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Bridging Firm's Innovation, Productivity and Export: An Analysis using Swedish CIS data

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ABSTRACT

This paper analyses the effect of innovation on the well-established productivity-export association in the literature. Here, we argue that actively innovative firms have a higher productivity, which make them more likely to become exporters. Moreover, exporting firms learn from their trading experiences and accumulate the necessary knowledge in order to innovate further, which may facilitate future productivity. We use the micro-data from two waves of Swedish Community Innovation Survey (CIS) to provide empirical evidences to test our argument concerning this interrelation between innovation, productivity, and export. The main finding is that firms which become innovative are more likely to also become an exporter, especially when they do not have prior export experiences.

JEL Classification: D22, D24, F14, O39

Keywords: innovation, productivity, export, Swedish CIS, micro-data

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1. Introduction

International trade has been a classical topic in industrial dynamics, which has mostly dealt with the location of industries and productions along product life cycle in a macro-level of analysis (Vernon, 1966; Hirsch, 1967). With the availability of the firm-level micro data in recent years, there has been a vast amount of literatures associating export and productivity of firms. These literatures can be categorized based on their empirical findings into so-called (1) firm selection (2) learning by exporting (LBE) and (3) joint decision. Firm selection literature basically links higher productive firms to be more exporters. LBE is about linking exporters to become more productive firms in future (converse causality direction of firm selection). Joint decision literature augments LBE literature by noting the join decision of firms to enter export market and invest in R&D, eventually leading to higher future productivity[1].

The starting point of this paper is that innovation is often ignored in the literatures associating export-productivity, while it is shown elsewhere to be an important source of productivity growth. For instance, Romer's (1990) model of endogenous technological change provides the explanation for it. Accordingly, there have been ample empirical evidences, using "knowledge production function" framework in micro-level studies of innovation, showing that innovation leads to higher productivity within firms (among others, Crepon et al, 1998; Lööf and Heshmati, 2006; Hall and Mairesse, 2006). Therefore, it is expected that, in the empirical setting of productivity-export association, omitting an innovation variable from the analysis might lead to the *overestimation* of such productivity–exports association. Therefore, this paper contributes to the existing literature on export-productivity association by incorporating innovation, i.e. analysing the trade-productivity association *through* an innovation channel.

The remainder of this paper is as follows. Next section provides a more in depth literature review on the various streams of literature dealing with productivity-trade

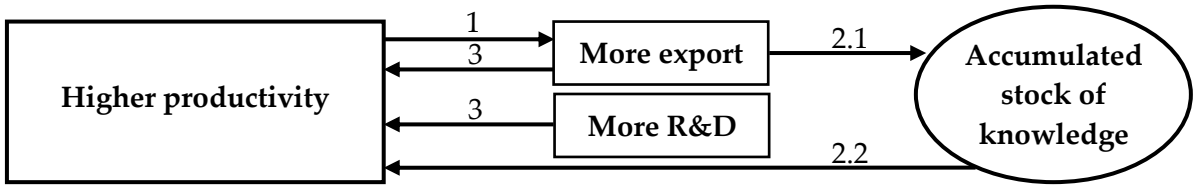
[1] In the first strand of literature dealing with export and productivity, so called "firm selection" literature, the main idea is the self-selection of productive firms into export activities. The argument is that firms have to pass a certain productivity threshold to afford the fixed and sunk entry costs in order to engage in the export activities. Following the second type of literature, namely the "learning by exporting" literature, export is linked to the learning effects that result in an increase of future productivity. Here, firms benefit from the technical expertise or best practices of their international buyers, which foster increased productivity (Clerides et al, 1998). The "joint-decision" literature augments the learning-by-exporting literature by noting R&D investments as a joint decision together with export activities, both leading to higher future productivity.

association, while tries to map these interrelated association. Then in section three, there will be the discussion in favour of inclusion of innovation into the existing framework of trade-productivity, in order to have a better understanding of this association. Last section concludes with suggestion for future empirical studies.

2. Three streams of literature concern with export and productivity

As noted briefly in introduction, there are three (not exclusive) streams of literature trying to bridge the productivity and trade. This section provides the more in depth review of them and the detail of each study is provided in the Appendix. Before having such review, it is useful to have an illustrative overview of these literatures, as shown in Figure 1.

Figure 1: Overview of the literatures regarding trade-productivity associations



Note: The numbers on the arrows refer to one of the streams of literature dealing with trade-productivity associations: (1) firm-selection literature (2) learning-by-exporting (LBE) (3) joint decision (to do export and investment in R&D inseparably). Rectangles are measurable constructs, while oval one is a conceptual construct (i.e. an assumption).

First of all, it is worthy to note that the distinction between three streams of literature illustrated in Figure 1 is not, however, clear cut. For instance Bernard and Jensen (1999) ask whether good firms become exporters (link 1 in Figure1) or whether exporting improves firm performance (Link 2 in Figure 1). Hence their study can be categorized as being both firm-selection and learning-by-exporting. However, since they found empirical evidence in support of only link 1 in Figure 1, i.e. higher productive firm becomes (self-select themselves to be) exporters, we categorize this study to be a so-called firm-selection study[2].

[2] It is the same in Delgado et al (2002), where they test both links ("productivity → export" and "export → productivity") both they found evidence for only the former one, i.e. firm-selection into export.

2.1 Firm-selection into export market (productivity → export)

In the first strand of literature dealing with export and productivity, so called "firm selection" literature, the main idea is that productive firms self-selection themselves to enter into export markets (link 1 in Figure1). The general argument is that firms have to pass a certain productivity threshold to afford the fixed and sunk entry costs in order to engage in the export activities.

Bernard and Wagner (1997) used a sample of 7624 German manufacturing firms during 1978-92 to document the significant differences in characteristics and performance between exporters and non-exporters. They observed that exporters are much larger, more capital-intensive, and more productive than non-exporters. Furthermore, in an attempt to detect the direction of causality, the bulk of the evidence in their study suggests that these performance characteristics predate entry into the export market, which means selection of productive firms into export markets. They find no positive effects on employment, wage or productivity growth after entry, which means no evidence for learning-by-exporting.

Using the US plant-level data in period of 1984-92 with 60,000 observations, Bernard and Jensen (1999) find that good plants (i.e. high productive plants among other measures) become exporters. Several years before they actually ship any goods abroad, future exporters have many of the same, desirable performance characteristics (higher productivity, among other measures). In addition, in the years just prior to the start of exporting, these plants are growing faster than their non-exporting counterparts. This is the clear evidence of firm-selection to be an exporter, as soon as their productivity reaches the threshold. Simply speaking, they find similar result to the German study (Bernard and Wagner, 1997) that success leads to exporting, rather than the reverse.

Delgado et al (2002) used sample of 1766 Spanish manufacturing firms over the period 1991–1996, which shows clearly higher levels of productivity for exporting firm than for non-exporting firms. Then they test two complementary explanations for such the greater productivity of exporting firms. In other word, they ask for the direction of causality, i.e. testing whether higher productive firms will select themselves to enter the export market, or the other way around, exporters would show higher future productivity. They find evidence supporting the self-selection of more productive firm in the export market, while the evidence in favour of learning-by-exporting shown to be rather inconclusive and limited to only younger exporters.

The empirical evidences concerning firm selection into export market is not limited to developed countries. Alvarez (2002) used sample of 5000 Chilean plants data during 1990-96 and he found the same evidence as US, German, and Spanish studies.

To sum up, in this stream of literature, usually the studies first observe the higher levels of productivity for exporting firm than for non-exporting firms. Then they try to find explanation for the observed higher productivity of exporters by testing two complementary explanations (1) the firm's selection hypothesis, and (2) the learning-by-exporting hypothesis. They usually find evidence for the former one while less inclusive evidence for the later one. However, the remaining question in this stream of literature could be about the *sources* of such high productivity of these exporting firms. How do firms obtain higher productivity levels that allow them to enter the export market?

2.2 Learning-by-exporting (export → productivity)

The second stream of literature dealing with productivity-trade association is concerned with learning-by-exporting (LBE). The hypothesis here is that export leads to the learning effects that result in an increase of future productivity (Links 2.1 and 2.2 in Figure 1). Here, exporters benefit from the technical expertise or best practices of their international buyers, which increase their sock of knowledge and absorptive capacity (Cohen & Levinthal, 1990), eventually leading to higher productivity (Clerides et al, 1998). This is the hypothesis which has not received empirical support in the firm selection literature, discussed in previous part. LBE literature emerged slightly later than firm selection, and it has been successful to provide empirical evidences for its hypothesis by modification on methodology and measurement issues. Castellani (2002) argued that when export behaviour is measured as export "intensity" (i.e. the share of foreign sales on total sales), it reveals a positive and significant effect on productivity growth. Conversely, when export behaviour is measured as a dummy indicating a firm's participation in the export market (which was usually the case in firm selection literature) it has no impact on the rate of growth of productivity. In other words, Castellani's (2002) empirical findings suggest that entering the export market does not produce any learning per se, while a significant involvement in international activities, specific investments and knowledge accumulated through time and experience of foreign contexts are needed in order to capture the benefits from exporting activities.

Andersson and Lööf (2009) add another measurement issues to export, i.e. "temporal dimension" of export activities. This dimension is motivated by persistency concept in the evolutionary economics literature. They distinguish between (i) non-exporters, (ii) temporary exporters, (iii) persistent exporters with low export intensity, and (iv) persistent exporters with high export intensity, by studying the exporting status of firms over a period of eight years in Sweden. They find a learning effect (leading to higher future productivity) among persistent export-intensive firms ("persistency" and "intensity" in exporting), but not among temporary exporters or persistent exporters with low export intensity.

Kraay (1999) also found the evidence of learning-by-exporting in the sample of Chinese firms during 1988-92. He fined that, controlling for past performance and unobserved firm characteristics, past exports lead to significant improvements in enterprise performance. Further, he showed that these "learning" effects are most pronounced among established exporters. This is in line with temporal dimension of export activities and persistency concept raised by Andersson and Lööf (2009).

2.3 Joint decision to export and invest in R&D

The last and somehow more recent stream of literature dealing with association between trade and productivity is a so-called join decision, which is probably the more comprehensive of two previous streams of literature, at least in terms of providing empirical evidences. It considers both hypothesis (firm selection and LBE) and also provides empirical evidences for firm selection hypothesis in one hand, and investigates and provide empirical evidences for the LBE hypothesis, on the other hand. Hence it considers both direction of causality (Link 1 and 2.1/2.2 in Figure 1). Nevertheless, probably the greatest contribution of this stream of literature is that it focusing on the joint decision of firms to export and R&D investment, which eventually leads to higher future productivity (Link 3 in Figure 1). More precisely, this joint-decision literature take into account the firm-selection hypothesis in one hand, and augments the LBE literature by noting the R&D investments as a joint (inseparable) decision together with export activities, both leading to higher future productivity, on the other hand.

Aw et al (2007) used the cross sectional data linked across the years (1986, 1991 and 1996) for Taiwanese Electronics industry to show (i) both directions of causality between trade and productivity and also to show (ii) noted joint decision of firms. First, they showed that the higher productive firms are more likely to export (in line

with firm selection literature). Then, the firm's decisions to export and invest in R&D and/or worker training are modelled with a bivariate probit model that recognizes the interdependence of the decisions. The findings indicate a significant interaction effect (joint decision) between "exporting" and "R&D investments" and future productivity, after controlling for size, age and current productivity. In other word, this means this study provides not only evidences for LBE hypothesis, but also augmented it by the inseparable decision of firms to invest in R&D/worker training, too. There were subsequent studies by Aw and colleagues using the again firm-level data for Taiwanese Electronics industry in the later years, which shows the further support in favour of the empirical findings of their first paper (see Aw et al, 2008; 2009).

Kafouros et al (2008) used the panel of 84 large UK manufacturing firms for the period between 1989 and 2002. They find that export can increase the return on R&D investment of the firms, or in other words, if the higher R&D intensity is accompanied with higher export intensity (joint decision), then the given firm enjoys the higher productivity.

3. Trade, Productivity, and Innovation

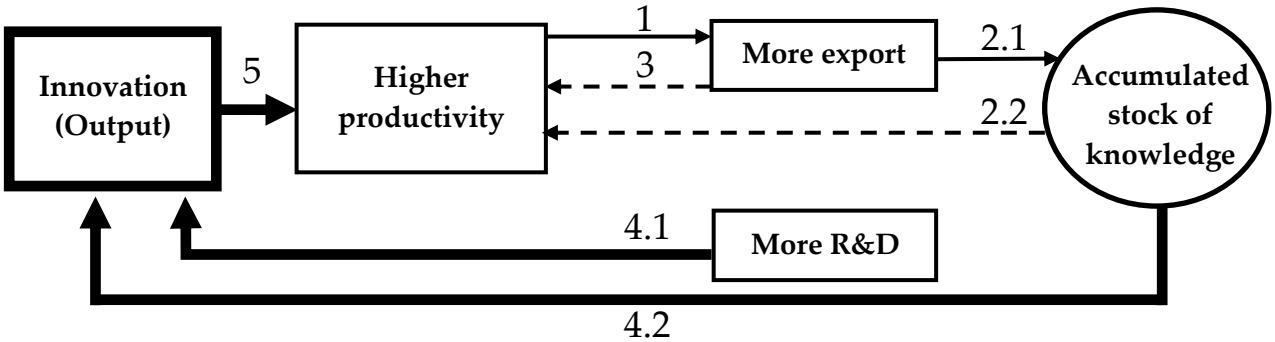
The purpose of this section is to have a critical view on the reviewed literatures in section 2 and find a gap in these existing literatures. Eventually a modified framework will be suggested to have a better understanding for the interrelation between trade and productivity, i.e. through innovation channel.

As it is shown in section 2, there has been a vast amount of literature bridging export and productivity of firms. However, while in all of the mentioned strands of literature (esp. in the second and third ones) there is an element of learning and investing in R&D (as classical "inputs" to innovation process), still there is no explicit explanation for higher productivity *through* the innovation channel. This is exactly the main argument of this paper to see the interrelation between trade and productivity through innovation. Specifically, there are at least two reasons for such argument. First, as noted in section 2, the basic idea in LBE and join decision literature is that the more firm export, the more accumulated stock of knowledge within the firm (augmented with R&D investment in joint decision literature), which eventually lead to the more future productivity. But Accumulated stock of knowledge and R&D investment are in fact classical "inputs" to innovation process

(Griliches, 1979), and we might expect the more innovation "output" in return. Such expectation has received numerous empirical supports in various countries (among others, Crepon et al, 1998; Griliches, 1998; Lööf and Heshmati, 2006; Mohnen et al, 2006)[3]. This argument suggests investigating Links 4.1 and 4.2 in Figure 2, instead of Link 2.2 and 3 in this figure.

Second, innovation is shown to be one important source of productivity growth (this relation is shown in Link 5 in Figure 2). The explanation for this is provided in Romer's (1990) model of endogenous technological change: i) technical change, or product innovation, provides the incentive for continued capital and knowledge accumulation, which leads to an increase in productivity, ii) the new set of instructions for workers, or process innovation, requires some fixed costs but later on such instructions can be used over and over again, which eventually lead to an economy of scale, lower cost of production, and again an increase in productivity. Accordingly, there have been ample empirical evidences, using "knowledge production function" framework in micro-level studies of innovation, showing that innovation leads to higher productivity within firms (among others, Crepon et al, 1998; Lööf and Heshmati, 2006; Mohnen et al, 2006; Hall and Mairesse, 2006).

Figure 2: Interrelation between Trade, Productivity, Innovation; a suggested Framework



Note: The thin lines represent the existing literature associating productivity and trade (discussed in section 2 and Figure 1). The thick lines represent the incorporation of innovation into the existing literature, as a suggestion of this paper. The dashed lines are substituted in this suggested framework by thick lines, hence, no need to consider them in empirical setting. Therefore, the interrelation between productivity-trade and innovation can be noted as follows: 1 → 2.1 → 4 → 5 → 1.

Considering link 4 and 5 in Figure 2 can provide a more holistic picture for a better understanding of the interrelation between trade, productivity, and now innovation.

[3] For an overview of such empirical studies showing that R&D investment (input) leads to higher innovation (output) see Hall and Mairesse (2006).

Therefore, the interrelation between productivity-trade and innovation can be noted as follows: 1→2.1→4→5→1. Such interrelation is possible to investigate empirically. Therefore, this paper suggests incorporating innovation into the existing literature on export and productivity, which is expected to provide more holistic picture for interrelation between trade and productivity.

Now we provide some few existing empirical evidences for suggested links in the framework, i.e. link 4 and link 5. While there are numerous studies considering innovation as a driver of productivity (Link 5 in Figure 2), such as micro-level studies of innovation noted earlier, there are only few of them that has incorporate this relation within productivity and trade discussion. Criscuolo et al (2010) used two waves of CIS (Community Innovation Survey) data for U.K. firms during 1994-2000 for which they used innovation inputs and outputs measures. They estimated the knowledge production functions and find that globally engaged firms (both exports and multinationals firms) do generate more ideas than their purely domestic counterparts (Link 2.1 in Figure 2). They argue that this is because they use more knowledge inputs in terms of researchers and they have access to a larger stock of ideas through sources including their upstream and downstream contacts with suppliers and customers. They also found that these stock of knowledge leads to generation of more innovation for exporters (Link 4 in figure 2). While they have not shown the empirically the effect of innovation on productivity (Link 5 in Figure 2), they take into granted that the more innovative firms are more productive, by incorporating the perspective of industrial organization that one of the main drivers of differences in productivity is differences in knowledge (It is possible to back up this argument with Romer's model, too, as discussed earlier).

Cassiman et al (2010) and Cassiman and Golovko (2011) argue that the positive association found between firm productivity and exports in the literature relates to the firm's innovation decisions. They note that innovation can affect the export activities of firms in two ways: First, it may have a direct effect on the export decision, in which innovative firms may start operations abroad in search for greater demand for their new products, or in order to spread out the research and development (R&D) costs over the larger sales volumes. Second, innovation activity may have an indirect effect on the export decision, i.e. through productivity-enhancing mechanism (i.e. firm selection literature). In line with indirect effect, innovating firms show higher productivity levels and grow faster than non-innovators. At the same time, these firms are more likely than non-innovating firms to become exporters. It implies that in the empirical setting, omitting an innovation

variable from the analysis may lead to overestimation of the productivity – exports association. For non-innovators, however, we expect to find a stronger positive association between exporting and productivity.This is again an argument in favour of the inclusion of innovation in the productivity-trade association, as noted earlier. Cassiman and Golovko (2011) use a panel of Spanish SMEs running from 1990 until 1998 and find that the link between productivity and exports to diminish once we account for previous innovation activity (and product innovation in particular).

An empirical strategy for incorporating the innovation into trade-productivity association could be what Cassiman et al (2010) and Cassiman and Golovko (2011) have done recently. They test for the differences in productivity of exporters and non-exporters *accounting* for firm innovation status in the previous time periods.

4. Data and preliminary results

The data used in this paper comes from a merge of two main databases. First, we merge the two waves of Swedish CIS (community Innovation Survey) which are CIS4 and CIS2006, in order to be able to trace the innovative behavior of firms in this period. This leaves us with the balanced panel dataset of 4207 observations and 1587 firms, which participate in both waves. Then, we augment this two waves of CIS data with Statistics Sweden's micro-level data, in which it consists of firm-level characteristics during 2000-2009, including, among other variables, import and export data. Such mergers leave us with the final unbalanced panel dataset composed of 7283 observations and 1587 firms.

In this paper a firm is perceived as innovative in 2004 if its innovation investments and its innovative sales are positive during 2002-2004. A firm is perceived as innovative in 2006 if the same criteria are satisfied but during 2004-2006 (such definition is in line with other studies using Swedish CIS data). Table 1 provides the number of firms divided in four groups depending on the shift on their innovation status during 2004 to 2006.

Table 1: Innovation status of firms from 2004 to 2006

Group	Innovation status of firms from 2004 to 2006	Number of firms
1	Innovative-Innovative	404
2	NonInnovative-Innovative	177
3	Innovative-NonInnovative	218
4	NonInnovative- NonInnovative	708
	Total	**1 587**

The most interesting group for further investigation is those that become innovative in 2006, while there were not innovative in 2004 (group 2), which are 177 firms.

Next, we analyse whether the firm's decision to become an exporter can be explained by its innovation status. To put it simply, we run a probit regression on the year 2006 with an innovative status as independent variables on a dependent variable, which is an exporter status after 2006 dummy. There are four regressions in total. The first model only include three innovation status dummies (the Noninnovative-Noninnovative is used as a reference group). The second regression controls for the heterogeneity of industry by adding industry dummies. The third and the fourth regressions are similar to the first and the second but with a restriction on the sample to include only those firms with no prior exporting experiences before 2004.

Table 2: Random-effect Probit regression

Dependent variable: A dummy with value 1 if the firm starts an export after 2006, 0 otherwise.

Variables	(1)	(2)	(3)	(4)
Innovative-Innovative	0.900***	0.803***	0.241	0.236
	(0.086)	(0.102)	(0.195)	(0.220)
Innovative-NonInnovative	0.645***	0.558***	0.386*	0.290
	(0.103)	(0.116)	(0.204)	(0.232)
NonInnovative-Innovative	0.508***	0.531***	0.622***	0.693***
	(0.109)	(0.127)	(0.189)	(0.206)
Constant	0.051	-0.914***	-1.333***	-1.824***
	(0.045)	(0.128)	(0.086)	(0.236)
Industry dummies				
Observations	1,587	1,571	627	602
Pseudo-R^2	0.066	0.264	0.027	0.109

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; Group 4 is the reference group.

The intuitive explanation for restricting the samples is that firms already pay upfront fixed costs of entering the foreign markets, so it is in the firms' interests to continue the operation to make profits and cover such entry costs, regardless of their innovative status. Table 2 lists all the results. In the first and second regressions, all variables are highly significant above 99%, even when we control for the industries. However, when we restrict the sample size to include only firms with no prior export experiences in the third and fourth regressions, only one variable remains highly significant and robust, that is, as we expect, Noninnovative-Innovative dummy. This means that when a firm transitions into becoming innovative, it is more likely that the gain in productivity leads them to also become an exporter later. Besides, the magnitude (coefficient) of this particular variable of interest gets larger and larger from each regression, while the other ones get smaller. Becoming innovative greatly affects the probability of becoming an exporter, especially when there is no prior experiences.

5. Conclusion and further research

This paper started with projecting an overview of the three streams of literature concerning the empirical association between trade and productivity. Furthermore, we recognize that there is a missing element in such literature, i.e. innovation of firms. We argue that considering the innovation (output) in the existing framework can provide the better understanding of the phenomena for at least two reasons: First, in the existing literature (especially in LBE) learning effect and R&D investment are leading to higher productivity. Instead, relying on numerous empirical evidences on innovation input-output relation, we argue that it is more plausible to associate such learning effect and R&D investment (i.e. innovation input) with innovation (output) of firms. Second, innovation is a source of productivity and it can explain the higher productivity of firms after they become exporters. Schematically speaking and referring to Figure 2, we raise the need for empirical investigation of link 4 (instead of or complementary to link 2.2 and 3) and link 5, in order to have a better and holistic understanding of interrelation between trade, productivity and innovation. We set out a test to determine whether becoming innovative would lead a firm to be more likely to also become an exporter. Our result confirms it.

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Appendix: Review of literatures concerning trade-productivity associations

Authors	Title	Literature Strand	Dependent Variable	Independent Variables	Data & Sample Size	Estimation Method	Results
Aw, Roberts, Winston (2007)	Export Market Participation, Investments in R&D and Worker Training, and the Evolution of Firm Productivity	Joint decision (Complementarity)	- I(Export$_{it}$) – binary choice - I(R&D/Work Training$_{it}$) – continuous choice R&D expenditures	- ln(firm's age) - ln(capital stock) - ln(avg. wage of production workers) - dummy 1 if firm enters between t-2 and t-1 - dummy 1 if multiple plants - Productivity - Productivity^2 - 3 dummies, 1 if invest/export in t-1 - 3 interaction terms between past discrete choices current productivity - Year dummies - 3-digit industry dummies	Taiwanese Electronics industry - Panel from surveys - 1986, 1991, 1996 - Total: 1,384 plants	- Participation Bivariate probit Contemporaneous correlation of errors (Corr(ex,er) is nonzero) - Intensity Random Effects of two separate equations	- Past export experience – export in current - Past experience in both – R&D in current - Past R&D experience – no impact - High productivity increases value of export, not R&D, diminishing - Negative on wage

Authors	Title	Literature Strand	Dependent Variable	Independent Variables	Data & Sample Size	Estimation Method	Results
Aw, Roberts, Xu (2009)	R&D Investment, Exporting, and Productivity Dynamics	Joint decision	- Productivity (from revenue) - Fixed & Sunk costs of Export & R&D - Demand elasticity, AD shifters, Marginal Cost		Taiwanese Electronics manufac-turers - 2000, 2002-2004 Total: - 1,237 plants - 7,772 observations		- Both activities have positive effects on future productivity - Higher productivity leads to more self-selection into both and contribute to more productivity gains
Aw, Roberts, Xu (2008)	R&D Investments, Exporting, and the Evolution of Firm Productivity	Joint decision	Policy functions: - Export dummy - R&D dummy - Investment dummy Profitability function - Profits	- ln(Revenue share) - R&D* - Export dummy - R&D * Export dummy - ln(Investment) - ln(Capital Stock) - Year & Industry dummies (* separate regressions using discrete & continuous dummies in the Profitability fn.)	Taiwanese Electronics manufacture rs - 2000, 2002-2004 Total: - 1,237 plants - 7,772 observations	Policy functions: - Probit - Tobit Profitability function: - OLS	- Interdependence of export status & R&D - Past export leads to more prob. of R&D - R&D leads to more profit - Export leads to more profit - But Export * R&D lead to less profit

Authors	Title	Literature Strand	Dependent Variable	Independent Variables	Data & Sample Size	Estimation Method	Results
Kafouros et al (2008)	The role of internationalizatio n in explaining innovation performance	Joint decision	Firms productivity	- R&D intensity (innovation) - Export (internationalization) - R&D intensity x Export - etc.	A sample of 84 large manufacturi ng UK firms for the period between 1989 and 2002 (i.e. 1176 obs).	OLS (using interaction effect)	Export can increase the return on investment of the firms (if the firm do both innovation and export, then the productivity is higher)
Lileeva, Trefler (2010)	Improved Access to Foreign Markets Raises Plant-Level Productivity	Joint decision	- Labour Productivity growth	- Treatment (Plant-specific tariff change) - Controls: - ln(Employees) - ln(Labour Productivity) - Avg. annual log change of labour productivity	- Plant-level of Canadian exports - 1984, 1996 - 5,233 obser-vations	- OLS - IV (Tariff cut as instruments)	- Produc-tivity gain comes from export - New exporters with prod. gains invest in R&D - Produc-tivity gains increase sales compared to nonexporters - Market size matters for innovation - Improved foreign market access induces innovation

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Clerides, Lach, Tybout (1998)	Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco	Learning-by-Exporting	Export Participation equation - Export dummy Cost function - Average Variable Cost ln(AVC)	Export - Plant characteristics - Real exchange rate - Marginal cost (AVC) - Start-up cost Cost - Capital stock - Lagged AVC - Lagged export dummy	Colombia, Mexico, Morocco - plant-level data in various industries	- Full-Information Maximum Likelihood (FIML)	- More efficient firms become exporters - Cost efficiency is not affected by past export experience - No learning effect except some in Morocco - Self-selection - Spill-overs from exporters to non-exporters
Cassiman, Golovko, Martínez-Ros (2010)	Innovation, Exporters, and Productivity	Firm Selection into Export	N/A	N/A	- ESEE survey - Panel of Spanish SMEs - 9,300 observa-tions	- Distribution of TFP between Exporters vs. Non-exporters - Transition probabilities of export status conditional on product or process innovations	- Product innovation affects productivity - and induces firms to becomes exporters

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Bernard and Jensen (1999)	Exceptional Exporters' Performance: Cause, Effect or Both?	Firm Selection into Export			US plant-level data - 1984-1992 - 60,000 obser vation	Linear probability with fixed effects	- Self-selection of exporters - Absence of learning from exporting - Higher productivity of exporters
Delgado, Farinas, Ruano (2002)	Firm Productivity and Export Markets: a Nonparametric Approach	Firm Selection into Export			Spanish firm-level data - 1991-96 - 1,766 firms	Nonparametric analysis of productivity distributions	- Higher productivity of exporters - Self-selection of exporters - Inconclusive evidence on learning
Aw and Hwang (1995)	Productivity in the Export Market: a Firm Level Analysis	Firm Selection into Export			Taiwanese firms - 1986 - 2,832 firms	Translog production function - Cross-section	- Higher productivity of exporters - Self-selection of exporters - Absence of learning from exporting

Authors	Title	Literature Strand	Dependent Variable	Independent Variables	Data & Sample Size	Estimation Method	Results
Castellani (2002)	Export Behaviour and Productivity Growth: Evidence from Italian Manu-facturing Firms	Learning-by-Exporting			Italian manufacturing firms - 1989-94 - 2,898 firms	Cross-section	- Higher productivity of exporters - Learning associated with export intensity - importance of measuring export by intensity (not dummy) to see the effect on learning
Kraay (1999)	Exports and Economic Performance: Evidence from a Panel of Chinese Enterprises	Learning-by-Exporting			Chinese firms - 1988-92 - 2,105 firms	Dynamic panel	- Higher productivity of exporters - Learning from exporting
Bernard and Wagner (1997)	Exports and Success in German Manufacturing	Firm Selection into Export			German manufacturing firms - 1978-92 - 7,624 firms	Panel data	- Higher productivity of exporters - Self-selection of exporters

Authors	Title	Literature Strand	Dependent Variable	Independent Variables	Data & Sample Size	Estimation Method	Results
Wagner (2002)	The Causal Effects of Exports on Firm Size and Labour Productivity: First Evidence from a Matching Approach	Firm Selection into Export			German firms - 1978-89 - 353 firms	- Panel data with Matching technique	- Higher productivity of exporters - Absence of learning from exporting
Alvarez (2002)	Determinants of Firm Export Performance in a Less Developed Country	Firm Selection into Export			Chilean plants - 1990-96 - 5,000 plants	- Ordered probit - Pooled data	- Higher productivity of exporters - Self-selection of exporters
Criscuolo et al (2005)		Export→innovation			2 U.K. CIS 1994-2000	estimate the KPF	Globally engaged firms generate more of the innovations that feed into higher productivity, largely because they learn more from more sources.
Andersson & Lööf (2009)		Learning-by-Exporting					(I) exports →productivity (II) evidence of learning-by-exporting (LBE).