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Exchange rate volatility

How the Swedish export is influenced

Master Thesis within ECONOMICS

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Abstract

The purpose of this thesis is to examine whether the exchange rate volatility has an impact on Swedish exports. This relationship has been tested in several studies but no consistent result has been found. It is therefore an interesting subject to investigate further and it has not been thoroughly tested for Sweden using aggregated data. Since the exchange rate volatility may have an effect on exports, and therefore on the whole economy, the effect can support a certain exchange rate regime. All the data used in this thesis is based on the aggregated data for Sweden and the Euro zone between the years 1993 and 2006. The method chosen is a statistical analysis using regressions. Three variables other than exchange rate volatility were included when conducting the regressions explaining Swedish exports and these are: the real effective exchange rate index, the industrial production in Sweden (“push” factor) and the import from the Euro Zone (“pull” factor). The overall conclusion found was that the industrial production in Sweden, the real effective exchange rate index, the time and lagged values of the export influence the export. There was no evidence found that the exchange rate volatility influences the exports for Sweden.

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Titel: Växelkurs fluktuation – Hur den svenska exporten påverkas

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Sammanfattning

Syftet med denna uppsats är att undersöka om förändringar i växelkursen påverkar den svenska exporten. Sambandet har testats i ett flertal studier men inget konsekvent samband har hittats. Detta gör det till ett intressant ämne att vidareutveckla. De flesta undersökningar som har gjorts har ej använt den aggregerade nivån i Sverige. Eftersom fluktuationen i en växelkurs kan påverka ett lands export, och därför hela ekonomin, kan effekten av denna påverkan stödja en viss växelkursregim. Datan som används utgörs av åren 1993 till 2006 och är baserad på den aggregerade nivån i Sverige och för Euro zonen. En statistisk analysmetod där regressioner använts ligger till grund för uppsatsen. De förklarande variablerna som används i regressionerna där den svenska exporten är den beroende variabeln är förutom växelkursfluktuation; index av den reella effektiva växelkursen, den industriella produktionen i Sverige ("pådrivande" faktor) och importen till Euro zonen ("attraherande" faktor). Den generella slutsatsen är att den reella effektiva växelkursen, den industriella produktionen i Sverige, tiden och laggade värden av export är de variabler som påverkar exporten. Inga bevis kunde stödja tesen att växelkursfluktuation påverkar exporten i Sverige.

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1 Introduction

The exchange rate is a very important macro variable that has influence on the whole economy and has therefore been the topic of many discussions amongst policymakers, academics and other economic agents. The issue of whether to have a fixed, pegged or floating exchange rate regime was highly debated during the 1970s, since then most currencies in Europe have been floating, until recently when the euro was introduced. The discussion is still very important since countries today again stand before the choice of which exchange rate regime to adopt.

The exchange rate regime in Sweden has shifted from being fixed to pegged, and to a floating regime. Since it is an important macro variable that influences the whole economy it is interesting to investigate. The exchange rate regime in Sweden has recently been questioned by the election for or against a membership in the European Monetary Union (EMU). One of the main arguments from those who were in favour of the membership was that the Swedish companies would gain from having a common and stable exchange rate with the rest of Europe. The gain would arise from lower transaction costs and a higher volume of trade as a consequence. The Swedish people voted against a membership in the EMU. One can never say now if Sweden would gain or lose from not joining the EMU. However, one can investigate the different arguments and gain understanding that can shed some light on the question in matter.

In light of the foregoing, the purpose of this thesis is to examine if the exchange rate volatility affects the Swedish exports and in what manner. Three other variables are also included and will be examined, these are: the real effective exchange rate index, the industrial production in Sweden ("push" factor) and the import from the Euro zone ("pull" factor).

The exchange rate volatility's influence on the trade for a country does not only affect the current account for a country but the whole economy and can also have effects on other countries. If the level of international trade and investment is decreased it lowers the welfare for the residents of all trading countries (Edmonds and So, 2004).

Policymakers and other economic agents that are involved in the financial market are very interested in the exchange rate volatility and how it is determined. In order to find and thereby conduct the most appropriate policy, policymakers use the information about how different macro variables influence the exchange rate volatility. The models that are able to estimate the exchange rate volatility are used by firms when they estimate the risk that it faces. The exchange rate volatility is also used as variables in different equations where prices are evaluated (Bauwens and Sucarrat, 2005).

The subject on how the exchange rate volatility affects the exports of a country has been investigated thoroughly and the results have varied widely. Some authors, for example Baum et al, 2001 and Clark, 1973 have found a negative relationship between the variables and others have found a positive: De Grauwe, 1992 and Sercu, 1992. The results found are however ambiguous depending on which assumptions used in relation to the exchange rate volatility. One of these issues is whether to use the nominal or the real exchange rate. Even though there have been many studies conducted in this field of economics, there is no common agreement on a single technique that is superior to other techniques (De Vita and Abbott, 2004).

The data used in this thesis are on the national level and includes the years 1993 to 2006. Thus, the aggregated exports for Sweden will be evaluated instead of different sectors that earlier studies have used.

The outline of the thesis is as follows; the second section will explain the exchange rate volatility and the history of the Swedish exchange rate since the 1970s. The section after that will include theories concerning the exchange rate's influence upon exports, the theory upon this relationship varies and there is no clear-cut relationship to be found. The empirical analysis follows, where a model is explained and verified through regressions. The last section will contain the conclusions drawn from the empirical analysis and suggestions to further studies within the subject.

2 Exchange rate volatility

The exchange rate is defined as the price of one currency in terms of another currency. In a floating exchange rate regime, the transaction costs are higher than with a pegged or fixed exchange rate (Jones and Kenen, 1990). Volatility is defined as an unobservable or latent variable, deterministic or stochastic. There have however been studies that try to make the exchange rate volatility an observable variable, with varied results (Bauwens and Sucarrat, 2005).

Exchange rates are highly volatile in the short run and are very responsive to political events, monetary policy and changes in expectations. In the long run, exchange rates are determined by the relative prices of goods in different countries (Samuelson and Nordhaus, 2001). The exchange rate is more volatile than the fundamental variables which determine the exchange rate in the long run (Gärtner, 1993).

Exchange rates have become more volatile in recent years due to the abandonment of the fixed exchange rates, which have resulted in a massive volume in foreign exchange transactions. These transactions have grown faster than international trade and international investments flows of capital. The risk associated with foreign exchange transactions and trading at the foreign exchange market has increased but so has also the awareness and knowledge about the subject. There are also better instruments to cover the risk. International private capital flows are much larger than trade flows today which indicates that exchange rates reflect mostly financial rather than trade flows, especially in the short run. However, the trade flow has a large influence upon exchange rates in the long run (Salvatore, 2004).

Exchange rate volatility is directly influenced by several macro variables, such as demand and supply for goods, services and investments, different growth and inflation rates in different countries, changes in relative rates of return and so forth. The present floating rate has been affected by previous real and monetary disturbances. Expectations about current events and future events are also important factors due to the large influence it has on exchange rate volatility. The volatility can also arise from “overshooting” behaviour which occurs when the current spot rate does not equal a measure of the long-run equilibrium calculated from a long-run model. If this behaviour arises because the financial market is not working correctly, high exchange rate volatility does not have to imply high transaction costs (Jones and Kenen, 1990).

It would only be efficient for the exchange rate to be highly volatile if the underlying economic variables are equally volatile. If not, there would exist abnormal profit opportunities for speculators that smooth exchange rate movements. The exchange rate cannot contain any pattern or signals about future rates, since it could be used to gain a profit. The volatility is a risk for a company that trade on the international market since it is a variable that can not be foreseen (Jones and Kenen, 1990).

The determination of exchange rate volatility is an important issue for both policymakers and economic agents involved in the financial market. Firms use volatility models in their estimation of risks and as inputs when they evaluate prices. The policymakers on the other hand use the information about how the factors impact the exchange rate volatility so that the most appropriate policy can be conducted (Bauwens and Sucarrat, 2005).

Historically exchange rate theories have differed. The modern exchange rate theory is conducted on the assumption that exchange rates are based on the decision on how to spread wealth over different assets, instead of the assumption that exchange rate is determined by the demand for foreign currency which was used earlier (Gärtner, 1993).

2.1 The Swedish exchange rate history after 1970s

Sweden was part of the Bretton Woods system which ended in 1972, after that the Swedish currency was bounded to the currency agreement of the European Union (EU). This currency agreement is referred to as “the snake” and Sweden was a member from 1973 until 1979. The exchange rates were only allowed to fluctuate +/- 2.25 per cent against other specific currencies. The Dutch Mark was the dominating currency in the system. Sweden joined the European Monetary System (EMS) in 1979, as a consequence from being a member of the EU. The EMS was based on a basket of EMS currencies weighted according to the country’s size (Gros and Thygesen, 1998).

In the 1970s the world economy was hit by two major shocks since the oil price was heavily increased in 1973 and in 1979. To handle this Sweden choose an expansionary domestic stability politic during 1974 until 1976. The aim was to avoid a depression; the result was however that the price and wage level rose by a higher degree in Sweden than in the other countries, which the Swedish krona was bound to. The Swedish krona was devaluated three times in the years 1976 and 1977 and then once in 1981 and in 1982 (Jonung, 1991).

In 1991 the Swedish currency was pegged to the ECU. The central bank decided to let the Swedish krona float on the 19th of November in 1992. The Swedish central bank was then forced to leave a fixed exchange rate and to let the krona float since almost all the currency reserves was lost in an attempt to keep the fixed exchange rate regime after heavy speculations against the krona (Sveriges Riksbank, 1992). Since 1992, Sweden has been involved in a floating exchange rate regime even though it has been questioned by the election of whether to join the EMU or not.

The Swedish exchange rate history can be seen in the following figure 2.1:

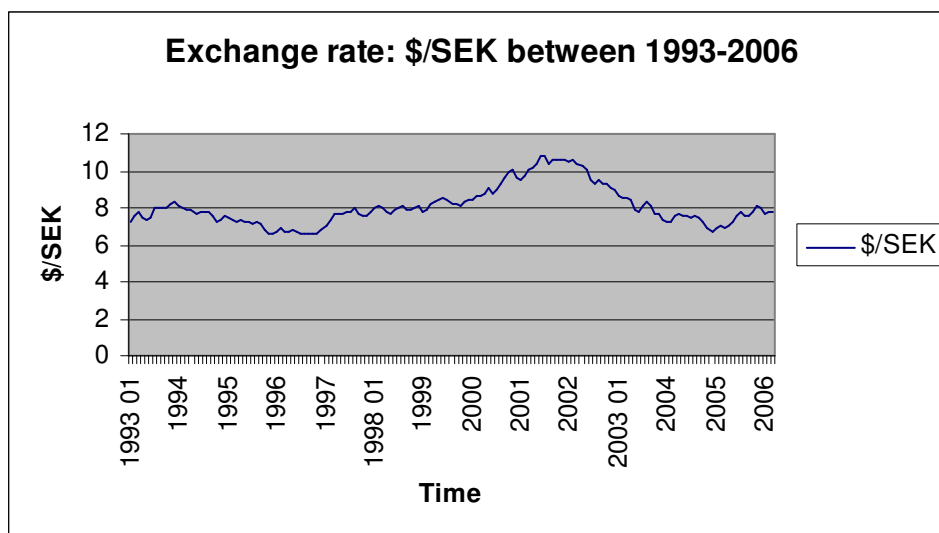


Figure 2.1: The Swedish exchange rate history since 1993.

Source: Swedish Statistics (SCB)

3 Exchange rate volatility's impact on exports

This section will provide different models and theories that handle the exchange rate volatility's impact on the exports for a country. The impact is however ambiguous, depending on which assumptions that are used in relation to the exchange rate volatility. One of the issues is whether to use the nominal or the real exchange rate. Even though there have been many studies conducted in this field of economics, there is no common agreement on a single technique (De Vita and Abbott, 2004). The most common expectation is that the exchange rate volatility increases risk and uncertainty which dampens the trade and investments (Sukar and Hassan, 2001).

The outcome of the relationship between exchange rate volatility and the volume of international trade depends on the source for the change in the volatility and is therefore ambiguous. The exchange rate uncertainty, and thereby the risk, increases by both an increase in the costs associated with international trade and by an increase in the volatility of the endowments. The higher costs to international trade decreases international trade but an increase in the volatility of the endowments increases the expected volume of trade (Sercu and Uppal, 2003).

Section 3.1, 3.2 and 3.3 explains the relationship between the level of the exchange rate and the level of exports. This theory is included in the thesis since this relationship explains how the volatility in the exchange rate influences the volatility in the exports. This in turn can give important insights in the relationship between the volatility of exchange rate and the level of exports. These sections also gives some feedback on the use of the variable the real effective exchange rate index since it is the level of exchange rate that influence the level of exports.

3.1 Standard trade theory

Foreign trade involves both imports "goods and services produced abroad and consumed domestically" and exports "goods and services produced domestically and consumed abroad". The volume of exports is mainly influenced by foreign output and the export price relative to foreign goods. If the exchange rate appreciates; the domestic commodities will become relatively more expensive and the export volume will decrease (Samuelson and Nordhaus, 2001).

A depreciation of the own currency stimulates the production of import substitutes and the production of exports and will lead to an increase in the domestic prices. Depreciation causes inflation, since both the import substitutes and export prices are part of the general price index used in the country. The larger the depreciation is the higher inflation will occur in the economy. The increase in the domestic price for import substitutes and exports will lead to a shift in the resources in production. It will shift towards the import substitutes and exports and away from non-tradable or purely domestic commodities. This reduces the price advantage that the domestic economy received from the depreciation (Samuelson and Nordhaus, 2001).

The elasticity of demand and supply for a country is an indication of how easy it is for the country to shift its resources in production from non-tradable and purely domestic commodities to import substitutes and to exports. It also shows how inflationary the shift will be (Salvatore, 2004).

Figure 3.1 explains the increase in exports as the domestic currency depreciates. The figure shows the domestic export market. D_f represents the foreign demand for the domestic export and S_d is the domestic supply of exports. Both the curves are expressed in terms of the domestic currency. Equilibrium (1) where D_f intersect S_d shifts when there is depreciation in the domestic currency. When the depreciation occurs the D_f curve will move upwards to D_f' since the exports becomes cheaper for the foreign market. The foreign currency is worth more in terms of the domestic currency i.e. the demand increase. The economy will end up in a new equilibrium (2), where D_f' intersect S_d where both the domestic price (P) and the quantity (Q) have increased (Salvatore, 2004).

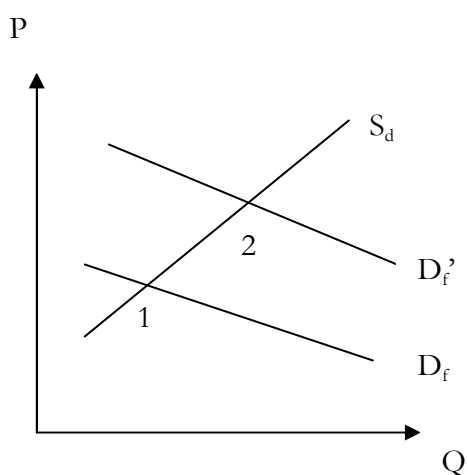


Figure 3.1 shows the effect on domestic exports due to depreciation of the domestic currency

Source: Salvatore, 2004

3.2 Marshall-Lerner condition

The Marshall-Lerner condition verifies whether the foreign exchange market is stable or unstable. Conclusions that can be drawn from the Marshall-Lerner condition is depending on the shape of the curves for the demand for import and exports in a country. The condition indicates that the foreign exchange market is stable if the sum of the price elasticity's of the demand for imports and exports are greater than one, in absolute terms. It is better for the country if the two elasticity's exceed one by a large amount since the current account then improves more in case of a depreciation. If the price elasticity's sum up to less than one in absolute terms, the foreign exchange market is unstable. The current account will be unaffected by a change in the exchange rate if the elasticities sum up to exactly one, in absolute numbers (Salvatore, 2004). If the Marshall-Lerner condition holds depreciation will improve the current account (Gärtner, 1993).

The reasoning behind the use of the Marshall-Lerner condition is to examine if the foreign exchange market is stable or unstable. The exact shape of the demand and supply curves of the foreign exchange market is hard to determine and it is therefore hard to determine if the foreign exchange market is stable or unstable. If the supply curves could be determined it would be straightforward to correct a deficit in the current account by depreciating the currency (Salvatore, 2004).

Policymakers today are taking the responsiveness of trade flows to relative price changes into account when constructing an exchange rate policy or a commercial policy. Histori-

cally, the elasticities of the demand for imports and exports had a bigger impact and were used more frequently by policymakers in order to make a decision (Bahmani-Oskooee and Niroomand, 1998).

The sum of the elasticities for the demand for imports and exports would need to be sufficiently larger than one so that the supply and demand curves of the foreign exchange rate are elastic enough and depreciation can therefore make it possible to correct a balance of payments deficit. This is the reason why it is important to calculate the real world value of the price elasticities of the demand for imports and exports (Salvatore, 2004).

3.3 The J-curve effect

The Marshall-Lerner condition is assumed to hold in the long run. The current account may however at first decrease after a depreciation before the effect from the Marshall-Lerner condition kicks in and starts to improve the current account. This development of the current account is called the J-curve effect or the J-curve phenomenon, since the situation resembles the letter J in a graphical sketch which can be seen in Figure 3.2 (Gärtner, 1993).

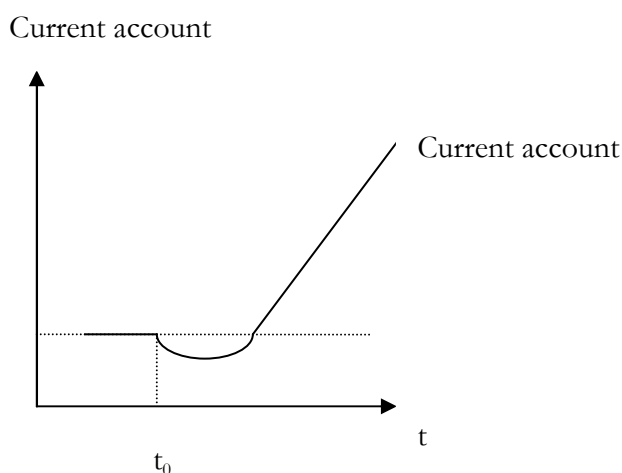


Figure 3.2 Sketch of the J-curve effect, t_0 is the time of depreciation

Source; Gärtner, 1993

It is first in the medium run after a depreciation that the current account is expected to improve, since it takes time for the importers and exporters to adapt to the new relative prices. Depreciation affects the current account through three different channels;

1. *Immediate response*; the prices and volumes are fixed through contracts that were stated before the depreciation, so the importers and exporters can not change their behaviour. The current account worsens, since more domestic currency has to be paid for imports that have a fixed price and volume. However, this does not occur if the contracts are fixed in domestic currency but this rarely happens.
2. *Medium-run response*; the new contracts that are set reflect the new relative prices that are in favour of the domestic products. This change in price shifts the demand to domestic products from foreign products. The current account starts to improve after the shift in demand takes place. This can occur soon after the depreciation but the full effect might take several years.

3. *Long-run response*; the only way for the prices to be unaffected by the increase in demand is if the domestic country experiences an extreme situation of unemployment. If the price elasticity of the domestic goods supply is finite, higher prices are a consequence from higher export volumes, thus the current account continues to improve. The comparative advantage that was gained by the depreciation becomes smaller because of the price increase. The new long-run level is above the initial long-run level (Gärtner, 1993).

The J-curve can also be explained by elasticities. If the price elasticities in absolute terms of export and import demand are high enough, the trade balance will rise in response to currency depreciation and vice versa if it is low. In the J-curve effect the elasticities are low directly after depreciation. The initially low elasticities can be explained by the fact that it takes some time to change input patterns in the production (Hacker and Hatemi-J, 2003).

The J-curve effect can also arise from differences in import and export prices. The domestic currency price of imports normally rises faster than prices of export after a depreciation which leads to small changes in the quantities. Gradually, the quantity of exports will rise and the quantity of imports fall, export prices catch up with import prices so that the country's national trade balance becomes positive (Salvatore, 2004).

The evaluation and examination of the J-curve is important for several reasons. First, it provides an indirect test of the Marshall-Lerner condition. Second, it provides crucial information for trade and exchange rate policy decisions, since it gives an approximation about the length and depth of the deterioration in the trade balance after depreciation (Demirden and Pastine, 1995).

The relationship also gives information concerning the current account. A current account that is either too large or too small is undesirable, due to the associated problems with suboptimal intertemporal trade situations. Policymakers are also interested in knowing if the trade balance is on a level that can be estimated to be optimal. The policymakers can easier reach the targeted trade balance at their time scale if they know how the exchange rate affects the trade balance in the long run. The policymakers might also gain important insights on the national income in the short run and can therefore help them target the optimal level of the national income (Hacker and Hatemi-J, 2004).

Some empirical studies confirm the existence of the J-curve effect. The studies found that the elasticities in the long-run experienced today are approximately twice as high as those in the 1940s. The reason behind this rise is that real-world elasticities are high enough for stability to be expected on the foreign exchange market in the short run. It also reflects that demand and supply schedules for the foreign exchange in the long-run are fairly elastic. However, in the very short run i.e. roughly six months, deterioration in the current account is found directly after depreciation due to the fact that the elasticities are small and after that an improvement occurs i.e. the J-curve effect. The foreign exchange market is unstable in the very short run (Salvatore, 2004).

There have also been studies in which the J-curve effect cannot be found. For small open economies the J-curve effect may not exist, this holds true especially in the short-run (Hsing, 2005). The long-run effect is also dependent upon other variables such as; domestic spending, international competitiveness of tradable goods and changes in the terms of trade which also affects the J-curve effect (Bahmani-Oskooee et al, 2005).

In the study made by Hacker and Hatemi-J (2003) empirical evidence is provided for the existence of the J-curve effect in Sweden along with four other small countries in the north

of Europe. They also found that the export-import ratio often converge to a higher long-run equilibrium.

The J-curve effect is assumed to arise from the existence of already made contracts. However, most developed countries today have their nominal trade balance, import prices and export prices expressed in terms of a foreign currency. In this case, the prefixed contracts cannot be a factor that explains the J-curve. When a country uses foreign exchange rate to express their own nominal trade balance, the J-curve effect can instead be explained by the degree of exchange rate pass-through and the short-run price elasticities of export and import demands. The scale of the J-curve is dependent upon the short-run degree of pass-through; the scale becomes larger as the degree of pass-through increases (Han and Suh, 1996).

3.3.1 Exchange rate Pass-Through

The degree of pass-through from the exchange rate to export prices can be defined as the percentage by which export prices, measured by the home currency, rises when the home currency depreciates. The same can be done for pass-through from the exchange rate to import prices (Han and Suh, 1996).

The degree of pass-through from the nominal exchange rate to export prices, which is measured by the foreign currency, might be different whether the home country's currency appreciates or depreciates (Han and Suh, 1996).

The pass-through from depreciation to domestic prices may be less than complete, which implies that the increase in the domestic price of the imported commodity may be smaller than the depreciation. This means that for example a ten per cent depreciation in the domestic currency account may result in an increase in the domestic price of the imported commodity that is less than ten per cent. The reason behind this is that foreign firms are very cautious about their market share in a country and are not willing to lose it by raising their export prices by too much. The start up costs are very high: it is very costly to plan and build or dismantle production facilities or to enter or leave a market. The firms absorb the price increase, to a certain extent, by lowering their profits. This is called the beachhead effect and is a sunk-cost model. The exporting firms might also believe that the depreciation is temporary and are therefore reluctant to increase the price by the full amount (Salvatore, 2004).

Sunk-cost models are models that explain why it might be optimal for a firm to not pass-through an exchange rate movement to its domestic currency export price. It also explains why firms continue to supply markets even if the exchange rate movement is unfavourable. These models predict a slow adjustment of both trade quantity and prices which is referred to as trade inertia. Trade inertia is an exogenous variable and can be seen as a "memory". There are several forces that may contribute to trade inertia such as: the time it takes for the market to clear, the time it takes for tastes to change and the time it takes for the trade contracts to resolve (Vesala, 1992).

The sunk-cost models are based upon the observation that sunk costs are crucial for the decision making in a firm and it yields hysteretic results i.e. temporary shocks leaves permanent effects. One of the implications in the sunk-cost models is that the firm can use a "wait and see" strategy: they remain in the current state and as time passes they receive more information so that they can make a more accurate decision. If the exchange rate changes to a large extent, firms will enter or exit the market depending on the direction of

the change and as a consequence the total supply will change as well. The change in the exchange rate (temporary shock) leaves a permanent effect, since the firms will not re-enter or exit the market if the exchange rate moves back to its initial state i.e. the effect is hysteric. The sunk-cost model explains why trade patterns can be unaffected by small changes in the exchange rate (Vesala, 1992).

When a country is small and open, its import prices are fixed, even if the country's currency depreciates since they are price takers on the international market. The degree of pass-through to import prices will always be one, measured in the domestic currency. The degree of pass-through in exports is therefore the factor that determines the value effect on the trade balance. For these countries the pass-through from the exchange rate to export prices will be more accurate. The mark-up and the cost proportion of imported material, measured by the home currency, in the production of exported goods are two factors that influence the pass-through. The pass-through is equal to one if the mark-up is fixed, and is equal to zero when the mark-up changes by the same proportion as the exchange rate. If the degree of pass-through is small there is little room for lowering the export prices, which happens if the cost proportion of imported materials are large (Han and Suh, 1996).

If a country would experience perfect "zero-pass-through" the domestic export price would increase and the domestic import price would stay at the same level in case of depreciation. This yields an increase in the trade balance. If a country instead experiences perfect pass-through, the domestic import price would increase and the domestic export price would stay the same leaving the country with a decrease in the trade balance (Hsing, 2005).

The degree of pass-through might be large in the short run, when depreciation occurs. The degree of pass-through will however decrease and becomes smaller in the long run since the cost pressure increases. Due to differences in degrees of pass-through and short-run dynamics, the absolute size of the effect on nominal trade balance from an exchange rate movement will be different whether the currency depreciates or appreciates. This results in different dynamic paths. The size and the degree of intervention of exchange rate policies should therefore be different whether the domestic currency is depreciating or appreciating (Han and Suh, 1996).

3.4 Effects of Exchange Rate Volatility That Can Be Positive or Negative

Real exchange rate volatility influences profitability, rents and the purchasing power to a large extent. However, the export volume has stayed almost at the same level while the exchange rate volatility has increased by a large amount. Hence, the larger part of these transfers is made between one agent to another and one should be indifferent to such transfers (Manzur et al., 1992).

Ethier (1973) found that exchange rate uncertainty influences only the degree of forward cover and not the amount of international trade when a firm knows how their revenue will be influenced by future exchange rate. However, uncertainty towards how the firm's revenue depends on future exchange rate will make the level of trade sensitive to exchange rate volatility and will reduce the level of trade and increase the terms of the trade-off of expected profit for a reduction in risk. These factors will be less significant if the firm is engaged in massive speculations.

Firms are able to plan their production and exports using the forward exchange rates. Firms will then behave as profit maximisers, using the fully covered marginal profit as a

planning equivalent, even if the firm may not cover the whole exchange rate risk. Thus, the exchange rate volatility has no effect upon international trade (Baron, 1976b).

An exporter that is facing uncertainty in a market can eliminate this risk completely if there is an unbiased forward/futures market, or another financial asset, that is perfectly correlated to the spot price of the underlying asset. A problem arises since not all currencies or commodities are traded in forward/futures markets. Even if there does not exist any financial asset that is perfectly correlated, the firm can reduce the risk if there is a financial asset that is highly correlated to the foreign exchange rate and is traded on the forward/futures market (Broll et al, 2001). When a firm is using alternative forward/futures contracts, the firm is conducting indirect hedging. The firm can gain an acceptable hedge by using this indirect instrument if the stochastic relationship remains stable over a time period. An international firm can benefit from indirect hedging in case of exchange rate uncertainty (Broll et al, 1995).

3.5 Negative Effects of Exchange Rate Volatility on Exports

International firms are of great importance in the world economy; they have an important role as importers and exporters and are involved in international capital flows. The future profit for a firm that arises from international trade and foreign direct investment (FDI) becomes uncertain by exchange rate volatility (Broll, 1994).

Exchange rate volatility has a negative effect upon world trade, since it increases the risk involved in international trade. This holds true even if forward/futures markets exist, since forward/futures markets cannot completely neutralise this effect which is due to several aspects: there is a cost involved, a risk premium, in the forward/futures market and few currencies have well-developed forward/futures markets across a wide spectrum of maturities. Even if a well-developed forward/futures market exists, the risk cannot be eliminated because exchange rate volatility affects exporting firms by different channels. Either by bringing a change in the amount received in terms of the domestic currency, or by bringing changes in the prices of the commodity exported in terms of the domestic currency which will affect the volume of trade. Both effects lower the profit for the exporting firm. The price of the commodity will be affected by a large number of factors such as; the market structure in which the firm operates, the policies of its competitors, the sensitivity of demand for its product to the exchange rate (elasticity), the extent to which consumers anticipate price changes and so forth. The price is sensitive not only to the spot price when the payment is due but to the behaviour of the exchange rate from the time the order is placed until the last unit is sold (Ethier, 1973).

When including both the import demand and the export supply of the market, the risk from exchange rate volatility can either be put on the importing firm or on the exporting firm. Contracts are normally set in the exporter's currency, which causes the importing firm to bear the risk. An increase in the exchange rate volatility, and thereby the risk, will reduce the volume of trade, if the firms are risk averse. This holds irrespective of which agent that bears the risk; the exporting or importing firm. The price is however affected differently depending upon which agent that is bearing the risk; if it is the importing firm the price will fall as import demand falls. The price will rise if it is the exporting firm that bears the risk since the exporter will charge an increasingly higher risk premium. *Ceteris paribus*, as exchange rate volatility increases, the imports as well as the market price decreases (Hooper and Kohlhagen, 1978).

Economic agents are unable to predict the domestic value of foreign transactions when there is exchange rate volatility. This leads to a greater uncertainty in international trade and investment. Since the cost and risk are enhanced, the international trade will decrease. The covering of exchange rate risk in a forward exchange market becomes more expensive when the volatility increases (Clark, 1973).

The willingness of a firm to engage itself in international trade is dependent upon the long-term prospects for profit in that activity. The firm is unable to make precise estimations of the domestic value of its foreign sales when the exchange rate is volatile. The unpredicted exchange rate volatility will cause the profit to change. If the exporting firm is risk-averse, the increased volatility in profit will reduce the volume of trade i.e. the supply schedules will shift up to the left. The exporting firm cannot predict the effect that the exchange rate volatility will have upon their foreign sales due to two main reasons; forward/future markets in foreign currency are not developed enough or the firm might be uncertain of the value of the foreign exchange that it wants to cover. If perfect foreign exchange market exists, the variability of profit that rises from exchange rate volatility could be reduced, but not completely eliminated (Clark, 1973).

When the decision to export is made, the present commitment of resources is valued against the future expected desired rate of return on these resources. The firm cannot predict the foreign exchange rate when taking the decision of whether to enter or continue on the export market. Some of the transactions that determine the profitability of the export activities can be hedged to avoid risk on the forward market, but not all. The covariance between the foreign price and the exchange rate has an important influence on the amount of expected profit that the exporter will cover on a forward/futures market. If the covariance between the two variables is largely negative, the smaller is the need for a forward/futures market to reduce the variability in the profits. The negative correlation works as a stabiliser and reduces the negative effect of exchange rate volatility (Clark, 1973).

Exchange rate or price volatility leads to an increased uncertainty which reduces the production and exports. The most important aspect of the financial market is therefore the possibility for firms to reduce currency or price risk, and the following impact on production and exports (Broll et al, 1995).

Baron (1976a) states that an exporter faces two types of risks, due to the exchange rate volatility: from the nature of the sales process and from the transaction risk resulting from converting revenue from one currency to another. The price can be set in the currency of the importer or the exporter, the profit of the exporter is however uncertain either way. The exporter faces transaction risk when converting the foreign currency into the domestic if the price is set in the importers currency. When the price is set in the domestic currency the exporter faces an uncertainty in the quantity demanded at the time the importer make the purchase.

The major currencies have experienced increased volatility ever since the fixed exchange rate regime was abandoned in the 1970s. Thus, international firms have been exposed to higher foreign exchange risk. A firm that is risk averse and has the opportunity to sell its commodity either on the domestic or foreign market experience export flexibility. The multinational firms are considered to have export flexibility, since they make use of distribution facilities that exist all over the world. The firm can then take the future foreign exchange spot rate into consideration before choosing which market it should penetrate. The firm will export if it is profitable, but will then be exposed to exchange rate risk. This implies that the firm's profit is not linear in the foreign exchange rate and that a forward/futures

contract cannot be used to form a perfect hedge. A more effective hedging tool is to write a European call option¹. The major flaw with this approach is that it assumes that there is no risk premium involved in the price of the call option. So the firms will endure a cost associated with the call option, which will make them reluctant to go forward with the export as the exchange rate volatility increases (Broll and Wahl, 1997).

Exchange rate volatility affects the optimal allocation of resources in a negative way which is due to the uncertainty in different variables such as profits. Exchange rate volatility might also influence trade flows in an indirect way; exchange rate volatility influences income volatility. Income volatility has an ambiguous effect upon trade, since it can reduce the trade through revenue uncertainty or increase the trade prospects by taking a real option perspective on the potential to establish operations in that market (Baum et al, 2001).

Real exchange rate volatility is considered to be a source of uncertainty for risk averse exporters. The volatility of the real exchange rate affects the decision to export if the following assumptions hold: there is no possibility to construct a perfect hedge; this effect would be reduced if access to forward/futures markets existed and that the exporters are risk averse. Risk averse exporters choose to export less if the volatility increases and fewer resources will be allocated to the exporting sector (Gonzaga and Terra, 1997).

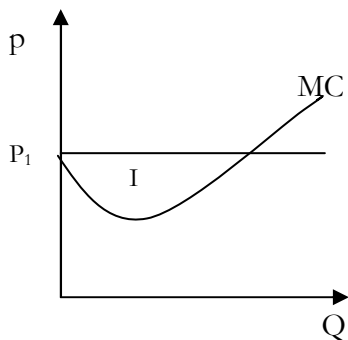
3.6 Positive Effects of Exchange Rate Volatility on Exports

When a firm is profit-maximising and a price-taker in the output market, exchange rate volatility might increase exports. This is shown in Figure 3.3, where the marginal cost (MC), the price (P) and the output (Q) are represented. The left panel shows the scenario of a constant price and perfect predictability for the firm. The right panel shows the opposite: prices are fluctuating in a symmetric way, in this case between P_2 and P_3 where $P_3 - P_1 = (P_2 - P_1)$ (De Grauwe, 1992).

In the left panel the area denoted by I represents the profit for each period when the fixed cost are excluded. In the right panel the profit will reflect the price it faces. If the price is low, (P_2), the profit is smaller by the area represented by BEDI (BEFI-EFD) than the profit in the case of price certainty. If the price is high, (P_3), the profit is larger than the case of price certainty by the area represented by BEHA (BEGA+EGH). The profit will be larger on average if the price is fluctuating since the area BEHA is larger than the area represented by BEDI. The difference in profit between price certainty and price uncertainty is shown by the areas EGH and DEF (BEHA-BEDI) in the right panel. Thus, the firm will increase its output and the profit if the price is high, since the revenue is higher per unit of output. The opposite will happen if the firm faces a low price, but a fall in price reduces profit not as much as the increase in profit due to an equivalent price increase. If P_2 and P_3 randomly occur with equal propability, expected profit will be higher than if price was always at P_1 despite the fact that the expected price is the same (P_1) in both cases. Even though this is a simplified model, the result is the same as in a more complex model that includes imperfect competition and adjustment costs (De Grauwe, 1992). The higher expected profits in the volatility price situation may induce firm entry if the deterrence from the additional risk is sufficiently weak.

¹ A European call option gives the right to buy an asset, the option can only be exercised at maturity (Melvin, 2000).

Price certainty



Price uncertainty

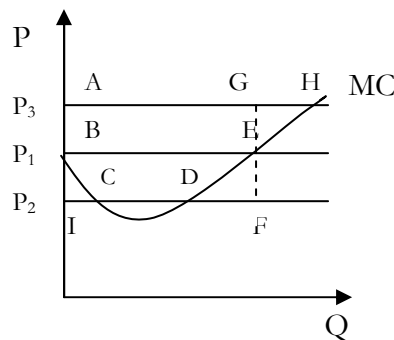


Figure 3.3: Profits of the firm under price certainty (left) and uncertainty (right)

Source: De Grauwe, 1992

Exchange rate volatility does not only represent a risk for a company, it also represents an opportunity to make a profit. When the volatility increases, it increases the opportunities of making large profits. One can see exporting as an option. A firm uses its option to export if the exchange rate is favourable, and the firm chooses to not use its option if the exchange rate is unfavourable. According to option theory the option value increases along with the variability of the underlying asset. Hence, a firm that has the option to export is better off if the exchange rate is volatile (De Grauwe, 1992).

Exchange rate volatility can positively affect the value of exporting firms through the price and volume impacts of exchange rates. It can also create more incentive for the exporting strategy compared to the one of FDI. This is due to the fact that the comparative advantages a firm can gain from exports become relatively more attractive when exchange rates become more volatile. An export-based strategy seems to be relatively more valuable than a FDI investment. Thus, investment in export production capacity could be a positive function of exchange rate volatility. The adjustment cost and the cost of financial distress are omitted (Sercu and Vanhulle, 1992).

The exchange rate volatility increases the value of the export strategy and the value of exporting for firms that experiences comparative disadvantage in international trade and follows a stationary bang-bang policy of entry and exit. A stationary bang-bang policy of entry and exit can be seen as an all-or-nothing strategy. The firm either totally ignores the market and stays out of it or totally commits to the market and enters; this policy can be seen as natural since the optimal policy is not known. The value of the export strategy and the value of exporting increase due to the fact that the expected cash flows from exporting grow faster than the associated entry and exit costs. A firm that experiences comparative disadvantage in international trade is facing a loss when exporting when the exchange rate equals the parity rate at which internationally traded commodities are equally expensive in the domestic market as in the foreign market. To enter a foreign market an exporting firm faces costs. If the firm stops exporting, the firm will face exit costs. Whether the expected export volume for a firm will grow with exchange rate volatility depends on the optimal export volume being a function of the exchange rate and the optimal adjustment of entry and exit rates. Firms will on average enter sooner and exit later when the volatility in-

creases, so the number of trading firms will on average increase and by this also the average trade. Hence trade benefits from exchange volatility (Franke, 1991).

According to Sercu (1992) so can exchange rate volatility on average increase trade since it implies a higher probability that ex post deviations from the Commodity Price Parity will be larger than tariffs and transportation costs. This assumption is based upon the facts that a firm's exposure can be replicated and hedged by standard options, the existence of perfect competition and complete monopoly. The same result cannot be found in general if the assumptions are relaxed, but neither can it be ruled out.

4 Empirical Analysis

In this section the model will be put forward and examined. The variables in the model and the data will be explained. The data will partly be explained by a graphical interpretation where the relationship between the exchange rate volatility and export is examined. This will be followed by an evaluation of the model using regressions. The Granger causality test will be examined.

4.1 Model

The model that will be used in the empirical analysis is based on the following export equation (4.1);

$$X_t = \alpha + \beta_1 REER_t + \beta_2 Y_t + \beta_3 I + \beta_4 V_t + \varepsilon_t \quad (4.1)$$

where α is the intercept, X is the volume of exports in Sweden, $REER$ is the real effective exchange rate index for Sweden, Y is the total volume of the Swedish industrial production, I is the total import in the Euro zone for consumption goods, V is a measure of exchange rate volatility and ε is the stochastic error term.

The real effective exchange rate index is calculated for the Swedish krona using the real exchange rate between the Swedish krona and other currencies. The different currencies have different weight in the index and this weight is calculated from the consumer price index in the two countries and their bilateral nominal exchange rate. A rise in the variable $REER$ represents a real appreciation of the Swedish krona. Y , the total volume of the Swedish industrial production and can be seen as a “push” factor for the Swedish export, I represents the total import in the Euro zone for consumption goods and can be seen as a “pull” factor.

The coefficient β_1 is expected to be negative i.e. if the real effective exchange rate index is increasing the country experiences appreciation and the commodities in the home country become relatively more expensive and economic agents will change their behaviour. The economic agents on the foreign market will choose domestic commodities since they are relatively less expensive. Hence, their import will decrease. The coefficient β_2 is expected to be positive since the exports increase if a “push” factor becomes stronger. If the Swedish production increases it will have spill-over effects on the export since the Swedish market is filled and a company has to go abroad to find a market for its commodities. The coefficient β_3 is expected to be positive since exports increases if a “pull” factor becomes stronger i.e. if the imports in the Euro zone increases the exports for Sweden will increase since Sweden to a large extent exports to the Euro zone. The coefficient β_4 of the variable V , the exchange rate volatility is however ambiguous.

The measure of the exchange rate volatility will be calculated using the variance of the exchange rate for five periods; the two periods before, the period examined and the two periods after. For example: when calculating the volatility for the month March the variance for the months January, February, March, April and May will be used. One can also calculate the volatility for a month by using the daily figures and take an average of those. The reasoning behind the chosen method is that the exchange rate is influenced by the expectations of what will happen in the coming periods and by events in the past periods.

The data are from between the years 1993 and 2006. The reason for the chosen period is that the Swedish currency started to float in November 1992. While investigating the rela-

relationship between exchange rate volatility and export a floating exchange rate regime is needed in the specific country since the exchange rate is allowed to fluctuate.

4.2 Graphical interpretation

In this section graphs will be used to interpret whether one can see a relationship between the exchange rate volatility and the exports. It also shows the characteristics of the chosen data. This is done as a complement to the regression analysis that follows in the next section.

The following Figure 4.1 shows total exports on a monthly basis for Sweden between the years 1993 and 2006. The main trend in exports, represented by the straight line, has been increasing through the years. Exports have been fluctuating around this trend.

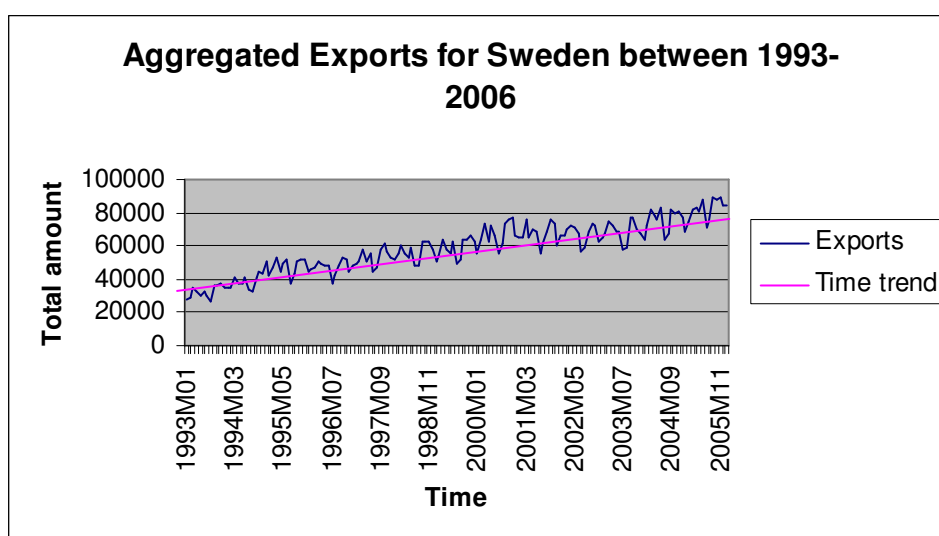


Figure 4.1: The total aggregated export in Sweden between 1993 and 2006.

Source: Statistics Sweden (Statistiska Centralbyrån).

Exports are growing over time which is consistent with applied theory and the reality of many countries. Even if the export is fluctuating it does not move extensively around the main core. Seasonality should not be found in the data since it has been adjusted for by the database. However some patterns can be seen in the later years, 2000 and onwards. By calculating the average for the months in all of the years, one can see if there are months that clearly distinguish themselves by having very high or very low values. When using all of the years October and November distinguish themselves from the other months. Since some patterns can be seen from the year 2000 and onwards, calculations were made for these years. In the later case the months March, October and November distinguish themselves from the other months.²

² To get rid of the problem of seasonality one can include dummy variables in the regression analysis for the months that clearly distinguish themselves from other months.

Figure 4.2, shows volatility in the exchange rate for the \$/SEK between the years 1993 and 2006 this data is also on a monthly basis.

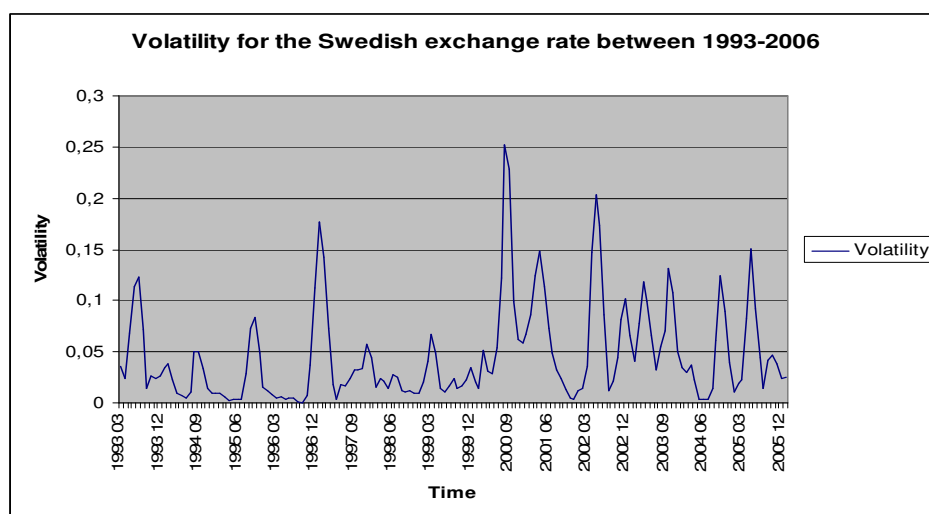


Figure 4.2: The Swedish exchange rate volatility between 1993 and 2006.

Source: Statistics Sweden (Statistiska Centralbyrån).

Volatility does not follow any seasonal pattern. Hence, seasonality is not a problem in either of the variables. Volatility does not have a trend that grows or decreases over time. However, one can see that the volatility is often higher since the year 2000.

There is no relationship to be found when comparing the two graphs. It is obviously hard to see a clear-cut relationship between the two variables in these figures due to the high frequency of the data.

4.3 Regressions

Three regressions will be presented in this thesis. The independent variables will be lagged in some of the regressions. By using the Schwarz information criterion, where it is minimised, the most appropriate number of lags was found. The reason for the use of lags is that the dependent variable is often influenced by the independent variables with a time lapse e.g. it takes time for the export to adjust to the new exchange rate since contracts have to be changed and the already made contracts hinder the companies to change their behaviour instantaneously.

A unit root test was conducted to verify if the data exhibited non-stationarity or stationarity, using the Elder and Kennedy (2001) approach. The only variable that was non-stationary was the industrial production in Sweden. The two variables Swedish exports and the import for the Euro Zone were trend stationary. A more detailed explanation of the unit root test can be found in the appendix.

The chosen data are gathered from different databases. From OECD the data for the real effective exchange rate index was collected. The industrial production in Sweden was from the Statistics Sweden (SCB). The import from the Euro zone was collected from the European Central Bank (ECB). The data for the first three variables were found in the Ecowin, which is a database that collects data from different sources. From the Statistics Sweden (SCB) Swedish exports data were collected and the exchange rate was found in the Swedish

central bank's database. The data found are already adjusted for seasonality so it is therefore no need to correct it further.

The variables in the first regression are transformed into growth using equation (4.2):

$$\text{Growth} = (X_t - X_{t-1}) / X_{t-1} \quad (4.2)$$

The first regression includes all the variables and all of them are transformed into growth represented by the $\hat{\cdot}$. The volatility variable is logged. All the variables are also lagged by one period to include the effect from one previous period, upon the dependent variable. The choice of one period was based on the Schwarz information criterion. Equation (4.3) is used:

$$\hat{X}_t = \alpha + \beta_1 \hat{REER}_t + \beta_2 \hat{Y}_t + \beta_3 \hat{I}_t + \beta_4 \text{Log} \hat{V}_t + \beta_5 \hat{REER}_{t-1} + \beta_6 \hat{Y}_{t-1} + \beta_7 \hat{I}_{t-1} + \beta_8 \text{Log} \hat{V}_{t-1} + \varepsilon_t \quad (4.3)$$

The result is found in the following Table 4.1:

Table 4.1. Result from first regression (equation 4.3)

Dependent variable: Growth of Exports		
Variable ³	Coefficient estimate	t-value
Real effective exchange rate index, ($REER_t$)	-0,406937	-0,50139
Industrial production, (Y_t)	0,679081	12,96908
Import Euro zone, (I_t)	0,202007	0,577792
Logged, Volatility of exchange rate, $\text{Log}(V_t)$	0,002403	0,304858
Real effective exchange rate index with one lag, ($REER_{t-1}$)	0,610557	0,884077
Industrial production with one lag, (Y_{t-1})	0,261424	4,352869
Import Euro zone with one lag, (I_{t-1})	0,103007	0,26342
Logged, Volatility of exchange rate, with one lag, $\text{Log}(V_{t-1})$	0,001874	0,240758
R^2	0,860241	

³ All the explanatory variables are in terms of growth, calculated as in equation 4.2

The coefficient estimates of the variables: industrial production in Sweden at time t and at time t-1, which represent the current and the previous period, were significant at the five percentage significant level, since their t-values were above two in absolute terms. The industrial production in Sweden had the expected sign in both cases. R^2 is approximately 86 per cent i.e. 86 per cent of the variance in the dependent variable can be explained by the model.

In the first regression the coefficient estimates of the volatility and the volatility with one lag were not significant, not even at a ten percentage significant level. Both the coefficients did have a positive sign which is interpreted as an increase in exports if volatility increases.

The coefficient estimate for the variable industrial production in Sweden is expected to be positive since it is considered to be a "push" factor. The Swedish market's demand for the commodities that are produced by the Swedish firms are too small to satisfy the supply from the Swedish firms.

In the second regression the level values of the variables are used. All the variables are logged so the results can be interpreted as percentage changes and hence the scales of the variables are not needed to take into account. The industrial production in Sweden is not included in this regression since it was tested to be non-stationary. A time variable is included to verify if export is growing over time. The equation (4.4) is used:

$$\text{Log}X_t = \alpha + \beta_1 \text{Log}REER_t + \beta_2 \text{Log}I_t + \beta_3 \text{Log}V_t + \beta_4 t + \varepsilon_t \quad (4.4)$$

The result is found in the following Table 4.2:

Table 4.2. Result from the second regression (equation 4.4)

Dependent variable: Log of Exports		
Variable	Coefficient estimates	t-value
Real effective exchange rate index, logged, $\text{Log}(REER_t)$	0,496824	3,068595
Import Euro zone, logged, $\text{Log}(I_t)$	-0,0022	-0,01302
Volatility of exchange rate, logged, $\text{Log}(V_t)$	-0,010653	-1,19845
Time (t)	1,96E-04	5,571107
R^2	0,830241	

The real effective exchange rate index and the time variable have significant coefficient estimates at the five percentage significant level, since they have a t-value above two in absolute terms. The real effective exchange rate index does not have the expected sign for its coefficient estimate. The time variable on the other hand has the expected sign. R^2 is approximately 83 per cent.

The coefficient estimate of the logged volatility was not significant and exhibits a negative sign i.e. volatility decreases exports. The coefficient estimate of the volatility had in this regression a higher t-value than in the other regressions presented in this paper.

The coefficient estimate real effective exchange rate index was in this case positive which can be explained by the fact that it takes some time for economic agents to change their behaviour when the economic environment changes. The coefficient estimate for the variable time is positive which indicates that the level of exports is growing over time.

The third regression is also based on the level values and all of the variables are logged. All of the variables are also lagged by one period. This regression is also examining the Granger causality by including the export variable, with one lag, at the right side in the equation. This variable takes into account omitted variables. A time variable is also included to verify if exports are growing over time. The equation (4.5) will be used:

$$\text{Log}X_t = \alpha + \beta_1 \text{Log}REER_{t-1} + \beta_2 \text{Log}I_{t-1} + \beta_3 \text{Log}V_{t-1} + \beta_4 \text{Log}X_{t-1} + \beta_4 t + \varepsilon_t \quad (4.5)$$

The result is found in the following Table 4.3:

Table 4.3. Result from the third regression (equation 4.5)

Dependent variable: Log of Exports		
Variable	Coefficient estimates	t-value
Real effective exchange rate index, logged, with one lag, $\text{Log}(REER_{t-1})$	0,22467	1,533161
Import Euro zone, logged, with one lag, $\text{Log}(I_{t-1})$	0,064009	0,431334
Volatility of exchange rate, logged, with one lag, $\text{Log}(V_{t-1})$	0,001366	0,174199
Export, logged, with one lag, $\text{Log}(X_{t-1})$	0,456934	6,375282
Time (t)	8,79E-05	2,591853
R^2	0,865646	

The coefficient estimates of the variables lagged exports and time are significant at the five percentage significant level, since they have a t-value above two in absolute terms. Both of the two variables have the expected sign. R^2 is approximately 86 per cent.

The coefficient estimate of the volatility when it was both logged and lagged by one period had a positive sign i.e. volatility increases exports but was not significant. This result resembles to the first regression where the coefficient estimates of the volatility, in the current period and the previous (one lag), was positive.

The coefficient estimate for time was also in this regression significant and positive which indicates that the level of exports is growing over time. The fact that the coefficient estimate of the lagged exports was positive can be interpreted as a positive correlation i.e. a positive value will be followed by a positive value.

The difference between regression two and three is that the third regression uses the variables with one lag and includes the lagged exports. The result from the two regressions differs however. The coefficient estimate for exchange rate volatility has opposite sign in the two regressions: it is negative in the second regression and positive in the third. This could be due to the fact that the third regression takes the time aspect into account, uses variables that are lagged by one period.

4.3.1 Granger Causality Test

Even though regression analysis can indicate a relationship of dependence on one variable upon another variable it does not need to imply causation. However, dealing with time series the situation might be different. If one event happens before another it is possible that the first event is causing the second event, the reverse is however impossible, the later event cannot cause the first one. This is the reasoning behind the Granger causality test. This test relies upon the assumption that the relevant information for the prediction of the respective variables is contained purely in the time series data on these variables. If for example the variable X causes variable Y then changes in X should precede changes in the variable Y since the future is unable to predict the past. If past values of X significantly improve the prediction of Y , in a regression where Y is the dependent variable and has independent variables that include its own past values than one can draw the conclusion that X causes Y (Gujarati, 2003).

The equations that will be used for testing Granger causality in the current context are the following:

$$X_t = \alpha + \beta_1 X_{t-1} + \beta_2 Y_{t-1} + \beta_3 t + \varepsilon_t \quad (4.6)$$

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + \beta_3 t + \varepsilon_t \quad (4.7)$$

The variables that were tested were: export causes the volatility and vice versa, export causes industrial production and vice versa, export causes the import from the Euro zone and vice versa and export causes real effective exchange rate index and vice versa. This test is a complement to the third regression (equation 4.5) that also checks for Granger causality. The result is shown in the following Table 4.4:

Table 4.4. Results from the Granger causality test

Causal Relation *	Coefficient estimates	t-values
Export → volatility	0,003874	0,832757
Volatility → export	-0,76354	-0,15345
Export → industrial production in Sweden	0,384953	5,733922
Industrial production → export	-0,43267	-3,0236
Export → import from the Euro zone	-0,45336	-1,37648
Import from the Euro zone → export	0,018043	1,062271
Export → the real effective exchange rate index	0,057036	0,089508
Real effective exchange rate index → export	-0,00315	-0,32195

*The symbol, →, represents the direction of causation, e.g. $X \rightarrow Y$ means that X causes Y . The associated coefficient estimate indicates the degree to which it is true, and the t-value is used to test whether lack of that causality can be rejected.

There could not be found any causality in either direction between the variables: export and volatility, export and the import from the Euro zone or from the export and the real effective exchange rate index. Between the variables export and the industrial production causality was found in both ways and with negative signs.

5 Conclusion

The results found in this thesis are that the following variables influence Swedish exports: the real effective exchange rate index, the industrial production in Sweden, time and the lagged value of exports. These variables showed significant results in the regressions conducted, although not all were significant in the same regression. The coefficient estimates of the exchange rate volatility did not show any significant result in any of the regressions conducted and exhibited both negative and positive signs.

The real effective exchange rate index unusually had a positive sign for its coefficient estimates, which is interpreted as when Sweden's currency experiences appreciation the exports increase. This is not consistent with applied theory. The reason behind this result can be that when Sweden's currency appreciates the country is doing well and is in an economic upswing and its exports are therefore increasing. It also takes a certain time period for an economy to adjust after there have been a change in important macro variables that affect the economy e.g. changes in the exchange rate.

The industrial production coefficient estimates had a positive sign in the regressions conducted which is consistent with applied theory since it is seen as a "push" factor. When the industrial production in Sweden increases its exports will increase as well. This is due to the fact that the firms need to find other markets to supply when the domestic (the Swedish) demand is not sufficient. Since Sweden is a relatively small country and therefore has a small market, the firms often need to find other markets to supply, i.e. they export.

When testing the time variable in the regressions it was found that the export is growing over time when the level of export is considered. This is consistent with applied theory and the real world since the level of exports is increasing over time. Even if the level of exports is increasing over time in a country it does not mean that it has increasingly higher growth in their exports.

The lagged values of exports were included in the regression to see if the current value of exports is affected by values from previous periods. When testing for the level of exports, the lagged value was positive in its coefficient estimate. Hence, the past value of the level of exports is increasing the current level of exports. This result is consistent with the result from the time variable.

The coefficient estimates of the variable exchange rate volatility did not show any significant effect on exports in any of the regressions. The coefficient estimates of the variable had both positive and negative signs. The coefficient estimate that was the most significant had a negative sign which can be interpreted as when the exchange rate volatility increase the export decreases. This is consistent with the theory that states that the risk increases along with the exchange rate volatility and therefore makes the exporting firms less eager to export. However the insignificant result with varying signs could also arise from drawbacks in the chosen model.

The fact that the variable exchange rate volatility did not show any significant results can be a result from the increased use of future and forward contracts and the increased accessibility of the futures and forward markets. If a firm uses the futures and forward markets they can hedge themselves, using different financial assets, from the exchange rate risk and can therefore export at the same level as with no exchange rate volatility. Hence, the exchange rate volatility has no impact on the exports in a country. The futures and forward markets have been increasingly growing in recent time periods.

If the Swedish firms that are exporting are following the strategy from the sunk-cost models then small changes in the exchange rate do not change their behaviour. This is because it is costly to exit or enter a market so when the firms have established themselves on a new market they are very reluctant to leave it. The exporting firms are also very cautious about losing market shares in the foreign market since it is hard to take them back. Hence, if the exchange rate volatility increases the firms does not pass on the changes to the foreign market.

The question of whether it is a good idea or not to join the EMU is still unclear. The argument that trade increases when using a common currency (so the exchange rate volatility equals zero) is not supported nor rejected; the result in this thesis does not support any decision. The exchange rate volatility's impact on exports is still ambiguous.

The relationship between the exchange rate volatility and the export in a country needs to be further investigated in other studies since no consistent results have been found. The studies ought to focus on the method used and try to improve the already existing ones. One can also take a more theoretical approach and conduct studies where interviews are used. By using interviews one can go deeper into the choice behind the actions of a firm when they face exchange rate volatility. The use of financial assets when a firm is involved in international trade can be further investigated. It could also be interesting to investigate the imports into a country and the exchange rate volatility's impact on this variable.

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Database

Ecwin

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Swedish Central Bank, webpage:

<http://www.riksbank.se/templates/Page.aspx?id=15867>

Statistics Sweden (SCB), webpage:

http://www.scb.se/templates/tableOrChart_26617.asp

Appendix

Unit root test

Asset prices such as stock prices and exchange rates often follow a random walk thus they are non-stationary. There exist two types of random walk: random walk without drift i.e. no constant or intercept term is present and random walk with drift i.e. a constant term is present. A non-stationary time series will have a time-varying mean or a time-varying variance or both. The problem with non-stationary time series is that only the behaviour in the period that is considered can be studied. It is therefore not possible to generalize it to other time periods. The unit root test is a way to verify the existence of stationary or non-stationary. Equation (1) is used in the unit root test:

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \beta t + \mu_t \quad (1)$$

where Δ is the first-difference operator, Y is a variable, α is the intercept, δ is a drift parameter that represents $(\gamma - 1)$, γ is the coefficient of autocovariance, β is the time trend and μ is a white noise error term. If γ is equal to one the model inhibits a unit root i.e. a random walk thus the time series is non-stationary. In equation (1) the null hypothesis that is tested is if δ is equal to zero which implies that γ is equal to one and a unit root is present. When testing, one takes the first difference of Y_t and regress them against Y_{t-1} and time and examine if the estimated slope coefficient in the regression for Y_{t-1} , δ , is zero or not; if it is zero Y_t is non-stationary (Gujarati, 2003).

The data used in the following regressions are transformed into monthly rates of change which ought to remove the non-stationary problem. The unit root test is however performed to determine whether non-stationarity is present. Each variable was tested for by using the Elder and Kennedy (2001) approach. Following this approach the time trend was included when the variable was expected to grow over time, in this case: the exports, the industrial production in Sweden and the imports in the Euro zone. First a normal regression was made to get the coefficient estimates for δ . A Dickey-Fuller (DF) test of the t-values is performed to investigate whether the δ estimates are significant or not. The following results can be seen in Table A.1:

Table A.1: The results for the different variables from the Unit Root Test

Variable	Coefficient estimates	Computed t-values	Critical value 1%	Critical value 5%
Export	-1.169398	-4.093320	-4.023042	-3.441330
Real effective exchange rate index	-0.768284	-9.977925	-3.472259	-2.879846
Industrial production	-1.315535	-1.146642	-4.023506	-3.441552
Import Euro Zone	-1.487672	-21.16134	-4.017568	-3.438700
Volatility	-0.923274	-6.164494	-3.577723	-2.925169

If the t-values computed using the DF test exceeds the critical value in absolute terms the null hypothesis can be rejected and thus the data is stationary. If, on the other hand, it is less than the critical value in absolute terms, the time series is non-stationary i.e. the null hypothesis cannot be rejected. The variables volatility and the real effective exchange rate index were calculated without a time trend since these variables are not expected to grow over time. Exports, industrial production and the imports in the Euro zone are expected to grow over time this is also confirmed when plotting the variables. The variables exports

and the imports from the Euro zone experience trend-stationarity. This implies that the variables are stationary around a time trend. The only variable that is non-stationary is the industrial production in Sweden since the computed t-value, using the DF test, is less than the critical value in magnitude. One can possibly use the first difference in the variable to get rid of the problem of non-stationarity.