VATT-KESKUSTELUALOITTEITA
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90

INTRAINDUSTRY TRADE, COMPETITIVENESS, AND PRICE RIGIDITIES IN THE FINNISH MANUFACTURING INDUSTRIES

Juha Honkatukia*

Valtion taloudellinen tutkimuskeskus
Government Institute for Economic Research
Helsinki 1995

Juha Honkatukia, Institue for Basic Research Helsinki School of Economics

* This study was financed by the Government Institute for Economic Research and is a part of the research project in the global economy. I should like to thant Pertti Haaparanta and Pasi Holm for their comments on earlier drafts of the study. The usual disclaimer applies.

ISBN 951-561-126-1
ISSN 0788-5016

Valtion taloudellinen tutkimuskeskus
Government Institute for Economic Research
Hämeentie 3, 00530 Helsinki, Finland

Painatuskeskus Pikapaino Opastinsilta
Helsinki, maaliskuu 1995

HONKATUKIA, JUHA: INTRAINDUSTRY TRADE, COMPETITIVENESS, AND PRICE RIGIDITIES IN FINNISH MANUFACTURING INDUSTRIES. Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Iinstitute for Economic Research, 1995. (C, ISSN 0788-5016; No 90) ISBN 951-561-126-1.

ABSTRACT: The demand and pricing of Finnish exports are studied at two digit industry level in the framework of intraindustry trade and monopolistic competition. Empirical demand functions display differences between industries and to some extent, between export markets. Pricing is studied under the assumption of sluggish adjustment due to pricing costs. Estimates on both own price and cost persistence in export prices are reported. We find rigidities to be greater in relatively more competitive industries. Price rigidities also appear greater when pricing is in Finnish markkas as opposed to U.S. dollars. Returns to scale affect price rigidity negatively.

KEY WORDS: intraindustry trade, monopolistic competition, pricing costs, returns to scale

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TIIVISTELMÄ: Tutkimuksessa tarkastellaan Suomen vientikysyntää ja vientihinnoittelua toimialatasolla. Näkökulmana on ristikkäiskaupan ja monopolistisen kilpailun teoria. Estimoidut kysyntäyhtälöt osoittavat koko tehdasteollisuuden kysynnän olevan samankaltaista eri kauppakumppaneissa. Toimialoittain on löydettävissä eroja sekä kysynnän rakenteen että kauppakumppanien välillä. Vientihinnoille estimoidut yhtälöt osoittavat hinnoittelun sopeutuvan hitaasti. Hinnoittelu ei myöskään sopeudu välittömästi kustannusshokkeihin. Hintasopeutuminen on hitainta avoimilla toimialoilla, joilla toimivilla yrityksillä on markkinavoimaa. Skaalatuotot vaikuttavat myös sopeutumisen nopeuteen.

ASIASANAT: ristikkäiskauppa, monopolistinen kilpailu, hinnoittelukustannukset, skaalatuotot

Contents

1 Introduction

Imperfect competition can contribute to the emergence and transmission of business cycles in many ways. It can be a direct source for cycles by leading to cyclicality in investment (Kiyotaki 1988); indirectly, the effects of small imperfections in price or quantity adjustment at the level of an individual firm, such as menu costs or staggered pricing, are magnified in an imperfectly competitive industry, leading potentially to great aggregate rigidity and making the industry in question sensitive to demand fluctuations (Ball, Mankiw and Romer 1988). Blanchard and Kiyotaki (1987) show this sensitivity to be greater the less competitive the industry and the smaller the returns to scale, given the magnitude of menu costs. It was shown by Honkatukia (1992) that openness of an economy can further magnify the effects of menu costs in the presence of intraindustry trade and monopolistic pricing. Therefore, price rigidities are more important in open economies than in closed.

Intraindustry trade is characterized by the exchange of differentiated brands or varieties of goods, most of which may well be produced in all of the countries. As such, it is unsatisfactorily accounted for by the concepts of traditional trade theory; for example, to be an exporter of a particular variety, a producer need not posses any comparative advantage. Most importantly, competition is necessarily imperfect rather than perfect in the presence of product differentiation. The degree of competition is directly dependent on the degree of product differentiation.

While intraindustry trade need not characterize all of the exporting industries, the potential relevance of imperfect competition as a source of price rigidities is apparent when it is realized that intraindustry trade nevertheless dominates the bulk of trade between industrialized countries. In Finland in particular, the exports of machinery and equipment (ISIC 38) alone are nearly as large as those of paper and pulp (ISIC 34), the largest Finnish net exporting industry; yet Finland is by far a net importer of machinery and equipment. By our estimates on the demand for Finnish exports, the demands for Finnish exports are fairly similar in its western trade partners. There are differences between various industries, however, and also between trade partners that in some cases may point out to possible barriers of trade, for example.

The empirical pricing equations reported in the current study indicate considerable degrees of both own price and cost persistence in the export pricing of Finnish, two digit manufacturing industries. Rigidity appears greater in domestic terms than in U.S. dollars, indicating that exchange rates have levelled off some of the peaks of demand and cost shocks.

We estimate returns to scale for Finnish industries, in the spirit of Caballero and Lyons (1990). These are relevant for two reasons. They may make the economy more prone to business cycles, as the New Keynesian literature suggests (e.g., Cooper and John 1988), but they also point out to possible gains from the point of view of economic growth. Recent growth theory suggests that the profit motive of becoming the monopolistic supplier of a differentiated product may explain the deliberate investment in research and development apparent in all of the industrialized countries. According to the theory, if there are externalities present, this innovative research effort can be driving the continuous increase of productivity that also has been evident in the industrialized world (Grossman and Helpman, 1991). While the current paper is not directly interested in externalities in innovation, our results do nevertheless suggest that large, positive, industry level externalities are present in Finnish manufacturing industries.

In chapter 2 of the study, a simple model of intraindustry trade is outlined. To study price rigidities, we assume quadratic pricing costs. The pricing models do not generally possess closed form solutions; their solutions depend on the stochastic processes driving the exogeneous variables. In chapter 4, we discuss these properties and present some results concerning returns to scale. Closed form solutions for pricing are derived on the basis of the plausible ARIMA-expressions for the exogeneous variables. To estimate the resulting empirical pricing models, national account data on cost shares and estimates on returns to scale are used to calibrate the models. Chapter 5 concludes. Chapter 3 of the study reports our estimates on the demand for Finnish exports and gives some back-ground information on Finnish net trade, as well as the relative prices of Finnish exports.

2 A model of intraindustry trade

2.1 Demand for differentiated products

Intraindustry trade is characterized by product differentiation. There are several reasons why product differentiation might arise, but fundamentally, there has to be demand for product variety. Demand for differentiated products can easily be described with the following model.

Let U be a homothetic objective function, to be maximized, such that

$$(1) \quad U \equiv U(C_1, C_2, ..., C_n), \text{ for } k = 1, .., n,$$

$$(2) \quad C_k = N_k\left(\frac{1}{N_k}\sum_{j=1}^{N_k} X_j^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}, \text{ for some } k.$$

Before giving an interpretation to C_k in equation (2), we make a brief remark on the objective function U. By homotheticity, U is separable in the arguments C_k. When the objective function is maximized subject to a constraint, there will then be essentially no interdependence between elements within the subsets k. In analyzing demand for variety, then, it is not necessary to assume that all of the arguments C_k take the form of equation (2).

Two interpretations are commonly given to the objective U and its arguments C_k. U can be regarded as a utility function, defined over n sub-sets of goods. For each set of goods, there are sub-utility functions C_k. Let some of the sets of goods consist of jk differentiated products. Then, C_k is a utility-index for the product group k, N_k is the number of products within the group k, and ϵ is the elasticity of substitution between products j within the group k. Demand for variety arises, as consumers want to consume all of the varities jk. Furthermore, utility is increasing in the number of products, N_k. This interpretation stems from Armington (1969), who takes X_j to be goods produced in different countries, and Dixit and Stiglitz (1977), who interprete them as being the products of individual firms.

Suppose that U is a production function instead. Some of the technological processes may then require the use of differentiated intermediate goods or capital goods. Some C_k are then functions of these differentiated products j, whereas other subsets k can be homogenous inputs of production, such as labour, in the standard manner. An important property under these interpretations is that productivity is increasing in the number of differentiated inputs. Then, international trade can be a source of productivity growth, if it increases the variety of intermediate goods available to producers (Ethier 1982), or if it makes more varieties of capital goods available, or leads to the introduction of new capital and intermediate goods (Grossman and Helpman 1991).

If U is a utility function, it is to be maximized subject to a budget constraint, resulting to demand functions for products X_j; if it is a production function, the minimization of costs gives rise to derived demand functions for the inputs X_j. The overhead function U only defines the shares of aggregate consumption expenditure or aggregate factor demand that is allocated to each sub-group k. The demand for differentiated products within group k, at time t, takes the form

$$(3) \quad X_{jt} = (\frac{P_{jt}}{P_t})^{-\epsilon}(\frac{s_{jt}M_t}{P_t}), \text{ where}$$
$$P_t = ((\sum_{j=1}^{n} s_{jt}P_{jt}^{1-\epsilon}))^{\frac{1}{1-\epsilon}},$$

where X_{jt} is the demand for product j, and s_j is the demand share for product j, which equals $1/N_k$ for the utility function of equation (1); M is aggregate nominal demand for products within the group. P_{jt} is the price of product j and ϵ is the price elasticity of demand, which is assumed equal between goods j. The functional form of the sub-utility index C_k allows derivation of an exact price index for group k, which is given by P_t in equation (2). For the same reason, the price elasticity of demand is exactly linked to the elasticity of substitution between products, and has the intuitive interpretation that demand for close substitutes is more elastic than demand for distant substitutes.[1]

From the point of view of pricing of Finnish exports, either interpretation for the function U is plausible. We make the Armingtonian assumption that Finnish products are close substitutes to each other but imperfect substitutes to products from other countries. The subsets can be interpreted to consist of products in different industries.

2.2 A model of monopolistic pricing

A crucial property of intraindustry trade is imperfect competition. This is directly due to product differentiation. The producer of each variety is essentially a monopolist, because the variety is unique.[2] Then, the producer is not a price taker; the price of its product can either be assumed to be set by the firm, so that the price determines the demand for the product (Dixit and Stiglitz 1977); alternatively, the firm may be assumed to select its level of operation and let the price be determined by the market (Horn 1985, Sukselainen 1986). The optimal price will be the same in either case, as discussed in Honkatukia (1993). Here, we assume price setting.

The producer of a variety is characterized by the demand function for its product and its production function. We assume production functions of the Cobb-Douglas form

$$(4) \quad X_{jt} = A(L_t)^{\alpha+\beta}(K_t/L_t)^{\beta},$$

[1] For a more detailed derivation of the demands and the price index, see Honkatukia (1992).

[2] Naturally, entry has to be restricted to some degree, so that the producer of a variety is not driven to marginal cost pricing by the entry of rivals producing the same variety.

where L_t is the input of labour, K_t of capital, α is the input share of labour, and β is the input share of capital.

In the short run, the capital stock can plausibly be regarded as fixed. Minimizing the cost of producing X_{jt}, the amount of product jk demanded, subject to the production function in equation (4), the following cost function is obtained:

$$(5) \quad C(X_{jt}) = W_t A^{\frac{-1}{\alpha+\beta}} (K_t/L_t)^{\frac{-\beta}{\alpha+\beta}} (X_{jt})^{\frac{1}{\alpha+\beta}} + R_t K_t,$$

where W_t is the nominal wage and R_t the rental price of capital, and X_{jt} is the demand for the firm's production.

The firm seeks to maximize profits from sales subject to the cost given by the cost function. Substituting X_{jt} in the cost function for the demand function in equation (3), the firms' problem can be stated as

$$(6) \quad \max_{P_{jt}} (\frac{P_{jt}}{P_t})^{1-\epsilon} s_{jt} M_t - A^{\frac{-1}{\alpha+\beta}} W_t P_{jt}^{\frac{-\epsilon}{\alpha+\beta}} P_t^{\frac{\epsilon-1}{\alpha+\beta}} (K_t/L_t)^{\frac{-\beta}{\alpha+\beta}} (s_{jt} M_t)^{\frac{1}{\alpha+\beta}} + R_t K_t.$$

The solution to this problem depends on the firms perception of competition. If it takes itself to be too small to influence market prices P_t, given by equation (2), then ϵ will also be its perceived elasticity of demand. In general, the elasticity of demand is

$$(7) \quad \sigma = \epsilon + (1-\epsilon) \frac{P_j^{1-\epsilon}}{\sum_{j=1}^{n} P_j^{1-\epsilon}},$$

where the latter term is the response of the price-level to a change in the price of product j. When the number of products is large, the latter term is negligibly small. For most industries, Finnish firms have small market shares, suggesting a small response of the price level to a change in the price of Finnish products. The firms could also make conjectures about the response of the price level, not necessarily according to equation (7). These conjectures would have to be studied indirectly, as they are unobservable. Here, we make the outright Chamberlinian assumption that firms are small, and justify it by the actual smallness of Finnish firms. As will briefly be seen, this assumption causes no great loss of generality in the empirical pricing models.

Performing the maximization yields the optimal price

$$(8) \quad P_{jt}^{o} = (\frac{\epsilon}{(\epsilon-1)(\alpha+\beta)})^{\frac{\alpha+\beta}{\epsilon+\alpha+\beta-\epsilon(\alpha+\beta)}} W_t^{\frac{\alpha+\beta}{\epsilon\alpha+\beta-\epsilon(\alpha+\beta)}} (K_t/L_t)^{\frac{-\beta}{\epsilon+\alpha+\beta-\epsilon(\alpha+\beta)}}$$
$$\times \quad (s_t M_t)^{\frac{1-\alpha-\beta}{\epsilon+\alpha+\beta-\epsilon(\alpha+\beta)}} P_t^{\frac{(\epsilon-1)(1-\alpha-\beta)}{\epsilon+\alpha+\beta-\epsilon(\alpha+\beta)}}.$$

The optimal price is seen to be affected by the wage cost, the capital stock, the price level, and the aggregate demand for goods, and the degree of returns to scale, $\alpha + \beta$.

The logarithm of the optimal price is somewhat more convenient to work with. It is given by

$$(9) \quad p_{jt}^{o} = C + \frac{\alpha+\beta}{\gamma} w_t - \frac{\beta}{\gamma}(k_t - l_t) + \frac{1-\alpha-\beta}{\gamma} m_t + \frac{(\epsilon-1)(1-\alpha-\beta)}{\gamma} p_t,$$

where

$$(10) \quad \gamma \equiv \epsilon + \alpha + \beta - \epsilon(\alpha+\beta),$$

$$(11) \quad C \equiv \frac{\alpha+\beta}{\gamma} log(\frac{\epsilon}{(\epsilon-1)(\alpha+\beta)}),$$

and

$$(12) \quad p_t = \sum_j s_{jt} p_{jt}.$$

Equation (11) is the logarithm of the mark-up coefficient, and p_t in equation (12) is a first-order approximation to the log of the true price-index in equation (2) around the geometric mean of prices.

We close the subsection by making some notions that are of importance for the estimation of demand functions. For the chamberlinian model of imperfect competition to be feasible, the price elasticity of demand, ϵ, has to have an eigenvalue greater than one, because otherwise the mark-up would be negative. The firms may, however, perceive larger price elasticities than ϵ, as was discussed above. This implies that even small observed values of ϵ do not necessarily exclude imperfect competition categorically, but rather point to the possibility of other forms of imperfect competition than Chamberlinian. Unfortunately, the mark-up is the only coefficient that would be affected by the inclusion of conjectures. In a regression equation, it would but rarely be identifiable from the regression constant. Therefore, conjectures are left outside the scope of the current study.

2.3 Prices under quadratic pricing costs

Equations (8) and (9) describe the price setting of a monopolistic firm in a frictionless world. In the actual world, price setting may not be totally frictionless; there may be institutional reasons that prevent continuous price adjustment in the face of cost, relative price, and demand shocks (Blanchard 1983). There may also be costs of price adjustment, due to menu costs (Blanchard and Kiyotaki 1987), or to customer dissatisfaction aroused by price changes (Rotemberg 1982), where the interpretation is that large price changes are costlier to the firm in terms of customer dissatisfaction than smaller ones, as large price changes are more unpleasant to customers. Imperfect information may also be a reason for imperfect price adjustment (Andersen and Hansen 1994, Gottfries 1988). Here, we assume quadratic pricing costs, following Alogoskoufis, Martin and Pittis (1990).

In the model of quadratic costs, firms face an adjustment cost in their pricing. There is a quadratic relationship between the price change and the cost, i.e., the larger is the price change, the larger is the cost. The model can be thought to describe the effect of customer dissatisfaction from price changes. Under this assumption, it will not be optimal for the firm to adjust its price fully to cost, price, or demand shocks, according to equations (8) and (9), because adjustment causes costs. Rotemberg (1982) shows that the firms problem is in effect one of minimizing the cost from having to set a sub-optimal price. It can be approximated by a quadratic objective, set up in terms of the optimal price. In particular, it can be shown that the problem in equation (6) under quadratic pricing costs is approximately equal to the problem

$$(13)\quad \min_{p_{jt}} E_t \sum_{k=0}^{\infty} \delta^k((p_{jt}-p^o_{jt})^2 + c(p_{jt+k}-p_{jt+k-1})^2),$$

where c is a parameter, and p^o_{jt} is the optimal price in the absence of rigidities, given by equation (9). The objective then consists of the cost from having to set a sub-optimal price - the first term in parenthesis - and from having to meet the quadratic cost of price adjustment - the second term in parenthesis.

The first order conditions for the problem (13) yield the characteristic equation

$$(14)\quad (1-(\frac{1+c+\delta c}{\delta c})L + \frac{1}{\delta}L^2)p_{jt} = \frac{-L}{\delta c}p^o_{jt},$$

where L is the lag-operator. The solution to the characteristic equation is

$$(15)\quad p_{jt} = \rho_1 p_{jt-1} + \frac{1}{\rho_2 \delta c}\sum_{k=0}^{\infty}(\frac{1}{\rho_2})^k E_t p^o_{jt+k},$$

where ρ_1 is the stable root of the characteristic equation and ρ_2 is the unstable root. The price set this period depends on the lagged price with coefficient ρ_1, which can therefore be interpreted as a persistence coefficient - price rigidity, in other words - and the conditional expectation of the path of the optimal price. The roots also satisfy

$$(16)\qquad \rho_1+\rho_2 = \frac{1+c+\delta c}{\delta c}$$

$$(17)\qquad \rho_1\rho_2 = \frac{1}{\delta}$$

and

$$(18)\quad (1-\rho_1)(1-\rho_2) = \frac{-1}{\delta c}.$$

Using equations (16) to (18), the price the firm sets under quadratic pricing costs can be written as

$$(19)\quad p_{jt} = \rho_1 p_{jt-1} + (1-\rho_1)(1-\rho_1\delta)\sum_{k=0}^{\infty}(\rho_1\delta)^k E_t p^o_{jt+k}.$$

A general solution to the pricing equation is not available, however, because the conditional expectation of the optimal price depends on the processes driving demand, costs and the aggregate price level. We return to this problem in chapter 4 after having motivated these processes for the particular case of Finland.

3 The demand for Finnish exports

In the current chapter, we present estimates on the demand for Finnish exports based on the model for demand for differentiated products of section 2.1. The estimated equations take the form

$$(20)\quad log(X_k^i) = c - \epsilon log(\frac{P_k^{Fi}}{P_k^i}) + \eta log(\frac{s_{Fi} M_k^i}{P_k^i}),$$

where X_k^i is the demand for Finnish exports of products of industry k in country i, P_k^{Fi} is the price of Finnish products of industry k, evaluated by Finnish GDP-deflators, ϵ is the price elasticity of demand, M_k^i is the aggregate demand for products of industry k in country i, η is the income-elasticity of demand, and s_{Fi} is the market share of Finnish firms in country i and industry k. Finally, P_k^i is a trade-weighted price index for imports of industry k products by country i. Our data allows the construction of this index for trade between most of (then) EEC-countries, the Nordic Countries, and the North American countries. Trade with the rest of the world is excluded, but particularly for the EEC and Nordic countries, the data covers the bulk of international trade. For Finland, the ratio of exports to the countries in our data to total Finnish exports is reported in Table 1.

TABLE 1 Data coverage

Industry (ISIC)	Year 1970	Year 1980	Year 1990	Year 1992
Total (3)	73.5	64.3	68.4	76.8
Food (31)	72.4	44.1	47.5	58.1
Textile (32)	83.7	73.4	64.8	75.3
Wood (33)	38.9	46.2	52.2	60.3
Paper (34)	71.0	64.7	74.8	81.0
Chemical (35)	67.0	61.7	71.2	74.6
Mineral (36)	86.4	69.0	73.7	74.4
Basic metal (37)	89.4	80.4	81.2	81.4
Machinery (38)	52.5	45.4	51.5	65.5
Other (39)	91.8	85.7	89.8	88.8

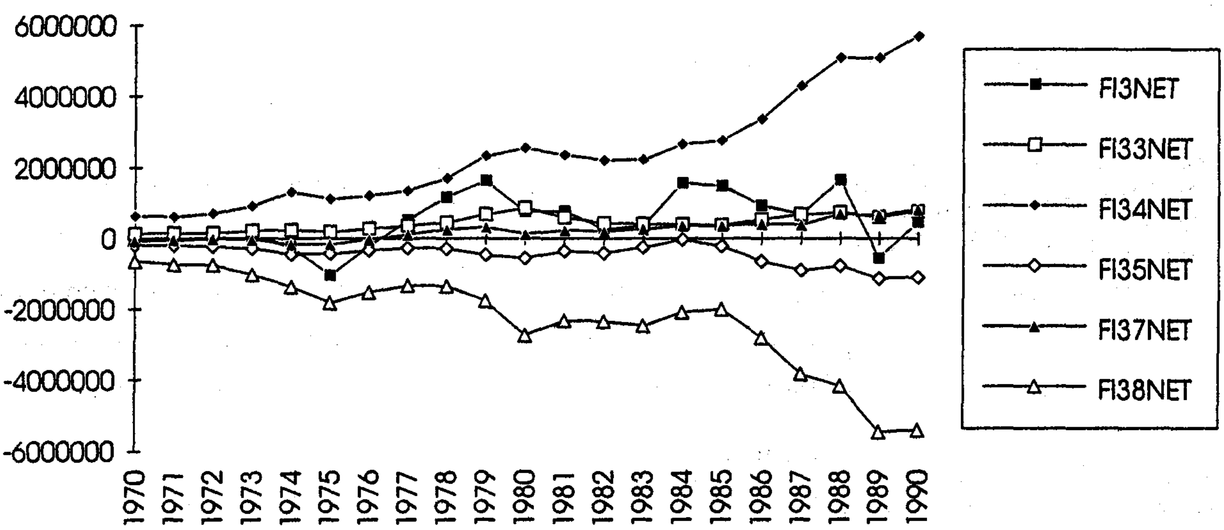
Table 2 reports the ratios of exports by the industries to total Finnish exports within our sample.

TABLE 2 Export shares of industries

Industry (ISIC)	Year 1970	Year 1980	Year 1990	Year 1992
Food (31)	3.7	3.1	2.2	2.2
Textile (32)	6.9	8.1	3.4	2.7
Wood (33)	1.6	14.8	7.5	7.2
Paper (34)	41.2	30.1	31.8	30.8
Chemical (35)	4.5	11.7	9.6	11.5
Mineral (36)	0.7	1.1	1.1	1.3
Basic metal (37)	6.8	7.3	8.1	9.7
Machinery (38)	19.5	22.3	35.6	33.9
Other (39)	0.5	0.8	0.6	0.6

As can be seen from Table 2, paper industry (ISIC 34) has retained a very significant share throughout our sample (and beyond), but manufacturing of machinery and equipment has steadily grown more important. Metal and chemical industries (ISIC 37 and 35, respectively) have been large exporters as well, with export shares of 11.5 and 9.7 per cent in 1990. The importance of intraindustry trade can be easily highlighted with the help of Figure 1.

Figure 1 Net exports of Finnish industries (in 1000 USD)



In the figure, the abbreviation NET denotes net exports, and the codes FI3 etc. refer to ISIC codes for Finnish industries, given in appendix A. As can be seen from the figure, the largest exporting industry of 1990, ISIC 38, was a very large net importer in the same year, as was chemical industry (ISIC 35). This is not what one would expect, if comparative advantage was the reason for large Finnish exports. The reason for such a trade pattern lies surely in the fact that trade consists of differentiated products.

The rest of the large exporting industries were also net exporters, paper industry (ISIC 34) clearly so. For wood industry (ISIC 33) and paper industry (ISIC 34), the comparative advantage explanation might be sounder.

Returning to the demand equation (20), there are some aspects worth noting before turning to the estimation results. The basic model of intraindustry trade of section 2.1. assumes that tastes are similar across consumers. In the current setting, this implies that price elasticities are equal in the countries of our sample. Naturally, this assumption need not hold in reality. We take account of this by estimating the demands for Finnish exports by other countries as a system. This has the advantage that differences in the price elasticities between various markets can be tested for, following Honkatukia (1993).[3] As discussed in section 2.2, this identifies differences in the market power of Finnish firms; if demand elasticities vary, so do the mark-ups, so that there will be pricing to market, provided that prices are set optimally. In the following sections, we present the most restricted price elasticity vectors for the demand systems for Finnish goods that stood the statistical tests for the resrictions.

A drawback of our use of GDP-deflators is that downward bias is induced to the estimate on the price-elasticity of demand. For this reason, we do not always obtain estimates on the price-elasticity that are consistent with all models of imperfect competition. When this is the case, comparisons on competitiveness become impossible, but naturally, differences between markets can still be identified.

[3]Specifically, demands have been estimated with the seemingly unrelated regression - method (SUR). This method makes it possible to construct a likelihood-ratio test for the parameter restrictions. The test statistics has a standard $\chi^2_{N_R-1}$ distribution, where the degrees of freedom are given by the number of restrictions, minus one.

3.1 Aggregate Finnish manufacturing exports (ISIC 3)

For the better part of our sample period, Finland's net trade with the eleven OECD-countries has been in surplus. Our sample covers 64.3 (1980) to 73.5 (1970) per cent of Finland's world trade. The largest trade partners have been Sweden, Great Britain and France, with whom Finland has run a trade surplus, and Japan and Germany, with whom Finland is a net importer. Figure 2 depicts the net trade of Finland and these countries, as well as Finnish net trade between all of the sample countries. Figure 3 plots price indices for Finnish and Swedish manufactures (FI3D and SW3D, respectively) and a trade- weighted price index, in U.S. dollars, for import prices for all of the countries in our sample. Both Finnish and Swedish exports appear to have been pricier than average, while Finnish price competitiveness has been slightly better than Swedish.

Table 3 reports demand functions for aggregate Finnish manufacturing exports. The hypothesis of equal price elasticities in all of the trade partners could not be rejected with either Wald or likelihood ratio tests. The price elasticities are clearly consistent with even the basic Chamberlinian model of monopolistic competition.

TABLE 3 Demand in ISIC 3 (SUR)

Model: $X_3^i = log(\frac{P_3^{Fi}}{P_3^i}) + log(\frac{s_{Fi}M_3^i}{P_3^i})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P_3^{Fi}}{P_3^{US}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{US}}{P_3^{US}}$	1.5163	.16647	1.565	.765
$\frac{P_3^{Fi}}{P_3^{Jp}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{Jp}}{P_3^{Jp}}$	2.1687	.37625	2.322	.456
$\frac{P_3^{Fi}}{P_3^{De}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{De}}{P_3^{De}}$	1.2477	.21545	1.955	.552
$\frac{P_3^{Fi}}{P_3^{Ca}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{Ca}}{P_3^{Ca}}$	.93310	.41664	1.662	.109
$\frac{P_3^{Fi}}{P_3^{Fr}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{Fr}}{P_3^{Fr}}$	.91604	.18995	2.035	.364
$\frac{P_3^{Fi}}{P_3^{GB}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{GB}}{P_3^{GB}}$	1.5344	.18465	2.356	.663
$\frac{P_3^{Fi}}{P_3^{It}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{It}}{P_3^{It}}$	1.5653	.22094	1.499	.663
$\frac{P_3^{Fi}}{P_3^{NL}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{NL}}{P_3^{NL}}$	1.9533	.29643	1.720	.478
$\frac{P_3^{Fi}}{P_3^{No}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{No}}{P_3^{No}}$	.50670	.35143	3.028	.258
$\frac{P_3^{Fi}}{P_3^{Sw}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{Sw}}{P_3^{Sw}}$	1.0013	.15141	1.722	.469
$\frac{P_3^{Fi}}{P_3^{Dn}}$	-1.0334	.14938	$\frac{s_{Fi}M_3^{Dn}}{P_3^{Dn}}$	1.1013	.11153	1.799	.681

System R^2=0.996, LR-test value=13.99 ($\chi^2_{(10)}$)

Figure 2 Net trade of aggregate manufactures (ISIC 3), 1000 USD

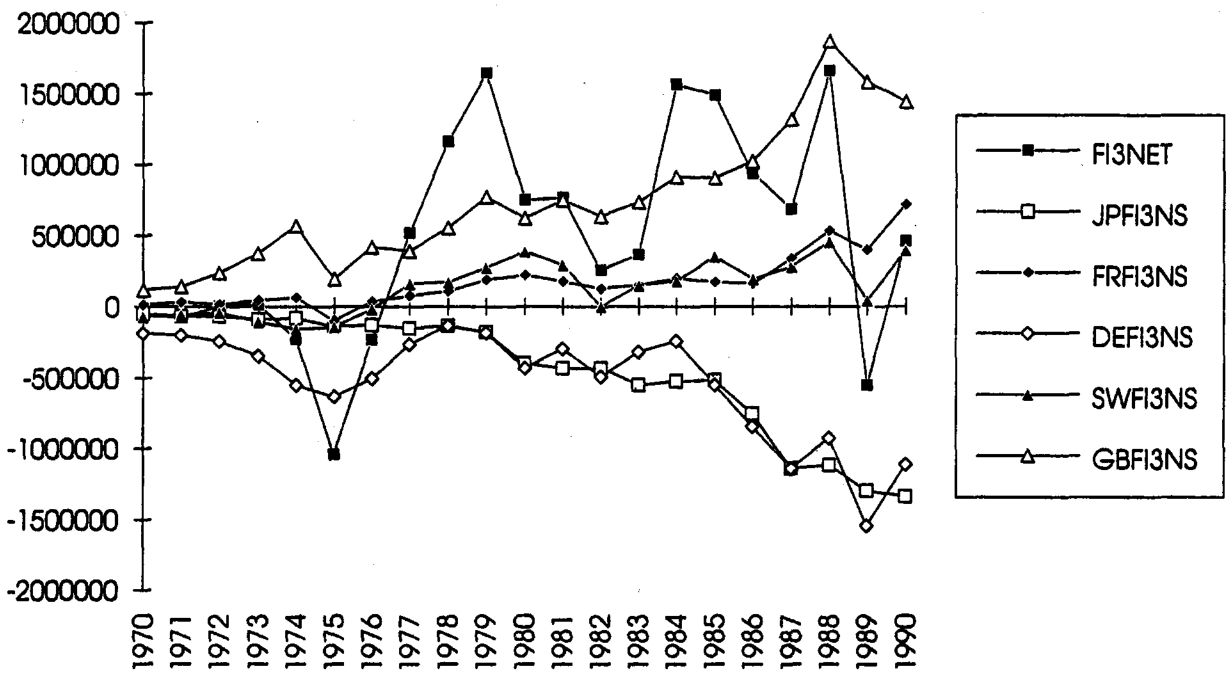
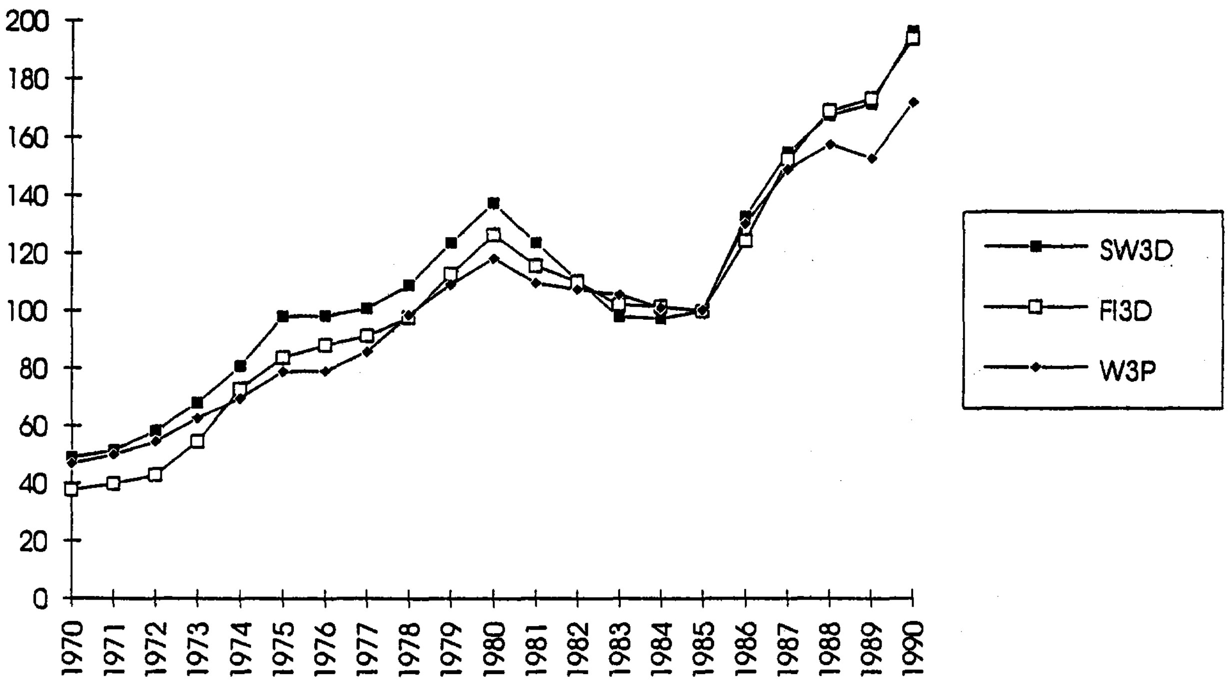


Figure 3 Relative prices in ISIC 3



3.2 Exports of food (ISIC 31)

Finland's net trade of food products has been mostly on the deficit for our sample period. Net imports have been largest from France, Germany, Great Britain and Sweden. The sample covers 44.1 (1980) to 72.4 (1970) per cent of Finland's world trade in food. Figure 4 depicts the net trade of Finland with these countries and all of the sample countries. Figure 5 plots price indices in the Finnish and Swedish food industries (FI31D and SW31D, respectively) and the trade-weighted world price index. Finnish and Swedish prices have been higher than world prices, with Finnish prices slightly lower than Swedish. It could perhaps be noted here that the price indices reported are based on value added and not on consumer prices, which in Finland have been higher than in Sweden. Table 4 reports demand functions for Finnish exports of food products. The hypothesis of equal price elasticities in all of the trade partners but Germany could not be rejected. The latter fails to be significant. The restricted price elasticity estimate for other markets is lower than one in absolute value, suggesting that competition may not be Chamberlinian in the food industry - hardly surprisingly.

TABLE 4 Demand in ISIC 31 (SUR)

Model: $X_{31}^i = log(\frac{P_{31}^{Fi}}{P_{31}^i}) + log(\frac{s_{Fi}M_{31}^i}{P_{31}^i})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P_{31}^{Fi}}{P_{31}^{US}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{US}}{P_{31}^{US}}$	1.038	0.173	1.581	.629
$\frac{P_{31}^{Fi}}{P_{31}^{Jp}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{Jp}}{P_{31}^{Jp}}$	0.752	0.516	2.903	.012
$\frac{P_{31}^{Fi}}{P_{31}^{De}}$	-0.095	0.373	$\frac{s_{Fi}M_{31}^{De}}{P_{31}^{De}}$	0.456	0.349	2.249	.0004
$\frac{P_{31}^{Fi}}{P_{31}^{Ca}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{Ca}}{P_{31}^{Ca}}$	2.066	0.468	1.619	.302
$\frac{P_{31}^{Fi}}{P_{31}^{Fr}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{Fr}}{P_{31}^{Fr}}$	0.917	0.418	2.199	.032
$\frac{P_{31}^{Fi}}{P_{31}^{GB}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{GB}}{P_{31}^{GB}}$	0.847	0.451	1.549	.035
$\frac{P_{31}^{Fi}}{P_{31}^{It}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{It}}{P_{31}^{It}}$	1.018	0.514	2.443	.110
$\frac{P_{31}^{Fi}}{P_{31}^{No}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{No}}{P_{31}^{No}}$	1.512	0.337	2.092	.314
$\frac{P_{31}^{Fi}}{P_{31}^{Sw}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{Sw}}{P_{31}^{Sw}}$	-0.405	0.485	2.923	.071
$\frac{P_{31}^{Fi}}{P_{31}^{Dn}}$	-0.709	0.179	$\frac{s_{Fi}M_{31}^{Dn}}{P_{31}^{Dn}}$	0.501	0.233	2.056	.267

System R^2=0.951, LR-test value=4.399 ($\chi^2_{(9)}$)

Figure 4 Net trade of food (ISIC 31), 1000 USD

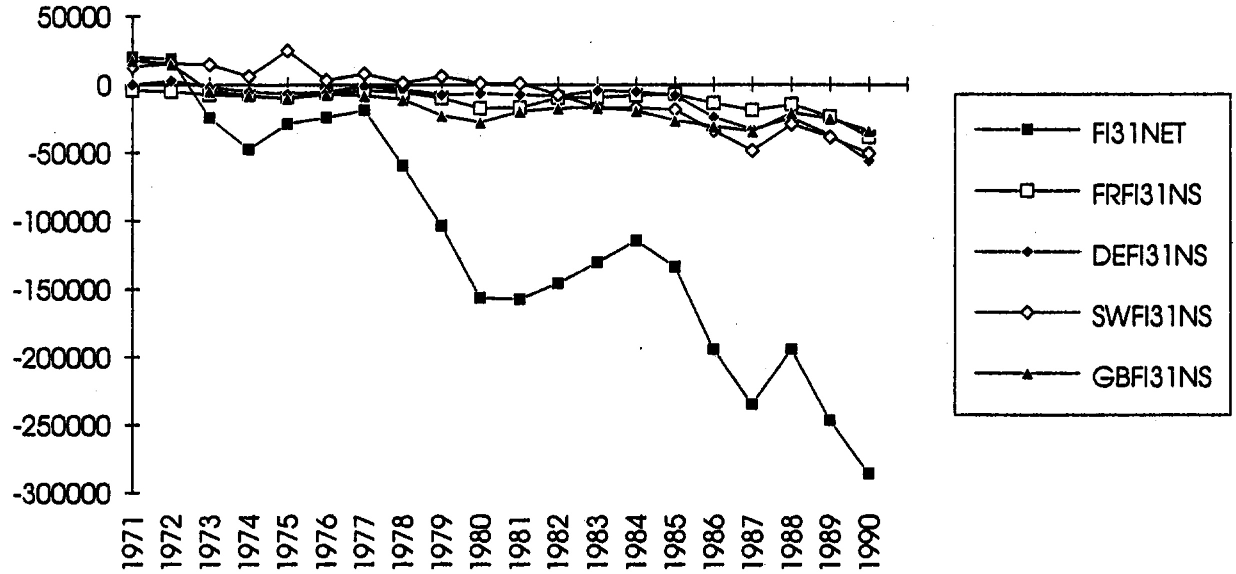
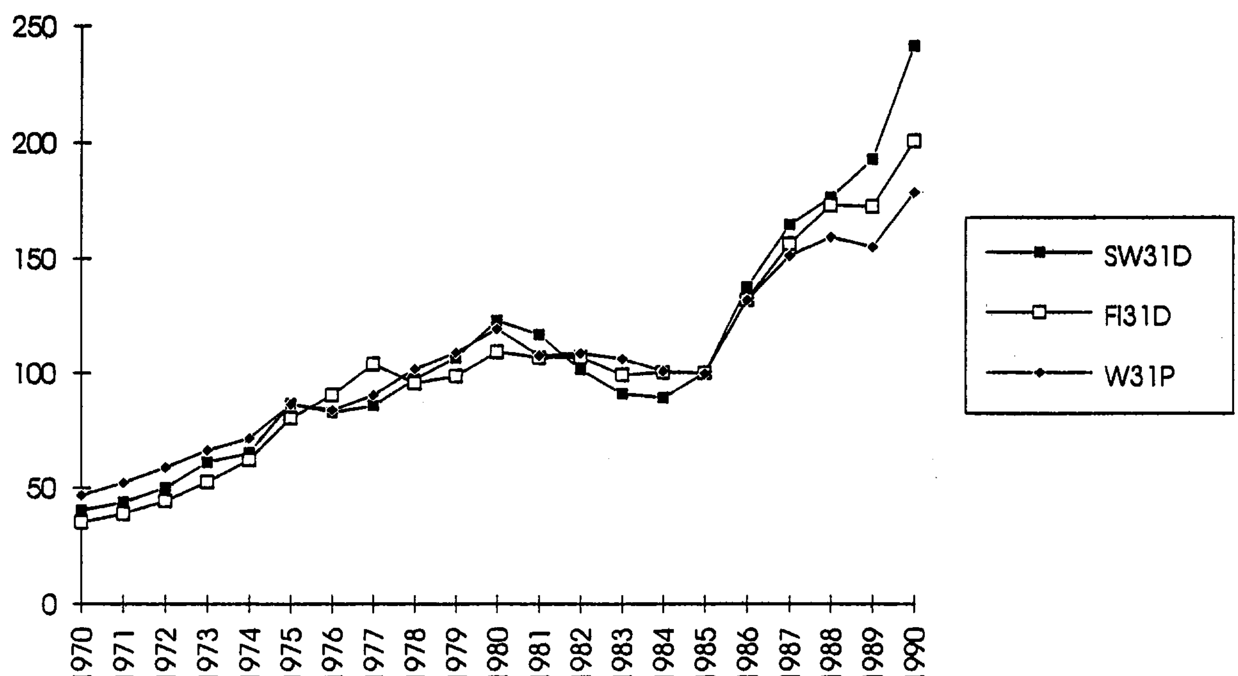


Figure 5 Relative prices in ISIC 31



3.3 Exports of textiles (ISIC 32)

Finland was a net exporter of textiles until mid-eighties, when it began to run a trade deficit. Sweden has remained a net importer of Finnish textiles, whereas Finland has been a net importer from France, Germany, Great Britain and Italy. For textile industry, our sample covers 64.8 (1990) to 83.7 (1970) per cent of Finland's world trade of textiles. Figure 6 depicts the net trade of Finland with the largest trade partners and all of the sample countries. Figure 7 plots price indices in the Finnish and Swedish textile industries (FI32D and SW32D) as well as the world price index. Finnish prices have been somewhat lower and Swedish higher than world prices. Table 5, in turn, reports the restricted demand functions for Finnish exports of textiles. The hypothesis of equal price elasticities in all of the trade partners can be rejected at one per cent level. The estimated price elasticity is lower than one in absolute value, suggesting that competition may not be Chamberlinian in the textile industry, which was found to apply to the unrestricted model as well.

TABLE 5 Demand in ISIC 32 (SUR)

Model: $X_3^i = log(\frac{P_3^{Fi}}{P_3^i}) + log(\frac{s_{Fi}M_3^i}{P_3^i})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P_{32}^{Fi}}{P_{32}^{US}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{US}}{P_{32}^{US}}$	1.095	.190	1.887	.478
$\frac{P_{32}^{Fi}}{P_{32}^{Jp}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{Jp}}{P_{32}^{Jp}}$	1.141	.164	1.185	.635
$\frac{P_{32}^{Fi}}{P_{32}^{De}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{De}}{P_{32}^{De}}$	1.778	.506	.890	.116
$\frac{P_{32}^{Fi}}{P_{32}^{Ca}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{Ca}}{P_{32}^{Ca}}$	.695	.334	1.586	.103
$\frac{P_{32}^{Fi}}{P_{32}^{Fr}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{Fr}}{P_{32}^{Fr}}$	.689	.440	1.467	.007
$\frac{P_{32}^{Fi}}{P_{32}^{GB}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{GB}}{P_{32}^{GB}}$	.885	.152	1.315	.418
$\frac{P_{32}^{Fi}}{P_{32}^{It}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{It}}{P_{32}^{It}}$	2.009	.196	1.180	.717
$\frac{P_{32}^{Fi}}{P_{32}^{NL}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{NL}}{P_{32}^{NL}}$	1.366	.304	1.525	.335
$\frac{P_{32}^{Fi}}{P_{32}^{No}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{No}}{P_{32}^{No}}$	1.121	.125	.820	.431
$\frac{P_{32}^{Fi}}{P_{32}^{Sw}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{Sw}}{P_{32}^{Sw}}$	.827	.148	.900	.236
$\frac{P_{32}^{Fi}}{P_{32}^{Dn}}$	-.236	.094	$\frac{s_{Fi}M_{32}^{Dn}}{P_{32}^{Dn}}$	1.167	.122	1.825	.450

System R^2=0.999, LR-test value=24.248 ($\chi^2_{(10)}$)

Figure 6 Net trade of textiles (ISIC 32), 1000 USD

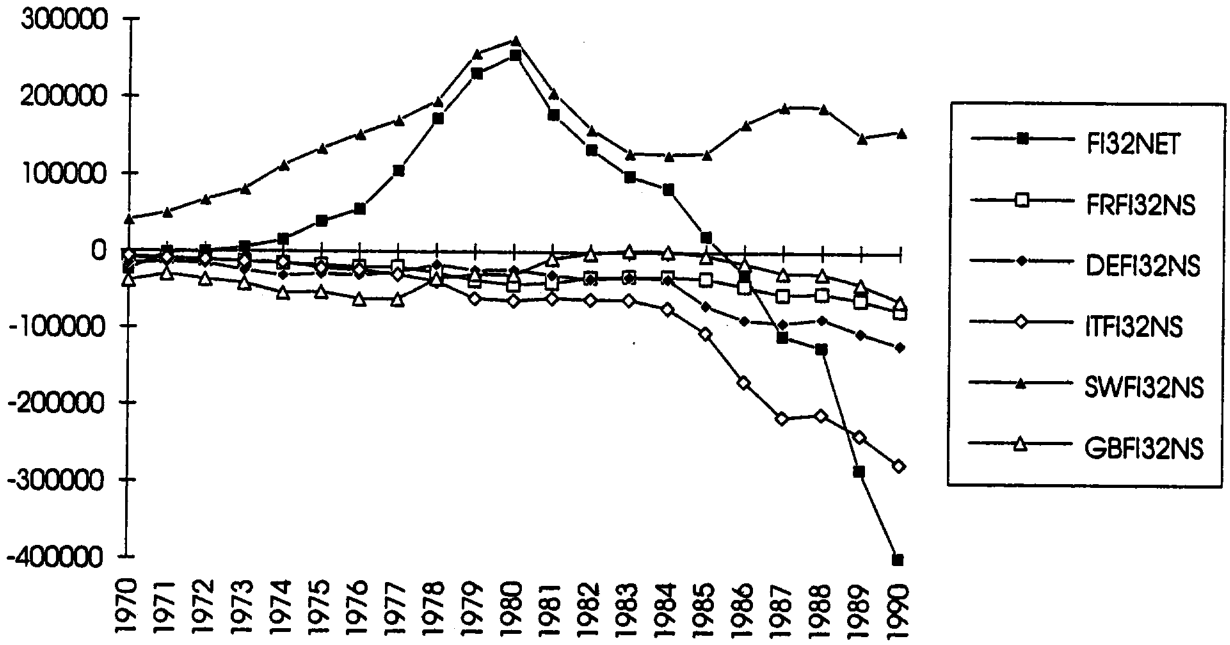
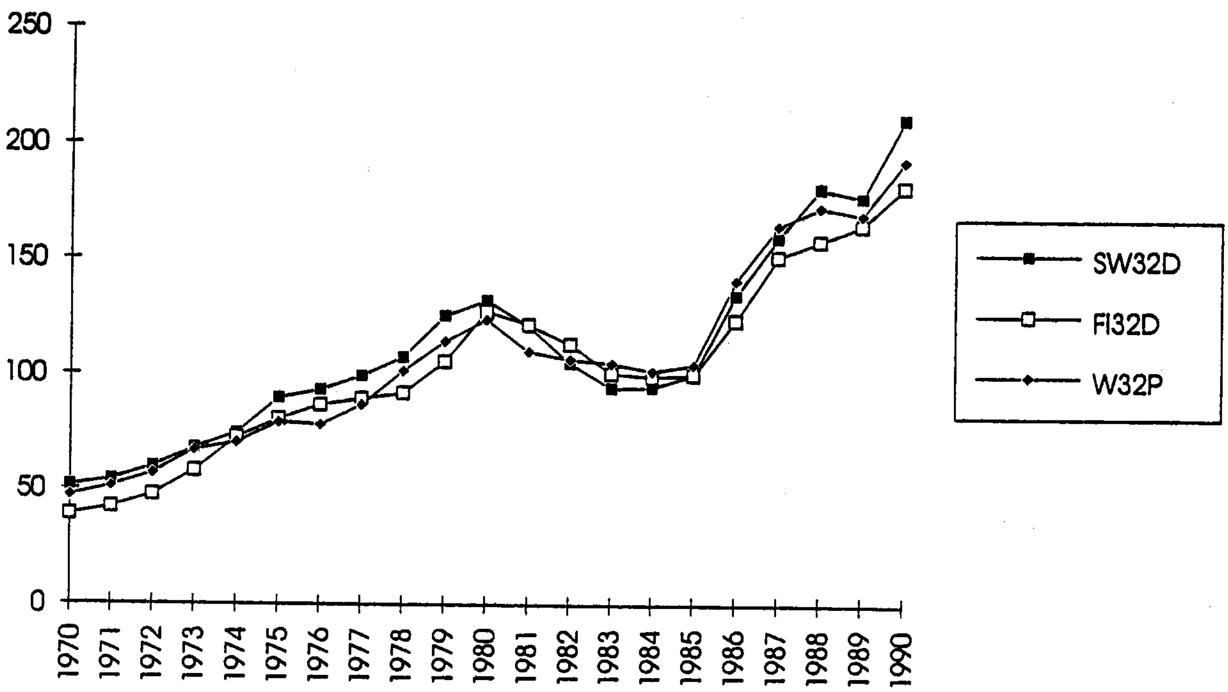


Figure 7 Relative prices in ISIC 32



3.4 Exports of wood and wood products (ISIC 33)

Throughout the sample, Finland has run a large trade surplus of wood and wood products. France, Germany, Great Britain and, somewhat surprisingly perhaps, Sweden have been the largest net importers from Finland. For ISIC 33, our sample covers 38.9 (1970) to 52.2 (1990) per cent of Finland's trade in wood. In Figure 8, the net trade of Finland with the largest trade partners and all of the sample countries are plotted. Figure 9 plots price indices in the Finnish and Swedish wood industries (FI33D and SW33D), together with the world price index. Finnish prices have been lower than Swedish but higher than world prices. Table 6 reports the demand functions for Finnish exports of wood. The hypothesis of equal price elasticities in all of the trade partners could only be rejected for Italy. No apparent reason for this is suggested by our data; Italy is a net importer from Finland as are the other trade partners within the sample. A study of the composition of Finnish exports to Italy would presumably suggest the explanation. As it is, the price elasticity in the Italian markets is the only one clearly consistent with any model of imperfect competition; the others are not, pointing as they are to less competition.

TABLE 6 Demand in ISIC 33 (SUR)

Model: $X^i_{33} = log(\frac{P^{Fi}_{33}}{P^i_{33}}) + log(\frac{s_{Fi}M^i_{33}}{P^i_{33}})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P^{Fi}_{33}}{P^{US}_{33}}$	-.606	.112	$\frac{s_{Fi}M^{US}_{33}}{P^{US}_{33}}$	.730	.222	1.556	.434
$\frac{P^{Fi}_{33}}{P^{De}_{33}}$	-.606	.112	$\frac{s_{Fi}M^{De}_{33}}{P^{De}_{33}}$	.877	.097	1.820	.691
$\frac{P^{Fi}_{33}}{P^{Ca}_{33}}$	-.606	.112	$\frac{s_{Fi}M^{Ca}_{33}}{P^{Ca}_{33}}$	1.243	.302	2.503	.317
$\frac{P^{Fi}_{33}}{P^{Fr}_{33}}$	-.606	.112	$\frac{s_{Fi}M^{Fr}_{33}}{P^{Fr}_{33}}$	.791	.199	1.595	.229
$\frac{P^{Fi}_{33}}{P^{It}_{33}}$	-2.797	.915	$\frac{s_{Fi}M^{It}_{33}}{P^{It}_{33}}$	1.445	.419	2.310	.303
$\frac{P^{Fi}_{33}}{P^{No}_{33}}$	-.606	.112	$\frac{s_{Fi}M^{No}_{33}}{P^{No}_{33}}$	1.059	.095	1.591	.807
$\frac{P^{Fi}_{33}}{P^{Sw}_{33}}$	-.606	.112	$\frac{s_{Fi}M^{Sw}_{33}}{P^{Sw}_{33}}$	.476	.147	1.224	.476
$\frac{P^{Fi}_{33}}{P^{Dn}_{33}}$	-.606	.112	$\frac{s_{Fi}M^{Dn}_{33}}{P^{Dn}_{33}}$	.743	.112	2.460	.379

System R^2=0.999, LR-test value=3.90 ($\chi^2_{(10)}$)

Figure 8 Net trade of wood and wood products (ISIC 33), 1000 USD

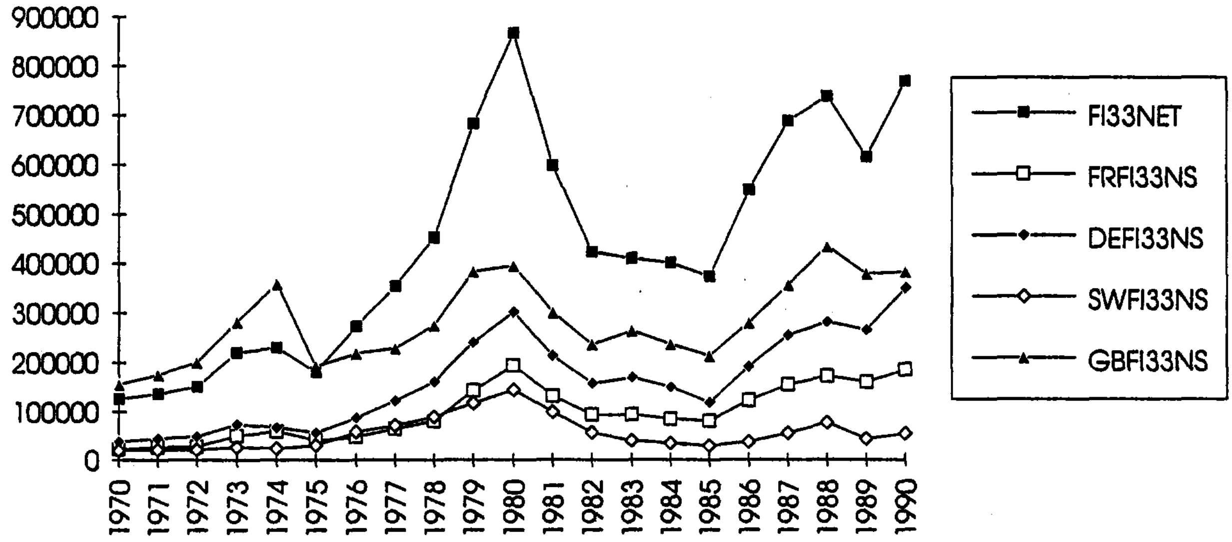
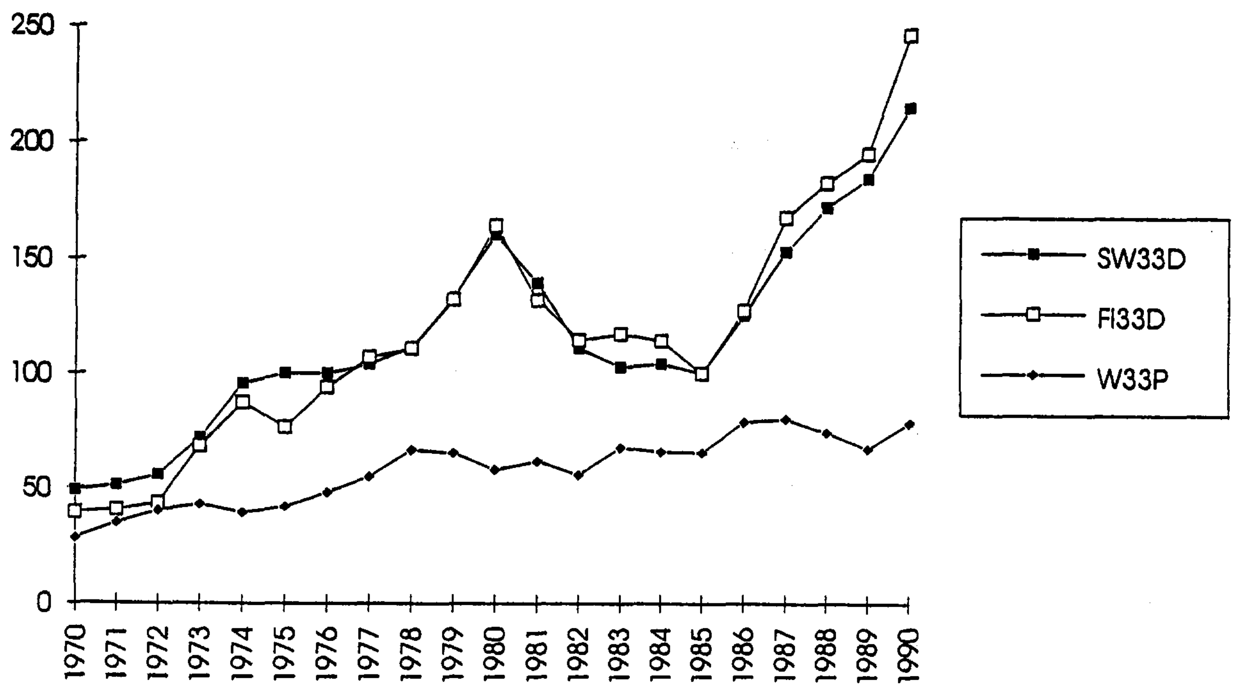


Figure 9 Relative prices in ISIC 33



3.5 Exports of paper (ISIC 34)

It is no news that Finland is a net exporter of paper, with its exports of paper amounting to 31.8 per cent of total manufacturing exports in 1990. France, Germany, Great Britain, Netherlands, the United States and Sweden are the largest net importers from Finland. The bulk of exports goes to western OECD countries, 64.7 (1980) to 74.8 (1990) per cent in our sample. Figure 10 plots Finnish net exports to the largest trade partners. Figure 11 plots the Finnish, Swedish and world price indices. Finnish prices were lower than Swedish in the seventies, approximately equal to Swedish from early to mid-eighties and have since been somewhat lower. From mid-seventies onwards, both countries have had higher prices than average. Particularly for Finland, this may well reflect an attempt to raise the quality of the paper exported - to specialize in higher grade paper, in other words. The trade surplus of Finland with Sweden may, on the other hand, be caused by the exports to Sweden by Finnish graphical industries and not of paper. Table 7 reports the demand functions for Finnish exports of paper. Equality of price elasticities could be very clearly rejected for France using a Wald-test. The restrictions in the reported model can be rejected at five per cent level of significance but not at one per cent using the more powerful likelihood ratio test. For France, the price elasticity is low, suggesting a form of imperfect competition where market shares are an explicit concern for firms. This is interesting against the background of the recent discussion of pricing of Finnish paper in France; in effect, French government has chosen to protect an inefficient domestic industry and thereby appears to have created extra profit opportunities for foreign competitors, such as the Finnish paper mills. While this is not to say that Finnish mills actually did dump in France, theory suggests that it would have been unoptimal not to have done so. Naturally, the same argument applies to more efficient industries from any country. Finally, the price elasticities in the other countries are higher than one in absolute value, so that even the Chamberlinian model is plausible.

TABLE 7 Demand in ISIC 34 (SUR)							
Model: $X^i_{34} = log(\frac{P^{Fi}_{34}}{P^i_{34}}) + log(\frac{s_{Fi}M^i_{34}}{P^i_{34}})$							
Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P^{Fi}_{34}}{P^{US}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{US}_{34}}{P^{US}_{34}}$	2.758	.443	1.596	.456
$\frac{P^{Fi}_{34}}{P^{Jp}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{Jp}_{34}}{P^{Jp}_{34}}$	1.902	.290	2.051	.541
$\frac{P^{Fi}_{34}}{P^{De}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{De}_{34}}{P^{De}_{34}}$	1.154	.102	2.159	.796
$\frac{P^{Fi}_{34}}{P^{Ca}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{Ca}_{34}}{P^{Ca}_{34}}$	1.181	1.316	1.494	.116
$\frac{P^{Fi}_{34}}{P^{Fr}_{34}}$	-.635	.0731	$\frac{s_{Fi}M^{Fr}_{34}}{P^{Fr}_{34}}$	.970	.087	.917	.694
$\frac{P^{Fi}_{34}}{P^{GB}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{GB}_{34}}{P^{GB}_{34}}$	1.036	.090	1.458	.843
$\frac{P^{Fi}_{34}}{P^{It}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{It}_{34}}{P^{It}_{34}}$	1.233	.132	2.043	.643
$\frac{P^{Fi}_{34}}{P^{NL}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{NL}_{34}}{P^{NL}_{34}}$	1.341	.272	1.208	.544
$\frac{P^{Fi}_{34}}{P^{No}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{No}_{34}}{P^{No}_{34}}$	1.708	.248	1.240	.624
$\frac{P^{Fi}_{34}}{P^{Sw}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{Sw}_{34}}{P^{Sw}_{34}}$	1.388	.236	1.797	.597
$\frac{P^{Fi}_{34}}{P^{Dn}_{34}}$	-1.008	.072	$\frac{s_{Fi}M^{Dn}_{34}}{P^{Dn}_{34}}$	1.254	.199	1.782	.764
System R^2=0.999, LR-test value=18.474 ($\chi^2_{(9)}$)							

Figure 10 Net trade of paper (ISIC 34), 1000 USD

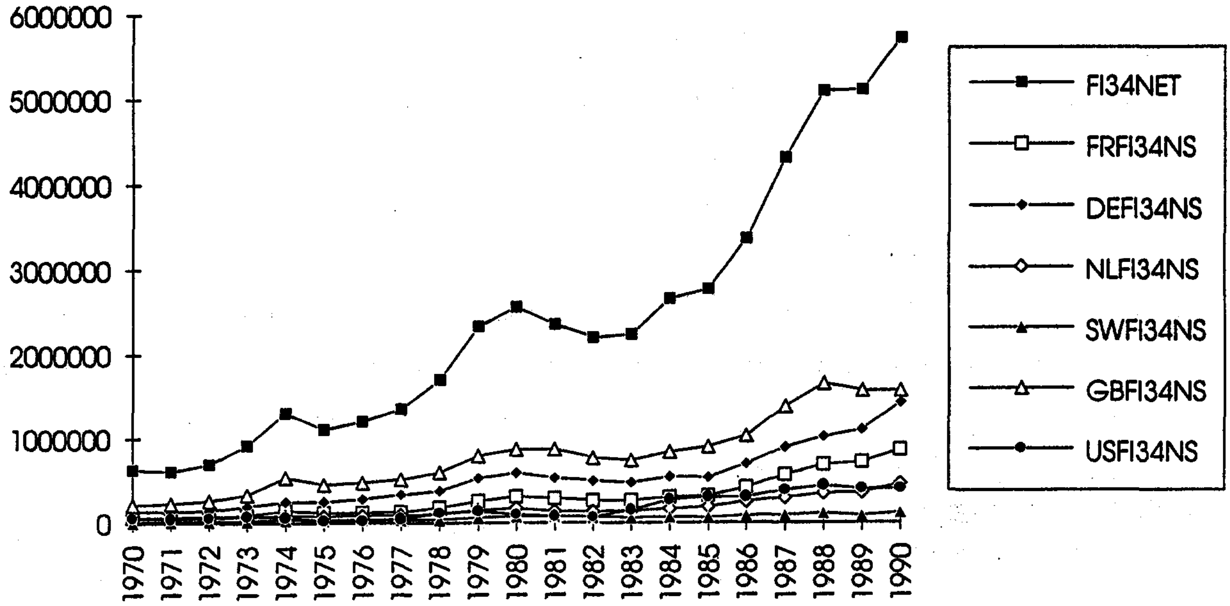
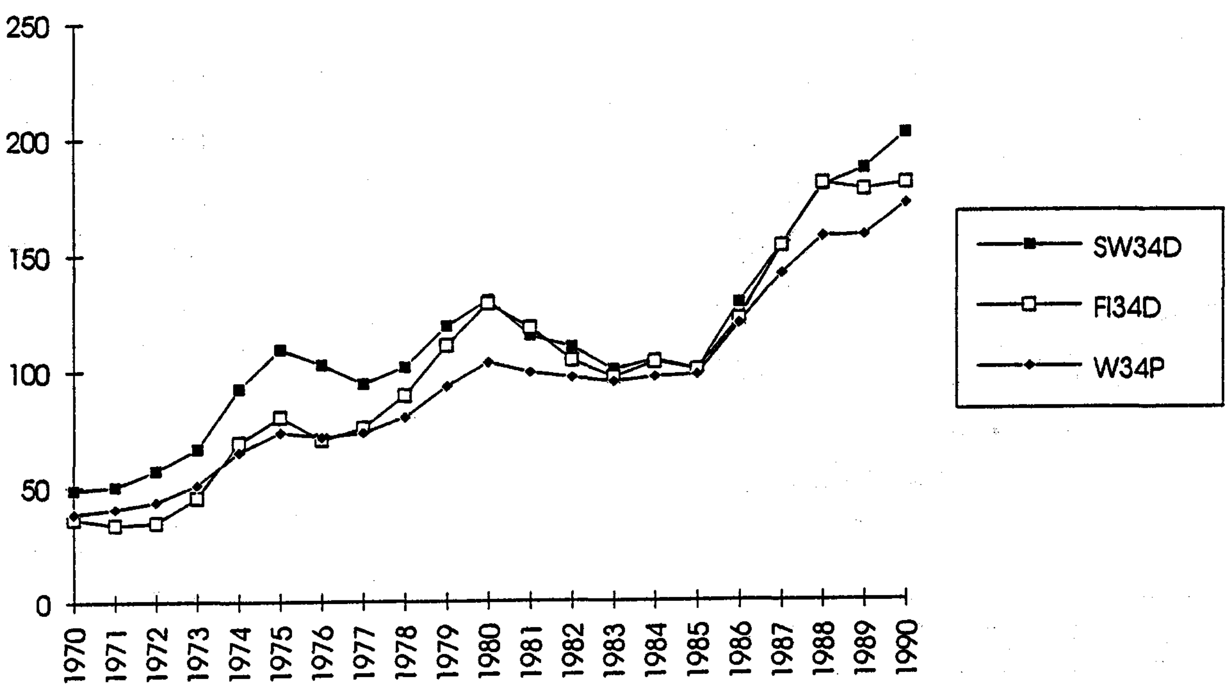


Figure 11 Relative prices in ISIC 34



3.6 Exports of chemicals (ISIC 35)

While exports by chemical industries were 9.6 per cent of total manufacturing exports in 1990, Finland has remained a net importer of chemical products throughout our sample. The largest trade partners have been France, Germany, Great Britain, the United States, and Sweden, the latter having been the only net importer from Finland from mid-Seventies on. The OECD countries in our sample received between 61.7 (1980) to 71.2 (1990) per cent of Finnish exports. Figure 12 plots Finnish net trade with the largest partners. Figure 13 plots the Finnish, Swedish and world price indices. Finnish prices were lower than world prices in the early seventies and late eighties; from mid-seventies to mid-eighties, they were somewhat higher, and close to the Swedish prices. Swedish prices were higher than world prices throughout the two decades. Table 8 reports the demand functions for exports by Finnish chemical industry. Equality of price elasticities could not be accepted for France. For France, the price elasticity is of the wrong sign but is not significant. Nordic countries appear to be a distinct market area for Finnish exports, because it could not be refuted that the price elasticity there was different from Central-European markets (The likelihood ratio test statistics is only significant at a ten per cent level of significance). The price elasticities in the Nordic countries are higher than one in absolute value, so that the Chamberlinian model is plausible, whereas they may be lower than one in the rest of the sample countries.

TABLE 8 Demand in ISIC 35 (SUR)

Model: $X_{35}^i = log(\frac{P_{35}^{Fi}}{P_{35}^i}) + log(\frac{s_{Fi}M_{35}^i}{P_{35}^i})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P_{35}^{Fi}}{P_{35}^{US}}$	-.912	.246	$\frac{s_{Fi}M_{35}^{US}}{P_{35}^{US}}$	2.384	.592	2.811	.224
$\frac{P_{35}^{Fi}}{P_{35}^{Jp}}$	-.912	.246	$\frac{s_{Fi}M_{35}^{Jp}}{P_{35}^{Jp}}$	1.995	.310	1.824	.547
$\frac{P_{35}^{Fi}}{P_{35}^{De}}$	-.912	.246	$\frac{s_{Fi}M_{35}^{De}}{P_{35}^{De}}$	1.641	.523	2.239	.262
$\frac{P_{35}^{Fi}}{P_{35}^{Ca}}$	-.912	.246	$\frac{s_{Fi}M_{35}^{Ca}}{P_{35}^{Ca}}$	-1.033	.693	3.053	.180
$\frac{P_{35}^{Fi}}{P_{35}^{Fr}}$	.348	.562	$\frac{s_{Fi}M_{35}^{Fr}}{P_{35}^{Fr}}$	.989	.528	1.934	.148
$\frac{P_{35}^{Fi}}{P_{35}^{GB}}$	-.912	.246	$\frac{s_{Fi}M_{35}^{GB}}{P_{35}^{GB}}$	1.002	.194	2.582	.515
$\frac{P_{35}^{Fi}}{P_{35}^{It}}$	-.912	.246	$\frac{s_{Fi}M_{35}^{It}}{P_{35}^{It}}$	2.625	.578	2.450	.423
$\frac{P_{35}^{Fi}}{P_{35}^{No}}$	-1.634	.288	$\frac{s_{Fi}M_{35}^{No}}{P_{35}^{No}}$	1.209	.424	3.177	.391
$\frac{P_{35}^{Fi}}{P_{35}^{Sw}}$	-1.634	.288	$\frac{s_{Fi}M_{35}^{Sw}}{P_{35}^{Sw}}$	1.744	.303	1.871	.487
$\frac{P_{35}^{Fi}}{P_{35}^{Dn}}$	-1.634	.288	$\frac{s_{Fi}M_{35}^{Dn}}{P_{35}^{Dn}}$	1.741	.428	1.995	.368

System R^2=0.986, LR-test value=13.92 $(\chi^2_{(7)})$

Figure 12 Net trade of chemical products (ISIC 35), 1000 USD

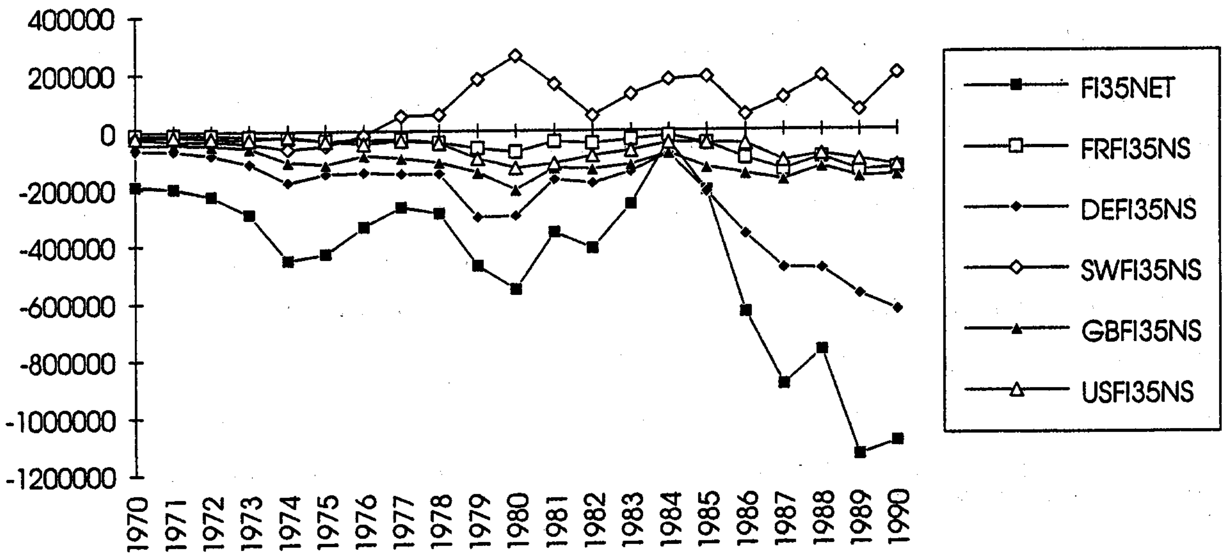
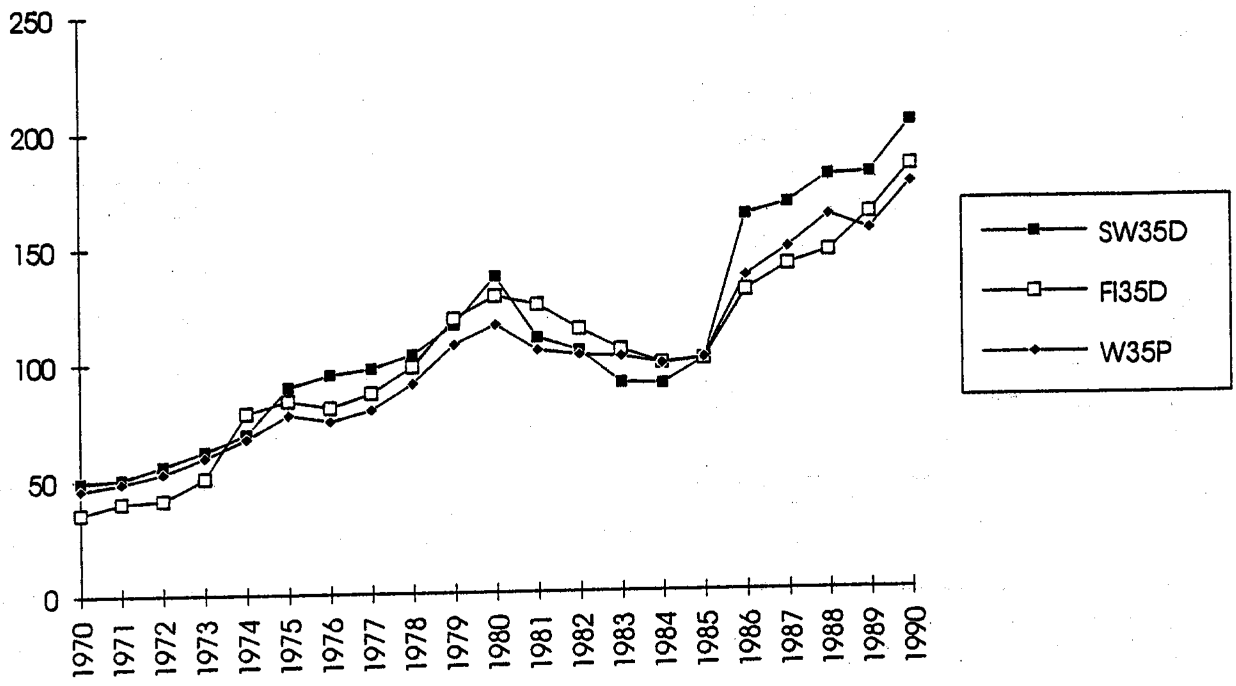


Figure 13 Relative prices in ISIC 35



3.7 Exports of minerals (ISIC 36)

Mineral products (other than petroleum) have a small share of Finnish total exports. The industry includes e.g. production of elements. Finland is a net importer, with net exports to only Norway and Sweden. In Central Europe, largest trade partners have been France, Germany, Italy. Between 69 (1980) to 86.4 (1970) per cent of exports have been to the OECD-countries of our sample. Figure 14 plots Finnish net trade, and Figure 15 the Finnish, Swedish and world price indices. Finnish prices were lower than or close to the world prices from the early seventies to late eighties; then, they rapidly rose, which is undoubtedly an effect of the late-eighties building boom in Finland. Swedish prices have mostly been somewhat higher than the world prices and Finnish prices. Table 9 reports the demand functions for exports by Finnish mineral industry. Equality of price elasticities could be accepted for all trade partners but Great Britain (at one pre cent level of significance), whose estimate is of the wrong sign and significant. The price elasticities elsewhere are higher than one in absolute value, making the Chamberlinian model plausible.

TABLE 9 Demand in ISIC 36 (SUR)

Model: $X^i_{36} = log(\frac{P^{Fi}_{36}}{P^i_{36}}) + log(\frac{s_{Fi}M^i_{36}}{P^i_{36}})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P^{Fi}_{36}}{P^{US}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{US}_{36}}{P^{US}_{36}}$	.447	.259	2.141	.092
$\frac{P^{Fi}_{36}}{P^{Jp}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{Jp}_{36}}{P^{Jp}_{36}}$	.815	.397	2.986	.115
$\frac{P^{Fi}_{36}}{P^{De}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{De}_{36}}{P^{De}_{36}}$	1.016	.374	2.382	.124
$\frac{P^{Fi}_{36}}{P^{Ca}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{Ca}_{36}}{P^{Ca}_{36}}$	1.260	.357	2.184	.334
$\frac{P^{Fi}_{36}}{P^{Fr}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{Fr}_{36}}{P^{Fr}_{36}}$	.025	.448	1.291	.142
$\frac{P^{Fi}_{36}}{P^{GB}_{36}}$	1.288	.492	$\frac{s_{Fi}M^{GB}_{36}}{P^{GB}_{36}}$	.705	.253	1.835	.152
$\frac{P^{Fi}_{36}}{P^{It}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{It}_{36}}{P^{It}_{36}}$	1.124	.525	2.711	.132
$\frac{P^{Fi}_{36}}{P^{No}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{No}_{36}}{P^{No}_{36}}$	.405	.161	2.000	.449
$\frac{P^{Fi}_{36}}{P^{Sw}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{Sw}_{36}}{P^{Sw}_{36}}$	.668	.258	2.398	.263
$\frac{P^{Fi}_{36}}{P^{Dn}_{36}}$	-1.154	.157	$\frac{s_{Fi}M^{Dn}_{36}}{P^{Dn}_{36}}$	.721	.243	2.892	.415

System R^2=0.971, LR-test value=18.582 ($\chi^2_{(8)}$)

Figure 14 Net trade of mineral products (ISIC 36), 1000 USD

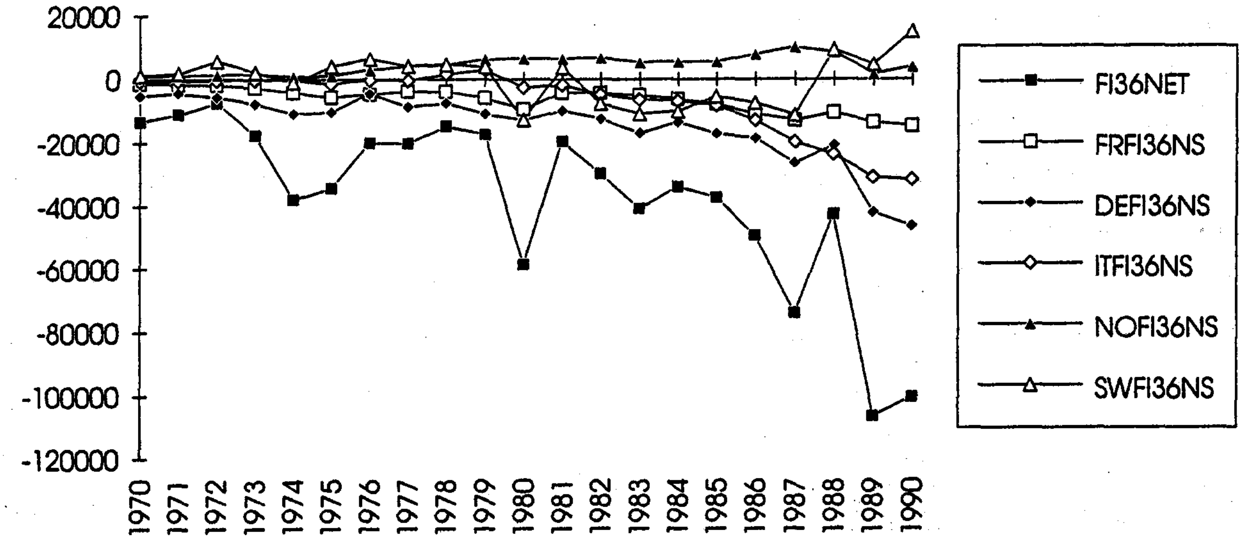
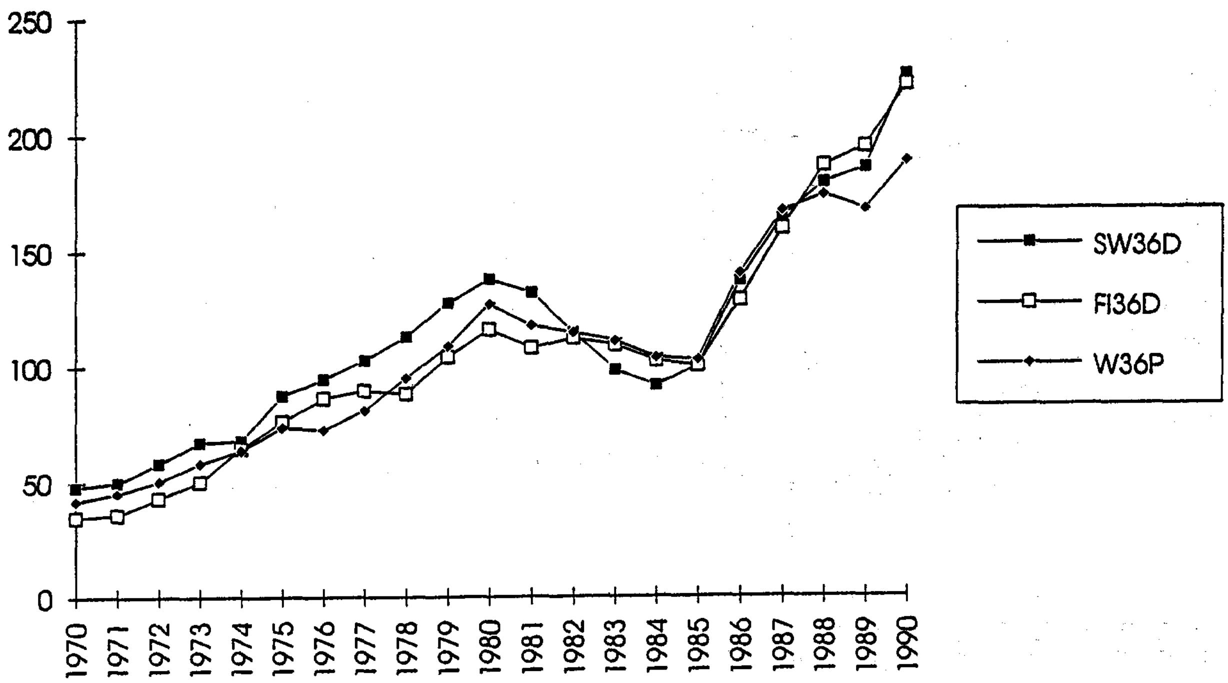


Figure 15 Relative prices in ISIC 36



3.8 Exports of basic metal industries (ISIC 37)

Basic metal industry is a large net exporter. In 1990, its share of total Finnish manufacturing exports was 8.1 per cent. The largest net importers from Finland have been Germany, Great Britain, Italy and the United States. Between 80.4 (1980) to 89.4 (1970) per cent of exports were to the OECD-countries of our sample. Figure 16 plots Finnish net trade, and Figure 17 the Finnish, Swedish and world price indices. Finnish prices were mostly higher than Swedish prices, which in turn were slightly higher or close to the world prices between 1970 and 1990. Table 10 reports the demand functions for exports by Finnish basic metal industry. Equality of price elasticities could be accepted but for Germany and Sweden (the test statistic is significant at five per cent level of significance). The price elasticities are higher than one in absolute value, in all other countries than Sweden. Germany and Sweden, in turn, have both been net importers from Finland, with no apparent irregularities in the pattern of trade.

TABLE 10 Demand in ISIC 37 (SUR)

Model: $X^i_{37} = log(\frac{P^{Fi}_{37}}{P^i_{37}}) + log(\frac{s_{Fi}M^i_{37}}{P^i_{37}})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P^{Fi}_{37}}{P^{US}_{37}}$	-1.3590	.161	$\frac{s_{Fi}M^{US}_{37}}{P^{US}_{37}}$	1.466	.467	2.357	.254
$\frac{P^{Fi}_{37}}{P^{Jp}_{37}}$	-1.359	.161	$\frac{s_{Fi}M^{Jp}_{37}}{P^{Jp}_{37}}$	1.001	.277	2.390	.296
$\frac{P^{Fi}_{37}}{P^{De}_{37}}$	-2.591	.341	$\frac{s_{Fi}M^{De}_{37}}{P^{De}_{37}}$	1.920	.324	3.111	.559
$\frac{P^{Fi}_{37}}{P^{Ca}_{37}}$	-1.359	.161	$\frac{s_{Fi}M^{Ca}_{37}}{P^{Ca}_{37}}$	-.666	.664	1.691	.216
$\frac{P^{Fi}_{37}}{P^{Fr}_{37}}$	-1.3590	.161	$\frac{s_{Fi}M^{Fr}_{37}}{P^{Fr}_{37}}$	1.128	.328	1.861	.559
$\frac{P^{Fi}_{37}}{P^{GB}_{37}}$	-1.359	.161	$\frac{s_{Fi}M^{GB}_{37}}{P^{GB}_{37}}$	.420	.229	2.197	.051
$\frac{P^{Fi}_{37}}{P^{It}_{37}}$	-1.359	.161	$\frac{s_{Fi}M^{It}_{37}}{P^{It}_{37}}$	1.286	.193	2.707	.420
$\frac{P^{Fi}_{37}}{P^{NL}_{37}}$	-1.359	.161	$\frac{s_{Fi}M^{NL}_{37}}{P^{NL}_{37}}$	1.856	.883	1.479	.123
$\frac{P^{Fi}_{37}}{P^{No}_{37}}$	-1.359	.161	$\frac{s_{Fi}M^{No}_{37}}{P^{No}_{37}}$	.451	.188	2.253	.303
$\frac{P^{Fi}_{37}}{P^{Sw}_{37}}$	-.527	.235	$\frac{s_{Fi}M^{Sw}_{37}}{P^{Sw}_{37}}$	.315	.216	2.491	.189
$\frac{P^{Fi}_{37}}{P^{Dn}_{37}}$	-1.3590	.161	$\frac{s_{Fi}M^{Dn}_{37}}{P^{Dn}_{37}}$	.679	.254	1.628	.496

System R^2=0.957, LR-test value=16.216 ($\chi^2_{(8)}$)

Figure 16 Net trade of basic metal products (ISIC 37), 1000 USD

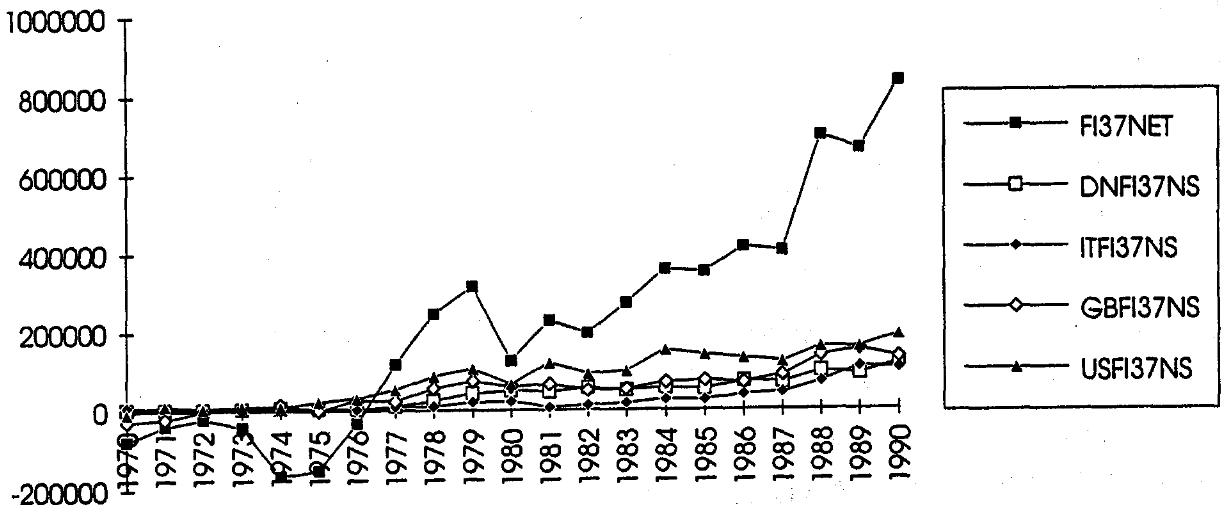
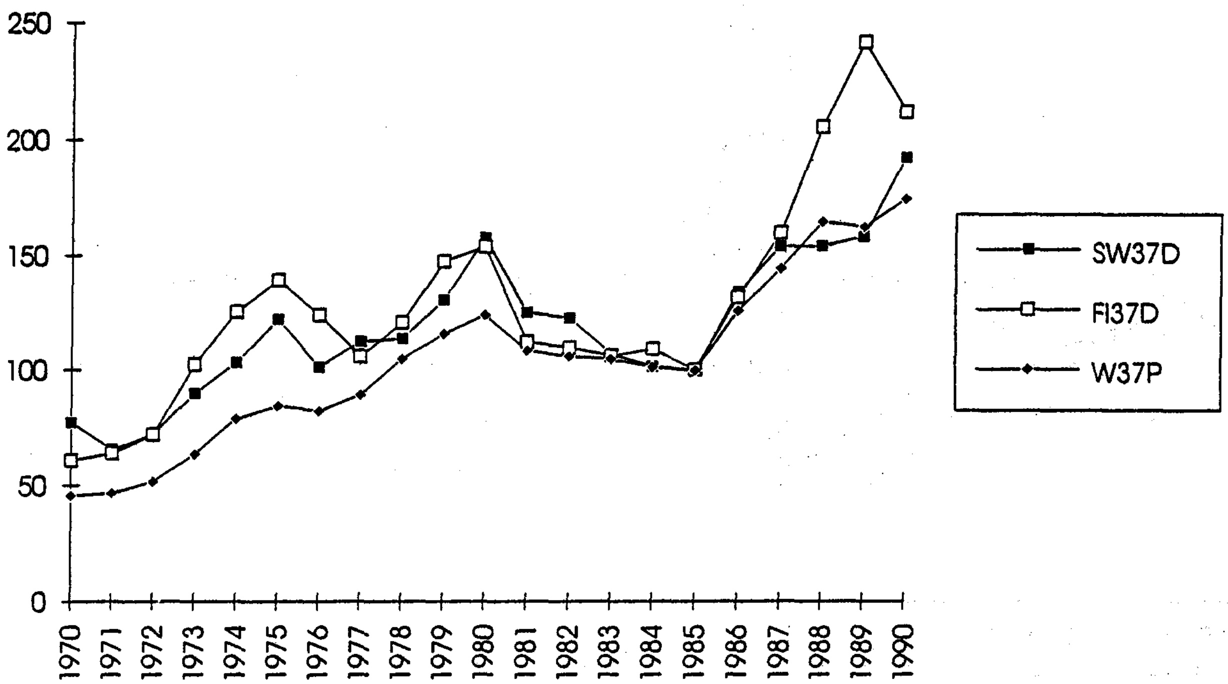


Figure 17 Relative prices in ISIC 37



3.9 Exports of machinery an dequipment (ISIC 38)

Exports of machinery and equipment amounted to 35.6 per cent of total manufacturing exports in 1990. The largest trade partners were Japan, Germany, Great Britain, the United States, and Norway; only the latter was a net importer from Finland, wehereas the others ran a trade surplus in their trade with Finland. Between 45.4 (1980) and 52.5 (1970) per cent of exports of machinery and equipment are covered by our data. The former Soviet Union was a large trade partner in this industry, which may account for the relatively low coverage. Figure 18 plots Finnish net trade, and Figure 19 the Finnish, Swedish and world price indices. Finnish prices were mostly close to world prices until late Eighties, when they rose above them. Swedish prices, in turn, have been slightly higher than the world prices. Norway is the only exception in the demand functions reported in Table 11. Only in Norway is the price elasticity higher than one in absolute value. Thus, Finnish firms appear to have relatively high market power in other markets.

TABLE 11 Demand in ISIC 38 (SUR)

Model: $X^i_{38} = log(\frac{P^{Fi}_{38}}{P^i_{38}}) + log(\frac{s_{Fi}M^i_{38}}{P^i_{38}})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P^{Fi}_{38}}{P^{US}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{US}_{38}}{P^{US}_{38}}$	1.051	.447	2.625	.253
$\frac{P^{Fi}_{38}}{P^{Jp}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{Jp}_{38}}{P^{Jp}_{38}}$	1.530	.324	2.508	.428
$\frac{P^{Fi}_{38}}{P^{De}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{De}_{38}}{P^{De}_{38}}$	.819	.385	2.815	.236
$\frac{P^{Fi}_{38}}{P^{Ca}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{Ca}_{38}}{P^{Ca}_{38}}$	-.131	.620	1.867	.002
$\frac{P^{Fi}_{38}}{P^{Fr}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{Fr}_{38}}{P^{Fr}_{38}}$	-.075	.587	1.595	.0124
$\frac{P^{Fi}_{38}}{P^{GB}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{GB}_{38}}{P^{GB}_{38}}$	1.782	.691	2.501	.179
$\frac{P^{Fi}_{38}}{P^{It}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{It}_{38}}{P^{It}_{38}}$	.818	.399	2.629	.088
$\frac{P^{Fi}_{38}}{P^{No}_{38}}$	-4.783	1.655	$\frac{s_{Fi}M^{No}_{38}}{P^{No}_{38}}$	2.191	.591	3.025	.261
$\frac{P^{Fi}_{38}}{P^{Sw}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{Sw}_{38}}{P^{Sw}_{38}}$	1.020	.110	1.285	.624
$\frac{P^{Fi}_{38}}{P^{Dn}_{38}}$	-.755	.143	$\frac{s_{Fi}M^{Dn}_{38}}{P^{Dn}_{38}}$	1.383	.252	2.159	.457
System R^2=0.983, LR-test value=9.769 ($\chi^2_{(9)}$)							

Figure 18 Net trade of machinery and equipment (ISIC 38), 1000 USD

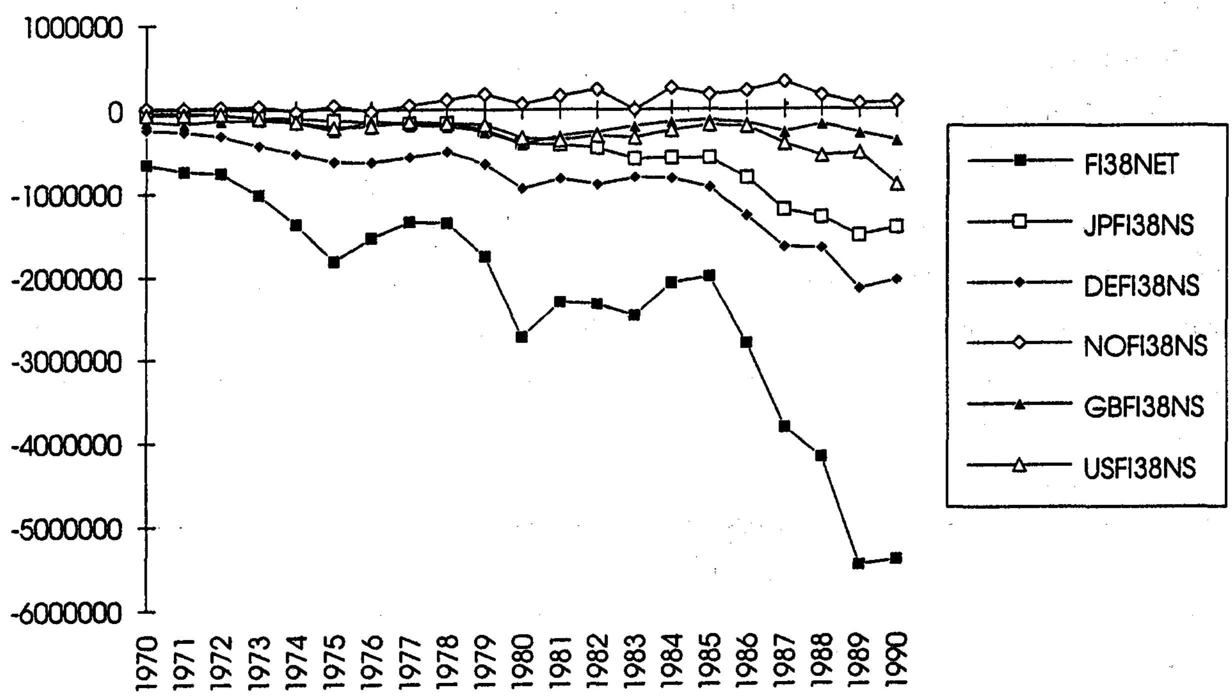
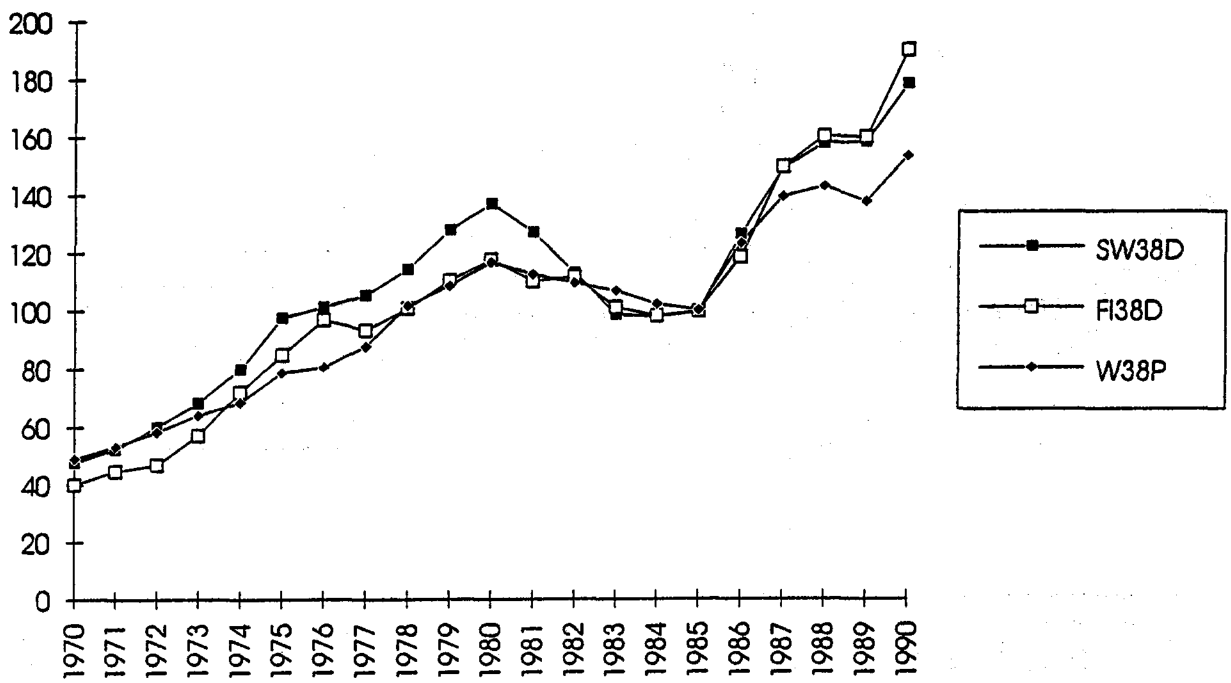


Figure 19 Relative prices in ISIC 38



3.10 Exports by other industries (ISIC 39)

Net trade by other industries turned into deficit in the late eighties. The share of these industries of Finnish exports has been low, between a half and one per cent for all our sample period. Japan, the United States, Italy, Norway, and Sweden were the largest trade partners. Trade with Sweden, Norway and the United States has mostly been in surplus for Finland. Apparently, most of this trade is with Western countries, as our data covers between 85.7 (1980) and 91.8 (1970) per cent of it. Figures 20 and 21 plot Finnish net trade and relative prices. Finnish prices have been mostly close to world prices, whereas Swedish prices have been slightly higher. The demands appear similar (test statistic significant at five per cent level of significance), as can be seen from Table 12.

TABLE 12 Demand in ISIC 39 (SUR)

Model: $X^i_{39} = log(\frac{P^{Fi}_{39}}{P^i_{39}}) + log(\frac{s_{Fi}M^i_{39}}{P^i_{39}})$

Variable	Coefficient	Standard error	Variable	Coefficient	Standard error	DW	R^2
$\frac{P^{Fi}_{39}}{P^{US}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{US}_{39}}{P^{US}_{39}}$	.664	.186	.876	.392
$\frac{P^{Fi}_{39}}{P^{Jp}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{Jp}_{39}}{P^{Jp}_{39}}$	.307	.092	2.770	.326
$\frac{P^{Fi}_{39}}{P^{De}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{De}_{39}}{P^{De}_{39}}$	.412	.136	2.472	.424
$\frac{P^{Fi}_{39}}{P^{Ca}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{Ca}_{39}}{P^{Ca}_{39}}$	-.106	.240	1.290	.019
$\frac{P^{Fi}_{39}}{P^{Fr}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{Fr}_{39}}{P^{Fr}_{39}}$	-.234	.490	2.489	.110
$\frac{P^{Fi}_{39}}{P^{GB}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{GB}_{39}}{P^{GB}_{39}}$	.277	.292	1.685	.160
$\frac{P^{Fi}_{39}}{P^{It}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{It}_{39}}{P^{It}_{39}}$	1.039	.272	2.551	.298
$\frac{P^{Fi}_{39}}{P^{No}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{No}_{39}}{P^{No}_{39}}$	1.146	.206	.989	.547
$\frac{P^{Fi}_{39}}{P^{Sw}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{Sw}_{39}}{P^{Sw}_{39}}$	.995	.127	.900	.526
$\frac{P^{Fi}_{39}}{P^{Dn}_{39}}$	-1.032	.128	$\frac{s_{Fi}M^{Dn}_{39}}{P^{Dn}_{39}}$	.922	.317	2.648	.179

System R^2=0.939, LR-test value=18.391 ($\chi^2_{(9)}$)

Figure 20 Net trade by other industries (ISIC 39), 1000 USD

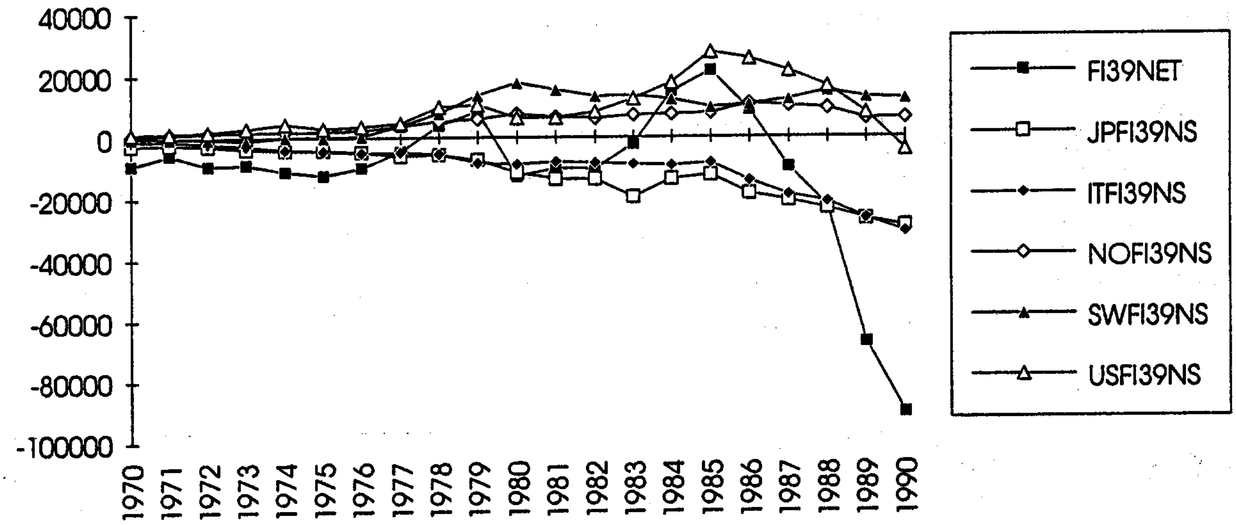
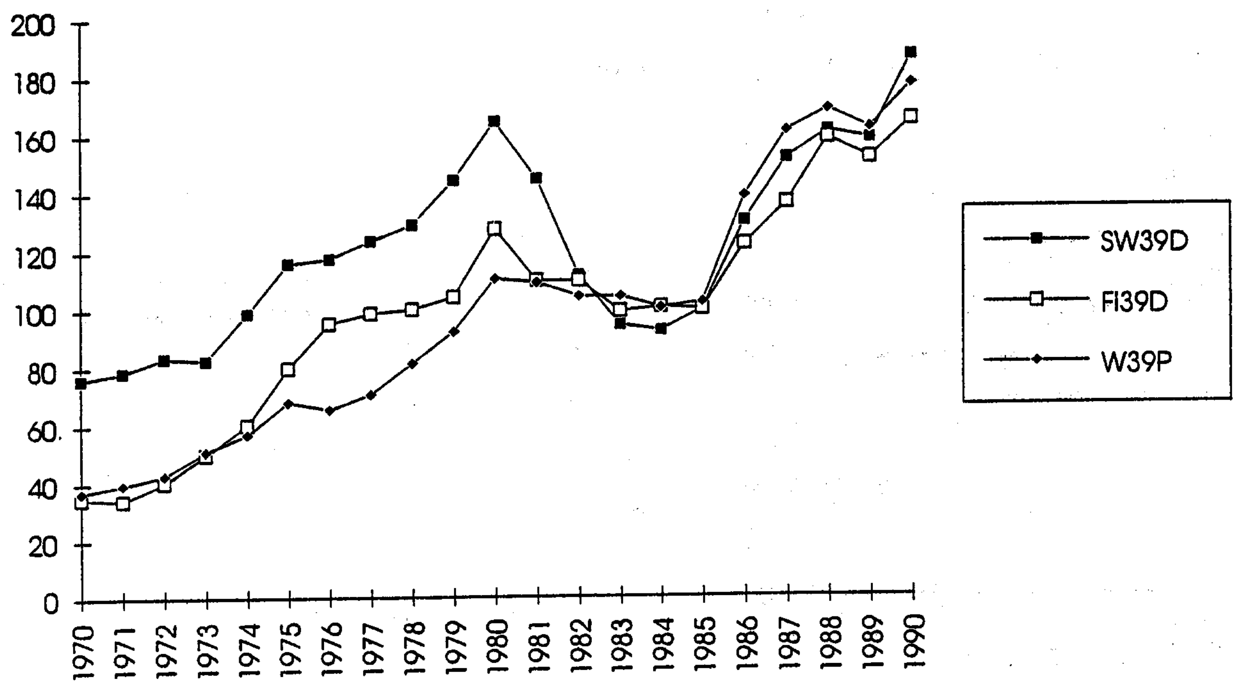


Figure 21 Relative prices in ISIC 39



4 The pricing of Finnish exports

In this chapter, we turn back to the pricing of Finnish exports. As was seen in the previous chapter, the demand for Finnish exports is by and large homogeneous, chemical and basic metal industries being the most notable exceptions. Thus, we consider Finnish export markets as an aggregate.

The solutions to the pricing pricing equations in chapter 2 were seen to depend on the stochastic properties of the exogeneous variables. In this chapter, we present some results on the components of costs and demand in the Finnish manufacturing industries in section 4.1. These allow us to specify structures for the exogeneous variables driving the processes for optimal prices in equation (9) and solve for the pricing functions in section 4.3.

To estimate the pricing models, returns to scale have to be taken into account. Estimates on the degree of returns to scale are presented in section 4.2. The pricing functions are calibrated for both constant and non-constant returns to scale, and in section 4.4, the results on pricing are presented.

Unfortunately, it is not possible to take explicitly into account the effect of domestic demand on pricing; we only have data on Finnish market shares in the world markets. To circumvent the problem, we follow Delgado (1991) by in effect assuming separate production technologies for exports and domestic supply. Thus the effects of demand shares become indistinguishable from the regression constants.

4.1 ARIMA-representations of exogeneous variables

The exogeneous demand, price, and cost variables were each modelled as univariate ARIMA-processes and tested for unit roots. Tables 13a and 13b present the augmented Dickey-Fuller unit root test statistics on the univariate ARIMA-models.[4] If a z-test is reported, the underlying ARIMA-representation is ARIMA(0,1,0), whereas the underlying process is ARIMA(1,1,0) if it is not. Thus, demands and prices can be identified as ARIMA(0,1,0)-processes, with the exception of paper industry, where an ARIMA(1,1,0)-process for world prices fits better. Marginal costs appear to be ARIMA(1,1,0)-processes. The parity of the Finnish markka appeared to follow an AR(1)-process in our yearly sample 1970-1990.

[4] For critical values of the test statistics, see Banerjee, Dolado, Galbraith and Hendry (1993).

Table 13a Dickey-Fuller tests on exogeneous variables

Model: $\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 \Delta y_{t-1}$

Variable	Test $\alpha_1 = 0$ (Z)	$\alpha_1 = 0$ (T)	$\alpha_0 = \alpha_1 = 0$ (F)
p_3^W	-1.216	-1.178	7.1224
p_{31}^W	-1.554	-1.313	6.488
p_{32}^W	-1.051	-0.924	6.036
p_{33}^W	-3.721	-2.308	5.156
p_{34}^W	-	-1.069	4.098
p_{35}^W	-1.016	-0.898	5.6812
p_{36}^W	-1.226	-1.17	6.496
p_{37}^W	-1.573	-1.348	5.879
p_{38}^W	-1.589	-1.616	8.092
p_{39}^W	-1.054	-1.143	7.657
m_3^W	-0.893	-1.663	23.747
m_{31}^W	-0.817	-1.007	9.255
m_{32}^W	-1.128	-1.386	11.9
m_{33}^W	-1.722	-1.877	9.945
m_{34}^W	-0.705	-0.848	9.634
m_{35}^W	-1.191	-1.798	15.356
m_{36}^W	-1.119	-1.593	15.255
m_{37}^W	-1.454	-1.097	4.201
m_{38}^W	-	-1.471	3.583
m_{39}^W	-0.906	-1.089	10.427

Table 13b Dickey-Fuller tests on exogeneous variables

Model: $\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 \Delta y_{t-1}$

Variable	Test $\alpha_1 = 0$ (Z)	$\alpha_1 = 0$ (T)	$\alpha_0 = \alpha_1 = 0$ (F)
w_3^{Fin}	-	-2.766	4.637
w_{31}^{Fin}	-	-2.894	5.071
w_{32}^{Fin}	-	-2.562	3.304
w_{33}^{Fin}	-1.427	-3.131	33.01
w_{34}^{Fin}	-	-2.43	4.189
w_{35}^{Fin}	-	-1.672	2.385
w_{36}^{Fin}	-	-1.75	3.474
w_{37}^{Fin}	-	-2.819	5.261
w_{38}^{Fin}	-	-2.993	5.91
w_{39}^{Fin}	-	-4.563	14.14
$k_3^{Fin} - l_3^{Fin}$	-.573	-2.912	164.17
$k_{31}^{Fin} - l_{31}^{Fin}$	-.433	-1.549	76.549
$k_{32}^{Fin} - l_{32}^{Fin}$	.015	.053	87.694
$k_{33}^{Fin} - l_{33}^{Fin}$	-	-.926	2.741
$k_{34}^{Fin} - l_{34}^{Fin}$	-	-1.616	3.215
$k_{35}^{Fin} - l_{35}^{Fin}$	-	-2.306	5.107
$k_{36}^{Fin} - l_{36}^{Fin}$	-.517	-2.727	164.51
$k_{37}^{Fin} - l_{37}^{Fin}$	-.371	-1.19	57.522
$k_{38}^{Fin} - l_{38}^{Fin}$	-	-2.462	6.599
$k_{39}^{Fin} - l_{39}^{Fin}$	-.601	-1.25	26.2

4.2 Returns to scale

In calibrating the pricing models, estimates for the shares of wage and rental costs were necessary. As Finnish value added is reported at factor cost in practice in the OECD databases, it is easy to get these shares under the assumption of constant returns to scale. However, returns to scale might not be constant in practice. Therefore, a method proposed in Caballero and Lyons (1990), extending Hall (1988), was used to get rough estimates on returns to scale. Caballero and Lyons regress the change in value added on the change of labour and capital inputs, both figures being readily available for Finland.

Four versions of the model were estimated. In the first,

$$
(21) \quad \Delta y_{jt}^{Fin} = \gamma_j \Delta(\alpha_{jt} l_{jt}^{Fin} + (1 - \alpha_{jt}) k_{jt}^{Fin}) \equiv \gamma_j \Delta x_{jt}^{Fin},
$$

where y_{jt} is change in the output of industry j, γ is the estimated returns to scale parameter, α_{jt} is the cost share of wages under the assumption of constant returns to scale, k_{jt} is the logarithm of the capital stock and l_{jt} the logarithm of labour in the respective industry. Hence, x_{jt} can be interpreted as total inputs in industry j. Table 14 reports the estimates, which indicate increasing returns to scale at the aggregate industry level, and for the two-digit industries of textile (ISIC 32), wood products (ISIC 33), cheramic (ISIC 36), and machinery and equipment (ISIC 38).

TABLE 14 Returns to scale (NLS)

Variable	Coefficient γ_j	Standard deviation	t-value	DW	R^2
Δx_3^{Fin}	1.356	0.303	4.480	1.428	.287
Δx_{31}^{Fin}	0.562	0.181	3.113	1.413	.275
Δx_{32}^{Fin}	1.021	0.186	5.493	1.556	.708
Δx_{33}^{Fin}	1.188	0.394	3.017	1.732	.374
Δx_{34}^{Fin}	0.098	0.351	0.279	1.560	.034
Δx_{35}^{Fin}	0.422	0.224	1.886	1.628	.017
Δx_{36}^{Fin}	1.034	0.319	3.236	1.798	.212
Δx_{37}^{Fin}	-0.270	0.376	-0.718	1.142	.181
Δx_{38}^{Fin}	1.717	0.244	7.041	1.711	.578
Δx_{39}^{Fin}	0.722	0.254	2.844	1.617	.272

However, the single-industry estimates on returns to scale are biased upwards, because the estimated coefficients -the γ_js- could in reality be a combination of externalities and returns to scale. In particular, Caballero and Lyons show that externalities cause aggregation bias in a model of the form

$$
(22) \quad \Delta y_{jt}^{Fin} = \gamma_j \Delta x_{jt}^{Fin} + \theta \Delta y_{3t}^{Fin}
$$

$$\Delta y_{3t}^{Fin} = \frac{\gamma_3}{1-\theta}\Delta x_{3t}^{Fin},$$

where θ is the externality, assumed to be equal across industries, and γ_3 is returns to scale at aggregate industry level. The reduced form of model (22) is

$$\text{(23)}\quad \Delta y_j^{Fin} = \gamma_j \Delta(\alpha_{jt} l_{jt}^{Fin} + (1-\alpha_{jt})k_{jt}^{Fin}) + \gamma_3 \Delta(\alpha_{3t} l_{3t}^{Fin} + (1-\alpha_{3t})k_{3t}^{Fin})$$
$$\equiv \gamma_j \Delta x_{jt}^{Fin} + \gamma_3 \Delta x_{3t}^{Fin},$$

where γ_3 is to be interpreted as a combination of returns to scale and externalities. Table 15 below reports the SUR-estimates of the reduced form, showing the externality to be present, positive, and significant, and leading to a reduction of the estimates of returns to scale in disaggregate industries. Remarkably, for textile and machinery (ISIC 32 and 38), returns still appear increasing. Table 16 reports non-linear three-stage least squares estumates (3SLS) of model (22). Externalities are positive and significant, but now there appear increasing returns only in textile industry.

TABLE 15 Returns to scale (SUR)

Variable	Coefficient γ_j	Standard deviation	t-value
Δx_3^{Fin}	0.153	0.21	0.73
Δx_{31}^{Fin}	0.355	0.131	2.717
Δx_{32}^{Fin}	1.429	0.117	12.226
Δx_{33}^{Fin}	0.6	0.243	2.47
Δx_{34}^{Fin}	-0.396	0.142	-2.786
Δx_{35}^{Fin}	0.231	0.08	2.9
Δx_{36}^{Fin}	0.544	0.269	2.021
Δx_{37}^{Fin}	-0.644	0.265	-2.43
Δx_{38}^{Fin}	1.129	0.198	5.714
Δx_{39}^{Fin}	0.499	0.219	2.283
System R^2=0.979, LR-test value=15.3, $(\chi^2_{(9)})$			

TABLE 16 Returns to scale (3SLS)

Variable	Coefficient γ_j	Standard deviation	t-value	DW	R^2
Δy_3^{Fin}	0.177	0.042	4.170	1.370	.287
Δx_{31}^{Fin}	-0.145	0.128	-1.130	2.500	.383
Δx_{32}^{Fin}	1.147	0.074	15.467	1.440	.631
Δx_{33}^{Fin}	0.318	0.182	1.749	1.780	.565
Δx_{34}^{Fin}	-0.181	0.055	-3.287	2.081	.721
Δx_{35}^{Fin}	0.303	0.07	4.359	1.684	.489
Δx_{36}^{Fin}	0.293	0.142	2.068	2.462	.479
Δx_{37}^{Fin}	-0.218	0.198	-1.101	1.148	.266
Δx_{38}^{Fin}	0.711	0.130	5.463	1.443	.535
Δx_{39}^{Fin}	0.414	0.213	1.942	1.806	.171
θ	0.843	0.026	32.222		

As an alternative to models (22) and (23), a combination of the reduced form and the original system was also considered. In this model,

$$(24)\quad \begin{aligned} \Delta y_{jt}^{Fin} &= \gamma_j \Delta x_{jt}^{Fin} + \frac{\theta\gamma_3}{1-\theta}\Delta x_{3t}^{Fin} \\ \Delta y_{3t}^{Fin} &= \frac{\gamma_3}{1-\theta}\Delta x_{3t}^{Fin}, \end{aligned}$$

so that the estimation equation for the aggregate industry in effect imposes restrictions on industry level. Results, presented in table 17 are close to those obtained by SUR.

TABLE 17 Returns to scale (3SLS)

Variable	Coefficient γ_j	Standard deviation	t-value	DW	R^2
Δx_3^{Fin}	0.324	0.084	3.842	1.327	.287
Δx_{31}^{Fin}	0.201	0.115	1.752	1.596	.221
Δx_{32}^{Fin}	1.109	0.057	19.320	1.866	.639
Δx_{33}^{Fin}	0.689	0.166	4.151	1.640	.340
Δx_{34}^{Fin}	-0.227	0.07	-3.248	1.687	.219
Δx_{35}^{Fin}	0.239	0.063	3.813	1.677	.091
Δx_{36}^{Fin}	0.332	0.162	2.050	1.701	.309
Δx_{37}^{Fin}	-0.268	0.223	-1.199	1.310	.085
Δx_{38}^{Fin}	1.010	0.165	6.089	1.491	.523
Δx_{39}^{Fin}	0.476	0.204	2.334	1.501	.139
θ	0.634	0.066	10.546		

In calibrating the pricing models below, we have mostly made use of the (biased) industry level estimates. This makes the pricing functions for food (ISIC 31), cheramic (ISIC 36), and to some extent other industries (ISIC 39), dubious. It can, however, be argued that the very low estimates on returns to scale are only a reflection of extremely low and even negative interest that installed capital has earned in Finland - inefficiency, in other words. As can easily be verified, the single equation estimate on aggregate industries is remarkably close to the coefficients for aggregate industries obtained from any of the models (22), (23), or (24), confirming the point of Caballero and Lyons that disaggregate externalities are internalized at higher levels of aggregation. For aggregate manufacturing, textile and machinery, then, inreasing returns to scale appear plausible by most of the estimates.

4.3 Prices under quadratic costs

Using the ARIMA representations for exogenenous variables, the conditional expectation of the optimal prices can be solved for. Using the result in the pricing function, closed form solutions to the pricing equations are obtained. These lead directly to the following estimation models

$$
\begin{aligned}
(25)\quad \Delta p_{jt} &= b + \frac{1-\rho_1}{1-\rho_1\delta\lambda_{w1}}\frac{\alpha+\beta}{\gamma}\Delta w_t - \frac{1-\rho_1}{1-\rho_1\delta\lambda_{k1}}\frac{\beta}{\gamma}\Delta(k_t - l_t) \\
&+ (1-\rho_1)(\frac{\alpha+\beta}{\gamma}w_{t-1} - \frac{\beta}{\gamma}(k_{t-1} - l_{t-1}) + \frac{1-\alpha-\beta}{\gamma}m_{t-1} \\
&+ (\epsilon - 1)\pi p_{t-1} - p_{jt-1}),
\end{aligned}
$$

or, second-differencing,

$$
\begin{aligned}
(26)\quad \Delta^2 p_{jt} &= b + \frac{1-\rho_1}{1-\rho_1\delta w_1}\frac{\alpha+\beta}{\gamma}\Delta^2 w_t - \frac{1-\rho_1}{1-\rho_1\delta k_1}\frac{\beta}{\gamma}\Delta^2(k_t - l_t) \\
&+ (1-\rho_1)(\frac{\alpha+\beta}{\gamma}\Delta w_{t-1} - \frac{\beta}{\gamma}\Delta(k_{t-1} - l_{t-1}) - \Delta p_{jt-1}).
\end{aligned}
$$

These error-correction models are to be estimated simultaneously with the ARIMA-models for exogeneous variables. On the basis of section 4.1, these are given by

$$
\begin{aligned}
(27)\quad \Delta m_t &= \lambda_{y0} \\
(28)\quad \Delta p_t &= \lambda_{p0} \\
(29)\quad \Delta w_t &= \lambda_{w0} + \lambda_{w1}\Delta w_{t-1} \\
(30)\quad \Delta(k_t - l_t) &= \lambda_{k0} + \lambda_{k1}\Delta(k_{t-1} - l_{t-1}).
\end{aligned}
$$

It is assumed that marginal cost is stable, so that $\lambda_{w1} = \lambda_{k1}$.

The coefficients ρ have the interpretation of being the degree of rigidity of prices, whereas $\lambda_{w1} = \lambda_{k1}$ are the degrees of persistence of cost shocks.

In table 18 below, we have followed Alogoskoufis et al. (1990) and assumed constant returns to scale. As can easily be seen by using this assumption in equation (19), relative prices and aggregate demand then become irrelevant. The figures can be compared to those reported by Alogoskoufis et al. (1990). Our estimates for aggregate Finnish manufacturing are close to their $\rho = 0.7$, and $\lambda_{w1} = 0.79$. Our results are by and large in line with these estimates.

TABLE 18 Pricing under constant returns to scale

Dependent variable	Coefficient ρ	Coefficient λ_{w0}	Coefficient λ_{w1}	Coefficient α	DW	R^2
Δp^{3}_{Ft}	0.734	0.037	0.565	0.62	.976	.579
	(0.091)	(0.018)	(0.125)			
Δp^{31}_{Ft}	0.752	0.05	0.406	0.59	1.310	.536
	(0.09)	(0.018)	(0.138)			
Δp^{32}_{Ft}	0.904	0.04	0.569	0.7	0.894	.287
	(0.043)	(0.02)	(0.117)			
Δp^{33}_{Ft}	0.619	0.066	0.409	0.77	1.778	.707
	(0.113)	(0.023)	(0.136)			
Δp^{34}_{Ft}	0.712	0.025	0.677	0.57	1.357	.486
	(0.108)	(0.018)	(0.131)			
Δp^{35}_{Ft}	0.797	0.028	0.529	0.46	1.420	.326
	(0.100)	(0.014)	(0.127)			
Δp^{36}_{Ft}	0.836	0.046	0.483	0.59	1.217	.420
	(0.062)	(0.018)	(0.128)			
Δp^{37}_{Ft}	0.781	0.06	0.424	0.68	1.126	.045
	(0.214)	(0.021)	(0.146)			
Δp^{38}_{Ft}	0.563	0.048	0.540	0.67	1.002	.595
	(0.19)	(0.02)	(0.190)			
Δp^{39}_{Ft}	0.79	0.059	0.268	0.56	1.652	.518
	(0.065)	(0.019)	(0.142)			

Alogoskoufis et al. allow for the effect of relative prices by assuming specialized production. To us, this is not a very happy solution, for the reason that specialized production may not be a good model for trade between industrialized countries.[5] In the current study, we therefore maintain the assumption of intraindustry trade but allow for non-constant returns to scale. Using the results of section 4.2, we calibrate the pricing models for non-constant returns and estimate the persistence co-efficients. As a consequence, an estimate of the price elasticity of demand has to be calculated as well. This may be better than the ones reported in chapter 3, because here, pricing and demand are in effect simultaneously determined. Finally, when demand and relative prices matter, the pricing currency may also.

Results of pricing in both markka (M) and dollar (D) are reported in Table 19. Pricing in markkas is both more rigid and cost shocks more persistent than in dollars. This is a reflection of the fact that exchange rate changes protect firms from demand shocks to some extent; therefore, if pricing is in the domestic currency, it does not have to adjust as often as it would, were it in dollars. In domestic terms, openness then increases price rigidity, as argued in Honkatukia (1992). Rigidity implies sensitivity to business cycles, in turn, but here, a reservation has to

[5] In Alogoskoufis et al, optimal prices are then given by $p^o_j = \tau e p^*_{2T} + (1-\tau) w_t$, where τ is the share of tradeables, e is the exchange rate, and w the marginal cost. When $\tau = 0$, the model is close to ours'; however, Alogoskoufis et al report much lower persistence for aggregate industry than our results here. Specifically, $\rho = 0.67$, $w_1 = 0.29$. The difference could be due to their using $\alpha = 0.67$ for calibration of the model.

be made. Under the assumption of quadratic pricing costs, prices are not adjusted fully, but, subject to the costs, they are still adjusted optimally. Thus, even though openness induces rigidity it does not necessarily mean that openness increases welfare losses from cyclicality, because the real costs from rigidity to the firm are not changed by openness. However, as there are externalities present, the effects of increased rigidity may spread to more closed sectors.

The last column of table 19 reports estimates of the mark-up coefficients calculated on the basis of equation (8), and the returns to scale and price elasticity estimates of table 19. Under price rigidity and non-constant returns to scale, the ratios of prices to marginal costs vary, but the mark-up coefficients do not under our assumption of Chamberlinian competition. Therefore, the coefficients may give an approximate view of the competitiveness of the industries. Accordingly, ISIC 38 would appear the least competitive of Finnish exporting industries, while textile and food industries, ISIC 31 and 32, respectively, appear close to being perfectly competitive.

TABLE 19 Pricing under quadratic costs and non-constant returns

Dependent variable	ρ	λ_{w1}	ϵ	α	β	Mark-up	DW	R^2
Δp^{3}_{FD}	1.27	0.69	11.06	0.5	0.86	1.117	1.25	.624
	(.124)	(.083)	(5.08)	(NLS)	(NLS)			
Δp^{3}_{FM}	0.965	0.876	2.21			2.04	1.02	.115
	(.053)	(.068)	(1.876)					
Δp^{31}_{FD}	0.788	0.359	33.019	0.33	0.23	1.023	1.39	.138
	(.113)	(.093)	(22.571)	(NLS)	(NLS)			
$\Delta^2 p^{31}_{FM}$	0.288	0.28	24.753			1.031	1.892	.335
	(.201)	(.220)	(239.05)					
$\Delta^2 p^{32}_{FD}$	0.856	0.849	42.038	0.74	0.28	1.025	1.87	.636
	(.095)	(.092)	(5.697)	(NLS)	(NLS)			
Δp^{33}_{FD}	1.071	.848	9.0	0.84	0.35	1.137	1.921	.762
	(.092)	(.070)	(3.376)	(NLS)	(NLS)			
Δp^{34}_{FD}	0.449	0.484	5.476	0.06	0.04	1.051	1.234	.333
	(.192)	(.091)	(4.092)	(NLS)	(NLS)			
Δp^{34}_{FD}	0.595	0.483	36.734			1.007	1.289	.289
	(.157)	(.110)	(14.355)					
Δp^{34}_{FM}	1.021	0.673	1.556			1.249	1.91	.892
	(.048)	(.086)	(6.75)					
Δp^{35}_{FD}	0.596	0.486	51.024	0.2	0.23	1.012	1.397	.263
	(.147)	(.077)	(23.013)	(NLS)	(NLS)			
$\Delta^2 p^{35}_{FM}$	0.348	0.627	1.271			1.029	1.594	.306
	(.220)	(.185)	(2.865)					
$\Delta^2 p^{36}_{FD}$	0.042	0.408	6.803	0.62	0.41	1.175	1.460	.710
	(.173)	(.154)	(3.293)	(NLS)	(NLS)			
$\Delta^2 p^{36}_{FM}$	0.418	0.465	3.066			1.493	1.840	.349
	(.065)	(.065)	(26.67)					
Δp^{38}_{FD}	0.392	0.465	3.126	0.8	0.33	1.509	1.140	.666
	(.017)	(.086)	(.966)	(SUR)	(SUR)			
Δp^{38}_{FM}	0.87	0.736	5.193			1.256	1.116	.084
	(.083)	(.079)	(1.235)					
Δp^{39}_{FD}	0.806	0.199	32.624	0.47	0.25	1.027	1.343	.098
	(.115)	(.105)	(21.289)	(NLS)	(NLS)			
$\Delta^2 p^{39}_{FM}$	0.964	0.264	14.968			1.06	1.361	.012
	(.047)	(.112)	(60.334)					

It is of interest to compare the results on competitiveness to two other Finnish studies. Alho (1993) reports a mark-up for the Finnish exports of 1.16. This is relatively close to our estimate for aggregate manufacturing exports (ISIC 3)of 1.117, when pricing is in USD. Alho reports a much higher mark-ups for pricing to domestic markets, suggesting that trade barriers have lead Finnish firms to price discriminate. Vaittinen (1994), in turn, follows Hall (1988) in calculating industry-level mark-ups, considering aggregate Finnish production, thus including domestic demand. For example, he reports a mark-up of 1.21 for food industry (ISIC 31), which is much higher than our estimates of 1.023 and 1.031 for exports of food; for textile industry

(ISIC 32) of 1, compared to our 1.025; for chemical industry (ISIC 35) of 1.44, much higher than our 1.012 or 1.029. All these sectors appear to depend on domestic markets, so that our low estimates on mark-ups for export pricing appear to corroborate the suggestion of Alho. For comparison, for the large, open industries of ISIC 341 (paper and pulp) Vaittinen reports a mark-up of 1.24 which is very close to our 1.249 for the whole of paper industry (ISIC 34); for electrical equipment (ISIC 383-5), he reports 1.34, close to our 1.256 for the whole of machinery and equipment (ISIC 38). We take this as evidence in favour of the hypothesis of pricing to market. On the whole, the market power of Finnish firms in foreign markets does not appear great, with the exception of paper industry and machinery and equipment. Then again, these industries accounted for 67.4 per cent of Finnish exports in 1990.

The persistence of both prices and costs appears great in the face of the estimates in table 19. Combined with the low mark-ups and high price-elasticities, pointing to high elasticities of substitution between Finnish and rivalling goods, this seems to suggest that some of the industries could be relatively helpless in the face of cost and demand shocks in the export markets. On the basis of the results of Alho and Vaittinen it could then be argued that the domestic markets have enabled them to survive. On the other hand, where mark-ups are high and price-elasticities low, exogeneous shocks have smaller effects in the short run. On this account, machinery and equipment industry fares best, paper industry less so.

5 Conclusion

We have studied the demand and pricing of Finnish manufacturing exports. We used ARIMA-representations of the exogeneous price, demand, and cost variables to obtain closed form solution to the pricing equations. Pricing equations were calibrated for constant returns by using cost shares for capital and labour, obtained from national accounts. However, under constant returns relative prices and aggregate demand do not affect pricing. This is counter-factual on the face of the evidence presented in previous studies. In particular, Alogoskoufis et al (1990) and Andersen and Hansen (1994) argue in favour of the specialized production model, where relative prices are an important determinant of domestic export prices. Rather than assume specialized production, which in other respects may not be a good description of intraindustry trade, we allowed for non-constant returns to scale. Under this assumption, relative prices and demand are important determinants of pricing even in the basic model of intraindustry trade. The pricing equations were calibrated for non-constant returns using returns to scale estimates obtained in the manner of Caballero and Lyons (1990). The results on returns to scale indicate that in total manufacturing industries, textile industries, and in the production of machinery and equipment, there appear to be increasing returns to scale, as nearly all of the variants of the model suggest this. Furthermore, there appears to be large externalities in the Finnish manufacturing industries.

Our estimates on total manufacturing show no differences between various trade partners; the demand for Finnish manufacturing products is homogeneous in the country's western trade partners. This is a strong case for the basic, Armingtonian model of intraindustry trade. The pricing equations showed price persistence coefficients between 0.734 (constant returns) to 0.965 (non-constant returns), and cost persistence coefficients between 0.565 (constant returns) and 0.876 (non-constant returns), while the mark-ups under non-constant returns varied from 1.117 to 2.04. Pricing in Finnish marks appears more rigid than in dollars (but also unstable). As for the two largest exporting industries, we found evidence of differences in demand for paper in France and for the demand of machinery in Norway. For France, institutional reasons seem a plausible explanation; for Norway, the case is not clear. For paper indutry, price persistence coefficients varied from 0.595 (non-constant returns) to 0.871 (constant returns), and cost persistence coefficients between 0.483 (non-constant returns) and 0.677 (constant returns), while the mark-ups under non-constant returns varied from 1.007 to 1.249. Pricing in Finnish marks appears more rigid than in dollars. For machinery and equipment, price persistence coefficients between 0.392 (non-constant returns) to 0.891 (constant returns) were obtained, while cost persistence coefficients lied between 0.465 (non-constant returns, pricing in dollars) and 0.736 (non-constant returns, pricing in markkas); the mark-ups varied from 1.256 to 1.509.

For the other industries, we also found evidence of strong persistence of costs and prices. The mark-ups we found are remarkable low, and price elasticities very high. It is of some interest that our estimates on export pricing give much smaller mark-ups than the estimates of Vaittinen (1994) and Alho (1993) for domestic demand. We take these results to suggest that Finnish firms are vulnerable to demand, price, and cost shocks in these industries. We also note that the presence of externalities enforces the effect of demand shocks, spreading shocks from one industry to another.

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A The ISIC classification

TABLE 20 ISIC classification

ISIC 3	Total manufacturing
ISIC 31	Food, beverages and tobacco
ISIC 32	Textiles, apparel and leather
ISIC 33	Wood products and furniture
ISIC 34	Paper, paper products and printing
ISIC 35	Chemical products
ISIC 36	Non-metallic mineral products
ISIC 37	Basic metal industries
ISIC 38	Fabricated metal products
ISIC 39	Other manufacturing