distance from exporting countries to destination regions in order to capture the extent of geographical dispersion of export markets. For each of the six regions, distance from each country where exporting firms are located is estimated by taking weighted average bilateral distance between the exporting country and all countries in the destination region, weighted by GDP of the latter.[22] In both these measurements, the dependent variable of market diversification is censored below at 0.

$$(15) \qquad MD_{ijk} = \begin{cases} \Psi_{ijk} & \text{if} \quad 0 < \Psi_{ijk} \\ 0 & \text{if} \quad \Psi_{ijk} \leq 0 \end{cases} \text{ and}$$

$$(16) \qquad \Psi_{ijk} = \alpha + \beta_1 * DC_{ijk} + \beta_2 * X_{ijk} + \beta_3 * Y_j + \beta_4 * Z_k + \varepsilon_{ijk}$$

The results of these estimations are presented in Table 7. The patterns of influences among the set of regressors are quite similar to those in the case of the export intensity model. There are positive significant effects from size, foreign ownership, capital intensity, new vintage capital, and Internet access. Customs delay negatively affects market diversification.

Interestingly, foreign ownership by Africans appears to have more significant positive effect on market diversification, compared to foreign ownership by non-Africans. For the specification II, foreign African share has a significant positive coefficient, but not foreign non-African share. Considering the presence of the *network effect* associated with foreign ownership, as discussed above, one may naturally think that non-African foreign owners would have stronger networks in markets outside Africa, hence contributing to market diversification. Also, foreign direct investment (FDI) from countries outside Africa may likely provide invested firms with access to more advanced technologies or higher technology effect, allowing these firms to penetrate into more markets. However, the network effect could also constrain the market diversification at the firm level in the sense that the network externality leads to concentration of exports in certain markets. In fact, Table

[22] Distance data are from CEPII (Centre d'Etudes Prospectives et d'Informations Internationales). The author thanks Souleymane Coulibaly for suggesting this measurement.

2 in the previous section shows that firms whose majority shareholders are foreign Africans appear to export more intensively in African markets outside the subregion, and in the markets outside Africa other than Europe and North America, relative to firms whose majority shareholders are foreign non-Africans.[23] There is a tendency among foreign non-African firms to be concentrating in exports to Europe.

5.3 Geographical Orientation: Regional vs. Global Exports

We now consider how firms' characteristics and domestic constraints influence their export intensity differently depending on where they export to. As discussed in Section 4 (Table 5), the firms that export within Africa seem to have distinct differences from those that export outside Africa in both overall export intensity and pattern of market diversification. Firms exporting outside Africa tend to export more intensively than the firms exporting within Africa. Firms appear to export more intensively either within Africa or outside Africa, but not both, creating a seemingly fragmented pattern of market diversification. In this section, we apply the earlier two-limit Tobit model of export intensity to the three different types of destination, namely exports within a subregion, exports within Africa (within subregion plus other African countries), and exports outside Africa. The results are presented in Table 8.

While the firm size and the Internet factors have positive significant impacts for all three types of markets, there are several clear qualitative differences between intra-Africa exports and global exports to markets outside Africa in the way other factors affect export intensity. Both new vintage capital and foreign ownership (for both foreign African and non-African ownership) have positive significant coefficients for the intensity in global exports. These findings are quite intuitive. The new vintage capital matters in promoting exports to the global market, which is supposedly more competitive both in terms of quality and price than the regional African market. Younger capital not only improves production efficiency but also promotes products of higher quality and enables firms to sell their products to developed countries such as the EU or the United States, which sets high product standards for imported products as well as domestically produced products. Foreign ownership would enhance global exports through both *network* and *technology effects*.

On the other hand, both capital vintage and foreign ownership seem to play little role in exports within a subregion or within Africa. Instead, these types of exports are much more affected by behind-the-border domestic constraints. Both customs delay and power outages have negative significant coefficients. As we hypothesized, ownership of generators alleviates the constraint of poor service from the power infrastructure. Although very small, the net impact of electricity service

[23] Another plausible explanation for this is that foreign African firms have better knowledge and access of informal distribution networks across African borders.

disruption is still negative on the firm's export performance. Even when a firm owns a generator, 10 days of power outage in a year would reduce the firm's exports by 0.2 percentage point of its total sales. If the firm does not own a generator, the reduction of its exports from 10 days of power outage a year would be 2.4 percentage points. Neither of these infrastructure factors is found to have a significant effect in the case of global exports, where private attributes of the firms, such as foreign ownership or capital vintage, both of which are related to the technological level of the firms, have more dominant influence over the intensity of exports.

While Internet access has a positive significant coefficient in all three types of destinations, the size of coefficient gets larger as the destination becomes more global than local. Other factors being constant, firms with Internet access on average have 140 percentage points higher proportion of their products sold to the global market compared with firms without access. This differential in the export performance is lower for the case of intra-Africa exports (44 percentage points) and much lower for subregional exports (36 percentage points). The strong effect of the Internet on the export performance in the global market validates the findings of Clarke and Wallsten (2006), which found that Internet access promotes exports from developing countries to developed countries more than exports between developing countries based on industry-level data.

These qualitative differences between intensity of regional export and global export can be observed from the results by estimating a multinomial probit model of market orientation.[24] Here, the model shows how the same set of factors that we have studied so far are related to firms' probability to be in one of the following three exclusive and exhaustive types of market orientation: (A) sell primarily in the domestic market; (B) substantial export mainly within Africa, and (C) substantial export mainly outside Africa. Firms export none or less than 10% of their total sales for type (A). For both types (B) and (C), firms export 10% or more of their total sales, but type (B) firms export more to countries within Africa, while type (C) firms export more to countries outside Africa.

This multinomial probit model certainly does not fully capture the firm-level intensity of exports as do the preceding models. However, by setting the threshold for export intensity at 10% rather than 0%, and comparing intra-Africa regional and extra-Africa global export intensities, some intensiveness aspects are retained. More importantly, the model allows us to analyze the effects of regressor variables in a specific type of market orientation, given the presence of alternative choices, which is not controlled in the above Tobit analysis.

The probit coefficient estimates and their marginal effects are summarized in Table 9, using type (A) as the base outcome. The table shows an almost parallel pattern as in Table 8 implying the robustness of the finding from the Tobit model of export intensity applied for regional and global exports. Size

[24] The two endogenous regressor variables, i.e., customs delay and power outage, are substituted by region-sector averages of respective variables, which are used as instruments in IVTOBIT model.

and Internet access have positive significant coefficients for the probability of firms to be regional exporters (B) and to be global exporters (C). However, foreign ownership and new vintage capital increase the probability of being global exporters, while domestic public infrastructure quality is more relevant for the probability of being regional exporters. Internet access raises probability to be a global exporter (by 7%) more than probability to be a regional exporter (by 5%).

The fact that the two variables of domestic public infrastructure quality do not have significant coefficients in the global export intensity in Table 8 should not be interpreted that domestic infrastructure does not matter in exports to the global markets. One caveat is that there may be some sector-specific patterns which are not captured in the above models. While the above models do include sector dummies to capture sector-specific factors, the domestic constraints may likely have affect sectoral export performance in qualitatively different ways. For example, customs delay matters more for sector producing goods which are time-sensitive in deliver (e.g., perishable products), while power outage matters more for energy-intensive sectors.[25] To see how customs delay and power outage impact export intensity differently across sectors, we incorporate interaction terms between sector dummies and these two domestic constraint variables for the three major exporting sectors, namely chemical, paints, and plastic, food and agro-industry, and textile, garment, and leather sector. These interaction terms are added to the sector dummies and other regressor variables in the destination-specific Tobit model similar to Table 8.

The coefficient estimates of these interaction terms in Table 9 show the interaction terms for exports within Africa are not significant, while the original two variables of domestic constraints continue to have negative significant coefficients. On the other hand, intensity of textile exports to the global markets is in fact sensitive to customs delay. One day delay of customs clearance would decreases textile exports in terms of export intensity by more than 20 percentage points lower than other sectors. One may expect that textile exports are less time sensitivity of relative to other products such as food products which are often perishable. The time-sensitivity of textile exports is likely related to the nature of the competitive global textile and apparel markets, where the supply chains are widely disintegrated spatially with tough competitions from producers of countries in other regions such as China. The buyer-driven networks of global apparel supply chains require shorter turn-around at each stage of supply chains.[26]

[25] See for example, Harrigan and Evans (2005), Djankov, Freund, and Pham (2005), Hausmann, Lee, and Subramanian (2005), for time sensitivity in international trade.
[26] Broadman (2007) discusses implications of buyer-driven networks and producer-driven networks in the context of increasing network trade opportunities for African manufacturers.

6. Conclusions

The theoretical model presented in Section 2 explains the way in which domestic supply constraints and other firm attributes would generate firm-level variations in market diversification and intensity of exports. Heterogeneity among firms in their product efficiency, based on their firm-specific attributes and varying degrees in which domestic supply constraints affect firms' production, leads to the difference in degree of export market diversification among firms. *Ceteris paribus*, more efficient firms export to a larger number of markets because they have positive marginal profit from expanding their export markets, net of sunk entry cost, in these markets. Consequently, export intensity of these firms is higher than that of firms with low production efficiency. Firm-specific attributes could also lower variable and fixed sunk trade costs for some firms, which then leads to variation in market diversification and export intensity.

The bivariate analysis of geographical orientation and market diversification in Section 4, using enterprise survey data from seven low-income African countries, showed a positive correlation between export intensity and market diversification measured as the number of export markets the firms serve. The median labor productivity was also found to be larger for firms exporting to more countries. Thus, in support of the theoretical framework in Section 2, more efficient firms export more intensively as they export to a more diversified set of markets. The pattern of market diversification appears to be rather segmented between exports within Africa and exports outside Africa. Subject to the limitation of analysis based on cross-sectional data, the data show that firms exporting within a subregion are likely to expand their markets to other African countries outside the subregion, but not to global markets such as Europe. On the other hand, among firms exporting to Europe, the likelihood is to expand to other global markets such as North America or Asia. Little overlap is found between intra-Africa regional exporters and exporters to countries outside Africa.

The estimations of Instrumental Variable (IV) Tobit models of firm-level export intensity and market diversification (Section 5) provides evidence of strong scale effects both in export intensity and market diversification. Larger firms export more intensively and export to geographically more diversified sets of markets. The result resembles the findings of other researchers that looked at firm-level export propensity among African manufacturing firms, where they found larger firms are more likely to export. The models also show that technology factors such as new vintage capital and Internet access have strong positive effects both on market diversification and export intensity. While these factors have positive efficiency effects in production, they also lower trade-related sunk entry cost by improving product quality and lowering the search cost for overseas market opportunities. Foreign ownership, which also lowers entry cost based on the firm's overseas networks and better access to foreign technologies, was also found to be positively related.

On the other hand, inefficiency in customs hampers firms' ability to export more goods and to more diversified markets.

The seemingly segmented pattern of market diversification between exports within Africa and outside Africa observed in Section 4 motivated us to see how domestic supply constraints and other firm characteristics affect export intensity differently depending on where exports go. Some qualitative differences were found between these two directions of exports when we applied the above Tobit model of export intensity to destination-specific exports. Foreign ownership, both foreign African-owned and foreign non-African-owned, is a significant factor in characterizing the intensity of global exports but not regional exports. The technology factors, i.e., new vintage capital and Internet access, are significant in explaining intensities of both types of exports, but more so in the case of global exports. On the other hand, public infrastructure constraints such as inferior power services and customs inefficiency seem to have more immediate impacts on the regional export intensity. These qualitative differences were also found from the multinomial probit model of market orientation, where we estimated probabilities of firms realizing the following three outcomes: not exporting; exporting and exporting more within Africa than outside Africa; and exporting and exporting more outside Africa than within Africa.

Overall, the size, foreign ownership, and the technology factors are dominant factors in explaining firm-level export performance in terms of intensity and market diversification, and particularly so for global exports. Domestic constraints in terms of inferior quality of infrastructure seem to affect regional exports relatively more seriously. This does not necessarily imply that domestic supply constraints do not matter for global exports. By taking into account sector-specific interaction with domestic constraints, textile exports to the global markets appear to be quite sensitive to customs delay, underscoring the importance of improving trade facilitation in Africa for competitive participation of its domestic industries in global supply chains. Also, firms participating in global exports have their firm attributes (private goods) such as networks and technologies to overcome domestic constraints created by inferior quality of infrastructure (public goods). Also, on the other hand, firms participating in intra-regional exports are more exposed to domestic constraints.

With recent "aid-for-trade" initiatives under the World Trade Organization Doha Round, there is an increasing interest among policy-makers and development practitioners in addressing "behind-the-border" factors in fostering integration of low-income countries into the global economy. While addressing domestic supply constraints should certainly continue to be an integral part of such an initiative, more immediate impacts of alleviating such constraints could be felt, in general, among intra-Africa manufacturing trade, in which the majority of domestic exporters participate. Removing such constraints to enhance domestic export competitiveness is relevant not only for integrating African firms into the global economy, but also harnessing private-sector-led

regional integration of business activities within African neighboring countries and realizing economies of scale from more integrated regional markets. The importance of customs efficiency for regional integration is quite straightforward if we consider the case of landlocked economies where the efficient access to their neighboring coastal countries is crucial. Improved domestic infrastructure such as power service quality enables firms to improve their productivity and trade across the border.

Of course, this should not be interpreted as saying that the domestic business environment is only a secondary issue for promoting African exports to global markets. Select manufacturing sectors such as textile and garment do require efficient trade logistics for African producers to effectively and competitively participate global supply chains. If foreign ownership continues to be a strong vehicle for global exports for African manufacturing sectors, as our econometric results suggest, attracting foreign direct investment (FDI), including investment from other African countries, should continue to be an important economic development strategy for low-income African countries. Many studies show that a favorable business environment, including better infrastructure service quality, is one of the key factors in locational choices for foreign investors in developing countries.[27] Although not controlled for in our econometric analyses, manufacturing exports to global markets are substantially affected by external conditions imposed by trade partners, including market access conditions. Comparing Africa's apparel exports to those of the EU and United States, Collier and Venables (2007) showed a significant AGOA effect behind the recent growth of apparel exports to the United States vis-à-vis European markets, which was related to the less restrictive rule of origin under the AGOA special rule for apparel products compared to the EU's EBA. Pooling together effective incentives for attracting FDI and for promoting exports, both from domestic behind-the-border reforms, trade facilitation, and external trade policies, seems to be the key in enhancing global exports of African manufacturers.

[27] For example, Multilateral Investment Guarantee Agency (2002) and Dollar, Hallward-Driemeier, and Mengistae (2004), and for Africa, Morisset (2000) for example.

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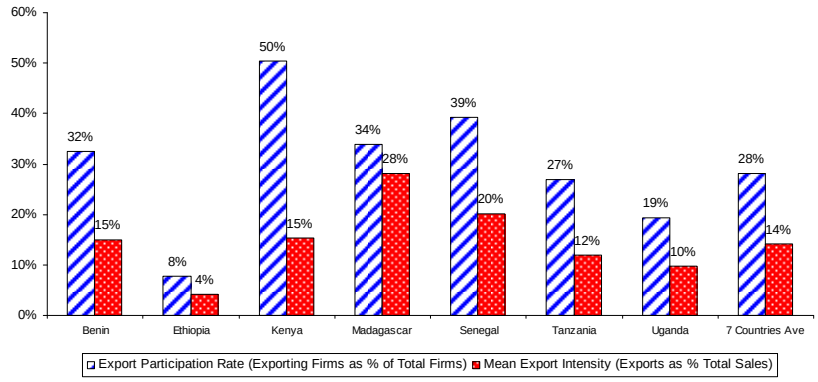
Appendix: Tables and Figures

Table 1: Africa Export Matrix: 2005

Product	Indicators	Destination					
		Africa	Western Europe	North America	Asia	Other	World
Agricultural Products	Volume in 2005 (US$ Billion)	5.5	15.3	2.0	5.0	2.3	32.3
	Share in Destination Total (%)	20.9	11.9	3.4	10.2	16.4	10.9
	Share in Product Total (%)	17.1	47.2	6.3	15.4	7.2	100.0
	Ave. Annual Growth Rate: 2001-05 (%)	*15.3*	*8.4*	*18.2*	*3.4*	*2.5*	*9.8*
Manufactures	Volume in 2005 (US$ Billion)	11.4	34.5	5.1	7.7	3.0	63.0
	Share in Destination Total (%)	43.0	27.0	8.4	15.8	21.1	21.2
	Share in Product Total (%)	18.1	54.7	8.1	12.2	4.8	100.0
	Ave. Annual Growth Rate: 2001-05 (%)	*19.9*	*10.4*	*7.2*	*18.5*	*10.7*	*12.6*
Mining Products	Volume in 2005 (US$ Billion)	9.4	74.2	52.9	33.4	8.8	194.2
	Share in Destination Total (%)	35.5	58.1	87.8	68.7	61.8	65.2
	Share in Product Total (%)	4.8	38.2	27.2	17.2	4.5	100.0
	Ave. Annual Growth Rate: 2001-05 (%)	*25.2*	*14.6*	*22.5*	*22.0*	*12.5*	*20.2*
Total Exports	Volume in 2005 (US$ Billion)	26.5	127.8	60.2	48.6	14.3	297.7
	Share in Destination Total (%)	100.0	100.0	100.0	100.0	100.0	100.0
	Share in Product Total (%)	8.9	42.9	20.2	16.3	4.8	100.0
	Ave. Annual Growth Rate: 2001-05 (%)	*20.5*	*12.1*	*20.5*	*18.0*	*10.2*	*16.7*

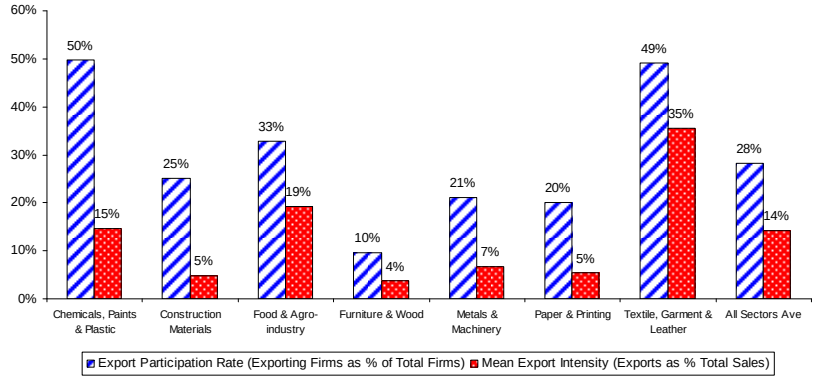
Source: WTO International Trade Statistics

Figure 1: Export Participation Rate and Mean Export Intensity, by Country



Source: World Bank Investment Climate Surveys.

Figure 2: Export Participation Rate and Mean Export Intensity, by Sector

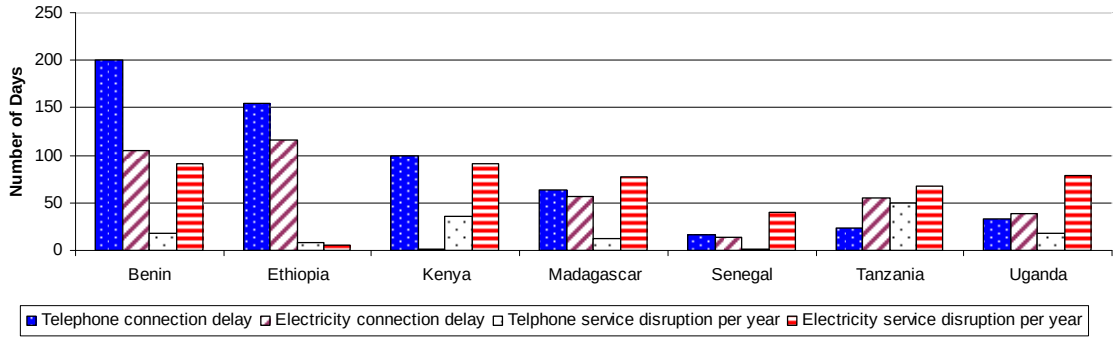


Source: World Bank Investment Climate Surveys.

Figure 3: Average Number of Days to Clear Ports and Customs

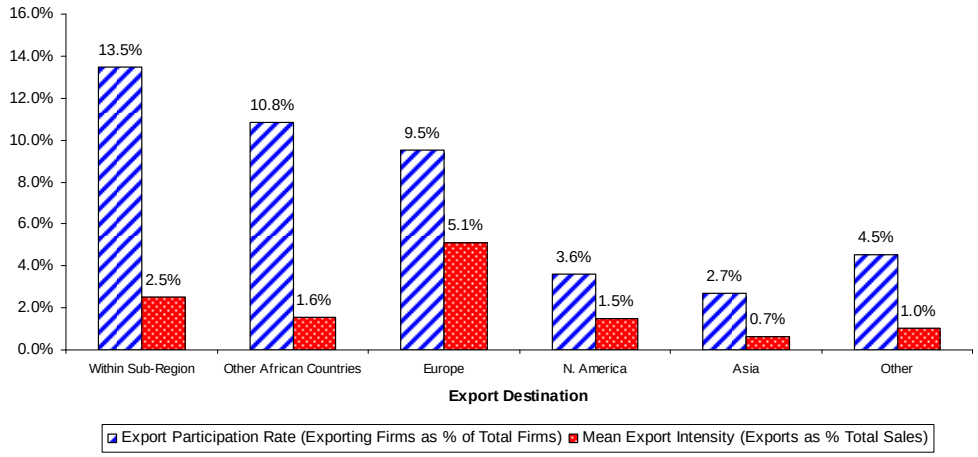
Source: World Bank Investment Climate Surveys.

Figure 4: Average Qulatiy of Infrastructure Service Quality



Source: World Bank Investment Climate Surveys.

Figure 5: Destination-Specific Export Participation Rate and Average Export Intensity



Source: World Bank Investment Climate Surveys.

Table 2: Average Destination-Specific Export Intensity, by Country, Sector, Nationality, and Size

	Export Destination					
Country:	Sub-Region	Other Africa	Europe	N. America	Asia	Other
Benin	4.8%	1.0%	3.4%	0.2%	0.3%	0.8%
Ethiopia	0.2%	0.0%	2.1%	0.1%	0.8%	0.2%
Kenya	**5.6%**	2.7%	2.3%	1.0%	0.7%	1.8%
Madagascar	1.3%	0.7%	**14.6%**	**7.6%**	0.2%	0.7%
Senegal	**5.2%**	4.8%	**6.4%**	0.5%	1.1%	1.7%
Tanzania	1.8%	1.3%	4.4%	0.7%	1.0%	1.6%
Uganda	1.3%	1.2%	3.5%	0.2%	0.4%	0.8%
Sector:	Sub-Region	Other Africa	Europe	N. America	Asia	Other
Chemicals, Paints & Plastic	**5.9%**	3.7%	1.4%	0.3%	0.7%	1.5%
Construction Materials	3.2%	1.3%	0.0%	0.0%	0.1%	0.0%
Food. Agro-industry	3.6%	1.7%	**7.6%**	0.6%	1.1%	1.9%
Furniture & Wood	0.8%	0.5%	1.7%	0.1%	0.1%	0.1%
Metals & Machinery	1.4%	2.7%	1.1%	0.0%	0.0%	0.4%
Paper & Printing	2.0%	1.5%	0.2%	0.0%	0.0%	0.3%
Textile, Garment & Leather	2.5%	1.5%	**16.0%**	**8.7%**	1.8%	1.8%
Nationality:	Sub-Region	Other Africa	Europe	N. America	Asia	Other
Domestic	2.4%	1.3%	3.1%	0.6%	0.5%	0.6%
Foreign (African)	3.4%	2.9%	**9.6%**	2.0%	1.8%	4.2%
Foreign (Non-African)	3.6%	2.7%	**19.4%**	**8.4%**	1.3%	2.5%
Size:	Sub-Region	Other Africa	Europe	N. America	Asia	Other
Micro	0.7%	0.4%	1.1%	0.1%	0.0%	0.3%
Small	1.5%	1.0%	2.3%	0.3%	0.2%	0.5%
Medium	4.8%	2.7%	**7.4%**	0.3%	1.2%	0.8%
Large	**5.3%**	3.4%	**13.7%**	**5.7%**	1.9%	2.9%

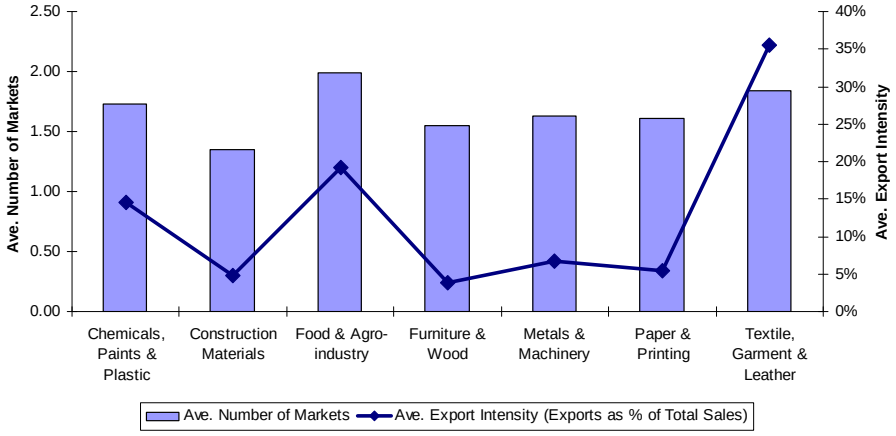
Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: Figures more 5% and more are bolded. Nationality: Domestic if domestic owns more than 50% of the shares; Foreign-African if foreign owns 50% or more and Foreign African shares > Foreign Non-African shares; and Foreign-Non-African if foreign owns 50% or more and Foreign Non-African shares >= Foreign Non-African shares than Size: Micro if total workers <10; Small if total workers <50 & >=10; Medium if total workers <100 & >=50; and Large if total workers >=100.

Table 3: Average Number of Export Destinations, by Country, Sector, and Direction

Country	Mean No. of Markets	Sector	Mean No. of Markets	Firms participating in exports to(*):	Mean No. of Markets
Benin	1.68	Chemicals, Paints & Plastic	1.73	Within Sub-Region	1.97
Ethiopia	1.81	Construction Materials	1.35	Other Africa	2.12
Kenya	1.95	Food & Agro-industry	1.99	Europe	2.20
Madagascar	1.61	Furniture & Wood	1.55	North America	2.59
Senegal	1.94	Metals & Machinery	1.63	Asia	3.13
Tanzania	1.82	Paper & Printing	1.61	Other	2.92
Uganda	1.50	Textile, Garment & Leather	1.84		
All	**1.80**				

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: (*) Firm groups are not mutually exclusive.

Figure 6: Average Number of Export Markets and Average Export Intensity by Sector



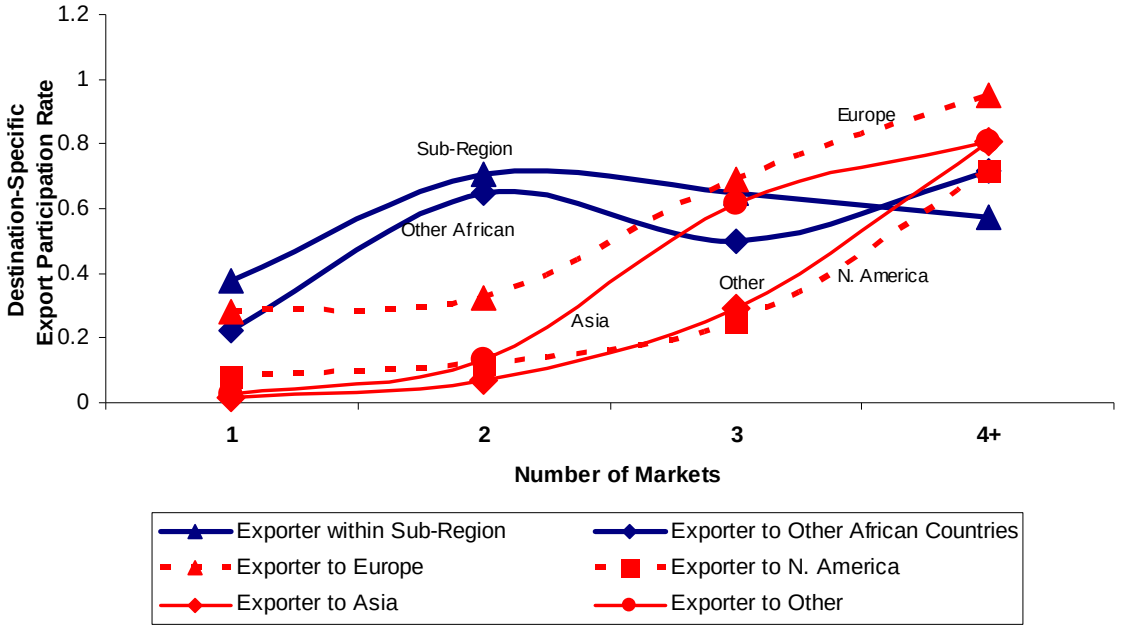
Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.

Table 4: Firm Characteristics by Number of Export Markets

	Number of Export Markets				
	0	**1**	**2**	**3**	**4 and more**
Mean Export Intensity (% Exports in Total Sales)	0.0	44.9	46.1	68.5	74.9
Mean Export Intensity: Exports within Africa (% Exports within Africa in Total Sales)	0.0	13.5	20.9	17.9	7.6
Mean Export Intensity Exports outside of Africa (% Exports to Non-African Countries in Total Sales)	0.0	31.4	25.0	50.4	66.7
Median Labor Productivity (Value Added per Worker in PPP US$)	6,543	15,248	22,063	22,778	24,561
Mean Size (No. of Production Workers)	80.8	240.7	267.5	421.4	542.8
Mean Foreign Share (% of Foreign Share)	9.4	34.8	31.2	34.9	28.5
Mean Age (Year)	40.4	34.4	45.9	51.1	20.6
Mean Capital Labor Ratio (Value of machinery & equipment / no. of production worker)	9.1	9.5	10.0	9.6	10.0
Mean Skill Ratio (% of Skilled Labor in Total Labor)	29.8	24.5	22.7	25.3	19.4
Manager's Education Level (% of Firms with University-Educated Managers)	42.5	63.0	71.3	75.4	76.5
Mean New Vintage Capital (% value of machinery & equipment 10 yrs or younger)	61.1	67.7	59.5	61.4	65.0
Generator Ownership (% of Firms Owning Self-Generators)	30.2	63.6	66.1	77.9	81.0
Internet Access (% of Firms with Internet Access)	37.4	85.8	87.2	92.6	76.2

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: (*) Firm groups are not mutually exclusive.

Figure 7: Destination-Specific Export Participation Rate by Number of Export Markets



Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.

Table 5: Average Destination-Specific Export Intensity, by Exporter Group

	Export Intensity (% of total sales) of Exports to:						
Firms participating in export to:	**Any Country**	**Sub-Region**	**Other Africa**	**Europe**	**North America**	**Asia**	**Other**
Any Country	51%	10%	6%	20%	6%	3%	4%
Sub-Region	36%	**19%**	7%	5%	1%	1%	2%
Other Africa	35%	**11%**	**14%**	4%	1%	2%	3%
Europe	78%	4%	2%	**54%**	7%	5%	7%
N. America	82%	4%	1%	**25%**	**41%**	2%	9%
Asia	83%	2%	1%	**34%**	5%	**25%**	**14%**
Other	66%	8%	2%	**24%**	3%	6%	**23%**

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: The figures are destination-specific export intensity among firms participating in export to specific markets. More than 10% are bolded.

Table 6: Instrumental Variable Tobit Model: Export Intensity

Dependent Variable: Export Intensity: All Markets	I	II	III
Total Worker (size factor 1) (ln total permanent workers)	0.296 *** (0.074)		0.306 *** (0.077)
Total Sales Volume (size factor 2) (ln total sales volume, US$ PPP exchange rate)		0.220 *** (0.057)	
Age (ln year since establishment)	-0.035 (0.055)	0.000 (0.060)	-0.021 (0.056)
Foreign Share (% share owed by foreigners)	0.007 *** (0.002)	0.006 *** (0.002)	
Foreign African Share (% share owed by foreigners in other African countries)			0.011 ** (0.004)
Foreign Non-African Share (% share owed by foreigners in Non-African countries)			0.005 *** (0.002)
Capital Intensity (Ratio of total capital stock to total labor)	0.082 * (0.045)	-0.001 (0.047)	0.079 * (0.045)
Skill Ratio (Ratio of skilled worker to unskilled worker)	-0.147 (0.261)	0.081 (0.284)	-0.168 (0.264)
Manager's Education (1 if manager has university-level education, 0 otherwise)	-0.024 (0.153)	0.010 (0.164)	-0.018 (0.153)
New Vintage Capital (% of machinery 10 years old or less in total capital stock)	0.004 ** (0.001)	0.004 ** (0.002)	0.004 ** (0.001)
Internet Access (1 if firm has Internet access, 0 otherwise)	0.790 *** (0.205)	0.771 *** (0.213)	0.782 *** (0.204)
Customs Delay (Ave. number of days for export customs clearance)	-0.235 * (0.142)	-0.245 * (0.149)	-0.242 * (0.144)
Power Outage (Ave. number of days with public grid power outage)	-0.001 (0.002)	-0.000 (0.002)	-0.001 (0.002)
Power Outage x Generator Ownership (Generator: 1 if firm owes a self-generator, 0 otherwise)	0.002 (0.001)	0.001 (0.001)	0.001 (0.001)
No. of Observation	662	558	659

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: Standard errors are in parentheses. *** =significant at 1%, ** =significant at 5%, and * =significant at 10%.
Customs Delay and Power Outage are instrumented by sector-regional averages.

Table 7: Instrumental Variable Tobit Model: Market Diversification

	I	II	III
Dependent Variable	**No. of Markets**	**No. of Markets**	**Geographical Dispersion**
Total Worker (ln total permanent workers)	0.707 *** (0.176)	0.731 *** (0.182)	5.498*** (1.355)
Age (ln year since establishment)	-0.011 (0.132)	0.025 (0.135)	0.719 (1.008)
Foreign Share (% share owed by foreigners)	0.011 ** (0.005)		
Foreign African Share (% share owed by foreigners in other African countries)		0.025 ** (0.011)	0.213** (0.085)
Foreign Non-African Share (% share owed by foreigners in Non-African countries)		0.008 (0.004)	0.063* (0.036)
Capital Intensity (Ratio of total capital stock to total labor)	0.245 ** (0.110)	0.237 ** (0.110)	1.413* (0.834)
Skill Ratio (Ratio of skilled worker to unskilled worker)	-0.313 (0.631)	-0.371 (0.639)	-5.846 (4.838)
Manager's Education (1 if manager has university-level education, 0 otherwise)	-0.094 (0.369)	-0.082 (0.370)	1.434 (2.785)
New Vintage Capital (% of machinery 10 years old or less in total capital stock)	0.008 * (0.004)	0.008 * (0.004)	0.08** (0.036)
Internet Access (1 if firm has Internet access, 0 otherwise)	1.874 *** (0.496)	1.852 *** (0.496)	14.468*** (3.892)
Customs Delay (Ave. number of days for export customs clearance)	-0.644 * (0.334)	-0.664 * (0.341)	-4.196 (2.711)
Power Outage (Ave. number of days with public grid power outage)	-0.006 (0.005)	-0.006 (0.005)	-0.023 (0.043)
Power Outage x Generator Ownership (Generator: 1 if firm owes a self-generator, 0 otherwise)	0.006 (0.004)	0.005 (0.004)	0.024 (0.034)
No. of Observation	660	657	657

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: Standard errors are in parentheses. *** =significant at 1%, ** =significant at 5%, and * =significant at 10%.
Customs Delay and Power Outage are instrumented by sector-regional averages.

Table 8: Instrumental Variable Tobit Model: Export Intensity for Regional and Global Exports

	I	II	III
Dependent Variable	**Export Intensity: Sub-Region**	**Export Intensity: All Africa**	**Export Intensity: Outside of Africa**
Total Worker (ln total permanent workers)	0.129 *** (0.042)	0.176 *** (0.051)	0.370 *** (0.133)
Age (ln year since establishment)	-0.001 (0.032)	-0.024 (0.039)	0.016 (0.094)
Foreign African Share (% share owed by foreigners in other African countries)	0.003 (0.002)	0.003 (0.003)	0.018 ** (0.008)
Foreign Non-African Share (% share owed by foreigners in Non-African countries)	0.000 (0.001)	0.001 (0.001)	0.008 ** (0.003)
Capital Intensity (Ratio of total capital stock to total labor)	0.052 ** (0.025)	0.058 * (0.030)	0.105 (0.078)
Skill Ratio (Ratio of skilled worker to unskilled worker)	-0.004 (0.146)	-0.030 (0.176)	-0.476 (0.464)
Manager's Education (1 if manager has university-level education, 0 otherwise)	0.004 (0.086)	0.015 (0.101)	-0.238 (0.266)
New Vintage Capital (% of machinery 10 years old or less in total capital stock)	0.000 (0.001)	0.001 (0.001)	0.009 ** (0.003)
Internet Access (1 if firm has Internet access, 0 otherwise)	0.364 *** (0.117)	0.441 *** (0.133)	1.400 *** (0.416)
Customs Delay (Ave. number of days for export customs clearance)	-0.151 * (0.077)	-0.165 * (0.090)	-0.306 (0.291)
Power Outage (Ave. number of days with public grid power outage)	-0.002 * (0.001)	-0.002 * (0.001)	-0.001 (0.003)
Power Outage x Generator Ownership (Generator: 1 if firm owes a self-generator, 0 otherwise)	0.002 ** (0.001)	0.002 * (0.001)	0.000 (0.003)
No. of Observation	657	659	659

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: Standard errors are in parentheses. *** =significant at 1%, ** =significant at 5%, and * =significant at 10%
Customs Delay and Power Outage are instrumented by sector-regional averages.

Table 9: Multinomial Probit Model: Market Orientations

	Regional Exporter Export more within Africa		Global Exporter: Export more to outside of Africa	
Base Group: No Export or Export less than 10% of total sales	**Coefficient**	**Marginal Effect**	**Coefficient**	**Marginal Effect**
Total Worker (ln total permanent workers)	0.541 *** (0.106)	0.039	0.403 *** (0.104)	0.022
Age (ln year since establishment)	0.020 (0.110)	0.001	0.056 (0.105)	0.004
Foreign African Share (% share owed by foreigners in other African countries)	0.008 (0.006)	0.001	0.017 *** (0.005)	0.001
Foreign Non-African Share (% share owed by foreigners in Non-African countries)	0.001 (0.003)	0.000	0.009 *** (0.003)	0.001
Capital Intensity (Ratio of total capital stock to total labor)	0.134 * (0.071)	0.010	0.069 (0.072)	0.003
Skilled Labor Ratio (Ratio of skilled worker to unskilled worker)	0.099 (0.481)	0.009	-0.150 (0.513)	-0.011
Manager's Education (1 if manager has university-level education, 0 otherwise)	0.280 (0.277)	0.024	-0.179 (0.294)	-0.014
New Vintage Capital (% of machinery 10 years old or less in total capital stock)	0.006 ** (0.003)	0.000	0.009 *** (0.003)	0.001
Internet Access (1 if firm has Internet access, 0 otherwise)	0.856 *** (0.334)	0.052	1.345 *** (0.355)	0.077
Customs Delay (Ave. number of days for export customs clearance)	-0.105 ** (0.043)	-0.008	-0.060 (0.049)	-0.003
Power Outage (Ave. number of days with public grid power outage)	-0.010 ** (0.004)	-0.001	-0.001 (0.004)	0.000
Power Outage x Generator Ownership (Generator: 1 if firm owes a self-generator, 0 otherwise)	0.005 (0.003)	0.000	0.002 (0.003)	0.000
No. of Observation: 644				

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: Standard errors are in parentheses. *** =significant at 1%, ** =significant at 5%, and * =significant at 10%.
The sector-regional averages are used for Customs Delay and Power Outage.

Table 10: Tobit Model: Export Intensity for Regional and Global Exports with Interaction Terms

	I	II
Dependent Variable	**Export Intensity: All Africa**	**Export Intensity: Outside of Africa**
Total Worker (ln total permanent workers)	0.091 *** (0.017)	0.205 *** (0.061)
Age (ln year since establishment)	0.010 (0.017)	0.046 (0.057)
Foreign Share (% share owed by foreigners)	-0.000 (0.000)	0.006 *** (0.001)
Capital Intensity (Ratio of total capital stock to total labor)	0.021 * (0.011)	0.007 (0.041)
Skill Ratio (Ratio of skilled worker to unskilled worker)	-0.060 (0.078)	-0.312 (0.300)
Manager's Education (1 if manager has university-level education, 0 otherwise)	0.050 (0.045)	0.097 (0.169)
New Vintage Capital (% of machinery 10 years old or less in total capital stock)	0.000 (0.000)	0.006 *** (0.002)
Internet Access (1 if firm has Internet access, 0 otherwise)	0.145 *** (0.051)	0.626 *** (0.200)
Customs Delay (Ave. number of days for export customs clearance)	-0.014 ** (0.007)	-0.041 (0.036)
Power Outage (Ave. number of days with public grid power outage)	-0.002 *** (0.001)	0.003 (0.004)
Power Outage x Generator Ownership (Generator: 1 if firm owes a self-generator, 0 otherwise)	0.000 * (0.000)	0.001 (0.002)
Textile x Customs Delay	0.010 (0.025)	-0.191 ** (0.084)
Food x Customs Delay	0.008 (0.018)	0.088 (0.069)
Chemical x Customs Delay	0.008 (0.024)	0.191 (0.137)
Textile x Power Outage	0.000 (0.001)	0.004 (0.007)
Food x Power Outage	0.002 (0.001)	-0.008 * (0.005)
Chemical x Power Outage	0.001 (0.001)	-0.001 (0.007)
No. of Observation	825	825
Pseudo R^2	0.2743	0.3079

Source: Author's computation based on World Bank Investment Climate Surveys in 7 SSA countries.
Note: Standard errors are in parentheses. *** =significant at 1%, ** =significant at 5%, and * =significant at 10%.
The sector-regional averages are used for Customs Delay and Power Outage.