CONSORTIUM POUR LA RECHERCHE ÉCONOMIQUE ET SOCIALE

Université Cheikh Anta Diop de Dakar
FACULTÉ DES SCIENCES ÉCONOMIQUES ET DE GESTION
Laboratoire d'Analyse des Politiques Publiques (LAPP)

SÉRIE DE DOCUMENTS DE RECHERCHE

Do firms learn by exporting or learn to export: evidence from Senegalese manufacturers' plants

Cisse Fatou and Ji Eun Choi

Consortium pour la Recherche Economique et Sociale
Rue 10 Prolongée Cité Iba Ndiaye Djadji
Lot 1 et 2 - Pyrotechnique - Dakar, Sénégal
CP : 12023 - BP : 7988, Dakar Médina
Tél : (221) 33 864 77 57 - (221) 33 864 73 98 - Fax : (221) 33 864 77 58
Email : cres_ucad@yahoo.fr / cres@cres-sn.org
Information : contact@cres-sn.org / Site Web : www.cres-sn.org

2013 / 52

Do firms learn by exporting or learn to export: evidence from Senegalese manufacturers' plants

Cisse Fatou[1]and Ji Eun Choi[2]

[1]Cisse Fatou (Corresponding author), Consortium pour la Recherche Economique et Sociale (CRES) and Universite Cheickh Anta Diop de Dakar (UCAD), Senegal, contact : fcisse@cres-sn.org

[2]JiEun Choi,African Development Bank, contact : j.choi@afdb.org

Abstract

The increasing number of literatures investigating on the impact of trade openness on firm efficiency has not yet provided a definite prediction on the direction of causality (Rodrik, 1988, 1992, and Tybout 1992). We investigate the relation between exporting and productivity on the Senegalese manufacturing sectors. Using a unique firm-level panel data for the period 1998-2011, we estimate productivity and exporting dynamics, controlling for other unobserved effects, using simultaneous functions based on Bigsten and al. (2002). Our results indicate the evidences of both self-selection of the most efficient firms enter into the export market and effect of Learning in the export market. Our findings suggest that workers' qualification and access to Patents and Licences have a positive effect on the process of learning. Also, small firms particularly learn more from exporting. From a policy perspective, this evidence of learning-by-exporting suggests that Senegal has much to gain from promoting its manufacturing sector towards exporting by supporting domestic firms to overcome the barriers to enter into foreign market, particularly by investing on skilled workers and promote access to Patents and Licences as well as disseminating benefits arising from exporting to non exporters.

Keywords: Exporting, Total Factor Productivity, Learning by exporting, General Methods of Moment

JEL : F14 –D24-L25- C33

1. Introduction

International trade benefits the trade parties through exposing countries to the knowledge stocks of their trading partners (Grossman and Helpman 1991). This 'learning by exporting effect may be important at both the country level and at the individual exporting firm level (Jim Love and al., 2010). However, detecting learning by exporting effects at the firm level is by not straightforward. Firm performance is heterogeneous even with in narrowly defined sectors (Bartelsman and Doms, 2000; Goddard et al., 2006). In addition, firms learn from many external as well as internal sources and thus it is not always easy to separate out the learning by exporting effect.

Despite the numerous empirical case studies supporting the association between exporting activities and efficiency (Albornoz and Ercolani, 2007; Crespi et al.. 2006), there is still little systematic evidence that efficiency firms may self-select into the export market or exporting causes efficiency gains. In the self-selection (SS) mechanism, only the more productive firms can afford the higher cost of exporting. This implies that future exporters have significantly higher productivity than non-exporters before they start exporting (Clerides et al. 1998; Melitz 2003). In the *Learning by exporting* (LBE) mechanism, firms improve their productivity after entering a foreign market (Clerides *et al.*, 1998). Therefore, exporting results in productivity gains because, exporters are exposed to knowledge flows from international buyers and competitors and to more intense competition in international markets. This lead to larger opportunities and incentives to improve productivity than firms that sell only on the domestic market experience.

There is a large literature in developing countries that examines the relationship between productivity and exporting, but the overall evidence is inconclusive. For example, Clerides et al. (1998) find that efficient firms self-select to become exporters but do not experience any efficiency gains as a result of being exporters in Columbia, Mexico and Morocco. In opposite, Bigsten et al. (2004) find in four African countries, significant efficiency gains from exporting that they interpret as learning-by-exporting effects. Similarly, Bigsten and Gebeeyesus (2008) find productivity improvements for exporting firms in Ethiopia post-participation in foreign markets.

Senegal, like as many developing countries, abandoned its inward-looking protectionist development strategies during the 1980s, for more opened trade programs as a reaction to the failure of previous import-substitution industrialization policies. However, there is yet no evidence of the effect of trade openness on the firm efficiency. Does export experience improve firm's efficiency? Are the most efficient firms most likely to become exporters? In this paper, we investigate on these questions by looking the causal links between exporting and productivity, using a unique firm-level panel data from Senegalese manufacturing sectors for the period 1998-2011.

Numerous methodological issues arise when testing the effect of exporting on productivity. One of the most common problems is the endogeneity and the sample-selection bias. The nature of the bias suggests that exporting firms might possess some unobservable characteristics that make them more productive than their domestic counterparts, thus allowing them to overcome sunk cost to enter into the export markets. Hence, estimating the learning-by-exporting effect using conventional econometric methods would lead to biased and spurious results. Our approach, which is similar to that of Bigsten and *al*, (2002),

involves simultaneous estimation of a dynamic output function and a dynamic discrete choice model for the decision to export, where we allow for causality running both from efficiency to exporting and from exporting to efficiency. This strategy enables us to control for unobserved heterogeneity in the form of firm specific effects that are correlated across the two equations. However, while Bigsten and al., (2004) use the output as outcome variable of interest to measure the firms's performance, we compute the total factor productivity (TFP) from the production function and then use it as the outcome variable in the econometric test for learning effects.

Our preliminary results indicate the evidences of both ways: the more efficient firms became exporters (self-selection) and firm's productivity increases by exporting (learning-by-exporting). Results are consistent to the inclusion of several firm characteristics such as firm firm age, firm size, skilled labour, labor productivity, ownership type, intangibles assets, and industry classification. Our finding suggest that larger firms and those with more qualified workers are generally much more likely to export. Another interesting finding is that firms which invest to access to intangibles assets as *Patents and Licences* have higher gains of efficiency in exporting. Finally small firms seem to particularly learn more from exporting.

From a policy perspective, the learning-by-exporting finding suggests that Senegal has much to gain from promoting its manufacturing sector towards exporting. One way is to increase the ability of domestic firms to overcome foreign market barriers as well as disseminating further benefits arising from exporting to non-exporters.

The rest of the paper is organized as follows. Section 2 is devoted to the background of the Senegalese industrial policies. Section 3 summarizes the related literature, while Section 4 presents our empirical framework and the econometric methods to test the relationship between the firm-level efficiency and export experience. Section 5 provides an overview of the data and presents some relevant descriptive statistics. In Section 6, we discuss the main results from our analysis. Finally, Section 7 concludes and discusses the policy implications.

2. Background: trade policy reforms and manufacturing performances in Senegal

The Senegalese industrial policy has first of all been marked by a strong desire of the state to counter divestment pressures associated with the shrinking domestic market following accession to national sovereignty. In fact, ex-French colonies were engage in processes to industrialize their economy. Typical import substitution industrialization policy instruments (tariff and non-tariff barriers) were established, along with complementary measures (creation of free trade zones and investment codes) to step in for the nascent private sector.

Starting in the mid-1980s, the arrival of structural adjustment programs led to economic liberalization processes, which resulted in the closure of many firms which faced competitiveness pressures in a context of an overvalued FCFA. The liberalization process was stalled by 1989 and did not pick up significantly until 1994, following a 50% devaluation of the FCFA foreign exchange rate. However, this massive devaluation occurred after a long period of currency overvaluation and thus cannot be explicitly interpreted as part of a program to implement an export promotion policy.

The second half of the 1990s saw the establishment of a new economic and monetary union with the goal of accelerating convergence and integration of West African countries with the FCFA in common, and which worked towards rationalization of the tariff barrier and elimination of non-tariff barriers. Greater awareness of the social dimensions of adjustment developed through the 1990s, leading to a second generation of reforms based on the development of human capital and infrastructure.

The January 2005 introduction of work on the Accelerated Growth Strategy (AGS) would ultimately integrate industrial policy through a cross-cutting state intervention initiative to promote private sector development. This implies the establishment of a business environment with international standards.

In summary, Senegal conducted import substitution policy over 1960-1986, largely by default, followed by a policy of support for the private sector based on liberalization of the economy.

2.1. The evolution of the Senegalese industry

After the independence, the West African countries began with import substitution policies which protected domestic industrial sectors. Senegal primarily used these policy instruments during the 1960s to preserve the industrial base inherited from the colonial period

From import substitution to economic liberalization

Over 1961-1969, during the first two economic and social development plans, import substitution industrialization was prioritized. Tariff and non-tariff barriers protected large enterprises which were created by mobilizing large amounts of (often public) capital. By 1970, an alternative policy emphasized the development of small and medium business through the creation of the National Company for Industrial Research and Development (SONEPI) in 1969, followed by the Dakar Industrial Free Trade Zone (ZFID) in 1974.

Adjustment policies and liberalization of the economy

The 1970s world economic crisis arrived in Senegal with the 1980-81 collapse of macro-financial stability, exacerbated by the return of the drought cycle. Faced with a growing deficit of resources, the state appealed to Bretton Woods institutions at the cost of more orthodox policy based on fiscal consolidation and the use of market forces to govern access to resources and their use. The adjustment policies were based on four pillars: (i) management of aggregate demand with the dual goal of controlling inflation and reducing the balance of payments deficit; (ii) restoration of market forces in determining allocations and prices of resources, (iii) opening of the economy to the outside; and (iv) withdrawal of the state and consolidation of public finances.

In 1979, the year of the first stabilization program, the state was to simplify and reduce import tariffs and taxes, while export taxes were eliminated except on peanuts and phosphates. By 1984, after progress to stabilize the economy was deemed satisfactory, a New Agricultural Policy (NPA) was launched to organize the withdrawal of the state from the agricultural sector. By 1986, it was the transformation sector's turn, with a New Industrial Policy (NPI) aiming to dismantle tariff barriers. Another major decision was taken in 1986 to abandon administrative pricing (used to address undervaluation of declared imports) to calculate tariffs on imports.

The NPI action plan was comprised of four axes: revised protections for domestic industrial sectors, export promotion, revival of investments and improvement of the environment for industrial activities. According to the first, the tariff code was revised, with rates cut from 65% to 30-40% over two years and by reducing the number and range of applicable rates. The resulting reduction in the anti-export bias was supplemented by introducing an export subsidy which totalled 10% of the FOB value of exports over 1980-1983. This rose to 15% of the FOB value over 1984-1986 and 25% of value added in export activities after 1986. Peanut products and phosphate exports, which did not benefit from the subsidy, saw tax levies eliminated in 1980. Reform of the export subsidy system was supplemented by establishing an integrated credit insurance and financing system for the export of manufactured goods.

According to the third and fourth axes of the NPI action plan, the investment code was also revised, an industrial restructuring fund was created, and assistance and advice provided to investors was expanded. To improve the business environment in the industrial sector, measures aimed to liberalize prices and marketing channels, reduce production factor prices and simplify administrative formalities. However, these measures were adopted in a context of persistent domestic currency appreciation and declining competitiveness of Senegalese firms. In 1989, being pressured by firms and faced with declining tax receipts, the state had to postpone implementation of the second phase of the NPI, referred to as the recovery phase, committed to in 1988. The 1989 reform plan could not be implemented until 1994, as part of the overall adjustment initiated by devaluation of the CFA franc.

The NPI remains a painful failure in the history of economic reform in Senegal, with the closure of under- or uncompetitive firms causing significant job losses (7% of permanent staff between mid-1987 and mid-1988).

Implementation of a Common External Tariff (CET)

The period preceding the 1994 devaluation saw a rich debate on the future of the WAMU. The perspective which prevailed was preservation of the Union, and ultimately provided the inspiration to transform it into an economic union with the goal of accelerating integration and convergence among economies in the CFA franc zone. This having been done, the goal of not creating a WAEMU “fortress” was upheld and the union proceeded with tariff reductions and established a common external tariff (CET). The 50% reduction in the FCFA exchange rate had already made possible the substantial 1994 reduction in tariff rates and simplification of import taxes which remained up to the initiative of each state.

Two exceptional taxes, which were temporary and degressive, are the degressive protection tax (TDP) and a special import tax (TCI) were introduced to compensate for major declines in tariff protections associated with the CET (in the case of the TDP) or with erratic variations in world prices (in the case of the TCI).

Implementation of the CET is considered as a productivity shock comparable to the NIP except that it came in the wake of the major productivity gains associated with devaluation of the CFA franc. Over 1995-2005, industrial activities grew by an annual average of 3.8% (Rapport du FMI n° 12/337, Novembre2012).

Deepening economic liberalization and other measures to promote the private sector

In the first two post-independence decades, price administration, the predominance of public and mixed enterprises and the prevalence of a restrictive regulatory environment all severely hindered the development of private enterprise with the exception of a certain number of privileged entrepreneurs in terms of regulations and other advantages. Given the benefits from devaluation, special conventions and protocols were renegotiated, in that many benefits were eliminated or reduced. Similarly, price control regimes were made more flexible and the privatization program initiated during the 1980s was extended to sectors previously considered as strategic, such as infrastructure services and the financial sector with the disappearance of the first public banks and the 25% limit on the state's share of bank capital (Programme d'ajustement du secteur financier, 1989-1991, Ministère de l'Economie et des Finances, 1988).Concerning the labour market, the reforms carried out over 1994-1997 allowed firms to resort to economic layoffs and also reduced restrictions on fixed term labour contracts. The dynamics of reform and consultation with employer organizations which accelerated following devaluation of the FCFA in 1994 led to the joint development of a private sector development strategy adopted upon agreement between parties in April 1999 regarding rationalization of the private sector support plan and improvement of the efficacy of state intervention.

Implementation of this strategy following the March 2000 transfer of power began with the creation in that year of the Investment Promotion and Major Projects Agency (APIX), and in 2001 of the Agency for the Development and Supervision of SMEs (ADEPME). This was followed by the 2002 transformation of the Senegalese Standards Institute nto an association in order to encourage professionals to be more accountable in product quality certification, the 2003 creation of the Modernization Office and in2005, creation of the Senegalese Export Creation Agency (ASEPEX). Previously, the interest of the state in improving the quality of its intervention in the economy and services provided to firms led to the January 2005 launch of a process to prepare the Accelerated Growth Strategy (SCA) by building upon the benefits linked to and orientations of the private sector development strategy (SDSP)adopted in 1999.

The SCA offers a common framework to establish a business environment with international standards which benefits all sectors including: transformation activities, the promotion of promising sectors such as horticulture, agro industry, aquaculture, telecommunications and tourism or the improvement of sectors such a fisheries and textiles through a competitiveness cluster approach.

However, real GDP growth slowed considerably over 2006-2011; the economy has proven rather vulnerable to the exogenous shocks of the energy, food and financial crises of 2007 to 2009. The industrial activity growth rate fell to 3.2% during this period (Rapport du FMI n° 12/337, November 2012).

2.2. The industrial policy framework and emerging questions

The industrial sector is entrusted to administration department which is also responsible for trade, SMEs and the informal sector. The redeployment and the industrial zones are the key features of the industrial sector policy validated in 2005. The objectives are: a rebalancing of industrial facilities across the country, which continue to be concentrated in the Dakar region; reorientation of the productive base

towards new promising sectors; and strengthening of managerial capacities required to promote highly productive competitive industries.

The industrial redeployment policy (PRI) is thus part of the orientations and objectives of the AGS which, in turn, is part of the action plan to reach the productivity and growth objectives of the National Social and Economic Development Strategy (NSEDS)2. Thus, the PRI rests on the stability of the macroeconomic environment, the policy of external openness and regional integration, the option to establish a business environment (Loi d'Orientation n°2008-03 du 08 janvier 2008, article 2). The competitiveness cluster approach is emblematic of opportunities for innovation within the AGS as well as for collaboration between actors along the value chain. With a focus on the competitiveness of Senegalese firms, it goes beyond import substitution and export promotion policies, to provide the 1995-2005 growth trend with greater sectoral and social bases. The aim is to diversify the sources of growth and to sustain this growth.

The observed advantages of an effective industrial redeployment policy are: (i) the presence of important measures to increase value added in industrial sectors; (ii) increased accountability in the private sector; (iii) the ongoing process to develop infrastructure; and (iv) access to foreign markets. Complicating factors include: (i) the strong concentration of industrial activity and population in Dakar, sources of aggregation effects and economies of scale which may render the redeployment less beneficial; (ii) the lack of synergies between the industrial sector and small-scale producers; (iii) backwardness in entrepreneurial spirit and technological innovation; and (iv) the cost of developing industrial sites.

With respect to these directions of industrial policy in Senegal, emerging issues involve: (i) the necessary restructuring of the productive apparatus and the basket of exported products in order to accelerate growth; (ii) the quality and maintenance of structural competitiveness factors such as infrastructure, notably including energy and human resources, including entrepreneurial spirit; (iii) the role of the undervaluation of the real exchange rate in the success of industrial redeployment and acceleration of growth.

2. Related literature on the LBE

As firm-level data become available, numerous studies have documented that there are heterogeneity across firms. It is found that exporting is a rare activity, for instance in the US in 2000, only 4% of firms engaged in exporting, and export market participation varies across industries within manufacturing (Bernard and Jensen 1995). Also, exporters tend to be larger, more productive, skill- and capital-intensive, to pay higher wages than non-exporting firms. This is the case not only for the developed countries such as the US but also developing countries, which are plausibly abundant in unskilled labor, therefore making hard to explain with the traditional comparative advantage. Both traditional and new trade theories cannot explain why some firms export and others produce only for the domestic market, or how the firm-level decision to export interacts with comparative advantage.

The finding that exporters are systematically more productive than non-exporters raises the question of where higher-productive firms self-select into export markets, or where exporting causes productivity growth through some form of "learning by exporting".

***Self-selection or Learning by exporting*?**

There are numerous studies supporting the self-selection in various developing countries. One possible explanation of self-selection is that there is sunk costs to enter into export markets, which lead only the most productive firms find it profitable to incur (Roberts and Tybout, 1997). Empirical findings on various countries are also supportive for self-selection. There is no evidence of productivity increase as a result of beginning to export for US firms (Bernard and Jensen, 1999) and no differential growth in firm productivity among exporters versus and non-exporters among firms in Colombia ,Mexico, and Morocco (Clerides, Lach and Tybout, 1998). Motivated by these empirical findings, Melitz (2003) developed a framework with firm heterogeneity in a general equilibrium model of trade. His model shows that the exposure to trade will induce only the more productive firms to enter the export market (self-selection) and will simultaneously force the least productive firms to exit. In this self-selection mechanism, only the more productive firms make higher revenues and can afford the fixed costs to enter the export market.

Meanwhile, there are different observations that the past exporting experience leading to learning effects and their results show strong productivity growth resulting from exporting (*learning by exporting*). In this mechanism, firms improve their productivity after entering a foreign market. Therefore, exporting results in productivity gains because, exporters are exposed to knowledge flows from international buyers and competitors and to more intense competition in international markets, which lead to larger opportunities and incentives to improve productivity than firms that sell only on the domestic market experience. Moreover, the export improve the economies of scale in production and improved capacity utilization, which resulting in better productivity performance in new export entrants than in non-exporters.

While the hypothesis of self-selection into export markets is strongly supported by widespread empirical evidence, the evidence on LBE is mixed and far from conclusive. Some works do not find any evidence of post entry productivity changes (Wagner, 2002, Arnold and Hussinger, 2005, Hansson and Lundin, 2004), and others fine evidence (Greenaway and Kneller, 2004, 2007b, 2008; Girma et al., 2004; Van Biesebroeck, 2005; Damijan and Kostevc, 2006; De Loecker, 2007, 2010; Serti and Tomassi, 2008; Máñez et al., 2010; and Dai and Yu, 2011). In contrast to the scarcity of studies finding improved firm productivity following entry into export markets, an abundance of evidence indicates that firms entering export markets grow substantially faster in employment and output than non-exporters, especially for countries like Columbia, several sub-Saharan African countries, Slovenia and Canada (Pacvnik 2002, Van Beisebroeck 2005, De Loecker 2007, Lileeva and Trefler 2010).

Different applications of learning by exporting model

While the question on the causal relations between export and productivity growth is still debatable, the recent literatures go beyond the on-going discussion and investigate specifically through which channels those impacts occur.

Innovation and technological upgrading are widely studied mechanisms with related to trade and productivity increase. In industrial organizations, standard approach is that firms invest in intangible assets, such as R&D and advertising, to overcome existing barriers to entry into new markets (Carton, 2005). However, recent empirical studies in trade demonstrate that exporting leads to productivity improvements by influencing process and product innovations, increasing labor productivity and inducing firms to upgrade technology for the most productive firms (Damijan et al., 2008, Lileeva and Trefler, 2010, Bustos,

2011).Changes in technology not only affect productivity but also can have implications for factor markets. For instance, the technology investment requires skilled labor and relative demand for skill increased in developing countries during the trade liberalization period (Goldberg and Pavcnik, 2007).

Market size may be another channel which motivate firms to innovate and hence being more productive. Market size and trade affect the competition across markets, in terms of the number and average productivity of competing firms, which then feeds back into the selection of producers and exporters in that market. Also, productivity and mark-ups respond to both the size of a market and the extent of its integration through trade. For instance, larger and more integrated markets exhibit higher productivity and lower mark-ups (Melitz and Ottaviano, 2008, Eaton, Kortun, Kramarz, 2011). Similar finding is that when firms will have improved access to foreign markets, which thus encourage firms to simultaneously export and invest in raising productivity (Lileeva and Trefler, 2010).

While previous discussion have been focused on heterogeneity across firms, the latest studies also shows that there are much economic dynamic happens within firms, such as decision on market entry and exit, product and market. Firms make endogenous entry and exit decision to markets. Once enter the exporting market, survival rates of new exporters on export markets are low and heterogeneous, and even lower in developing countries. The low survival rates might be explained by the fact that ex ante exporters don't know their own ability and firms learn its per-period fixed costs after enter into the exporting markets. There is direct effect of multinational ownership or tariffs on the probability of survival (Bernard and Jensen, 2007). Also, credit constraints might be bigger in the initial stage of exporting.

Whichever factors they are, exporter's survival is a significant factor in explaining differences in long run export performance, particularly in developing countries (Bernard, Redding and Schott, 2011, Besedes and Prusa, 2011). Moreover, each surviving firms chooses optimally the range of products to supply to each market and often switch their products. If firms survived in exporting market, growth is higher in the first year and first market than in others (Albornoz, Pardo, Coscos and Ornelas, 2012). In Africa, it is observed that the success rate rises with the number of same-country competitors exporting the same product to the same destination, suggesting the existence of some cross-firm externalities by information spill-over, such as information about demand and role of banks (Cador, Iacovone, Rauch and Pierola, 2011).

Other literature made sectorial analysis to compare the export's impact on productivity across sectors. There is evidence that service sector firms are able to reap the benefits of exposure to export markets at an earlier (entry) stage of the internationalization process than are manufacturing firms (Contractor and al (2003, 2007), Love and al, 2010). From UK firm data, Harris and Li (2011) found that productivity gains from entering and exiting export markets, however such productivity effects are larger in the services, in particular, financial and business services than in production including agriculture, manufacturing and construction.

4. Model specification and estimation procedure

4.1 Model specification

We assess the link between exporting and efficiency using a production function approach. We followed the approach in Bisgten *et al.*, (2004) which is based on the Clerides S., Lach and J. Tybout (1998) model. The approach involves jointly estimation of a dynamic productivity function and a dynamic discrete choice model for the decision to export, where we allow for causality running both from efficiency to exporting and from exporting to efficiency. This strategy enables us to control for unobserved heterogeneity in the form of firm specific effects that are correlated across the two equations. While Bigsten and al., (2004)use the output as outcome variable of interest to measure the firms' performance, we consider the total factor productivity (TFP) and compute it in an initial step from the production function and then use it as the outcome variable in the econometric test for learning effects.

Most studies on productivity on the firm-level assume the production function (measured as deflated gross output or value added) to be a function of inputs, such as labor and capital, and productivity of the firm. Following Beveren (2010), we use an augmented Cobb-Douglas production function to estimate the total factor productivity. Considering its linear form in logs, the empirical specification can be written as follow:

$$y_{it} = \alpha_0 + \alpha_k k_{it} + \alpha_l l_{it} + \omega_{it} + \varepsilon_{it} \qquad (1)$$

where y_{it}, k_{it} and l_{it}refer to respectively the logarithms of added value, capital stock and employment; i and t are firm and time indices respectively; the parameterα_0 is a mean efficiency level across firm and over time, α_k andα_l are estimated elasticities of value added with respect to inputs. Furthermore, ω_{it} and ε_{it} are error terms representing shocks to production or productivity. ε_{it} is unobservable or unpredictable by the firm, while ω_{it} is supposed to be observable or predictable and can be considered as productivity shock. The firm-level productivity (TFP) or efficiency is represented by $A_{it} = \alpha_0 + \omega_{it} + \varepsilon_{it}$. The estimated form of this productivity is: $\hat{A}_{it} = \varepsilon_{it} + \hat{\omega}_{it}$.

Following the standard approach to measure TFP, we first need estimating equation (1), then calculate the productivity as a Solow residual term :

$$\hat{A}_{it} = y_{it} - \hat{\alpha}_k k_{it} - \hat{\alpha}_l l_{it}. \qquad (2)$$

Note that $\hat{A}$ is the productivity in log. The productivity in levels is the exponential of $\hat{A}$.

We use the firm-level TFP estimation as the outcome variable to study the effect of exporting on productivity. As learning is unlikely to be instantaneous, we assume, as many studies on the Learning by exporting (see for example Bigsten, et al (2004), Keiko. I, and Lechevalier, S., (2010) and Greenaway, D. and Kneller R., 2004) that this effect operates with a one-period lag. This specification suggests that firm *i*'s past experience (A_{it-1}) may be an important driving factor of its current performance (A_{it}). Building on Bigsten et al.'s learning-by-exporting idea, we assume that A_{it}also depends on firm *i*'s exporting

experience, $Export_{it-1}$.This approach is analogous to that of De Loecker (2007, 2010), Facundo and al, (2007) and Fernandes (2008) which allow the law of motion of productivity to depend on past export status. We allow for heterogeneity in A_{it}, by controlling firm's characteristics (X_{it}) and a dummy variable for industry denoted $Sector_{it}$ .We hence write the efficiency equation A_{it} in logarithmic form as :

$$A_{it} = \beta_1 A_{it-1} + \beta_2 Export_{it-1} + \beta_3 X_{it} + \beta_4 Sector_{it} + \mu_i + \epsilon_{it} \quad (3)$$

where Export is a dummy variable equal to one if there is some exporting and zero if there is not ; β_1, β_2, β_3, β_4 denote parameters to be estimated, μ_i. is an unobserved heterogeneity in the form of firm specific effects and ϵ_{it} is a homoskedastic, serially uncorrelated and normally distributed residual.

We rely on the existing literature for selecting the variables which are relevant for firm characteristics X_{it}. The literature recognizes that learning-by-exporting is conditional on firm characteristics such as firm age(Delgado et al., 2002; Fernandes and Isgut, 2007), firm size, skilled workers, capital (Bigsten and al, 2002 and Facundo and al, 2007), export intensity (Kraay, 1999; Castellani and Zanfei, 2007; Damijan et al., 2007 and Girmaa et al., 2004), the existence of foreign capital (Greenaway and Kneller, 2003). Another strand of the literature argues that learning-by-exporting is conditional on the existence of intangibles assets[3] (Harris, R. I. D. and al., 2005). We also take account the capital-labour ratio and the specificity of the sectors by including dummy variable that indicating industry sub-group : we have classified the firms within manufacturing into three sub-sectors: textile sector, agro food industry and others which includes construction, equipment, paper, wood, etc.

In the equation (3), the coefficient $\beta_1$captures the effect of past productivity level on the firm's productivity decision today. This past experience effect is usually called state dependence effect. β_2 indicate the effect of lagged export status on the firm productivity. However, the positive association between exports status and productivity can be due to the self-selection of the relatively more efficient plants into foreign market rather than learning. Clerides S., Lach and J. Tybout (1998) deal with this problem by formulating a probit model to identify the probability of becoming exporter in which they control for unobserved firm effects that are potentially correlated with the unobserved firm effects in the productivity equation. We use a similar approach in this paper.

Then, we assume that export participation depends on previous export participation,$Export_{it-1}$, and productivity,A_{it-1}, firm characteristicsin the current period X_{it}(age, size, skilled workers, foreigninvestment, capital-labor ratio, intangible asset, which is coded one if the firm have more than zero intangibles assets and zero otherwise, and a dummy variable for industry,$Sector_{it}$. Because our exports variable is a binary we employ a latent variable formulation and write the exports decision probability equation as below:

$$Prob(Export_{it} = 1) = \phi(\alpha_1 A_{it-1} + \alpha_2 Export_{it-1} + \alpha_3 X_t + \alpha_4 Sector_i + d_i + \Psi_{it}) \quad (4)$$

Where ϕ is a probit function, Export is a dummy variable equal to one if there is some exporting and zero if there is not. $\alpha_1, \alpha_2, \alpha_3$and α_4 denote parameters to be estimated, $d_i$is an unobserved firm specific

[3] Assets refer to corporate intellectual property (e.g. patents, copyrights, trademarks, etc.)

time invariant effect affecting the decision to export and $\Psi_{it}$is a homosedastic, serially uncorrelated and normally distributed residual.

The equations (3) and (4) form the basis for our econometric test for learning effects.

$$A_{it} = \beta_1 A_{it-1} + \beta_2 \text{Export}_{it-1} + \beta_3 X_{it} + \beta_4 \text{Sector}_{it} + \mu_i + \epsilon_{it} \quad (3)$$

$$\text{Prob}(\text{Export}_{it} = 1) = \phi(\alpha_1 A_{it-1} + \alpha_2 \text{Export}_{it-1} + \alpha_3 X_t + \alpha_4 \text{Sector}_i + d_i + \Psi_{it}) \quad (4)$$

The equation (3) is a linear regression of the productivity to test the learning by exporting (LBE). The coefficient β_2 captures the learning by exporting effect. If $\beta_2 > 0$, then this is evidence of learning, i.e. exporting results in higher productivity. The equation (4) is a probit model of the decision to export. If there is support for self-selection-into-exporting, i.e. that efficient firms become exporters, α_1 would be positive. If there are fixed costs associated with exporting, so that firms tend to continue exporting once they have entered the international market,α_2 would be positive; (Roberts and Tybout, 1997).

Although results from regressions using standard estimation techniques like instance OLS or the standard panel GLS (“random effects” estimator) to test the relation between exporting and efficiency will tell us a lot about the main patterns in the data in term of existence of LBE and self-selection, the disadvantage is that these approaches cannot control for unobserved heterogeneity as the firm’s management capacities, or endogeneity between export status and productivity. Then exporting firms might possess some unobservable characteristics that make them more productive than their domestic counterparts, thus allowing them to overcome sunk cost and enter the export markets. Thus, the essential problem at the core of evaluating the effect of exporting is to obtain an estimate of the unobserved counterfactual that is not biased because of any simultaneous relationship between the decision to export and the gains from exporting. Hence, failing to allow for these factors, may lead to spurious results in testing the Learning by exporting or the Self-selection existence.

As discussed in Harris (2005), there are several standard approaches that attempt to eliminate the bias that arises from self-selection. The first approach is instrumental variable (IV) estimation.This method requires finding appropriate instrument variables that affect the treatment decision (decision to export)but do not directly influence the outcome variable (TFP). A second approach to dealing with self-selection bias is matching. Essentially, this involves matching every exporting firm with another firm that has very similar characteristics but does not export. Essentially, under the matching assumption exporters and non-exporters have the same observable attributes that impact on productivity (and the probability of exporting). Thus the non-exporting, matched sub-group constitutes the counterfactual for the missing information on the outcomes that exporters would have experienced, on average, if they had not exported. Thirdly, the standard Heckman two-stage (or control function) approach is a widely used approach to dealing with self-selection bias, which is closely linked to the IV approach. This approach begins with a first-stage use of a probit (or logit) estimator to generate first-stage predicted values of the probability of exporting, with the second stage estimation of the equation of efficiency including the sample selectivity correction terms from the first-stage model. That is, if is the predicted propensity score of exporting for firm *i* at time *t* , then the inverse Mills ratios (or selectivity terms) from this model. One other popular method to handle simultaneity bias is the one step estimation of both the exporting decision and the efficiency equations using a dynamic-

panel data estimation in a GMM (difference-GMM (Arellano and Bond, 1991) or system GMM (Blundell and Bond, 1998). We use this approach in our estimation.

4.2. Estimation procedures

Our estimation follows two steps : the TFP calculation and the self-selection and learning-by-exporting test controlling for unobserved effects.We start with estimating equation (2) following Beveren (2010) approach to estimate the TFP. Measuring TFP is one of the most discussed topics in the areas of trade and industrial organization since the seminar work by Solow (1957). More recently, the increasing availability of firm-level data allowed for the TFP estimation. However, several methodological issues emerge when TFP is estimated using traditional methods.

To summarize, the productivity estimates using ordinary least squares (OLS) could lead multiple biases, including simultaneity (endogeneity of input choice), selection bias (not allowing firms enter into and exit from the market, by using panel data), endogeneity of attrition, omitted prices (typical practice of proxying for firm-level prices using industry-level deflators), and the relevant level of analysis for the estimation of a production (pervasiveness of multi-product firms).

The idea is that using OLS to estimate equation (2) assumes that the input variables are exogenous and then are independent from the firm characteristics as its efficiency. However, it has been proved in the literature that these assumptions are not realistic by given evidence of correlation between productivity shocks and level of inputs (De Loecker, 2007; Marschak and Andrews, 1944; etc.). Fixed Effects and Instrumental Variables are some of the popular methods used to deal with this bias issue. There are some improvements in recent work including Olley and Pakes (1996), Blundell and Bond (1999), Levinsohn and Petrin (2003), or Ackerberg et al. (2010). The Endogeneity of Attrition is related to the use of balanced panel in estimating the Total Factor Productivity (TFP). The entry or exit status/decision of the firm is correlated to the firm productivity (Jovanovic, 1982; Hopenhayn, 1992; Farinas and Ruan, 2005; Dunne et al., 1988). Moreover, there is a need to include the exit decision in the model as there is room for correlation between ε_{it} and the capital stock (k_{it}). Given a same level of ψ_{it} for two firms, the firm with smaller fixed capital will have less capacity to avoid exit.

The omitted price is another source of bias on estimating TFP. Firm-level prices are not always available to deflate input and output. Using industry-level prices to deflate the inputs and output of the firm leads to bias in input coefficients, particularly when input choice is correlated with firm-level price variations (De Loecker, 2007).

There is source of biases relevant to firms producing multiple products with different production technologies or different demand systems. If detailed data on the multiple products are not available, firms can be grouped by single product and then estimate specific TFP for each group. However, this approach underestimates the TFP as it does not include the relations in the production process of the multiple products.

Then, the estimation of the TFP requires some specific methods to take into account the bias issues described above :Fixed Effects, Instrumental Variables, Generalized Method of Moments, Semi-parametric Estimation (Olley and Pakes, 1996; Levinsohn and Petrin, 2003), Collinearity correction following Ackerberg

et al. (2010), etc. However, recent literatures which have applied some of the different methods to one firm-level data have reported that the differences between the different estimators are relatively small when comparing estimated TFP (Soderbom and team 2004; Beveren 2010).

Due to the movements of entry and exit of firms on the export market, we use unbalanced fourteen year panel data to account for attrition effect on the estimation of TFP and the Learning effect.

To estimate the TFP, we deflate the value of the output and inputs. Due to the limitations of data, we use index to deflate firm input and output. We construct an index for capital using the data on the Gross fixed capital formation panel data and a national consumer price index (CPI). Then we deflate physical capital using this capital index. The value added and employment are deflated using the consumer price index. The estimated form of the total productivity factor is:

$$\hat{A}_{it} = y_{it} - \hat{\alpha}_k k_{it} - \hat{\alpha}_l l_{it}. \qquad (2)$$

In the second step, we estimate equation (3) of the learning by exporting and equation (4) of the self-selection using the TFP estimations as the outcome variable of the firm performance. Follow Bigsten et ali., 2004 methods of testing learning by exporting hypothesis, we jointly estimated both equation of productivity (3) and probability to export (4) by GMM in a one step procedure using the *xtabond2* command in stata. The general model is a Cobb-Douglas production function.

5. Data and summary statistics

5.1. Data

We explore a unique panel of firm-level data comprising a representative set of Senegalese manufacturing firms that allows us to identify the link between firm efficiency and exporting.

The data are collected annually by the CUCI (Centre Unique de Collecte d'Informations), department of the National Agency for Statistics and Demography (NASD) of the Senegalese Ministry of Economy and Finances for the period 1998-2011.

The data set covers all firms in the Senegalese manufacturing, agriculture, mining, commerce sectors and several other service sectors. We use observations for the manufacturing sector which is our focus on this topic.The data was collected through two tables. The first one which is are necessarily filled by firms that have a turnover of at least 30 million CFA francsgives detailed and information on firm-level business activities in which the firm operates, sales, capital stock, intermediates materials, purchases, exports, assets as Research and development and Patents and Licenses, various other financial data such as costs, profits, debts, subsidies and investment. The second table concerns all the firms currently operated and gives information on the number of employees, the number of employees by qualification and the salaries.

After merging the two sub data set, the initial panel data consists of about 1789manufacturing firms (15035 observations). In order to construct an appropriate data set for the purpose of our research, we restrict the data to firms that provided information for at least three consecutive years over the period 1998 to 2011 (because this is the minimum time period necessary to control for unobserved firm effects in the econometric analysis) and without missing information on critical variables for the analysis, such as firm

output, value added, capital, labor, employment, age, among others. The resulting unbalanced panel has of 1177 manufacturing firms (11063 observations) including exporters and non-exporters.

5.2 Descriptive statistics

As regards the firm export activity, Table 1 reports both the export participation and export intensity rates by industry for the period1998-2011.The firm export status is computed as a dummy variable indicating whether the firm has exported during this year or not. Among all the Senegalese industries in the 1998-2011 period, only 164 are exporting and 1013 offer in the local market. The proportion of exporting firms is low (on average 14%) although there are significant differences across industries (the highest export participation rate, 33.33%, corresponds to the industry *Textile*, and the lowest to the *Buildings and Public Works*, 3%. The *food industry* (agro-industry, *drink and tobacco)* have a export participation of average 16.37%. As regards export intensity (exports over sales), we observe an average of 31.15% for all industries, with also significant differences across industries (Except for the bloc *other industry* which is very aggregate, the *Food industry* has the highest export intensity rate, 31%, and *Textile industry* has 6% and BTP the lowest (less than 2%).

Table 1. Export participation and export intensity by industry.

Industry	Export participation	Export intensity
Others Industries	22,47	65.54
BTP	3,09	1.59
Textiles industry	33,33	6.19
Food industry (agro food, drink and Tobacco)	16,37	31.12
All	13,93	31.15

Source : Authors estimations

For the main variables of interest of the estimations, we test the difference between the mean values of the two groups of exporters and non-exporters. Table A.2 shows summary statistics on the main variables and the conclusion of the equality test of the means, by export status. On average, exporters firms are older, larger, more qualified employees, and highly capital intensive, than non-exporters. They spend more on raw materials, and capital and have larger value added. They also pay higher wages and spend more on intangibles assets. However, non-exporting firms are more homogeneous with respect to the variables mentioned above, except for the capital and intangibles assets patents. The dispersion around wages, however, remains the same for both categories of firms.

Using the unbalanced panel data for the estimations of TFP and the relation between TFP and the exporting, we account on the movement of exit and entry of the firm. Hence, by studying the firms' exporting status over the whole period, we distinguish between four different types of firms: never exports (*ne*), permanent exporters (*pe*), single entry (*se*), single exit (*se*) and switchers (*sw*). No exporters are firms which never export during all the period 1998-2011. Permanent exporters are firms that export during all the period. Single entry are firm which began export after the initial year but once they enter the export market, they did not exit until the last year. Single exit (or Quitters) are firms which began to export after the initial year but once they exit, they did not enter again. Finally, the switcher firms enter and exit more than one time in the period of data base.

Table A4summarizes the number of firms by export status and sector over the period 1998-2011. The table shows that of the manufacturing firms in the dataset, 81 percent supplied only the domestic market during the period 1998-2011. At the same time, nearly 20 percent were single entry exporters, 20 percent stopped exporting and did not start exporting again suggesting that a significant number of exporters quit exporting later. Almost, 14 percent of the firms are switchers. The minority of the firms, 0,12 percent, were persistent exporters over the fourteen-year period.

6. Results

We use panel on Senegalese manufacturing observed over the period 1998-2011. Our results for the specification of the self-selection (equation 4) and the learning by exporting(equation 3) using the estimation strategy outlined in the previous section are reported on table 2. As exporter's survival is a significant factor in explaining differences in long run export performance, particularly in developing countries (Bernard, Redding and Schott, 2011, Besedes and Prusa, 2011), we take into account for the movements of entry and exit of the firms using an unbalanced panel data 1998-2011.

Table2: Self-selection and Learning by exporting effects, Senegal 1998-2011

Variables	Self Selection	Learning by Exporting
A_{it-1}	0.0792868**	0.1362903***
	0.0339634	0.0121778
E_{it-1}	1.840304***	0.1572953***
	0.0741146	0.0339953
Lnage	-0.0265948	0.0009513
	0.0407716	0.012817
lnsize	0.2074637***	-0.5207598***
	0.0315404	0.0149113
Skillworkers	0.4176225***	0.2791582***
	0.104516	0.0345007
Lncapital-labour	0.1893683***	-0.755737***
	0.0373625	0.0146822
Foreignownership	0.0618314	0.4325706***
	0.0858136	-0.048
Research &developmemt	-0.0144678	0.0718185
	0.1598724	0.0667902
Brevets and Licenses	0.1277417***	0.113433***
	0.075107	0.0318201
Constant	-5.103966***	9.568494***
	0.5156551	0.1985762
Observations	3,481	3,309

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

Source : Authors estimations

The first column of the table 1 reports the results for the export probit equation. The coefficient on lagged TFP, which is used in the literature to account for the self-selection of the most efficiency firm in the foreign market (Roberts and Tybout, 1997; Bernard and Jensen (1999), Greenaway and Kneller (2006), Wagner et al. (2007)), is positive and highly significant, providing a fairly strong evidence for self- selection process of the more efficient firms into exporting. This suggests that an increase in the firm's efficiency at time t increase the probability of exporting at times t+1, as predicted by the self-selection hypothesis.

The estimated coefficient on lagged export status variable is positive and highly significant (at the one per cent level) indicating a strong persistence of the previous exporters firms in the export decision. This suggests that firm's current involvement in exporting activity may well lower the fixed costs of engaging in exporting in the next period. (Bigsten and al, 2002, Roberts and Tybout, 1997).The log of firm's age have no effect on the likelihood of the decision to export. By cons, the coefficient on firm's size measured by the number of employees is positive as expected and highly significant suggesting that larger firms are more likely to engage into exporting activity. The positive size effect on the probability to export is not surprising. In line with other studies, our results suggest that larger firms are more likely to export. The variable *skillworkers* which indicate the quality of labor, measured by the ratio number of employers with high level qualification and total employees, matters for the decision to export. In line with the findings on previous studies(Facundo, A. and Marco, E., 2007, we find that firms with higher proportion of skilled workforce are much more likely to enter export markets. Though it is easy to argue that skilled workers allow for better appropriation of knowledge involved in exporting experience.

Another interesting finding of the export decision results is that firms with non-zero intangible assets are much more likely to export, and this again points to a need to invest in highly productive resources that lead to a greater ability to internalize external knowledge in order to overcome barriers to exporting. The coefficient of the intangible assets (*Patents, licenses, software)* is positive and significant at the five per cent level providing an evidence for a strong effect of intangible asset in the export decision.

Exporting decision is driven by others firm characteristics. Among these characteristics, we explore the driving role played by ownership on the decision to export. Although the coefficient on foreign capital is positive as expected, but it is not statistically significant suggesting that the presence of foreign capital does not affect the decision to export.

The second column of table 6.1 shows a strong confirmation about the learning-by-exporting effects with the positive and highly significant coefficient on lagged *Exports.* This suggests that firms who had exported one year previously report more learning from their partners.

Exporting is associated with some firms characteristics: capital-labour level, existence of foreign ownership and intangibles assets, firms' age, firm's size and quality of employment, (Facundo and al, 2007). The coefficient on capital-labour is positive and significant at 5%. This suggest that richer exporters increase productivity more rapidly as they have more financial resources to hire highly qualified workers and modern equipment which is very likely to be translated into higher productivity. The finding that exporters with foreign ownership increase productivity more rapidly is interesting for it suggests that that experience in international markets is important for the extent of learning by exporting. Innovation and

technological upgrading are widely studied mechanisms with related to trade and productivity increase: firms invest in intangible assets, such as R&D, advertising, new technology to overcome existing barriers to entry into new markets (Carton, 2005). As expected, the estimated coefficient on intangible asset shows a positive and strong effect on exporters' productivity. This suggests that firms who access to Patents, licenses, software report more learning from buyers and this again points to a need to invest in highly productive resources that lead to a greater ability to internalize external knowledge in order to overcome barriers to exporting. The firm age which indicates the firm's survival as a one component of the firm's performance may well indicate the benefits of the knowledge involved in exporting experience. As on the equation of exporting, our findings indicate a positive but not significant coefficient of Firm age on the learning process.

As to the rest of firm characteristics, observe that Small-Employer exporters and exporters with high Skilled-Labor learn more from their exporting activities as indicated by the large statistical significant of size and skillworkers variables. Taken together these results highlight the fact that learning requires fluid dissemination of knowledge. Though it is easy to argue that skilled workers allow for better appropriation of knowledge involved in exporting experience, the size effect is surprising. On one hand, large firms are generally more structured and this would facilitate a better absorption and use of new knowledge. On the other hand, in a small firm, knowledge might be easier to disseminate. Our result suggests that the latter offsets the former.

7. Conclusion

Learning-by-exporting has been advanced as one theoretical explanation for the empirically verified export premium. The rationales for such an effect focus on knowledge and information flows from foreign customers and competitors, incentives for innovation and reduction of inefficiency (Martin Andersson1 and Hans Lööf). The empirical literature, however, did not show a systematic evidence that efficiency firms may self-select into the export market (Export-by-learning) or exporting causes efficiency gains (Learning by exporting).

Our paper aims to provide evidence on the learning by exporting and self-selection. Using a unique firm-level panel data from Senegalese manufacturing sectors on 1998-2011 period, we investigate these questions using a two step strategy. In the first step we use a dynamic Cobb Douglas production function to estimate firm productivity. In a second step, following Bigsten and al. (2002) approach, we jointly estimated both equation of productivity and probability to export by General Method of Moment (GMM), controlling for other unobserved effects.

Our preliminary results indicate the evidences of both ways: the more efficient firms became exporters (self-selection) and firm's productivity increases by exporting (learning-by- exporting). Results are consistent to the inclusion of several firm characteristics such as firm size, skilled labour, physical capital, capital structure, ownership structure, assets, and industry classification. Our finding suggest that larger firms and those with more qualified workers are generally much more likely to export, and this again points to a need to invest in highly productive resources that lead to a greater ability to internalize external knowledge in order to overcome barriers to exporting. Exporting firms acquire external knowledge through various channels. Foreign owned firms learn more from clients. Our results suggest also that firms with

skilled workers are more able to reap the benefits of exposure to export markets than are others manufacturing firms. Another interesting finding is that firms which invest to access to intangibles assets as Brevets and Licences have higher gains of efficiency in exporting. Finally small firms seem to particularly learn more from exporting.

From a policy perspective, the learning-by-exporting finding suggests that Senegal has much to gain from promoting its manufacturing sector towards exporting by increasing the ability of domestic firms to overcome foreign market barriers as well as assimilate further benefits arising from exporting. Given the importance of the skills of workers in the process of acquisition of productivity gains on the external market, special attention should be accorded to the training of the workforce. Hence, the State could help developing curricula into colleagues and senior secondary schools or other training programs enable companies to have the skills they need. Special public strategies to promote firms' access to Patents and Licences and Innovation must be implemented. Finally, supports favour to small and medium enterprises programs could strengthen their productivity gains on the external market. The initiatives already undertaken favour to the small plants might be continued and reinforced.

References

Albornoz, Facundo, H. F. Calvo Pardo, G. Corcos, and E.I Ornelas(2012). "Sequential Exporting." *Journal of International Economics* 88, no. 1): 17-31.

Amiti, Mary, and J. Konings. "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia." *American Economic Review* 97, no. 5 1611-38.

Albornozand Ercolani (2007) Learning by Exporting: Do Firm Characteristics Matter? Evidence from Argentinian Panel Data. Working Paper.

Ana M. Fernandes and A. E. Isgut (2007), 'Learning by Exporting Effects Are They for Real' Working paper.

Arnold, J. and K. Hussinger (2005), Export Behavior and Firm Productivity in German Manufacturing: A Firm-level Analysis, *Review of World Economics*, Weltwirtschaftliches Archiv, 141, 2, 219–43.

Aw, B. Y. and A. R. Hwang (1995), 'Productivity and the Export Market: A Firm-Level Analysis,' *Journal of Development Economics* 47, pp. 313-332.

Aw, B., S. Chung and M. J. Roberts (2000), 'Productivity and Turnover in the Export Market: Microlevel Evidence from the Republic of Korea and Taiwan (China),' *World Bank EconomicReview* 14, pp. 65-90.

Bernard, Andrew B., J. Bradford Jensen, S. J. Redding, and P. K. Schott (2007). "Firms in International Trade." *NBER WORKING PAPER SERIES* Working Paper 13054 (April.

Bernard, A. B. and J. B. Jensen (1995), 'Exporters, Jobs and Wages in US Manufacturing 1976-87,'

Brookings Papers on Economic Activity Microeconomics, pp. 67-119.

Bernard, A. B. and J. B. Jensen (1999), Exceptional Exporter Performance: Cause, Effect, or Both? *Journal of International Economics*, 47(1), 1–25.

Bartelsman, E.J. and M. Doms (2000), "Understanding productivity: lessons fromlongitudinal microdata", Journal of Economic Literature, 38,. 569-595.

Bernard,A., S.Redding, and P. Schott (2007) . "Comparative advantage and heterogeneous firms," Review of Economics Studies, Vol. 74, No. 1, : 31-66

Beveren, V. (2010). Product and process innovation and firms' decision to export.

Bigsten, A. and al., (2002), 'Do African Manufacturing Firms Learn from Exporting?' CSAE Working Paper Series /2002-09.

Blundell and Bond (1999), Estimating dynamic panel data models: a guide for macroeconomists

Cadot, Olivier., Iacovone, Leonardo., Pierola, Denisse., Rauch, Ferdinand (2011). "Success and Failure of African Exporters" World Bank

Castellani and Zanfei, 2007; Review of Multinational firms, innovation and productivity

Evidence From Colombia, Mexico and Morocco,' *Quarterly Journal of Economics* 113, pp. 903-948.

Crespi, G., C . Criscuolo,. and J. Haskel, (2006) 'Productivity, Exporting and the learning by doing Hypothesis Direct Evidence from UK Firms. Working paper.

Criscuolo, C., J. Haskel, and R. Martin, (2003), 'Building the Evidence Base for Productivity

Policy Using Business Data Linking, Economic Trends, 600, November, 39-51, available at

www.statistics.gov.uk/articles/economic_trends/ETNov03 Haskel.pdf

Damijan, Jože P., Črt Kostevc, and Sašo Polanec. "From Innovation to Exporting or Vice Versa?". *World Economy* 33, no. 3 (2010): 374-98.

Damijan, J.P. and C. Kostevc (2006), Learning-by-exporting: continuous productivity improvements or capacity utilization effects? *Review of World Economics*, 142, 599–614.

Damijan et al. (2008), 'From innovation to exporting or vice versa? Causal link between innovation activity and exporting in Slovenian microdata'. Working paper.

Eaton, Jonathan, Samuel Kortum, and Francis Kramarz. "An Anatomy of International Trade: Evidence from French Firms." *Econometrica* 79, no. 5 (2011): 1453-98.

Eric J. Bartelsman and D. Mark (2000); Understanding Productivity: Lessons from Longitudinal

Facundo A. and M. Ercolani, (2007), 'Learning by exporting Do firm characteristics matter. Evidence from Argentinian panel data'. Working Paper, Department of Economics University of Birmingham.

Fafchamps, M., S. El Hamine and A. Zeufack, (2002), 'Learning to Export: Evidence from Moroccan

Manufacturing,' CSAE Working Paper WPS/2002-02. Oxford: Centre for the Study of African Economies, Oxford University.

Girma, S., D. Greenaway and R. Kneller (2004), Does Exporting Increase Productivity? A Microeconometric Analysis of Matched Firms. *Review of International Economics*, 12, 5, 855–66.

Goddard J, Tavakoli M and Wilson J O S (2006) 'Determinants of profitability inEuropean manufacturing and services: evidence from a dynamic panel model', *AppliedFinancial Economics*, 15, 1269-1282.

Goldberg, P. and N. Pavcnik (2007). " Distributional Effects of Globalization in Developing Countries", *Journal of Economic Literature*, March 2007, 45(1), : 39-82

Greenaway, D. and R. Kneller (2004), 'Exporting and Productivity in the UK'. *Oxford Review of Economic Policy*, 20, 3, 358–71.

Greenaway, D. and R. Kneller (2007), 'Firm Heterogeneity, Exporting and Foreign Direct Investment'. *Economic Journal*, 117, 517, 134–61.

Grossman, G. and E. Helpman, 1991, *Innovation and growth in the Global Economy.* Cambridge,Massachussets: The MIT Press.

Haddad, M., (1993), 'How Trade Liberalization Affected Productivity in Morocco,' Policy Research Working Paper no 1096. Washington D.C.: The World Bank.

Harris, Richard, Qian Cher Li, and John Moffat(2013):. "The Impact of Higher Education Institution–Firm Knowledge Links on Establishment-Level Productivity in British Regions*." *The Manchester School* 81, no. 2 143-62.

Hansson, P. and N. Lundin (2004), Exports as Indicator on or a Promoter of Successful Swedish Manufacturing Firms in the 1990s. Review of World Economics/ WeltwirtschaftlichesArchiv, 140, 3, 415–45.

Hansson and Lundin (2004), Exports as an indicator on or promoter of successful swedish manufacturing firms in the 1990s

Harrison, A., (1994), 'Productivity, Imperfect Competition, and Trade Reform: Theory and Evidence,' *Journal of International Economics* 36, pp. 53-73.

Helpman, Elhanan. "Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries." *Journal of the Japanese and International Economies* 1, no. 1 (1987): 62-81.

Helleiner,G. (1991), 'Closing the Technology Gap: Does Trade Liberalization Really Help?' in *Trade Policy, Industrialization and Development: New Perspectives*, edited by G. Helleiner. Oxford Clarendon Press.

Hopenhayn, (1992); Entry, exit, and firm dynamics in long run equilibrium. EconometriaVol 60 n°5

Lileeva, Alla, and Daniel Trefler. "Improved Access to Foreign Markets Raises Plant-Level Productivity…for Some Plants." *The Quarterly Journal of Economics* 125, no. 3 (August 1, 2010 2010): 1051-99.

Manova, Kalina, and Zhiwei Zhang. "Export Prices across Firms and Destinations." *The Quarterly Journal of Economics* 127, no. 1 (February 1, 2012 2012): 379-436.

Marschak Andrews, (1944); Random Simultaneous Equations and the Theory of Production

Mánez-Castillejo, J.A., M. E. Rochina-Barrachina and J.A. Sanchis-Llopis (2010), Does firm size affect self-selction and learning-by-exporting? The World Economy, 33 (3), 315-346.

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

Melitz, Marc J. 'The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity' *Econometrica* 71, no. 6 (2003): 1695-725.

Melitz, Marc J., and Giancarlo I. P. Ottaviano. "Market Size, Trade, and Productivity." *The Review of Economic Studies* 75, no. 1 (2008): 295-316.

Neary, J. Peter. "Putting the "New" into New Trade Theory: Paul Krugman's Nobel Memorial Prize in Economics." *Scandinavian Journal of Economics* 111, no. 2 (2009): 217-50.

Nishimizu, M. and J. M. Page Jr., (1982), 'Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia 1967-78,' *Economic Journal* 92, pp. 920-36.

Olley, G. S. and A. Pakes (1996), 'The dynamics of productivity in the telecommunications equipment industry'. Econometrica, 64(6), 1263–1297.

Robert Salomon and Byungchae Jin (2008). Does knowledge spill to leaders or laggards? Exploring industry heterogeneity in learning by exporting.

Roberts and Tybout, 1997, ***Roberts***, Mark J & ***Tybout***, James R, ***1997***. 'The Decision to Export in

Colombia: An Empirical Model of Entry with Sunk Costs, '*American Economic Review.*

Robert M. *Solow*, (1957). ' Technical Change and the Aggregate Production Function ', *The Review of Economics and Statistics*, vol. 39, No. 3.

Rodrik, D., (1988), 'Imperfect Competition, Scale Economies and Trade Policy in Developing

Countries,' in *Trade Policy Issues and Empirical Analysis*, edited by R.E. Baldwin. Chicago: University of Chicago Press.

Yu, M. and M. Dai (2011), Pre-Export R&D, Exporting and ProductivityGains: Evidence from Chinese Firms. China Trade Research Group Working Paperseries, 11.

Salomon R and B. Jin (2008) 'Does knowledge spill to leaders or laggards? Exploring

industry heterogeneity in learning by exporting', *Journal of International BusinessStudies*, 39, 132-150.

Serti, F., and C. Tomasi (2008). Self-Selection and Post-Entry Effects of

Exports:Evidence from Italian Manufacturing Firms. Review of World Economics/WeltwirtschaftlichesArchiv, 144 (4), 660–694.

Söderbom, M. and F. Teal, (2000), 'Skills, Investment and Exports from Manufacturing Firms in Africa,' *Journal of Development Studies* 37, pp. 13-43.

Tybout, J. R. and M. D. Westbrook, (1995), 'Trade Liberalization and the Dimensions of Efficiency Change in Mexican Manufacturing Industries,' *Journal of International Economics* 39, pp. 53-78.

Tybout (1998) Manufacturing Firms in Developing Countries: How Well Do They Do, and Why? Journal of Economic Literature Vol. XXXVIII (March 2000) pp.11–44.

Van Biesebroeck, J. (2005), 'Exporting Raises Productivity in Sub-Saharan Manufacturing Plants.' Journal of International Economics, 67, 2, 373–91.

Wagner, J. (2002), The Causal Effects of Export on Firm Size and Labour Productivity: First Evidence from a Matching Approach, Economics Letters, 77(2), 287–92.

Wagner J (2007) 'Exports and productivity: a survey of the evidence from firm-level data', *The World Economy*, 30, 60-82.

World Bank (1993) *The East Asian Miracle* (New York: Oxford University Press)

Annexes

Table A1: Senegal, Industrial Policy Matrix

Table A1: Senegal, Distribution of the firm by sector, 1998-2011

Year	Textiles	Agro-industries	Others industries	Total firms
1998	18	91	314	423
1999	20	102	346	468
2000	21	114	374	509
2001	22	125	428	575
2002	23	145	465	633
2003	22	154	503	679
2004	26	191	600	817
2005	27	205	641	873
2006	27	225	698	950
2007	27	239	732	998
2008	27	259	764	1050
2009	30	253	766	1049
2010	36	254	769	1059
2011	21	242	717	980

Source : Authors estimations

Table A.2. Senegal, Summary statistics by export status

Variables	Number of exporters (					Number of non exporters				
	Testofequality of means					Test for equalityof variances				
	Non export	Export	Ecart (NE-E)	p-value	Null hypothesis	Non export	Export	Ecart (NE-E)	p-value	Null hypothesis
Turnover	1,75E+09	1,11E+10	-9,35E+09	0	Rejected	1,20E+20	1,03E+21	-9,10E+20	0	Rejected
Raw material and other supplies	4,03E+08	1,92E+09	-1,52E+09	0	Rejected	3,58E+18	2,17E+19	-1,81E+19	0	Rejected
Capital	3,97E+08	1,09E+09	-6,93E+08	0,0001	Rejected	2,88E+19	2,66E+19	2,20E+18	0,0868	Rejected (à 5%)
Staff cost	1,90E+08	8,67E+08	-6,77E+08	0	Rejected	1,17E+18	2,27E+18	-1,10E+18	0	Rejected
Salaries	239793,8	671172	-4,31E+05	0	Rejected	1,4095E+12	1,3623E+12	4,73E+10	0,2654	Accepted
Values added	2,64E+08	2,02E+09	-1,76E+09	0	Rejected	5,74E+18	2,61E+19	-2,04E+19	0	Rejected
Skill labor	3,972272	8,410292	-4,44E+00	0	Rejected	55,32711	196,3259	-1,41E+02	0	Rejected
Firm size	97,98043	262,058	-1,64E+02	0	Rejected	151628	255646	-1,04E+05	0	Rejected
Value added per capita	6701479	1,03E+07	-3,60E+06	0,0228	Rejected	2,007E+15	5,4289E+14	1,46E+15	0	Rejected
Capital per capita	**5661545**	**5093933**	**5,68E+05**	**0,5891**	**Accepted**	**8,8209E+14**	**7,322E+13**	**8,09E+14**	**0**	Rejected
Firm age	12,92267	20,25803	-7,34E+00	0	Rejected	156,723608	248,482257	-9,18E+01	1	Accepted
Costs of research and development	1,26E+09	3,14E+07	1,23E+09	0,0195	Rejected	1,4288E+19	7,1234E+15	1,43E+19	0	Rejected
Patents, licenses, software	**1,59E+07**	**1,61E+07**	**-2,00E+05**	**0,9491**	**Accepted**	**1,0201E+16**	**4,356E+15**	**5,85E+15**	**0**	Rejected

Source : Authors estimations

Table A3: Senegal, Distribution of the firm by status and by sector, 1998-2011

Export status	Proportion
Never export	0,8143361
Permanent exporters	0,0012655
Single entry	0,0199765
Single exit	0,0195245
Switchers	0,1448974

Source : Authors estimations

Table A4: Senegal, Distribution of the firm by status and by sector, 1998-2011

				Exports status during the period 1998-2011				
Industry	**Number of firms**	**% in the total firms**	**Observations**	**Entry single**	**Single exit**	**switcher**	**Permanent**	**Never**
ENERGIE	41	3.48	315	1		3		37
FABRITION D'AUTRES PRODUITS MINERAUX NON	14	1.19	162	1		3		10
INDUSTRIES CHIMIQUES	58	4.93	642	2	3	19	1	33
BOULANGERIE, PATISSERIE ET PATES ALIMENT	163	13.85	1342	2		4		157
INDUSTRIES DES BOISSONS	14	1.19	119	1		2		11
INDUSTRIES DES OLEAGINEUX	5	0.42	54			2		3
INDUSTRIES LAITIERES	14	1.19	148		1	2		11
INDUSTRIES DIVERSES	29	2.46	273			7		22
INDUSTRIES DU BOIS	18	1.53	185			1		17
INDUSTRIES DU CAOUTCHOUC ET PLASTIQUES	38	3.23	420	3	1	10		24
INDUSTRIES DU CUIR ET DE LA CHAUSSURES	13	1.10	157		2	2		9
INDUSTRIES DU PAPIER ET CARTONS, DE L'ED	90	7.65	887	4	1	9		76
INDUSTRIES TEXTILES ET HABILLEMENT	29	2.46	333		1	9		19
METALLURGIE ET TRAVAIL DES METAUX	63	5.35	636			8		55
PREPARATION DE SITES ET CONSTRUCTION D'O	337	**28.63**	2878			8		329
PRODUCTION DE VIANDE ET DE POISSONS	38	3.23	391	2	4	10		22
TRANSFORTION DES FRUITS ET LEGUMES ET FA	47	3.99	468	3		10		34
TRAVAIL DES GRAINS ET FABRICATION DE PRO	6	0.51	77			4		2
TRAVAUX D'INSTALLATION ET DE FINITION	115	9.77	1082		1	5		109
AUTRES INDUSTRIES MECANIQUES	45	3.82	480	2	4	6		33
Total	**1177**	100.00	**11049**	21	18	124	1	1013

Source : Authors estimations

Table A5. Table A1: Senegal, Industrial Policy Matrix

Indicate the time period	Policy objectives	sectors / activities targeted	Instruments	Results
1960s and 1970s	protection of local industry	Promotion of private sector Activities of processing of local and imported products Promotion of investment Senegalese businessmen Large companies Foreign investors Small and medium enterprises Exporting companies	High port duties, quotas, licensing, Prohibition Investment Code Investment Code to lower investments 20 millions Raising capital, including public capital Special agreements and memoranda of understanding between business companies and government Industrial areas EPZ Dakar	An industrial fabric composed of large enterprises without trade between them and weakly competitive during the 1960s and 1970s
1980s and 1990s	Improvement of the overall business environment, under the New Industrial Policy (NIP) during the years 1979-1993	All sectors Exporting companies	Macroeconomic stabilization Reducing the level of protection Liberalization of prices and marketing channels Simplification of administrative procedures Improving the efficiency of public services Subsidies / export financing Status of free points established in 1991 Business closures and job losses, particularly in the textile sector between 1988 and 1993	Fermetures d'entreprises et pertes d'emplois, notamment dans le secteur textile entre 1988 et 1993
	Improving competitiveness Facilitating access to counseling industrial activities	Industrialactivities	Devaluation in 1994 and reforms Creation of Private Sector Foundation Industrial Restructuring Fund Abandonment of quantitative restrictions Simplification of the system of tariffs and reduced rates in the Common External Tariff (CET) of WAEMU	Renewed dynamism and growth of the industrial sector during the years 1995-2005 after the forced restructuring driven by the NIP and in the effect of devaluation and possibly CET
Since2000	Rationalization of the support system to the private sector.	SMEs	Creation of APIX (2000), ADEPME (2001), ASN (2002), the CPI (2002)	Slow growth during the years 2006 - 2011 under the effect of exogenous shocks, and insufficient competitiveness
	Recovery / promotion of industries, industrial redeployment	Sectors and SMEs	Business environment of international standard, Economic centers Special Economic Zones	
	Improving export competitiveness	Export businesses	Growth clusters approach (2005) Creation of ASEPEX (2005)	