

Export-biased Productivity Growth in Swedish Manufacturing

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Introduction

A growing body of empirical work have documented a superior performance of exporting firms compared to firms producing only for the domestic market. Micro-level analyses have shown that exporting firms or plants are larger, more productive, more capital- and technology intensive and, consequently they pay higher wages. Previous empirical research have mainly focused on firm-level productivity and the growing body of empirical studies confirm that exporting firms, in general, are more productive than those producing only for the domestic market (Bernard and Jensen, 1997, 2000, 2001, Sjöholm, 1999, Girma, et al., 2002, Clerides et al. 1998, Roberts and Tybout 1997 among others). However, there are few empirical evidences that exporting firms achieve higher rates of productivity growth. The recent empirical findings point to the fact that exporters are better than non-exporters, but do not support the idea of learning by exporting. Rather, the empirical literature in the field has concluded that there is a self-selection process among firms prior to entering the export market. Only in few cases, empirical research have found evidences of higher productivity growth rates in exporting firms compared to non-exporting firms in following years¹.

However, Greenaway, Gullstrand and Kneller (2003) show that in Swedish firm-level data there are no empirical evidences that firms' export entry is accompanied by increased productivity levels. These results are strikingly different from the empirical findings described previously. Although the authors uses a matched difference-in difference methodology that is particularly well suited to isolate effects of first time export market entry, they find no differences in the productivity growth between exporters and non-exporters. Yet, as in other data samples, exporting firms tend to be larger and grow more rapidly than other firms. The authors suggest that Swedish firm-level data yield different empirical results because of the large proportion of Swedish firms that engage in export activities. In average over the sample period 1980-1997 as much as 85 per cent of the firms were exporting. This figure is far above corresponding figures in other OECD countries and may be the explanation to why Swedish results are so different; there may be smaller differences in firm productivity because of the wide spread exposure to international market. The study implies that in Sweden, the selection of firms takes place at the time of industry entrance rather than at the point in time where the firm enters the export market. Despite the lack of empirical evidence of shifts in productivity level and subsequent superior productivity growth as a result of export market entrance, Greenaway, Gullstrand and Kneller may conclude that the total factor productivity (TFP) is around 10 percentage points higher in export firms compared to non-exporters, after controlling for differences in the average level of productivity across industries.

The results obtained on Swedish firm data calls for some further investigation. If the large international exposure of Swedish manufacturing requires firms to be internationally competitive in order to enter the industry, independently of export intentions, the impact of export on productivity

¹ See Greenaway, Gullstrand and Kneller (2003) for an over view of empirical results in this field of research.

may be distinguishable on the sectoral level rather than on the firm level. The vast majority of recent empirical findings reject the hypothesis that international trade induce technology and knowledge diffusion. If trade induces higher productivity growth rates, these are likely to be derived from reallocation effects rather than from international knowledge spill over or technology transfers. Reallocation of resources as a consequence of trade expansion is, on the other hand, is a well established phenomenon in theoretical as well as in empirical trade literature. Given that productivity levels differ across firms or sectors, many production factors would yield higher returns if employed in other establishment or other production activities. A reallocation of factors from low-productivity to high-productivity establishments generates productivity growth at the aggregate level, independently of technological advances. Several studies on aggregate productivity growth estimates that reallocation yield substantial contributions to national productivity growth rates. For example, Bernard and Jensen (1999) that within-sector reallocation accounts for 20% of U.S manufacturing productivity growth, while Foster and Haltiwanger (2002) make similar conclusions when analyzing productivity growth in the U.S retail trade sector. Reallocation and national productivity differences have been studied by Hansson and Lundberg (1991). They suggest that the low aggregate productivity growth rate in Swedish manufacturing compared to other OECD countries during the 1970s and 1980s, partly depends on rigidities and imperfections in Swedish factor markets.

Moreover, several studies reveal that factor reallocation is more prevalent within sectors than between them (Roberts and Tybout, 1996, Levinsohn, 1999; Faggio, 2000), which suggests that an empirical analysis at sectoral level rather than national level may deepen the understanding of productivity responses of export performance. For the purpose of analyzing the impacts of export expansion on productivity growth in Sweden this paper focus on the aggregate industry productivity rates. Only at the industry level reallocation effects can be captured. In this paper we examine the link between export and productivity growth at sectoral level in Swedish manufacturing. We use 4-digit industrial data in analysing the relation between export intensity, in terms of export to output ratios and number of exporting firms, and sectoral productivity in a panel data setting, covering 170 manufacturing industries during the period 1998 to 2002. The main hypothesis is that not only sectoral export intensity contributes to sectoral productivity growth but also the type of export activity.

In the next section we will describe the theoretical foundation of the empirical analysis. Section 3 presents the empirical methodology used in this paper and the empirical results are discussed in section 4. A summary of the empirical findings and conclusive comments terminates this study.

Theoretical Framework

Most economists of today believe that openness to international exchange contributes to countries' growth performance. Traditionally, theoretical as well as empirical contributions to the trade-growth literature emphasized differences in factor returns, induced by differences in factor endowments or differences in factor productivity, as the source of welfare gains from international trade. In the classical Ricardian model of international trade, differences in labour productivity induce specialization and trade in which all countries are able to achieve a higher level of welfare. However, the model does not predict that open countries necessarily will grow faster than closed ones, once they have opened up. According to the traditional export-led growth hypothesis export growth causes positive effects on productivity through various externalities. Production for international markets allow small open economies to overcome the limitations of the domestic market in exploiting scale economies and ensuring full employment of the production factors. Even in cases where the domestic market allows full exploitation of economies of scale, it will rarely permit effective competition making firms abstain from monopolistic behaviour. Export activities boost productivity and dampen wage inflation (given that wages are not hundred percent productivity-indexed) which in turn improves the price competitiveness that becomes a subsequent export stimulus. The essence in the export-led growth model (Kaldor, 1970; Dixon and Thirlwall, 1975) is that there is a cumulative causation between export performance and productivity growth that is in line with the endogenous growth literature including contributions by for example Lucas (1988) and Romer (1990, 1994).

New trade theory, based on imperfect competition, scale economies, product differentiation, and an expanding variety of traded intermediate products, suggests that productivity growth will occur due to increased production scales, which causes intra-industry trade and possibly intra-industry spillover of technology and knowledge. However, the direction of causality between export expansion and productivity advances is ambiguous in the modern trade literature. In the classical model differences in labour productivity give rise to comparative advantages which allows all countries to gain from trade through specialization. Productivity differences cause export expansion and there are no reverse causality. In new trade theory, on the other hand the causal links between export and productivity may be bi-directional². Export expansion is not necessarily exogenously determined, which implies that trade may be the result of increased production, caused by productivity growth (or other factors), as well as the source of it.

Nevertheless, trade may increase aggregate productivity by reallocating resources between or within different industries. Many production factors might earn higher returns if employed in other production activities and, consequently, a reallocation of resources is, independently of technological

² See Nessel (2003) for a discussion of the identification problem and thorough empirical analysis of the causality between export and productivity.

advances, a potential source of aggregate productivity growth. Indeed, the growing international economic integration of today has large impact on resource reallocation as opportunities of specialization, factor accumulation and trade expansion are inseparable from access to international goods and factor markets. If productivity rates differ across firms or sectors, resource shifts from low-productivity to high-productivity firms might alone induce significant productivity growth in the total economy. Given that structural shift works toward a pareto optimal resource allocation, reallocation of production factors might generate large efficiency gains and subsequent economic growth. In spite of ambiguous causality at the micro level, trade-induced reallocation of factors is an unconditional link between export and productivity at the aggregate level.

Although empirical work have preceded theoretical advances in this field of research, some recent theoretical works have significantly improved the understanding of recent empirical evidences. Clerides, Lach and Tybout (1998) shows in a partial equilibrium model that if there are some sunk cost associated with export market entry, firms must self-select before entering the export market, which explains the self-selection phenomenon that pre-dominates other effects in the empirical literature. Bernard et al. (2000) have developed theoretical framework that provides explanations to the firm-level characteristics, including the links between efficiency and firm size, firm export status and measured productivity, that seems to be shared by most exporters, independently of country sample. Melitz (2002) have made a substantial contribution by constructing a general equilibrium model with productivity heterogeneity across firms. Melitz, builds a dynamic industry model that explains why international trade causes resource shifts among firms within the same industry. In accordance with Clerides *et al* (1998) Melitz assumes that there are some fixed costs of entering the export market. There is only one factor of production and symmetry of nations implies that wages are equalized so that heterogeneity in firms' marginal cost is entirely due to difference in firms' unit labour requirement. Thus the standard logic applies: only firms at a certain level of productivity will have marginal cost that is sufficiently low to motivate the initial sunk cost of entering the export market. All firms share the same fixed cost of entry, which is independent of export intensity, which allow for determination of a specific cutoff productivity level. Firms with a lower productivity level than the cutoff level will make negative profits and immediately exit the market. The cutoff productivity level and the distribution of productivity levels over incumbents relative output shares determine the average level of productivity in an industry. The aggregate productivity level equals the average productivity level since it completely summarizes the distribution of productivity over firms and, hence, the aggregate level of productivity is independent of the number of firms. The model's steady state equilibrium is determined by the interaction of the zero profit cutoff condition and a free entry condition involving the fixed cost require for entry. The equilibrium yield a steady state level of cutoff productivity and a steady state average level of firm profit. Moreover, Melitz shows that trade have a significant impact on productivity through the reallocation of factors as trade liberalization results in the exit of the least productive firms. This is because the new trade opportunities results in higher

cutoff productivity level. Noteworthy is that this higher cutoff level is not a result of increased competition via import but a result of the fact that export opportunities have different effects on firm depending on the productivity level. New export markets only translates into increased profits for the more productive firms that can afford the investment necessary for entering the new market. In equilibrium, an increase in the profits of more productive firms will attract new firms to enter, which leads to a higher cutoff productivity level. As Melitz puts the word: *“It is therefore the “push” of the export markets, rather than the “pull” of import competition that forces the least productive firms to exit.”*

The model predicts that continuous economic integration with subsequent reduction in trade costs lead to an increase in the aggregate productivity because of continuous reallocation of factors from low-productivity to high-productivity production. This implies that although the productivity level is independent of export intensity at the firm level, as the cost of entering the export market is assumed to be independent of the volume exported by the individual firm, both the magnitude and the scope of export activities may affect the productivity at the aggregate level.

Empirical Methodology

In purpose of determining the impact of export activities on sector-specific productivity levels and industry productivity growth rate we use panel data including 165 Swedish manufacturing industries classified on four-digit SNI codes. Confidential reasons sometimes lead to reporting of two or more industries in the same observation. The data covers five years (1998-2002) which yields a sample of 825 observations. Manufacturing industries are likely to have some features in common, yet there is a considerable degree of heterogeneity across industries. Therefore we use a fixed effect model (FEM) approach in this study that allow us to control for sector-specific effects that is unobserved. The FEM model testing the relationship between export and sector productivity level is formulated as:

$$A_{it} = \alpha_i + \beta_1 X I_{it} + \beta_2 RC_{it} + \beta_3 II_{it} + \beta_4 Z_{it} + \varepsilon_{it} \quad (1.)$$

where A is the productivity level in sector i in period t , α_i denotes the fixed sector-specific effect, X is the export intensity, RC is the revealed comparative advantage of sector i at time t , II is the Grubel-Lloyd index of intra-industry trade and Z is a vector of control variables associated with capital-intensity and scale. Finally, ε_{it} is an error term assumed to have zero mean and constant variance. All variables, except a variable reflecting the magnitude of intra-industry trade, are used in their logarithmic form. The same model is used in explaining labour productivity and total factor productivity (TFP). Labour productivity is measured as value added per person employed, while the TFP is estimated in a standard neoclassical growth framework. A conventional Cobb-Douglas production function is assumed with no restrictions imposed on the returns to scale:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta} \quad (2.)$$

Y is the value added in industry i in period t , A is the productivity factor and K and L denotes capital and labour respectively. Taking natural logarithms and differentiate with respect to time yields the commonly used formulation of TFP growth:

$$g = \frac{\dot{A}}{A} = a + \alpha \frac{\dot{K}_{it}}{K_{it}} + \beta \frac{\dot{L}_{it}}{L_{it}} + \varepsilon_{it} \quad (3.)$$

By estimating equation 3 on the panel data set leave us with GLS estimates of α and β , which is used to calculate the TFP level in each industry with the implicit assumption that α and β is equal across industries and over time. By rearranging equation 2, the aggregate industry TFP is calculated as:

$$A_{it} = \frac{Y_{it}}{K_{it}^{\alpha} L_{it}^{\beta}} \quad (4.)$$

The variables RC and II both control for sectoral differences in the type of export activities. As discussed in section 3, the classical Ricardian model states that trade is a result of differences in factor productivity, implying that export production is oriented to sectors in which the country has comparative advantage. Hence, industries that produce in accordance with the country's comparative advantage, undoubtedly have higher productivity levels than other tradable sectors. In the absence of information of unit factor requirements in production this analysis uses the revealed comparative advantage defined as a specialization ratio (Hansson et al. (1991):

$$RC_{it} = \frac{Q_{it}}{Q_{it} + M_{it} - X_{it}} = \frac{Q_{it}}{C_{it}} \quad (5.)$$

where Q denotes total sector production, M and X is the values of the sector's import and export and C denotes the domestic consumption of industry i goods. If the ratio between domestic production and domestic consumption is larger than unity, the country is a net exporter of the industry i good, which reveals comparative advantage. Consequently this variable is expected to have a positive impact on the productivity level of an industry.

The other type of export activity considered in this analysis is intra-industry trade, which differs from the comparative advantage case in the respect that it is not based on productivity differences but on product differentiation that brings some monopolistic power to the producing firms. The magnitude of intra-industry trade measured by the traditional Grubel-Lloyd index:

$$II_{it} = 1 - \left(\frac{|X_{it} - M_{it}|}{X_{it} + M_{it}} \right) \quad (6.)$$

where X and M, as before denotes export and import and the usual subscripts interpretation applies. The GL index range from 0 to 1, with higher levels indicating a larger share of intra-industry trade in total trade volume.

Both types of export activities apply in Melitz's framework: in the presence of fixed export market entering costs, firms have to be sufficiently productive in order to motivate these sunk costs and avoid making negative profits. Intuitively, though, the self-selection process among firms may differ between the two types of exports because in comparative advantage industries all production is oriented toward the export market and only a small fraction of output is consumed at the domestic market. Thus, the market entering decision of the individual firm is not a choice of exporting or not exporting, but rather if produce or not produce. This reasoning is supported by the fact that industries with a high ratio of specialization (RC) consists of larger firms than two way trade-industries, which implies that scale economies is important. If the optimal production scale is large it is likely that the costs of any market entry are high.

The industries where the intra-industry trade dominates, on the other hand, is characterized by a smaller average firm size, and a larger number of firms, which suggests that the cost of entering an II-industry is lower than in the RC-industry. Moreover, in the II-industry the choice of entering the

export market is a different one than entering the industry. Consequently, the productivity differences between exporting and non-exporting firms are likely to be larger in two-way trade industries than in comparative advantage industries. According to the theoretical model by Metlitz (2002) an expansion of trade, due to new trading partners or reduction in trade cost, increases the expected profits of entering the export market, hence attracting a number of new firms that are willing to make the initial investment associated with export market entry. At the same time increased exposure to international trade forces the least productive firm to exit so the cutoff productivity level increases.

Besides the export-related variables we include a set of other control variables: capital-to labour ratio (KL), the average firm output (Scale) and average wage rate as a proxy for human capital intensity (w).

Empirical Results

The empirical analysis is performed on a panel data set covering 165 industries and 5 years. The regression model in equation 1 is used to estimate eight different regression specifications. In all regressions Lagrange Multiplier tests for group-specific effects, and Hausman tests for random versus fixed effects confirm that the choice of a fixed effect model is appropriate. Moreover, F-test on model specification indicates that a model without period-specific effects is preferable. Pre-testing also confirms that there is substantial cross-sectional heteroscedasticity, for what reason White's "robust error" covariance matrix is used to correct the panel data estimates.

In the first six regressions, the empirical analysis considers the impact of trade on sectoral productivity levels. In regression 1, 2 and 3, the independent variable is labour productivity, measured as value added per worker, and we apply three alternative specifications that differs with respect to the export activity variables. In the first regression we only include the export intensity variable, excluding both variables reflecting the type of export activity. In the second regression the revealed comparative advantage variable is included and in regression 3 we also include the intra-industry trade variable³.

The results of the first three regressions are presented in table 1. In contradiction to expectations the export intensity has significant negative impact on the labour productivity levels in Swedish manufacturing industries. The negative relationship is significant on the highest level independently of model specification, controlling for the type of export activity does not alter the results. The RC variable is significant at the highest level in regression 2 and three, whereas the II-variable is significant only at the twelve percent level in regression 3. Both the RC and II export activities have positive effects on the level of labour productivity, which correspond to the predictions drawn from Melitz's theoretical model. The other control variables included, all have the expected sign, yet the average wage level, being a proxy for human capital intensity, does not show to have any significant relationship to sectoral labour productivity. The models explanatory powers are almost 75%, and do not vary substantially over different specifications.

³ One may suspect that the three export related variables are correlated and consequently induce multicollinearity in the regressions. A correlation matrix (see appendix) reveals that the correlation coefficients between the three variables is very small. To further test the possibility of linear dependency among the export-related variables three regressions are estimated where two of the variables are regressed on the third. The results (see appendix) show no significant dependency between the three variables.

Table 1. Estimated effects of Export Activities on Labour Productivity Level

Dependent Variable: Value Added per worker

Number of observations: 825

Explanatory variables	Regression 1 Estimated coefficients t-values in parenthesis	Regression 2 Estimated coefficients, t-values in parenthesis	Regression 3 Estimated coefficients, t-values in parenthesis
XI	-0.1947* (-2.818)	-0.1956* (-3.250)	-0.1943* (-3.225)
RC	-	0.2222* (2.972)	0.2206* (2.964)
II	-	-	0.2842 (1.587)
KL	0.2714* (4.726)	0.2822* (5.018)	0.2799* (4.992)
W	0.1961 (1.291)	0.1663 (1.142)	0.1722 (1.194)
Scale	0.0928** (2.211)	0.0628*** (1.671)	0.0641*** (1.677)
Adjusted R ²	0.7303	0.7443	0.7434

*significant at the 1% level, ** significant at the 5 % level, significant at the 10% level.

Regression 4, 5 and 6, estimates the effects of export on total factor productivity levels, using the same model specifications as in the previous regressions. However, the functional form of the model is a linear-log in regression 4 to 6 (instead of log-log in regression 1 to 3). This change in functional form is motivated by an insufficient variance in the log of the TFP. As Consequently, the estimated regression coefficients can not be interpreted as elasticities⁴ and the parameter values should not be compared with the values estimated in previous regressions. The regression results are presented in Table 2, and shows that the impact of export on TFP is very similar to the impact on labour productivity, the main difference being a small improvement of the significance level of the intra-industry trade variable, which is now significant at the ten percent level. Noteworthy is that human capital seems to be more relevant in explaining the TFP level than the levels of labour productivity. The estimated parameters for the wage variable significant at the 5 percentage level in all regression specifications in the TFP analysis, compared to no significant impacts in the analysis of labour productivity. Moreover, the scale seems be more important for the TFP level than for the labour productivity level, as estimates are now significant on the highest level.

⁴ The elasticity values are obtained by dividing the parameter values with the values of the explanatory variables.

Table 2. Estimated effects of Export Activities on Total Factor Productivity Level

Dependent Variable: TFP

Number of observations: 825

Explanatory variables	Regression 4 Estimated coefficients t-values in parenthesis	Regression 5 Estimated coefficients, t-values in parenthesis	Regression 6 Estimated coefficients, t-values in parenthesis
XI	-302.919* (-4.207)	-303.552* (-3.880)	-301.114* (-3.897)
RC	-	184.240** (2.397)	181.370** (2.363)
II	-	-	56.307*** (1.919)
KL	166.192* (2.791)	175.240* (2.850)	170.661* (2.792)
Wage	268.046*** (1.819)	243.259*** (1.663)	255.043*** (1.773)
Scale	294.935* (4.715)	269.951* (4.577)	272.462* (4.574)
Adjusted R ²	0.9060	0.9070	0.9080

*significant at the 1% level, ** significant at the 5 % level, significant at the 10% level.

The results of regression 1 to 6 confirm the hypothesis that export activities have a positive impact on industrial productivity levels independently of the type of export. Yet, it seems like export production in accordance with revealed comparative advantage closer connected to the level of productivity than are intra-industry trade production. These results are in line with theoretical predictions but an analysis of causality is needed in order to establish the direction of causality between exports and productivity. The striking finding in the regression analysis is that the industrial export intensity is negatively related to the average industry productivity level. This result is robust and highly significant in all specifications. Although the theoretical framework by Melitz are based on the assumption that firm-level export intensity does not matter, the sectoral export intensity is here assumed to reflect frequency of exporting firms within each industry. If a large fraction of the firms within an industry are exporters previous empirical results and theoretical contributions suggest that this sector would have a higher productivity level. Although Swedish manufacturing firms behaves somewhat different than theirs foreign counterparts, Greenaway, Gullstrand and Kneller (2003) still find that exporting firms in Sweden have higher productivity than non-exporting firms. The sector-

level analysis here shows that whereas exporting activities increases the average sector productivity, the export intensity of the industry have a negative impact on industrial productivity levels. These results are contradictory. One explanation is that the XI variable actually does not reflect the extent of export activities within sectors, but rather reflects that in sectors where the cost of export market entry is low, export activities is extensive because firms does not have to be exceptionally good performers in order to survive in the export market, or by using Melitz's terminology, the equilibrium cutoff productivity level does not differ very much between the domestic and the world market. This reasoning corresponds to the empirical results obtained by Greenaway et al (2003) on firm-level data and provides an explanation to the negative impact of sectoral export intensity on sectoral productivity levels.

Turning the interest to industrial productivity growth rates, as a result of export activities, we expect to find positive effects on aggregate sectoral productivity growth because of a continuous reallocation of resources from less productive to more productive firms within each industry. The theoretical framework suggests that the larger is the international exposure, the more efficient is the factor allocation. This implies that both the level and the growth rate of export-related explanatory variable may have an impact on the aggregate productivity growth. Furthermore, the type of export activity may have some implication for the productivity growth rates. As discussed in the previous section, differences in productivity levels are likely to be larger in intra-industry trade sectors than in comparative advantage sectors. This implies that factor reallocation makes larger contributions to aggregate productivity growth in II-industries than in RC-industries.

Regression 7 and 8 estimates the impact of the export activities on labour productivity growth and TFP growth respectively. We use exactly the same variables as in previous regression except some adjustments among the control variables. The previous control variables capital-labour ratio, scale and wage rate is replaced by the average industry productivity level. We also include the change in the capital-to-labour-ratio as a variable. The results, presented in table 3, suggests that whereas the export intensity is irrelevant in explaining labour productivity growth rates, the type of exporting activity seems to matter. As predicted the II-variable have a positive and significant effect on labour productivity growth, while the estimates for TFP growth (also positive) is significant only at 17% level. The results of regression 7 and 8 suggest that the productivity levels are most important in explaining productivity growth rates.

Table 3. Estimated Results of Export Activities on productivity growth rates

Explanatory variables	Regression 7 Dependent Variable: Growth in Labour productivity Estimated coefficients, t-values in parenthesis	Regression 8 Dependent Variable: TFP growth Estimated coefficients, t-values in parenthesis
XI	-0.0640 (0.107)	-0.1756 (1.492)
RC	-0.0005 (0.005)	0.2739 (1.395)
II	0.0457** (1.963)	0.0163 (1.390)
ΔKL	0.0955*** (1.762)	0.0504 (0.555)
Labour Productivity	0.6912* (7.189)	
TFP	-	0.0001 (1.235)
Adjusted R ²	0.3406	0.031

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