Exchange Rate Sensitivity of Swedish Regions

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ABSTRACT

This paper studies how Swedish manufacturing export to six trade areas (EMU-countries, West European non-EMU countries, rest of Europe, North America, South East Asia, Japan) was affected by the exchange rates during the 90s. The exchange rates of the trade areas are weighted, based on the shares of the individual countries' trade with Sweden. The individual countries' GDP determine demand of manufactured products. The Swedish regions' share of manufacturing industry and branch composition determines their sensitivity to exchange rates. The share of export to each of the trade areas governs the sensitivity to changes in the exchange rates to this particular area. A conclusion is that changes in international demand influence Swedish exports to a higher degree than changes in exchange rates do. The regions which stand out in this study as most exchange-rate sensitive seem to be characterised in the main by the following features:

- They are small and the industry has a considerably higher employment share than the national average. They are dominated by one or two firms, or in one case, by networking small firms in some dominant sectors.
- The leading industrial firms in these markets are in most cases active in mature and/or price-competitive sectors, in which economies of scale in the form of large plants or geographical concentration have a great influence on competitiveness.
- The regions in question are dominated primarily by labour-intensive and secondarily by capital-intensive industries – a circumstance which further underlines the element of mature and/or price-competitive sectors.

1. Introduction

This paper throws light on how Sweden's *exports* at sector level have been influenced by demand, exchange-rate and price changes in the period 1993-98. Exports became an increasingly important component of the Swedish economy during the 1990s. Their proportion of GDP increased from 34% in 1993 to 48 % in 1998 (measured as a proportion of GDP at fixed prices)[1]. The study thus highlights the fact that Swedish production and employment have become more and more dependent on the outside world.

The concentration of the study on the export trade means that it only shows one side of the coin. We shall not reach any conclusions as to how the exchange rate affects import restrictions on various sectors of the domestic market. Thus the study is precluded from considering the effect of imports on Swedish production and employment when Swedish firms are competing with firms located outside the national frontiers.

There are gaps in the Swedish regional statistics which mean that the regional consequences of macroeconomic disturbances cannot be discerned directly. To be able to deal with regional effects of changes in the outside world, therefore, it is necessary for the study to focus on the sectoral trade with the outside world. For this reason we have opted not to concentrate on trade in goods and services, which is the recording method chosen by Statistics Sweden (SCB). Instead we examine how exports have developed for different sectors of *manufacturing industry*. This trade is conducted by sectors of manufacturing industry which comprised 20.2% of total Swedish employment and 83% of total exports in 1995.

The main questions considered in the study are:

❑ How are the export prices of the various sectors of manufacturing industry influenced by exchange-rate movements and demand in the outside world?

❑ How sensitive is the export volume of these sectors to price changes and international demand?

❑ Which regions show, by their sectoral structure, the highest sensitivity to exchange-rate movements?

The overall aim of the study is to analyse the exports of various goods-producing sectors on the basis of price, exchange-rate and demand changes. By doing this the study may help to shed light on the regional imbalances which can arise because of changes in these macroeconomic variables.

This is interesting for several reasons. Certain sectors are more dependent on price changes than others. A price reduction in one industry may trigger a large increase in export volume, while in another sector it may have no effect at all. Moreover, a weak krona may enable exporters in one sector to raise prices, while in another sector it fails to bring any change of price.

Secondly, exchange-rate fluctuations are not uniform *vis-à-vis* all countries. A weakening of the krona against the US dollar can happen at the same time as the krona is strengthening against the pound sterling. For this reason it is essential to take account of changes in numerous currencies.

Thirdly, specific sectors concentrate their exports on certain countries. Some sectors have their chief export market in countries against which the krona has weakened during recent years while other sectors have the lion's share of their trade with countries against which the krona has strengthened. Therefore it is to be expected that exports from different sectors may be differently affected by exchange-rate movements.

Finally, a fourth reason for studying the influence of the exchange rate on exports is Sweden's possible entry into the EMU. Membership of the EMU, or a switch to fixed exchange rates via ERM2, would mean that exports would no longer be affected by currency fluctuations *vis-à-vis* countries in the EMU. By studying how different sectors are affected by exchange-rate movements *vis-à-vis* these countries, we can form an idea of which industries will be faced with the biggest and smallest readjustments respectively if (or when) Sweden decides to change its exchange-rate system.

This report discusses the influence of a few macroeconomic variables on the exports of Swedish manufacturing industry. In Section 2 a brief outline is given of the state of research with regard to exchange rates, the EMU and trade. Section 3 provides an overview of the way the empirical study is arranged. The study's content, limits and method are defined in an introduction which considers the effect of various factors on foreign trade. Section 4 presents the results of the empirical study at sector level. Section 5 shows the regional outcomes and summarises.

2. State of research

Basic macroeconomic theory teaches that for a small open economy such as Sweden's, the volume of exports is largely governed by what happens abroad. Demand for Swedish products is chiefly determined by two factors: income levels in, and price levels *vis-à-vis*, the outside world. Relative prices are affected by changes in three factors: domestic production costs, foreign costs and the exchange rate.

The uncertainty created by exchange-rate fluctuations may be reduced in the short run by hedging. In the longer run firms can reduce uncertainty by means of loans. The problem confronting firms operating on the international market is that trade transactions frequently involve a number of currencies. For larger firms this is a minor problem because they often have resources for managing their risks and currency flows. It is harder for smaller firms which cannot afford to employ staff for this kind of business.[2]

The high degree of volatility and uncertainty which characterises exchange-rate movements has caused their influence on trade to be noticed more and more. The studies which discuss the subject do not show clear results, however. On the one hand a number of studies have shown that exchange-rate fluctuations will entail costs for risk-averse actors, who will therefore prefer trade within the national frontiers rather than foreign trade. The reason is that traders face an exchange-rate risk which increases if currency hedging is impossible or expensive. The fluctuations in exchange rates will then reduce the expected profit of the trade (Akhtar and Hilton 1984). Chowdbury (1993) shows how the total export volume of the G7 countries was influenced by foreign demand, relative prices and exchange-rate volatility during the period 1973-1990. His results suggest that currency fluctuations have a significant negative impact on export volumes in all countries. The conclusion he draws is that if market actors are risk-averse, exchange-rate uncertainty will cause them to reduce foreign trade and change prices or the direction of trade flows so as to minimise exposure to exchange rates. On the other hand studies by Giovannini (1988) and others show that trade becomes more profitable when exchange rate fluctuations increase. Trade is then regarded not as a threat but as an opportunity for enterprise. Just as with stocks and shares, the value of trade can be enhanced by the fluctuations.

The Swedish EMU Report (*EMU-utredningen*) of 1996 makes reference to a large number of empirical studies bearing upon the correlation between currency fluctuations and the volume of aggregate foreign trade. The conclusion drawn by the Report is that foreign trade is influenced little or not at all by changes in exchange rates. This conclusion is regarded as fairly safe, partly because the various studies use different measures of currency uncertainty and partly because many countries or groups of countries, different periods and exchange-rate systems have been incorporated in the studies. However, the Report does point out that studies touching on the question of a switch from floating or fixed currencies to a monetary union are lacking. It is possible that such a switch would precipitate a pattern of events different from those indicated by earlier studies.

Marcusson (1997) has studied the sensitivity to changes in a range of macroeconomic variables displayed by employment in manufacturing industry in the three Swedish metropolitan areas during the period 1968-1992. He shows that international and domestic demand was of great importance to employment in manufacturing industry in Stockholm, Gothenburg and Malmö. Unexpected exchange- and interest-rate changes had little or no effect on employment in the three regions. The failure of shock interest rates to affect employment may be explained by the fact that during the period under scrutiny, Sweden had a fixed exchange rate, which resulted in the effect of monetary policy on the domestic economy being weak.

Hervey & Strauss (1998) show in a study that exchange-rate movements do not affect all American regions alike. An appreciation of the dollar against the Deutschmark during the period 1970-1996, for example, had a greater effect on the eastern than on the western United States. The reason for this was that the western United States conducted trade largely with Mexico, Japan and Canada whereas the eastern side's trade was orientated more towards Europe. In this way a general depreciation of the dollar could signify in reality an appreciation in a particular region because the latter's structure of trade and exposure to currency differed from the trade orientation of the United States in total.

2.1. Exposure to exchange rates

A firm's exposure to exchange rate risks can be measured through its "economic exposure", as it is called, which is the total effect of exchange rates on the firm's economic value. This measure is usually estimated by seeing how the firm's share value is affected by changes in exchange rates. Estimates made by Friberg & Vredin (1996) for the period 1980-1996 show that a depreciation of the krona by one per cent raised the total Swedish stock market value by 0.4%. But there were differences between the various currencies. A depreciation against the Finnish mark or the US dollar gave large increases of stock market value, whereas depreciations against the pound sterling and the German mark lowered the stock market value. The conclusion drawn by the authors is that Swedish firms' exchange-rate exposure is not determined solely by the krona's fluctuations against the Deutschmark and other EMU countries' currencies. The Swedish krona's movements *vis-à-vis* the US dollar can be at least equally important.

2.2. Exchange rates and pricing

It is well known empirically that relative prices between countries are more volatile when nominal exchange rates are more flexible. Consumer price indices are more stable than nominal exchange rates in the short run, which brings the consequence that, to a large extent, short-term fluctuations in real exchange rates (relative consumer prices expressed in the same currency) reflect the fluctuations of the nominal exchange rates. If Swedish exporting and importing firms encounter prices which are exogenously determined in foreign currency on the world market, they cannot change their prices when the exchange rate fluctuates. If the costs are fixed in the short run, therefore, exchange-rate movements will have considerable effects on firms' profitability.

The linkage between exchange-rate movements and prices of goods, i.e. "pass-through", is by definition the degree by which changes in exchange rates affect pricing in foreign currencies. Studies in this field were formerly focused mainly on countries' total exports, but during the latter years of the

1980s, individual sectors became interesting objects of research. For example, Dornbusch (1987) discovered that there were significant dissimilarities in the effects of exchange-rate changes on different sectors. If such is still the case, studies at the aggregated level ought to be treated with caution, since they represent an average of many different sectors. Nor is there any natural reason why costs, demand and competition should be the same in all sectors.

The question in which currency an exporter chooses to set his price is important. If a Swedish exporter opts to set his price in foreign currency he will find that the quantity sold will be stable while the revenue in kronor will vary according to the exchange rate. If he sets the price in Swedish kronor instead, the quantity sold will vary according to the exchange rate while the price in kronor is stable. In both cases the total sales revenue will vary in step with exchange rates. This uncertainty *may* have a discouraging effect on foreign trade.

In a study of Australian sectors, Menon (1992) shows that exchange-rate movements influence prices, but that the effects differ between industries. The study also shows that there are clear correlations with pricing and ownership. If the firm is foreign-owned, prices of goods in foreign currency change to a higher degree when exchange rates change. Thus the variations in profits become smaller over time. But if the firm is Australian-based, the pricing abroad does not alter when exchange rates change. The result is that to a large extent the profit margins for home-based firms covary when exchange rates change.

2.3. Price discrimination

The conventional assumption with regard to exporters in small open economies is that they are "price-takers", as they are called. This means that they encounter an exogenously-determined export price in foreign currency and that there is complete and immediate "pass-through" from both exchange rates and world market prices to their own prices in the home currency. It is also well known that exporters from big countries are able to avail themselves of price discrimination. Empirical studies show that they set different prices in different markets, and that the relative export prices between different markets are influenced by nominal exchange rates (Adolfson 1999). According to a study by Alexius & Vredin (1996), however, this also applies to Swedish exporters. They believe that different prices on different markets result not from price discrimination alone but from price rigidities on the local markets as well.

One conclusion which Friberg & Vredin (1996) draw concerning price and exchange-rate data is that nominal exchange-rate movements are related to changes in the relative prices of exports. It is regarded as a sign that Swedish firms can set different prices in different markets, which implies that the hypothesis of Sweden as a small open economy can be called into question.

Gottfries (1991) shows that after the devaluations of 1981 and 1982 (which gave competitive advantages internationally), Swedish exporters did not increase their market shares. They chose to raise prices and increase their profit margins instead. With the krona floating, as has been the case since 1992, this behaviour ought not to be as widespread in Gottfries´ view. The reason is that changes in a floating exchange rate cannot be expected to be as permanent as adjustments of a fixed rate. As a result of this, individual pricing in specific markets ought to have diminished since 1992. Another consequence is that it can also be hard to determine how the EMU will affect the currency exposure of Swedish firms.

What explains pricing in a specific market, i.e. what conditions determine price discrimination and its extent? Earlier studies have drawn attention to the significance of *market structure*. The extent of individual pricing in different markets has been related for example to the size of market shares and the determination to retain them. Because of tardy adaptation to demand, present prices will affect the future customer-base and future profits, which supports the supposition that it may be worthwhile to have stable short-term prices and secure market shares. Market conditions in the country of destination appear to be important factors in export and import pricing. Even in small open economies, export producers seem to have a degree of market power and opportunities of influencing prices (Adolfson 1999). Sibert (1992) shows that there are markets in which the foreign price is not adjusted in step with exchange-rate movements. How large an impact exchange rates have on prices depends in her view on the number of home and foreign firms (market concentration) and the competition.

The majority of empirical analyses of the subject have assumed that exchange-rate changes are exogenous. Kongsted (1998) studies Danish manufacturing industry between 1971 and 1991. The study shows that Danish export firms act differently in the short and the long term. In the short term firms sell at various prices (in the exporter's currency) depending on which country they are exporting to. In doing so, prices are not adjusted in step with exchange-rate movements. In the longer term prices are set on the basis of a constant mark-up on costs.

2.4. Further factors affected by the exchange rate

The point also ought to be made that the nominal exchange rate does not affect only pricing. Changes in the value of the krona also influence labour costs, costs of input goods (which are often imported) and interest rates. One example which may be cited is that Swedish firms' relative labour costs fell by roughly 25% during the devaluation period 1981-83 (Friberg and Vredin 1996).

Exchange rate changes are not the only source of uncertainty for firms and perhaps not even the most important one. In spite of this, analyses of pricing in different markets and "exchange rate

pass-through" are often based solely on them. In Friberg & Vredin's (1996) opinion, however, it is not against all reason to do so within the framework of a static analysis for short periods of time. But the longer the periods are, the greater becomes the significance of fundamental variables.

2.5. Effect of exchange rate on exports

The primary reason for analysing the value of the currency is that changes in exchange rates between countries are not uniform in magnitude and direction. During the period measured in the study (1993-1998), the krona depreciated at times against the US dollar, the German mark, the pound sterling and quite a number of other European currencies. But – and this is worth noticing – the krona did *not* depreciate against all currencies. In point of fact the krona strengthened against the majority of Asian currencies (markets which account for ten per cent of Sweden's foreign trade). For this reason it is essential to take heed of changes among several currencies. (See e.g. Figure 2.1, which shows the Swedish krona's divergent movements in terms of the German mark, the pound sterling, the US dollar and the Norwegian krona during the period 1993-1998.)

Figure 2.1 Index of selected exchange rates.
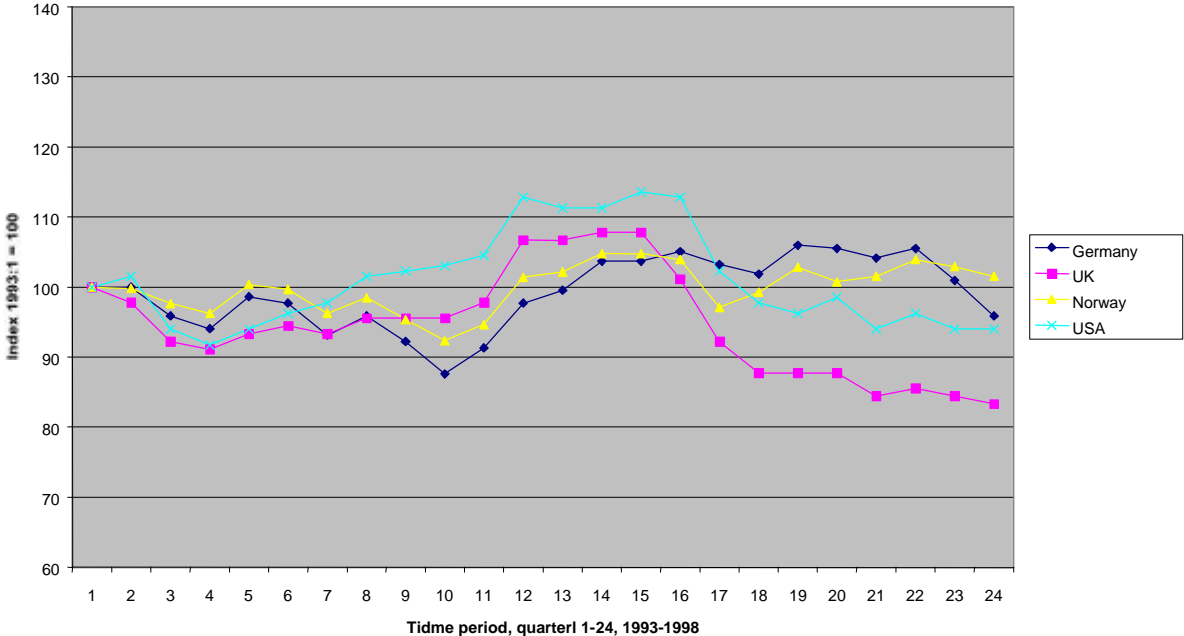
Source: Own figures based on data from Oanda (www.oanda.com/converter/cc_table 1999-01-04—1999-03-02).

Moreover, regions in Sweden trade with different foreign markets. These trade flows in turn result from regional dissimilarities of industrial structure and industry's dependence on other countries. One consequence of this is that specific regions and sectors have a tendency to concentrate their

foreign trade on certain countries. Thus, because changes of exchange rate are not uniform between countries, exports from different Swedish regions and sectors may be expected to be affected differently by such changes.

3. Method

The empirical study discusses and analyses how exports by sectors of manufacturing industry have evolved on a quarterly basis during the period 1993-1998. In other words the measurement period features a period of floating exchange rates (the changeover having taken place in November 1992). The starting point of the study is a grouping of sectors based on the standard classification of Swedish trade and industry, SNI 92. It is a classification of economic activities in which production units with similar production processes are assigned to the same group. It is also a sectoral classification in which a sector is defined as a group of production units. This study is primarily interested in exports of goods, and production of goods is largely concentrated in a single section of SNI 92, *manufacturing industry*. This section consists of 103 groups (at three-figure level). Of these, 79 are included in the study.

The export trade with Sweden's chief trading partners, categorised in six geographical areas, is analysed on the basis of the above classification. Altogether 38 countries are involved, accounting for 89 per cent of Sweden's exports 1997. All except one of the countries not covered by the study have less than an 0.5 per cent share of the exports (the exception being Australia with 1.3 per cent in 1997).

The report analyses exports from two standpoints: the effect of exchange-rate movements and international demand on price, and the influence of price and international demand on export volume. Thus other factors which could conceivably influence the volume and pattern of trade are ignored. The majority of studies which discuss exchange rates take note of the fact that exchange-rate fluctuations also affect production costs of firms (see e.g. Adolfson 1999, Kongsted 1998 and Sibert 1992). By confining the study to the demand side alone we cannot give a full answer to the question whether a price rise is associated with increased profit margins or higher marginal costs.

3.1 The model's distinctive features

3.1.1 The trading areas

The 38 countries covered by the study are grouped, as stated earlier, in six trading areas (see Table 3.1). The grouping is geographically based save for the European countries, which are grouped according to their degree of participation in the process of European integration.

Previous studies of the foreign trade of individual countries have usually taken one of two approaches. Either its export (or import) trade with the entire outside world has been analysed or else it has been evaluated *vis-à-vis* each individual trading partner (country)[3]. However, grouping by aggregated markets makes it possible to examine trade flows (and the influence of certain factors upon them) to and from the trading areas which are important to Sweden, viz Europe, Asia and North America. Moreover, the geographical demarcation facilitates specific analyses *vis-à-vis* individual markets. This is of interest when considering the pros and cons of EMU membership. The Asian countries' currency problems can also be elucidated closely via this type of grouping. Finally, aggregation reduces the risk of data disturbances, as for example when a large export order to a particular country has only a minor impact on the total trade within a sector.

Table 3.1 Trading areas.

Trading area	*Countries comprising the respective trading area*
EMU	Belgium, Finland, France, Ireland, Italy, Luxembourg, Holland, Portugal, Spain, Germany and Austria.
Non-EMU countries of Western Europe	Denmark, Greece, Iceland, Norway, Switzerland and Great Britain.
Rest of Europe	Estonia, Latvia, Lithuania, Poland, Russia, Czech Republic, Turkey and Hungary.
North America	Canada, Mexico and United States of America.
Southeast Asia	Philippines, Hong Kong, Indonesia, China, Malaysia, Singapore, South Korea, Taiwan and Thailand.
Japan	Japan

3.1.2 Currencies

Currencies for the 38 countries are taken from Oanda[4]. The exchange rate, which is defined as the *interbank rate*, is presented quarterly, the average exchange rate for the quarter (foreign currency/Swedish krona) for the country in question being used as the measure. The exchange rates are indexed, the first quarter of 1993 serving as base (=100).

3.1.3 Exchange-rate weighting

The exchange-rate index of the aggregated trading areas reflects the exchange rates and trade of the individual countries. The weightings assigned to the respective countries in the aggregate are based on each individual country's average (1993-94) share of the trading area's total imports from Sweden. This means that all branches receive the same exchange-rate weighting. Savvides (1992) and Chowdbury (1993) use weighting similar to that in this study, with the difference that the average is calculated over several years.

As has been remarked, Sweden's trade with the EU countries has increased during the 1990s. Thus the choice of a fixed basis of weighting raises questions as regards deviations from the index the further on in time from the base years we estimate the results. Hervey & Strauss (1998) suggest that weightings employing so-called moving averages, which take account of the altered composition of trade over time, may be desirable. While conscious of this defect, however, the present work uses fixed weightings, mainly so as be able to see how that very composition of exports may itself have been affected by exchange-rate developments.

Aggregated exchange-rate indices can either use a weighting mechanism based on bilateral trade weightings for the currencies/countries comprised in the index (e.g. Swedish exports to plus imports from the country in question) or multilateral trade weightings (e.g. total world trade of each country in the index). The advantage of multilateral trade weightings is that they take better account of the effects on third countries in terms of changes in exchange rates. The present study nevertheless opts not to employ multilateral weightings, since these pay no regard to the fact that Swedish exports do not have the same destination areas as global trade. When the aim of the report is to shed light on conditions in Swedish manufacturing industry, the weightings selected for the study are considered to be more appropriate.

The "third country aspect" must not be overlooked, however. What it means, briefly, is the following. Let us suppose that the krona depreciates *vis-à-vis* a bilateral trading partner. This change of exchange rate affects relative competitiveness *vis-à-vis* that partner. But it can also affect the relative competitiveness of Sweden and the bilateral trading partner *vis-à-vis* a third country. We take partial account of this aspect by aggregating individual currencies into a trading area. By doing this we include effects on third countries as long as they form part of the trading area.

Finally, using weightings which are based solely on export volume means that a degree of caution is required in analysing results. The exchange-rate indices employed in the study relate only to the exchange rates confronting *exporters*. While it may be interesting to study the pattern of exchange rates confronting exporters, questions also arise along the lines: "What effects do exchange-rate movements have on home regions?" Bilateral indices which contain both export and import weightings treat this question in a more appropriate manner.

For the question posed above contains two key points: first how regions are affected by exchange rates and exports, and second how exchange-rate movements affect regional imports. Only the export side is dealt with in this study.[5]

3.1.4 International demand

International demand is measured via GDP at current prices (measured in US dollars) on an annual basis for every quarter. The same measure is used by Chowdbury (1993) and others. The reasons for measuring GDP at current rather than fixed prices are firstly that GDP at fixed prices is a measure of volume and secondly that the study's primary aim is to observe the effect of the exchange rate on the price of exports, not on the volume. The trading area's demand is the same as the sum of the individual countries' GDP. The GDP of the respective trading area is expressed as an index (1993, quarter 1 = 100). GDP data are taken from the OECD (1998).

3.1.5 Trade data

The Swedish export trade is reported by SCB in the form of exports of goods and services. However, this study focuses not on the trade in goods and services but on which sectors the trade emanates from. A good (or group of goods) may be manufactured and sold in several different sectors. Similarly, a sector may manufacture and sell a number of different goods. Therefore conversion of the material obtained from SCB is necessary in order to accomplish the aim of studying manufacturing industry's dependence on foreign trade. The original data material (prior to conversion) contains quarterly data relating to export product-groups going to each and every one of the 38 countries included in the study. These data are recorded for the product-groups at three-figure level (SITC Rev 3) and show exports to the country of destination expressed by quantity and value respectively.

The material obtained has been converted so as to show exports from sectors at group level on the basis of SNI 92[6]. The conversion was effected with the aid of a conversion key between

SITC and SNI 92 furnished by SCB. Altogether the conversion involved the grouping of a total of more than 10 000 articles into 79 sectors.

The data material used in the study accordingly comprises the respective sectors' exports to destination countries expressed by quantity and value respectively. The export price is expressed in kronor per kg and is calculated by dividing, for each sector and country, the value of the trade by its quantity (expressed in kg).

Conversion of the data from product-groups to sectoral affiliation, which is necessary in order to accomplish the study's purposes (and to facilitate further research), can detract from the reliability of the results. This problem arises because one product-group does not have to be assigned to one sector in all cases. However, the composition of most product-groups is such that they do in fact belong wholly to one sector. Interpretations and analyses of results must therefore bear these shortcomings in mind.

3.2 Models and method

The model employed in the study of manufacturing industry thus makes use of the following variables in order to explain the magnitude of trade flows between Sweden and the six trading areas:

- ❑ The export price in the respective sector for each individual quarter.
- ❑ Size of the receiving area's GDP every quarter. This measure represents the demand capacity for exports.
- ❑ Exchange rate *vis-à-vis* each trading area every quarter

Export demand is written as

$$X_{i.v,t} = a P_{i,v,t}^{b} Y_{v,t}^{l} \ Y_{v,t-1}^{m} e_{x}$$

where

$$P_{i,v,t} = c \, Y_{v,t}^{g} e_{v,t}^{d} P_{i,v,t-1}^{u} e_{p} \qquad \text{and} \qquad e_{v,t} = \sum_{j=1}^{n} \left(\frac{R_{j}}{R_{v}} \cdot V_{j} \right)$$

where
$X_{i,v,t}$ = total export quantity for sector i to trading area v, quarter t
$P_{i,v,t}$ = export price per kg for sector i to trading area v, quarter t
$Y_{v,t}$ = GDP of trading area v, quarter t
R = value of exports (average 1993-94)
V = exchange rate (foreign currency/Swedish kronor), index 1993 quarter 1=100,
$e_{v,t}$ = exchange-rate index for trading area v, quarter t (1993, quarter 1 = 100)
j = country (1 to n)
β, λ, μ, γ, δ, υ = elasticities
α, χ = constants, and
ε = residuals.

The model has been estimated in linear form, which means that the variables have been expressed as logarithms. Thus the variables are introduced into the equations by addition, not by multiplication. It also means that the parameters below can be interpreted as measures of elasticity. β shows the effect of export price on quantity exported. λ and μ show the effect of international demand on export quantity. How export price (in Swedish kronor) is affected by international demand is shown by γ. Effect from earlier price is shown by υ. Finally, the influence of exchange-rate movements on export price is represented by δ.

The model is made up of two equations in one system. Export price and export quantity are endogenous variables, i.e. they are determined within the equation system. GDP and exchange-rate index are determined outside the model, which makes them exogenous. Two predetermined variables, viz price and GDP for the previous quarter, are included in addition to the exogenous variables. The model is in structural form, i.e. the form is given by underlying theory.

At least two problems present themselves in the specification of a simultaneous equation system. Firstly: Are the variables embodied in the model exogenous or endogenous, i.e. is the equation system simultaneous? Secondly: Is it possible to estimate the structural parameters in a reduced form, i.e. are the equations identified?

To answer the first question a *Hausman test* was made for the various sectors. The test investigates whether simultaneity is present, i.e. whether the endogenous variable of explanation and the residual are correlated. The zero hypothesis of the test is that no simultaneity is present, which signifies that the endogenous variable of explanation and the residual are uncorrelated. It was found that such was not the case, however, so that the zero hypothesis was rejected.

A feature of the simultaneous equation system, of course, is that it cannot be estimated consistently with the least squares method. The reason is that the endogenous variables are correlated with the residuals because the endogenous variables in an equation are back-coupled to variables in another equation. In order to get over this problem it is necessary for the endogenous variables to be estimated as a function of only the predetermined and exogenous variables, which is called reduced form. Thus estimates with the help of instrumental variables are required in order to obtain both consistent and efficient estimates.[7]

The second problem, viz whether we can estimate the parameters of the model at all, is called the identification problem. An equation is unidentified if there is no way of estimating all structural parameters from the reduced form. The equation is exactly identified if there is a unique parameter value and overidentified if there is more than one value for certain parameters. A necessary condition (the order condition) for an equation to be identified is that the predetermined variables excluded from the equation are at least as numerous as the endogenous variables included in it. Another way of defining this condition is that the number of predetermined variables (including the constant) in the system (five) must be at least as great as the number of parameters in the equation in question.[8]

The equations have been estimated with the aid of the two-stage-least-squares (2SLS) method, which uses the information available from the specification of an equation system to obtain a unique estimate for each structural parameter. The first stage of 2SLS comprises the creation of instruments, while the second involves the estimation of instrumental variables. 2SLS functions as ordinary instrumental variable technique but with all predetermined variables as instruments.

If the equation is exactly identified, then 2SLS, the indirect least squares method (ILS) and instrumental variable estimates will give the same parameter estimates. However, if the equation is overidentified, ILS can give several different solutions, while 2SLS and the instrumental variable method

give the same consistent estimates provided that all predetermined variables in the equation system are used as instruments in 2SLS.

The advantage of 2SLS is that it gives consistent parameter estimates when the equation systems are simultaneous. They allow for one or more predetermined variables being omitted from the equation which is to be estimated. However, 2SLS does not allow for the possibility that there may be a correlation between the random terms of different equations. This can be resolved by using 3SLS estimation or SUR (seemingly unrelated regression), which estimates the entire equation system, unlike 2SLS which estimates each equation in the system separately. The disadvantage of estimating the entire system, however, is that the estimates of the individual parameters become more sensitive to how the entire model system is designed. A serious specification defect in an equation can affect the parameter estimates in the other equations of the system.

Another difficulty which can arise with this type of model is that the residuals are serially correlated, i.e. the residuals for a given time-period affect the errors in future periods. The serial correlation affects both the consistency and the effectiveness of 2SLS estimates.

The presence of serial correlation of the first degree has been tested by means of a *Durbin-Watson test*. It should be noted, however, that the validity of this test diminishes when there is a lagged dependent variable in the equation, as is the case in the price equation.[9] Those equations in the study which were unable, from a Durbin-Watson test, to show non-serial correlation with certainty, have been corrected with the aid of an autoregressive process of the first order (AR(1)) with all predetermined variables as instruments.[10]

4. Exchange-rate sensitivity of industry at sector level

The results presented in this section relate to effects on export price and quantity, expressed quarterly during the period 1993-1998. The results discussed consists of estimates which are corrected for serial correlation where necessary. These corrections have on the one hand caused the number of significant parameters (deviating from zero) to diminish substantially. On the other hand the corrections have made the estimates consistent.

The results recorded show, to the best possible extent, in which sectors the dependent variable is affected most by changes in the relevant variable of explanation, given that the other variables of explanation are held constant. It ought to be noted too that the study takes account only of the demand side, which means that we cannot give a clear answer to the question of how the supply side influences and is influenced by changes in macroeconomic variables. In other words, we cannot clarify with certainty whether a price increase brings increased profit margins for firms or whether it is caused by increased production costs.

4.1 Effect of international demand on export price

International demand is measured in the study by the gross domestic product of the respective trading areas, which is the aggregate production of goods and services. It is measured at current prices, which means that no account has been taken of price rises. Both increased sales of goods and services and higher prices can be causes of an increased GDP. An increase in GDP means that consumers' incomes rise, which as a rule should bring rising consumption in its train. In this way a rise in the level of GDP in the outside world will probably cause demand for Swedish export goods to increase, which in turn should raise the export price (inferior goods excepted).

Of the total of 79 sectors, there were 26 in the EMU in which demand influenced price positively and 5 where the correlation was negative. Similar results were obtained for non-EMU countries in Western Europe (27 positive and 3 negative) and North America (21 positive and 7 negative). In the remaining trading areas the scale of the effects was smaller, and in the case of Southeast Asia the negative correlation was dominant. This result indicates that export prices were mainly influenced by the way income developed in the three "big" markets for Swedish exports: the EMU area, Western Europe and North America. We may also note that the effect of GDP in North America has a greater covariance with non-EMU countries than with EMU countries. This may result from the fact that the United States, viewed historically, has always had a stronger link with Great Britain (which is not a member of the EMU) than with continental Europe as regards orientation of production, trade and currency.

4.2 Effect of exchange rate on export price

Whether exchange-rate movements influence export price depends largely on whether the price was set in the home or the foreign currency. If the Swedish krona weakens *vis-à-vis* the outside world this means, *ceteris paribus*, that Swedish goods become cheaper for foreign consumers to buy. The quantity exported ought to increase accordingly. But in such case the Swedish exporter is able to raise his home prices so that the price paid by the foreign importer remains the same as before the depreciation. The effect will be that the exporter's profit margin rises. In other words, if the export price was set in Swedish currency the effect on price ought not to be so great. But if the export price was set in foreign currency, the home price is directly affected by the exchange-rate changes.

The regression results show that North America is the trading area in which the rate of exchange influences price in the most sectors (30 out of 79). This may result from the fact that Swedish exports are largely dependent on the dollar. If the price of goods is set in dollars, a change in the dollar rate will affect the domestic export price. Exchange-rate movements also have relatively strong ef-

fects on prices in Western Europe. The export price to Asia, however, is relatively little affected by exchange-rate fluctuations.

Table 4.1 The ten sectors in each of three currency areas in which exchange rate has strongest influence on export price.

EMU	Exchange rate elasticity
Flourmill products and starch industry	-28.27
Iron- and steelworks	-1.07
Heavy chemical industry	-1.06
Tubular iron and steel industry	-1.01
Textile industry	-0.85
Office machinery and computer industry	-0.71
Industry for machinery producing mechanical power	-0.67
Industry for motor vehicle parts and accessories	-0.65
Plastic products industry	-0.63
Synthetic fibre industry	-0.2

Non-EMU in Western Europe	Exchange rate elasticity
Fish-processing industry	-4.57
Pharmaceuticals, pharmaceutical chemicals and botanical products industries	-3.55
Rubber industry	-3.27
Measuring instruments industry	-2.28
Glass and glassware industry	-1.88
Veneer and wood-based products industry	-1.49
Synthetic fibre industry	-1.23
Sawmills and planing mills	-1.10
Automobile and truck industry	-0.32
Industry for electricity distribution and control apparatus	-0.24

North America	Exchange rate elasticity
Other wood products industry	-3.34
Ceramics industry	-2.63
Other textile industry	-2.36
Measuring instruments industry	-2.34
Oil and fat products industry	-2.29
Electronic components industry	-1.68
Plastic products industry	-1.62
Glass and glassware industry	-1.17
Pharmaceuticals, pharmaceutical chemicals and botanical products industries	-1.07
Radio, TV and line telephony industry	-0.86

The table reports only elasticities which affect the export price significantly (10 % significance threshold).

In the majority of cases the export price is influenced negatively or not at all by exchange-rate fluctuations. In some instances, however, the export price does rise when the krona appreciates (or else falls when the krona depreciates). Table 4.1 shows in which sectors the price falls most when there

is an appreciation. The figures refer only to the EMU, non-EMU countries in Western Europe and North America since other trading areas are only affected slightly by exchange rate fluctuations.

Overall, at the aggregated level, the results with regard to the significance of the exchange rate show two main things. Firstly, there is no clear pattern of how exchange-rate movements generally influence export prices. Secondly, it is impossible to say at sector level what impact a general krona appreciation has on export prices. They can be raised against one trading area at the same time as they are being lowered against another geographical area. What has been said above suggests firstly that the possibility cannot be excluded of exporters setting different prices on different markets (price discrimination), and secondly that there may be other variables which the exchange rate influences to a greater extent (interest rates, prices of input goods etc).

4.3 Effect of international demand on export volume

The majority of the statistically reliable results suggest that the correlation between international demand and export volume is positive. The trading area in which exports are influenced most is Rest of Europe, comprising Eastern European countries. Thus it can be observed that a better economic climate in Eastern Europe influences Swedish exports heavily in the form of increased export volume rather than higher prices. In the Asian trading areas demand has little influence on exports.

There are no clear tendencies showing whether the export volume of individual sectors is influenced more by international demand or less. The exports of all sectors are relatively insensitive to demand in the outside world. If we look at exports to individual trading areas, however, a pattern emerges. High demand in Rest of Europe has a positive impact on Swedish exports. In the case of other trading areas, the effect of rising GDP is low and scattered over many sectors.

One conclusion which can be drawn is that for the most part and with the exception of East Europe, international demand influences export prices rather than export volume. One reason for this may be that firms produce a certain quantity of goods regardless of the international economic climate. In other words there is a restriction on the volume of exports in the form of limited production capacity, whereas considerable scope exists for raising export prices.

4.4 Effect of export prices on export volume

The correlation between export price and export volume is probably negative normally, as is confirmed in the main by the results. The clearest correlation (most sectors) is *vis-à-vis* non-EMU countries of Western Europe, Japan and North America (24 sectors for each of the three currency areas). The EMU area and Rest of Europe have fewer sectors in which the export price influences the quantity exported (15 and 13 sectors respectively).

The trading area in which price-sensitivity generally speaking is highest is Southeast Asia (with which 19 sectors show significant correlation). Transport distance may be a factor in this. Moreover, a lower income level than in Europe and North America means that the markets are in large part characterised by cheaper products. In such a price-competitive environment Swedish exporters may have difficulty in competing with local producers, which can cause sales to decline drastically even with small price rises. Exports to EMU countries have the lowest level of price-sensitivity. Reasons for this may be the common market, similar consumption patterns and income levels, and a large proportion of two-way trade (the same types of goods being both imported and exported).

4.5 Summary – Swedish manufacturing industry's exports

In this section a more detailed account is given of the sectors where significant results have been obtained as regards both the effect of exchange rate on price and that of price on export volume. The trade with North America shows the most instances (12 out of 79). The least significant result is that for the trade with Japan, where only one case was found.

Table 4.2 below shows the sectors in which significant results have been obtained in respect of the two calculations. Positive correlation (negative correlation) means that a krona appreciation raises (lowers) the export price. The correlation betwen export price and export volume is negative in all cases except one (export of *knitwear* to Rest of Europe, which is not reported). The table shows only significant measures of elasticity (10% level of significance). As table 4.2 shows, the most usual situation, given a negative correlation between price and quantity, is that a krona appreciation results in a lower price. In other words, because a stronger Swedish krona makes Swedish goods more expensive for foreign consumers to buy, producers opt to reduce prices. This scenario, with a fairly stable export volume but with export prices varying with the rate of exchange, is probably of common occurrence if the price is set in foreign currency.

However, this does not justify the conclusion that a stronger krona brings increased exports. Certainly a stronger krona often leads to a lower price, and a lower price brings increased exports. But – and this is worth noting – these correlations apply only given that all other variables are held constant outside the particular equation. That is to say, a lower price results in increased exports given that the rate of exchange is held constant.

Table 4.2 Sectors showing significant correlations between exchange rate and export price, and between export price and export volume.

Positive correlation (left-hand column)

EMU	Exchange-rate elasticity	Export price elasticity
Publishing and graphics industry	1.37	-1.10

Non-EMU in Western Europe		
Tobacco industry	2.81	-0.78
Industry for cutlery and tools	0.79	-1.90

Rest of Europe		
Glass and glassware industry	0.38	-1.38
Industry for clothing and other accessories	0.32	-0.33

North America		
Industry for electric motors, generators and transformers	3.94	-0.59
Other chemical industry	3.24	-0.83
Petroleum refineries	2.26	-4.05
Dairies and ice-cream industry	1.16	-5.32
Other metalware industry	0.88	-1.37
Woodpulp, paper and board industry	0.60	-3.34

Southeast Asia		
Petroleum refineries	3.79	-2.89
Industry for optical instruments and photographic equipment	3.77	-0.62
Machine tool industry	1.98	-0.72

Japan		
Industry for medical equipment	1.63	-0.99

Negative correlation (right-hand column)

EMU	Exchange-rate elasticity	Export price elasticity
Textile factories	-0.85	-2.00
Industry for office machinery and computers	-0.71	-1.47
Industry for machines for generating mechanical power, not motors	-0.67	-1.87

Non-EMU in Western Europe		
Fish-processing industry	-4.57	-1.53
Industry for pharmaceuticals, pharmaceutical chemicals and botanical products	-3.55	-0.79
Rubber products industry	-3.27	-0.72
Industry for measuring instruments	-2.28	-0.72
Glass and glassware industry	-1.88	-0.90

Rest of Europe		
Yarn industry	-0.74	-1.59
Motor vehicle bodywork industry	-0.59	-1.12
Other chemical industry	-0.29	-4.31
Paint industry	-0.19	-3.73
Industry for paper and board products	-0.09	-1.98

North America		
Ceramics industry	-2.63	-0.86
Industry for measuring instruments	-2.34	-1.15
Industry for electronic components	-1.68	-1.16
Plastic products industry	-1.62	-1.74
Glass and glassware industry	-1.17	-0.87
Industry for radio, TV and line telephony	-0.86	-1.06

Southeast Asia		
Industry for pharmaceuticals, pharmaceutical chemicals and botanical products	-1.92	-1.24
Sports goods and toys industry	-1.18	-2.20
Knitwear factories	-0.86	-3.81
Glass and glassware industry	-0.74	-4.26

The number of cases in which a positive correlation exists is easily reckoned. That a positive correlation occurs at all may be the result of trade within the sector being reallocated from cheaper to dearer goods as the krona appreciates – and from dearer to cheaper as it weakens. On other words, when the krona strengthens, cheap and competitive Swedish goods become too dear. Importers in other countries then opt to reallocate their purchases of these goods from Sweden to some other country. The consequence is that the proportion of dearer goods in the sector increases, which means that the sector's export price automatically rises. As the study is so designed that it takes no account of the fact that relative prices *between* the various trading areas are changing, i.e. that a so-called "third country aspect" arises. Furthermore, the study takes no account of exchange-rate influence on imports, the inclusion of which might also afford a partial explanation of the pricing.

The sectors which exhibit a negative correlation between rate of exchange and export price in exports to the EMU do not exhibit a negative correlation in trade with any other trading area On the other hand there are certain resemblances as regards the trade to North America and non-EMU countries of Western Europe.

4.6 Conclusions of the sectoral study

This section has examined Sweden's manufacturing industry's exports from two standpoints, viz the effect of exchange-rate movements and international demand on price, and the effect of price and international demand on export volume. When interpreting the results, therefore, we must bear in mind that we are ignoring other factors which could be thought to influence the amount and pattern of trade, such as transaction costs, distance to the receiving country, price relative to those of other countries, size of population, and cultural similarities and differences. Moreover, the study takes cognisance only of the demand side of the economy and therefore ignores firms' production costs.

Conversion of the mass of data from product-groups to sectoral affiliation has given rise to defects of reliability in the results. This problem has come about because of the simplification involved in assigning **one** product-group to **one** sector. The effects of changed macroeconomic conditions may accordingly be incomplete at sector level.

The breakdown by trading areas has the advantage that it enables analyses to be made of trade with groups of countries. For example we can study how exchange-rate movements influence exports to the EMU area. The disadvantage of this procedure is that we cannot see whether the export pattern changes *vis-à-vis* all countries in this area or whether, for example, it is only exports to Germany and France that are affected.

Moreover the study takes no account of the so-called "third country aspect", i.e. the fact that relative prices between the various trading areas change over time. In the study made this aspect may explain why, for example, a weakening of the krona has brought lower export prices in its train. One explanation of this may be that a weaker krona makes Swedish goods cheaper for foreign importers. These then opt to switch their purchases from other countries to Sweden instead. The effect then is that the proportion of cheap products in the sector increases, with the consequence that their export price falls automatically. To take account of this dilemma it may be necessary to resort to multilateral trade weightings. While conscious of the above-specified shortcomings, the basic results of the study are summarised below.

Manufacturing industry's export prices to the EMU, generally speaking, are influenced more often and to a greater degree by aggregated demand changes than by exchange-rate changes. The same can be said to apply to non-EMU countries in Western Europe and North America. The export price of goods for Southeast Asia and Japan is affected seldom and little, relatively speaking, by either GDP changes or exchange-rate fluctuations. In the general analysis of the factors determining export price, the deviant is Rest of Europe (Eastern Europe), where demand has little influence on prices and krona appreciation influences prices in a weakly positive direction.

As regards export volume, there is a clear general negative correlation between export price and quantity exported. This corrrelation occurs most frequently in the trade with non-EMU countries in Europe, North America and Japan. Generally speaking international demand influences volume in a positive direction, but the results show a weaker linkage than that between price and export volume. Here too, however, the exception is Eastern Europe.

The vulnerability of the export price to exchange-rate fluctuations is modest. Neither at aggregated nor at sector level can any clear general correlation be observed. Nor, therefore, can the possibility be excluded that exporters may be able to practise price discrimination, i.e. set different prices *vis-à-vis* different markets. That changes in exchange rates do not influence prices directly to any significant extent, however, is not to imply that they are uninteresting as determinants of Swedish foreign trade. The currency may very well influence other variables such as interest rates and prices of input goods, which in turn has repercussions on foreign trade.

It may also be noted with regard to exchange-rate fluctuations that changes in the values of currencies in the EMU area and non-EMU countries of Western Europe (which include EU countries not in the EMU) have had similar effects on Swedish export prices in the same sec-

tors. The EMU therefore does not appear to be a worse alternative for Swedish export industries than the present exchange-rate régime of floating currencies. Two aspects should be noted at this point, however. Firstly, 1999 does not fall within the framework of the study. This was a year when the euro, the currency of the EMU area, weakened substantially. Had this period been included, this might have produced results different from those shown by our study. Secondly, it is worth remembering that to a large extent Swedish firms sell goods to Swedish consumers. EMU membership might create new conditions for the Swedish economy and Swedish economic policy, and this could change the situation for Swedish home demand (and thus Swedish firms' profitability) in a way different from what might happen if Sweden did not become a member. In other words, it is of great importance to keep in mind that Swedish firms sell goods both within and without the national frontiers, and that Swedish exports are also governed by factors other than those within the scope of this study.

As far as export volume is concerned, it is impossible to find any clear tendency at sector level for the effects of a rise in GDP. But on the other hand the quantity exported is influenced negatively if the export price is raised. It appears that there is no common pattern applicable to exports from all sectors to all trading areas. Both similarities and differences exist for the various sectors of manufacturing industry.

Two general conclusions may be drawn about how Swedish manufacturing industry's exports are influenced by international demand and exchange rates. The first is that changes in international demand, measured in terms of GDP, influence Swedish exports to a higher degree than changes in exchange rates do. That changes in the exchange rate do not produce any greater effects on exports may result from the exchange-rate system prevailing in Sweden. A weakening of the krona by five per cent today can be quickly corrected so that the krona is back at the same level again within half a year. If Sweden had had a fixed krona which had been devalued by five per cent, it is not certain that the result would have been the same. In such a situation the deterioration of the krona would have been more definitive, which mean exporters being able to adjust their prices without any great risk of needing to alter them again at a later point in time.

The other general conclusion is that an increase of the outside world's GDP affects the export industry in two ways: directly via increased export prices and indirectly in that the higher prices in themselves give a smaller exported quantity. Whether increased economic growth in the outside world produces higher revenues for exporters depends partly on how much prices are boosted by increased demand and partly on how price-elasticities look in the sector concerned.

5. Regional effects of exchange-rate movements

The regional repercussions of the results presented above are discussed in this section. The account is based on the 108 *local labour markets* into which SCB divides Sweden. As a rule these are larger than municipalities – except in parts of Norrland – but smaller than counties (the county of Gotland excepted). We begin with an account of employment in the ten sectors whose export volume displays the highest price-sensitivity *vis-à-vis* various trading areas. On average these sectors account for between two and four per cent of employment nationally. The sectors whose exported volume is price-sensitive *vis-à-vis* the EMU area have the largest share at 3.98%. The corresponding sectors have the lowest share (2.10%) *vis-à-vis* the non-EMU countries of Western Europe. The charts show how employment in the region behaves compared with the national average for these sectors.

Generally speaking, employment in sectors with the most robust correlations between price changes and export volume is strongest in a number of smaller labour markets in southern Sweden. These are relatively weakly diversified labour markets in which manufacturing industry accounts for a considerable employment share. The majority of these labour markets are dominated by labour-intensive industry and about half of them have earlier been considered to be the regions expected to encounter the most serious problems of adaptation when East European countries become members of the EU.[11]

That price-sensitive industries have large shares of employment in certain regions, however, does not necessarily mean that these are specially sensitive to exchange-rate movements, since the exchange rate, as has been pointed out, is only one of several factors which influence export price. A comparison of employment shares for the local labour markets in the ten sectors where the exchange rate has the strongest impact on export price *vis-à-vis* the trading areas where such correlations occur to any major extent, was therefore made.

As was observed in Section 4.2, a negative correlation between exchange-rate movement and export price (i.e. a fall in the exchange rate being followed by a rise in price and *vice versa*) is the most usual correlation – insofar as there is any significant correlation at all. The three trading areas where these correlations are most numerous were those shown in Table 4.1, i.e. the EMU, the Rest of Western Europe and North America.

In the trade with Eastern Europe and North America there are also a number of sectors with a positive correlation. Our explanation of this is that the exchange-rate movement probably triggers a shift between products in various price-ranges of the sector's exports. Table 4.2 showed that the elasticity values for these sectors' Eastern Europe exports were low (i.e. less

than one) in all cases except one, whereas the elasticities for North America were clearly higher than one.

The majority of labour markets whose exports have the biggest *negative* price-sensitivity do not belong to those with the biggest price-volume correlation

On the other hand the regions whose industry has a strong *positive* correlation between exchange rate and export price (i.e. where the exchange rate probably influences the composition of the sector's exports of goods) *vis-à-vis* the North American market consist largely of the same regions as those whose export volume is price-sensitive, i.e. chiefly regions possessing in the main certain labour-intensive industries along with some element of capital-intensive industries. It therefore seems as though exports to North America are those which display the strongest correlation between exchange rate, price and volume, and that it is regions with exports orientated towards the North American market which are accordingly most sensitive to exchange-rate movements.

This conclusion is supported by the figures in Table 5.1. Those industrial sectors which bear a significant correlation both between price and volume and between exchange rate and price *vis-à-vis* the North American market have a significantly larger employment share at national level than those which export to other markets.

Table 5.1. Shares of total employment in Sweden 1997 for the industrial sectors showing significant correlation both between price and export volume and between exchange rate and price *vis-à-vis* various trading areas.

Trading area	Employment share %
EMU countries	2.12
Non-EMU, Western Europe	1.09
Rest of Europe	0.94
North America	4.17
Southeast Asia	0.99
Japan	0.23

Figures 5.1-5.6 show the regional employment for sectors having significant correlations *both* between price and export volume *and* between exchange rate and price *vis-à-vis* the various trading areas. (National average: Index 100). There are very few regions which have employment of at least double the national average in the EMU-significant sectors, a fact which suggests that exchange rates have a very limited influence on regional differences in Swedish exports to the EMU area.

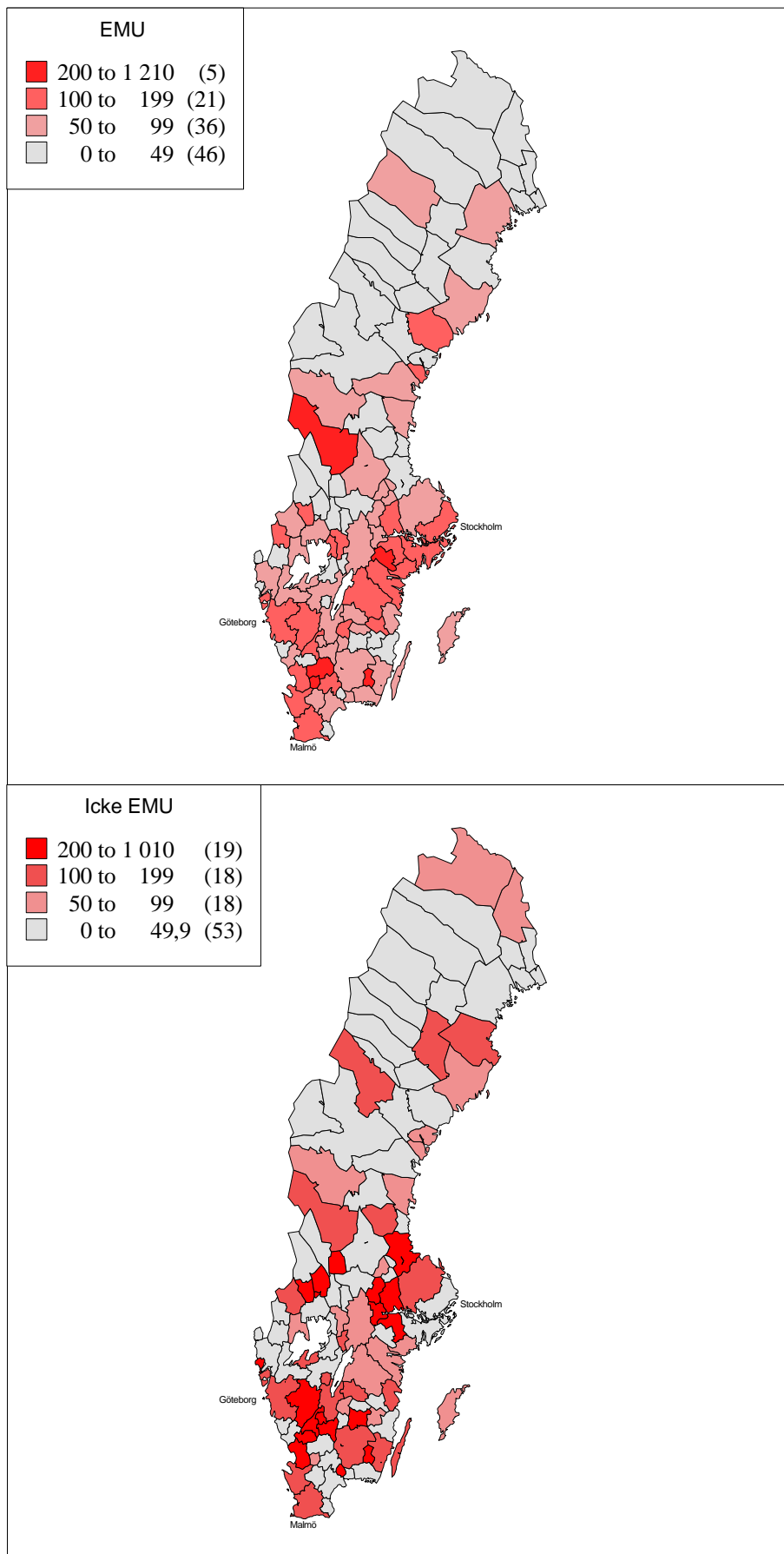Figure 5.1. (EMU) and 5.2. (Non-EMU countries in Western Europe)

EMU

■	200 to 1 210	(5)
■	100 to 199	(21)
■	50 to 99	(36)
■	0 to 49	(46)

Stockholm

Göteborg

Malmö

Icke EMU

■	200 to 1 010	(19)
■	100 to 199	(18)
■	50 to 99	(18)
■	0 to 49,9	(53)

Stockholm

Göteborg

Malmö

Figure 5.3. (Eastern Europe) and 5.4. (North America)

Övriga Europa

■	200 to 3 500	(21)
■	100 to 199	(20)
■	50 to 99	(12)
☐	0 to 49,9	(55)

Stockholm

Göteborg

Malmö

Nordamerika

■	200 to 712	(16)
■	100 to 199	(25)
■	50 to 99	(42)
☐	0 to 49	(25)

Stockholm

Göteborg

Malmö

28
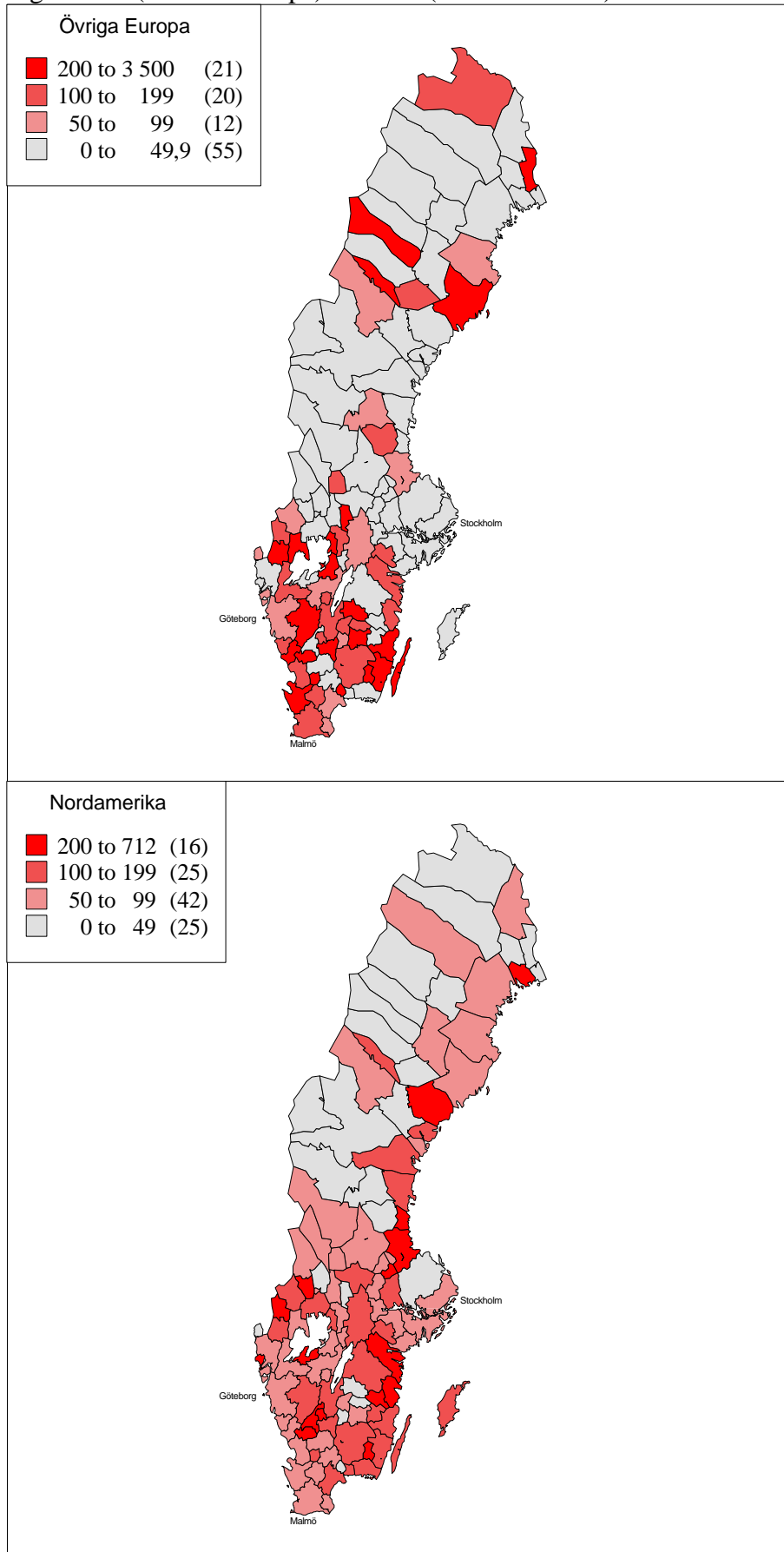
Figure 5.5. (Japan) and 5.6. (South East Asia)

Japan
- 200 to 415 (7)
- 100 to 199 (4)
- 50 to 99 (13)
- 0 to 49 (84)

Stockholm

Göteborg

Malmö

Sydostasien
- 200 to 2 740 (13)
- 100 to 199 (17)
- 50 to 99 (15)
- 0 to 49 (63)

Stockholm

Göteborg

Malmö
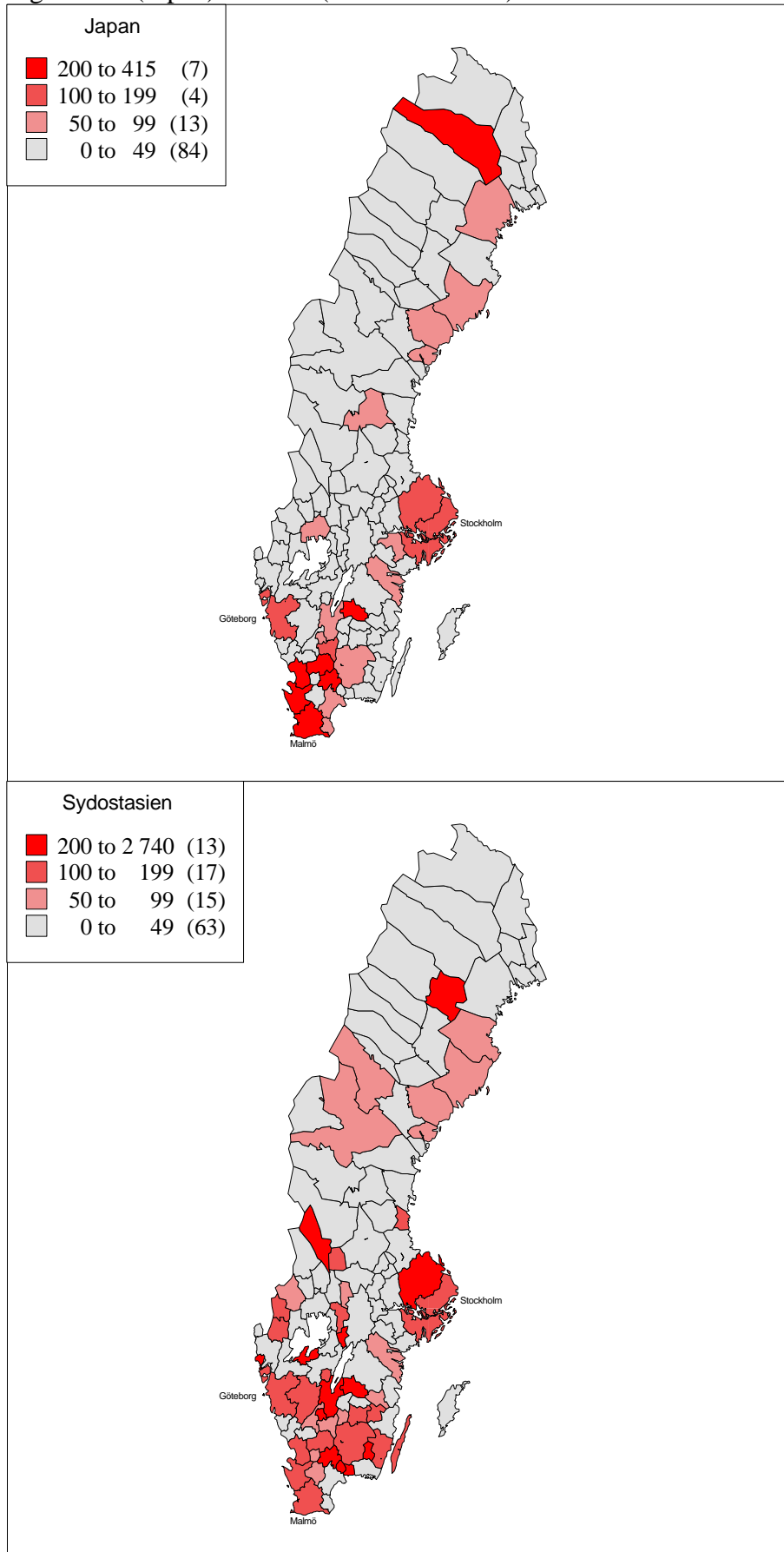
Vis-à-vis the countries of Western Europe not affiliated to the EMU (Figure 5.2) the regional differences are considerably larger, and several regions are specialised on the sectors in question. In principle, the regions which have the largest proportion of exchange-rate sensitive sectors *vis-à-vis* the non-EMU group of Western Europe are the labour-intensive and capital-intensive industrial regions standing out in the comparisons above.

The regional differences for sectors in the trade with Eastern Europe which are exchange-rate sensitive are shown in Figures 5.3. The greatest sensitivity is exhibited by regions with certain labour-intensive and capital-intensive industries. As Table 4.2 shows, however, the elasticity values for all these sectors are considerably lower than one, which means that Figure 5.3 certainly shows the regional differences in sensitivity but also shows that that sensitivity lies at a considerably lower level than it does *vis-à-vis* other groups of countries.

Figure 5.4 shows corresponding regional differences for sectors exhibiting exchange-rate sensitivity in the trade with North America. The pattern has certain resemblances to that for non-EMU countries of Western Europe (Figure 5.2), but some labour markets with certain capital-intensive industries (though not steel industry) seem, relatively speaking, to be more specialised on these sectors.

The regional variations for sectors which are exchange-rate sensitive with respect to their exports to Southeast Asia are set forth in Figure 5.6. Here a number of "new" regions, with e.g. pharmaceutical industry, are revealed to have a high degree of specialisation. Regions with a high degrees of specialisation on sectors which are exchange-rate sensitive *vis-à-vis* the Japanese market (Figure 5.5) are few, however, and many labour markets do not have such sectors at all.

Only a few local labour markets have employment shares which are more than double the national average of the exchange-rate sensitive sectors *vis-à-vis* three or more trading areas. Only one has these high values *vis-à-vis* four trading areas. Labour-intensive industry, and to a certain extent capital-intensive industry, is the foremost characteristic of these areas, with exception of one labour market, whose industry is primarily classified as knowledge-intensive.

Although this study in no way purports to provide a comprehensive picture of the exchange-rate sensitivity of Swedish regions *vis-à-vis* different trading areas, an attempt is made here to draw certain general conclusions.

1. This study has only considered the export industry. For self-evident reasons it is probable that that is the segment of the economy which is most sensitive to changes in exchange rates –

with the exception of one important sector in the private services field, viz tourism. No detailed studies of the exchange-rate sensitivity of tourism exist, but a couple of recently-published reports have shown a clear correlation between the fall of the Swedish krona in the autumn of 1992 and a rise in foreign purchases of holiday homes in the years that followed (Pettersson 1997, Müller 1999). Comparative studies of the exchange rate's possible divergent regional effects on tourism are still not available.

2. As has been remarked, the study has not considered the influence of exchange rates on industry's cost side. There are no Swedish studies of differences in industrial sectors' cost distribution between Swedish and foreign currency. However, industry representatives have maintained that it is chiefly export sectors based on home-produced raw materials, such as forestry, engineering and the steel industry, that suffered most from a strong krona (see e.g. Dagens Industri, 9 June 2000). By June 2000 the exporting firms in these sectors had their raw materials and labour costs in a high-value Swedish krona but their revenues in low-value foreign currency. With a low-value krona the situation becomes reversed – which in short was the motive underlying the Swedish devaluations of the 1970s and 1980s. However, it is important to remember that this applies to the export-orientated raw materials-based industry. Industry producing for the home market in general derives benefits from the economic boom which normally coincides with a strong currency.

A study of the cost side of the export industry would accordingly probably do something to reveal other sectors and regions which are sensitive to exchange-rate movements. Such a study would therefore form a necessary complement to the present study.

3. Of the industrial exports to the six trading areas studied, it is those to North America whose composition seems to signify that the vagaries of exchange rates produce the most powerful repercussions in terms of differences between local Swedish labour markets. Exports to North America have the most sectors with significant correlations both between exchange rate and export price and between export price and export volume. These sectors also have a considerably larger share of employment at national level (4.17 %) than sectors with significant correlations *vis-à-vis* other trading areas. The elasticities – i.e. sensitivity to a percentage change in exchange rate and price – are also generally speaking highest for the North America sectors. This may plausibly be interpreted to mean that in the first instance it is the local labour markets appearing in Figure 5.4 that are the most sensitive to fluctuations in exchange rates.

As regards the elasticities, however, the important sectors exporting to non-EMU countries of Western Europe also show high values (see Table 4.2). Nevertheless the current sectors in

question account at the national level for only a quarter of the employment shown by the North America sectors. But in certain local labour markets these sectors have a significant employment share. Therefore the regions with the highest employment shares in Figure 5.2, along with those in Figure 5.4 for North America, ought to be designated the most sensitive to flucutations in exchange rates.

On the other hand the results of this however do not mean that exports to the EMU are affected to any notable extent by exchange-rate changes. Relatively few sectors show signficant values in Table 4.2, and by comparison with exports to North America and non-EMU countries, these sectors have considerably lower elasticity values. Neither do fluctuations of the exchange rate *vis-à-vis* EMU countries seem to give rise to any marked regional differences. Even though employment in the important sectors accounts for just over two per cent of total employment nationwide, employment in these sectors is relatively evenly distributed nationwide. Only a handful of regions have a strong concentration of the sectors in question.

For the three other trading areas, the important sectors *vis-à-vis* Eastern Europe and Southeast Asia account for barely one per cent of employment each. The exchange-rate elasticity values for the East European sectors are low, however, so that the regional effects are probably small. The Southeast Asia sectors have considerably higher elasticity values. About half of the regions with highest employment in these sectors are also to be found among the most exchange-rate sensitive regions *vis-à-vis* North America, which underlines the special position of these regions.

Finally, the Japanese market shows only one sector with significant double correlations. Many local labour markets lack this sector entirely and only a few have a marked concentration of employment in it.

4. The sector study showed a number of sectors with double correlations (exchange rate – price and price – export volume), and the regional incidence of these sectors has been charted in this chapter. It transpires that these sectors are chiefly concentrated in small labour markets in southern Sweden. Only in a few instances have regional centres had a high concentration of employment in sectors significant in relation to any of the six trading areas. Then how do these exchange-rate sensitive labour markets compare with the rest of the country as regards employment as a whole?

The answer is that of the six above-mentioned local labour markets with strong employment concentration in sectors which are important *vis-à-vis* at least half of the trading areas, four are to be found among the six labour markets having the highest industrial employment in

Sweden! Even the two others have more than 50% higher industrial employment than the national average.

But of course it is not a simple matter of a high share of industrial employment coinciding automatically with high exchange-rate sensitivity. Among the most densely-industrialised regions there are several which are concentrated on sectors of no importance *vis-à-vis* any of the trading areas or only important *vis-à-vis* one.

The labour markets which stand out in this study as most exchange-rate sensitive seem to be characterised in the main by the following features:

- They are small and the industry has a considerably higher employment share than the national average. They are dominated by one or two firms, or in one case, by networking small firms in a few dominant sectors.

- The leading industrial firms in these markets are in most cases active in mature and/or price-competitive sectors, in which economies of scale in the form of large plants or geographical concentration have a great influence on competitiveness.

- When classifying industrial firms as labour-intensive, capital-intensive and knowledge-intensive, the labour markets in question are dominated primarily by labour-intensive and secondarily by capital-intensive industries – a circumstance which further underlines the element of mature and/or price-competitive sectors.

5. The study has shown that changes in international demand measured in terms of GDP influence Swedish exports more than exchange-rate movements do. This probably means that in general, international demand also has stronger regional effects than exchange-rate changes have. Therefore the importance of the exchange rate should not be exaggerated under normal circumstances with floating exchange rates. This applies even more to exports to EMU countries than to the Rest of Western Europe and North America. The economic effects of possible Swedish membership of the EMU on Swedish industry will therefore probably be small from the pure exchange-rate perspective – with two important reservations:

- If the pattern of Swedish costs during membership of the EMU becomes higher than that of other EMU countries, Swedish industry will be exposed to competitive pressure of the type which it suffered during the fixed exchange-rate years of the early 1990s, which then resulted in a drastically reduced industrial employment.

- Exports to North America, on which the exchange rate has revealed itself to have the biggest effects measured in numbers employed in significant sectors, will in the event of Swedish EMU membership come under the influence of the euro's exchange rate against

the dollar. The same applies to exports to other trading areas, which show lower ex-change-rate sensitivity, however. But here too, whether this has any overall significance for Swedish exports probably depends mainly on how the pattern of internal costs develops.

Acknowledgements

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Endnotes

[1] Based on data from www.scb.se/ekonomi/nr/forsbalfast.asp, 2000-01-10.

[2] According to Friberg, R. & Vredin, A. (1996) the 100 largest exporting firms in Sweden accounted for 71.3 per cent of Swedish exports in 1994. This suggests on the one hand that exchange-rate risks are not a great problem for Swedish export industries. On the other hand the limited exports by small firms may mean that exchange-rate uncertainties are a big obstacle to smaller firms wanting to gain access to international markets.

[3] The first type of study is exemplified by e.g. Chowdbury, A. R. (1993) and Kongsted, H. C. (1998). For studies of bilateral trade, see e.g. Hayward, D. J. & Erickson, R. A. (1995), Hervey, J. L. & Strauss, W. A. (1998), Johansson, B. (1993) and Menon, J. (1992).

[4] Based on data from Oanda, http://www.oanda.com/converter. Extracted during the period 19990104-19990302.

[5] Hayward, D. J. & Erickson, R. A. (1995) present an alternative measure for measuring the magnitude of import competition.

[6] SNI 92 has six different levels of classification. The group level is the third finest and comprises a total of 222 items.

[7] A parameter is more effective the lower its variance, i.e. the confidence interval becomes narrower as effectiveness increases. A parameter is consistent if the probability distribution for the estimate approaches a single point as the field of choice becomes larger. The parameter thus also agrees asymptomatically with expectancy.

[8] In order to make the equations identified it was found necessary to enlarge the model by introducing two variables of explanation, viz the previous quarter's GDP and the previous quarter's export price.

[9] At the commencement of the statistical work (the regression runs), a so-called Breusch-Godfrey test was made on a selection of the equations. This test is intended to identify serial correlation of a higher degree than one, i.e. several quarters backwards in time. It appeared, however, that the serial correlation was of the first degree in almost all cases, and after that the serial correlation was tested only with the aid of a Durbin-Watson test.

[10] Alternative correction methods are Cochrane-Orcutt and Hildreth-Lu for example. These are usable mainly when it is not known in what form the serial correlation manifests itself. One of their drawbacks, however, is the risk that the estimate of the correlation coefficient may not minimse the so-called least square sums of the residuals, which in turn may mean that the solution will be local rather than global.

[11] Regionala konsekvenser av EU:s östutvidgning. SOU1997:160, p 11-12 and 116-118.