

# NON-TARIFF BARRIERS, MARKET ACCESS, AND TRADE\*

Thomas MATHÄ

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## ABSTRACT:

This paper analyses the effects of non-tariff barriers, in terms of both variable and fixed export costs, on trade structure. The relationship between fixed and variable trade costs determines whether international trade emerges. If trade emerges, only variable, but not fixed export costs, influence the trade structure. The empirical results suggest that non-tariff barriers act, in particular, as fixed export costs, as the trade and intra-industry trade emerge in a larger number of industries than prior to the Single European Market programme, while the share of intra-industry trade is unaffected.

*Keywords:* Factor Endowments, Country Size, Non-Tariff Barriers, Market Access, Economic Integration, Intra- & Inter-Industry Trade

*JEL Classification:* F12, F15

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\* Stockholm School of Economics, European Institute of Japanese Studies, Box 6501, 11383 Stockholm, Sweden, and Central Bank of Luxembourg, Monetary Affairs, Economic Analysis & Statistics, 2 Boulevard Royal, 2983 Luxembourg, Luxembourg, Tel.: 00352 4774-4270, E-mail: T.Mathae@gmx.de. This paper is part of a Ph.D. thesis at the University of East Anglia, Norwich, UK. Earlier versions were presented at the annual Royal Economic Society conference in Durham in 2001, the conference of the European Trade Study Group (ETSG) in Glasgow in September 2000, the annual meeting of the European Association for Research in Industrial Economics in Lausanne in September 2000, and the conference of the Swedish Network for European Studies in Economics and Business (SNEE) in Mölle in May 2000, as well as various workshops at the University of East Anglia, and the Stockholm School of Economics. Apart from the respective discussants, I would like to thank Ari Kokko and Stephen Davies. Special thanks to Bruce Lyons and Michael Pfaffermayr for their help and insightful comments, as well as to Nicholas Horsewood for the provision of the trade data. Financial help from the DAAD and SI is gratefully acknowledged. Opinions expressed in this paper are personal opinions of the author and do not necessarily reflect those of the Central Bank of Luxembourg.

## I. INTRODUCTION

The ‘new’ international trade literature has not been very innovative with regard to modelling trade barriers, such as transport costs. Almost all contributions focus on ‘iceberg’ transport costs. Recently, the attention of policy makers and international organisations has shifted to non-tariff barriers (NTBs) as sources of hindrance for further trade liberalisation and economic integration between countries. These non-tariff barriers are commonly modelled as a tariff equivalence to ad valorem tariff barriers. In doing so, it may be possible to capture the quantitative effects of these NTBs, though it is generally doubtful as to whether such measures can adequately capture the structural implications on trade and industry. This is due to NTBs consisting of both variable and fixed trade cost components. Except for Venables (1994), such a distinction is completely missing in the theoretical literature. Moreover, to the best of my knowledge, there has been no previous attempt to incorporate both fixed and variable trade costs in order to analyse the trade structure between countries.

The aim of this paper is to develop, both theoretically and empirically, the idea that non-tariff barriers also exhibit fixed cost components. In monopolistic competition general equilibrium trade models, the differentiated product will always be traded, due to the love for variety, unless tariff rates or transport costs are infinitely high (e.g. Helpman & Krugman, 1985). The variable trade costs merely determine the volume of international trade. This is not only conceptually unsatisfactory, but it also highlights the virtue of introducing fixed trade costs.

Due to the trade related fixed costs the equilibrium industry structure may change, rendering exporting infeasible for firms. We know that countries do not trade all products, and that countries trade more products in a larger number of industries with some countries than with others. I believe that the incorporation of fixed trade costs makes a step towards accounting for these stylised facts.

The empirical analysis demonstrates, in using Swedish bilateral trade data with six EU countries between 1970 and 1994, that the results are consistent with the ideas forwarded in the theoretical section. In particular, it is demonstrated that countries do not necessarily trade in all industries, and that intra-industry trade does not emerge in all industries. This fact is related to difference in relative and absolute factor endowments, but also to the state and type of economic integration between the trading countries. Furthermore, the results are consistent with the notion that non-tariff exhibit substantial

fixed cost components, which have been significantly reduced by the Single European Market (SEM) programme.

The remainder of this paper is organised as follows: Section 2 sets up the theoretical model. Section 3 concerns the data and the econometric specification. Section 4 discusses the empirical results, while section 5 concludes.

## II. A MODEL OF MARKET ACCESS

The model, which is in the tradition of Krugman (1981) and Helpman & Krugman (1985), assumes that there are two countries with two sectors and two factors of production.<sup>1</sup> Each country consists of one differentiated product industry operating with increasing returns to scale and one homogenous product industry operating with constant returns to scale. The industry specific technologies, which are assumed to be identical to those in the foreign country, are respectively given by

$$l_{1,i} = \alpha + \beta x_{1,i} \quad (1) \quad \text{and} \quad l_{2,j} = \beta x_{2,j} \quad (2)$$

An individual firm has in total  $l_{1,i}$  hours of labour available, where  $\alpha$  and  $\beta$  represent the fixed and marginal cost of production. Assuming full employment  $x_{1,i}$  units of output can be produced. The market structure in the former is monopolistic competition and in the latter perfect competition. In the homogenous product sector prices equal marginal costs, i.e.

$$p_{d,2} = p_{f,2} = \beta w_2 \quad \text{and} \quad P_{d,2} = P_{f,2} = \beta W_2. \quad (3)$$

Due to the assumption of costless trade, it follows that prices and wages in the homogenous product industry will be the same in both countries.

In the differentiated product industry it is assumed that trade exhibits trade barriers of the form  $TB_1 = t + \gamma x_{f,1}$ , which include both fixed and variable cost components.  $\gamma x_{f,1}$  reflects the variable export costs, which depend on the export volume.  $\gamma$  is a parameter for the distance, while  $x_{f,1}$  denotes the exported quantity.  $t$  can be seen to reflect the amount of fixed export costs, such as registration fees, market research, additional costs due to countries adopting different product standards, legislation or setting up a distribution network. The profit function of a representative *domestic* firm in differentiated product industry can be written as

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<sup>1</sup> This is a condensed version of the theoretical model developed in Mathä (1998).

$$\pi_1 = p_{d,1}x_{d,1} + p_{f,1}x_{f,1} - (\alpha + \beta x_{d,1} + t + (\beta + \gamma)x_{f,1})w_1. \quad (4)$$

The subscript  $d$  denotes domestic prices and output, while subscript  $f$  refers to prices charged in the foreign country, and output sold in the foreign country.<sup>2</sup>  $p_{d,1}x_{d,1}$  is the domestic revenue, and  $p_{f,1}x_{f,1}$  represents the revenue generated in the export market at export prices.  $(\alpha + \beta x_{d,1})w_1$  is the production cost of the domestically sold goods in terms of nominal costs. Finally,  $(t + (\beta + \gamma)x_{f,1})w_1$  is the production cost of exported goods. Modelling trade barriers in this particular way means that the costs of exporting have to be borne by the producer. Products to be exported have higher marginal costs and exhibit a fixed trade cost component. Due to the assumptions of costless product differentiation and identical input requirements, all firms in the differentiated product industry will price at the same level. This means that all domestically produced and all imported varieties will be consumed in respectively equal quantities.

Individuals in both countries are assumed to have identical consumer preferences. Furthermore, it is assumed that these preferences are of the Dixit & Stiglitz (1977) type, i.e. the preferences can be modelled as part of a utility function

$$U = x_1^\chi x_2^{1-\chi} \text{ with } x_1 = \left( \sum_{i=1}^{n^*} x_{1,i}^\theta \right)^{\frac{1}{\theta}} \quad (5)$$

with a constant elasticity of substitution, where consumers like variety as such.  $x_1$  and  $x_2$  represent the consumption of the differentiated product and homogenous good respectively.  $\theta$  is a measure of product differentiation. The demand for the homogenous good can be represented as a constant share of expenditure divided by its price, i.e.

$$x_2 = \frac{(1-\chi)e}{p_2}. \quad (6)$$

Following Helpman & Krugman (1985, p. 118), the home (foreign) country demand for home country produced varieties can be written as

$$x_{d,1} = \frac{P_{d,1}^{-\sigma}}{np_{d,1}^{1-\sigma} + NP_{f,1}^{1-\sigma}} \chi e \quad (7) \quad \text{and} \quad x_{f,1} = \frac{P_{f,1}^{-\sigma}}{np_{f,1}^{1-\sigma} + NP_{d,1}^{1-\sigma}} \chi E \quad (8)$$

<sup>2</sup> The indices referring to individual firms in industry 1 are omitted for convenience, as they are identical due to the symmetry assumption. For the wage rate, this subscript can be omitted as wages are always domestic wages.

with  $\sigma = 1/(1-\theta)$  and  $\sigma > 1$ . The equations for the respective demand functions for foreign country produced varieties are similar.  $\sigma$  represents the elasticity of substitution between two product pairs in the differentiated product industry.  $\chi$  is the share of expenditure spent on goods from the differentiated product industry, while  $e$  and  $E$  represent the total expenditure in the respective countries. The notation used throughout this paper will be such that lower and upper case characters will denote the home country and foreign country respectively. Thus, home country consumers can consume  $n$  domestic and  $N$  foreign varieties.

Profit maximisation with respect to  $x_{d,1}, x_{f,1}, X_{d,1}$  and  $X_{f,1}$  yield the pricing conditions in the respective countries  $p_{d,1} = \beta w_1 \theta^{-1}$ ,  $p_{f,1} = (\beta + \gamma) w_1 \theta^{-1}$ ,  $P_{d,1} = \beta W_1 \theta^{-1}$  and  $P_{f,1} = (\beta + \gamma) W_1 \theta^{-1}$ . The mark up over marginal cost is constant, equals  $\theta^{-1} = \sigma / (\sigma - 1)$ , and is identical for both domestic and exported varieties. These can now be substituted into equations (7) and (8). After some rearrangement, two equations can be derived, linking the demand for exported varieties from the home (foreign) country, and the demand for domestic varieties in the foreign (home) country

$$x_{f,1} = \left( \frac{\beta + \gamma}{\beta} \right)^{-\sigma} \left( \frac{w_1}{W_1} \right)^{-\sigma} X_{d,1} \quad (9) \quad \text{and} \quad X_{f,1} = \left( \frac{\beta + \gamma}{\beta} \right)^{-\sigma} \left( \frac{W_1}{w_1} \right)^{-\sigma} x_{d,1}. \quad (10)$$

In equilibrium output and demand are equal, allowing us to substitute equations (9) and (10) into the equation (4). Denoting  $\tau = ((\beta + \gamma) / \beta)^{1-\sigma}$  and  $\delta = (w_1 / W_1)^{-\sigma}$  yields the result of

$$\pi = (1 - \theta) p_{d,1} [x_{d,1} + \tau \delta X_{d,1}] - \theta p_{d,1} (\alpha + t) / \beta \quad (11)$$

$$\text{and} \quad \Pi = (1 - \theta) P_{d,1} [X_{d,1} + \tau \delta^{-1} x_{d,1}] - \theta P_{d,1} (\alpha + t) / \beta. \quad (12)$$

Knowing that free entry assures zero profits in equilibrium, we can equalise equations (11) and (12) and establish the relationship

$$x_{d,1} / X_{d,1} = (1 - \tau \delta) / (1 - \tau / \delta) \quad (13)$$

between a home country firm's domestic output and foreign country firm's domestic output. Equation (13) can be substituted back into the profit function to obtain domestic firms output functions, such as domestically sold output, which is given by

$$x_{d,1} = (\sigma - 1) \frac{\alpha + t}{\beta} \frac{1 - \tau \delta}{1 - \tau^2}. \quad (14)$$

### *Trading Versus Autarky*

Equation (14) also determines whether we observe an autarky or a trading equilibrium, as firms will only choose to export if they can recoup the fixed costs, in doing so. In autarky  $n = l_1 / (\sigma\alpha)$  domestic firms produce  $x_{d,1} = (\sigma - 1)\alpha / \beta$  units of output. In a trading equilibrium, the number of home country firms equals  $n = l_1 / (\sigma(\alpha + t))$ , each of which produces  $x_{d,1}$ , see equation (14), units of output for home country individuals. Separating the trade independent part from the trade dependent part of equation (14), and dividing the latter by the former yields the export entry condition

$$\frac{t}{\alpha} \leq \frac{\tau\delta - \tau^2}{1 - \tau\delta}. \quad (15)$$

This expression determines how large the fixed export costs as share of the production fixed costs can be without rendering exporting infeasible to individual firms. Exporting becomes infeasible if the export revenue is not sufficient to recoup the additional export costs. This depends on the variable export costs and on the relative factor prices, which in turn are determined by the factor endowments of the countries. In the case of identical countries  $\delta$  equals unity, which reduces the export entry condition to  $t/\alpha \leq \tau$ . Otherwise, it is a priori quite difficult to determine when exactly the equilibrium ‘flips’ from autarky to trade. This is as  $\delta$  is endogenous and solely determined by the general equilibrium constraint. For example, the effects of increased trade liberalisation on relative wages may be non-monotonic (e.g. Krugman & Venables, 1990; Amiti 1998). This is particularly the case if countries differ in economic size. Secondly, the resulting home market effect may be overshadowed by factor endowment differences.

Hence, we will have to content ourselves with a graphical illustration of the effects of factor endowments on the export entry condition. As Figure 1 shows, the entry condition will be affected by the differences in factor endowments and country sizes. This is due to the endogenous change of factor price differentials between countries, in order to satisfy the trade balance restriction.<sup>3</sup>

If countries are identical with respect to economic size, but different with respect to their relative factor endowments, the entry condition lies north-westerly of that for

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<sup>3</sup> See appendix for the exact determination of  $\delta$ .

identical countries. The reason is that the home country, the net exporter of the differentiated products, has the relatively lower wage in the differentiated product industry. As Figure 1 illustrates, the more unequal countries are with respect to their relative factor endowments, the larger the fixed export costs can be relative to the variable trade costs without deterring the emergence of trade.

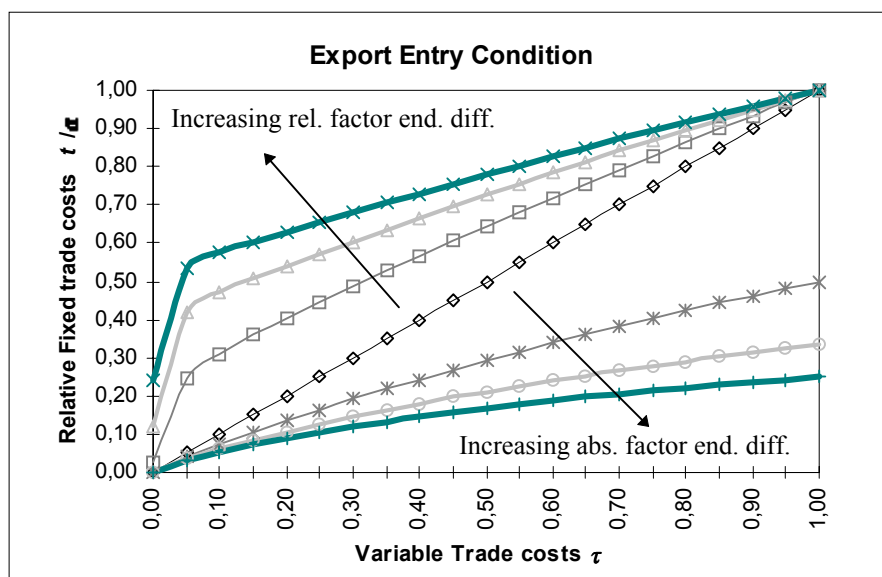


Fig. 1. Export entry conditions different factor endowments and country sizes

*Hypothesis 1: The larger countries' differences in their relative factor endowments, the more likely it is, for given fixed and variable export costs, that trade occurs (in a specific industry).*

If countries differ with respect to their economic size, but are identical with respect to their relative factor endowments, the entry condition lies south-easterly of that for identical countries. Here, the reason is that the larger country has the relatively higher equilibrium wage in the differentiated product industry.

*Hypothesis 2: The larger countries' differences in their absolute factor endowments, the less likely it is, for given fixed and variable export costs, that trade occurs (in a specific industry)*

In monopolistic competition trade models countries will always trade all varieties. Trade liberalisation in terms of variable trade costs reductions merely determines how much trade takes place between countries, unless, at the very extreme, the variable trade costs are infinitely high. This is, however, conceptually not very appealing, and we will therefore exclude this extreme case. Thus, the possibility of no trade solely rests on the interaction between fixed and variable trade cost reductions, which can be termed improvement in market access.

*Hypothesis 3: Improvements in market access have a positive effect on the number of industries in which countries trade.*

The importance of the fixed export costs should not be underestimated. For example, if the situation in Europe in the late 1970s and early 1980s is adequately described by declining tariff, but not non-tariff barriers, it is unlikely that the trade liberalisation process generated trade in new industries. If the SEM succeeds in dismantling the remaining non-tariff barriers, this will result in improved market access for third countries, such as Sweden at that time, and is therefore likely to result in trade in new industries. Additionally, intra-industry trade will emerge in more industries than has previously been the case.

### *International Trade Structure*

For simplicity, we will assume that the home country is either the larger country and/or has a comparative advantage in the differentiated product industry. This assumption ensures that the home country will be the net exporter of the differentiated product.<sup>4</sup> Under this assumptions then, the trade volume equals two times the home country exports in the differentiated product industry. This is due to the fact that there is only one way trade in the homogenous product. Furthermore, as the homogenous product sector has the mere role of ensuring that trade is balanced, it will not be clear from the following expressions alone whether countries differ in economic size or not. Although it is true that the following equations do not distinguish between factor endowment and country size differences, the wage ratio, which has been endogenously determined in the trade balance, will typically not be the same. Hence, the shares of inter- and intra-industry trade will be different. The share of inter- and intra-industry trade to total trade are given by

$$\frac{T_N}{T_T} = 1 - \delta^{\frac{1-\sigma}{\sigma}} \frac{1 - \tau\delta}{\delta - \tau} \frac{L_1}{l_1} \quad (19) \quad \text{and} \quad \frac{T_I}{T_T} = \delta^{\frac{1-\sigma}{\sigma}} \frac{1 - \tau\delta}{\delta - \tau} \frac{L_1}{l_1}. \quad (20)$$

The interpretation of these expressions is straightforward though. The share of inter-industry trade is determined by the differences in factor endowments, and thus

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<sup>4</sup> However, the comparative advantage in the differentiated product industry may lie with the smaller country. Thus, the larger country may become the net exporter of the homogenous product, despite having the absolutely larger differentiated product industry. Knowing that the trade balance also determines which country will become the net exporter of the homogenous product, we can account for such scenarios in simply adjusting the expressions for the trade volumes in the trade balance, see appendix. Thus, this restriction does not reduce the generality of the results.



varieties produced in the differentiated product sector. This includes country size differences. The share of intra-industry trade is determined by the amount of ‘*overlap*’ or similarity between the two countries. Again, this includes both relative factor endowments and country sizes.

*Hypothesis 4: Given that trade is feasible, the smaller countries’ differences in their relative factor endowments, the larger the share of intra-industry trade in total trade.*

*Hypothesis 5: Given that trade is feasible, the smaller countries’ differences in their absolute factor endowments, the larger share of intra-industry trade in total trade.*

Importantly, the reduction the fixed export costs results in a reduction in the domestic revenue by an amount which is offset by an increase in the number of firms. In other words, the fixed export costs do not affect the trade structure, but merely whether countries trade or not. In contrast, variable export costs also determine the structure of trade.

*Hypothesis 6: Given that trade is feasible, variable but not fixed export costs affect the share of intra-industry trade in total trade.*

Combining the hypotheses (1), (2) and (3), see also Figure 1, with hypotheses (4), (5), and (6), respectively leads to yet another set of testable hypotheses, which do not appear in traditional monopolistic competition models.

*Hypothesis 7: The larger countries’ differences in their relative factor endowments the less likely it is for given fixed and variable export costs, that intra-industry trade occurs (in a specific industry).*

*Hypothesis 8: The larger countries’ differences in their absolute factor endowments the less likely it is for given fixed and variable export costs, that intra-industry trade occurs (in a specific industry).*

*Hypothesis 9: Improvements in market access have a positive effect on the number of industries, in which intra-industry trade emerges.*

### III. DATA AND ECONOMETRIC SPECIFICATION

The empirical section aims to analyse the effects of relative factor endowment and country size differences, as well as the effects of the Single European Market programme, as opposed to the free trade liberalisation process during the 1970s and early 1980s. The data covers Swedish bilateral trade with six EU countries in the period

1970 to 1994. These countries are Belgium/Luxembourg, France, Germany, Italy, Portugal, and the United Kingdom. The data distinguishes 82 industries at the 4-digit level of the ISIC classification Rev. 2. Thus, this is a longitudinal cross-country analysis, with a panel of six countries and 25 years.

### *Dependent Variables*

To test whether European integration has resulted in trade and intra-industry trade in new industries, a straightforward, but as we believe, nevertheless very appealing measure is constructed. It is simply sum of the number of industries in which no trade is observed between Sweden and the trade partner  $k$  at time  $t$ . It is constructed as follows:

$$NTRADE0 = \sum_{i=1}^{82} \min(X_{i,k,t}, Y_{i,k,t}), \text{ with}$$

$$X_{i,k,t} = \begin{cases} 1 & \text{for } EXP_{i,k,t} = 0 \\ 0 & \text{for } EXP_{i,k,t} > 0 \end{cases} \quad \text{and} \quad Y_{i,k,t} = \begin{cases} 1 & \text{for } IMP_{i,k,t} = 0 \\ 0 & \text{for } IMP_{i,k,t} > 0 \end{cases}.$$

$EXP_{i,k,t}$  and  $IMP_{i,k,t}$  denote the value of exports and imports between Sweden and partner country  $k$  in industry  $i$  at time  $t$ . Hence, if these two countries trade in all 82 four-digit manufacturing industries, this measure will be zero.

A similar measure is devised for the emergence of intra-industry trade. It reflects the number of industries in which no intra-industry trade is observed between Sweden and partner country  $k$  at time  $t$  and is constructed as follows:

$$NIIT0 = \sum_{i=1}^{82} \max(X_{i,k,t}, Y_{i,k,t}), \text{ with}$$

$$X_{i,k,t} = \begin{cases} 1 & \text{for } EXP_{i,k,t} = 0 \\ 0 & \text{for } EXP_{i,k,t} > 0 \end{cases} \quad \text{and} \quad Y_{i,k,t} = \begin{cases} 1 & \text{for } IMP_{i,k,t} = 0 \\ 0 & \text{for } IMP_{i,k,t} > 0 \end{cases}.$$

The Grubel-Lloyd index is used to measure the share of intra-industry trade between Sweden and trade partner  $k$  at time  $t$ . The Grubel-Lloyd index is calculated as

$$IIT_{k,t} = \frac{\sum_{i=1}^{82} 2 \min(EXP_{i,k,t}, IMP_{i,k,t})}{\sum_{i=1}^{82} (EXP_{i,k,t} + IMP_{i,k,t})}.$$

As the Grubel-Lloyd index is bound between 0 and 1 the following logistic transformation is applied:  $LIIT = \log(IIT / (1 - IIT))$ .

### *Econometric Estimation Method*

As it happens *NTRADE0* is censored at the lower tail. Therefore, estimation of the dependent variable with Ordinary Least Squares is not appropriate, as the estimated coefficients are biased. This problem is avoided by specifying a TOBIT estimation, which accounts for censoring at the lower tail (e.g. Greene, 1993). The estimated model is as follows:

$$\begin{aligned} y_i^* &= \beta'x_i + \mu_i && \text{where } y_i^* \text{ is the unobserved latent variable,} \\ y_i &= y_i^* && \text{if } 0 < y_i^* < 1, \\ y_i &= 0 && \text{if } y_i^* \leq 0. \end{aligned}$$

The dependent variables *NIIT0* and *LIIT* are not censored. In order to make use of the panel structure of the data set, a group-specific regression model is used which allows for:<sup>5</sup>

1. groupwise heteroscedasticity, i.e.  $E(\varepsilon_{it}^2) = \sigma_{ii}$ ,
2. cross group correlation, i.e.  $Cov(\varepsilon_{it}, \varepsilon_{jt}) = \sigma_{ij}$ ,
3. within group autocorrelation, i.e.  $\varepsilon_{it} = \rho_i \varepsilon_{i,t-1} + \mu_{it}$ .

The different specifications can be estimated as restrictions of the least restrictive specification. The estimation procedure will be iterated Generalised Least Squares.<sup>6</sup>

There are different ways of capturing the similarity in country size. We follow Helpman (1987) and Hummels & Levinsohn (1993, 1995) who use the similarity index

$$\begin{aligned} SIM_{k,t} &= \log(GDP_{k,t} + GDP_{SWE,t}) * (1 - e_{k,t}^2 - e_{SWE,t}^2), \text{ with} \\ e_{k,t} &= \frac{GDP_{k,t}}{GDP_{k,t} + GDP_{SWE,t}}, \text{ and } e_{SWE,t} = \frac{GDP_{SWE,t}}{GDP_{k,t} + GDP_{SWE,t}}. \end{aligned}$$

It is imminent that this variable captures two effects. The first term captures the combined size effect of the two trading partners in question, whilst the second term captures the differences in their relative country size. The proxy is large if countries are both large and similar in country size. Therefore, we separate the variable *SIM* into two

<sup>5</sup> Both fixed and random effects, or indeed a two factor model could have been estimated. Most commonly, panel data sets involve a large cross-section, while there are only a few time periods. The data set used in this paper, however, contains a relatively narrow cross-section and a relatively large number of time periods. As we are interested in explaining both the cross-section and the time series dimension, the group-specific regression models seems to be the adequate choice.

<sup>6</sup> For each specification, nine estimations are computed to test the different restrictions against each other. Thus, it is not feasible to present all different estimations. The estimation selected for the presentation is always the least restrictive estimation supported by the data. The full output file is available upon request.

independent variables, i.e.  $LGDP_{TOT}$  and  $RELSIZE$ . These are defined as  $LGDP_{TOT}_{k,t} = \log(GDP_{k,t} + GDP_{SWE,t})$  and  $RELSIZE_{k,t} = (1 - e_{k,t}^2 - e_{SWE,t}^2)$ .

The difference in relative factor endowments is proxied by the GDP per capita ratios, which are calculated from OECD national accounts. The proxy is defined as the absolute difference in the GDP per capita between country k and Sweden at time t, with GDP per capita ratio being expressed as logarithmic transformation:

$$LINC_{DIF}_{k,t} = \left| \log \left( \frac{\text{Per Capita GDP}_{k,t}}{\text{Per Capita GDP}_{SWE,t}} \right) \right|.$$

In order to capture the effects of conventional trade costs such as tariffs, freight and insurance, as well as unconventional trade costs, such as geographical proximity, cultural and lingual affinity, we include,  $LDIST_k$ , the logarithmic transformation of the geographical distance between Sweden and the trading partner.

During the period 1970-94, a number of changes have occurred in Sweden's trading relationship with the countries concerned. In 1973, the free trade agreement between the EFTA and EC came into force. At the same time the UK joined the EC. In 1986, when Portugal followed suit, the EC prepared for the looming of the Single European Market. In 1991, Sweden submitted its application for full EU membership. On 1 January 1994 the EEA agreement between the EFTA countries and the EU came into force, giving EFTA firms virtually the same access to the Single Market as EU firms. These changes may have a number of potentially different implications for the trading relationship between Sweden and these countries. It is virtually impossible to assess all these changes simultaneously and separately. We restrict ourselves to focus on two main processes, i.e. the trade liberalisation between EFTA and EC, and the effects of the SEM programme and its effects on Swedish access to the European market.

Two different time trends are used in the analysis to capture these two different integration processes. The time trend,  $TREND$ , accounts for the general ongoing trade liberalisation process between Sweden and the EC countries during the 1970s and 1980s. A second time trend,  $DTREND$ , is included to analyse whether there is evidence of a structural break after 1986. If this was the case, this would lend some support to the argument of the trade liberalisation process between EFTA and the EC being different to the effects of the SEM.

#### IV. EMPIRICAL RESULTS

The following figures give an indication of the changes which have occurred in the last 25 years with regard to the trade structure between Sweden and six EU member states. These graphs demonstrate that there are significant differences between countries. There is a general indication of downward trend for *NTRADE0* and *NIITO*. Also, it seems that it is more pronounced after the year of 1986. For Germany and the UK, *NTRADE0* is actually zero throughout the period 1970-94, which is in line these two countries being Sweden's single most important trading partners. They are among the larger countries in the EU, and are therefore able to sustain production in a larger number of industries. For smaller countries, it is likely that industrial production is more specialised. This is because some industries are subject to large economies of scale.

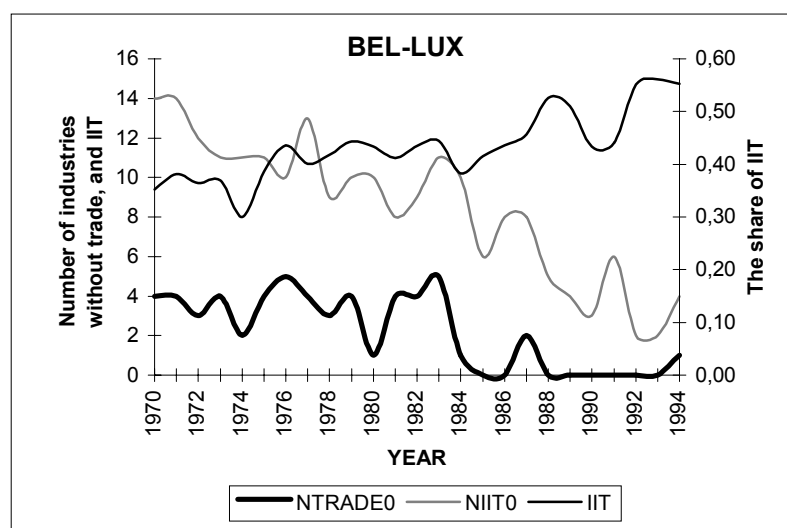


Figure 2: Trade structure between Sweden and Bel-Lux, 1970-94

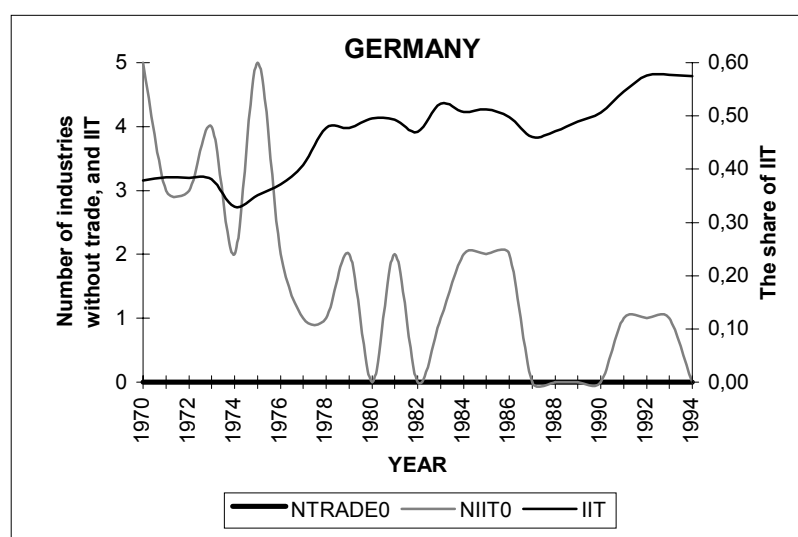


Figure 3: Trade structure between Sweden and Germany, 1970-94

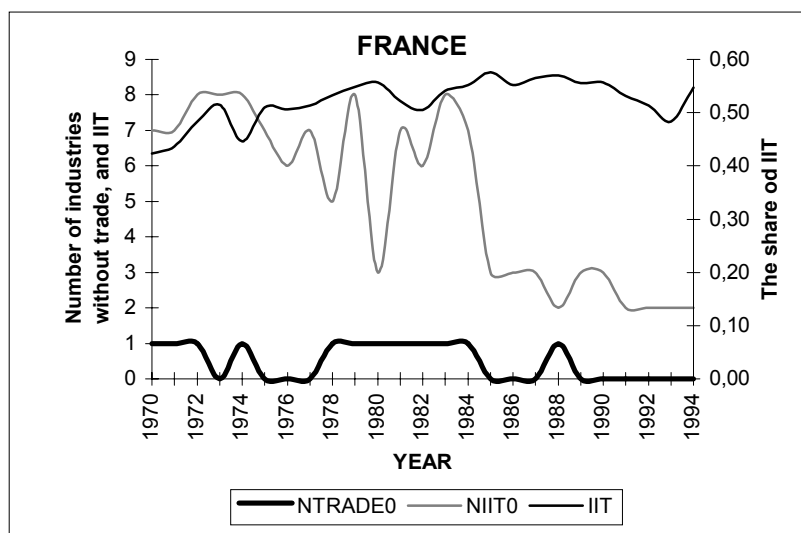


Figure 4: Trade structure between Sweden and France, 1970-94

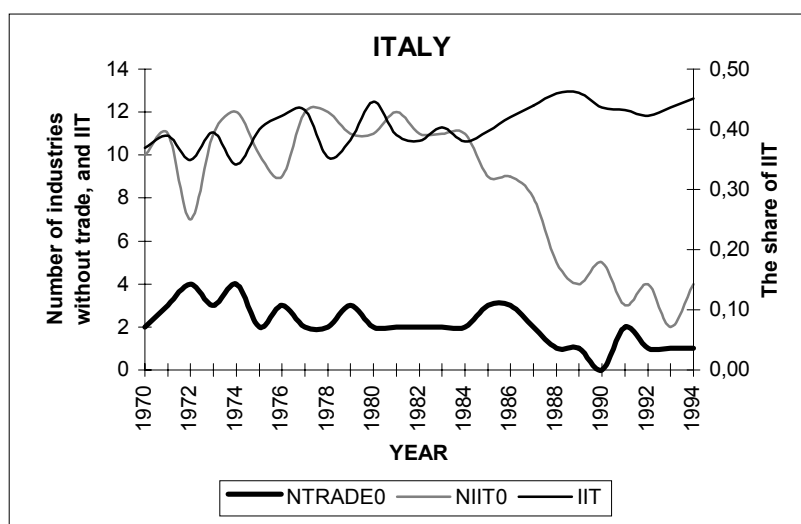


Figure 5: Trade structure between Sweden and Italy, 1970-94

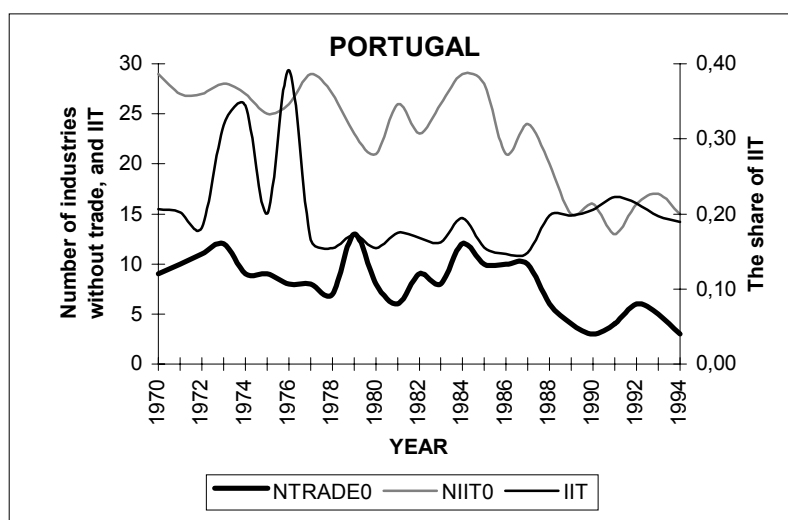


Figure 6: Trade structure between Sweden and Portugal, 1970-94

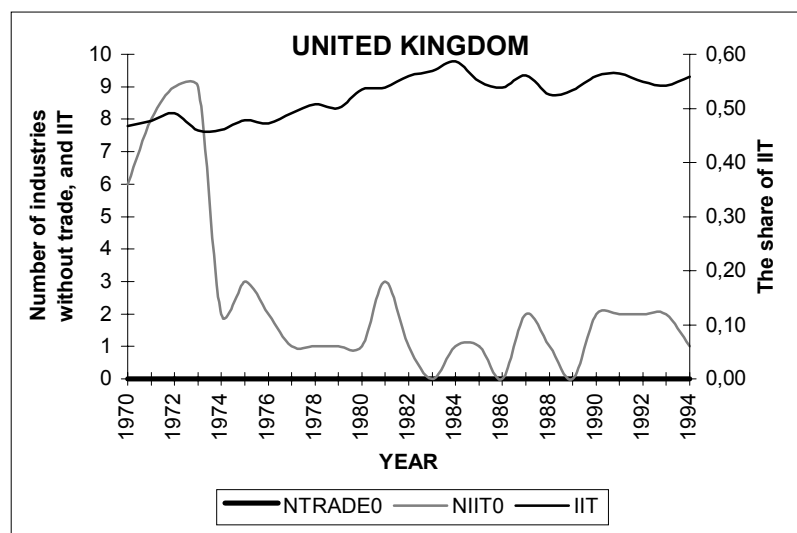


Figure 7: Trade structure between Sweden and the UK, 1970-94

### *Econometric Results*

#### *Specification (I)*

The results demonstrate that the number of industries in which Sweden trades with its respective trading partners is positively increasing in the similarity index *SIM*. Separating the similarity index *SIM* into the combined country size *LGDP TOT*, and the relative country size *RELSIZE*, reveal that both are significantly negative in explaining *NTRADE0* (Hyp. 2). All coefficients are significant at the 1% level.

The coefficient of *LINCDIF* is negatively significant at the 1% level (Hyp. 1). If countries differ with regard to their relative factor endowments, they are likely to develop their strengths in industries with different factor intensities. Due to this inter-industry specialisation, these countries tend to trade in a larger number of industries. In this sense, this result supports one of the core predictions of the factor proportions theory.

The number of industries in which no trade is recorded is also increasing the geographic distance between Sweden and its trade partner. The coefficient of *LDIST* is negatively significant at the 1% level. This may be the result of cultural and linguistic affinity, which declines with increasing distance. Distance may also capture other unconventional trade barriers. As Leamer & Levinsohn (1995) suggested, proximity may act as a source of comparative advantage.

Lastly, the trade liberalisation process between the EFTA and the EC did not have any significant effect on *NTRADE0*, while the Single European Market programme

seems to have improved the market access. This is in line with non-tariff barriers consisting of, or acting as, fixed export costs (Hyp. 3).

Table 1:  
*TOBIT Estimates of NTRADE0*

Specification (I)		
Est. Technique	TOBIT	
Dep. Var.	<i>NTRADE0</i>	
No. of obs.	150	
Threshold value	Lower=0, Upper=+infinity	
Specification	Ia	Ib
Log likelihood	-160.4	-161.1
<i>CONSTANT</i>	36.512 (3.739)	48.392 (1.561)
<i>SIM</i>	-9.185 (-7.564)	
<i>LGDPOT</i>		-8.884 (-4.848)
<i>RELSIZE</i>		-21.843 (-2.315)
<i>LINCDIF</i>	-10.647 (-4.735)	-10.558 (-4.074)
<i>LDIST</i>	13.486 (6.814)	13.633 (6.725)
<i>TREND</i>	0.050 (1.179)	0.048 (1.020)
<i>DTREND</i>	-0.105 (-3.394)	-0.107 (-3.426)

T-statistic in brackets. Estimates are heteroscedastic consistent.

### *Specifications (II) and (III)*

The results in specification (II) show clearly that the larger countries' similarities are with regard to their economic size, the larger the number of industries in which IIT emerges. The coefficients of *SIM*, *LGDPOT* and *RELSIZE* are negatively significant at the 1% level (Hyp. 8). The coefficient of *LINCDIF* is significantly positive at the 5% level in specification (IIa), but not in specification (IIb). This supports, at least to some extent that the more similar relative factor endowments between the two trading partners, the greater the number of industries in which intra-industry trade emerges (Hyp. 7). This result is, however, not robust across specifications. Nevertheless, together with the results in specifications (Ia) and (Ib), it can be argued that the factor proportion explanation cannot be discarded.

The geographic distance is negatively significant in both specifications (IIa) and (IIb). This may be due to information asymmetries, differences in culture and linguistic affinity, which may be increasing with distance. Nevertheless, it is still not easily understood what economic effect this variable actually captures.



Table 2:  
*Groupwise Regression Model: Estimates of NIIT0 and LIIT*

Groupwise Regression Model	Specification (II)		Specification (III)	
	Groupwise heteroscedasticity, within group autocorrelation		Groupwise heteroscedasticity, cross group correlation, within group autocorrelation	
Est Technique	Iterated GLS		Iterated GLS	
Dep. Var.	<i>NIIT0</i>		<i>LIIT</i>	
No. of obs.	144		144	
Specification	IIa	IIb	IIIa	IIIb
Log likelihood	-286.8	-289.5	93.7	94.0
<i>CONSTANT</i>	67.871 (4.944)	178.30 (3.984)	-3.216 (-1.602)	-12.934 (-3.005)
<i>SIM</i>	-6.920 (-6.284)		0.632 (3.871)	
<i>LGDP TOT</i>		-12.437 (-4.621)		0.874 (3.855)
<i>RELSIZE</i>		-46.994 (-3.561)		3.857 (3.341)
<i>LINCDIF</i>	4.223 (2.121)	-1.769 (-0.546)	-0.012 (-0.046)	0.112 (0.417)
<i>LDIST</i>	5.105 (3.430)	5.055 (3.701)	-0.813 (-2.877)	-0.278 (-1.132)
<i>TREND</i>	-0.042 (-0.980)	-0.033 (-0.547)	0.007 (1.354)	0.004 (0.645)
<i>DTREND</i>	-0.093 (-3.282)	-0.065 (-1.866)	-0.004 (-1.438)	-0.003 (-1.090)
Likelihood Ratio Test for Homo-scedasticity $\chi^2(5)$				
	16.027	11.969		
Likelihood Ratio Test for cross group correlation $\chi^2(15)$				
			26.313	26.081
Group specific autocorrelation coefficients <sup>7</sup>				
Bel-Lux	0.313	0.204	0.501	0.442
Germany	0.750	0.677	0.957	0.912
France	-0.222	0.325	0.789	0.740
Italy	0.703	0.719	0.829	0.837
Portugal	0.500	0.488	0.534	0.593
United Kingdom	0.874	0.756	0.958	0.908

T-statistic in brackets.

Additionally, the results confirm the presence of a structural break in the trend variable. Again, this result is consistent with the suggestion of the SEM improving the market access for third countries, and with the suggestion that non-tariff barriers exhibit a significant share of fixed trade costs (Hyp. 9). Their removal affects generates trade in new industries and thus in new varieties, something which the trade liberalisation process in the 1970s, merely aiming to reduce tariff barriers, apparently did not achieve.

Specification (III) reports the results with regard to the share of intra-industry trade in total trade. The similarity of countries is an important determinant of the share

<sup>7</sup> A test for the significance of the correlation coefficients can be based on  $(T-1)r_i^2(1-r_i^2) \approx \chi^2(1)$ , where  $r_i$  refers to the group specific residual autocorrelation coefficient, and T to the time period.

of intra-industry trade. The coefficients of *SIM*, *LGDP TOT* and *RELSIZE* highly significant (Hyp. 5). Factor endowment differences and geographic distance are, however, not significant in explaining the share of intra-industry trade. Hence, hypothesis (4) is not supported. Neither of the two trend variables is significant. This result supports the idea that the SEM would not affect the share of intra-industry trade, if the SEM achieved to reduce mainly the fixed trade cost components in the non-tariff barriers (Hyp. 6).

Summing up, it appears that economic distance, relative factor endowment differences and non-tariff barriers are important determinants for the emergence of intra-industry trade, but not for the share of intra-industry trade in total trade.

### *Sensitivity Analysis*

The following tables present the results of the sensitivity analysis carried out in order to examine whether the results are robust to changes in the starting year for the interaction term *DTREND*. The years 1987, 1988, 1989, and 1990 were used as alternative starting years.

It is straightforward to see that the results are very robust. Firstly, the distance, country size and factor endowment variables are unaffected. Secondly, the significance of the interaction term *DTREND* is not affected by the choice of *SIM* or *LGDP TOT* and *RELSIZE* as explanatory variables. The significance of *DTREND* is very robust with regard to different starting years. The significance of *DTREND* is affected neither in specification (I) nor in specification (III). In specification (II), *DTREND* is significant for most of the starting years.

In contrast, the variable *TREND* is neither robust across specifications nor across time. In tables 3 and 4, the coefficient of the *TREND* is positively significant if the interaction term *DTREND* starts in the years 1987 or 1988. This result would have suggested, had been robust, that the trade liberalisation process during the 1970s and 1980s actually lowered the number of industries, in which trade emerges. This would be consistent with an even stronger hypothesis than put forward in this paper, namely, that the trade liberalisation process in the 1970s and the 1980s was accompanied by rising non-tariff barriers, which resulted in a reduction of trading industries.

Table 3:  
Sensitivity Analysis for the TOBIT Estimates of *NTRADE0* and *SIM*

Specification (Ia)					
Est. Technique	TOBIT				
Dep. Var.	<i>NTRADE0</i>				
No. of obs.	150				
Threshold value	Lower=0, Upper=+infinity				
Dtrend>0 if year>=	1986	1987	1988	1989	1990
Log likelihood	-160.4	-158.5	-152.7	-150.5	-154.4
<i>CONSTANT</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>SIM</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>LINCDIF</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>LDIST</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>TREND</i>	(+)	(+)	(+) **	(+) **	(+)
<i>DTREND</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***

Sign of coefficients in brackets. \*, \*\*, \*\*\* denotes significance at the 10%, 5%, and 1% level, respectively.

Table 4:  
Sensitivity Analysis for the TOBIT Estimates of *NTRADE0* and *LGDPTOT*, *RELSIZE*

Specification (Ib)					
Est. Technique	TOBIT				
Dep. Var.	<i>NTRADE0</i>				
No. of obs.	150				
Threshold value	Lower=0, Upper=+infinity				
Dtrend>0 if year>=	1986	1987	1988	1989	1990
Log likelihood	-161.1	-159.3	-153.6	-151.2	-155.0
<i>CONSTANT</i>	(+)	(+) *	(+) **	(+) **	(+) ***
<i>LGDPTOT</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>RELSIZE</i>	(-) ***	(-) **	(-) **	(-) **	(-) **
<i>LINCDIF</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>LDIST</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>TREND</i>	(+)	(+)	(+) *	(+) **	(+)
<i>DTREND</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***

Sign of coefficients in brackets. \*, \*\*, \*\*\* denotes significance at the 10%, 5%, and 1% level, respectively.

Additionally, in specification (IIa), the coefficient of *TREND* is negatively significant in all cases except for the starting year 1986. It is not surprising that the coefficient of *TREND* significant for later years, as the variable captures part of the effect of *DTREND* at earlier starting years. More importantly, though, this result is not

robust across specifications, as it does not appear in specification (IIb). We summarise that the econometric results presented in the previous section can be considered robust to changes in the choice of the starting year of the interaction term *DTREND*.

Table 5:  
*Sensitivity Analysis for the Estimates of NIIT0 and SIM*

Specification (IIa)					
Est. Technique	Groupwise Regression Model				
	Iterated GLS				
Dep. Var.	<i>NIIT0</i>				
No. of obs.	144				
Dtrend>0 if year>=	1986	1987	1988	1989	1990
Log likelihood	-286.8	-288.5	-287.4	-289.4	-290.6
<i>CONSTANT</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>SIM</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>LINCDIF</i>	(-) **	(-) **	(-) *	(-) *	(-) *
<i>LDIST</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>TREND</i>	(-)	(-) **	(-) *	(-) ***	(-) ***
<i>DTREND</i>	(-) ***	(-) **	(-) ***	(-)	(-)

Sign of coefficients in brackets. \*, \*\*, \*\*\* denotes significance at the 10%, 5%, and 1% level, respectively.

Table 6:  
*Sensitivity Analysis for the Estimates of NIIT0 and LGDPTOT, RELSIZE*

Specification (IIb)					
Est. Technique	Groupwise Regression Model				
	Iterated GLS				
Dep. Var.	<i>NIIT0</i>				
No. of obs.	144				
Dtrend>0 if year>=	1986	1987	1988	1989	1990
Log likelihood	-289.5	-290.4	-287.9	-290.1	-291.9
<i>CONSTANT</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>LGDPTOT</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>RESIZE</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) **
<i>LINCDIF</i>	(-)	(-)	(-)	(-)	(-)
<i>LDIST</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>TREND</i>	(+)	(+)	(+)	(+)	(+)
<i>DTREND</i>	(-) *	(-) *	(-) ***	(-) **	(-)

Sign of coefficients in brackets. \*, \*\*, \*\*\* denotes significance at the 10%, 5%, and 1% level, respectively.

Table 7:  
Sensitivity Analysis for the Estimates of LIIT and SIM

Est. Technique	Specification (IIIa)				
	Groupwise Regression Model Iterated GLS				
Dep. Var.	<i>LIIT</i>				
No. of obs.	144				
Dtrend>0 if year>=	1986	1987	1988	1989	1990
Log likelihood	93.7	93.0	93.3	92.8	93.1
<i>CONSTANT</i>	(-)	(-)	(-)	(-)	(-)
<i>SIM</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>LINCDIF</i>	(-)	(-)	(-)	(-)	(-)
<i>LDIST</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>TREND</i>	(+)	(+)	(+)	(+)	(+)
<i>DTREND</i>	(-)	(+)	(-)	(+)	(+)

Sign of coefficients in brackets. \*, \*\*, \*\*\* denotes significance at the 10%, 5%, and 1% level, respectively.

Table 8:  
Sensitivity Analysis for Estimates of LIIT and LGDPTOT, RELSIZE

Est. Technique	Specification (IIIb)				
	Groupwise Regression Model Iterated GLS				
Dep. Var.	<i>LIIT</i>				
No. of obs.	144				
Dtrend>0 if year>=	1986	1987	1988	1989	1990
Log likelihood	94.0	93.3	93.6	93.4	93.8
<i>CONSTANT</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>LGDPTOT</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>RESIZE</i>	(+) ***	(+) ***	(+) ***	(+) ***	(+) ***
<i>LINCDIF</i>	(+)	(+)	(+)	(+)	(+)
<i>LDIST</i>	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
<i>TREND</i>	(+)	(+)	(+)	(+)	(+)
<i>DTREND</i>	(-)	(+)	(-)	(+)	(+)

Sign of coefficients in brackets. \*, \*\*, \*\*\* denotes significance at the 10%, 5%, and 1% level, respectively.

## V. CONCLUDING REMARKS

This paper analyses the effects of non-tariff barriers on the structure of trade and industry. It is argued that non-tariff barriers typically include both fixed and variable

cost components. Due to the introduction of fixed export costs, the industrial structure might undergo significant changes when trade barriers are reduced beyond a certain threshold. The equilibrium number of firms changes, and the equilibrium flips from autarky to trade. Hence, improvements in market access may generate trade in new industries. This is not possible in solely considering variable trade costs, where all varieties are always traded and variable trade costs merely determine the volume of trade.

The econometric results demonstrate, in using bilateral trade data between Sweden and six EU countries, that countries do not necessarily trade in all industries, and that intra-industry trade does not emerge in all industries. This is due to differences in relative and absolute factor endowments, but also due to the state and type of economic integration between the trading countries. The results suggest that the SEM has generated trade in new industries, and intra-industry trade in new industries. Such evidence could not be found for the trade liberalisation process during the 1970s. All in all, the evidence is consistent with the notion of non-tariff exhibiting substantial fixed cost components, which have been significantly reduced by the Single European Market programme and improved market access to the EU.

## VI. APPENDIX

In equilibrium, factor income equals expenditure, and the trade balances of both countries are zero. Furthermore, net exports from the home country have to equal net imports to the foreign country in the respective industry, and vice versa. We assume without loss of generality that  $n \geq N$ . The trade balance in the home country is given by

$$p_{d,1}x_{d,1} \left[ \left( \frac{\tau\delta - \tau^2}{1 - \tau\delta} \right) n - \tau\delta^{\frac{1-\sigma}{\sigma}} N \right] + p_2(x_2 - c_2) = 0 \quad (16)$$

or 
$$w_1 \left( \frac{\tau}{1 - \tau^2} \right) \left[ (\delta - \tau)l_1 - (1 - \delta\tau)\delta^{\frac{1-\sigma}{\sigma}} L_1 \right] + \chi w_2 l_2 - (1 - \chi)w_1 l_1 = 0. \quad (17)$$

$x_2$  and  $c_2$  refer to home country's production and consumption of the numéraire, respectively. Furthermore, we know that the home country's net imports of the homogenous good are of equal value to their corresponding net exports from the foreign country  $p_2(x_2 - c_2) = -P_2(X_2 - C_2)$ . This is the constraint for the trade balance. As  $w_2 = W_2$ , it follows that

$$w_1 = \frac{w_2 \chi (L_2 + L_1)}{(1 - \chi)(L_1 + \delta^{\frac{1}{\sigma}} L_2)} \quad (18)$$

Selecting  $w_2 = 1$  and substituting (18) into (17) yields the final equation that can be solved for  $\delta$ . Having solved for  $\delta$ ,  $w_1$  can be solved by substituting  $\delta$  into (17).

Subsequently  $W_1$  can be solved by using the relationship  $\delta = (w_1 / W_1)^{-\sigma}$ .

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