FEP WORKING PAPERS
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RESEARCH WORK IN PROGRESS
N. 364, MAR 2010

LEARNING-BY-EXPORTING: WHAT WE KNOW AND WHAT WE WOULD LIKE TO KNOW

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Learning-by-exporting: what we know and what we would like to know

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Abstract

This paper revises the thesis that exporting firms learn to be more innovative and efficient as they have contact with certain information flows from their foreign activity (e.g., from buyers, suppliers or competitors). The paper begins by exploring the connections between two distinct concepts: Self-Selection (of more efficient firms into exports) and Learning-by-Exporting. The study then proceeds with a comparative analysis of the most recent literature and presents common facts and evidence, as well as key issues still open to debate. Learning-by-Exporting should be measured directly using firms´ innovative performance. However, given the lack of suitable data on firms' innovative activities most studies have followed an indirect approach, using productivity measures. Several methodologies have been employed to estimate Total Factor Productivity and to test the Learning-by-Exporting hypothesis, but so far no final consensus has been reached on the best way to do it.

Keywords: Learning-by-exporting; self selection; total factor productivity.

JEL classification: F10, F20, O47.

February 2010

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1. Introduction

Productivity is crucial to determining living standards and thus anything that changes productivity levels or their growth rate is decisive. Moreover, for most countries foreign sources of technological knowledge are of paramount importance in accounting for productivity growth. The diffusion of international technological-knowledge expertise and consequent learning by firms justifies the interest of researchers and policy makers.

At the macro level, the links between growth and trade, especially the positive connection between exports and growth (export-led growth), seems to be well established and consolidated. At the micro level, studies and data availability are both much more recent and, in spite of extensive literature produced over recent years (especially in the empirical domain), the links between exports and firms' productivity growth are not fully understood.

Despite widespread agreement that only the most productive firms can overcome the sunk costs of initiating exports (the Self-Selection (SS) thesis) there is much discussion over the possibility that exports may also enhance productivity (the Learning-by-Exporting (LBE) thesis). Although not mutually exclusive, the former concept means that "more efficient firms become exporters" while the latter concept holds that "exporters become more efficient firms". Beyond these one-sided explanations some authors have presented an integrated explanation for the correlation between exports and productivity. They argue that both the export entry and the associated increase in productivity are the result of the management's previous and conscious decision to enter foreign markets, and the need to increase efficiency thereafter – "conscious self-selection" using the words of Alvarez and Lopez (2005). They consider that when firms decide to focus on foreign markets they anticipate investments that will allow them to compete in that context (thus causing a concurrent path of foreign exposure and productivity) instead of assuming that those investments are exogenously decided.

The importance of the LBE effect is more than an academic issue. Indeed, if LBE really exists then governmental aid for the internationalization of firms should be clearly justified by productivity advances in those firms, and eventually in others benefiting from possible positive externalities of exporters. The empirical literature on this subject reveals some controversy surrounding the existence of LBE effects, with contrasting results between case studies that confirm LBE and several empirical works that suggest otherwise. This paper has three main goals: i) to clarify the meaning of LBE and its links with similar concepts; ii) to understand the connection between the ways in which it has been tested by empirical studies and the results obtained, namely why there is so much variability in conclusions; iii) to identify work that needs to be done to get an adequate and full understanding of the LBE.

The rest of the paper proceeds as follows. Section 2 analyses conceptual issues, Section 3 reports empirical results and their main contributions and handicaps. Section 4 discusses LBE in a broader framework and the links between trade and productivity at firm level. Finally, there are some concluding remarks in section 5.

2. Conceptual issues

2.1. Learning-by-exporting: origins of the concept

The idea that exporting firms may benefit from their foreign buyers' technical and managerial expertise or the expertise of other foreign contacts (e.g., competitors, suppliers or scientific agents) began to be discussed and studied (empirically and theoretically) in the mid-80s with Rhee *et al*. (1984), Westphal *et al*. (1984) and in the 90s with Grossman and Helpman (1991) and the World Bank (1993). The motivation for this arose from the study of successful links between country-level exports and economic growth in Asian countries in the 60s and 70s.

LBE at firm level has been researched using two different but complementary approaches: in the case study approach firms are questioned about the sources of

technological knowledge improvements, and more recently, large firm-level data sets are used to test the importance of exports on productivity improvements.

Case studies seem to be decisive to the understanding of the core concept of LBE. Rhee *et al*. (1984) surveyed 112 Korean exporting firms and noticed that 40% of them claimed to have learned from their foreign buyers. That learning materialised in improved techniques of quality control and production, and was the result of interactions involving personal contacts, blueprints and specifications: "The important thing about foreign buyers (…) is that they do much more than buy and specify. The same is true (…) of foreign suppliers. Foreign buyers and suppliers provide access to information about what product styles are wanted and about how to make products of a desired style. They come in, too, with models and patterns for Korean engineers to follow, and they even go out to the production line to teach workers how to do things" (Rhee *et al*., 1984, p. 41).

Along the same line, Evenson and Westphal (1995) argued that it was the foreign buyers' desire to buy products with more quality and lower prices that clearly generated an incentive for producers (exporters) to become more efficient: "(…) a good deal of the information needed to enhance basic capabilities has come from the buyers of the exports who freely provided product designs and offered technical assistance to improve process technology (…) some part of the efficiency of export-led development must therefore be attributed to externalities derived from exporting" (Evenson and Westphal, 1995, p. 2264).

The effect of foreign buyers improving their suppliers technical performance is well documented in Keesing and Lall (1992); they report for five Asian firms (in the period 1979-1980) that foreign buyers often established offices in exporting countries in order to more efficiently advise local firms on new technologies, quality control or design changes. In another example, Egan and Mody (1992) studied U.S. imports of bicycles and footwear from East Asian countries in the mid-eighties and found that the links between developed country

buyers and developing country suppliers acted as a channel for information about marketing and production technology and provided access to larger industry networks.

Lopez (2005) reports other case studies where one can empirically observe the role of foreign customers in firms' improvements in expertise and technological-knowledge led by their exports. That role may include, among others, help with factory layout, assembly machinery, engineering support or assistance to ensure quality.

Grossman and Helpman (1991) developed a theoretical model in which intangible ideas spillover through the exchange of tangible commodities. Trade opens up firms to the knowledge held by their trading partners and allows it to be incorporated into domestic production, enabling higher productivity and production growth. They present LBE as an (positive) effect on local knowledge stock, derived from the extent of contacts between domestic agents and their counterparts in the international research and business communities. The number of such contacts increases with the commercial exchange level and this is how the connection between efficiency improvements and exports is established. The same idea underlying LBE is that "exporting activities enable firms to increase their efficiency since they obtain access to new technology and technical assistance" (Chongvilaivan, 2008, p. 3). Also Salomon (2006, p. 56) argues that exporting firms become privy to technological discoveries made in foreign locations and "as such, the firm may gain some technological insight and use this knowledge to improve its product or process".

As an example of the implementation of these ideas Utar (2009) tests successfully for Chilean firm-level data, that exporting firms may benefit from higher opportunities to access and absorb foreign technology and information obtained in the international technical and professional services markets. From his perspective LBE can result from an intentional effort to properly use and develop technological abilities enhanced by foreign contacts with technical and professional services.

From a historical perspective, Bernard and Jensen (1995) and Aw and Hwang (1995) presented the first studies on LBE based on large firm-level datasets. Although they recognised that export-oriented firms had higher productivity levels, they could not distinguish empirically between two alternative hypotheses: whether productivity differences were the result or the cause of export activity. What was clear and solid at case-study level became confused at large firm panel data sets. In the following years most studies tried to distinguish between LBE and SS. In addition, studies evolved from studying static trade effects on productivity levels to the dynamic trade effects on productivity growth at the firm level and also at sectoral and macro levels.

2.2. Connections with similar concepts

LBE assumes that exporting can induce within-firm improvements. Those benefits are not static as they refer to the innovative advances, organizational efficiency or communication competencies over time. However, not all exporting effects refer to LBE, for example the static gains from scale effects; additionally, exporting may also generate spillovers to other firms beyond the exporting ones. Thus, several related concepts require some clarification.

2.2.1. Learning-by-doing

The concept of LBE has high similarity with the idea of *Learning-by-Doing* (LBD) of Arrow (1962). LBD occurs when workers and managers gain experience in solving technical or organisational problems. As the knowledge gap begins to shorten, LBD is subjected to diminishing returns. Applying Arrow's LBD to "learning-by-doing-exports" is justified because firms breaking into export markets must learn as they face more demanding foreign consumers, higher quality standards and more demanding timing orders. Hence, young plants are much more likely to face new technical and organisational problems and then are much more able to benefit from the experience of beginning to export.

Fernandes and Isgut (2005) found strong evidence of this logic among Colombian firms. They noticed that young firms that entered the export markets observed Total Factor Productivity (TFP) growth rates 3% to 4% higher than those in young plants that never export. They also concluded that firms already having the ability to succeed in export markets and which were export-experienced are unlikely to learn from exports, in contrast with firms poorly involved with exporting, which had a lot to learn if they wanted to achieve success.

2.2.2. Increases in capacity utilisation

During the initial exporting period a firm reveals higher productivity growth than non-exporting firms, and this event can be connected with an initial one-time scale effect induced by access to larger product markets. Kostevc (2005) found that in Slovenian firms there is only increased productivity growth in the entry year of exporting. This is different from LBE, where productivity growth would be permanent and often not even observed in the first year.

Kostevc (2005) admits that, given the larger markets generated by exports, firms could diminish their average production cost and then increase the value added compared to non-exporting firms. He considers that exporting firms could benefit from spare capacity, which would not reflect any learning process. He clearly points out that difference by stating (p.30) "the effect of the productivity hike diminishes quickly as firms proceed to increase their size to accommodate the increased sales. The observed productivity improvements are hence primarily a reflection of the growth in inputs".

Other studies have also found increases in capacity utilization: Alvarez and Lopez (2005) found short-run productivity gains for plants entering foreign markets, but they did not make a clear distinction between LBE and scale effects. They argue that the initial productivity gains for exporters could also derive from differences in product mix between exporters and non-exporters, or from different mark-ups in domestic and in international

markets. Tekin (2007) in a study for Chilean plants finds a hike in productivity only in the entry exporting year, while the productivity growth of entrants is no higher in the next years.

Similarly, Pisu (2008) argues that "true" LBE does not reveal itself at once, and its effects should take some time before they are detected since managerial improvements, innovations and adoption of new technologies cannot cause immediate effects in productivity. He also states that LBE effects could never last only one period (year) as scale effects do. However, he observes that researchers use only annual data and then are unaware of the exact time (day or month) a firm started to export in a given year, disabling further detail work.

2.2.3. Productivity spillovers of exports

Productivity Spillovers by Exporting (PSE) or "demonstration effects" are the effects that exporting firms generate on other domestic and/or exporting firms' sales or productivity. PSE can arise due to the accumulated knowledge of technology, foreign markets and marketing that internationalized firms possess. This could be used by other firms to increase their productivity.[1] PSE could also be negative or have mixed effects, since an increase in the new exporters' demand for labour or other specialised input can generate an increase in input prices or even a shortage of it – Karpaty and Kneller (2005) call it "congestion effects".

In discussing the effects of exporting firms on the economy, the PSE is more relevant than the LBE issue. Indeed, the existence of PSE may justify public export promotion, while LBE may not. PSE materialises as a positive externality from investment on external sales, labour training or improving goods for foreign markets. These actions can be imitated by other firms (the so-called "demonstration effects") without supporting the same costs.

The literature on PSE is highly limited owing to the lack of direct data on individual transactions between an exporter and its customers or suppliers. Moreover, to test the capacity

[1] As Alvarez and Lopez (2008) state, this transmission is costless and justifies the idea that investing in new markets, developing new products or training the labour force for international markets may have costs that are lower than the socially optimal level.

of some exporting firms to increase other firms' performance, one must account for the existence of sunk costs to entry in foreign markets, and only high PSE levels could overcome those costs and be observable. Alvarez and Lopez (2008), in an empirical study of PSE on domestic owned enterprises, found evidence of positive productivity spillovers from exporters to their suppliers. They also noticed that higher exporting activity in a sector increased the productivity of the other plants in the sector. They also found that exporters' ability to create spillovers to other firms was not much different between domestic-owned exporting firms and foreign-owned exporting firms. Greenaway and Kneller (2008) also found evidence of PSE for the UK firms that have neighbour exporters or are located in high-export intensity regions.

2.2.4. Learning-to-export

Alvarez and Lopez (2005) define LBE as the productivity change in firms after they begin to export, distinguishing it from "learning to export" or "conscious self-selection to export". The latter concept represented gains in efficiency after the decision of becoming an exporter was taken but before exports really begin. They argue that firms consciously adopt measures to increase productivity and to overcome the higher entry costs of foreign markets. They also acknowledge that future exporters contact (or are contacted by) future foreign buyers to plan business. Iacovone and Javorcik (2008) also present evidence of a conscious preparation by future exporters, namely with investments that enhance or upgrade product quality.

To analyse the relationship between performance and internationalization, the problem of identifying whether selection or learning is the engine at work becomes crucial. Although the two mechanisms are not mutually exclusive and are even likely to coexist, for policy purposes it is essential to distinguish the causality direction and the weight of each effect.

2.2.5. Learning to innovate (by exporting)

The LBE hypothesis has been difficult to prove empirically. Indeed, international market informational flows obtained in contact with foreign economic agents may more probably

result in additional ability of domestic firms to innovate (mainly in product innovation to meet a particular specification for their foreign customers) than in significant productivity effects.

Recently, some LBE studies have focused on testing the impact of exporting directly on innovation, thus recognizing the role of innovation as a driver of productivity differences across firms. A small number of papers, mainly exploring Community Innovation Surveys (CIS), tried to use a more direct measure for LBE, studying the connection between firm's performance on innovation (the consequence) and exporting (the cause). This Learning-to-Innovate-by-Exporting (LIBE) literature has contributions by Salomon and Shaver (2005), Crespi *et al*. (2008), Liu and Buck (2007) and Damijan *et al*. (2008). In all these papers, a positive association is found between exporting and innovation performance at the firm level.

As exporting is a knowledge-transmission channel, the ability of exports to promote innovation may result from several sources: information exchange with foreign markets, personal contacts with foreign buyers and intermediaries and higher competition pressure., Domestically, however, innovation may also be influenced by a firm's own R&D infrastructure as well as by horizontal or vertical domestic spillovers.

2.3. Fundamental causes of LBE

Castellani (2002, p.2) refers to LBE as "a change in the stochastic process governing firms' productivity that is induced by export behaviour". The reasons for this change could be: either the exploitation of economies of scale from the larger international markets (static efficiency gains) or the (true) LBE process based in fierce competition, contacts with foreigner buyers and new problems that challenge technological development and can produce dynamic efficiency gains. In that sense LBE is not simply the outcome of a presence in the export market, but depends on the experience and commitment of the exporting firms. Serti and Tomasi (2007) also refer to "post-entry effects" as the outcome of firms that become more efficient after they begin to export. For them, LBE is one of the two main mechanisms that

explain those "post-entry effects" and it refers specifically to the technological drivers of productivity increases. The other mechanism, economies of scale, does not rely on technological improvements but only in static gains from greater efficiency.

The existing literature (e.g., Greenaway and Kneller, 2007; Hiep and Otha, 2009) presents some reasons why exporting can lead to a persistent increase in a firm's productivity. Firstly, exporting firms can more easily access new technologies of production or new designs. Secondly, those firms can also receive technical assistance either from their foreign buyers (e.g., Blalock and Gertler, 2004) or from international technical and professional services that are more easily available to exporting firms (e.g., Utar, 2009). Thirdly, exporting firms in contacts with their foreign counterparts and competitors can also more easily access advanced managerial skills or marketing techniques that may enhance efficiency.

In an empirical application on this subject, Blalock and Gertler (2004) interviewed several Indonesian factory managers in 2000 and found that Japanese and German buyers sent engineers to local plants in order to review production methods, to adapt product to destination markets or even to advise local managers about machinery investment. They also relate that exporting firms may benefit from additional competition in foreign markets.

Conceptually, LBE requires "experience". As Andersson and Loof (2008, p.5) stress, "The potential for learning from an activity is in this view linked to the persistence of the activity". Thus, LBE may take some time to occur, which, as many firms are only temporary exporters, opens a discussion on the ability of empirical research to detect LBE. Some studies in the management and marketing literature (e.g. Koh - 1991) clearly demonstrate that during the internationalisation process a firm gradually "learns" to organise production and processes in accordance with competitive international markets, even if this "learning" is not substantial enough in the first period to be classified as LBE. Thus, LBE should be observable for some time even after exporting ceases, in line with certain economic hysteresis mechanisms.

3. Review of empirical literature on LBE

3.1. Modelling empirical work

In contrast with the SS thesis and its background in heterogeneous-firm trade theories for which several theoretical models were applied (*e.g.*, Melitz, 2003; Bernard and Jensen, 2004.b; Yeaple, 2005), there are only a few models that offer support for LBE arguments in endogenous growth studies, to guide the empirical evaluation of LBE.

Clerides *et al*. (1998) presented a theoretical model of export participation with learning effects which integrate LBE. Their model was based on hysteresis literature and on a dynamic problem of forward-looking decision-making on whether to export or not in each period. LBE was formally linked to the marginal cost function, as this cost was a decreasing function of the previous participation of the firm in foreign markets. Empirically, comparing productivity (measured by average variable costs) trajectories for firms with different export participation they found that on average, cost and productivity did not alter after firms entered foreign markets. Additionally, performing a type of Granger causality test, they simultaneously estimated an autoregressive cost function and a dynamic discrete choice equation which described the export market participation decision. Overall, they found LBE consistent only in Moroccan apparel and leather products (but not in Mexico or Colombia). Ten years later, Trofimenko (2008) developed and extended the model of Clerides *et al*. (1998) in two ways: i) assuming higher entry costs in more developed markets and ii) assuming different export learning rates depending on the development level of the destination market.

Pack and Saggi (1999) developed a model in which they explain the fundamentals of LBE as firms from industrial countries transfer technology to a developing-country exporter firm. These transfers can reduce the price of the exported good and then provide a saving for the importer. Moreover, they also held that if technology is transferred to a developing country firm, even if there were a leakage of technology to a third developing country firm,

this would increase the competition among developing-country suppliers and would benefit the industrial country's firm even more.

Kostevc (2005) and also Damijan and Kostevc (2006) present general equilibrium models of trade and foreign market monopolistic competition in which higher competition environment generates the need for LBE. These models rely on the monopolistic competition general equilibrium trade modelling proposed by Fujita *et al*. (1999). In fact, as a firm (mainly from a less developed country) faces strong competition from foreign markets and the price elasticity of the demand is higher in those markets, the firm needs to improve its productivity (lowering its marginal costs) to stay in the market. As the number of supplied varieties of differentiated goods increases in developed countries, these authors assume that the elasticity of substitution between varieties rises, implying that as the price-demand elasticity becomes higher it then decreases the slopes of individual demand curves and the price of those firms.

3.2. Methodological issues

The empirical research on LBE has been done with business case studies and with micro panel data studies. In order to empirically test for the existence of LBE several econometric methods have been employed and their difficulties and problems are identified; matching methods have proven to be the most promising ones.

3.2.1. Case studies

During the eighties firm-level empirical investigation on exports-productivity connections was conducted by case-study approach and mainly for East Asian firms. That analysis consisted of asking managers (of selected firms engaged in exporting sales) directly if they had received some kind of assistance or information from the contact with their foreign customers. López (2005) presents a survey of these studies, involving firms from Asia and South America. Buckle and Cruickshank (2007) also mention some studies of this kind.

These studies clarified and stressed the mechanisms by which technological knowledge and expertise flowed internationally. They also had some limitations: they had a selection bias, as tended to choose and study most successful exporters, and they were unable to quantify the effect of exports on firms' productivity and performance.

3.2.2. Micro panel-data studies

***Common evaluation difficulties* – the role of the unobservable and the TFP estimation.**

The connection between the beginning of exporting activity and productivity gains may have several explanations. LBE may be one factor but other possibilities exist. A change in firm management or ownership or taking a new attitude concerning both the risk and challenge of internationalisation are other explanations. The fact that a firm does not export at a given time does not have to necessarily be related with the level of productivity of the firm; the beginning of an exporting activity may not be connected with a productivity issue but to a management issue instead. Given the fact that these factors are not observable, common tests of LBE disregard such understandings and do not disentangle "true" LBE from "simple" changes in firms' management or strategy.

Saxa (2008) is an important exception to this approach. He studies firms that start to export due to exogenous causes such as variations on industry-specific exchange rates and industry-specific producer prices, in order to identify exogenous factors that could motivate firms to export. This way he endeavours to disentangle learning-by-exporting from "simple" changes in firm management that bring the firm to enter foreign markets and at same time to introduce productivity increasing measures which are not LBE.

At another level, since the large majority of empirical works on LBE use productivity in levels or growth as the explained variable (reflecting the learning obtained by exporting), this measurement is of upmost importance for a correct LBE assessment. However, differences in productivity measures imply differences in the conclusions about LBE reality.

The use of a simple labour productivity indicator has been the choice for several authors (e.g., Aldan and Gunay, 2008 or Saxa, 2008). TFP should be used instead, as a more precise indicator of productive efficiency because it also accounts for both capital intensity and capital productivity. However, two main difficulties arise in measuring TFP: first, the choice of the production function[2] and second the very estimation of TFP, since productivity and input choices are likely to be correlated. In fact, TFP estimation involves endogeneity problems that require other methods than the simple OLS regression in a production function for which not all output is explained by the inputs consumption. In order to overcome such problems of endogeneity several procedures were tested. The use of instrumental variables estimator has been most common.

Different approaches include, e.g., Blundell and Bond (2000) who use input prices and lagged values of inputs consumption, Olley and Pakes (1996) who use firm investments as a proxy controlling for the part of the error term correlated with inputs, and Levinhson and Petrin (2003) who use intermediate inputs as proxies that control for correlation between input levels and unobserved firm-specific productivity process. It is also worth mentioning that a different approach is employed in some studies (e.g., Hahn and Park, 2009; Bellone et al., 2008 or Delgado et al., 2002) that compute a TFP index for each firm at each year. The use of this methodology was pioneered by Caves et al. (1982) and Good et al. (1997).

Different assessment methodologies applied

To assess LBE two main approaches have been used; using firm productivity level or growth as the dependent variable, and innovation levels or growth as the explained variable.

i) LBE assessed through productivity

Beginning with Bernard and Jensen (1995) a standard approach to the evaluation of the differences between exporters and non-exporters became common in empirical assessments of

[2] Cobb-Douglas production function was dominant but also translog functions were used: e.g. Bisten et al. 2000.

SS and LBE. Specifically for LBE evaluation, this method means to use regression of log productivity or of productivity growth differences between groups of firms, on current export starter dummies and other controls. This way it is possible to compare firms that are"new" exporters with non-exporters a few years after exports begin.

In some variants of this methodology some authors have developed sectoral studies, while others use particular nuances: Clerides *et al*. (1998) used the General Method of Moments (GMM) with panel data, as they were interested in estimating both SS and LBE. Bigsten *et al*. (2000) mixed GMM with maximum likelihood and Hallward-Driemeier *et al*. (2002) used the instrumental-variables method.

Meanwhile, different structural approaches were tested. One method was to the test for stochastic dominance of productivity distribution for exporters over the productivity distribution for non-exporters, tested non-parametrically using the Kolmogorov-Smirnov test. This method was used to discuss the issue of exports and productivity for the first time by Delgado et al. (2002) but other applications were also made: e.g., Girma et al. (2003) or Cassiman and Golovko (2007).

A related extension of the standard approach consisted in the analysis of the relationship between exports and productivity by a quantile regression, introduced to this field by Yasar et al. (2003). Quantile regression allows testing for differences in the effects of exporting on firm productivity by moves from the lower to the upper tail of the conditional productivity distribution, and to identify the regions where these effects are stronger or weaker.

Despite the different approaches, common problems and handicaps of this framework are noticed, namely the selection bias of starters. It is now well-recognized in the literature that the decision to become an exporter is not a random event but the result of deliberate choice, thus requiring a special effort to correctly identify the true effect of becoming an exporter on firm's productivity (e.g., Loecker 2007). In fact, the decision to be an exporter is

likely to be correlated with the stochastic disturbance terms in the data generating process for a firm's productivity, so that the traditional simple mean difference test on productivity differences between exporters and non-exporters does not provide the correct answer.

Moreover, matching methods assume that for a firm, beginning to export is like starting a treatment and, therefore, the econometric aim must be to assess the effects of treatment on the treated. Nevertheless, given the self-selection of more productive firms to export, we cannot compare the performance of the treatment group (new exporters) with the non-treated (non-exporters). Matching enables constructing a group of pseudo-observations containing the missing information on the treated outcomes if they had not been treated by paring each participant with members of the non-treated group. The crucial assumption is that, conditional on some observable characteristics of the participants, the potential outcome in the absence of the treatment is independent of the participation status. Then differences between treated and matched non-treated outcomes can proxy for treatment effect (exporting).

A matching approach on LBE, pioneered by Wagner (2002), was followed by several authors (*e.g.*, Girma *et al*., 2004; Fernandes and Isgut, 2005; De Loecker, 2007; Tekin, 2007). Several extensions of the matching methods based on propensity scores were also presented: Arnold and Hussinger (2005) complemented it with the Granger causality test; Fryges and Wagner (2007) extended it to a new methodology: the generalised propensity score (GPS), which allows continuous treatment for different levels of the firm's export activities. Currently, matching methods are the most commonly used method to assess LBE.

ii) LBE assessed through innovation

In a different and less frequent framework, some authors (e.g., Damijan *et al*. 2008) use firms´ innovation instead of productivity in order to evaluate both the SS and the LBE hypothesis. In this branch of the literature it is common to assume that SS materializes in the firms´ decision to begin to export, which is linked to a previous productivity increase enabled by a

product innovation. In addition, LBE occurs as a result of increased exporting activity that generates the need and the opportunity to process-type innovations and the consequent productivity increment. Several studies have studied the relationship between exports and innovation using direct information on the innovation activity of firms. But most of them have investigated whether innovation induces exports (e.g., Roper and Love, 2002 or Cassiman and Martinez-Ros, 2007, or Caldera, 2009,[3] among others) rather than the reverse.

Nevertheless, some contributions must be highlighted as they shed light on how exporting activity may influence innovation. Crespi *et al*. (2008) used direct data on "learning", which means that they got data on the sources of knowledge changes for all innovations carried out by firms. Using CIS for the UK they confirm the LBE hypothesis, generated by two connected facts. On the one hand, past exporting is associated with statistically significant higher learning from buyers (as firms who export were more likely to report learning from their buyers, relative to other sources of learning – e.g., suppliers, competitors, universities). On the other hand, firms who report more learning from buyers, relative to other forms of learning, are more likely to experience higher growth in TFP.

Salomon and Shaver (2005) and Salomon and Jin (2008) use innovative productivity (for which a count of patent applications can be used) as the dependent variable. They found that exporting is connected with increases in two measures of a firm's innovation: product innovation and patent applications. In the same line, to take account of potential endogeneity of exporting with respect to innovation Bratti and Felice (2009) use an instrumental variable specification in both a linear model and a probit model in which they regress a dichotomous variable "product innovation" on lagged "exports" status, controlling for region fixed effects, year the firm was set up, firm type or proxies for absorptive capacity and process or product qualities. They found that exports induce strong learning effects on firms´ innovative ability.

[3] In a study for Spanish firms, Caldera finds that upgrading products firms are between 2% to 16% more likely to export, next period, than non-innovators.

In a study of Chinese firms from high-tech industries, Liu and Buck (2007) regress innovation performance (measured by new product sales per employee) in several sources of technological spillovers, such as R&D activities from Multinationals, imported technology, exports (measured by export sales in total sales), domestic R&D activities and absorptive ability of firms (measured by the share of scientists and technicians in total employees). They report that learning by exporting promotes innovation.

The special case of meta-analysis

Given the substantial divergence in the conclusions of several studies on LBE, Greenaway and Kneller (2007) advanced two explanations for this apparent inconsistency: firm's heterogeneity associated with the age, sector or country of the firm and the timing of the observation period. Nevertheless, an important reason for such disparities results from different methodologies used.

In spite of considerable heterogeneity across the many studies that examine the question of the causal impact of exporting, some studies adopt a meta-analysis approach. This means that the aim of these studies is to understand whether there are any systematic relationships between the characteristics of each study and its results, given the fact that there are several dimensions and characteristics in which a specific paper can be different from other studies: i) the range of country coverage, ii) the type of dependent variable, iii) the characteristics of the sample, and iv) the estimation methods. In an attempt to mitigate methodological differences in LBE analysis, the International Study Group on Exports and Productivity (ISGEP) arose as a result of the co-ordinated effort to produce micro-econometric studies for many countries using common approaches, empirical models and even econometric software.

In 2007, the ISGEP presented a study for each of a group of 14 countries in what concerns their manufacturing industries.[4] Firstly, export productivity premia are computed, from a regression of *log* labour productivity in the current export status and a set of control variables; the results presented show that the export premia are statistically significant for all countries (except for Sweden if we consider fixed firm effects), although it varies with the share of exports in total sales. Secondly, the SS hypothesis is studied (the pre-entry *premium*) for which the logarithm of labour productivity is regressed three years before exporting; it is clear that there is strong evidence in favour of SS, namely in less developed countries. Finally, the test for LBE consists of a regression of what is called "ex-post export premium" and is only proved for Italy. Several authors of this study agree on the need to use "more sophisticated" methods (such as matching) in order to correctly assess LBE.

Martins and Yang (2007) developed another meta-analysis, surveying 32 papers that measure productivity effects for firms that become exporters in respect to firms that stay in the domestic market. Unlike the ISGEP study, they take account of studies using matching methods. They found several clear patterns concerning the export-productivity relationship: i) the impact of exporting upon productivity is higher in the first year of exporting, ii) that effect is also higher for firms of developing countries than for firms of developed countries, iii) no publication bias was found[5] and LBE effects seem to be weaker when matching is made using only matched firms. Overall, this survey points to the importance of LBE in firms of developing countries, especially at the beginning of their internationalisation process due to the distance between these firms and firms on the technological frontier.

3.3. Review of empirical results

[4] The study covers countries in Asia (China), Latin America (Chile, Colombia), and the European Union (Austria, Belgium, Denmark, France, Germany, Ireland, Italy, Slovenia, Spain, Sweden and the United Kingdom), with contributions by economists in all these countries.

[5] Publication bias means that studies that report significant effects are more likely to be published than the others that report no significant effects.

From the review of empirical literature it is possible to identify several conditions that are commonly associated with the existence of LBE and impinge on its strength. In effect, most of the empirical works that confirm the LBE hypothesis do so only in limited circumstances: (i) LBE only for younger firms and entrants into foreign markets; (ii) LBE only for firms highly exposed to foreign markets; (iii) LBE only for firms of industries or countries with particular characteristics; (iv) LBE only for firms that export to high-income countries; (v) LBE depending on a mix of determinants; (vi) The special case of Learning-to-Innovate-by-Exporting; (vii) no LBE found.

LBE depending on firm's experience

Using a survey on Spanish manufacturing firms, Delgado *et al*. (2002) collected data from the period 1991-96. They used a non-parametric methodology based on the concept of stochastic dominance (test of Kolmogorov-Smirnov). They compared productivity distributions of groups of firms with different transition patterns between the domestic and the foreign market, using a double technique: first at the entry zone (the ex-ante productivity of entering exporters should be higher than the corresponding productivity of non entering firms) and then at the exit zone (firms that leave export markets should have lower productivity than those that remain in it). They found that SS was observed from the data and also that the LBE was only confirmed for a sub-sample of the younger firms. They assume learning effects are more intensive for younger firms with a short period of learning and a short market life cycle.

Based on Arrow´s concept of learning, which relies on experience in solving problems and challenges, Fernandes and Isgut (2005) presented a study for Colombian plants for the period 1981-1992 in which they specifically studied LBE for younger plants that enter into exports and that, much more than experienced exporters, face new organizational and technical problems. Using several econometric methods they found strong evidence of proven LBE for younger plants: those plants had registered annual average TFP growth rates of 3%

to 4% higher than other young plants that had never exported and, more crucially, they noticed that TFP increased 4% to 5% for each year as an exporter. Greenaway and Yu (2004) found for the UK chemical sector that the LBE effect was strongest among new firms, weaker for those with more past export practice and even became negative for established exporters.

Along the same lines, Harris and Li (2008 and 2007) developed a study for UK industry for the period 1996-2004 using three different techniques to control for endogeneity and sample selection. They estimated a substantial post-entry productivity effect for new entrants into foreign markets (a 34% increase in the year of entry and only a 5% increase in the following year) and also a negative effect for firms exiting overseas markets, thus confirming the existence of LBE only for new entrant firms.

LBE only for firms with a minimum export intensity level

Kraay´s (1999) study of Chinese industrial enterprises between 1988 and 1992 found quite large LBE effects among "established exports" and state-owned enterprises. In addition, using a dynamic panel specification with lagged effects he found that LBE was insignificant for new entrants, in clear contradiction with the previous collection of studies.

Castellani (2002) argues that the most important thing for evaluating LBE is to use the right measure of export behaviour, which needs to be a continuous one (like the share of foreign sales in total sales) and not a discrete indicator. In his study on Italian manufacturing firms for the period 1989-94 he notices that there are sunk costs for entering foreign markets, which may induce firms to maintain exporting even when profit margins fall (in an example of economic hysteresis). He also found that exporters did not appear to have significantly different productivity paths relative to non-exporters, and, that positive effects from exporting on productivity occurred only if a certain threshold of export intensity was attained.

Moreover, he asserts that LBE effectiveness requires willingness and ability to learn. Considering that higher export intensity firms may have a higher degree of commitment to

foreign operations and also a more sophisticated structure and organisational capabilities, this would explain their higher capacity for learning and their higher productivity growth. On the other hand, low export intensity firms may account for the existence of occasional exports without a clear exporting strategy that limits the chance to profit from a higher productivity growth. Hence, Castellani admits that higher degrees of learning (higher rates of productivity growth) could be achieved by more integrated forms of internationalisation such as FDI.

Reinforcing the idea that LBE positive effects require a certain level of export intensity and not only a simple export participation, a study for Singapore industry by Chongvilaivan (2008) also found that LBE relies more on the intensity of the exporting activities (measured by export sales ratio to total sales, lagged one period) than on the simple exporting status: "(…) export-market participation will not result significantly in the learning effect if the industry's export status is not improved" (p. 4). His findings support the existence of LBE (proxied by export intensity and not by export status) generated by technology transfer, administrative and organisational knowledge. He also reports higher levels of labour and capital use under LBE, along with falls in the consumption of other materials or energy.

In a rare study of African firms, Mengistae and Patillo (2002) presented a study for Kenya, Ghana and Ethiopia for the nineties and for certain industries. They tried to disentangle the exports among some sub-groups, as in the case of direct exporters (those who are in contact with their foreign clients) and indirect exporters (who sell through domestic intermediaries) and also the sub-group of those firms who export to destinations outside Africa as opposed to those who sell only to African markets. Considering that the exporters productivity premium is a function of several forms of external links and not only of LBE, they assume that LBE would be closer to direct exporters, since they are likely to learn more with contacts with their buyers, especially if the exports are with countries outside Africa. They confirmed these hypotheses and concluded they were consistent with LBE theory.

Fernandes and Isgut (2007) found that for Colombian firms there was a positive impact of export experience on productivity, but only connected with a certain degree of exposure to export activities. They found no effect of export experience on productivity for plants that had exited foreign markets. They also noticed that the LBE effect was negligible for firms that participate marginally in the foreign market. Moreover, each additional year as an exporter added up to a maximum of 3.3% per year to productivity in plants with high export intensity.

Crespi *et al*. (2008), using a panel of UK firms from 1996 to 2000, found that firms that changed their exporting status and became exporters presented increased learning from buyers relative to other learning sources (e.g., competitors, suppliers or governmental institutions) within only two years, and that those firms were more likely to experience increases in labour productivity in the same two-year period.

Testing the assumption that LBE requires persistence and intensity of exporting activity, Andersson and Löof (2008), using longitudinal data for manufacturing firms in Sweden from 1990-1997 and a GMM system two-step estimator, proved that only persistent and high-intensity exporters could experience LBE effects.

LBE depends on features of firms, industries or countries from which they export

Studying Spanish firms for the period 1990-98, Cassiman and Golovko (2007) argue that "once we take into account the innovation strategy, firm productivity turns out to be independent of whether or not a firm participates in export activity" (p. 15). That is, LBE effectiveness seems to be reliant on the innovation strategy of the firm. On one hand, LBE is still possible for firms with low or medium productivity levels because they can still benefit from their contacts abroad to get technological information or to gain from being in a higher competition environment. For innovating firms, as their initial level of productivity is already high, exporting does not produce strong LBE effects to alter their initial productivity level.

Complementarily, using Italian manufacturing firms' data for the period 1989-1997, Serti and Tomasi (2007) found robust evidence of positive average effects of exports on productivity, sales, capital and number of employees. They also noticed these effects increased as firms accumulated experience in foreign markets. Moreover, they also found signs of some heterogeneity in LBE effects varying with respect to the exporting firm's region, size and sector. Although all sets of firms benefited with respect to improvements in sales and unit labour costs, as far as productivity was concerned, the improvements depended mainly on skill intensity and on capital levels of exporting firms.

Reinforcing the same thesis, Albornoz and Ercolani (2007) worked on a panel with Argentinean firms from 1998 to 2003 and concluded that LBE is not an automatic process. It depends on a firm's features and ability to absorb and process knowledge. This ability is based on the firm's export experience, level of highly skilled workers and its rate of imported inputs. They argue that exporting exposes firms to new technologies and knowledge that may improve their productivity. In order to absorb these inputs, firms must congregate a certain level of ability and therefore firms' features drive LBE.

From another perspective, disaggregating LBE effects through industrial sectors instead of using only aggregated levels, allowed Yasar *et al*. (2007) to find that LBE is stronger for the Turkish textile and apparel industry than for the motor and parts industry. They explained it by the highly concentrated, more capital intensive and extensive FDI in the motor and parts industry, clearly suggesting that LBE depends on the technology level of the industrial sector considered and may be more effective in less technologically developed sectors. Despite using innovation patent activity instead of factor productivity, Salomon and Jin (2008) also point out that LBE is also a function of the technological-knowledge industry heterogeneity. Their study indicated that firms from "laggard" industries learned more by engaging in trade than firms belonging to "leading" industries.

The same authors had presented a similar study in 2006, but at firm level. Observing the behaviour of Spanish firms for the period 1990-1997, they found exporting had a positive effect on firms´ innovation both for lagged and leading technological firms. Nevertheless, that effect was more pronounced for technologically leading firms, as they applied for more patents subsequent to exporting. Salomon and Jin's studies rely on the debate in the literature on "convergence macroeconomic" and on "firm capabilities". The former assumes that technological lagging firms gain more from exporting as they can "catch-up with" their advanced counterparts more rapidly. The latter argues that technologically leading firms are more suited to making adequate use of knowledge available in foreign markets.

LBE depends on features of partners and countries to which they export

For Trofimenko's (2008) work on Colombia, the potential for LBE depends on the "quality of the environment" in which the learning occurs. Thus, she states that LBE materialises in the acquisition of knowledge incorporated in higher quality products, new inputs or new methods of production. In addition, as advanced countries possess more quality, LBE would be expected to show greater potential when firms' trading counterparts belong to those countries.

She analyses the impact of exporting to developed markets in the context of Colombian manufacturing plants in the 1980s and distinguishes how LBE takes place as the destination market changes. If the exporting takes place with countries at a similar development level, plants become more productive before exporting (conscious SS) but their productivity suffers a negative shock once they start exporting and rarely recovers. Otherwise, if Colombian firms export to OECD countries there is a strong productivity increase and it lasts and even grows with time. Moreover, she found that the differential in productivity between exporting and domestic plants (the export *premium*) increased with the development level of the trading partner. The learning rate varies with the destination markets, but also relies on the level of

technology incorporated in the exports themselves - in low-tech industries the LBE effects (even for advanced markets) are only partly observed.

Similarly, De Loecker (2007) found that firms starting to export only to low-income regions get inferior additional productivity gains of 10%, on average, in comparison with their counterparts exporting to high-income countries. He argues this proves that LBE depends on the characteristics of the destination markets.

The special case of Learning-to-Innovate-by-Exporting (LIBE)

Bratti and Felice (2009) found evidence of higher product innovation in exporting firms. This effect was generated by knowledge spillovers produced by contacts with foreign customers, competitors, trade intermediaries and higher competitive markets. They estimated an export premium on the possibility of introducing a product innovation of between 14% and 16%.

Liu and Buck (2007) found LIBE evidence in Chinese high-tech industries. They emphasized that other sources of international technological spillovers, like R&D activities or being part of Multinationals, did not prove to be consistent determinants of the innovative performance of firms, as exports did.

This capacity of innovation from exporting firms was also registered by Salomon and Shaver (2005). They found evidence of LIBE for Spanish manufacturing firms (1992-1997) as they observed that exporters increase product innovations within a time lag of two years subsequent to exporting. They also noticed exporters increased their patent applications, but with a longer time lag after exporting. In a comparative study of British and Irish exporting firms, Girma *et al*. (2008) found that prior exporting experience enhanced the innovative capacity of Irish firms. They showed a higher ability to absorb the knowledge obtained via exports, since those firms export to more demanding markets.

No LBE

Several studies do not find any evidence on LBE and therefore do not support this hypothesis. For instance, Aw *et al*. (2000) studying firms from Taiwan and Korea found no continuous improvement of exporters relative to non-exporters; there was no "ongoing learning by exporting effect". The same idea is expressed by Kostevc (2005) for Slovenian firms (1994-2002), which only reached higher productivity growth in the first period of exporting. A third example is given by Arnold and Hussinger (2005). Using firm-level data for German exporters and employing matching methodology they found no significant productivity differences between exporting and non-exporting firms, neither in levels nor in growth rates. They conclude in a very expressive statement: "the good ones go abroad, while exporting itself does not help a firm to improve its productivity" (p. 240).

3.4. The misestimation of LBE

The previous literature review allows the detection of several factors that may generate misestimation of LBE effects, mainly by underestimation.

3.4.1. Underestimation of LBE

LBE takes time

Aw *et al*. (2005) argued that the difficulty in recognizing LBE derives from the fact that investments made to assimilate the knowledge and expertise actually obtained with foreign markets may take a long time to produce effects. This means that LBE may take some time to be observed and that is probably why researchers cannot detect it, as they do not observe data for the required time period. These explanations seem to have gathered strength recently, as several studies (*e.g.*, Damijan *et al*., 2008) have shown that it is mainly process innovation (which takes a longer time than product innovation) that drives productivity growth.

Andersson and Löof (2008) pointed out the weaknesses of the large majority of LBE tests was that they did not separate temporary from persistent exporters and high-intensive from low-intensive exporters. "Strong learning effects from exporting that influence a firm's

productivity are unlikely to take place when exporting is a temporary activity and of minor importance for the firm's sales" (p. 776).

Lack of revelant information for direct tests

For Crespi *et al*. (2008), LBE refers to an informational learning type requiring availability of firms' informational data on advances, innovations and adaptations. However, given the lack of that kind of data, most studies use productivity as a dependent variable and examine LBE indirectly. They assume that changes in the knowledge stock and even in the input stock are mainly derived from both managerial ability and learning. That ability to learn is determined by factors such as exporting, managerial ability, exchange rates and learning from buyers.

Bellone *et al*. (2008) posit that there is systematic underestimation of LBE associated with difficulties in estimating TFP. Exporters make high investments in new technology whose depreciation rate is above the standard; given the fact that capital input is, in most cases, computed from the book value of tangible assets in the previous period (depreciated by the standard perpetual inventory method) and by investment, it is probable that capital stocks are overestimated, thus creating an underestimation of TFP. Besides, as exporters may have less market power when they arrive at distant markets, the use of a standard domestic price deflator may then lead to an underestimation of output and consequently of TFP.

Pisu (2008) also finds that LBE is sometimes underestimated because of the lack of information on the export market's features. Thus, when information on the level of development of the destination countries is absent it is not possible to distinguish between exports that are associated with LBE (when destination countries are highly developed) and those exports that cannot provide LBE.

LBE´ effects spillover to non-exporters

Ahn (2005) states that LBE effects are not detected because they are rapidly diffused to non-exporters in the same industry. These spillovers (externalities) of LBE were found by Ahn for

Korean plant-level data in spite of the fact that the spread of spillovers is dependent on competition outside the export market, on the development of institutional areas like capital and labour markets and also on the effectiveness of business networks.

Aw *et al*. (2000) also remark that there is an inconsistency between a vast number of empirical studies that do not recognise the existence of LBE and several micro-surveys in which links between exporters and their international buyers (that generate positive connections such as the case for production engineering knowledge coming from international purchasers or quality advice) are reported. They associate this inconsistency with quick diffusion of LBE across exporters and non-exporters, which may hinder observation of the productivity differences across groups (exporters and non-exporters).

Catch-up in productivity

During the nineties it was common to test for LBE by comparing productivity differentials between exporters and non-exporters over time with the help of regression analysis; if that differential increased then the LBE thesis would be supported. Huang *et al.* (2006) state this method generates underestimation of LBE because the learning effect is a "catch-up phenomenon", in terms of productivity levels for export entrants in comparison with incumbents within the same market (be it domestic or foreign). Thus, in their opinion, a greater learning ability in the export market may not mean a widening over time of the productivity differential between exporters and non-exporters. They tested their new approach on Taiwan firm-level data and found that learning effects existed in both export markets and domestic markets, but in this case the export effects were stronger than in domestic markets.

3.4.2. Overestimation of LBE

The use of propensity score matching as the preferred current methodology of assessing LBE is not free of critics. One of the most common criticisms is that it generates an upward bias. Eliasson *et al*. (2009) refer to the choices made on the composition of treated and control

groups as the main focus of this bias. In particular, choosing only successful new exporters as the treated group and never exporters (instead of not-yet entrants in the export market) as the control group is a frequent cause of error that overstates the importance of LBE.[6]

Additionally, Fernandes and Isgut (2007) argue that the use of matched samples based on a common characteristic of new exporters and non-exporters may produce upwardly biased estimates of the LBE effect. In fact, among all other factors the decision to enter the export market depends on a plant's productivity index, and plants may be able to start exporting due to favourable productivity shocks (unobservable). However, non-exporters do not enter the export market during the sample period, because they do not receive such favourable productivity shocks. As a result, the expected outcomes of the matched new exporters and non-exporters are unlikely to be conditionally independent from the decision to enter the export market, violating the main assumption of the matching method (Heckman and Navarro-Lozano, 2004). Empirically, they found evidence of a positive bias in the estimates of the LBE effect when using both the propensity score of entry into exporting and a simpler criterion to match new exporters and non-exporters.

4. Trade and productivity revisited

Given the handicaps of LBE assessment, the explanation of firms' connections between productivity growth and superior openness requires more integrated and wider frameworks in which the role of imports and of reallocation effects across firms must be included.

4.1. The importance of imports

Since only a small percentage of firms are really engaged in the creation of new technologies, the international transmission of technology becomes a crucial element in the development of

[6] Eliasson et al. (2009) understand that the choice for export markets is a process of dynamic treatment assignment (as some firms choose to enter the export market early and others decide it later and some even prefer to never do it) but it is assimilated as a static process, thus generating a bias.

most firms (especially in developing countries). Moreover, technology can be transmitted by contacts with foreign partners; foreign suppliers (and clients), licensing; technological spillovers (from firms integrated in world business), and mobility of individuals or trade. In this way one can thus understand the strong connection between trade openness and technological adoption. These facts explain the surge of the "learning-by-importing" literature in the middle of this decade (*e.g.*, Keller, 2004). This branch of literature assumes that imports of capital goods enable technology transmission and firm-level productivity growth.

Almeida and Fernandes (2007) focus on the importance of trade as a technology transmitter, by considering that importers can improve their technology by incorporating imported capital goods or inputs not available domestically; they also consider that exporters can be more innovative as they interact with more advanced foreign buyers. Using a dataset from a World Bank survey for 68 developing country firms (Investment Climate Survey), they found a very strong correlation between openness and technology adoption as (after controlling for firm characteristics and country and industry fixed effects) they observe that importers and exporters are, respectively, 4.3% and 7.3% more likely to adopt and adapt new technologies than firms that do not engage in each of these activities.

Castellani *et al*. (2008) show that internationalised Italian firms have better performance (in number of employees and productivity) than non-internationalised firms. Moreover, two-way traders were the most productive, followed by only importers and only exporters.

In an integrated approach, Albornoz and Ercolani (2007) found LBE more relevant for exporting firms that made intensive use of imported inputs or that were foreign-owned. They conclude that LBE depends on each firm's ability to absorb and use new technologies or knowledge provided by foreign contacts and induced by exports. They also found that labour productivity increases as the number of countries that firms trade with rises, as do the number

of products exported or imported, supporting the idea that the fixed costs of entry are different for each new country a firm starts to trade with or each new product a firm starts shipping.

In a panel data study of Chilean plants, Pavcnik (2002) showed that individual plants that had the highest productivity gains were connected to import competition. In particular, using unweighted productivity, she noticed that the productivity of the import-competing goods producers improved more than the productivity of plants in the non-traded goods sectors by 3% to 10% on average. Moreover, the evidence for plants in the export-oriented sectors of the economy was much less conclusive.

In a more relevant role for imports, Kim *et al*. (2007) studied Korean firms using causality tests and found no correlation between exports and TFP growth, but a unidirectional causality from imports to TFP growth instead. This fact motivated an additional effort to distinguish what kind of imports really caused TFP growth and which did not. They found capital imports and imports of consumer goods did improve TFP whereas imports of raw materials did not. Moreover, only imports coming from more developed countries mattered for that causality.

4.2. Beyond within-firm level: reallocation effects across firms

Melitz (2003) developed a forward-looking model which predicted that exporting would increase productivity, because the best firms expand their market share whereas the worst reduce their share. In order to empirically evaluate the effect of export dynamics on productivity some studies tried to measure the "export premium"; i.e., the firm's performance changes due to exports. Other studies seek to compare productivity amongst diverse sub-groups of exporting firms and between non-exporters. These kinds of studies allowed the decomposition of productivity growth between within-firm effects and inter-firm effects.

Along this line, some studies highlight the importance of reallocation in explaining productivity growth, while others stress the role of within-firms effects.

Criscuolo *et al*. (2004) found that productivity growth in UK firms from 1980 to 2001 was increasingly due to external restructuring based on market selection. They found that the share of net entry rose from an average of 25% of productivity growth in the five-year period of 1980-85 to a share of 40% of productivity growth in the final five-year period of 1995-2000. Bernard and Jansen (2004.a) studied USA manufacturing firms. They decomposed the annual change in the aggregate TFP into within plant effects (own) and between plant effects (reallocation). Reallocation accounted for almost 40% of TFP growth. Bernard and Jensen (2004.a) noticed that trade improved welfare by facilitating the growth of high productivity plants, not by increasing productivity growth at those plants.

Reaching a different conclusion, Hanson and Lundin (2004) found that the decomposition of Swedish TFP growth into within-firm productivity effect and reallocation effects (both by within-industry and between industry) clearly showed that own firm productivity growth (within-firm) was particularly large in exporting firms and had been the major contributor to TFP growth. The reallocation effects were of minor importance, moreover, if between-firm effects seemed to have occurred from less to more productive firms, otherwise between industry effects seemed to have occurred in the wrong way – from more productive industries to less productive ones.

4.3. Further investigation lines

Aiming to overcome the main difficulties and handicaps mentioned earlier, future lines of investigation on LBE should focus on resolving methodological problems and on deep testing of some still fragile achievements.

At the empirical level, given the fact that most empirical studies of LBE did not possess information about firms export experience but had only the export participation levels, and considering this as potentially underestimating LBE, it would be important to gather information at the level of engagement of firms in export markets (number of years of

exporting or an index of cumulative exports). Additionally, in order to test the SS and the post-entry LBE effects, it would be interesting to evaluate it not only with respect to productivity and size, as is usually done in the literature, but also taking into consideration other firm features such as capital endowment, workforce composition and labour cost competitiveness. Moreover, it would be important to enlarge the number of studies that address the issue of the quality of the environment in which learning takes place. As this requires specific data on export destinations an additional effort would be necessary to treat this information and to pool it together with more traditional elements.

In methodological terms, Fryges and Wagner (2007) applied a new approach (generalised propensity score, GPS) which allows for continuous treatment of exports. It means that different levels of the firms' export activities are now considered. It would be important to test it for other countries in order to understand if exporting improves labour productivity growth only within a sub-interval of the range of firms' export-sales ratios, as estimations obtained for Germany showed. Another methodological issue opened up to further discussion (by Fryges and Wagner, 2008) concerns exporters´ profits. In general, firms increase profits as they export more. Nevertheless, in Germany, only those firms that generate 90 percent or more of their total sales abroad do not benefit from exporting in terms of an increased rate of profit. This means that the usually observed higher productivity of exporters is not completely absorbed by the extra costs of exporting or by higher wages paid by internationally active firms.

Finally, some other particular aspects of LBE that were untested, tested only once or with a limited dataset deserve further development in order to evaluate their validity properly: (i) the alleged U-shaped curve of the productivity dynamics of exporters tested for French firms by Bellone *et al*. (2008); (ii) the type of technological progress associated with LBE (the alleged non-neutral technological progress of firms in Singapore: labour and capital

augmenting as in Chongvilaivan, 2008); (iii) the possible connections between LBE and the business cycle. In fact, since some firms do relatively better LBE during upturns in the business cycle while other firms do relatively better during downturns in the business cycle (*e.g.*, Albornoz and Ercolani, 2007); iv) the possibility of important connections between exporting firms and access to superior availability of capital may be another channel by which some exporting firms may benefit from reduction in financial constraints.

5. Concluding remarks

The correlation between exports and productivity growth has attracted the attention of numerous researchers and politicians. To understand the way these two variables are linked is a difficult task, but various theoretical and empirical works have aimed to find explanations and evidence over the last decade.

The Self Selection of most productive firms into the export markets is an easier thesis to prove both in theory and in practice. Otherwise, Learning-by-Exporting postulates that firms learn to innovate and to be more efficient as they come into contact with certain informational flows from their foreign buyers, competitors and other sources that are unavailable to non-exporters. However, the attempt to prove LBE has been done mostly using indirect data, namely connecting TFP growth to exports. Ideally, LBE should be measured using information on the specific mechanisms through which firms learn in order to innovate or to become more efficient (direct measure), but difficulty in accessing such data hinders that procedure. This fact means that we are not yet able to know as much as we would like about LBE and also suggests that future development and studies may focus on the analysis of particular learning channels instead of analysing LBE in an abstract way. Be that as it may, we reviewed the methodologies, results and difficulties that underlie the majority of studies on LBE, involving firms from over thirty countries. The main conclusion from those studies is that LBE may be underestimated in most cases, and that nowadays researchers are trying to

connect LBE and SS to exports and imports in a wider explanation on the ways trade and productivity connect with each other.

In this line, Wagner (2007) states that the research on this issue must proceed not only with microeconometric studies but also with case studies, which are necessary to produce the anecdotal evidence that may allow a better understanding of what is still beyond the estimations.

References

Ahn, S. (2005). "Does exporting raise productivity? Evidence from Korean microdata". *Asian Development Bank Institute Research Papers* 67, July 2005.

Albornoz, F. and Ercolani, M. (2007). "Learning by exporting: do firm characteristics matter? Evidence from Argentinean panel data". *University of Birmingham, Department of Economics, Discussion Paper* No.07/17.

Aldan, A. and Gunay, M. (2008). "Entry to export markets and productivity: analysis of matched firms in Turkey". *The Central Bank of Republic of Turkey Working Paper* 08/05.

Almeida, R. and Fernandes, A. (2007). "Openness and technological innovations in developing countries: evidence from firm-level surveys. *IZA Discussion Paper* No. 2907, July 2007.

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

Alvarez, R. and Lopez, R. (2008), "Is Exporting a source of productivity spillovers?" *Review of World Economics* 144(4): 723-749.

Andersson, M. and Loof, H. (2008). "Learning-by-exporting revisited - the role of intensity and persistence". *Review of World Economics* 144(4): 774-801.

Arnold, J. M. and Hussinger, K. (2005). "Export behaviour and firm productivity in German manufacturing: a fir-level analysis". *Review of World Economics* 141(2): 219-243.

Arrow, Kenneth J. (1962). "Economic welfare and the allocation of resources for inventions." In Nelson R. (ed.), *The Rate and Direction of Inventive Activity*, Princeton University Press.

Aw, B., Roberts, M. and Winston, T. (2005). "The complementary role of exports and R&D investment as sources of productivity growth". *NBER Working Paper* No.11774

Aw, B., Chung, S. and Roberts, M. (2000). "Productivity and turnover in the export market: micro evidence from Taiwan and South Korea". *The World Bank Economic Review* 14(1): 65-90.

Aw, B. and Hwang, A.R. (1995). "Productivity and the export markets: a firm-level analysis". *Journal of Development Economics* 47(2): 313-332.

Bellone F., Musso, P., Nesta, L. and Quere, M. (2008). "The U-shaped productivity dynamics of French exporters". *Review of World Economics* 144(4): 636-659.

Bernard, A. and Jensen, J. (2004.a). "Exporting and productivity in the USA" *Oxford Review of Economic Policy* 20(3): 343-357.

Bernard, A. and Jensen, J. (2004.b). "Why some firms export". *The Review of Economics and Statistics* 86(2): 561-569.

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

Bernard, A. and Jensen, J. (1995). "Exporters, Jobs and Wages in US manufacturing 1976-1987". *Brookings Papers on Economic Activity: Microeconomics*, 67-119.

Bigsten, A., Collier, P., Dercon, S., Fafchamps, M., Gauthier, B., Gunning, J.W., Habarurema, J., Oostendorp, R., Patillo, C., Soderbom, M., Teal, F. and Zeufack, A., (2000). "Exports and firm-level efficiency in African manufacturing". *Centre for the study of African economies, Oxford University*. *Working Paper Series* 2000-16.

Blalock, G. and Gertler (2004). "Learning from exporting revisited in a less developed country". *Journal of Development Economics* 75(2004): 397-416.

Blundell, R. and Bond, S. (2000). "GMM estimation with persistent panel data: an application to production functions". *Econometric Reviews* 19(3): 321-340.

Bratti, M. and Felice, G. (2009). "Export and product innovation at firm level". *Mimeo*. February 2009.

Buckle, R. and Cruickshank, A. (2007). "The challenge of structural change in APEC economies". *New Zealand Treasury, Working Paper* 06/07.

Caldera, A. (2009). "Innovation and exporting: evidence from Spanish manufacturing firms". *ECARES Working Paper* 2009/014.

Cassiman, B. and Golovko, E. (2007). "Innovation and the export-productivity link". *IESE Business School – University of Navarra Working Paper* No. 688.

Cassiman, B. and Rós, E. (2007). "Product innovation and exports: evidence from Spanish manufacturing". *Mimeo*.

Castellani, D., Serti, F. and Tomasi, C. (2008). "Firms in international trade: importer and exporter heterogeneity in the Italian manufacturing industry". *LEM Working Paper Series*, 2008/04.

Castellani, D. (2002). "Export behaviour and productivity growth: evidence from Italian manufacturing firms". *Review of World Economics (Weltirtshaftliches Archiv)* 138(4): 605-628.

Chongvilaivan, A. (2008). "Learning-by-exporting and high-tech capital deepening in Singapore manufacturing industries 1974-2006". *Singapore Centre for Applied and Policy Economics Working Paper Series*, 2008/04.

Clerides, S., Lach, S. and Tybout, J. (1998). "Is learning by exporting important? Micro-Dynamic evidence from Colombia, Morocco and Mexico". *Quarterly Journal of Economics* 113(3), 903-948.

Crespi, G., Criscuolo, C. and Haskel, J. (2008). "Productivity, exporting and the learning by exporting hypothesis: direct evidence from UK firms". *Canadian Journal of Economics* 41(2): 619-638.

Criscuolo, C., Haskel, J. and Martin, R. (2004). "Import competition, productivity, and restructuring in UK manufacturing". *Oxford Review of Economic Policy* 20(3): 393-408.

Damijan, J., Kostevc, C. and Polanec, S. (2008). "From innovation to exporting or vice versa? Causal link between innovation activity and exporting in Slovenian microdata". *Licos Discussion Papers* 204/2008.

Damijan, J. and Kostevc, C. (2006). "Learning by exporting: continuous productivity improvements or capacity utilization effects? Evidence from Slovenian firms". *Review of World Economics* 142(3): 599-614.

Delgado, M., Fariñas, J. and Ruano, S. (2002). "Firms productivity and the export market: a nonparametric approach". *Journal of International Economics* 57(2): 397-422.

De Loecker, J. (2007). "Do exports generate higher productivity? Evidence from Slovenia". *Journal of International Economic* 73(1): 69-98.

Egan, M.L. and Mody, A. (1992)."Buyer-seller links in export development". *World Development* 20(3): 321-334.

Eliasson, K., Hansson, P. and Lindvert, M. (2009). "Do Firms Learn by Exporting or Learn to export? Evidence from Small and Medium-Sized Enterprises (SMEs) in Swedish manufacturing". *Öerebro University Working Paper* No. 15/2009.

Evenson, R. and Westphal, L. (1995). "Technological change and technology strategy" in T.N. Srinivasan and Jere Behrman Eds., *Handbook of Development Economics*, Vol. 3, Amsterdam North – Holland, 1995.

Fernandes, A. and Isgut, A. (2007). "Learning by exporting effects: are they for real?". *Munich Personal Repec Archive Paper* No. 3121.

Fernandes, A. and Isgut, A. (2005). "Learning-by-doing, learning-by-exporting, and productivity: evidence from Colombia". *World Bank Policy Research Working Paper* 3544.

Fryges, H and Wagner, J. (2008). "Exports and profitability: first evidence for German manufacturing firms". *IZA Discusion Paper* No.3798.

Fryges, H and Wagner, J. (2007). "Exports and productivity growth: first evidence from a continuous treatment approach". *IZA Discusion Paper* No. 2782.

Fujita, M., Krugman, P. and Venables, A.J. (1999). *The Spatial economy. Cities, regions and international trade*. Cambridge. The MIT Press.

Girma, S., Görg, H and Hanley, A. (2008). "R&D and exporting: a comparison of British and Irish firms". *Review of World Economics* 144(4): 750-773.

Girma, S., Greenaway, D. and Kneller, R. (2004). ”Does exporting increase productivity? A microeconometric analysis of matched firms”. *Review of International Economic* 12(5): 855-866.

Greenaway, D. and Kneller, R. (2008), “Exporting, productivity and agglomeration”. *European Economic Review* 52(5): 919-939.

Greenaway, D. and Kneller, R. (2007), “Firm heterogeneity, exporting and foreign direct investment”. *The Economic Journal* 117: F134-F161.

Greenaway, D., Gulstrand, J. and Kneller, R. (2005), “Exporting and productivity: theory, evidence and further research”. *The Singapore Economic Review* 50: 303-312.

Greenaway, D. and Yu, Z. (2004), “Firm-level interactions between exporting and productivity: Industry specific evidence”. *Review of World Economics* 140(3): 376-392

Grossman, G. and Helpman, E. (1991). *Innovation and growth in the global economy.* Cambridge, Massachussets. The MIT Press.

Hallward-Driemeier, M, Iarossi, G. and Sokoloff, K. (2002).”Exports and manufacturing productivity in East Asia: a comparative analysis with firm-level data”. *NBER Working Paper* No. 8894.

Hanson, P. and Lundin, N. (2004). “Exports as an indicator of or promoter of successful Swedish manufacturing firms in the 1990s”. *Review of World Economics* 140(3): 415-45.

Harris, R. and Li, Q. (2008). “Evaluating the contribution of exporting to UK productivity growth: some microeconomic evidence”. *The World Economy* 31(2): 212-25.

Harris, R. and Li, Q. (2007). “Firm level empirical study of the contribution of exporting to UK productivity growth”. *Report submitted to the UKTI.*

Heckman, J. and Navarro-Lozano, S. (2004). “Using matching, instrumental variables, and control functions to estimate economic choice models”. *The Review of Economics and Statistics* 86(1): 30-57.

Hiep, N and Otha, H. (2009). “Superiority of exporters and the causality between exporting and firm characteristics in Vietnam”. *Research Institute for Economics & Business Administration, Kobe University Discussion paper series* 239.

Huang, D.S., Lin, P. and Huang, Y. (2006) "Learning-by-exporting: micro-dynamic evidence from Taiwan". *Global Economic Review* 35(4): 397-411.

Iacovone, L. and Javorcik, B. (2007). "Getting ready: preparation for exports". *University of Oxford mimeo.*

Karpaty, P. and Kneller, R. (2005). "Demonstration or congestion? Export spillovers in Sweden". *University of Nottingham GEP Research paper 05/44.*

Keesing, D. and Lall, S. (1992). "Marketing manufactured exports from developed countries: learning sequences and public support" in Gerald Helleiner (ed.), *Trade Policy, Industrialization and Development* (Oxford University Press, 1992)

Keller. W. (2004). "International technology diffusion". *Journal of Economic Literature* 42: 752-782.

Kim, S., Lim, H. and Park, D (2007). "The effects of imports and exports on Total Factor Productivity in Korea" *Research Institute of Economy, Trade and Industry Discussion Paper Series* 07-E-022.

Koh, A.C. (1991). "Relationships among organisational characteristics, marketing strategy and export performance". *International Marketing Review* 8(3): 46-60.

Kostevc, C. (2005). "Performance of exporters: scale effects or continuous productivity improvements". *LICOS Discussion Papers* 159/2005.

Kraay, A. (1999). "Exportations et performances economiques: étude d´un panel d´entreprises chinoises ». *Revue d´Economie du Dévelopment*, 1-2/1999.

Liu, X. and Buck, T. (2007). "Innovation performance and channels for international technology spillovers: evidence from Chinese high-tech industries". *Loughborough University Business School Research Policy* No.36: 355-366.

López, R. (2005). "Trade and Growth: reconciling the macroeconomic and microeconomic evidence". *Journal of Economic Surveys* 19(4): 623-648.

Macgarvie, M. (2006). "Do firms learn from international trade?". *The Review of Economics and Statistics* 88(1): 46-60.

Martins, P. and Yang, Y. (2007). "The impact of exporting on firm productivity: a meta-analysis". *Queen Mary, University of London, School of Business and Management, Centre for Globalisation Research Working Papers* No. 6.

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

Mengistae, T. and Pattillo, C. (2002). "Export orientation and productivity in sub-Saharan Africa". *International Monetary Fund Working Paper* 02/89.

Pack, H. and Saggi, K. (1999). "Exporting, externalities and technology transfer". *The World Bank, Policy Research Working Paper* 2065.

Pavcnik, N., (2002). "Trade liberalization, exit, and productivity improvements: evidence from Chilean plants". *Review of Economic Studies* 69: 245-276.

Pisu, M. (2008). "Export destinations and learning-by-exporting: evidence from Belgium". *National Bank of Belgium, Working Paper Research* No. 140.

Rhee, Y., Ross-Larsen, B. and Pursell, G. (1984). *Korea´s competitive edge: managing the entry into world markets*. Baltimore: The Johns Hopkins University Press.

Roper, S. and Love, J. (2002). "Innovation and export performance: evidence from UK and German manufacturing plants". *Research Policy* 31(7): 1087-1102.

Salomon, R. and Jin, B. (2008). "Does knowledge spill to leaders or laggards? Exploring industry heterogeneity in learning-by-exporting". *Journal of International Business Studies* 39: 132-150.

Salomon, R. and Jin, B (2006). "Convergence or capabilities? Explaining firm heterogeneity in learning by exporting". *Mimeo*.

Salomon, R. (2006). *Learning from exporting. New insights, new perspectives*. Edward Elgar Publishing Inc., Cheltenham, U.K.

Salomon, R. and Shaver, J.M. (2005). "Learning by exporting: new insights from examining firm innovation". *Journal of Economics and Management Strategy* 14(2): 431-460.

Saxa, B. (2008). "Learning-by-exporting or managerial quality? Evidence from the Czech Republic". *Cerge-Ei Working Paper Series* 358.

Serti, F. and Tomasi, C. (2007). "Self-selection and post-entry effects of exports. Evidence from Italian manufacturing firms". *Sant´Anna School of Advanced Schools – Pisa*, *LEM Working Paper Series*, 2007/20.

Tekin, M. (2007). "Plant productivity and the effect of exporting: evidence from Chile". *Mimeo*.

The International Study Group on Exports and Productivity (ISGEP). (2007), "Exports and productivity: comparable evidence from 14 countries". *Centre for Industrial Economics, Discussion Papers, 2007-11*.

Trofimenko, N. (2008). "Learning by exporting: does it matter where one learns? Evidence from Colombian manufacturing plants". *Economic Development and Cultural Change* 56(4): 871-894.

Utar, H. (2009). "Learning by Exporting through access to foreign technical service markets". Mimeo.

Yasar, M., Garcia, P., Nelson, C. and Rejesus, R. (2007). "Is there evidence of learning-by-exporting in Turkish manufacturing industries?" *International Review of Applied Economics* 21 (2): 293-305.

Yeaple, S.R. (2005). "Firm heterogeneity, international trade and wages". *Journal of International Economics*, 65(1): 1-20.

Wagner, J. (2007), "Exports and productivity: a survey of the evidence from firm-level data". *The World Economy* 30(1): 60-82.

Wagner, J. (2002). "The causal effect of exports on firm size and labour productivity: first evidence from a matching approach". *Economic Letters* 77(2): 287-292.

Westphal, L., Rhee, Y. and Pursell, G. (1984). Sources of technological capability in South Korea. In M. Fransman and K. King (eds), Technological Capability in the Third World. London: Macmillan.

World Bank (1993). *The East Asia miracle. Economic growth and economic policy*. New York: Oxford University Press.

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