Stockholm School of Economics
Department of Economics
Bachelor Thesis

The Impact of Changes in the Value of the Krona on Swedish Exports

An Empirical Study on the Industry Level

Abstract

The impact of changes in the value of the krona on Swedish trade at the aggregated level has been well covered in empirical research papers over the years. The findings stemming from these papers have been highly mixed, showing no unambiguous support for the assumption that if the krona weakens, Swedish exports increase. In this thesis, we investigate this matter with the use of a more recent and less investigated approach, where data is disaggregated down to the industry level.

By applying first differenced regressions on export data from Sweden's 20 largest export industries, we find no evidence for the existence of a systematic relationship between the strength of the krona and these industries' export volumes. Furthermore, we can conclude that the impact of the krona on exports has undergone two changes since the year 2000: it has become less immediate, and its effect on the service sector has weakened.

Keywords: Swedish export, J-Curve, currency depreciation

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1. Introduction

1.1. Background

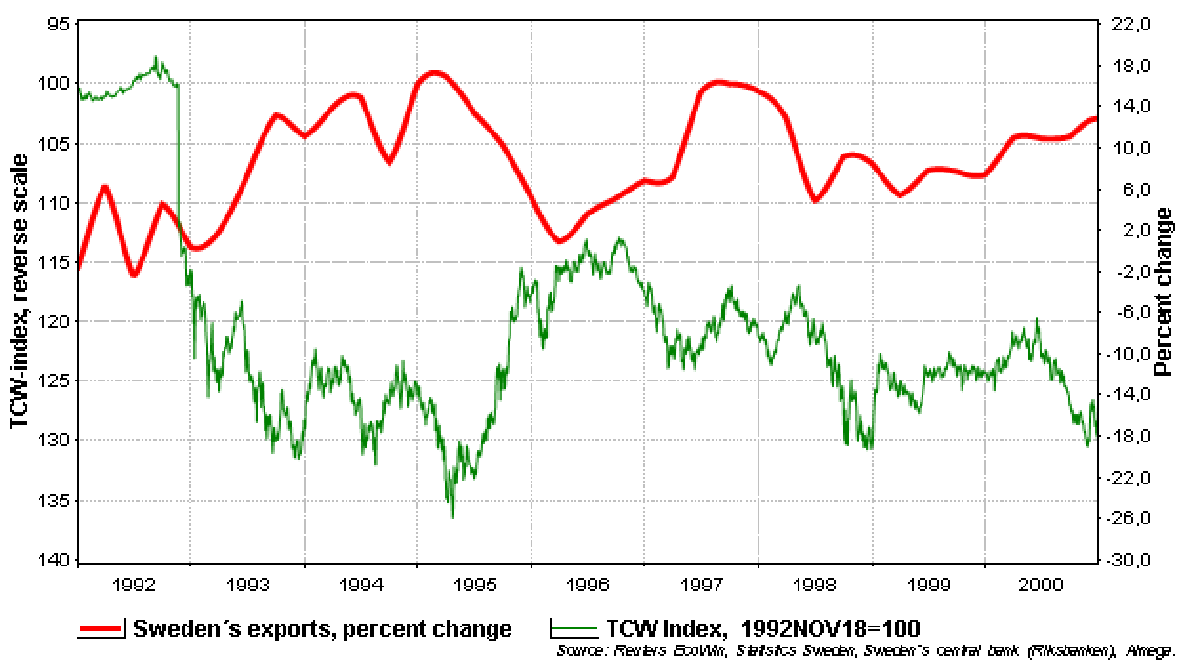
In late 2008, as the financial crisis struck the world market, the Swedish krona was depreciated with a whole 15 percent during only a few months time; a historically dramatic development (The Riksbank, 2009, p. 58). While such a turn of events naturally may be a cause for concern, one good thing is likely to come of it, at least according to many prominent economists; as the depreciation lowers the relative prices on Swedish goods and services, exports will be stimulated and increase. As exports have accounted for more than 45 percent of Sweden's total GDP during the last five years (Statistics Sweden, 2010a), such a development could very well be the determining factor behind a future uplift for the Swedish economy as a whole. The following statements, recently made by representatives from the Riksbank (Sweden's central bank) and the Swedish Trade Council, reflect this view:

> The weaker krona makes imports more expensive in krona at the same time as Swedish goods and services become less expensive for buyers abroad. This stimulates exports, which in turn strengthens the growth of GDP. The weakening of the krona acts as a shock absorber in the economy (…).
> (The Riksbank, 2009, p. 61)

> Sweden is an economy led by exports, and it is very important that we enter this recession with a relatively strong competitive power. That we gain further stimuli by a weakened krona is something I regard to be purely positive in a situation like this. [Interview with Mauro Gozzo, Chief Economist at the Swedish Trade Council, authors' own translation]
> (Fredriksson & Elowsson Tosting, 2008)

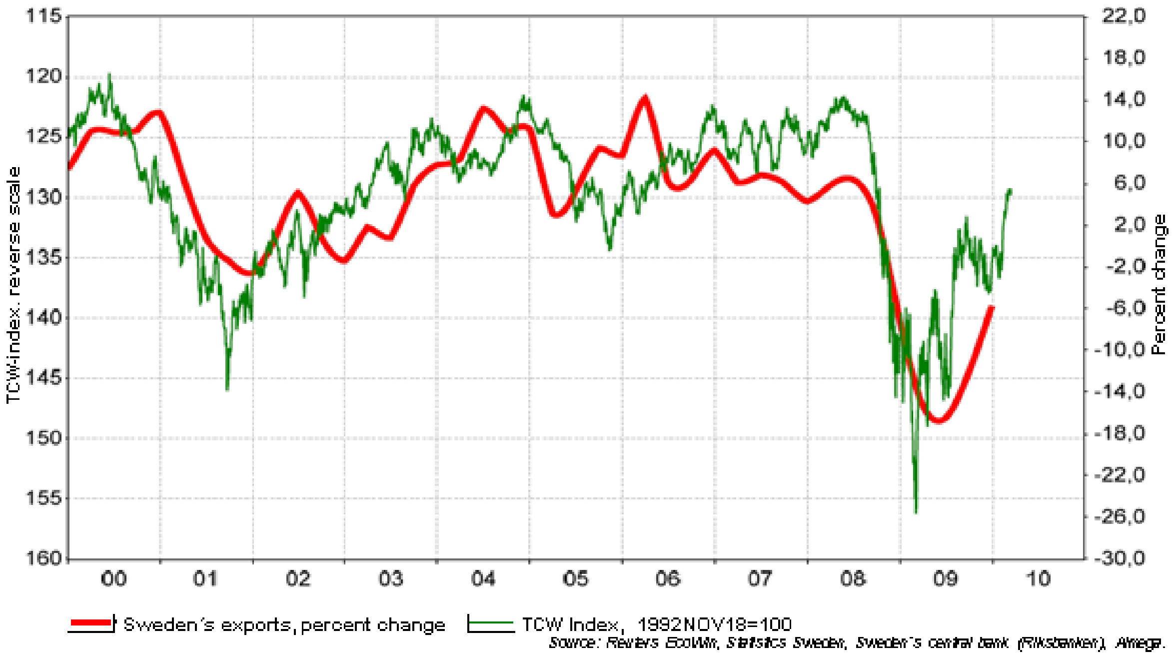
However, despite the fact that the reasoning promoted by institutions such as the Riksbank and the Swedish Trade Council is intuitively logical, it is not given that it is actually applicable on the current Swedish economy. Actually, there are primarily two factors indicating the opposite. Firstly, many previous studies have empirically investigated the impact of exchange rates on international trade, and from them, there is no one conclusion to draw regarding the effects from currency depreciation on exports. Instead, the results have been highly mixed – some studies support the theory that depreciation will lead to increased exports, whereas some studies entirely discard it. Secondly, despite the depreciation of the krona, total Swedish export volumes actually declined with 16 percent between February 2008 and February 2009 (Statistics Sweden, 2009, p. 5). To conclude, even if the reasoning regarding a stimulation of exports used to be applicable in the late 1960's, when it was introduced, it might have changed over time. This is explicitly suggested in a newly released business cycle forecast from Almega, Employer and Trade Organization for the Swedish Service Sector. In this forecast, the below diagrams are presented, indicating that even if a clear link between the strength of the Swedish krona and Swedish exports *did* exist during the 1990's, that link has been considerably weakened since the early 2000's.

Figure 1. The correlation between the Swedish effective exchange rate and Sweden's export growth for the period 1993 – 2000



Source: Almega Konjunkturprognos våren 2010 (2010), p. 17

Figure 2. The correlation between the Swedish effective exchange rate and Sweden's export growth for the period 2000 – 2010



Note: The TCW-index is a measure of the Swedish krona against a basket of other currencies. When the krona is weak, the TCW takes on a high value and vice versa.

Source: Almega Konjunkturprognos våren 2010 (2010), p. 18

1.2. Purpose

As reflected in the above section, the weakened krona and its predicted effects on exports is a much discussed topic in Sweden at the moment. Leading economists and politicians are explicitly pointing at the depreciation of the krona as a key to the upswing of the Swedish economy of today, despite the fact that this reasoning lacks consistent, empirical support. Therefore, we find it motivated to choose as the purpose of this paper to shed light over what impact the strength of the krona actually has had on exports from Sweden's main export industries since the krona became floating in 1992. Moreover, since Almega's statement regarding a potentially weakened relationship over time between the exchange rate and exports is very relevant in this context, we also wish to investigate this matter further.

2. Theoretical Framework and Previous Studies

We wish to clearly show in what ways this study goes beyond the scope of existing papers regarding exchange rates and its impact on trade patterns. To accomplish this, we consider it necessary to first of all provide the reader with a descriptive summary regarding the two theories that dominate the macroeconomic discussions regarding exchange rates and international trade patterns today; the so-called Marshall-Lerner condition (the ML condition) and the theory of the J-Curve. These two twin concepts constitute the base upon which the assumption that weak currencies lead to stimulated exports rests. After the presentation of these two theories, a review of relevant empirical studies that have been written with a purpose similar to ours will be presented. We conclude with a short summary of how our study differs from, and complements, its predecessors.

2.1. Theoretical Framework

2.1.1. The Marshall-Lerner Condition

The ML condition provides an elasticity-based explanation to how trade is affected by a depreciation of a country's currency. In brief, the ML condition states that the effect of depreciation depends on the demand elasticities of export and import, and it is given by the equation $n_{ex} + n_{im} > 1$ where n_{ex} and n_{im} denotes the price elasticities of demand for exports and imports with respect to exchange rates. If the sum of the elasticities is greater than 1, a depreciation of the currency is said to have a positive effect on the trade balance for that specific country. The reasoning behind the condition is that if demand for exports is highly elastic, it is very sensitive to price. This makes demand for exports increase drastically with a depreciation of the currency, since the depreciation lowers the relative price of the exports. The opposite goes for imports – a weak currency will decrease imports if the demand for it is highly elastic. In other words, high elasticities would result in an increase in exports and a decrease in imports as the currency weakens, thus improving the trade balance (Krugman & Obstfeld, 2009, p. 457 – 459). Studies have been made on the ML condition, showing that several countries satisfy it (see Bahmani-Oskooee & Niroomand, 1998). However, other studies have shown that even when the condition is fulfilled, it is only after a first, inevitable period of deterioration that the trade balance improves; it follows a J-shaped curve, in other words. This indicates that in the short-run, demand for imports and exports are more inelastic than in the long-run (Bahmani-Oskooee, 1985).

2.1.2. The J-Curve

The theory of the J-Curve was developed in an attempt to capture and explain this first period of deterioration and the J-Curve shape that it leads to. It can therefore be seen as a continuance of – or an overlapping complement to – the ML condition. According to Magee (1973), who was first to write about the J-Curve in an academic paper (see section 2.2.), there is one main reason to why the trade balance deteriorates immediately after depreciation: the “currency-contract” effect. This effect occurs in the brief period following immediately after currency depreciation, during which contracts negotiated prior to the change fall due. In this period, the value of exports, which is reported in the home currency, automatically decreases compared to the value of imports, which is reported in the foreign currency. This makes the trade balance deteriorate (Carlin & Soskice, 2006, p. 303). But why does the trade balance continue to deteriorate even after the initial period during which pre-negotiated contracts fall due? According to the theory of the J-Curve, the occurrence of lags is one of the central answers to that question.

Several forms of lags have been suggested. The most commonly referred to among these are the lags identified by Junz and Rhomberg (1973): lags in the recognition of the devaluation, in the decision to change real variables, in delivery time, in the replacement of inventories and materials, and in production. The “lag explanation” simply states that if trading countries had the possibility to give a quicker response to changed exchange rates, they would do so, thus causing a faster increase in exports from a country with a weakened currency. But because of the lags mentioned, their reaction inevitably gets held up.

2.2. Previous Studies

The purpose of our paper is closely related to that of previous J-Curve studies. These studies, as our, are aiming at clarifying how changes in countries’ currencies affect their trading patterns. Presenting a review of the J-Curve studies is therefore necessary in order to clarify in what ways our study complements current knowledge.

Magee has often been referred to as the introducer of the theory of the J-Curve, since he was the first to develop and, on a detailed level, describe the theory in an academic paper. Referring to him as the founder of the concept is, however, a mistake; when his paper was published, there had already been much discussion regarding the J-Curve phenomenon, in light of both the 1967 British and the 1972 U.S. devaluations (Magee, 1973). Magee refers to the following quotation from the Wall Street Journal (December 18, 1972) as an illustration of this:

> ’Buying patterns don’t change overnight because prices have changed’, a U.S. trade expert says. The effect on a nation’s trade caused by devaluation of its currency can be plotted in what economists call a J-curve, because the trade picture worsens before showing

improvement. ‘But when devaluation takes hold’, a British official says, recalling the pound’s devaluation in 1967, ‘the change can come quite suddenly’.

The Magee study investigated what implications adjustment lags (such as currency contracts, pass-through and quantity adjustments) have for a country’s trade balance. It was followed by the Junz and Rhomberg (1973) study, which further developed and supplemented the lag theories, by identifying the five forms of lags described in section 2.1.2.

It was not until in 1985 that a sustainable, empirical method for testing the J-Curve phenomenon was introduced, by Bahmani-Oskooee (1985). They used the following equation:

$$TB_t = a_0 + a_1Y_t + a_2YW_t + a_3M_t + a_4MW_t + \sum_i \{\beta_i (E/P)_{t-i}\} + u_t \quad \text{(Eq. 1)}$$

In this equation E/P is the exchange rate variable, where P is the domestic price level and E is the number of units of foreign currency per unit of domestic currency. The other explanatory variables are world income (YW_t), the level of domestic high powered money[1] (M_t) and the level of the rest of the world’s high powered money (MW_t). TB_t, the dependent variable, is the trade balance, defined as the difference between exports and imports. This equation has functioned as the starting point for more or less all of the later empirical studies looking at the J-Curve. The most common form of it today is one where the trade balance is defined as the ratio of imports to exports, a definition introduced by Bahmani-Oskooee and Alse (1994), as a way to express it in unit free terms. Furthermore, the explanatory variables most commonly used are proxies for domestic and foreign economic activity, an approach first used by Shirvani and Wilbratte (1997).

Most of the earlier studies that empirically tested the J-Curve did so using aggregate trade data (the sum of a country’s overall trade), an approach which still is quite commonly used. These papers resulted in highly mixed conclusions; some found no empirical support for the traditional J-Curve (see e.g. Flemingham, 1988; Rosensweig & Koch, 1988 or Zhang, 1996), some found supporting results (see e.g. Himarios, 1985; Bahmani-Oskooee, 1985; Lal & Lowinger, 2002 or Hacker &

[1] High powered money is another term for the monetary base of a country, i.e. the money which is under the direct control of the central bank, and consists of all currency in circulation, plus all bank deposits with the central bank.

Hatemi-J, 2003) and some came to contradictory conclusions (see e.g. Bahmani-Oskooee & Malixi,1992 or Bahmani-Oskooee & Alse, 1994).

In more recent studies, empirical tests have also been done on bilateral trade data, i.e. researchers have sought to determine the relationship between two, or more, specific countries. Rose and Yellen (1989) were first to use this bilateral approach, and several studies have followed their lead. The results from these studies are as mixed as those from the aggregate approach. While some found that the J-Curve is supported by empirical data (see e.g. Marwah & Klein, 1996 or Bahmani-Oskooee & Kantipong, 2001), others came to the opposite conclusion (see e.g. Bahmani-Oskooee & Brooks, 1999) and contradicting results (see e.g. Wilson, 2001; Bahmani-Oskooee & Goswami, 2003 or Bahmani-Oskooee & Ratha, 2007b). The main argument to why the bilateral approach is preferable to the aggregate one is that aggregate data can suppress the actual movements taking place on the bilateral level. This since improvements in a country's trade balance or currency in relation to one trading partner can be netted away by deterioration in the trade balance or currency in relation to another (Rose & Yellen, 1989).

Lately, yet another approach has entered the field; one where trade data is disaggregated by industry. This is a way of both avoiding the problems related to aggregate data and shed light on how the short- and long-run relation between exchange rates and trade patterns differs between industries. This approach has been used by several researchers during the last few years (see e.g. Bahmani-Oskooee & Ardalani, 2006; Bahmani-Oskooee & Ardalani, 2007; Bahmani-Oskooee & Hajilee, 2008 or Bahmani-Oskooee & Mitra, 2009). In the Bahmani-Oskooee and Ardalani (2006) study, it is not the trade balance, as captured by a ratio or a sum, but exports and imports separately, that are used as the dependent variables. The results from these studies show support for the J-Curve in only a few of many chosen industries.

2.3. Is the Current Knowledge Comprehensive Enough?

On the aggregated level, the relationship between exchange rate changes and trade is well covered by previous studies. When it comes to the approach where the data is disaggregated down to the industry level though, much remains to be done. Only one research paper has used this approach on Swedish trade: Bahmani-Oskooee and Hajile (2008). A limitation of their study is that it looks at trade between Sweden and the U.S. only, despite the fact that the U.S. actually represents only 6.5 percent of Sweden's total exports (Swedish Trade Council, 2009). By using Sweden's total exports as a starting point, and disaggregating it down to the industry level, more general conclusions about Swedish exports can be drawn. We intend to do so, thus providing new knowledge within this area of research. Moreover, no previous research paper has had as an explicit aim to investigate if the relationship between the exchange rate of the krona and Swedish exports has weakened over time. Including that aim in our purpose makes our study even more unique.

3. Delimitations and Research Questions

3.1. Delimitations

In order to study the relationship between exchange rates and exports in a reasonable way, it is necessary for us to impose certain delimitations on our study. Firstly, we need to decide which of Sweden's export industries to examine. We choose the 20 largest of these, as the export volumes of smaller industries vary a lot and quite often include missing values, which causes dubious results. Since the chosen industries represent 87.8 percent of Sweden's total exports, it is clearly enough to study only them and still get a good overall view of how exports and the exchange rate of the krona interact.

Secondly, we choose to focus only on the time period between 1993 and 2009. Up until 1992, Sweden had a system of fixed exchange rates, where the krona was first pegged to a basket of other currencies and later on pegged to the ecu, a calculated average of European currencies. After the financial instability in the beginning of the 1990's, the krona was set floating in 1992. Thus, by choosing 1993 as our base year, we have a consistent measure for the exchange rate over the whole period, and do not have to account for the effects of a changed financial system.

Finally, we choose to look at exports exclusively, instead of the trade balance. This makes our dependent variable deviate from the dependent variable used in most previous studies. It appears like Bahmani-Oskooee and Ardalani (2006) are the only ones to treat exports separately, in their research paper examining the effect of exchange rate fluctuations on exports and imports for 66 industries in the U.S. We choose to use this variable for several reasons. First of all, when using a country's trade balance as the dependent variable, actual development within export industries can get suppressed. For example, increased exports within one industry can get netted away by increased imports in another. Second of all, in order to draw conclusions regarding exports when using the trade balance as the dependent variable, thorough analysis regarding the exchange rate's effects on import prices needs to be made. Instead, we find it more straightforward to look at exports only, without the interference of the effects of import prices, as this allows us to distinguish if a weak currency in fact stimulates exports or not. Third of all, since we use data disaggregated by industry, using a ratio of exports to imports would be somewhat illogical, as the ratio for a specific industry says very little about the trade balance for a country as a whole. The drawback of our approach is that it makes it difficult to judge the existence of a J-Curve phenomenon, since the J-Curve theory was developed with regard to trade balance.

3.2. Research Questions

Having made these restrictions, we can move on to specifying three main research questions for this essay:

I. How have changes in the exchange rate of the krona affected exports from Sweden's 20 largest export industries since the krona was set free in 1992?

II. Do the observed effects go hand in hand with the classical, macroeconomic reasoning that currency depreciation stimulates exports, which is captured in e.g. the theory of the J-Curve?

III. Has the relationship between the exchange rate of the krona and exports from Sweden's 20 largest export industries weakened since the year 2000?

4. Method

In studying the relationship between exports and exchange rates, we intend to use a set-up similar to that used by previous researchers within this field. A country's exports and imports have usually been related not only to exchange rates, but also to levels of economic activity in both the domestic and foreign market. Here, we follow the same basic reasoning, and use, as the starting-point for our empirical study, the below regression equation:

$$\text{lnExport Volume}_{j,t} = \alpha + \beta \,\text{lnTCW}_t + \gamma \,\text{lnEMV}_t + \lambda \,\text{lnGDP}_t + u_t$$

(Eq. 2)

All variables are expressed as indices, which allow the use of logarithms. This gives us results in percentage rather than unit form, while it also makes the set-up less sensitive to units of measurement. In accordance with previous studies (see e.g. Bahmani-Oskooee & Hajilee, 2008) the log of Swedish real GDP (lnGDP_t) is used as a proxy for economic activity domestically, while the log of import volumes on Sweden's main export markets (lnEMV_t) function as our proxy for economic activity abroad. As the variable denoting exchange rate, we use a log of the TCW-index

(Total Competitiveness Weights, denoted $\ln TCW_t$ in our equation). The TCW-index is a measure of the value of the Swedish krona against a basket of other currencies. When the krona is weak, the TCW takes on a high value and vice versa. Our dependent variables ($\ln \text{Export Volume}_{j,t}$) are the log of export volumes from Sweden's 20 largest export industries. Further discussion of the chosen variables follows in section 5.

In our method, we follow the basic setup of Campa, Goldberg and Gonzáles-Mínguez (2005), and begin by testing if our processes have unit roots. When performing regressions on time series, the time series processes should ideally be stationary, so that its probability distributions are stable over time. With the occurrence of a unit root, the current value of a variable equals the previous period's value plus a weakly dependent disturbance; $Y_t = Y_{t-1} + \varepsilon_t$ (a non-stationary process). In a non-stationary time series process, the joint distributions are not constant over time, and this should be corrected for before the time series are used in regressions (Wooldridge, 2009, p.377-381). Earlier research by Hurlin (2004) shows that non-stationarity is a systematic feature of macro-economic time series. Thus, it is necessary for us to control for unit roots. We, as Campa et al., do this by performing an Augmented Dickey-Fuller test (ADF test) on as well our dependent as our explanatory variables. To find out if we should account for a trend in the ADF test, we plot all variables. By doing this, it becomes clear that all variables except industry 135 and TCW follow a trend over time (see Appendix B). Therefore, we use the ADF test with a trend on every variable except for these two. The hypothesis of the ADF test is that there is a unit root in the process, and this hypothesis will be rejected only if the observed value is lower than the critical Dickey-Fuller value. The results from the tests show that we can reject the hypothesis for only one of the industries (see Appendix C). Since this indicates that there are unit roots in close to all the processes, we introduce first differenced variables in our model, in order to achieve stationarity:

$$\Delta \ln \text{Export Volume}_{j,t} = \delta + \beta\, \Delta \ln TCW_t + \gamma\, \Delta \ln EMV_t + \lambda\, \Delta \ln GDP_t + \Delta u_t \qquad \text{(Eq. 3)}$$

In order to detect if there are any delayed effects of exchange rate fluctuations, lags of the explanatory variables have to be included in the model. Before being able to specify the final model, we select the appropriate amount of lags based on the Akaike Information Criterion.[2] After performing the regressions with between zero and four lags, the AIC-criterion shows that for a majority of the industries, four lags are to prefer (see Appendix D). We wish to apply the same number of lags on all industries for maximized comparability and therefore choose to use four lags in all regressions. Based upon this, our final equation can be specified as follows:

$$\Delta \ln \text{Export Volume}_{j,t} = \delta + \sum_{k=0}^{4} \beta_k \Delta \ln TCW_{t-k} + \sum_{k=0}^{4} \gamma_k \Delta \ln EMV_{t-k} + \sum_{k=0}^{4} \lambda_k \Delta \ln GDP_{t-k} + \Delta u_t$$

(Eq. 4)

Since we want to see if there are any differences over time, we initially perform regressions for the whole period, 1993-2009, and then continue by performing the same regressions again, but divided into the time periods 1993-1999 and 2000-2009. As a final test of the validity of the regression equations, we conduct a Ramsey Regression Equation Specification Error Test (RESET-test) for each industry (See Appendix E). The RESET-test controls for misspecification of the equation, with the null hypothesis being that there are no omitted variables of the model. The hypothesis could be rejected on a 5 percent significance level for only two of the 20 industries (134 and 261). Based upon this, we regard Eq. 4 to be adequate for the purpose of this study.

5. Data

In the following sections, we will present the data used in our regressions. The data comes from the Riksbank, Statistics Sweden and Oxford Economic Forecasting. We deem all of these sources to be reliable, and see no need for concern regarding the validity of our numbers.

5.1. The Dependent Variable

For our dependent variables (export volumes from the 20 largest export industries in Sweden), we use a data set on Swedish trade, disaggregated to the two-digit product group level according to SPIN, provided by Statistics Sweden (2010c). With the use of annual volume growth rates between a specific quarter and the same corresponding quarter the previous year, we construct an index for each industry's exports, with the first quarter of 1993 as baseline. The advantage of using indices based on

[2] The AIC is a measure of the goodness of fit of an estimated statistical model. Given a data set, alternative models are ranked according to their AIC value, with the one having the lowest AIC value being regarded as the best fit.

actual volume growth rather than monetary volume is that we sidestep the issue of nominal versus real prices. Our sample is arranged so that the industries within the service sector are denoted "2XX", whereas the industries in the goods sector are denoted "1XX". To see what number corresponds to which industry, see Appendix A.

However, in order to perform Regressions D and E (see section 6.3.), we also need to look at exports on an aggregated level. This imposes some challenges, as we do not have any annual aggregated growth rate for these specific 20 industries. In theory, we could apply the same approach here as we did on the industry variables. We would then first have to make total exports in the first quarter of 1993 our base year for an index, and then create a weighted average annual growth rate for each quarter, with weights based upon each industry's part of total exports in every quarter. However, as we feel this measure would be highly arbitrary, we instead choose to include an additional dependent variable; the sum of exports from the 20 industries, expressed in monetary terms. This variable is based upon the same two-digit SPIN data as the disaggregated variables. To avoid biased results caused by nominal values, we deflate the monetary values with CPI, using the first quarter in 1993 as the reference time period (Statistics Sweden, 2010e).

5.2. The Explanatory Variables

5.2.1. The Exchange Rate Variables

The choice of a variable denoting exchange rate is rather complex. Other researchers typically use real exchange rate (RER), a measure introduced by Himarios (1985). RER accounts for both the nominal exchange rate and inflation differences between countries. It can either be defined on the basis of Purchase Power Parity or on the basis of tradable and non-tradable goods. In short, both approaches compare the domestic price level to the foreign price level, in order to determine relative competitiveness between countries. However, both definitions rely on the assumption that a country only has one trading partner. As this assumption is not compatible with the real world, a real effective exchange rate is usually calculated by the use of some kind of weighting criteria. For example, different foreign countries' share of total trade volume can serve as weights in a calculated real effective exchange rate (Kıpıcı & Kesriyeli, 1997). As we are not looking at bilateral trade, but at Swedish trade with the rest of the world, the validity of such a calculation would be questionable. This is the reason to why we use a quarterly average of the TCW-index (The Riksbank, 2010).

The signs of the exchange rate coefficients are an important part of our study. If there is a direct positive response in export volume to currency depreciation, we expect the first lag of the exchange rate coefficient to be positive, since the TCW index increases when the krona weakens. However, if the export pattern instead follows a J-curve, the estimate of β_k should be negative at lower lags and positive at higher lags. As for the regressions divided into two time periods, if the hypothesis that the relationship between exchange rates and exports has weakened is to hold, we expect the coefficients of the TCW variable to be less significant in the later period than in the first.

5.2.2. The Control Variables

Domestic Economic Activity

Among researchers who try to establish a link between exchange rates and trade patterns, the measure most commonly used to express domestic economic activity is a country's real GDP (first used by Rose and Yellen, 1989).When looking at the trade balance, GDP is typically considered to function primarily as a demand variable, since if the domestic national income increases, the demanded import volumes usually increase to a larger extent than the supplied export volumes do. This as, in the short-run, the production of exports is limited by production capacity restrictions. In studies looking at the trade balance, the expected sign of the GDP coefficient is therefore usually negative. However, the increase in exports *can* in some cases be larger than that in imports. In such cases, the sign of the GDP coefficient would be positive. As we in this study look only at exports, it is not relevant for us whether the increase is larger in imports than in exports. The relevant part of the above reasoning is instead simply that an increase in GDP should correspond to increased exports, so we expect the signs of our GDP variables to be positive. For our GDP variable, we have used quarterly data collected from Statistics Sweden (2010f). The data was initially expressed in constant prices with reference year 2000, but we transformed it into an index, with the first quarter of 1993 as baseline.

Economic Activity Abroad

When using the bilateral approach, the choice of a proxy for economic activity abroad is straightforward; one simply uses the foreign country's GDP. When using the aggregate approach though, it becomes more complicated, as the proxy needs to capture not only one, but all trading partners' economic activity. We have solved this by using an index for seasonally adjusted import volumes on Sweden's main export markets, on a quarterly basis, weighted based upon their share of Sweden's total exports. Again, the baseline for the index is set to the first quarter of 1993. The data comes from Oxford Economic Forecasting (Oxford Economic Forecasting, 2010).

The expected effect of an increase in foreign national income, when looking at the trade balance, is that the demand for the home country's exports increase, which improves the trade balance. However, as in the case of domestic national income, the effect can be reversed. This if the increase in economic activity abroad increases foreign supply capacity to a larger extent than foreign demand for the home country's exports. This would have a negative effect on the domestic trade balance (Hacker & Hatemi-J, 2003). When it comes to our study, where exports exclusively are used as the dependent variable, we expect the sign of the economic activity abroad variable to be positive, as an increased economic activity should lead to increased demand for imports in foreign countries.

6. Results

We wish to make the presentation of our results as easy as possible for the reader to follow. Therefore, we will use the same presentational set-up for each of the regression that we have performed. Firstly, we will provide an introductory overview regarding the intention with the specific regression. We continue with a brief discussion regarding the coefficients corresponding to the control variables Swedish GDP and Export Market Volume. Finally, we more thoroughly present the coefficients corresponding to our variables in focus; the exchange rate variables. Please note that as the results do not fit into one table, we have chosen to present the exchange rate estimates and the estimates of the control variables in different tables.

Again following the setup of Campa et al., we define the short-run effect of changes in the exchange rate as the coefficients of the TCW variable, while we define the long-run effect as the sum of the TCW coefficient and its' four lags, i.e. $\sum_{k=0}^{4} \beta_k$. We test the significance of the long-run estimate by F-testing the TCW variable and its lags for joint significance. Worth mentioning before the presentation of all regressions is that the size of the R^2 values indicates a good fit for most of the regressions (R^2 is larger than, or equal to, 0.7 in a majority of the regressions).

6.1. Regressions A: The Impact of the Exchange Rate in the Period 1993-2009

In these regressions we estimate Eq. 4 for each of our 20 industries, by using the disaggregated volume data for the whole period between 1993 and 2009. The aim with this is to see what overall impact the exchange rate of the krona has had on exports from Sweden's 20 largest export industries since the krona became floating. The results from the regressions are presented below, in Table 1 and 2.

Table 1.

Regressions for the 1993 – 2009 period on the industry level: TCW variables.

Industry	**Δ lnTCW**		**Δ $lnTCW_{t-1}$**		**Δ $lnTCW_{t-2}$**		**Δ $lnTCW_{t-3}$**		**Δ $lnTCW_{t-4}$**		**Long-run**	**Joint sign.**
115	0.420	*(0.124)*	-0.314	*(0.249)*	-0.024	*(0.929)*	0.066	*(0.805)*	-0.370	*(0.181)*	-0.223	*(0.250)*
120	-0.279	*(0.299)*	****0.437**	*(0.081)*	-0.168	*(0.508)*	0.016	*(0.947)*	-0.302	*(0.248)*	-0.296	*(0.389)*
121	-0.100	*(0.575)*	0.118	*(0.471)*	-0.208	*(0.222)*	0.061	*(0.711)*	0.171	*(0.324)*	0.043	*(0.581)*
123	0.197	*(0.775)*	0.244	*(0.701)*	-0.867	*(0.189)*	0.262	*(0.681)*	-0.426	*(0.526)*	-0.589	*(0.770)*
124	-0.047	*(0.863)*	0.247	*(0.322)*	-0.181	*(0.481)*	-0.187	*(0.453)*	0.251	*(0.340)*	0.083	*(0.615)*
125	-0.049	*(0.836)*	-0.239	*(0.273)*	-0.113	*(0.614)*	-0.001	*(0.996)*	-0.044	*(0.847)*	-0.446	*(0.817)*
127	-0.294	*(0.288)*	***-0.564**	*(0.030)*	-0.268	*(0.309)*	0.188	*(0.461)*	0.389	*(0.150)*	***-0.549**	*(0.011)*
128	0.396	*(0.151)*	***-0.646**	*(0.013)*	-0.221	*(0.395)*	0.189	*(0.454)*	0.280	*(0.293)*	***-0.002**	*(0.012)*
129	0.057	*(0.753)*	-0.073	*(0.659)*	****-0.325**	*(0.062)*	***0.336**	*(0.048)*	-0.194	*(0.271)*	-0.200	*(0.149)*
131	****-0.758**	*(0.057)*	-0.006	*(0.988)*	-0.087	*(0.815)*	****0.703**	*(0.056)*	***-1.600**	*(0.000)*	***-1.747**	*(0.002)*
132	-0.890	*(0.224)*	0.636	*(0.345)*	-0.637	*(0.358)*	-0.305	*(0.649)*	0.049	*(0.944)*	-1.147	*(0.663)*
133	*** 0.815**	*(0.012)*	0.031	*(0.915)*	0.078	*(0.793)*	0.291	*(0.317)*	0.048	*(0.873)*	1.263	*(0.132)*
134	0.143	*(0.719)*	***-0.932**	*(0.014)*	0.066	*(0.862)*	0.210	*(0.567)*	0.186	*(0.629)*	-0.326	*(0.114)*
135	-0.947	*(0.581)*	1.303	*(0.411)*	-0.755	*(0.643)*	0.082	*(0.959)*	-2.392	*(0.155)*	-2.708	*(0.680)*
261	0.560	*(0.515)*	-0.496	*(0.532)*	0.315	*(0.700)*	-0.396	*(0.618)*	-0.206	*(0.805)*	-0.223	*(0.956)*
263	***1.987**	*(0.013)*	-0.195	*(0.786)*	0.411	*(0.578)*	-0.380	*(0.597)*	0.162	*(0.830)*	1.985	*(0.240)*
272	***2.067**	*(0.029)*	-0.532	*(0.534)*	0.207	*(0.814)*	0.601	*(0.483)*	-0.514	*(0.569)*	1.829	*(0.240)*
274	****0.698**	*(0.099)*	****0.675**	*(0.083)*	***-0.991**	*(0.015)*	0.594	*(0.127)*	-0.580	*(0.156)*	***0.397**	*(0.013)*
299	***1.287**	*(0.007)*	-0.037	*(0.930)*	0.191	*(0.664)*	-0.278	*(0.517)*	0.233	*(0.605)*	1.396	*(0.153)*
25A	1.062	*(0.169)*	-0.920	*(0.196)*	0.338	*(0.642)*	-0.051	*(0.942)*	0.922	*(0.218)*	1.351	*(0.464)*

No. of observations per industry: 67
**=significant on the 5% level*
***=significant on the 10% level*
Note: Numbers inside parentheses are the p-values for each obs. (P>t). Δ $lnTCW_{t-k}$ is defined as the log of the first-differenced value of the TCW index, which is measured on a quarterly basis. The long-run variable is defined as $\sum_{k=0}^{4} \beta_k$, and the joint significance is based upon an F-test for the short-run variables.

Table 2. Regressions for the 1993 – 2009 period on the industry level: Control Variables and R^2

Ind.	Const.		Δ lnEMV		Δ lnEMV$_{t-1}$		Δ lnEMV$_{t-2}$		Δ lnEMV$_{t-3}$		Δ lnEMV$_{t-4}$	
115	0.010	*(0.304)*	0.401	*(0.267)*	0.137	*(0.715)*	0.141	*(0.735)*	-0.409	*(0.299)*	0.641	*(0.119)*
120	-0.002	*(0.716)*	0.123	*(0.717)*	-0.370	*(0.108)*	0.080	*(0.724)*	0.190	*(0.374)*	0.209	*(0.293)*
121	-0.001	*(0.800)*	0.366	*(0.108)*	-0.149	*(0.327)*	-0.006	*(0.966)*	0.037	*(0.793)*	0.051	*(0.699)*
123	0.007	*(0.689)*	-0.511	*(0.558)*	-0.294	*(0.616)*	0.010	*(0.987)*	0.109	*(0.843)*	0.152	*(0.766)*
124	0.008	*(0.266)*	0.089	*(0.794)*	-0.101	*(0.660)*	0.244	*(0.287)*	**0.464**	*(0.035)*	0.283	*(0.160)*
125	-0.003	*(0.605)*	0.429	*(0.153)*	0.030	*(0.882)*	0.294	*(0.143)*	**0.393**	*(0.040)*	**0.673**	*(0.000)*
127	-0.009	*(0.218)*	**0.642**	*(0.070)*	-0.154	*(0.512)*	**0.483**	*(0.043)*	**0.513**	*(0.023)*	0.090	*(0.660)*
128	**-0.016**	*(0.022)*	0.509	*(0.144)*	-0.150	*(0.519)*	0.182	*(0.433)*	0.072	*(0.740)*	**0.747**	*(0.000)*
129	**-0.010**	*(0.027)*	**0.965**	*(0.000)*	0.026	*(0.868)*	0.147	*(0.338)*	0.039	*(0.787)*	0.150	*(0.263)*
131	0.008	*(0.403)*	0.323	*(0.514)*	0.505	*(0.133)*	0.221	*(0.505)*	-0.001	*(0.998)*	**0.528**	*(0.072)*
132	0.018	*(0.342)*	1.211	*(0.191)*	0.489	*(0.430)*	0.393	*(0.524)*	-0.068	*(0.906)*	0.749	*(0.167)*
133	-0.005	*(0.530)*	**0.687**	*(0.087)*	0.056	*(0.834)*	0.144	*(0.588)*	-0.029	*(0.908)*	0.143	*(0.538)*
134	**-0.022**	*(0.034)*	**1.523**	*(0.004)*	0.053	*(0.875)*	0.480	*(0.158)*	0.272	*(0.393)*	0.078	*(0.791)*
135	-0.040	*(0.357)*	1.819	*(0.403)*	-0.238	*(0.870)*	-0.193	*(0.894)*	0.992	*(0.470)*	0.275	*(0.828)*
261	0.001	*(0.970)*	-0.810	*(0.457)*	-0.006	*(0.994)*	-0.475	*(0.515)*	-0.237	*(0.730)*	0.615	*(0.335)*
263	-0.014	*(0.477)*	0.948	*(0.337)*	-0.292	*(0.659)*	-0.261	*(0.692)*	-0.186	*(0.764)*	0.613	*(0.288)*
272	0.007	*(0.772)*	1.840	*(0.120)*	0.110	*(0.889)*	0.173	*(0.825)*	-0.012	*(0.987)*	-0.839	*(0.224)*
274	0.011	*(0.311)*	-0.130	*(0.805)*	0.073	*(0.838)*	0.196	*(0.579)*	0.104	*(0.755)*	0.025	*(0.934)*
299	0.012	*(0.301)*	0.628	*(0.286)*	0.005	*(0.989)*	**-0.882**	*(0.028)*	-0.033	*(0.929)*	**0.664**	*(0.057)*
25A	0.017	*(0.371)*	0.960	*(0.323)*	0.503	*(0.441)*	0.473	*(0.467)*	0.250	*(0.683)*	-0.528	*(0.352)*

Ind.	Δ lnGDP		Δ lnGDP$_{t-1}$		Δ lnGDP$_{t-2}$		Δ lnGDP$_{t-3}$		Δ lnGDP$_{t-4}$		R^2
115	**0.009**	*(0.019)*	-0.003	*(0.482)*	-0.001	*(0.899)*	0.000	*(0.965)*	**-0.008**	*(0.048)*	0.752
120	**0.011**	*(0.005)*	0.003	*(0.513)*	0.000	*(0.965)*	-0.004	*(0.285)*	-0.003	*(0.376)*	0.909
121	0.002	*(0.351)*	0.002	*(0.493)*	0.001	*(0.825)*	-0.001	*(0.783)*	-0.002	*(0.334)*	0.400
123	0.011	*(0.262)*	0.007	*(0.507)*	-0.004	*(0.736)*	-0.002	*(0.885)*	-0.001	*(0.934)*	0.435
124	**0.008**	*(0.035)*	0.001	*(0.772)*	-0.004	*(0.312)*	**-0.008**	*(0.068)*	**-0.008**	*(0.033)*	0.693
125	**0.009**	*(0.011)*	-0.002	*(0.637)*	-0.005	*(0.216)*	**-0.009**	*(0.013)*	**-0.013**	*(0.000)*	0.736
127	**0.011**	*(0.006)*	0.003	*(0.429)*	**-0.009**	*(0.035)*	**-0.012**	*(0.008)*	-0.004	*(0.253)*	0.913
128	**0.021**	*(0.000)*	0.002	*(0.670)*	-0.001	*(0.777)*	-0.003	*(0.450)*	**-0.016**	*(0.000)*	0.830
129	**0.009**	*(0.000)*	-0.002	*(0.522)*	-0.002	*(0.393)*	-0.002	*(0.400)*	-0.002	*(0.390)*	0.953
131	0.002	*(0.693)*	-0.009	*(0.148)*	-0.004	*(0.500)*	-0.004	*(0.472)*	-0.006	*(0.270)*	0.682
132	0.010	*(0.328)*	-0.012	*(0.291)*	-0.006	*(0.617)*	-0.003	*(0.795)*	-0.014	*(0.163)*	0.506
133	**0.011**	*(0.012)*	-0.003	*(0.589)*	-0.002	*(0.614)*	0.001	*(0.908)*	-0.003	*(0.540)*	0.854
134	**0.014**	*(0.013)*	-0.001	*(0.895)*	-0.010	*(0.124)*	-0.008	*(0.193)*	-0.002	*(0.665)*	0.904
135	0.003	*(0.883)*	0.010	*(0.712)*	-0.001	*(0.970)*	-0.012	*(0.651)*	0.000	*(0.993)*	0.298
261	0.012	*(0.293)*	0.003	*(0.799)*	0.013	*(0.336)*	0.005	*(0.688)*	-0.012	*(0.305)*	0.295
263	0.007	*(0.503)*	0.002	*(0.895)*	0.008	*(0.503)*	0.005	*(0.698)*	-0.012	*(0.275)*	0.390
272	-0.005	*(0.718)*	0.000	*(0.995)*	-0.002	*(0.886)*	0.002	*(0.885)*	0.012	*(0.358)*	0.291
274	**0.010**	*(0.080)*	-0.002	*(0.758)*	-0.001	*(0.839)*	-0.001	*(0.868)*	-0.004	*(0.479)*	0.735
299	-0.010	*(0.105)*	-0.003	*(0.634)*	**0.018**	*(0.016)*	0.004	*(0.558)*	**-0.013**	*(0.056)*	0.921
25A	0.003	*(0.746)*	-0.006	*(0.587)*	-0.010	*(0.406)*	-0.003	*(0.821)*	-0.001	*(0.954)*	0.371

Note: Numbers inside parentheses are the p-values for each obs. (P>t). Bold coefficients are significant on at least the 10% level. Δ $lnEMV_{t-k}$ and Δ $lnGDP_{t-k}$ are defined as the log of the first-differences values of the export market volumes and Sweden's GDP, respectively. For further details on the control variables, see section 5.2.

6.1.1. The Control Variables

Beginning by looking at the Export Market Volume variable (Δ lnEMV_{t-k}), we find that at least one of the short-run coefficients is significant at the ten percent significance level for nine of the 20 industries (124, 125, 127, 128, 129, 131, 133, 134 and 299). This implies that the Export Market Volume plays a larger role for some of the industries than it does for others. It is reasonable, as some industries are more dependent on growth and cyclical demand in export markets than others. The industry for which Export Market Volume plays the largest role is industry 134, *Motor driven vehicles, transport equipment*. Its dependency was well illustrated during the 2008-2009 financial crises, when the Swedish car industry was struggling for survival. The decrease in exports from this industry can be viewed in Figure 3 (see Appendix F). Furthermore, all of the coefficients – except that for industry 299 – carry a positive sign, which means that an increase in the Export Market Volume generally has a positive effect on Swedish exports.

Continuing with the Swedish GDP variable (Δ lnGDP_{t-k}), we find that at least one of the short-run coefficients is significant at the ten percent significance level for 11 of the 20 industries (115, 120, 124, 125, 127, 128, 129, 133, 134, 274 and 299). Thus, GDP can be considered a relevant factor for exports from the majority of Sweden's main export industries. All of the coefficients – except one of the two significant coefficients for industry 299 – carry a negative sign. This seems intuitively illogical, since exports account for a large part of Sweden's GDP, so increases in the GDP should correspond to increases in exports – not the opposite. However, as the signs are of a very marginal magnitude (they range from -0.008 to -0.022), they should not be over-interpreted. One possible explanation is that a raised GDP goes hand in hand with increases in domestic demand. If this is the case, Swedish buyers start competing with foreign buyers for domestically produced goods and services when the GDP increases. As a result of this, some of these goods and services get sold inside of Sweden instead of to foreign trading partners, and thus exports decrease.

6.1.2. The Exchange Rate Variable

Consider first the short-run exchange rate variable (Δ lnTCW_{t-k}) results. For eleven of the 20 industries – industry 120, 127, 128, 129, 131, 133, 134, 263, 272, 274 and 299 – at least one of the short-run coefficients is significant at the ten percent significance level. This indicates that a weakened krona has a short-run impact on these industries' exports. However, the sign of the significant short-run coefficients differs widely; while it is positive for five out of six of them (133, 263, 272, 274 and 299) in the immediate period, it is both negative and positive in the following periods, following no systematic pattern, such as a J-Curve. The significant coefficients are consistently positive in only five of the industries (120, 133, 263, 272 and 299). So it seems that for these industries only, a depreciation of the krona has a purely positive short-run impact on exports. These industries belong to both the goods- and the service sector, and we can distinguish no common industry attribute among them.

From the long-run exchange rate estimates, defined as the sum of the coefficients for all TCW variables for each industry ($\sum_{k=0}^{4} \beta_k$), we gather that the exchange rate has an impact on exports at the ten percent significance level in only four of the 20 industries; 127, 128, 131 and 274. Only one of these estimates, that for industry 274 (*Business services)*, carries a positive sign. The negative signs of the other three (*Metals*, *Metal goods* and *Other electrical machines and articles*) can be explained by the fact that all these industries are heavily dependent on imported input goods (Statistics Sweden, 2009, p. 5). As the krona weakens, the imported inputs become more expensive in domestic terms. This can have both a negative effect on production and make export prices increase rather than decrease as a result of the currency depreciation.

Based upon the above results, we find no strong support for the assumption that a depreciation of the krona is likely to stimulate exports from Sweden's main export industries in the long-run.

6.2. Regressions B and C: Impact of the Exchange Rate Over Time

In order to see if the relationship between the strength of the krona and Sweden's export has changed over time, we once again estimate Eq. 4, but for the 1993-1999 and 2000-2009 periods separately. We use the same disaggregated volume data as before.

6.2.1. Regressions B 1993-1999

The results from the regressions covering the 1993-1999 period are presented below, in Table 3 and 4.

Table 3. Regressions for the 1993-1999 period on the industry level: TCW variables.

Industry	Δ lnTCW		Δ lnTCW$_{t-1}$		Δ lnTCW$_{t-2}$		Δ lnTCW$_{t-3}$		Δ lnTCW$_{t-4}$		Long-run	Joint sign.
115	0.274	*(0.367)*	-0.272	*(0.325)*	****<u>-0.555</u>**	*(0.068)*	-0.238	*(0.372)*	***<u>-0.996</u>**	*(0.009)*	***<u>-1.786</u>**	*(0.033)*
120	****<u>-0.642</u>**	*(0.085)*	-0.008	*(0.981)*	-0.081	*(0.826)*	-0.550	*(0.133)*	****<u>-0.663</u>**	*(0.096)*	-1.943	*(0.167)*
121	-0.256	*(0.459)*	-0.114	*(0.732)*	-0.502	*(0.181)*	-0.241	*(0.484)*	-0.102	*(0.779)*	-1.216	*(0.677)*
123	-0.286	*(0.783)*	0.877	*(0.393)*	-1.912	*(0.101)*	1.093	*(0.303)*	-1.030	*(0.362)*	-1.257	*(0.497)*
124	-0.264	*(0.441)*	0.400	*(0.240)*	-0.526	*(0.159)*	0.050	*(0.883)*	-0.286	*(0.435)*	-0.626	*(0.598)*
125	-0.110	*(0.830)*	-0.424	*(0.403)*	-0.306	*(0.574)*	-0.277	*(0.590)*	-0.488	*(0.381)*	-1.604	*(0.823)*
127	***<u>-0.809</u>**	*(0.018)*	-0.136	*(0.641)*	-0.335	*(0.297)*	-0.403	*(0.192)*	-0.211	*(0.510)*	-1.894	*(0.113)*
128	0.416	*(0.157)*	***<u>-0.759</u>**	*(0.016)*	****<u>0.520</u>**	*(0.100)*	-0.397	*(0.174)*	0.406	*(0.194)*	0.186	*(0.112)*
129	-0.236	*(0.403)*	0.168	*(0.539)*	-0.015	*(0.958)*	0.226	*(0.423)*	-0.159	*(0.596)*	-0.017	*(0.897)*
131	***<u>-1.300</u>**	*(0.017)*	-0.328	*(0.484)*	-0.250	*(0.619)*	0.789	*(0.116)*	***<u>-1.375</u>**	*(0.018)*	***<u>-2.464</u>**	*(0.033)*
132	-0.845	*(0.250)*	****<u>1.349</u>**	*(0.072)*	-0.060	*(0.936)*	-0.277	*(0.698)*	0.056	*(0.941)*	0.224	*(0.319)*
133	***<u>0.873</u>**	*(0.043)*	-0.122	*(0.750)*	-0.105	*(0.799)*	0.360	*(0.364)*	-0.407	*(0.340)*	0.600	*(0.149)*
134	0.627	*(0.377)*	-0.585	*(0.397)*	0.166	*(0.821)*	-0.021	*(0.976)*	0.207	*(0.781)*	0.394	*(0.897)*
135	0.277	*(0.904)*	0.062	*(0.978)*	0.113	*(0.963)*	0.001	*(1.000)*	-3.288	*(0.197)*	-2.834	*(0.777)*
261	0.017	*(0.982)*	-0.461	*(0.547)*	-0.513	*(0.536)*	0.099	*(0.899)*	-0.861	*(0.313)*	-1.719	*(0.828)*
263	***<u>2.051</u>**	*(0.006)*	-0.432	*(0.482)*	0.754	*(0.265)*	-0.524	*(0.406)*	0.348	*(0.604)*	2.197	*(0.107)*
272	1.021	*(0.430)*	-0.180	*(0.885)*	0.029	*(0.983)*	-0.304	*(0.812)*	-1.053	*(0.446)*	-0.487	*(0.864)*
274	0.482	*(0.386)*	0.314	*(0.559)*	-0.982	*(0.109)*	**<u>1.058</u>**	*(0.073)*	-0.450	*(0.447)*	0.421	*(0.170)*
299	***<u>2.121</u>**	*(0.002)*	-0.822	*(0.124)*	0.449	*(0.418)*	0.136	*(0.793)*	0.497	*(0.378)*	***<u>2.382</u>**	*(0.024)*
25A	0.625	*(0.442)*	-0.010	*(0.990)*	0.866	*(0.318)*	-0.642	*(0.429)*	0.180	*(0.834)*	1.019	*(0.835)*

No. of observations: 67 per industry.
**=significant on the 5% level*
***=significant on the 10% level*

Note: Numbers inside parentheses are the p-values for each obs. (P>t). Δ $lnTCW_{t-k}$ is defined as the log of the first-differenced value of the TCW index, on a quarterly basis. The long-run variable is defined as $\sum_{k=0}^{4} \beta_k$, and the joint significance is based upon an F-test for the short-run variables.

Table 4. Regressions for the 1993-1999 period on the industry level: Control Variables and R^2.

Ind.	Constant		Δ lnEMV		Δ lnEMV$_{t-1}$		Δ lnEMV$_{t-2}$		Δ lnEMV$_{t-3}$		Δ lnEMV$_{t-4}$	
115	-0.049	*(0.199)*	1.205	*(0.193)*	**2.045**	*(0.005)*	-0.303	*(0.704)*	**-2.323**	*(0.003)*	0.955	*(0.342)*
120	**-0.049**	*(0.023)*	**2.568**	*(0.012)*	**-0.877**	*(0.024)*	-0.519	*(0.112)*	-0.236	*(0.436)*	0.024	*(0.944)*
121	-0.029	*(0.144)*	**1.734**	*(0.063)*	-0.438	*(0.212)*	-0.229	*(0.452)*	-0.169	*(0.568)*	-0.149	*(0.660)*
123	0.025	*(0.666)*	-1.557	*(0.553)*	-0.592	*(0.567)*	-0.136	*(0.882)*	-0.521	*(0.561)*	0.449	*(0.662)*
124	0.018	*(0.350)*	-0.944	*(0.279)*	-0.316	*(0.354)*	0.280	*(0.357)*	0.341	*(0.254)*	**0.785**	*(0.035)*
125	-0.033	*(0.255)*	1.594	*(0.230)*	-0.422	*(0.412)*	0.011	*(0.981)*	0.102	*(0.816)*	**0.891**	*(0.099)*
127	**-0.047**	*(0.013)*	**2.302**	*(0.009)*	**-0.749**	*(0.024)*	-0.016	*(0.952)*	0.288	*(0.273)*	0.072	*(0.806)*
128	**-0.043**	*(0.015)*	**2.066**	*(0.012)*	-0.264	*(0.351)*	-0.087	*(0.727)*	0.096	*(0.692)*	**0.565**	*(0.061)*
129	-0.024	*(0.136)*	**1.527**	*(0.047)*	0.028	*(0.918)*	0.179	*(0.471)*	0.231	*(0.343)*	0.259	*(0.356)*
131	-0.002	*(0.946)*	0.888	*(0.462)*	-0.021	*(0.964)*	-0.186	*(0.659)*	-0.471	*(0.262)*	0.716	*(0.147)*
132	**0.071**	*(0.089)*	1.086	*(0.547)*	0.475	*(0.505)*	-0.105	*(0.867)*	0.030	*(0.960)*	-0.950	*(0.195)*
133	-0.006	*(0.791)*	0.716	*(0.470)*	-0.066	*(0.864)*	0.254	*(0.466)*	0.073	*(0.828)*	0.317	*(0.418)*
134	-0.016	*(0.679)*	0.900	*(0.609)*	0.114	*(0.869)*	0.606	*(0.335)*	0.571	*(0.350)*	0.374	*(0.590)*
135	-0.057	*(0.652)*	2.090	*(0.717)*	0.453	*(0.842)*	0.183	*(0.928)*	1.686	*(0.399)*	0.076	*(0.973)*
261	-0.021	*(0.618)*	0.568	*(0.772)*	-0.068	*(0.930)*	-0.435	*(0.531)*	-0.506	*(0.455)*	0.493	*(0.525)*
263	-0.005	*(0.889)*	1.387	*(0.383)*	0.556	*(0.376)*	-0.385	*(0.489)*	0.469	*(0.388)*	-0.018	*(0.977)*
272	-0.028	*(0.685)*	3.412	*(0.299)*	-0.861	*(0.500)*	-0.339	*(0.764)*	-0.233	*(0.832)*	-0.815	*(0.522)*
274	0.015	*(0.614)*	-0.387	*(0.778)*	-0.060	*(0.911)*	0.241	*(0.620)*	0.035	*(0.941)*	0.319	*(0.558)*
299	0.046	*(0.123)*	-0.583	*(0.655)*	**1.059**	*(0.058)*	-0.402	*(0.387)*	0.243	*(0.588)*	0.509	*(0.331)*
25A	0.021	*(0.635)*	1.286	*(0.527)*	0.159	*(0.841)*	0.401	*(0.574)*	0.409	*(0.556)*	-0.236	*(0.766)*

Ind.	Δ lnGDP		Δ lnGDP$_{t-1}$		Δ lnGDP$_{t-2}$		Δ lnGDP$_{t-3}$		Δ lnGDP$_{t-4}$		R^2
115	**0.019**	*(0.003)*	0.012	*(0.054)*	**0.012**	*(0.046)*	**0.009**	*(0.100)*	-0.007	*(0.154)*	0.965
120	**0.015**	*(0.047)*	**0.014**	*(0.050)*	**0.011**	*(0.078)*	0.004	*(0.465)*	0.002	*(0.815)*	0.967
121	0.001	*(0.848)*	0.008	*(0.201)*	0.006	*(0.356)*	0.003	*(0.576)*	0.002	*(0.711)*	0.586
123	0.023	*(0.268)*	0.010	*(0.601)*	0.003	*(0.853)*	0.009	*(0.611)*	-0.006	*(0.750)*	0.627
124	**0.017**	*(0.025)*	0.004	*(0.528)*	-0.003	*(0.619)*	-0.007	*(0.263)*	**-0.016**	*(0.028)*	0.868
125	**0.017**	*(0.100)*	0.006	*(0.489)*	0.002	*(0.795)*	-0.004	*(0.670)*	-0.016	*(0.137)*	0.751
127	**0.014**	*(0.028)*	**0.014**	*(0.023)*	0.000	*(0.968)*	-0.006	*(0.237)*	-0.002	*(0.782)*	0.975
128	**0.017**	*(0.009)*	0.005	*(0.368)*	0.002	*(0.726)*	-0.003	*(0.563)*	**-0.012**	*(0.050)*	0.938
129	0.008	*(0.154)*	-0.003	*(0.617)*	-0.004	*(0.370)*	-0.006	*(0.218)*	-0.004	*(0.518)*	0.968
131	0.013	*(0.175)*	0.000	*(0.959)*	0.005	*(0.566)*	0.003	*(0.688)*	-0.010	*(0.300)*	0.876
132	-0.012	*(0.410)*	-0.008	*(0.546)*	-0.003	*(0.837)*	0.000	*(0.997)*	0.018	*(0.201)*	0.875
133	0.012	*(0.120)*	0.000	*(0.995)*	-0.004	*(0.577)*	-0.002	*(0.787)*	-0.004	*(0.590)*	0.926
134	0.017	*(0.230)*	-0.003	*(0.842)*	-0.012	*(0.325)*	-0.013	*(0.288)*	-0.008	*(0.552)*	0.919
135	-0.001	*(0.973)*	0.002	*(0.969)*	-0.011	*(0.776)*	-0.024	*(0.545)*	0.005	*(0.911)*	0.648
261	0.011	*(0.481)*	0.004	*(0.772)*	0.014	*(0.290)*	0.009	*(0.501)*	-0.009	*(0.561)*	0.675
263	-0.019	*(0.129)*	-0.008	*(0.490)*	0.006	*(0.556)*	-0.008	*(0.458)*	-0.001	*(0.960)*	0.908
272	-0.009	*(0.702)*	0.018	*(0.432)*	0.008	*(0.713)*	0.005	*(0.820)*	0.017	*(0.494)*	0.487
274	0.013	*(0.244)*	0.000	*(0.989)*	-0.002	*(0.847)*	-0.002	*(0.807)*	-0.009	*(0.400)*	0.763
299	**-0.023**	*(0.040)*	**-0.020**	*(0.050)*	0.009	*(0.339)*	-0.002	*(0.777)*	-0.013	*(0.226)*	0.979
25A	-0.001	*(0.939)*	-0.002	*(0.900)*	-0.008	*(0.559)*	-0.005	*(0.702)*	-0.002	*(0.914)*	0.696

Note: Numbers inside parentheses are the p-values for each obs. (P>t). Bold coefficients are significant on at least the 10% level. Δ $lnEMV_{t-k}$ and Δ $lnGDP_{t-k}$ are defined as the log of the first-differences values of the export market volumes and Sweden's GDP, respectively. For further details on the control variables, see section 5.2.

6.2.1.1. The Control Variables

From the Export Market Volume variable (Δ lnEMV_{t-k}), we again find that at least one of the short-run coefficients is significant at the ten percent significance level for nine of the 20 industries (115, 120, 121, 124, 125, 127, 128, 129 and 299). Also like before, the coefficients of almost all of the variables (except for two of them: 115 and 120) carry a positive sign. This implies that the same reasoning as for the period of 1993-2009 is applicable on the 1993-1999 period too.

Continuing with the Swedish GDP variable (Δ lnGDP_{t-k}), we find that at least one of the short-run coefficients is significant at the ten percent significance level for seven of the 20 industries (115, 120, 124, 125, 127, 128 and 299). The majority of the significant coefficients carry a positive sign.

6.2.1.2. The Exchange Rate Variable

When looking at the short-run exchange rate variable (Δ lnTCW_{t-k}) coefficients, we find that at least one is significant on the ten percent significance level in ten of the 20 industries (115, 120, 127, 128, 131, 132, 133, 263, 274 and 299). For six of the industries, the very first TCW variable has a significant coefficient, indicating that during the time period of 1993-1999, changes in the value of the krona to a large extent had an immediate impact on exports. Three of these coefficients (120, 127 and 131) carry a negative sign, while the other three (133, 263 and 299) carry a positive sign. As the results are so divergent, we cannot draw any conclusion regarding whether a depreciation of the krona had a positive or a negative immediate impact on Swedish exports during this period. No conclusion can be drawn based upon the TCW-lags either, as they too carry both positive and negative values, following no systematic pattern. Worth noting though is that for industry 263, 274 and 299 (all of them service industries), all significant coefficients carry a positive value that is greater than one. As they represent 64 percent of all service exports included in our data set (which in turn make up for 78 percent of Sweden's total service exports), it seems like a weakened krona stimulated a majority of the service exports during the 1990's.

When looking at the long-run coefficients, we find that those belonging to industry 115, 131 and 299 (*Food and beverages, Other electrical machines and articles* and *Unallocated service production*) are significant at the ten percent level. The coefficients for 115 and 131 are highly negative (-1.786 and -2.464), while the one for 299, an industry that represents 22 percent of the included service exports, is highly positive (2.382). This positive value goes hand in hand with the short-run results presented above, and strengthens the hypothesis that a depreciation of the krona stimulated service exports in the 1990's.

6.2.2. Regressions C 2000-2009

The results from the regressions covering the 2000-2009 period are presented below, in Table 5 and 6.

Table 5.

Regressions for the 2000-2009 period on the industry level: TCW variables.

Industry	Δ lnTCW		Δ lnTCW$_{t-1}$		Δ lnTCW$_{t-2}$		Δ lnTCW$_{t-3}$		Δ lnTCW$_{t-4}$		Long-run	Joint sign.
115	0.055	*(0.884)*	-0.344	*(0.415)*	0.086	*(0.835)*	0.443	*(0.258)*	-0.258	*(0.517)*	-0.017	*(0.765)*
120	0.093	*(0.773)*	0.568	*(0.121)*	-0.505	*(0.161)*	0.433	*(0.197)*	0.211	*(0.533)*	0.799	*(0.394)*
121	0.084	*(0.723)*	-0.104	*(0.693)*	-0.005	*(0.985)*	0.072	*(0.767)*	0.054	*(0.830)*	0.101	*(0.991)*
123	1.745	*(0.141)*	*-2.848	*(0.034)*	1.581	*(0.221)*	-0.651	*(0.584)*	0.636	*(0.602)*	0.462	*(0.306)*
124	0.009	*(0.984)*	0.335	*(0.526)*	0.007	*(0.989)*	-0.232	*(0.634)*	*1.157	*(0.028)*	1.277	*(0.377)*
125	-0.409	*(0.133)*	0.106	*(0.719)*	-0.114	*(0.696)*	-0.008	*(0.977)*	**0.563	*(0.052)*	0.138	*(0.249)*
127	0.122	*(0.741)*	**-0.772	*(0.069)*	0.447	*(0.276)*	0.186	*(0.624)*	0.384	*(0.327)*	0.368	*(0.233)*
128	0.107	*(0.833)*	0.150	*(0.789)*	**-1.123	*(0.052)*	*1.141	*(0.036)*	-0.124	*(0.815)*	0.150	*(0.219)*
129	0.383	*(0.189)*	-0.199	*(0.532)*	-0.359	*(0.259)*	*0.713	*(0.022)*	-0.389	*(0.203)*	0.149	*(0.113)*
131	-0.088	*(0.891)*	0.249	*(0.727)*	-0.610	*(0.390)*	0.325	*(0.622)*	*-1.594	*(0.025)*	-1.718	*(0.275)*
132	-1.011	*(0.450)*	0.101	*(0.945)*	-1.422	*(0.335)*	-0.552	*(0.686)*	0.560	*(0.689)*	-2.323	*(0.798)*
133	0.149	*(0.772)*	*1.190	*(0.045)*	-0.402	*(0.478)*	-0.251	*(0.635)*	0.606	*(0.267)*	1.292	*(0.275)*
134	-0.821	*(0.248)*	-0.903	*(0.252)*	0.382	*(0.620)*	0.525	*(0.467)*	0.006	*(0.994)*	-0.811	*(0.359)*
135	-2.547	*(0.380)*	5.350	*(0.104)*	-5.049	*(0.120)*	-0.020	*(0.995)*	2.948	*(0.334)*	0.682	*(0.464)*
261	2.133	*(0.282)*	-2.404	*(0.274)*	2.116	*(0.329)*	-1.450	*(0.472)*	0.432	*(0.834)*	0.826	*(0.803)*
263	2.074	*(0.123)*	-1.597	*(0.278)*	1.711	*(0.241)*	-1.051	*(0.437)*	-1.004	*(0.468)*	0.134	*(0.534)*
272	*3.234	*(0.013)*	-1.628	*(0.234)*	-0.233	*(0.861)*	**2.201	*(0.086)*	*-2.691	*(0.043)*	*0.883	*(0.034)*
274	-0.167	*(0.791)*	*2.108	*(0.005)*	*-1.431	*(0.047)*	-0.098	*(0.879)*	-0.730	*(0.275)*	*-0.319	*(0.025)*
299	0.509	*(0.476)*	0.432	*(0.584)*	-0.482	*(0.538)*	0.106	*(0.884)*	1.210	*(0.114)*	1.774	*(0.554)*
25A	1.316	*(0.183)*	0.549	*(0.610)*	-1.645	*(0.131)*	-0.022	*(0.982)*	0.153	*(0.881)*	0.351	*(0.324)*

No. of observations per industry: 67
**=significant on the 5% level*
***=significant on the 10% level*
Note: Numbers inside parentheses are the p-values for each obs. (P>t). Δ $lnTCW_{t-k}$ is defined as the log of the first-differenced value of the TCW index, measured on a quarterly basis. The long-run variable is defined as $\sum_{k=0}^{4} \beta_k$ *, and the joint significance is based upon an F-test for the short-run variables.*

Table 6. Regressions for the 2000-2009 period on the industry level: Control Variables and R^2

Ind.	Constant		Δ lnEMV		Δ $lnEMV_{t-1}$		Δ $lnEMV_{t-2}$		Δ $lnEMV_{t-3}$		Δ $lnEMV_{t-4}$	
115	0.010	*(0.290)*	0.502	*(0.302)*	0.069	*(0.887)*	0.619	*(0.270)*	0.165	*(0.741)*	0.454	*(0.298)*
120	-0.004	*(0.577)*	0.519	*(0.214)*	**-0.757**	*(0.075)*	0.454	*(0.342)*	0.690	*(0.114)*	-0.282	*(0.446)*
121	0.004	*(0.488)*	0.305	*(0.320)*	**-0.558**	*(0.076)*	-0.004	*(0.991)*	0.056	*(0.858)*	-0.174	*(0.523)*
123	0.009	*(0.740)*	-0.361	*(0.808)*	-0.991	*(0.505)*	1.099	*(0.520)*	1.757	*(0.257)*	-0.923	*(0.488)*
124	0.008	*(0.509)*	0.938	*(0.131)*	0.607	*(0.323)*	0.689	*(0.329)*	**1.919**	*(0.005)*	-0.216	*(0.691)*
125	-0.004	*(0.537)*	**0.856**	*(0.018)*	0.145	*(0.670)*	**0.979**	*(0.018)*	0.589	*(0.103)*	**0.544**	*(0.083)*
127	-0.011	*(0.235)*	0.682	*(0.158)*	**0.836**	*(0.087)*	**0.919**	*(0.100)*	0.114	*(0.815)*	0.227	*(0.593)*
128	**-0.023**	*(0.068)*	0.371	*(0.567)*	0.213	*(0.742)*	0.208	*(0.780)*	-0.206	*(0.758)*	**1.030**	*(0.084)*
129	**-0.013**	*(0.060)*	**0.642**	*(0.089)*	0.110	*(0.764)*	-0.192	*(0.649)*	0.033	*(0.931)*	0.009	*(0.978)*
131	-0.003	*(0.855)*	-0.246	*(0.764)*	**1.413**	*(0.095)*	**-2.234**	*(0.025)*	0.753	*(0.378)*	0.905	*(0.225)*
132	0.010	*(0.765)*	1.767	*(0.304)*	-1.218	*(0.477)*	1.866	*(0.345)*	-1.353	*(0.444)*	2.301	*(0.139)*
133	-0.002	*(0.897)*	0.864	*(0.196)*	0.479	*(0.469)*	-0.539	*(0.477)*	0.103	*(0.879)*	-0.061	*(0.918)*
134	-0.023	*(0.176)*	1.228	*(0.178)*	0.420	*(0.640)*	1.128	*(0.279)*	0.039	*(0.966)*	0.179	*(0.823)*
135	-0.017	*(0.810)*	3.247	*(0.381)*	1.850	*(0.617)*	-4.242	*(0.322)*	**8.801**	*(0.028)*	-3.268	*(0.326)*
261	0.006	*(0.899)*	-2.081	*(0.409)*	-0.932	*(0.710)*	-2.100	*(0.468)*	0.908	*(0.726)*	-1.177	*(0.600)*
263	0.002	*(0.941)*	0.968	*(0.565)*	**-2.912**	*(0.092)*	1.511	*(0.436)*	-2.812	*(0.114)*	0.828	*(0.582)*
272	0.023	*(0.423)*	1.878	*(0.233)*	-0.238	*(0.878)*	-0.576	*(0.747)*	0.761	*(0.636)*	-1.073	*(0.442)*
274	0.005	*(0.744)*	0.701	*(0.387)*	0.480	*(0.553)*	1.027	*(0.273)*	-1.380	*(0.107)*	**1.502**	*(0.046)*
299	-0.008	*(0.642)*	0.676	*(0.459)*	**-1.749**	*(0.063)*	-0.464	*(0.657)*	-0.213	*(0.821)*	**1.466**	*(0.080)*
25A	-0.009	*(0.712)*	-0.738	*(0.553)*	1.957	*(0.124)*	**-4.308**	*(0.005)*	-2.141	*(0.104)*	**2.089**	*(0.069)*

Ind.	Δ lnGDP		Δ $lnGDP_{t-1}$		Δ $lnGDP_{t-2}$		Δ $lnGDP_{t-3}$		Δ $lnGDP_{t-4}$		R^2
115	0.006	*(0.204)*	-0.008	*(0.231)*	-0.004	*(0.579)*	-0.002	*(0.809)*	**-0.008**	*(0.091)*	0.865
120	**0.008**	*(0.060)*	0.001	*(0.880)*	-0.003	*(0.640)*	-0.007	*(0.257)*	-0.003	*(0.435)*	0.958
121	**0.005**	*(0.082)*	0.003	*(0.488)*	0.002	*(0.641)*	0.002	*(0.718)*	-0.003	*(0.260)*	0.590
123	0.011	*(0.458)*	0.002	*(0.918)*	-0.011	*(0.611)*	-0.010	*(0.652)*	-0.006	*(0.677)*	0.607
124	0.002	*(0.711)*	-0.011	*(0.203)*	**-0.016**	*(0.076)*	**-0.019**	*(0.036)*	**-0.013**	*(0.032)*	0.755
125	0.001	*(0.716)*	-0.008	*(0.128)*	**-0.010**	*(0.046)*	**-0.015**	*(0.006)*	**-0.012**	*(0.001)*	0.877
127	**0.008**	*(0.086)*	-0.001	*(0.940)*	**-0.014**	*(0.054)*	**-0.016**	*(0.028)*	-0.006	*(0.207)*	0.957
128	**0.020**	*(0.004)*	0.003	*(0.776)*	-0.001	*(0.913)*	-0.003	*(0.782)*	**-0.015**	*(0.024)*	0.868
129	**0.012**	*(0.002)*	0.002	*(0.657)*	0.002	*(0.679)*	0.003	*(0.619)*	0.000	*(0.935)*	0.970
131	0.009	*(0.252)*	-0.003	*(0.806)*	0.001	*(0.907)*	0.000	*(0.994)*	-0.006	*(0.455)*	0.766
132	0.003	*(0.843)*	-0.016	*(0.514)*	-0.010	*(0.687)*	-0.007	*(0.788)*	-0.017	*(0.294)*	0.513
133	0.009	*(0.166)*	-0.004	*(0.648)*	-0.002	*(0.857)*	0.001	*(0.878)*	-0.001	*(0.824)*	0.908
134	0.010	*(0.285)*	-0.004	*(0.762)*	-0.011	*(0.378)*	-0.008	*(0.531)*	0.000	*(0.971)*	0.923
135	-0.007	*(0.844)*	-0.012	*(0.821)*	-0.017	*(0.743)*	-0.032	*(0.546)*	-0.010	*(0.779)*	0.499
261	0.029	*(0.242)*	0.021	*(0.565)*	0.030	*(0.402)*	0.021	*(0.555)*	-0.010	*(0.665)*	0.309
263	0.019	*(0.267)*	0.011	*(0.653)*	0.012	*(0.605)*	0.019	*(0.430)*	-0.009	*(0.561)*	0.495
272	0.013	*(0.387)*	-0.004	*(0.859)*	-0.005	*(0.839)*	0.007	*(0.768)*	0.002	*(0.917)*	0.738
274	0.003	*(0.671)*	-0.009	*(0.427)*	-0.008	*(0.478)*	-0.007	*(0.545)*	-0.005	*(0.543)*	0.883
299	-0.007	*(0.455)*	0.007	*(0.608)*	0.023	*(0.082)*	0.011	*(0.407)*	-0.007	*(0.422)*	0.939
25A	**0.023**	*(0.072)*	0.022	*(0.220)*	0.016	*(0.384)*	0.022	*(0.227)*	0.011	*(0.343)*	0.805

Note: Numbers inside parentheses are the p-values for each obs. (P>t). Bold coefficients are significant on at least the 10% level. Δ $lnEMV_{t-k}$ and Δ $lnGDP_{t-k}$ are defined as the log of the first-differences values of the export market volumes and Sweden's GDP, respectively. For further details on the control variables, see section 5.2.

6.2.2.1. The Control Variables

Beginning with the Export Market Volume variable (Δ $\ln EMV_{t-k}$), we find that at least one of the short-run coefficients is significant at the ten percent significance level for 13 of the 20 industries (120, 121, 124, 125, 127, 128, 129, 131, 135, 263, 274, 299 and 25A). This indicates that more of Sweden's main export industries are affected by the Export Market Volume after the year 2000 than before. Unlike before, the significant coefficients are no longer almost exclusively positive; for industry 120, 121 and 263 (*Wood and wood products, Pulp, paper and paper articles* and *Handling of goods, inventories, other transport services*), they are actually consistently negative. This means that increased import volumes from Sweden's main export markets has corresponded to decreased exports from these industries. One possible explanation is that during the 2000's, these industries' competitive power has decreased, and therefore our trading partners choose to import from other countries than Sweden.

Continuing with the Swedish GDP variable (Δ $\ln GDP_{t-k}$), we find that at least one of the short-run coefficients is significant at the ten percent significance level for eight of the 20 industries (120, 121, 124, 125, 127, 128, 129, 25A). This is very similar to the result from the 1993-1999 period. Interestingly, all coefficients belonging to the first GDP variable are positive, while those for the lags are negative.

6.2.2.2. The Exchange Rate Variable

Consider first the short-run coefficients of the exchange rate variable (Δ $\ln TCW_{t-k}$). As during the 1993-2009 period, there are significant short-run coefficients in ten of the 20 industries at the ten percent significance level (123, 124, 125, 127, 128, 129, 131, 133, 272 and 274). However, one obvious difference is that these industries are not the same as the ones before the year 2000; industry 115, 120, 132, 263 and 299 carried significant coefficients in the 1993-1999 period but no longer does so, while industry 123, 124, 125, 129 and 272 have gone from carrying none to carrying one or more significant values. The only distinction that we can make between the industries in the first and the second period is that those in the first are less capital intensive than those in the second.

Another difference is that the significant coefficients now correspond to lags rather than to the immediate TCW variable; only one coefficient is significant in the current period. This implies that the reaction of exports to a change in the exchange rate of the krona takes longer time after the year 2000 than it did in the 1990's. As in earlier results, the significant coefficients are both negative and positive, following no systematic pattern. When looking at the service industries, we now find that there are significant short-run coefficients for only two of them; 272 and 274 (*IT and computer services* and *Business services*), representing 35 percent of total included service exports. These two industries also provide us with the only two significant long-run estimates for this time period. Unlike in the 1993-1999 period, the values of the significant coefficients in the service sector are no longer only positive. Instead, there is a mix of positive and negative values, implying that only nine percent of the service exports are positively affected by a depreciation of the krona in the short-run. The long-run coefficient is weakly positive (0.883) for 272, while it is weakly negative (-0.319) for 274. Thus, it seems like the hypothesis regarding the weakened link between the exchange rate of the Swedish krona and Sweden's export volumes is mainly applicable on the service sector.

6.3. Regressions D and E: The Impact of Exchange Rate Changes on Service Exports

One of the most central findings from regressions B and C is that the relationship between the exchange rate and export volumes from the service sector seems to have weakened over time. In order to further investigate this, we wish to separate the impact of exchange rate changes on exports of services from that on total exports. Therefore, we extend Eq. 4 by including a dummy for the service sector (SD) and interaction terms between the dummy and the exchange rate variable and its four lags ($SD * \Delta \ln TCW_{t-k}$). This gives us:

$$\Delta \ln Export\ Volume_{j,t} = \delta + \varphi SD + \sum_{k=0}^{4} \beta_k \Delta \ln TCW_{t-k} + \sum_{k=0}^{4} \gamma_k \Delta \ln EMV_{t-k} + \sum_{k=0}^{4} \lambda_k \Delta \ln GDP_{t-k} + \sum_{k=0}^{4} \omega_k SD^* \Delta \ln TCW_{t-k} + \Delta u_t$$

(Eq. 5)

We estimate Eq 5. using our aggregated trade data for the periods 1993-1999 and 2000-2009, respectively. As the purpose of this regression is to see whether the impact of the krona's exchange rate on exports of services might have changed since the year 2000, the variables in focus here are the interaction terms. The results from both the 1993-1999 and the 2000-2009 regressions (Regressions D and E) are shown in Table 7.

Table 7.

Regressions on the aggregated level: Interaction Terms

	1993-1999		**2000-2009**	
Variables	**Coef.**	**P>t**	**Coef.**	**P>t**
Δ lnTCW	-0.140	*(0.707)*	0.436	*(0.451)*
Δ lnTCW$_{t-1}$	0.064	*(0.851)*	0.800	*(0.225)*
Δ lnTCW$_{t-2}$	-0.418	*(0.219)*	-0.273	*(0.676)*
Δ lnTCW$_{t-3}$	0.086	*(0.797)*	0.374	*(0.544)*
Δ lnTCW$_{t-4}$	***-1.153**	*(0.002)*	0.149	*(0.809)*
Long-run TCW	***-1.561**	*(0.040)*	1.486	*(0.633)*
Δ lnEMV	****1.671**	*(0.098)*	***1.495**	*(0.038)*
Δ lnEMV$_{t-1}$	0.989	*(0.111)*	0.903	*(0.201)*
Δ lnEMV$_{t-2}$	-0.596	*(0.516)*	0.443	*(0.585)*
Δ lnEMV$_{t-3}$	-0.129	*(0.833)*	****1.382**	*(0.054)*
Δ lnEMV$_{t-4}$	0.549	*(0.623)*	-0.170	*(0.783)*
Δ lnGDP	****1.109**	*(0.061)*	1.337	*(0.193)*
Δ lnGDP$_{t-1}$	1.144	*(0.107)*	-1.555	*(0.304)*
Δ lnGDP$_{t-2}$	1.045	*(0.127)*	-1.570	*(0.298)*
Δ lnGDP$_{t-3}$	0.556	*(0.400)*	-1.635	*(0.275)*
Δ lnGDP$_{t-4}$	-0.033	*(0.957)*	***-2.396**	*(0.016)*
SD	0.000	*(0.987)*	0.008	*(0.636)*
SD*ΔlnTCW	***2.077**	*(0.000)*	0.207	*(0.809)*
SD*Δ lnTCW$_{t-1}$	-0.520	*(0.306)*	1.096	*(0.279)*
SD*Δ lnTCW$_{t-2}$	0.420	*(0.420)*	-0.297	*(0.775)*
SD*Δ lnTCW$_{t-3}$	-0.716	*(0.142)*	0.965	*(0.341)*
SD*Δ lnTCW$_{t-4}$	***1.612**	*(0.002)*	-0.157	*(0.866)*
Long-run	***2.872**	*(0.001)*	1.814	*(0.709)*
Constant	-0.061	*(0.127)*	-0.010	*(0.453)*
R^2	0.203		0.078	

No. of observations: 460

**=significant on the 5% level*
***=significant on the 10% level*
Note: Numbers inside parentheses are the p-values for each obs. (P>t). Δ $lnTCW_{t-k}$ is defined as the log of the first-differenced value of the TCW index, which is measured on a quarterly basis. SD*Δ lnTCW$_{t-k}$ is an *interaction term between the dummy for the service sector (SD) and the TCW variables. The long-run variables are defined as$\sum_{k=0}^{4}\beta_k$, and $\sum_{k=0}^{4}\omega_k$. The significance of these values is based upon F-tests for joint significance for the corresponding short-run variables. Δ $lnEMV_{t-k}$ and Δ $lnGDP_{t-k}$ are defined as the log of the first-differences values of the export market volumes and Sweden's GDP, respectively. For further details on the control variables, see section 5.2.*

Consider first the results belonging to the 1993-1999 period. As can be seen, the interaction term is significant at as much as the one percent significance level for both two of the five short-run estimates and the long-run estimate. Furthermore, all significant coefficients related to the interaction term carry a largely positive value (2.077 and 1.612 for the two short-run estimates, 2.872 for the long-run estimate). This tells us that between 1993 and 1999, there was a strong relationship between the exchange rate and export of services. That relationship was both more significant and more positive than that between the exchange rate and export of goods. In the long-run, one percent currency depreciation caused a 1.561 percent decrease in export of goods. For the service industries, however, a one percent depreciation of the krona actually increased exports with 1.311 percent (-1.561+2.872=1.311). The case is similar for the significant short-run interaction term coefficients. In conclusion, the regressions show us that currency depreciation functioned as a greater stimulus for exports of services than it did for exports of goods during 1993-1999.

Moving on to looking at the results belonging to the 2000-2009 period, we find that these differ considerably from the results in the 1993-1999 period. None of the interaction term coefficients are significant, neither in the short- nor in the long-run. This shows that the relationship between the exchange rate and export of services that we found in the 1993-1999 period no longer prevails after year 2000. In short, exports of Swedish services appear to have been stimulated by currency depreciation of the krona in the 1990's, but after the year 2000, this is no longer the case.

7. Discussion

To briefly summarize the above findings, the results regarding the impact of the krona on exports are divergent for the time period 1993-2009; no unambiguous support for a positive impact of a depreciation of the krona can be found. When comparing the 1990's to the 2000's, we find that some changes in the relationship between exports and the exchange rate changes appear to have taken place. Firstly, the impact of a weaker krona seems to be less immediate in the later period. Secondly, the exports from service industries seem to be less affected by depreciation of the krona in the 2000's than in the 1990's. In the following section, we provide a brief discussion about why our findings look the way they do. We will first discuss the results from Regressions A, both from a general and a country specific point of view. We will then move on to discussing the results from Regressions B, C, D and E in two separate sections.

7.1. Discussion Regarding Regression A

Discussing why their empirical findings look the way they do has not been a norm among our predecessors within the field of J-Curve studies. Instead, these researchers have usually been satisfied with simply making a thorough presentation of all empirical results. We have therefore chosen to turn to another study, Obstfeld's *Exchange Rates and Adjustment: Perspectives from the New Open-Economy Macroeconomics* (2002), in order to get general explanations to our results. In his study, Obstfeld discusses and evaluates plausible explanations to why the assumed effects of exchange rate changes on international trade patterns have gained little empirical support. The one of his explanations that is most applicable on our results is related to intra firm trade, i.e. trade between a company's subsidiaries. Intra firm trade has become an essential part of many countries' trade patterns, due to the last decade's increase of large conglomerates with facilities across the globe. Obstfeld argues that intra firm transactions may be less responsive to exchange rate changes than open market transactions are. This because companies that are parts of a firm cannot freely switch from internal to external suppliers when relative price levels change due to currency fluctuations. Thus, the intra firm transactions make trade patterns more independent of exchange rate changes. When it comes to trying to explain our results, the relevant essence here is that a firm's – or an industry's – response to changes in exchange rates to a large extent relies on unpredictable, firm-specific factors. In other words: the response to a weakened krona is highly individual between Swedish firms and industries, and hence expecting an automatic upswing for all industries upon currency depreciation is not realistic. This complicates the attempts to find a general model that is supposed to predict trade patterns for all industries.

In addition to Obstfeld's generally applicable explanation, two aspects regarding the composition of Swedish exports should be taken into account for a deeper understanding of our results.

The first aspect is that a large share of Swedish exports consists of input- or investment goods used in further production (Statistics Sweden, 2010b, p. 6). In times of economic turbulence, many companies put their investment plans on hold and reduce production, which decreases their need for input- and investment goods. Thereby the demand for Swedish export goods diminish. When this happens, a depreciation of the krona can do very little to help out. No matter how relatively cheap Swedish input- and investment goods are, they will be exported only when foreign investments actually are being made and foreign production is up and running. The last year's development within the industry *Machines* illustrates this (see Appendix F, Figure 5). Machines are a typical investment good, and when the financial crisis struck in 2008, the industry experienced a severe decline in exports – despite the weakened krona.

The second aspect is that a significant part of the exported goods to a large extent are made of imported input goods (Statistics Sweden, 2009, p. 5). When the krona weakens, producing the import dependent goods becomes more expensive, and this restrains both production and the ability to lower prices. Thereby, a weakened krona can for some industries result in decreased, rather than increased, export volumes. This explains many of the negative exchange rate coefficients in our result tables. The above reasoning is mostly applicable on capital-intensive industries, such as *Metals* and *Motor driven vehicles, transport equipment*. These were also among the industries that showed the biggest drop in exports during the recent crisis (see Appendix F, Figure 3 and 4), whereas for example service industries such as *IT and computer services* managed much better (see Appendix F, Figure 6).

Yet another possible explanation can be that some of the 20 chosen industries do not satisfy the M-L condition. This is not unlikely, as one central conclusion from the previous studies that have empirically investigated whether the condition is satisfied or not is that it is hard to draw any general conclusions on the country level (see e.g. Bahmani-Oskooee & Ratha, 2007a or Hatemi-J & Irandoust, 2005). Depending on the time-perspective, some industries in a country might satisfy the condition, while others do not, and in relation to some trading partners it might be satisfied, while in relation to others it is not.

7.2. Discussion Regarding Regressions B, C, D and E

When it comes to the finding that the short-run impact of changes in the exchange rate on exports has become less immediate during the 2000-2009 period, possible explanations are hard to find without becoming too speculative. It could be the case that contracts in general have become more long-term since the year 2000 than before. As the need for companies to establish long-term, mutual relationships with trading partners often is said to be greater now than before – due to increased globalization and competition on the international market – this reasoning could very well be valid. However, our main conclusion regarding the lagged effect after the year 2000 is that it is a matter well-suited for further research.

Concerning the weakened relationship between exchange rate changes and the export of services, we believe increased competitiveness in primarily knowledge-intensive service industries to be the main explanation to our results. The European Commission’s report *The competitiveness of business-related services and their contribution to the performance of European enterprises* (2003) reflects this. It concludes that the European knowledge-intensive service sector creates more new job opportunities and contributes with more value added than any other macroeconomic sector. Moreover, it shows the largest growth potential and the highest numbers of business start-ups. In this kind of sector, price is seldom the determining factor behind trade. Rather, it is the quality of the human capital that is the most important competitive advantage (Almega, 2009). This reasoning supports our finding that even if a weakened Swedish krona seems to have stimulated export of services in the 1990's, this is no longer the case. However, the changed relationship has not resulted in decreased export of services. Sweden's share of the total export of services from it and its 18 most important comparative countries grew with 54 percent between 1998 and 2008 (Swedish Trade Council, 2010, p. 8). According to the above results, this growth is not attributable to depreciation of the krona. Instead, it seems to be a result of increased competitive power within Sweden's knowledge intensive service sector; there is demand for its products regardless of the strength of the currency.

7.3. Discussion Regarding the Reliability of the Results

In order to make all our regressions belong to the optimum equations, we have used the same set-up as previous researchers and applied statistical tests such as ADF, AIC and RESET on them. Despite this, we can still not entirely disregard that they might be affected by factors such as functional form misspecification and omitted variables. One issue is that we use four lags in all our regressions, even though the AIC test shows that another number would be a better fit for some industries. We still choose to do so for maximized comparability of the results. Another issue is related to our proxies for Swedish economic activity (Sweden's GDP), foreign economic activity (Export Market Volumes) and the exchange rate of the krona (the TCW index). While we have judged them to be as highly correlated with the unobservable variables as necessary, there is still a minor risk for that the measurement errors of these proxies are not random variables which are independent of the true explanatory variables. This would cause biased results. However, as similar variables have been frequently used among previous researchers, and as both our R^2 values and our RESET tests indicate that the regressions are valid, we regard the risk of that to be negligible. A third issue is that we have defined our dependent variables as exports only, not the trade balance, but still use J-Curve studies as a starting point for our thesis. This can seem inconsistent. But for reasons stated in section 3.1., and because of the fact that the theory of the J-Curve rests upon the same assumptions regarding currency depreciation as a stimulating factor for exports as those we investigate in our thesis, we regard this approach to be legitimate.

8. Conclusions

Based upon the above presentation and analysis of our results, we will provide the reader with a comprehensive summary of them, and explicitly point at how they answer our research questions. We will also relate them to the findings of previous researchers.

8.1. Conclusions Regarding Regressions A

The purpose with Regressions A was to find answers to research questions I. and II.:

I. How have changes in the exchange rate of the krona affected exports from Sweden's 20 largest export industries since the krona was set free in 1992?
II. Do the observed effects go hand in hand with the classical, macroeconomic reasoning that currency depreciation stimulates exports, which is captured in e.g. the theory of the J-Curve?

To summarize the results from these regressions, they show that while the exchange rate has a short-run impact on exports for 11 out of the 20 industries, this impact follows no systematic pattern. The signs of the coefficients differ widely, and for only five of the industries, the impact is purely positive. Furthermore, only four of the industries appear to be affected in the long-run, and for merely one of them, this effect is positive. Hence, to answer the first of our research questions, changes in the exchange rate has had both a positive and a negative impact on Swedish exports since 1992. For our second question, the answer is that we find no support for neither the assumption that a depreciation of the krona has a systematically stimulating effect on Swedish export volumes, nor the J-Curve pattern.

The findings summarized above go hand in hand with the findings from the most recent study of Swedish exports on the industry level; the Bahmani-Oskooee and Hajilee (2008) study on Swedish-American trade. It concluded that for 50 of 83 industries investigated, at least one exchange rate variable was significant in the short-run – but in merely seven of these industries, a classical J-Curve pattern could be identified. Furthermore, they concluded that real depreciation of Swedish kronor had "…a favorable effect on the trade balance of 23 industries in the long-run, adverse effects on the trade balance of three industries and no effects in the results for 61 industries. In the cases of 23 industries, there was no specific industry attribute." (Bahmani-Oskooee and Hajilee, 2008, p. 91). In other words, their results were as divergent as ours.

The fact that three out of our four long-run coefficients were negative goes hand in hand with results presented in Hacker and Hatemi-J (2003). When using monthly trade data regarding Sweden and her main trading partners, they found that the long-run response to a real depreciation of the krona actually is a slightly weakened trade balance, which implies no major stimulation of exports.

We consider it relevant to compare our results to those of Bahmanii-Oskooee and Ardalani (2006), since they also used exports, not the trade balance, as their dependent variable. They found that in the long-run, a depreciation of the dollar stimulated exports from half of the 66 U.S. industries in their sample. This somewhat contradicts our results, but it is not very surprising, given the differences between the economies of Sweden and the U.S. For example, it is reasonable to believe that, compared to Sweden, the U.S. export industries are less dependent on imported input goods, thanks to their big domestic market. This in turn makes them less affected by increases in import prices when the dollar depreciates.

8.2. Conclusions Regarding Regressions B, C, D and E

The purpose with regressions B, C, D and E was to answer research question III.:

III. Has the relationship between the exchange rate of the krona and exports from Sweden's 20 largest export industries weakened since the year 2000?

To summarize the results from regressions B and C, they imply that the relationship between exchange rate and exports in fact has changed in two different ways:

Firstly, it seems like the exchange rate's impact on exports is more immediate in the 1993-1999 period than in the 2000-2009 period. Secondly, and most importantly, our results show that since the year 2000, a clear change has occurred within the service sector. From Regressions B and C, we gather that while a depreciation of the krona seems to have worked as a stimulus for service exports during the 1993-1999 period, this is no longer the case during the 2000-2009 period. This observation is further enhanced by the results stemming from Regressions D and E, where the interaction terms were included.

We regard the above conclusion concerning services to be the most valuable answer to research question III; yes, the relationship between the exchange rate of the krona and exports from Sweden's 20 largest export industries has changed since the year 2000. That change is taking place within the service sector, and consists of a diminished impact of exchange rate fluctuations on export volumes.

Since we have been unable to find previous academic studies treating these distinct matters, we cannot compare our results with those of other researchers.

9. Summary

The aim for this paper was to shed new light on how Swedish exports on the industry level have been affected by changes in the value of the krona since it was set floating in 1992. In order to do so, we used first-differenced multiple regression equations. The results from them showed no evidence of a systematic relationship between the exchange rate of the krona and Swedish exports. However, we discovered that the impact of exchange rate changes on exports has undergone some changes since the year 2000. First of all, the short-run effects of exchange rate fluctuations appear to be less immediate during the 2000's than during the 1990's. Second of all, the service sector appears to be less affected by exchange rate fluctuations during the 2000's than during the 1990's. We encourage fellow researchers to further investigate both these findings.

In conclusion, we regard our results to be highly relevant. Instead of merely accepting the prevailing macroeconomic arguments regarding the effects of changes in the exchange rate out of routine, it is important that there is a true understanding of the real driving forces behind exports. Many economists currently point at a weakened krona – and a following increase in Swedish exports – as a shock absorber and a valuable factor for Sweden's future economic development. As our findings show, this reasoning lacks empirical support.

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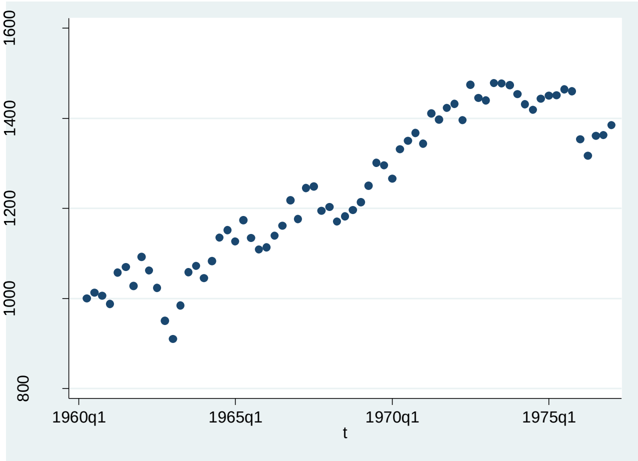
11. Appendix

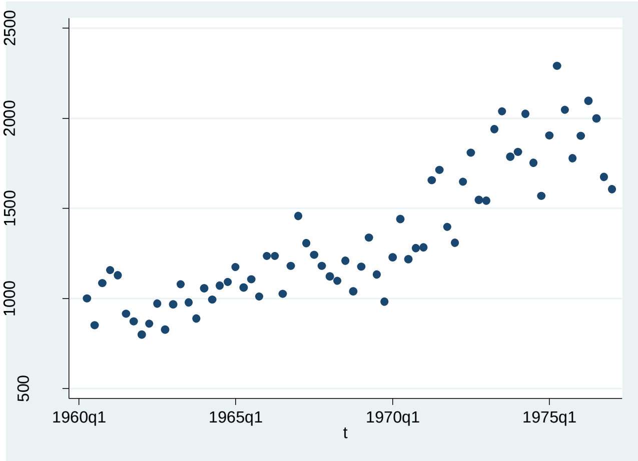
11.1. Appendix A: Industry List

	Industry (2000-2009)
115	Food and beverages
120	Wood and wood products (not furniture)
121	Pulp, paper and paper articles
123	Coal, petrolium products, nuclear fuel
124	Chemicals and chemical products
125	Rubber- and plastic products
127	Metals
128	Metal goods (not machines)
129	Machines (not office machines or computers)
131	Other eletcrical machines and articles
132	Telecommunication products
133	Precision- and optical instruments, medical products, clocks
134	Motor driven vehicles, transport equipment
135	Other transport equipment
261	Sea transports
263	Handling of goods, inventories, other transport services
272	IT and computer services
274	Business services
299	Unallocated service production
25A	Provisions, domestically produced

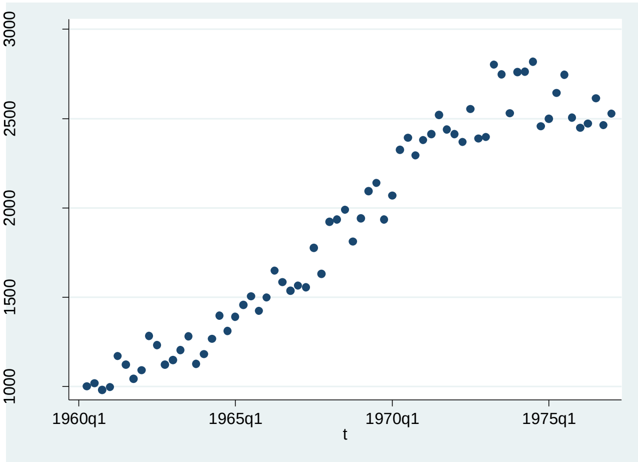
11.2. Appendix B: Scatter Plots of All Variables



Ind. 121 (1993-2009)



Ind. 123 (1993-2009)



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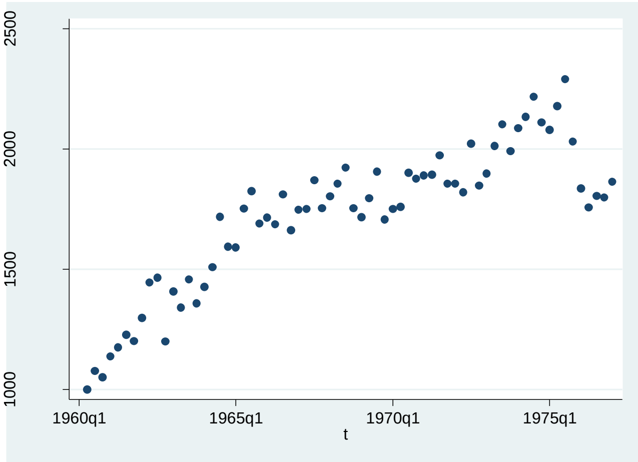

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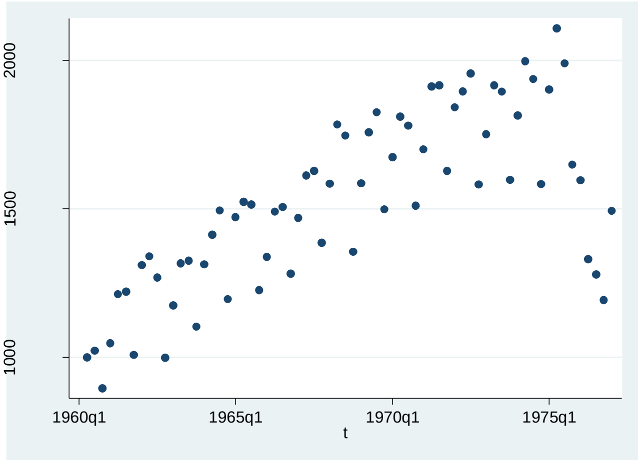

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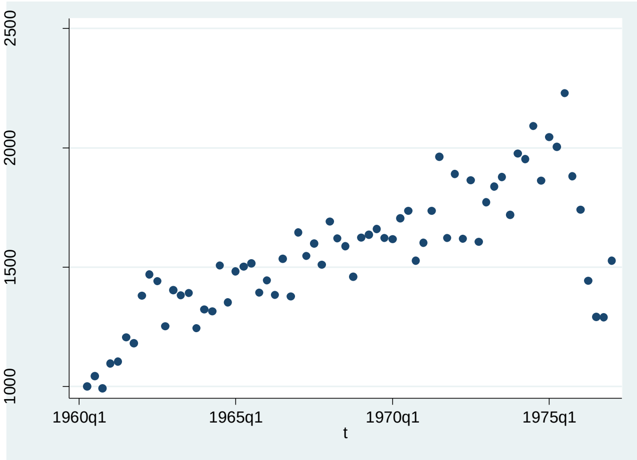

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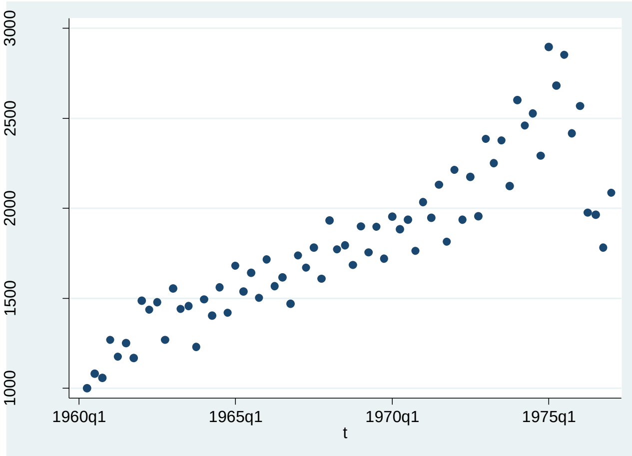

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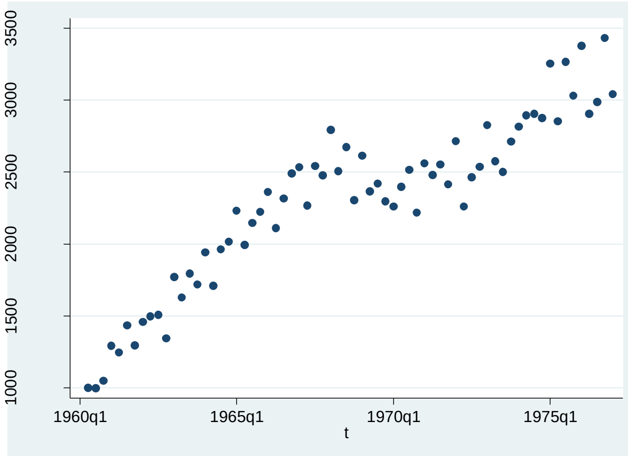

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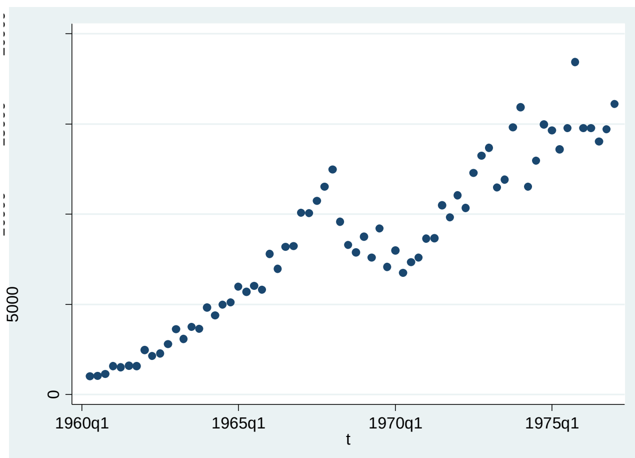

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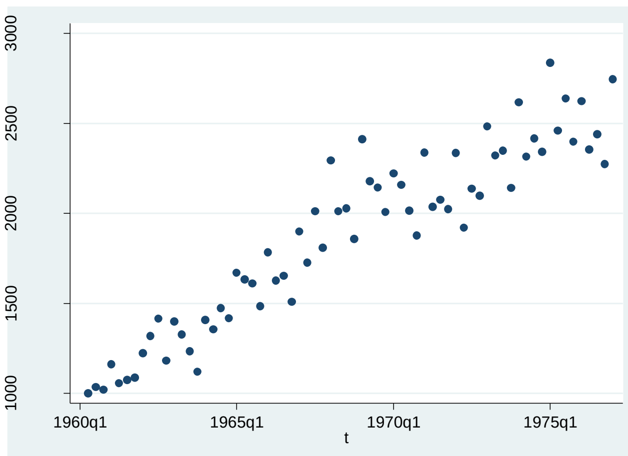

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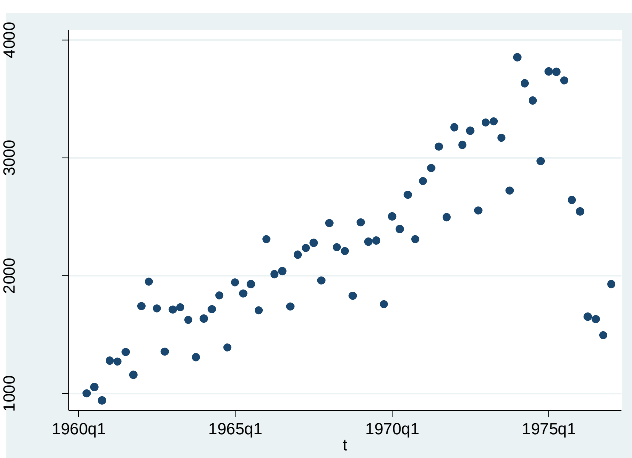
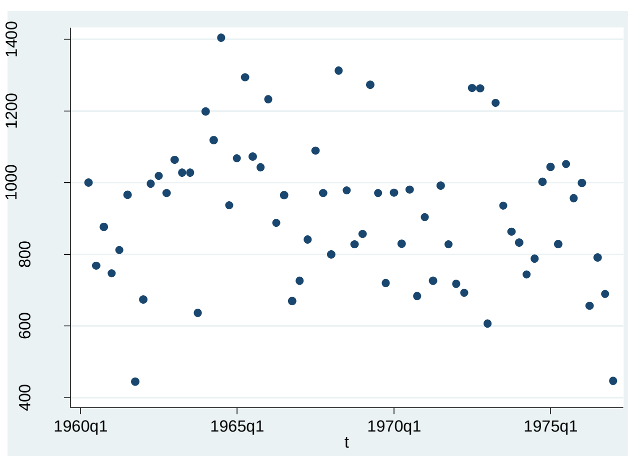


Ind. 134 (1993-2009)



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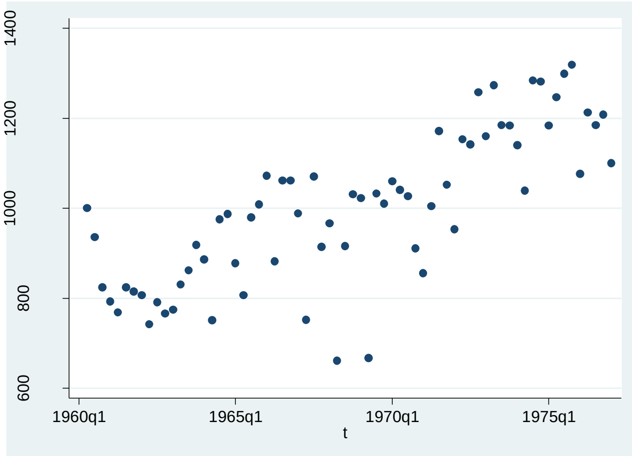

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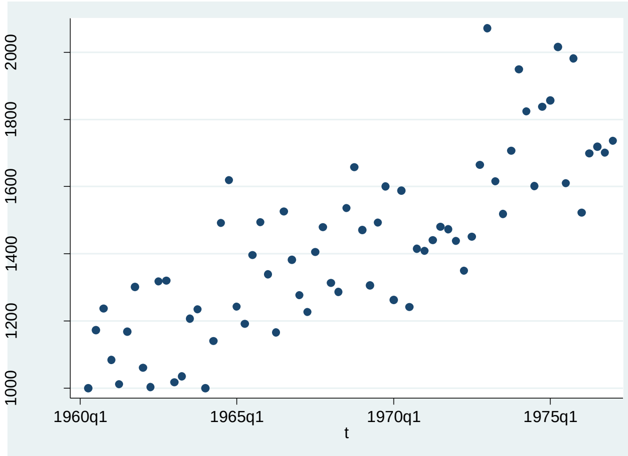
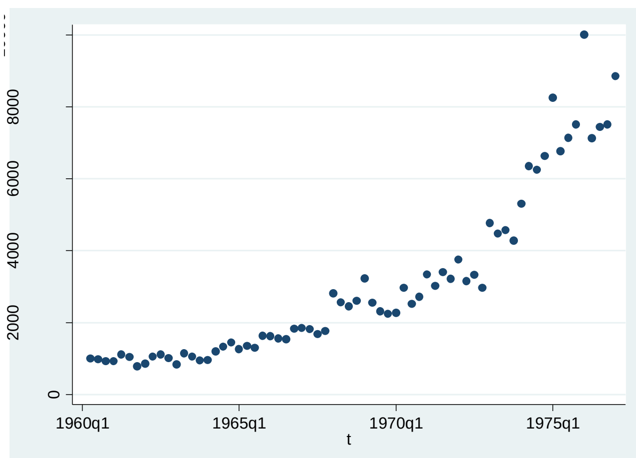


Ind. 263 (1993-2009)



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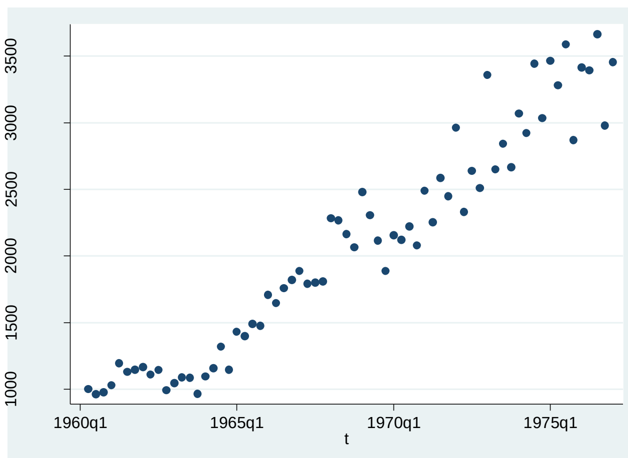

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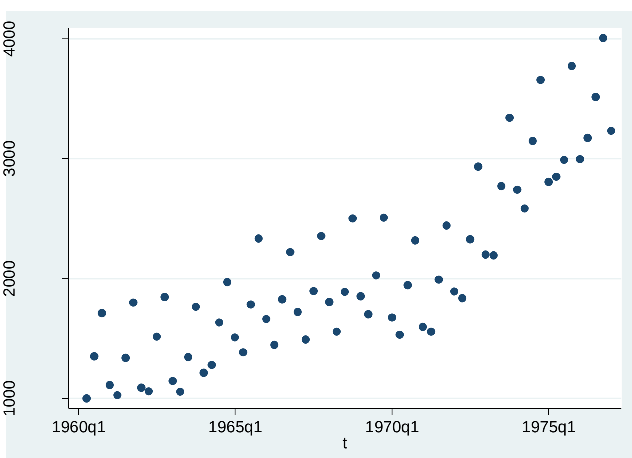
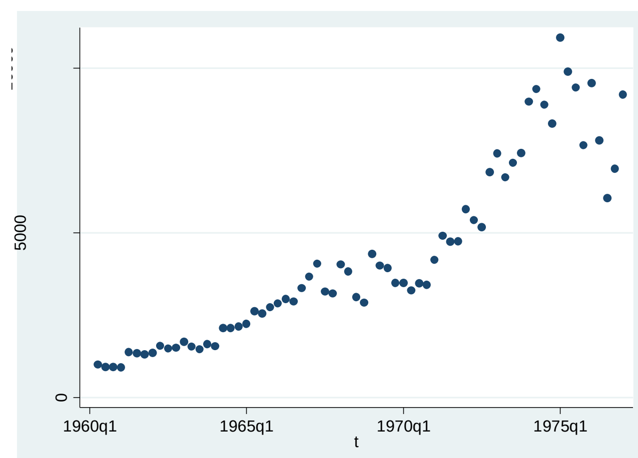
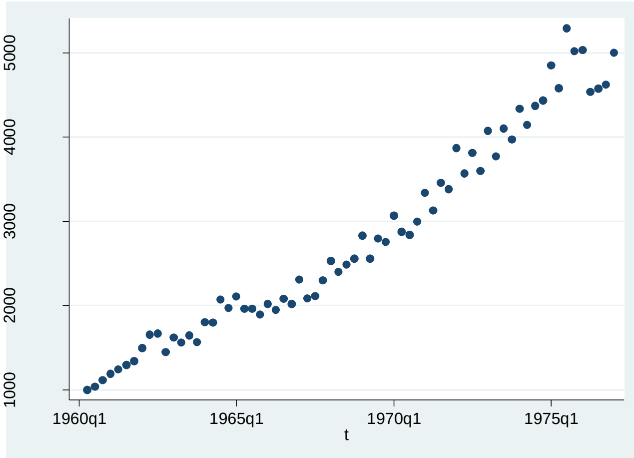


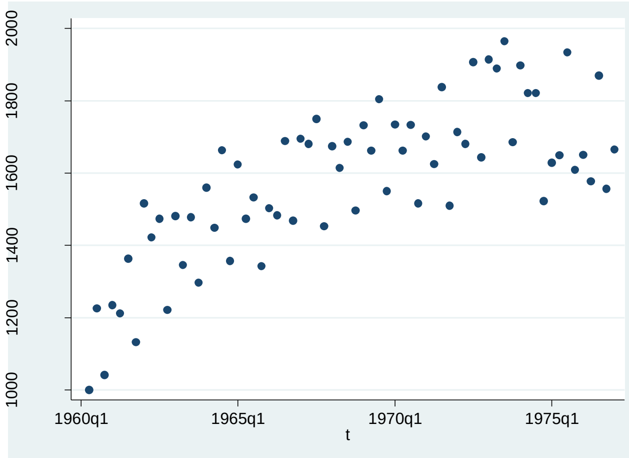
Ind. 299 (1993-2009)



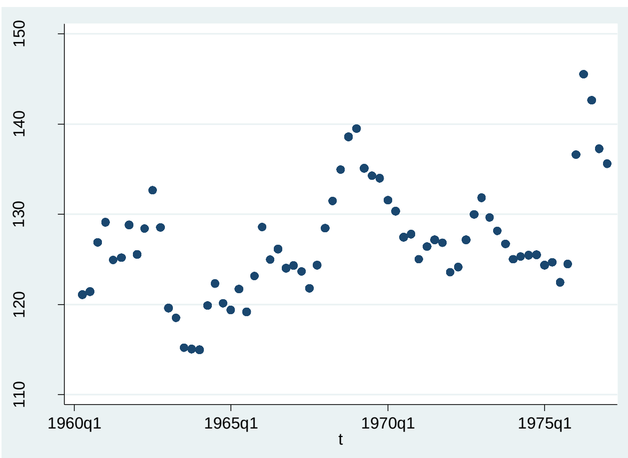
Ind. 25A (1993-2009)



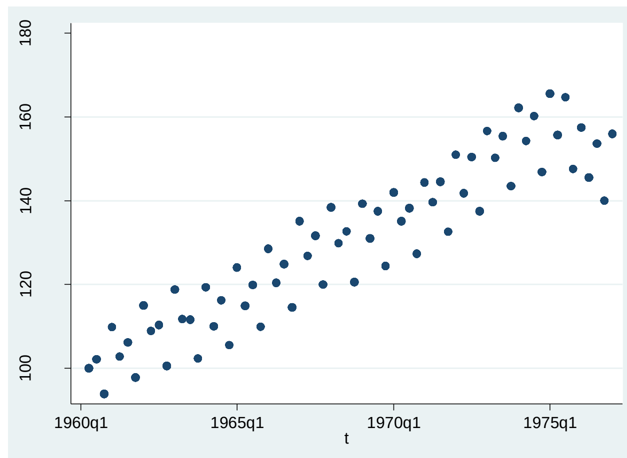
Ind. 115 (1993-2009)



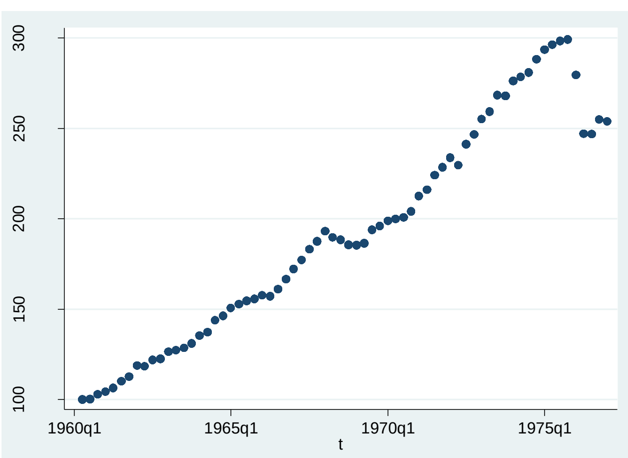
Ind. 120 (1993-2009)



TCW-index (1993-2009)



GDP-index (1993-2009)



Export Market Volume (1993-2009)

11.3. Appendix C: The Augmented Dickey Fuller Test

Interpolated Dickey-Fuller values for:	1%	5%	10%
Industries	-4.121	-3.487	-3.172
TCW	-3.567	-2.923	-2.596
EMV	-4.13	-3.491	-3.175
GDP	-4.13	3.491	-3.175

ADF Test Results

Variable	Z(t)
1 15	-2.122
1 20	-2.422
1 21	-1.599
1 23	-2.852
1 24	-0.738
1 25	-2.017
1 27	-2.247
1 28	-3.229
1 29	-4.552
1 31	-1.935
1 32	-2.471
1 33	-2.524
1 34	-3.455
1 35	-2.654
2 61	-2.599
2 63	-2.448
2 72	-1.527
2 74	-3.254
2 99	-1.123
2 5A	-2.653
TCW	-2.049
EMV	-2.709
GDP	-2.937

Note: The hypothesis that there is no unit root is rejected when the Z(t) value is lower than the interpolated Dickey-Fuller value.

11.4. Appendix D: The AIC Test

	AIC-value for lags				
Ind.	0	1	2	3	4
115	951.321	938.063	902.448	879.138	855.509
120	825.602	801.916	784.977	783.693	780.695
121	744.972	737.262	735.228	732.151	737.626
123	898.425	898.539	888.570	873.460	874.899
124	883.602	856.119	853.548	854.144	858.411
125	859.670	841.628	825.201	822.847	820.385
127	889.346	842.909	839.578	841.225	827.429
128	852.219	844.647	839.156	836.241	831.102
129	824.261	819.970	822.066	817.374	805.825
131	945.730	948.398	950.144	946.813	928.039
132	1195.086	1198.129	1203.419	1204.265	1187.155
133	843.496	848.355	850.945	848.359	849.602
134	980.139	970.945	973.314	972.840	965.743
135	918.474	919.621	919.186	920.196	918.324
261	827.302	825.693	825.321	825.208	824.026
263	866.019	863.490	868.260	873.358	877.455
272	1143.561	1129.464	1120.177	1089.870	1087.799
274	893.224	892.376	891.388	892.970	888.714
299	974.346	947.210	943.626	932.236	890.463
25A	1106.548	1101.347	1091.935	1083.958	1082.583
Aggr. data.	63136.5	62197	61260.7	60316.77	59387.5

Note: The AIC is a measure of the goodness of fit of an estimated statistical model. Given a data set, alternative models are ranked according to their AIC value, with the one having the lowest AIC value being regarded as the best fit. We have for each industry begun testing Eq. 4, and then added one to four lags.

11.5. Appendix E: The RESET Test

Ind.	Prob > F
115	0.726
120	0.601
121	0.078
123	0.264
124	0.616
125	0.304
127	0.229
128	0.660
129	0.402
131	0.589
132	0.240
133	0.708
134	0.049
135	0.434
261	0.010
263	0.777
272	0.670
274	0.083
299	0.188
25A	0.771

Note: The RESET-test controls for misspecification of the equation, with the null hypothesis being that there are no omitted variables of the model.

11.6. Appendix F: Development of Export Volumes Over Time

Figure 3.

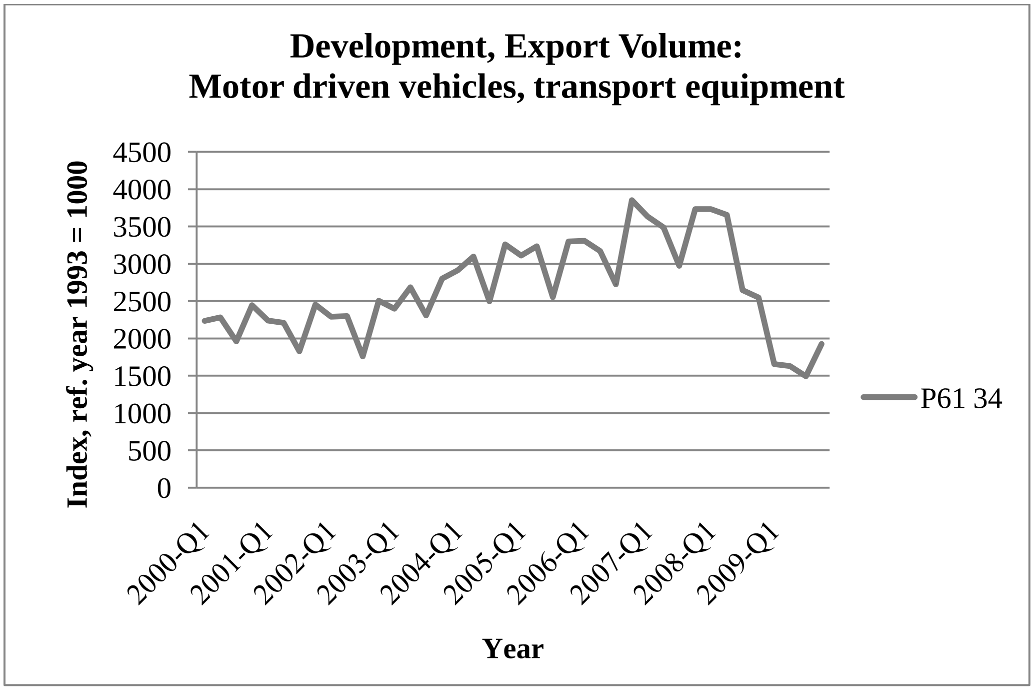
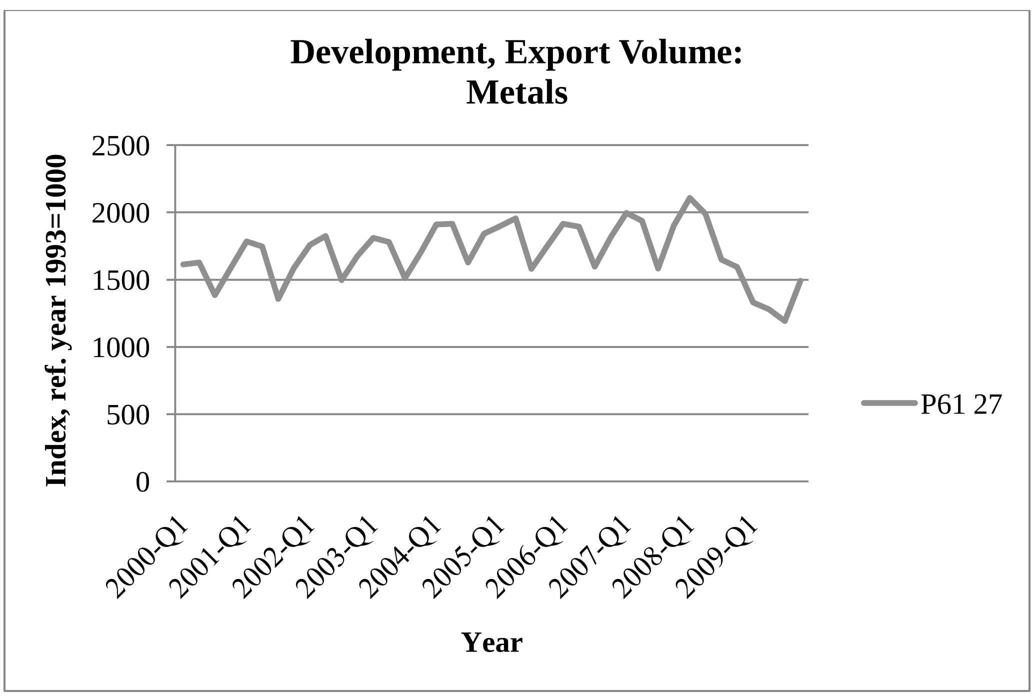


Figure 4.



Figur 5.

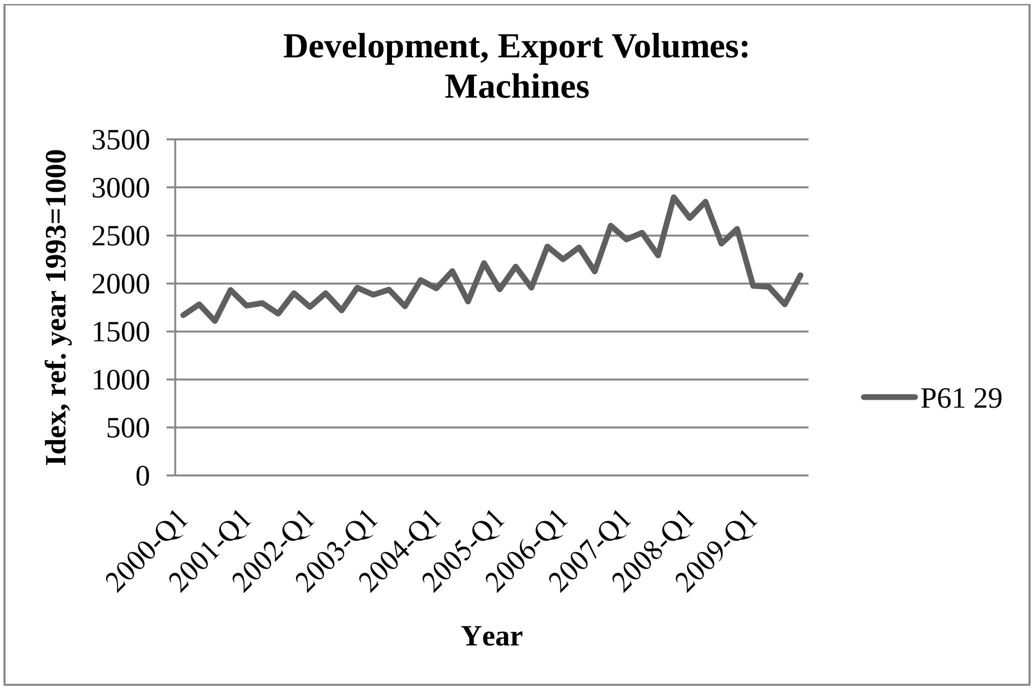


Figure 6.