Do exports lead to higher mark-ups?
- Microeconomic evidence from
Swedish manufacturing in the 1990s

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Abstract

This paper examines how exports affect mark-ups of Swedish manufacturing firms during the 1990s. Applying Roeger's (1995) method, I perform the empirical analysis based on detailed firm-level data first to estimate an average mark-up level of the Swedish manufacturing and then to assess the impact of exporting behaviour, taking account of both product and geographic differentiations.

The general finding is that exporting behaviour indeed has an effect on firm-level mark-ups, however, not always positive, even given that exporters have some efficiency advantages over non-exporters. The relationship between export and mark-up turns out to be a joint outcome of both efficiency superiority and exporting market effects such as elasticity of demand and competition intensity.

JEL classification: F12, F15, L13, L60
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1. Introduction

The link between international trade and market power has been extensively investigated in a large body of empirical work. From the import side, import competition in the domestic market has been seen as a disciplinary device to constrain market power of domestic firms. Levinsohn (1993), Harrison (1994), Katics and Petersen (1994), Krishna and Mitra (1998), Konings and Vandenbusssche (2002), Konings et al. (2003) have provided evidences of disciplinary effect imposed by import competition.[1] From the export side, the examination of the link between exporting behaviour and market power is so far very limited. This link is less straightforward and in the scarce existing literature, the theoretical link between exporting behaviour and market power is established indirectly via productivity advantages of exporters. In Bernard et al. (2003), Bertrand competition is introduced into the Richardian framework. The link between productivity, exporting and mark-up can be summarized in the following predictions:

- With Bertrand competition, producers who are more efficient also tend to have cost advantages over their competitors and set higher mark-ups. These more efficient rivals are more likely to beat out rivals in foreign markets.
- At same time, more efficient producers are likely to have more efficient rivals and therefore might charge lower prices.

There are plentiful empirical evidences supporting that exporting firms are more productive than non-exporting firms, provided by for example Aw and Hwang (1995), Clerides et al. (1998), Bernard and Jensen (1999), Hallward-Driemeier et al. (2002), Girma et al. (2003). For the Swedish manufacturing, Hansson and Lundin (2003) have also found the evidences supporting that exporters are more productive than non-exporters and exporting behaviour further enhances productivity of the exporting firms. However, the link between export and mark-up has not been extensively investigated. Görg and Warzynski (2003) are the first who address the question if more productive exporters are also able to sustain higher mark-ups. Their analysis of manufacturing firms in the U.K. shows that exporting firms have higher mark-ups than non-exporting firms and this distinction is most apparent in sectors that produce differentiated goods. For a small and open economy like Sweden, the effects of both import competition and export orientation are highly relevant for the development of manufacturing sectors. Swedish data for the 1990s is particularly interesting to analyze because it is a period with a remarkable increase in the export intensity of manufacturing firms.[2] Furthermore, Sweden has the highest R&D expenditure to GDP ratio among the OECD countries, and the private sector, particularly some manufacturing groups play an import role in R&D investment.[3] It implies that product differentiation is an important competition strategy of Swedish manufacturing firms in the global market. Given that exporters are more productive than non-exporters in the Swedish manufacturing, are the exporters also able to sustain higher mark-ups? It seems to be no straightforward answer but an open empirical question. Based on the model developed by Bernard et al. (2003), the effect of exporting behaviour on mark-up is somehow ambiguous. It depends not only on productivity advantage, but also on demand elasticity and competition intensity in foreign markets. The demand elasticity and competition intensity are in turn closely associated with both the degree of product differentiation and market condition in various destinations of exports. In this paper, I aim to empirically investigate the link between exporting behaviour and mark-up in various demand and competition conditions. More specifically, I look at not

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[1] See e.g. Tybout (2003) for a more detailed survey on the existing empirical literature, particularly application to micro-level studies.
[2] See, e.g. Hansson and Lundin (2003) for a more detailed description of exporting behavior of Swedish manufacturing firms.
[3] See e.g. OECD STI Scoreboard 2003 for more detailed information.

only the average effect of exporting behaviour on mark-up but also the differential effects that are associated with product and geographical differentiations.

This paper contributes to the existing literature in various ways. First, the empirical evidences on relationship between exporting and mark-up are very limited. This paper, to my knowledge, is the second study that looks at the comparison of mark-ups between exporters and non-exporters after Görg and Warzynski (2003). Secondly, regarding their study as a benchmark, an additional dimension of geographic differentiation in the exporting behaviour of Swedish manufacturing firms is included to the empirical analysis. Finally, to obtain a proper measure of the mark-ups, I apply Roeger's method (1995), which makes it feasible to estimate marginal cost mark-ups consistently by OLS[4].

To preview the results, the exporting behaviour has an impact on mark-ups in Swedish manufacturing firms in the 1990s. Similar to the U.K. study by Görg and Warzynski (2003), I find also evidence indicating that exporting firms, particularly firms in sectors producing differentiated goods are able to sustain higher mark-ups. Furthermore, as an additional dimension of differentiation, it seems that different geographic exporting destinations are also important determinants of exporting firms' mark-up.

The paper proceeds as follows. The methodology applied to estimate mark-up is introduced in section 2. Section 3 presents data and gives some descriptive facts on development of export orientation and sectoral characteristics in Swedish manufacturing sectors in the 1990s. The empirical specifications and results are contained in section 4 and I conclude in section 5.

2. Methodology

Let me first begin with some brief description and discussion of the method developed by Roeger (1995), which I apply to estimate price-cost margins. The method precedes from a standard production function of a firm *i* at time *t*

$$Q_{it} = A_{it} F_i \left(K_{it}, S_{it}, U_{it}, M_{it} \right) \tag{1}$$

where Q is output, *K* is capital, *S* is skilled and *U* is unskilled labour, and *M* is material input. *A* denotes the technological level, which is assumed to be a Hicks-neutral technical change.

Under the assumption of constant returns to scale, the primal Solow residual *SR* can be expressed as:[5]

$$SR_{it} = \hat{Q}_{it} - \left(1 - \theta_{iSt} - \theta_{iUt} - \theta_{iMt}\right)\hat{K}_{it} - \theta_{iSt}\hat{S}_{it} - \theta_{iUt}\hat{U}_{it} - \theta_{iMt}\hat{M}_{it} =$$
$$\left(1 - \beta_{it}\right)\hat{A}_{it} + \beta_{it}\left(\hat{Q}_{it} - \hat{K}_{it}\right) \tag{2}$$

$\hat{X}$ denotes relative change in *X*. $\hat{A}_{it}$ is technical change and θ_{Jit} is the share of factor *J* ($J = K, S, U, M$) in total revenue. β_{it} is the Lerner index, which is closely related to the mark-up, $\mu_{it} = p_{it} / m_{it}$, price over marginal cost:

$$\beta_{it} = \frac{p_{it} - m_{it}}{p_{it}} = 1 - \frac{1}{\mu_{it}} \tag{3}$$

Hence, the primal (quantity) residual is a weighted average of technical change and the rate of change of capital productivity, and the Lerner index determines the weights.

By using the cost function that corresponds to the production function in Equation (1), I can derive the dual (price-based) Solow residual *SRP* as the following:

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[4] See, e.g. Konings et al. (2002, 2003) applies this methodology to Belgian manufacturing and a number of transition economies. Görg and Warzynski (2003) have also applied the same methodology to the manufacturing in U.K.

$$SRP_{it} = (1-\theta_{iSt}-\theta_{iUt}-\theta_{iMt})\hat{w}_{iKt} + \theta_{iSt}\hat{w}_{iSt} + \theta_{iUt}\hat{w}_{iUt} + \theta_{iMt}\hat{w}_{iMt} - \hat{p}_{it} =$$

$$(1-\beta_{it})\hat{A}_{it} - \beta_{it}(\hat{p}_{it} - \hat{w}_{iKt}) \qquad (4)$$

$\hat{w}_{iJt}$ and $\hat{p}_{it}$ are the relative changes in the price of factor *J* and the output price. Likewise in Equation (2), the dual (price-based) Solow residual *SRP* is a weighted average of a technical change and the rate of change of output prices minus the rate of change of capital costs. The weights here are determined by the Lerner index as well.

The basic idea of Roeger's method is that the difference between the primal and the dual Solow residual is due to imperfect competition in the product market. Subtracting SRP_{it} from SR_{it} yields:

$$(\hat{Q}_{it} + \hat{p}_{it}) - (1-\theta_{iSt}-\theta_{iUt}-\theta_{iMt})(\hat{K}_{it} + \hat{w}_{iKt}) - \theta_{iSt}(\hat{S}_{it} + \hat{w}_{iSt}) - \theta_{iUt}(\hat{U}_{it} + \hat{w}_{iUt}) - \theta_{iMt}(\hat{M}_{it} + \hat{w}_{iMt})$$

$$= \beta_{it}\left[(\hat{Q}_{it} + \hat{p}_{it}) - (\hat{K}_{it} + \hat{w}_{iKt})\right] \qquad (5)$$

By letting ΔY_{it} denote the expression on the left hand side, ΔX_{it} denote the expression within the brackets on the right hand side, and adding an error term ε_{it}, I obtain:

$$\Delta Y_{it} = \beta_{it}\Delta X_{it} + \varepsilon_{it} \qquad (6)$$

This is the baseline model that I estimate in the coming empirical analysis. The most appealing feature of this methodology is the simplicity. When the productivity (technical change) term is cancelled out, as shown above in equation (5), price-cost margins can be estimated consistently by using OLS. Furthermore, this method requires only nominal variables, and thus it helps to overcome measurement errors owing to lack of detailed price

[5] A detailed derivation of the expression for the primal Solow residual *SR* and for the dual Solow residual *SRP* in Equation (4) below is given in Appendix 1.

data. Despite these advantageous features associated with Roeger's methodology, there are some critical theoretical and empirical issues that need to be discussed before moving on to the estimations.

Theoretically, Roeger's method relies on the assumption of constant returns to scale. This restrictive assumption leads, as shown by Basu and Fernald (1997) to upward (downward) bias in the mark-up estimation depending on decreasing (increasing) returns to scale. Empirical estimates of returns to scale are somewhat mixed. Haskel et al. (1995) and Linnemann (1999) find constant returns to scale in UK and German manufacturings. The result in Basu and Fernald (1997) of using US manufacturing data indicates that firm-level returns to scale are constant or slightly decreasing, while Klette (1999), which analyses Norwegian manufacturing implies decreasing returns to scale. Also Kee (2002), which relaxes both the assumptions of constant returns to scale and perfect competition in a study of Singapore's manufacturing, finds evidence of decreasing returns to scale, as well as of market power. In this study, the focus of the empirical analyses is the mark-up. I choose Roeger's method, which provides a straightforward estimate of mark-up. Nevertheless, I am also aware that potential bias may emerge in the presence of non-constant returns to scale. In this study I would expect a potential downward bias as a result of increasing returns to scale. This expectation can be motivated by the following factors. First, the firms included in this study are of relatively large sizes with firms employing more than 50 employees. Second, Sweden as one of the relatively more advanced economies is supposed to have relatively effective factor utilization. Both these two factors make it plausible that increasing returns to scale may emerge at the firm level.

Empirically, the non-zero error term in Equation (6) may cause problem for consistent estimation. The error term is supposed to be zero given that the productivity term is cancelled out in the derivation. However, as discussed in Roeger (1995) and in other empirical applications of his method, e.g. Kennings et al. (2002) and Görg and Warzynski (2003), measurement errors in production factors are potential sources for a non-zero term.

Measurement errors in capital stocks K_{it} are of particular concern. The book value of capital stocks in the balance sheet of enterprises is used and I employ firm-specific depreciation rates to construct the firm-specific rental price of capital w_{iKt}.[6] To assess potential measurement errors in the book-value capital stocks I have computed an alternative capital stock measure by applying a perpetual inventory method.[7] The correlation between this alternative capital stock measure and the book-value capital stock is high (0.82), which indicates that these measures are very similar and the measurement errors in the capital stock can be regarded as fairly limited. One drawback with the perpetual inventory method is that it suffers more from missing value problem; as soon as data on net investment is missing, the accumulation is stopped. Since these two measures are so similar, the book-value capital stocks in the financial accounting of enterprises are used in the estimation.[8]

Another potential source of measurement error is the labour input. The labour input used in this study is the number of skilled and unskilled employees at the firm level, and not hours worked by different skill categories. Yet, according to Konings et al. (2003), this measurement error does not cause problem for the estimation since the labour input appears

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[6] Appendix 3 shows how the rental price of capital has been constructed.
[7] Hansson and Lundin (2003) contains a description of the generation of this capital stock.

only on the left hand side of Equation (6). On the other hand, the inflexibility of the labour market in response to demand shifts in the product market results in labour hoarding that may cause more concern. This may be particularly valid in the highly centralised and unionised labour market in Sweden. As in earlier empirical applications, I include year dummy variables to control for such demand effects.

To summarize, even if the productivity term is cancelled out and I can therefore avoid some of earlier endogeneity problems, due to potential measurement errors and the assumption of constant returns to scale, it is important to keep in mind that the estimated mark-ups are likely to represent a lower bound for firms operating under increasing returns to scale. Furthermore, potential measurement errors in capital stock, labour inputs and adjustment rigidities over the business cycle may also induce downward bias.[9]

Finally, it is difficult to estimate a firm-specific mark-up due to the lack of degrees of freedom, especially when the number of firms is getting large. The common solution is to apply a restriction that the average mark-ups are the same for all firms in a given industry, in other words, to estimate a fixed parameter as an average mark-up across firms. This will be employed here too.

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[8] The difference in the number of observations by using these two capital stock measurements is 776. Yet, I have estimated all the models in the following sections by using both types of capital stocks and they yield very similar results.

[9] See, e.g. Martins et al. (1996) for a more detailed discussion.

3. Data and variables

The data used in this paper are from Statistics Sweden and have been complied into a microeconomic database at Trade Union Institute for Economic Research (FIEF). From the annual financial reports of the enterprises, data on sales, capital stocks, wage bills and costs of material are obtained. By using data from the register-based labour market statistics (RAMS) I am able to divide firm-level wage bills into wage bills of skilled and unskilled labour.[10] The dataset consists of all manufacturing firms larger than 50 employees for the period 1990-1999.[11] This leaves me with a panel of 3197 unique firms belonging to 93 manufacturing industries at the 3-digit level of the SNI92 classification.[12] The firm-specific rental price of capital has to be derived and I present detailed information on the construction of this variable in Appendix 3.

Since the division of total export by trading partner is not available at the firm level, the export data by industry at the 3-digit level and by trading partners are used to construct sectoral export intensity measures. I divide the total exports into the following five country groups:[13]

k=1: EU 14 member countries

k=2: EU10 candidate countries

k=3: Japan & Asian Newly Industrialized Countries (NIC)

k=4: other high-come countries

k=5: other lower-income countries

[10] I define skilled labor as employees with a post-secondary education, i.e. with more than 12 years of schooling.
[11] Manufacturing firms with less than 50 employees are excluded because of problems with missing values in export, capital stock and net investment. This might lead to an upward bias in the estimated mark-ups due to the exclusion of small firms.
[12] Table A2.1 in Appendix 2 presents more information on the panel.

The greatest advantage of using the industry-level export intensities is the possibility to distinguish various geographic destinations of exports. However, the drawback is that it imposes a restrictive assumption, namely that all the firms within a same industry have the same trading partner composition in their exports.

Table A1: *Export intensities to various country groups (1990-1999)*

In table A1, as indicated by export ratios, defined as exports over total turnovers in the Swedish manufacturing, we can observe that Swedish manufacturing is highly exposed to international exporting markets. The EU member countries are the most important trading partners in terms of exports. The largest change in export intensity in the period 1990-1999 has taken place in the increase of exports from Sweden to the EU candidate countries. The distribution of the export intensities among country groups has been relatively stable over time.

As described in introduction, I am not only interested in the average effect of exporting behaviour but also the differential effects of export that are associated with product differentiation on firms' mark-ups. Therefore, I divide the manufacturing sector into high- and low-differentiated sectors in Table A2.

Table A2: *Descriptive statistics for different industry structures (1990-1999)*

[13] See table A3.2 in data appendix 1for detailed classification of these 5 country groups.

The structure taxonomy is based on R&D intensity.[14] The R&D intensity is taken as a proxy for product differentiation and degree of innovation. The general impression we get from the descriptive data is that firms in high-differentiated sectors are relatively larger, more skill-intensive comparing to the firms in low-differentiated sectors. In relation to international competition, the firms in high-differentiated sectors export more to international markets, but at the same time, face more intensive import competition.

4. Empirical specifications and results.

The empirical analysis is conducted in three steps. First, I estimate the baseline model of Equation (6) to evaluate the average mark-up level in the Swedish manufacturing. After that, I include export dummy variable in the model to evaluate the export premiums in mark-ups. In the last step, export intensity is introduced into the model to further investigate the impact of export extensity on mark-ups, conditional on that the firm is an exporter.

4.1 Mark-up estimation

Based on the discussions in section 2 I employ the following model to estimate average mark-ups during the 1990s for different sectors *j* at the SNI92 2-digit level, as well as for manufacturing as a whole:

$$\Delta Y_{ijt} = \beta_j \Delta X_{ijt} + \lambda_t Year_t + \varepsilon_{ijt} \quad (7)$$

[14]A more detailed description of this simplified classification device can be found in Matins et al.(1996), page 23, table 6. Product differentiation can take place either through innovation (vertical differentiation) or by adding new varieties of exiting products (horizontal differentiation). In this simplified classification, such distinction between vertical- respective horizontal differentiations is not explicitly made. Nevertheless, the strategy is applied in the OECD Structural Analysis database (STAN) to bring market structure to the analysis of industrial development. Most recent empirical studies that take account for product differentiation also use the Rauch Classification of Goods (1999) that is classified by SITC Rev2. I experiment with linking the ISIC Rev. 3.1 in our dataset to the SITC Rev2 to construct Rauch classification. The result is not very satisfactory since the majority of Swedish manufacturing sectors are classified as homogenous products. It may due to both

Year dummy variables $Year_t$ control for unobserved yearly fluctuations. The estimation procedure imposes a constraint that the average price-cost margin is constant over time and over firms *i* within a same industry *j*; β_j is a fixed parameter. All the specifications in the following sections are estimated by applying OLS, fixed- and random effects estimators. The inclusion of fixed effects aims at capturing some unobservable time-invariant factors that are likely to have an effect on mark-ups, such as unobserved technology, sunk costs or advertising outlays at the firm level. There are several additional advantageous features with the fixed- and random effects estimators. First, the fixed estimation relies on the within-firm variations and it reveals the changes in the mark-ups overtime. Second, the fixed-effects catch also some of the time-invariant measurement errors at the firm level. Finally, most of the previous evidences achieved by using similar methodology rely on the fixed effects estimator at either the industry- or the firm level.[15] The fixed effects estimates thus provide possibility to make some comparisons to previous studies.[16] *Table 1* reports the results.

Table 1: *Baseline estimation of mark-ups*

The estimates of average price-cost margins are robust to different estimators. On average, the mark-up in Swedish manufacturing as a whole is above 30 percent ($\beta = 0.23$). However, there are significant variations across different sectors. We observe relatively high mark-ups (over 40 percent) in industrial sectors such as radio, TV and communication equipment, publishing and print, refined petroleum products, chemicals and chemical products (where pharmaceuticals are included), and professional instruments. On the other hand, the mark-

the problem with compatibility between these two classifications, and duo to different differentiation indicator used by Rauch.

[15] See e.g. Konings & Vandenbussche (2002), Konings et al. (2001,2002).

[16] See Lundin (2003) for more detailed comparisons between mark-ups in Swedish manufacturing sector and some previous studies on Sweden and other small and open economies.

ups are relatively low (below 20 percent) in leather and footwear, office machinery and computers, and furniture and manufacturing not elsewhere classified.

4.2 Export premiums and mark-ups

To assess the effects of exports on the mark-ups of Swedish manufacturing firms, I start with the following model:

$$\Delta Y_{it} = \beta_1 \Delta X_{it} + \beta_h \Delta X_{it} \times H_{jt} + \beta_{ex\,dummy} \Delta X_{it} + \sum_{t=1}^{9} \beta_t \Delta X_{it} \times Yeardummy_t + \gamma_1 Exdummy_{it} + \gamma_2 H_{jt} + \gamma_3 Yeardummy_t + \varepsilon_{it} \tag{8}$$

Where

$Exdummy_{it}$: a dummy variable for the current export status.

H_{jt} : Industry concentration, Herfindahl index for the j th industry in year t .

$Yeardummy_t$: Year dummy variables.

In the above model, if the export status has a positive effect on mark-up, I expect a positive sign of $\beta_{exdummy}$. Furthermore, the concentration ratio variable H_{jt} is used to control for the effect of the domestic competition on mark-ups. The prediction is that higher the concentration, less competition pressure on the domestic market, and thus higher the mark-ups. I expect therefore a positive sign of coefficient β_h . I use also the interaction terms between ΔX_{it} and year dummy variables to control for the year-specific effects on mark-ups and thereby relax the assumption that mark-ups are constant over time.

In the next step, I modify the above model by including the dimension of product differentiation into the specification and the following equation is estimated:

$$\Delta Y_{it} = \beta_1 \Delta X_{it} + \beta_h \Delta X_{it} \times H_{jt} + \beta_{ex\,dummy} \Delta X_{it} \times Exdummy_{it} + \beta_{exdiff} \Delta X_{it} \times Exdummy_{it} \times Diffdummy_j + \beta_{diff} \Delta X_{it} \times Diffdummy_j + \sum_{t=1}^{9} \beta_t \Delta X_{it} \times Yeardummy_t + \gamma_1 Exdummy_{it} + \gamma_2 Diffdummy_j + \gamma_3 H_{jt} + \gamma_4 Yeardummy_t + \varepsilon_{it} \quad (8.1)$$

In Equation 8.1, *Diffdummy* is a dummy variable, which equals to one if the firm is in a sector that produces high-differentiated goods. The coefficient $\beta_{exdummy}$ measures the average effect or the effect of export status in the low-differentiated sectors, while the coefficient β_{exdiff} measures the differential effect of export status in the high-differentiated sectors. The differentiation coefficient β_{diff} is included to measure the direct effect of product differentiation on mark-ups.

Table 2: *Export premiums (export dummy variable)*

The results of the above models are reported in Table 2. In column 1.1, 1.2 and 1.3, I report the estimates of Equation (8) without product differentiation, while in column 2.1, 2.2 and 2.3, the product differentiation is inserted into the Equation (8.1). The OLS, fixed- and random effects estimators yield very similar results. I regard the random effects estimates are the preferred ones, since both the variations across- and within firms are taken into account and the Hausman specification test is also in favour of the random effects estimator. The concentration coefficient β_h yields the expected and significantly positive effect on the mark-ups. However, the export premium coefficient $\beta_{exdummy}$ is negative in all specifications and it is statistically significant in the fixed- and random effects estimations. It implies that, exporters, even given higher productivity; do not necessarily have higher mark-ups. The next question is if product differentiation will make any difference. The inspection of the estimates in column 2.1, 2.2 and 2.3 reveals that the differential effects in high-differentiated sectors are positive, and statistically significant in the fixed- and random effects estimations. However, indicated by the direct effect of product differentiation β_{diff} , which is negative and with almost equal size (in absolute value) as the differential effect of export premium in the high-differentiated sectors, there is no clear-cut evidence supporting that exporters, even in the high-differentiated sectors have higher mark-ups than non-exporters. It is because product differentiation, through e.g. R&D investment increases actually production cost for exporters, who try to enhance their competitiveness in high-differentiated markets. As a matter of fact, the average effect of export status is negative.

However, using export dummy variable can be an over-simplified way to describe firm's exporting behaviour. In the next section I continue with incorporating more quantitative information, namely export intensity into the analysis.

4.3 Export intensity and mark-ups

The modifications of the model to investigate links between export intensity and mark-ups are straightforward. First, instead of export dummy variable $Exdummy_{it}$, I use firm-level export intensity EXC_{it} defined as total export over total turnover to assess the impact of exports on mark-ups. Second, I use industry-level export intensities that are divided into five country groups to address the importance of geographic differentiation. The export intensity may affect the mark-ups of the firms if firms are able to segment markets and price discriminate. Whether mark-ups will be higher in the export markets depend also on the relative elasticity of demand for the firms' products at home and abroad. Thus we cannot a priori determine the sign of the effect of the export intensity on mark-up, and the sign is actually ambiguous. The follow model is estimated and results are reported in Table 3.1.

$$\Delta Y_{it} = \beta_1 \Delta X_{it} + \beta_h \Delta X_{it} \times H_{jt} + \sum_{k=1}^{5} \beta_k \Delta X_{it} \times EXC_{jkt} + \sum_{t=1}^{9} \beta_t \Delta X_{it} \times Yeardummy_t + \sum_{k=1}^{5} \gamma_k \times EXC_{jkt} + \gamma_2 H_{jt} + \gamma_3 Yeardummy + \varepsilon_{it} \tag{9}$$

Where

EXC_{jkt} : Industry level measure for export intensity, measured as share of export to destination k in total turnover.

H_{jt} : Industry concentration, Herfindahl index for the j th industry in year t .

$Yeardummy_t$: Year dummy variables.

Table 3.1: *Effect of export intensity (exporters only)*

I start with looking at the effect of total export intensity at the firm- level on mark-up and then dividing the industry-level export intensities into various geographic destinations. In column 1.1, 1.2 and 1.3 in Table 3.1, we observe the negative effects that are similar to the export dummy variable in Table 2. When total exports are divided into five country groups, interestingly, we can observe both positive and negative differential effects of export intensities, depending on different destinations of the exports. Indicated by the random effect estimates, higher export intensities to EU candidate countries and to Japan and Asian Newly Industrialisation countries (NIC) yield higher mark-ups while higher export intensities to EU member counties and other high-income countries will depress mark-ups. However, there is no any significant effect found in exports to other low-income countries. To check the potential endogeneity problem, I run the same specification with lagged export intensities by one year and two years and the results turn out to be similar.

To assess the effect of product differentiation and its joint effect together with geographical differentiation, I estimate the following equation: [17]

$$\Delta Y_{it} = \beta_1 \Delta X_{it} + \beta_h \Delta X_{it} \times H_{jt} + \sum_{k=1}^{5} \beta_k \Delta X_{it} EXC_{jkt} + \sum_{k=1}^{5} \beta_{kd} \Delta X_{it} EXC_{jkt} \times diffdummy_j + \beta_{diff} \Delta X_{it} \times diffdummy_j + \sum_{t=1}^{9} \beta_t \Delta X_{it} \times Yeardummy_t + \sum_{k=1}^{5} \gamma_k EXC_{jkt} + \gamma_2 H_{jt} + \gamma_3 diffdummy_j + \gamma_4 Yeardummy_t + \varepsilon_{it} \quad (9.1)$$

Table 3.2: *Export intensity and product differentiation (divided into 5 country groups)*

As shown in Table 3.2, when the product differentiation and its interactive terms with export intensities to various country groups are included, it seems that exports in high-differentiated sectors to EU candidate countries and to other high-income countries have a positive effect on mark-ups. On the other hand, the increases in export intensities to EU member countries and other low-income countries actually decrease the mark-ups in the high-differentiated sectors. For the export intensities to other high-income counties, the effect is negative in low-differentiated sectors, while it is positive in high-differentiated sectors. Finally, the positive and significant effect of export intensities to Japan and Asian NIC disappear when the product differentiation interactive term is inserted into the model. It might be explained by the fact that the multicollinearity between exports of low- and high-differentiated products to this country group is quite high.

Based on the above results from estimations with and without differentiation interaction terms, there are two empirical observations that emerge. First, increases in export intensities do not uniformly yield higher mark-ups of Swedish manufacturing firms. Second, increases in export intensities in high-differentiated sectors do not either guarantee higher mark-ups. From previous studies, exporters are found to be more productive and have cost advantages

[17] I estimate also the model with the interaction between total export intensity at the firm-level and product differentiation. For briefness, the results are reported in appendix 4 as additional results.

over non-exporters. However, the competition and demand situations in the exporting markets are also important determinants of mark-ups. The inclusion of geographic differentiation provides some possibility to identify such heterogeneous competition and demand conditions in various exporting markets and the results reveal that the geographical differentiation makes difference in exporting firms' mark-ups.

In general, increases in export intensity to EU candidate countries and Japan and Asian NIC yield higher mark-ups. To some extent, these results confirm both the demand elasticity and efficiency aspects of the link between exporting behaviour and mark-up. First, it may imply that Swedish products have some quality/ technological advantages in these markets. Second, only the most efficient firms will be able to export to countries with large geographical distances because trade cost to these countries will be higher.[18] The consumer preferences and tastes are presumably quite different from Sweden in those Asian markets. It implies that the demand elasticity of prices for Swedish products might not be very high and Swedish products have some quality advantages in these markets and the prices can therefore be sustained at a relatively high level. However, the lower mark-ups associated with exports to EU member countries and other high-income countries may reflect higher demand elasticity and more intensive competition in those markets. Swedish producers have to lower price in these markets. Nevertheless, in the high-differentiated sectors, increases in export intensities to other high-income countries will increase mark-ups, while the opposite effect emerges in the export markets in EU member countries. It reveals some efficiency differences in exporting firms. Only the most efficient firms might be able to cover the higher trade costs to other high-income countries (e.g. the U.S.) outside Europe and they are

[18] In Melitz (2003), firm heterogeneity is defined in term of productivity difference. This productivity difference implies further difference in ability to overcome trade cost. Only firms with high productivity are able to export while firms with low productivity sell only on the domestic market. Furthermore, the most

also the firms that are competitive in those markets. On the other hand, the exporters with "intermediate" level of efficiency advantages compete in EU member countries, where both demand elasticity of prices and competition intensity are high. The negative effect observed in high-differentiated sectors indicates that Swedish export products do not achieve competitive advantages in price and/ or quality in these EU markets.

5. Concluding remarks

This paper estimates the average level of mark-ups by applying Roeger's method to Swedish manufacturing sectors, and assesses how exporting behaviour affects manufacturing firms' mark-ups.

The effect of exports of Swedish manufacturing firms cannot be found in the specifications that include simply export status dummy variable. In the further analysis with average firm-level export intensity and industry-level export intensities divided into both different geographic destinations and various degrees of product differentiation, the results suggest that exports do have an impact on mark-ups. The increases in export intensities to EU candidate counties and Japan and Asian NIC, in general, have a positive effect on the mark-ups of Swedish manufacturing firms, and the strongest effect is found in the high-differentiated sectors. Furthermore, in the high- differentiated markets, increases in export intensity to EU member countries yield a negative effect whereas a positive effect merges in export markets in other high-income countries.

The results are consistent with the predictions of the model dealing with links between productivity, exporting and mark-up developed by Bernard et al. (2003). Compared to the

productive firms expot to countries with larger geographic distance because they are able to overcome higher benchmark study of the U.K. manufacturing, the results achieved in this study has confirmed the hypothesis that exporters, who enjoy the cost- and efficiency advantages over non-exporters are also likely to have higher mark-ups. However, the cost- and efficiency advantages can only be regarded as necessary, but not sufficient promise to sustain higher mark-ups. As shown in this study by introducing both geographic and product differentiations into the analysis, the competition and demand conditions in specific exporting markets are also very important determinants of mark-ups, even given that exporters have higher efficiency.

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trade costs.

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Table A1: *Export intensities to different country groups (1990 –1999)*

Country Group	Export ratio 1990	Export ratio 1999
EU 14 members	0.34	0.38
EU 10 candidates	0.01	0.05
Japan and Asia NICs	0.02	0.03
Other high-income countries	0.16	0.17
Other low-income countries	0.05	0.07
All countries	0.58	0.70

Table A2: *Descriptive statistics for different industry structures (1990-1999)*

	Total Manufacturing	High-differentiation	Low-differentiation	Difference (t-ratio)
Firm size	**306**	394	252	142 (10.23)
Capital intensity	**270**	216	303	-86.83 (-17.46)
Skill intensity	**0.14**	0.18	0.11	0.70 (39.45)
R&D intensity	**0.018**	0.038	0.006	0.32 (4.29)
Export intensity	**0.32**	0.430	0.261	0.169 (36.17)
Import penetration	**0.44**	0.611	0.330	0.281 (87.90)
Nr. Observation	**17443**	6568	10875	

Table 1: *Baseline estimation of mark-ups* $\Delta Y_{it} = \beta_j \Delta X_{it} + \lambda_1 Yeardummy_t + u_{it}$

Sector	**OLS** Lerner index: $\beta_{it} = \frac{p_{it} - mc_{it}}{p_{it}}$	**OLS** Implied PCM: $\mu_{it} = \frac{p_{it}}{mc_{it}} = \frac{1}{1-\beta_{it}}$	**Fixed-effect** Lerner index: $\beta_{it} = \frac{p_{it} - mc_{it}}{p_{it}}$	**Fixed-effect** Implied PCM: $\mu_{it} = \frac{p_{it}}{mc_{it}} = \frac{1}{1-\beta_{it}}$	**Random –effect** Lerner index: $\beta_{it} = \frac{p_{it} - mc_{it}}{p_{it}}$	**Random –effect** Implied PCM: $\mu_{it} = \frac{p_{it}}{mc_{it}} = \frac{1}{1-\beta_{it}}$	**Hausman test p-value**	**Nr.obs**
All manufacturing (year dummy)	0.233 [14.75]*	1.304	0.234 (47.09)	1.305	0.233 (53.03)	1.303	0.56	13220
15: Food & Beverage	0.236 [13.64]	1.309	0.235 (13.54)	1.307	0.236 (15.33)	1.309	1.00	1057
16: Tobacco	-	-	-	-	-	-	-	22
17: Textiles	0.189 [6.50]	1.233	0.163 (6.44)	1.195	0.174 (7.14)	1.211	1.00	287
18: Wearing apparels	0.213 [2.02]	1.271	0.135 (1.31)	1.156	0.183 (2.10)	1.224	0.99	101
19: Leather, footwear	0.116 [0.63]	1.131	-	-	-	-	-	21
20: Wood products	0.192 [13.04]	1.238	0.197 (15.80)	1.245	-	-	-	1007
21: Pulp and paper	0.251 [6.67]	1.335	0.249 (15.54)	1.332	0.251 (16.31)	1.335	0.01	612
22: Publishing, print	0.312 [13.13]	1.453	0.310 (16.15)	1.449	0.312 (17.95)	1.453	0.89	1307
23: Refined petroleum products	0.437 [3.58]	1.776	0.438 (3.93)	1.779	-	-	-	45
24: Chemicals & chemical products	0.339 [7.56]	1.513	0.356 (19.93)	1.553	-	-	-	659
25: Rubber and plastic products	0.193 [4.23]	1.239	0.208 (8.35)	1.263	0.193 (8.89)	1.239	0.81	640
26: Other non-metallic mineral products	0.249 [8.57]	1.332	0.243 (10.18)	1.321	-	-	-	501
27: Basic metals	0.182 [9.79]	1.222	0.195 (9.41)	1.242	-	-	-	496
28: Fabricated metal products	0.234 [14.16]	1.305	0.252 (14.87)	1.337	-	-		1397
29: Machinery	0.186 [9.45]	1.228	0.194 (17.08)	1.241	0.189 (18.60)	1.233	0.01	2104
30: Office machinery & computers	0.129 [1.50]	1.148	0.167 (2.96)	1.200	0.143 (2.83)	1.167	0.99	136
31: Electrical machinery & apparatus	0.252 [7.85]	1.337	0.283 (14.54)	1.395	0.273 (14.79)	1.376	0.00	550
32: Radio, television, communication equipment	0.323 [7.26]	1.477	0.347 (10.35)	1.531	-	-	-	239
33: Medical, precision instrument	0.299 [5.16]	1.427	0.306 (6.69)	1.441	-	-	-	417
34: Motor vehicles, trailers	0.199 [10.48]	1.248	0.201 (8.10)	1.252	-	-	-	667
35: Other transport equipment	0.167 [4.84]	1.200	0.100 (3.58)	1.111	0.121 (4.59)	1.138	0.00	264
36: Furniture, manufacturing n. e. c.	0.142 [8.15]	1.166	0.135 (7.40)	1.156	-	-	-	691

Note: the coefficients are almost identical with the industry-dummy variables. Square brackets [ ] give White's heteroskedasticity- consistent t-statistics for OLS regression , and t-statistics and z-statistics in parentheses for fixed- and random effect estimations..* Standard errors are adjusted for the heteroskedasticity and potential dependency among firms in the same industry.

Table 2: *Export premium (export dummy variable)*

	1.1	1.2	1.3	2.1	2.2	2.3
	OLS*	Fe	Re	OLS*	Fe	Re
β_1	0.257 [4.97]	0.258 (18.01)	0.257 (21.79)	0.268 [4.70]	0.270 (18.62)	0.268 [22.34]
β_h	0.104 [1.58]	0.106 (7.20)	0.103 (7.55)	0.115 [1.97]	0.116 (7.74)	0.114 (8.18)
$\beta_{exdummy}$	-0.044 [-1.42]	-0.047 (-9.34)	-0.045 (-9.80)	-0.054 [-1.53]	-0.058 (-10.11)	-0.055 (-10.29)
β_{exdiff}				0.050 [1.34]	0.061 (4.81)	0.051 (4.49)
β_{diff}				-0.052 [-1.22]	-0.061 (-5.08)	-0.053 (-4.98)
Year dummy * ΔX_{it}	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Hausman test	-	-	0.73	-	-	0.53
R^2	0.52	within: 0.54	within: 0.54	0.52	within: 0.55	within: 0.55
		between:0.33	Between:0.33		between:0.32	Between:0.33
		overall: 0.52	overall: 0.52		overall: 0.52	overall: 0.52
Nr. of observation	13220	13220	13220	13220	13220	13220

Note: The coefficients are almost identical with industry dummy variables included.

* Standard errors are adjusted for the heteroskedasticity and potential dependency among firms in the same industry.

Table 3.1: *Effect of export intensity (exporters only)*

	1.1	1.2	1.3	2.1	2.2	2.3
	OLS*	Fe	Re	OLS*	Fe	Re
β_1	0.212 [8.56]	0.207 (12.51)	0.210 (15.62)	0.228 [8.54]	0.222 (13.44)	0.226 (16.80)
β_h	0.139 [2.66]	0.143 (9.06)	0.138 (9.43)	0.125 [2.45]	0.130 (7.47)	0.125 (7.70)
β_{total}	-0.013 [-0.71]	-0.008 (-1.15)	-0.012 (-1.82)			
Group1: EU14 β_{eu14}				-0.025 [-0.70]	-0.012 (-1.06)	-0.023 (-2.32)
Group2: EU10 β_{eu10}				0.220 [1.06]	0.152 (1.57)	0.210 (2.45)
Group3: Japan & NIC $\beta_{j\&n}$				0.425 [2.22]	0.509 (6.15)	0.458 (6.05)
Group 4: Other high-income countries $\beta_{high-income}$				-0.176 [-2.37]	-0.204 (-6.79)	-0.183 (-6.69)
Group5: Other low-income countries $\beta_{low-income}$				0.016 [0.28]	-0.020 (-0.61)	0.004 (0.14)
Year dummy * ΔX_{it}	Yes	Yes	Yes	Yes		
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Hausman test	-	-	0.81	-	-	0.62
R^2	0.52	within: 0.55	within: 0.54	0.51	within: 0.54	within: 0.54
		between:0.32	Between:0.32		between:0.33	Between:0.33
		overall: 0.52	overall: 0.52		overall: 0.51	overall: 0.51
Nr. of observation	10505	10505	10505	11045	11045	11045

Note: The coefficients are almost identical with industry dummy variables included.
* Standard errors are adjusted for the heteroskedasticity and potential dependency among firms in the same industry.

Table 3.2: *Export intensity and product differentiation (divided into 5 country groups)*

	OLS*	Fe	Re
β_1	0.231 [6.69]	0.227 (13.44)	0.230 (16.51)
β_h	0.135 [2.50]	0.148 (7.60)	0.138 (7.62)
Export to EU14 β_{eu14}	-0.005 [-0.10]	0.008 (0.48)	-0.0004 (-0.03)
Export to EU10 β_{eu10}	0.135 [0.49]	0.094 (0.84)	0.125 (1.22)
Export to Japan and Asian NICs $\beta_{j\&n}$	0.154 [0.54]	0.137 (0.87)	0.152 (1.04)
Export to other high income countries $\beta_{high-income}$	-0.231 [-2.41]	-0.263 (-6.69)	-0.243 (-6.72)
Export to other low-income countries $\beta_{low-income}$	0.096 [1.34]	-0.018 (-.0.22)	0.055 (0.74)
Export to EU14 × product differentiation $\beta_{eu14diff}$	-0.061 [-1.00]	-0.046 (-1.90)	-0.061 (-2.73)
Export to EU10 × product differentiation $\beta_{eu10diff}$	1.168 [2.55]	1.354 (4.05)	1.242 (4.18)
Export to Japan & NIC × product differentiation $\beta_{j\&ndiff}$	0.251 [0.69]	0.341 (1.79)	0.284 (1.62)
Export to other high-income × product differentiation $\beta_{highdiff}$	0.183 [1.17]	0.168 (2.69)	0.185 (3.25)
Export to other low-income × product differentiation $\beta_{lowdiff}$	-0.218 [-2.19]	-0.152 (-1.62)	-0.194 (-2.27)
Product differentiation β_{diff}	-0.005 [-0.17]	-0.012 (-1.31)	-0.007 (-0.88)
Year dummy	Yes	Yes	Yes
Hausman test	-	-	0.35
R^2	0.52	within: 0.55	Within: 0.55
		between: 0.32	Between: 0.33
		overall: 0.52	Overall: 0.52
Nr. of observation	10300	10300	10300

Note: The coefficients are almost identical with industry dummy variables included.
* Standard errors are adjusted for the heteroskedasticity and potential dependency

Appendix 1 Derivation of primal and dual Solow residuals

The primal analysis

Log-differentiation of the production function in equation (1) in section 2 gives

$$\hat{Q}_{it} = \hat{A}_{it} + \alpha_{iKt}\hat{K}_{it} + \alpha_{iSt}\hat{S}_{it} + \alpha_{iUt}\hat{U}_{it} + \alpha_{iMt}\hat{M}_{it} \qquad \text{(A.1)}$$

α_{iJt} is the elasticity of output with respect to input *J*, which in turn equals the factor *J*'s share of total cost, i.e. $\alpha_{iJt} = w_{Jit}J_{it} / m_{it}Q_{it}$, where w_{Jit} is the price of factor *J* and m_{it} is marginal cost.

The mark-up, price over marginal cost, is $\mu_{it} = p_{it} / m_{it}$ and the share of factor *J* in total revenue $\theta_{Jit} = w_{Jit}J_{it} / p_{it}Q_{it}$. This involves that we can write the cost share of factor *J* as

$$\alpha_{Jit} = \left(\frac{p_{it}}{m_{it}}\right)\left(\frac{w_{Jit}J_{it}}{p_{it}Q_{it}}\right) = \mu_{it}\theta_{Jit} \qquad \text{(A.2)}$$

Under perfect competition $\alpha_{Jit} = \theta_{Jit}$, while imperfect competition implies that $\mu_{it} > 1$ and hence $\alpha_{Jit} > \theta_{Jit}$.

We assume constant returns to scale and from Euler's theorem we know that

$$\sum_{J=K,S,U,M} \alpha_{Jit} = 1 \qquad \text{(A.3)}$$

Using (A.3), substituting (A.2), and adding $\hat{Q}_{it}$ and subtracting $\hat{K}_{it}$ on both sides of the equal sign, in equation (A.1) gives after some rewriting the Solow residual SR_{it}

$$SR_{it} = \hat{Q}_{it} - (1 - \theta_{iSt} - \theta_{iUt} - \theta_{iMt})\hat{K}_{it} - \theta_{iSt}\hat{S}_{it} - \theta_{iUt}\hat{U}_{it} - \theta_{iMt}\hat{M}_{it} =$$
$$\mu_{it}^{-1}\hat{A}_{it} + (1 - \mu_{it}^{-1})\hat{Q}_{it} - (1 - \mu_{it}^{-1})\hat{K}_{it} \qquad \text{(A.4)}$$

A common measure of market power, which is closely related to the mark-up, is the Lerner index or price-cost margin β_{it}

$$\beta_{it} = \frac{p_{it} - m_{it}}{p_{it}} = 1 - \frac{1}{\mu_{it}} \text{ or } \mu_{it} = \frac{p_{it}}{m_{it}} = \frac{1}{1 - \beta_{it}} \qquad \text{(A.5)}$$

We replace the mark-up with the Lerner index in (A.5) and obtain

$$SR_{it} = (1-\beta_{it})\hat{A}_{it} + \beta_{it}(\hat{Q}_{it} - \hat{K}_{it}) \qquad \text{(A.6)}$$

The dual analysis

The cost function that corresponds to firm *i*'s production function in equation (1) in section 2 is

$$C_i(w_{iKt}, w_{iSt}, w_{iUt}, w_{iMt}, Q_{it}, A_{it}) = \frac{G_i(w_{iKt}, \ldots w_{iMt})Q_{it}}{A_{it}} \qquad \text{(A.7)}$$

and the marginal cost function is

$$m_{it} = \frac{G_i(w_{iKt}, \ldots w_{iMt})}{A_{it}} \qquad \text{(A.8)}$$

Log-differentiation of (A.8), making use of Shepard's lemma, which means that $(\partial G_i / \partial w_J) = J_{it} A_{it} / Q_{it}$, and that total cost $C_{it} = G_{it} Q_{it} / A_{it}$, we get the following expression

$$\hat{m}_{it} = \hat{A}_{it} + \alpha_{iKt}\hat{w}_{Kt} + \alpha_{iSt}\hat{w}_{St} + \alpha_{iUt}\hat{w}_{Ut} + \alpha_{iMt}\hat{w}_{Mt} \qquad \text{(A.9)}$$

Assuming constant mark-up over the period *t* implies

$$\hat{p}_{it} = \hat{m}_{it} \qquad \text{(A.10)}$$

Replacing $\hat{m}_{it}$ with $\hat{p}_{it}$, using (A.3) and substituting (A.2), adding $\hat{w}_{iKt}$ and subtracting $\hat{p}_{it}$ on both sides of the equal sign, in equation (A.9) gives after some reshuffling the price-based Solow residual SRP_{it}

$$SRP_{it} = (1-\theta_{iSt} - \theta_{iUt} - \theta_{iMt})\hat{w}_{iKt} + \theta_{iSt}\hat{w}_{iSt} + \theta_{iUt}\hat{w}_{iUt} + \theta_{iM}\hat{w}_{iMt} - \hat{p}_{it} =$$
$$\mu_{it}^{-1}\hat{A}_{it} + (1-\mu_{it}^{-1})\hat{w}_{iKt} - (1-\mu_{it}^{-1})\hat{p}_{it} \qquad \text{(A.11)}$$

By replacing the mark-up with the Lerner index from (A.5) we get

$$SRP_{it} = (1-\beta_{it})\hat{A}_{it} - \beta_{it}(\hat{p}_{it} - \hat{w}_{Kt}) \qquad \text{(A.12)}$$

Appendix 2

Table A2.1: *Panel information*

Year	Number of firms
1990	1921
1991	1853
1992	1706
1993	1542
1994	1551
1995	1623
1996	1696
1997	1674
1998	1737
1999	1755
Sum	**Total number of firm-years: 17058**

Years in the panel	Number of firms
10	816
9	150
8	135
7	161
6	173
5	174
4	232
3	348
2	453
1	555
	Total number of firms: 3197

Table A2.2: *Country group classification*

group1: other OECD	**group2: EU14 (exl. Sweden)**	**group3: Japan & NIC**	**group4: EU 10 candidate countries**	**Group5: ROW***
Australia	Belgium	Japan	Czech Republic	Mexico
Canada	Demark	Taiwan	Estonia	Bulgaria
Iceland	Germany	Hong Kong	Cyprus	Turkey
New Zealand	Greece	South Korea	Latvia	Romania
Norway	Spain	Singapore	Lithuania	
Switzerland	France		Hungary	Other less developed countries
United State	Ireland		Malta	
	Italy		Poland	
	Luxembourg		Slovenia	
	The Netherlands		Slovakia	
	Austria			
	Portugal			
	Finland			
	United Kingdom			

*See data appendix of “The death of manufacturing plants”, which provides a list of US “low-wage” trading partners, 1989-1999”

Appendix 3: Definitions of variables

Rental price of capital

Following Hall and Jorgenson (1967) the rental price of capital in firm *i* in industry *j* at time *t* is derived:

$$R_{ijt} = [(i_t - \pi_t) + \delta_{it}] * p_{jt}$$

i_t : Long-run nominal interest rates proxied by yields on public sector bonds of 10 years maturity

π_t : expected inflation rate

δ_{it} : Firm-specific rate of depreciation

p_{jt} : Industry-specific deflator for fixed business investment

In the dataset capital stocks are divided into buildings and machinery, i.e. $K_{ijt} = K_{ijt}^B + K_{ijt}^M$. Depreciation rates and deflators are defined as weighted averages:

$$\delta_{it} = \frac{K_{it}^B}{K_{it}^B + K_{it}^M}\delta^B + \frac{K_{it}^M}{K_{it}^B + K_{it}^M}\delta^M \quad \text{and} \quad p_{jt} = \frac{K_{jt}^B}{K_{jt}^B + K_{jt}^M}p_{jt}^B + \frac{K_{jt}^M}{K_{jt}^B + K_{jt}^M}p_{jt}^M$$

The depreciation rate for buildings δ^B is 3 percent and for machinery δ^M 11 percent. p_{jt}^k are industry-specific deflators for buildings and machinery, $k = B, M$.

Measurements of competition

Measurement of competition

1. Export ratio: export as a fraction of domestic production
2. Import penetration ratio: import as a fraction of domestic consumption

Measurement of concentration

1. H: Herfindahl index: $\sum_{i=1}^{N} S_i^2$, where S_i is the market share of the i^{th} firm.

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Appendix 4: Additional results

Effect of total export intensity and product differentiation

$$\Delta Y_{it} = \beta_1 \Delta X_{it} + \beta_h \Delta X_{it} \times H_{jt} + \beta_{ex\,int} \Delta X_{it} \times Ex\,int_{it} + \beta_{ex\,int\,diff} \Delta X_{it} \times Ex\,int_{it} \times Diffdummy_j + \beta_{diff} \Delta X_{it} \times Diffdummy_j$$
$$\sum_{t=1}^{9} \beta_t \Delta X_{it} \times Yeardummy_t + \gamma_1 Ex\,int_{it} + \gamma_2 Diffdummy_j + \gamma_3 H_{jt} + \gamma_4 Yeardummy + \varepsilon_{it}$$

	OLS*	Fe	Re
β_1	0.222 [7.41]	0.217 (12.88)	0.219 (15.93)
β_h	0.138 [2.70]	0.140 (8.83)	0.137 (9.28)
$\beta_{ex\,int}$	-0.033 [-1.10]	-0.032 (-3.08)	-0.033 (-3.47)
$\beta_{ex\,int\,diff}$	0.043 [1.25]	0.048 (3.21)	0.044 (3.20)
β_{diff}	-0.018 [-0.78]	-0.018 (-2.33)	-0.018 (-2.57)
Year dummy * ΔX_{it}	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes
Hausman test	-	-	0.80
R^2	0.52	within: 0.55	within: 0.55
		between:0.32	Between:0.33
		overall: 0.52	overall: 0.52
Nr. of observation	10505	10505	10505

Note: The coefficients are almost identical with industry dummy variables included.
* Standard errors are adjusted for the heteroskedasticity and potential dependency among firms in the same industry.