EXCHANGE RATE EXPOSURE & THE STOCK MARKET

- A SWEDISH STUDY 2001-2005 -

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Abstract
This thesis aims to test the co-variation between stock performance and exchange rate fluctuations in Sweden, by running times series regressions on 172, non-financial, firms quoted on the Stockholm Stock Exchange (OMX) from 2001 to 2005. From this sample, 13 portfolios are constructed aimed to test for a possible pattern between firm characteristics and exposure. A cross-sectional regression is also run to further test for determinants. Hence, this thesis contributes to the scarce research on foreign exchange rate exposure in small open economies. Our expectations are to find significant positive exposure based on the high degree of openness and exports in Sweden. Foreign involvement is expected to be a determinant. We find weak significant positive contemporaneous exposure and somewhat higher significant negative lagged by one month exposure, at the 5% level. The negative lagged exposure dominates both our firm level and portfolio level results. However, when accounting for market capitalisation, contemporaneous and positive exposure is found to be significant. No significance is found in our cross-sectional regression. Analysing our results, hedging activities, foreign debt, import levels and the denomination of imports and exports, as well as a possibly lagged effect on the economy following a change in the exchange rate, are discussed as possible explanations.

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1 Introduction

The Swedish press repeatedly communicates its belief that changes in the exchange rate affect the Swedish stock market. Sudden and often unexpected falls in the dollar are used to explain subsequent falls on the Swedish Stock market. *Dagens Industri* wrote that a drop in the dollar in the end of November last year caused *Atlas Copco* and *Volvo* stocks to plummet 3.8% and 1.2% respectively.[1] Such headlines are not unexpected in a small open economy like Sweden, where many firms either export to a high extent or are faced with import competition.

However, the global market for foreign exchange hedging has been growing. A report published in 2004 by the BIS[2] shows that the global daily turnover in foreign exchange and interest rate derivatives contracts rose by an estimated 74%, to $2.4 trillion, in the three years to April 2004[3]. This report indicates that Swedish firms have increased their use of currency derivatives. However, information on hedging activities has not been publicly available on the firm level until recently. Hence, for the entire testing period we do not know which companies are actively hedging their foreign exchange exposure and neither do we know the exact transactions each company is executing. Consequently, it is difficult to draw any clear cut conclusion on the effect of the hedging on the Swedish stock market, other than that it should have lead to a reduction in exchange rate exposure.

Thereby, there are two effects pointing in opposing directions. The first effect is the openness of the Swedish economy indicating high exposure which the strong business headlines also support. The second effect is the growing market for foreign currency hedging indicating a reduction in exposure. In addition, the limited public information on hedging activities complicates this issue further. Thereby, it is difficult to clearly predict the net effect on exchange rate exposure.

Nevertheless, exchange rate exposure is acknowledged by both media and firms who actively hedge it. This leads one to believe that the market is also pricing it. However,

[1] Dagens Industri, 24.11.2006 ”Börsen: Dollarras tynger”
[2] Bank of International Settlements
[3] **http://www.bis.org/publ/rpfx05t.pdf**

there is surprisingly little research on foreign exchange exposure. Empirical evidence from small open economies, such as Sweden, is especially scarce and it is thus of value to perform further research on it.

The aim of this paper is to contribute to the scarce research of the co-variation between stock performance and exchange rates in small open economies.

Our research questions will be the following:

1) What is the sensitivity of the value of 172 Swedish non-financial firms, actively traded on the Stockholm Stock Exchange (OMX) during the period January 2001 to January 2006, to exchange rate changes?
2) Is there a possible pattern between a firm's exchange rate exposure and its characteristics?

We attempt to answer the first question by conducting firm level regressions on the 172 Swedish non-financial firms in our sample. The second question, we attempt to answer by constructing five portfolios; (i) *Portfolio based on Sales Abroad* (ii) *Portfolio of Companies with only Domestic Sales* (iii) *Portfolio based on Size* (iv) *Portfolio based on Foreign Ownership* (v) *Portfolio of Foreign Registered Firms*. These portfolios are also tested by running regressions. Additionally, we also examine eight sector portfolios, in order to try to spot the correlation between exchange rate fluctuations and sector characteristics. All of these portfolios essentially aim to test the co-variation between a firm's level of foreign involvement and its level of foreign exchange rate exposure. We also perform a cross-sectional regression to further test for the determinants of exchange rate exposure for the firms in our sample.

Our expectations are that a substantial share of firms has significant levels of exposure, as Sweden is a small open economy with high level of exports. Due to the majority of export firms, we expect the exposure coefficient to be, on average, positive. Hence, the SEK[4] and exporting firms' stock prices experience positive correlation: as the SEK depreciates (appreciates) the stock price rises (falls). Respectively, the SEK and importing firms' stock prices experience negative correlation: as the SEK depreciates (appreciates)

[4] The Swedish Krona

the stock price falls (rises)[5]. Our expectations for our portfolio regressions are also to find a positive correlation between foreign involvement, which we as earlier mentioned are essentially aiming to test for, and exchange rate exposure. Consequently, our expectations for our cross-sectional regression which test for determinants of such exposure are also to find a positive correlation between determinants and exposure.

In summary, our empirical findings were quite the opposite of our expectations. We found that negative exposure for individual firms on the Swedish stock market, shows higher levels of significance than positive exposure. As well, our proxy portfolios for firms with high exposure showed the unexpected negative exposure more significant in the equally weighted portfolios, than the positive exposure in the less significant value weighted portfolios. However, when taking market capitalisation into account through the value weighted portfolios, the exposure is found to be significant and positive in line with expectations. Nevertheless, the importance of hedging activities, foreign debt, import levels, the currency denomination of the imports and exports, and a possibly lagged effect on the economy following a change in the SEK, are discussed as potential explanations. Suggestions for further research follow from the discussion.

The outline of this thesis is as follows. Section 2 introduces the theoretical basis. The third Section provides an overview of the literature on this topic and relating issues. Section 4 explains the methodology used. In section 5 the sample selection and data description are laid out. Section 6 presents the empirical results and section 7 provides both a discussion of these results and subsequent suggestions for further research.

2 Theory

In this section, we give an overview of different forms of exchange rate exposure and how they relate to the value of the firm. This underlies the test specifications and interpretations of the results in the empirical work.

Firstly, we present theories that explore if exchange rate risk should be priced into stock prices. Secondly, we present theories on different forms of exchange rate exposure. Lastly, we look at different specificities of exchange rate exposure.

[5] Appendix 1 clarifies the interpretation of the coefficients

2.1 Modigliani and Millers' Irrelevance Theorems

First and foremost, it must be stated that we do not discuss whether or not a firm should hedge its exchange activities. According to the irrelevance theorems of Modigliani and Miller (1958, 1961) a firm cannot increase its value by undertaking activities that investors can perform themselves, based on the perfect capital market assumption. Hence, hedging a currency position does not add value as an investor can diversify his/her own portfolio. However, given a scenario of market imperfections, reasons for foreign exchange hedging exist although we do not explore them.

2.2 CAPM Theory

In order to pin down further underlying theory to whether or not exchange rate exposure should be expected to be priced into the stock market, one can consider the Capital Asset Pricing Model theory (CAPM)[6].

CAPM: $R_{it} = r_f + \beta_{im}(r_m - r_f)$

R_{it}	Return on stock
r_f	Risk free rate
β_{im}	Stocks correlation with market
r_m	Market return
r_f	Risk free return
$(r_m - r_f)$	Risk premium

Return on a stock depends on the firm specific risk and the extent to which it is correlated with the market (idiosyncratic risk = beta of stock). According to CAPM, firm specific risk can be diversified away, whereas market risk cannot, hence firm specific risk is not included when calculating for return on stock R_{it}. Exchange rate risk is considered to be firm specific and can thus theoretically be diversified away by the sole investor. Thereby, this theory, assuming perfect markets, suggests that it should not be priced into the market.

[6] Investments, International Edition 2005

This theory supports that exchange rate risk is not priced into stock prices based on strong assumptions of perfectly functioning markets. However, it does not contradict that news can have an impact on the pricing of stocks, *the one time effect*. Hence, news of a change in the exchange rate could still have an effect. Theory on exchange rate exposure is also vast. A summary follows below.

2.3 Exchange rate exposure

Foreign exchange economic exposure is generally defined as the effect of an exchange rate change on the value of a firm. Movements in the exchange rate result in direct changes in the relative prices of domestic and foreign goods which influences both current and future expected cash flows. In addition, changes in exchange rates alter the domestic currency value of foreign currency-denominated fixed assets and liabilities, thereby adding another dimension to how exchange rate changes affect the value of firms.

Following research by Shapiro (1996) most textbooks on International Corporate finance divide exchange rate exposure into two categories; *economic exposure* and *translation exposure*. *Economic exposure* can in its turn be divided into *transaction* and *operating exposure*.

Transaction exposure is the exposure a firm faces when it has entered into a contract denominated in a foreign currency but which will be settled in the future. A change in the exchange rate means that the value of a future inflow or outflow will subsequently be influenced. *Transaction exposure* is a clear-cut measure which does not necessarily reflect the total exposure of the firm. However, it is often only this exposure that firms hedge, as the short-term impact from exposure on individual transactions can be hedged rather easily by using financial instruments. The long-term effect, the *operating, exposure* is much more difficult to control for.

Operating exposure is the exposure that firms face as exchange rates change and affect existing financial (or operational) contracts. Since the exchange rate is the price of a currency, it determines the price of domestic products sold abroad. Ultimately the exchange rate affects the competitiveness of domestic firms abroad. If a large share of costs and revenues are denominated in the same currency the effects may cancel each other out and exposure is reduced. However, if costs and revenues are incurred in different countries, exposure depends on the correlation between these countries' currencies.

Economic exposure combining *transaction* and *operating exposure*, accounts for the degree to which exchange rate fluctuations affect the present value of expected future cash flows; the firm value and is a real exposure. Thereby, it is this exposure that firms in theory wish to deal with. However, it is in practice very difficult to identify and hedge. Using *economic exposure* as a measure, it is quite clear that few firms remain oblivious to exchange rate fluctuations. It is also apparent that one would expect currency exposure to vary substantially across firms**.**

Translation exposure exists when firms need to translate financial statements of a foreign subsidiary into the reporting currency of its parent in order to construct a consolidated statement. This is not a real exposure in the sense that it does not affect the current or future cash flows of the firm nor does it affect firms that have no foreign subsidiaries. Furthermore, given that investors value stocks based on expected future cash flows, one would not expect *translation exposure* to be priced into the market.

2.4 Firms with no international activities

It is also interesting to point out that exposure depends not only on the amount of international transactions the individual firm executes, but also on the extent of foreign involvement in the economies where they carry out these transactions. Since exchange rate changes result in changes in domestic prices, they also impact firms that have no direct international activities. Firms with no foreign operations are thus subjected to *operating exchange rate exposure;* exchange rate fluctuations alter competition since prices of inputs may be affected. This can be explained by the fact that a depreciation of the exchange rate benefits exporting firms; the demand for inputs increase. Firms with no foreign operations may demand the same inputs as exporting firms, and when the demand for these inputs increases, the price increases, and consequently the profit declines for the firms with no foreign operations. Thereby, their *operating exposure* is negative; depreciation of the exchange rate has a negative effect on the cash flows of the firm.

2.5 Joint determination of stock prices and exchange rates

Adler and Dumas (1984) point to that we cannot automatically interpret significant correlations between stocks and exchange rates as evidence of a causal effect. Stock

prices and exchange rates are determined jointly and are partly affected by the same common shocks to the economy. Hence, no causal relationship can be established.

Naturally, the relationship between endogenous variables such as stock prices and exchange rates depends on the nature of the shocks affecting the economy. Exposure may just be reflecting the simultaneous impact of monetary factors on exchange rates and stock prices. On the other hand, such shocks and movements should be accounted for by inserting the market return into the regression model, and these should thereby theoretically not have a significant impact in the result. However, it could still be of interest to consider important macroeconomic variables operating during the chosen time period. The market index added to a regression model, accounts for the aggregated exposure of the whole market to the macroeconomic changes, but individual firms may be more or less exposed to these changes. The aggregated market index may therefore not reflect the true importance of the macroeconomic changes for each individual firm which the regression is performed upon. Each individual firm has firm beta, a specific correlation with the market, which has not been accounted for in the model. Therefore, the market index may not account for the full impact of changes in the macroeconomic factors on the firm in question, and further discussions on the implications of these, could thus contribute to the analysis of the results.

2.6 Lagged response hypothesis and Miss-pricing theory

The *lagged response hypothesis* suggests that investors learn the effect exchange rate movements have on stock prices with experience. The lag is caused by *miss-pricing*. Furthermore, companies tend to hedge transactions over the near future implying that exposure is long-term and not immediate. Nevertheless, improving communication technology has increased the flow and accessibility of information for investors, and one can thus assume that the effect of exchange fluctuations is feeding through into the market with an increasing speed.

3 Literature Overview

3.1 Little Significance found

In the early 1970s Heckerman (1972) investigated the possible sources of exchange rate exposure. Several papers followed on this subject, the most famous by Shapiro (1977) and by Adler and Dumas (1980).

However, no empirical studies of the effect from exchange rate fluctuations on the value of firms and the determinants of such exposure were made until the early 1990s. This could be compared to the multitude of studies made on the effect of interest rates and inflation on firm value during the same period. Hence, it is surprising how little research has been dedicated to this subject.

Furthermore, the studies were all carried out on the US market. Jorion (1990) produced one of the leading papers, investigating the effect of exchange rate fluctuations on US Multinationals. He found only a weak relation: 15 out of 287 (5, 23%) firms showed a significant exposure at the 5% level. This percentage is not different from what would be expected by random.

Jorion (1991) investigated the pricing of exchange rate risk in the US stock market and found that the relationship between stock market returns and exchange rate fluctuations differs systematically across industries; the co-movement depends on the level of foreign operations. However, it was found that exchange rate risk is not priced in to the stock market, and hence active hedging policies will not affect the cost of capital as investors can diversify the risk. Hence, Jorion's empirical studies provide limited evidence of a statistically significant relationship between exchange rate fluctuations and stock market value of US firms, but points to foreign involvement as a determinant for such exposure.

3.2 Critique of earlier studies

Bartov and Bodnar (1994) present two possible drawbacks of earlier studies. Firstly it is the sample selection criteria; they argue that only firms that are heavily exposed to currency rate changes should be studied. Secondly, miss-pricing is another possible drawback; investors introduce systematic errors when estimating the relationship between firm value and exchange rate movements.

Bartov and Bodnar argue that systematic errors may arise because of the complex set of issues associated with modelling and estimating this relation. Among these complexities are (i) identifying possible asymmetries in the impact of appreciations and depreciations on firm value, (ii) determining the extent to which a currency movement is temporary versus permanent, and (iii) judging the impact of the various changes in different foreign currencies for the economic performance of the firm. In addition, determining the

impact of a change in the exchange rate on firm performance is further complicated by the fact that investors are not always aware of the firm's activities to hedge foreign currency exposures. Neither do they know how the firm's production plans nor prices will be altered in response to the new competitive conditions, or whether the currency movement will result in a change in the strategic behaviour of the firm.

Therefore, Bartov and Bodnar argue that investors need time to interpret the exchange fluctuations. They include lagged changes of the exchange rate in line with the *lagged response hypothesis* and not just contemporaneous changes, as in earlier studies. A series of tests are performed using a sample of firms with large international exposure and both the contemporaneous and lagged changes in the dollar as explanatory variables. However, Bartov and Bodnar still do not find significant results supporting a relationship between stock market returns and changes in the exchange rate.

Dumas and Solnik (1995) point to another factor affecting the detection of exchange rate exposure. They present the importance of time-variation in exchange rate risk and risk premia. Dumas and Solnik argue that exposure varies over time. Thereby, exchange rate risk is only priced when time variation is allowed. Long term predictability of exchange rates is possible due to the theory of interest rate parity. However, in the short term exchange rates are erratic and difficult to predict. Similarly to Bartov and Bodnar (1994) the inclusion of lagged exchange rate changes is suggested. Allayanis and Olek (1996) point to the importance of hedging activities when examining exchange rate exposure. Allayanis and Olek find that active hedging reduces exchange rate exposure, which may partially explain the lack of significant results.

Another critique of earlier research is that is has been done in the least open economy of the OECD countries, the USA. Friberg and Nydahl (1999) examine the relationship between the stock market valuation and an effective exchange rate in 11 industrialised economies. They find that the more open the economy, the stronger the relationship between stock market return and the exchange rate. Hence the general level of foreign involvement in the economy is positively correlated to the level of exposure.

3.3 Significance found

Following the above stated critique, several papers based on data from the 1990s have found a stronger link between stock returns and exchange rates.

He and Ng (1998) find significant exposure in 25% of 171 Multinational Japanese firms. Nydahl (1999), and Dahlqvist and Robertson (2001) find high levels of significant exposure in the Swedish stock market (25% and respectively, 15% - 30%). Nydahl (1999) tests a selective sample of companies; excluding firms that do not have FDIs[7], have not been traded on the Stockholm Stock exchange throughout the entire period December 1992 to February 1997 and companies that do not have foreign sales and foreign wage data available. Nydahl's sample only contains 47 firms. Dahlqvist and Robertson (2001) study a relatively large sample of Swedish listed firms (352) between 1988 and 1998 and present other possible drawbacks, which may help explain the failure of finding significant exchange rate exposure amongst listed companies. The main reason is the use of too aggregated economic measures; the construction of portfolios may entail such a risk, since a portfolio may contain firms with opposing exposure. This may result in exposure cancelling out and thereby show miss-guided information. This can be controlled for by including a firm level analysis. Dahlqvist and Robertson (2001) also find that significant exposure is positively correlated to export levels, size and foreign ownership. Dahlqvist and Robertson also discuss the possible importance of common shocks to the economy which effect both stock returns and exchange rates, implying that exchange rate exposure is just commons shocks feeding through into the stock market.

Martinez-Solano (2000) finds significance in 20% of the firms in a sample of 71 non-financial Spanish firms listed on the Spanish stock exchange between 1992 and 1997. He also studies, by doing a portfolio level analysis, if this effect is related to the level of exports, imports, foreign debt and hedging proxies of these companies. Martinez-Solano uses size as a proxy both for foreign involvement and as a proxy for currency hedging activities. Size is assumed to be positively correlated to foreign involvement as multinationals are often large firms. Data on hedging is not readily accessible and it can be assumed that size is also positively correlated with the level of hedging activities as larger firms are more prone to hedge their exposure. Hence one can expect opposing results for exposure when creating a portfolio based on size. On the one hand one would expect high levels of significance when testing for foreign involvement. On the other hand one would expect low levels of significance when testing for hedging activities.

[7] Foreign Direct Investments

Foreign involvement is found to be the main determinant of exchange rate exposure as in all of the above mentioned papers.

Recent literature on this subject has thus taken significant steps towards establishing the relationship between firm value estimated by stock return and exchange rate fluctuations measured as exposure and its determinants.

3.4 Contribution of our paper

Following the footsteps of recent research, we aim to, as stated in section 1, investigate the sensitivity of the value of Swedish non-financial firms quoted on the Stockholm Stock Exchange from January 2001 to January 2006, to exchange rate fluctuations. The time period studied is more recent than earlier research. As well, Sweden has, as an economy, become more open after the entry into the European Union in 1995, and therefore, our paper further contributes to this research area with more recent and updated results. Furthermore, important economic factors during this period, such as the steady upward market trend since the slump in 2002, the low and decreasing interest rate, as well as the appreciation of the SEK, will differentiate the macroeconomic scenery from the earlier periods examined by Nydahl (1999) and Dahlquist and Robertson (2001). During this earlier period (1990-1997 and 1988-1998), Sweden suffered from a long recession, a hard depreciation of the SEK and sky high interest rates[8]. As well, an increased use of communication technology and currency hedging since the 1990s imposes an additional difference in the reaction towards movements in the currency. We also choose to use a combination of methods presented in earlier research. We perform a firm level analysis similar to the initial research by Jorion (1990), as opposed to studying a selective sample as Nydahl (1999), in order to examine the general level of sensitivity on the Swedish stock market. We also choose to perform a portfolio level analysis similar to Martinez-Solano (2000), in order to examine a possible pattern between a firm's characteristics and its exchange rate exposure. The portfolios constructed essentially aim to test if and how the level of foreign involvement co-varies with exchange rate exposure. Where data availability allows, testing for the importance of the exposure determinants will also be performed through a cross sectional regression analysis.

[8] Appendix II shows diagrams over the mentioned economic variables during these time periods.

Thereby our paper contributes to the existing literature in several ways; studying an open economy using a combination of earlier used methods. Most importantly, we complement the scarce research of exchange rate exposure in small open economies like Sweden, with more recent results and during a time period when the macroeconomic environment differentiates from the ones previously studied.

4 Methodology

Adler and Dumas (1980) define economic exposure to exchange rate movements, as the regression coefficient of the real value of the firm on the exchange rate, across states of nature. Hence, a Swedish investor measures the currency exposure of a firm's single stock, or a portfolio of stocks, by the slope coefficient of a linear regression of the value of the stock, or the portfolio, on the exchange rate.

4.1 Time series regression

Following Jorion (1990), for our firm level and portfolio level analyses, we estimate *foreign exchange economic exposure* by calculating the coefficients β_{xi} and β_{zi} in a time series regression on returns R_{it}. Return is defined as the percentage price change of the stock or the portfolio $[\log P_t - \log P_{t-1}]$. The price of the portfolio is calculated using two different methods; equally weighted and value weighted[9]. The regression on returns R_{it}, is performed with respect to the change in market returns R_{mt} and the change in the exchange rate (both current, R_{xt} and lagged by one month, R_{xt-1}).

$$R_{it} = \beta_{i0} + \beta_{mi} R_{mt} + \beta_{xi} R_{xt} + \beta_{zi} R_{xt-1} + \varepsilon_{it} \qquad t = 1,\ldots,T \quad [1]$$

β_{mi} , β_{xi} and β_{zi} measure the sensitivity of stock or portfolio return to market movements and foreign exchange fluctuations, ε_{it} is the disturbance term. As earlier mentioned, the inclusion of the market index controls for market movements, which is necessary as stock prices and exchange rates are assumed to be determined jointly. Thus the specification in [1] does not imply a causal relationship between exchange rates and

[9] In an equally weighted portfolio, the prices of the different stocks included, have an equally big share of the total portfolio value. In a value weighted portfolio, each stock price has a proportion of the total portfolio value. The proportion corresponds to the market capitalisation of that firm, in relation to the other firms included in the portfolio. Hence, the stocks are "weighted" according to market capitalisation.

the value of the firm or the value of the portfolio of firms. Still, since a firm's value, or a portfolio's value, is a small fraction of an entire economy it is realistic to assume that the exchange rate depends predominantly on factors different from the actions of a single firm or a group of firms included in our portfolios.

The values of β_{xi} and β_{zi} are interpreted as the level of exposure to foreign exchange rates, since they indicate the sensitivity of the individual stock, or the portfolio of stocks, to these fluctuations. R_{xt} and R_{xt-1} are the rates of change in the trade-weighted index TCW. The value of TCW is measured as the rate of the Swedish Krona against a basket of foreign currencies. A positive (negative) coefficient means that the stock returns increases (decreases) as the Swedish Krona depreciates against the foreign currencies included in the basket.

The time series regression [1] is used to evaluate the levels of exposure to foreign exchange rate fluctuations, which is indicated by the significance of the coefficients β_{xi} and β_{zi}, and the direction of the exposure, is indicated by the signs of these coefficients[10].

Since we are using returns and changes in exchange rates it is probable that heteroscedasticity is present in the data. Therefore, all the regressions are run in the SPSS Newey West syntax in order to control for heteroscedasticity and autocorrelation. The Adjusted R-Squares, as opposed to the R-Squares, are presented with our coefficient results in order to correct for the inclusion of multiple regressors.

4.2 Cross Sectional regression

In order to identify the determinants of the exposure to foreign exchange fluctuations, we run a cross-sectional regression between the coefficients of such exposure and the corresponding explanatory factors. The proposed model, as suggested by Martinez-Solano (2000), is as follows:

$$\hat{\beta}_{ix} = \gamma_0 + \sum \gamma_f F_{fi} + \varepsilon_i \qquad i = 1,\ldots..,N \quad [2]$$

[10] Appendix 1 clarifies the interpretation of the coefficients

$\hat{\beta}_{ix}$ is the estimate of the sensitivity of the stock price for each individual firm to foreign exchange risk obtained from the time series regressions on all of the 172 firms in our sample. It will thus be the dependent variable. γ_f is the coefficient of factor *f* and will represent the possible relationship between the explanatory factor *f* and the estimate of sensitivity $\hat{\beta}_{ix}$. F_{fi} is the value of explanatory factor *f* for company i during the whole time period and is hence the independent variable in the cross sectional regression. ε_i is the disturbance term.

A positive γ_f coefficient will represent a relationship between the explanatory variable and the $\hat{\beta}_{ix}$ sensitivity, and will hence identify the determinant factor *f* and express its strength. A negative γ_f coefficient will on the other hand show an inverted relationship between *f* and $\hat{\beta}_{ix}$, and will hence go against a hypothesis of a positive relationship. Insignificance of the γ_f coefficient will reject the possibility of any relationship between the two variables.

5 Sample selection and data description

5.1 Period chosen

The chosen period, January 2001 to January 2006, represents the most recent data, and the length of five years is in line with earlier research in Nydahl (1999) and Martinez-Solano (2000). Another reason for choosing this time period is that the chosen data sources, Orbis and Datastream, have limited information for the creation of certain portfolios before January 2001. Therefore, in order to also be able to include as many firms as possible we choose a five year period.

5.2 Firm level analysis

5.2.1 Selection of firms

The inclusion of companies differs from earlier studies, as Equation [1] is estimated for a sample of 172 non-financial firms *quoted* on the Stockholm Stock Exchange (OMX)

during our chosen five year period[11]. Thereby, our paper does not study the companies presently listed on the Stockholm Stock Exchange (OMX), but the stock returns of the companies that were quoted during our studied period. Hence, only the relevant stock returns of companies quoted during the chosen period are regressed on the exchange fluctuations[12]. This is done to increase the accuracy of our results. As well, when firms have listed both A and B shares, we choose the most liquid one for our sample. The monthly observation used, is the stock price quoted on the first trading day of the month.

Companies that have not been quoted on the Stockholm Stock Exchange (OMX) for any part of the studied period are excluded, reducing the sample size to 172 companies. Monthly stock prices for the sample of 172 firms were obtained from Datastream. Using monthly data we hope to reduce some of the noise in the daily and weekly series, but still have a large enough number of observations. The stock prices obtained from Datastream are not adjusted for dividends which facilitates our analyses as changes in the stock prices due to dividends do not directly reflect reactions due to changes in the exchange rate.

5.2.2 Exclusion of financial firms

All financial firms*;* banks, insurance firms, property companies and investment trusts, are excluded from our study, which is in line with earlier research made by Martinez-Solano (2000). This increases the comparability of our data, as creating a homogeneous benchmark with these firms in the sample is difficult. The reason for this is that their international transactions differ greatly from other industries.

The firm level analysis on all 172 firms is carried out providing a study of exposure of all individual firms within different industries. Thereby, our firm level analysis aims to compensate for the risk of using aggregated data when executing our portfolio level analysis, as suggested by Dahlqvist and Robertson (2001).

5.2.3 Choice of market portfolio

As mentioned, our way to control for shocks that affect both stock prices and exchange rate is to include the market portfolio whose coefficient captures the sensitivity to market

[11] Appendix III: Firms (172) included in the sample

[12] In order to reconstruct this list of companies we obtained lists of quoted and de-listed companies throughout our chosen period from OMX.

movements of the individual stock return being tested. Then the question of how to represent the market portfolio arises. We choose the domestic market index. However, in theory the idea of fully integrated capital markets suggests that the world market portfolio should be used. In addition, the Swedish market is a small fraction of the global market capitalisation and Sweden has no restrictions on foreign ownership. However, Lewis (1995) argues that investors have a home country bias and prefer to invest in the domestic market. Ferson and Harvey (1993) argue for allowing partial segmentation in capital markets and Nydahl (1999) shows in his research that adding the world market portfolio does not improve his results for Sweden. Thereby, in order to approximate the returns on the market portfolio we use, as earlier studies, a domestic market index: the OMX Price Index.

5.2.4 Exchange rate

For the exchange rate, the trade weighted exchange rate index, TCW, is used. The index has been weighted according to IMF's "Total Competitive Weights". It accounts for the importance of different countries as trading partners, as well as competitors[13]. Schnabel (1989), points out that if the exposure coefficients to exchange rate risk were to be expressed in as many independent variables as the number of currencies which each firm handles, this multi-currency approach would result in multicollinearity problems. Furthermore, Nydahl (1999) shows that breaking down the exposure to single currencies does not improve his results for the Swedish firms. Thereby, a trade weighted index is a convenient way to represent effective exchange rate movements. A trade weighted exchange rate index is also argued to be more appropriate as opposed to single currency exchange rates as it takes into consideration the weighted relative importance of various currencies rather than focusing on single currencies. On the other hand, the weighting may not be relevant for an individual firm. However, as concluded in earlier research the risk of multicollinearity dominates this issue. Furthermore, given the low inflation that the Swedish economy is experiencing and experienced throughout our test period, we see no problem with using the nominal, as opposed to the real, exchange rate in our testing. The exchange rate on the first trading day of the month is used to represent the price of the TWC index.

[13] http://www.riksbank.se/svenskstat/#Foot

In line with the paper by Bartov and Bodnar (1994), we use a lagged exchange rate together with the contemporaneous one for both our firm and portfolio level analysis. The contemporaneous exchange rate has been included with regards to an understanding of the increased use and development of communication technology; well developed markets such as the Stockholm Stock Exchange (OMX) is presumably faster than it was 10-15 years ago. The length of the one month lag was decided upon according to the found significance. The introduction of a lag is primarily due to the fact that market participants will need time to understand how the change will reflect on their positions. Considering the exchange rate complex effect on firm value, and the fact that investors are making decisions based on merely available, public information, some lag must be accounted for. To determine the length of a delay of such nature is rather arbitrary and with guidelines from older research and the fact that the significance of our results highly diminished when testing for 3 and 6 months, the one month lag was chosen to be included in our model. This approach was decided upon due to the necessity of delimitations of our research questions and it is not considered to be within the scope of this paper.

All the above mentioned data forms the basis for the basic regression on the firm-level. Several conditions of the basic model are examined to improve the accuracy of our data. The coefficients of the regressions for all firms are saved to later be used in the cross sectional regression.

5.3 Portfolio level analysis

The five firm characteristics of foreign exchange exposure that are presented in the portfolio level analysis includes: (1) *Sales Abroad*, (2) *Domestic Sales*, (3) *Total Sales*, (4) *Foreign Ownership* and (5) *Foreign Registration*. Another eight portfolios are also accounted for, dividing the firms into *Industrial Sectors*.

Each portfolio is presented both in the form of an equally weighted portfolio, and that of a value weighted portfolio. In the equally weighted portfolio, each firm accounts for the same share of the portfolio, regardless of size, activity or any other feature. The value weighted portfolio on the other hand, is based on the relative market capitalisation of

each firm[14], so that its weight relative to the rest of the firms included in the portfolio is accounted for. This is in line with earlier research by Martinez-Solano (2000).

An account of the sample selection and data description for the portfolio level analysis follows below.

5.3.1 Sales Abroad

We use Sales Abroad as a proxy for exports, as they are not publicly available on the firm level. The data needed to construct a *Sales Abroad Portfolio* is calculated by subtracting Swedish sales data from Total Sales data. The Swedish sales data is obtained from the database Orbis and when such information was not available, from individual Chief Financial Officers of the companies. An average of Sales Abroad is calculated over the five years. In total we manage to obtain such sales data for 142 of our 172 companies. We create three different groups where, within each group, firms have similar proportions of sales abroad. The first group has average sales abroad over 50% (53 firms), the second group has average sales abroad over 70% (32 firms) and a third group has average sales abroad over 80% (19 firms)[15]. The different groups are created to test if the significance rises as the level of sales abroad rises. As mentioned above, we create both equally weighted and value weighted portfolios. Hence, for each group there will be two portfolios, resulting in six portfolios all together.

The proportional level of average sales abroad to total sales for all firms, will later also be used in the cross sectional regression as the explanatory factor.

5.3.2 Domestic firms

We create a purely domestic portfolio, including the companies that have all their sales in Sweden throughout the entire period (8 firms)[16]. Swedish sales data is obtained from Orbis and in a few cases from Financial Officers.

5.3.3 Total Sales

Total sales are obtained from Orbis and from financial reports when this information is missing in Orbis. The average of total sales over our five year period is computed, and then the companies are divided into quartiles according to size of total sales. The lower

[14] The market capitalisation is obtained from Datastream
[15] Appendix IV: Firms included in Portfolio based on Sales Abroad
[16] Appendix V: Firms included in Portfolio of Companies with only Domestic Sales

quartile (51 firms) includes firms with average total sales, lower than 25 % of the average total sales of all 172 firms, during the given period. The upper quartile (53 firms) includes firms with total sales higher than 75% of the sample total[17]. Including an equally weighted portfolio and a value weighted portfolio for both quartile groups, a total of four portfolios will be constructed. Total sales is as a measurement of company turnover, used as a proxy for two different factors; foreign involvement and currency hedging. Hence, the four portfolios are of interest in two different ways, depending on which proxy we test.

5.3.4 Foreign Ownership

Foreign ownership is obtained by first collecting the *organisation number* [18] of all 172 firms. These numbers are obtained from OMX. These numbers were sent to *Institutet för Tillväxtpolitiska Studier* **(**ITPS). From ITPS we obtain information on foreign ownership over the five chosen years. The portfolios are built depending on varying degrees of foreign ownership. According to ITPS way of presenting this data, as well a general consensus, a firm is owned by foreigners if at least 50% of the outstanding shares are in foreign possession on average throughout the accounting year. Two groups are constructed: one including firms that have been in foreign possession during at least one of the five years studied (14 firms), and another including firms that have been in foreign possession during at least 3 years (10 firms)[19]. Each group has both one equally weighted portfolio, and one value weighted. The total number of portfolios is hence four.

5.3.5 Foreign Registration

Six of the firms with foreign ownership during our testing period are not registered in Sweden and therefore have no such *organisation number*. These firms form their own portfolio, Foreign Registered Firms (6)[20].

5.3.6 Industrial Sectors

In order to test for sector belonging, eight portfolios based on OMX's classification of Industrial Sectors are also constructed[21]. The following groups are used[22]:

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[17] Appendix VI: Firms included in Portfolio based on Size
[18] Organisationsnummer
[19] Appendix VII: Firms included in Portfolio based on Foreign Ownership
[20] Appendix VIII: Firms included in Portfolio of Foreign Registered firms
[21] Appendix IX: Firms included in Sector Portfolios
[22] 5 firms are not classified by OMX. Hence the sample for sector classification only consists of 167 firms

1. *Consumer Discretion* (24 firms)
2. *Consumer Staples* (4 firms)
3. *Energy* (3 firms)
4. *Healthcare* (22 firms)
5. *Industrials* (46 firms)
6. *Information Technology* (51 firms)
7. *Materials* (13 firms)
8. *Telecom* (4 firms)

Each group is presented as both an equally weighted portfolio, and as a value weighted portfolio. The sector portfolios are intended to, in line with earlier research; study if exposure is homogeneous across industries and if certain industries experience higher exposure.

5.4 Shortage of public data

Due to the nature of public data and the limitations it imposes, we will not be able to construct certain portfolios which we believe would have contributed to our research. Notably three firm features, which are not publicly available but out of high interest, are accounted for below:

1. *Imports* Firms with high levels of foreign sales may also have high levels of imports and thus the exposure may cancel out. Thereby, only studying foreign sales, and not *net exports*, may give misleading information. Moreover, the level of imports could also be tested with the cross sectional regression. However, the import level of an individual firm is not public information and thereby, we have not been able to account for it.

2. *Foreign Debt* Firms are today contacting debt denominated in foreign currency. The total exposure of the firm is hence also depending on the debt currency, as well as the structure of the debt and the importance of it to the firm. Such information is however not publicly available and hence this is something one just have to take into account when analysing the results.

3. *Hedging Activities* Information on hedging activities was not public information until recently[23]. In line with earlier research we use Size as a proxy.

6 Empirical Results and Analysis

6.1 Firm level regression

We first study whether our sample of 172 individual non-financial firms shows any exposure to the contemporaneous and the lagged, by one month, TCW exchange rate index. Hence, we run the regression in Equation [1], with the changes in the contemporaneous and lagged TCW index as regressors, together with the market index in order to control for market movements.

$$R_{it} = \beta_{i0} + \beta_{mi} R_{mt} + \beta_{xi} R_{xt} + \beta_{zi} R_{xt-1} + \varepsilon_{it} \qquad t = 1,\ldots,T \quad [1]$$

6.2 Firm level results

The distribution of the two estimated exposure coefficients (contemporaneous and lagged by one month) is shown in *Table 1*.

Table 1. Distribution of the Exchange Rate Exposure Coefficients for 172 Non-Financial Swedish firms

	Mean	Minimum	Maximum
β_{xi} (Contemporaneous)	0. 3074	-3.406	5. 3
β_{zi} (Lagged by one month)	-0.7602	-5.182	2.654

Significant at 5 %	Number of firms	Positive	Negative	Percentage
β_{xi} (Contemporaneous)	9	8	1	5.23%
β_{zi} (Lagged by one month)	22	0	22	12.79%
Significant at 10%				
β_{xi} (Contemporaneous)	21	13	8	12.21%
β_{zi} (Lagged by one month)	33	2	31	19.19%

Mean Adjusted R-Square	0.2680

This table reports the exposure coefficients. These coefficients have been estimated from monthly times-series regressions of stock returns on market returns and the contemporaneous and lagged by one-month TCW exchange rate index. Note: All coefficients are obtained from the Newey West SPSS Syntax.

[23] IAS 39

6.3 Firm level analysis

6.3.1 Degree of Openness in an Economy

Similar to Jorion (1991), we only find the existence of a weak relationship between contemporaneous exchange rate fluctuations and stock company return, as merely 5.23% of the firms in our sample show a significant exposure at the 5% level. This percentage is not different from what would be expected by random. This is interesting, as we expected to find higher exposure on the Swedish stock market, than Jorion did on the US stock market. This expectation was, as earlier stated, based on the findings of Friberg and Nydahl (1999), which showed that the relative degree of openness in an economy was positively related to exchange rate exposure. Such findings lead us to expect that Sweden, being a relatively more open economy than the US, would also show higher levels of exposure.

6.3.2 CAPM theory

Finding no noteworthy significance among the contemporaneous results, may be interpreted as a result of the CAPM theory. Investors have already through portfolio diversification limited their exposure to exchange rate fluctuations and find no need to respond to such events. CAPM is however a hard drawn, none the less the most recognised, theoretical approach to understand capital markets. Hence, doubts must be made whether the insignificance of our sensitivity coefficients really is a result of the investors' perfectly diversified portfolios. A portfolio perfectly diversified against currency fluctuations would include a multitude of complicated correlation calculations, and above all, perfect knowledge of the firms. This is something which is not available today and therefore, this explanation to the insignificance of changes in the exchange rate for a majority of the firms in our sample is questionable.

6.3.3 Miss-pricing theory and Lagged response Hypothesis

On the other hand, the results show that the one-month lagged changes in the exchange rate index, affects stock prices *beyond* that of contemporaneous changes. 12.79% of the firms show significant lagged exposure at the five percent level and close to 20% of the firms in our sample show significant exposure at the ten percent level. The section *Literature Overview* above, mentions both Bartov and Bodnars' (1994) and Dumas and Solniks' (1995) analysis of the inclusion of lags. The complexity of the *operating exposure* of individual firms, contributes to the lack of contemporaneous correlation between

changes in the exchange rate and the stock market. Stock investors simply need some time to analyse the impact of the change. What is more, the fact that long term changes in exchange rate are more straightforward than the erratic short term fluctuations, makes the choice of a short lag seem appropriate.

In other words, adding one-month lagged changes does not affect the percentage of firms affected by the contemporaneous changes. Hence, more exposure is found when including lags in the regressions. Thereby, our results show relatively substantial support for *the miss-pricing theory* and *the lagged response hypothesis*, as opposed to Nydahl (1999) and He and Ng (1998). Nydahl did not find any significant difference between his contemporaneous and lagged by one week regression results. One week may have been too short and we choose as earlier mentioned to use a one month lag to reduce the noise. Nonetheless, as mentioned earlier in the *Sample Selection and Data Description*, the chosen length of time for the lag we use has been rather arbitrarily decided upon. This approach was decided upon due to the necessity of delimitations of our research questions and it is not considered to be within the scope of this paper. Further research and discussions on the length of the time lag, for a change in the exchange rate to feed through into the Swedish stock market, is of interest.

6.3.4 Negative lagged Coefficient

The results also show that the direction for contemporaneous exposure is predominantly positive whereas the one-month lagged exposure is predominantly negative. As well, the lagged coefficients are on average larger than the contemporaneous ones and more significant. This is graphically demonstrated by the histograms below in *Figure 1 to 4*.

Figure 1. Histogram of the contemporaneous significant Firm betas at the 5 % level

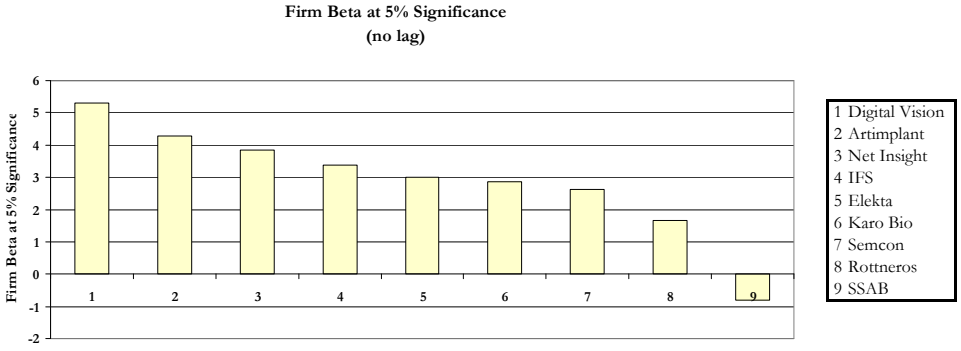
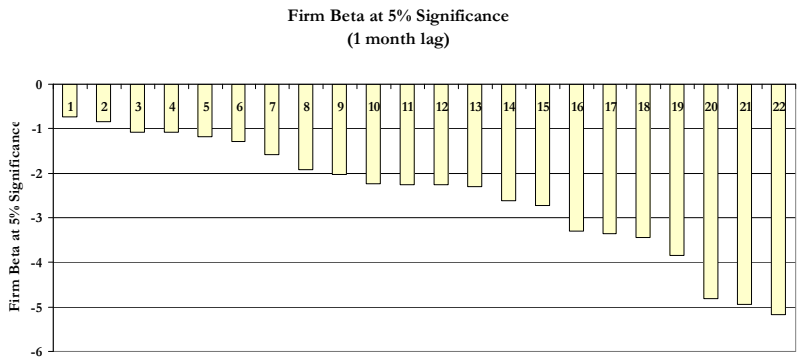
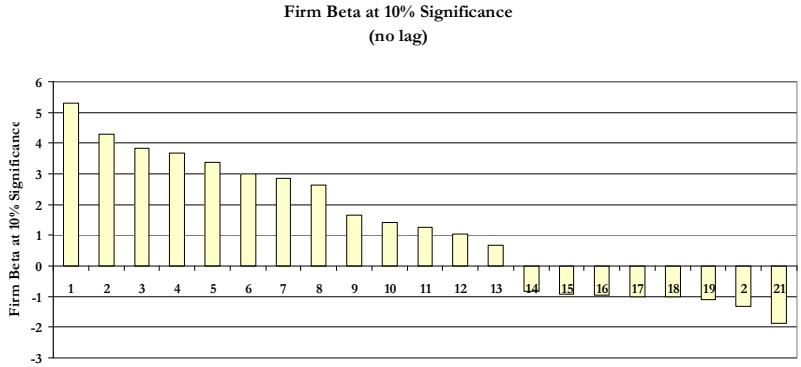


Figure 2. Histogram of the lagged significant Firm betas at the 5 % level



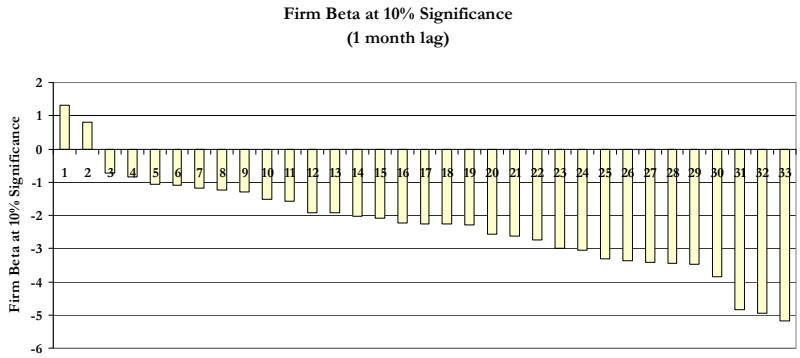
1 Telelogic
2 Scania
3 Volvo
4 Nefab
5 OEM International
6 Rederi AB TNSAT
7 Fenix Outdoor
8 Elanders
9 Biogaia
10 Scribona
11 IBS
12 Cherryföretagen/Betsson
13 Micronic Laser Sys.
14 Ortivius
15 Doro
16 Sectra
17 Multiq International
18 Biotage
19 A-Com
20 Enea
21 Anoto Group
22 Nocom

Figure 3. Histogram of the contemporaneous significant Firm betas at the 10% level



1 Digital Vision
2 Artimplant
3 Net Insight
4 Biolin
5 IFS
6 Elekta
7 Karo Bio
8 Semcon
9 Rottneros
10 Bongs Ljungdahl
11 Gambro
12 Securitas
13 Hoganas
14 SSAB
15 Bilia
16 Malmbergs
17 Beijer Alma
18 Electrolux
19 Tele2
20 Thalamus Networks
21 Modern Times GP. MTG

Figure 4. Histogram of the lagged significant Firm betas at the 10 % level



1 Securitas
2 Fagerhult
3 Telelogic
4 Scania
5 Volvo
6 Nefab
7 OEM International
8 Elekronikgruppen BK
9 Rederi AB TNSAT
10 Lindex
11 Fenix Outdoor
12 Doro
13 Elanders
14 Biogaia
15 Poolia
16 Scribona
17 IBS
18 Cherryföretagen/Betsson
19 Micronic Laser Sys.
20 Observer
21 Ortivius
22 Cybercom Group Europé
23 Ticket Travel
24 Mandator
25 Sectra
26 Multiq International
27 Fingerprint Cards
28 Biotage
29 Teligent
30 A-Com
31 Enea
32 Anoto Group
33 Nocom

The unexpected, significant and strong negative coefficients for the lagged exchange rate, is another interesting observation. The Swedish economy has relatively high levels of exports and thus, an overall positive exposure was initially expected to be found in the lagged by one month results.

6.3.5 Exporting firms' hedging of Foreign Exchange economic exposure

There are several possible explanations to these interesting and unexpected results. One reason for the predominantly negative exposure for Swedish firms could be that the exporting firms in our sample are well-hedged, whereas the firms with mainly domestic sales and a natural negative exposure are not. Thereby, the positive exposure is hedged away and consequently does not appear as significant, leaving the un-hedged negative exposure to dominate the results.

A viable reason for why exporting firms would be more prone to hedge their foreign exchange exposure is that these firms more actively take part in activities which directly raise their awareness of exchange rate exposure, than firms with predominantly domestic sales do. By such activities we mean the exposure a firm faces when it has entered into a contract denominated in a foreign currency but which will be settled in the future. This type of exposure, presented in Section 3, is *Transaction exposure*. *Transaction exposure* is also the most commonly hedged exposure as it is easy to identify as opposed to the *Operating exposure*. Thereby, exporting firms with a natural positive exposure hedge their easily identified *Transaction exposure* whereas domestically oriented firms leave their negative *Operating exposure* which is not easily identified un-hedged.

6.3.6 An exporting firm hedging its Foreign Exchange exposure

A couple of firms in the sample have been particularly revised and examined, in order to seek out possible explanations for the reasoning above. *Holmen*, for example, is a Swedish paper and pulp producer, with high export ratios and high proportions of domestically produced raw materials (forestry). The firm's exposure would hence be expected to show a significant positive exposure, but *Holmen* however, is not significant at all in the firm specific regression. When studying the annual reports over our five year period, it appears that the firm is rather open with its currency hedging. The firm acknowledges a high exposure, especially towards the Euro and US Dollar regions (Annual Report 2004), but they are also informative on the extent to which certain contracts, denominated in these currencies, are protected. For an example, we find that in the annual report of

2005, net income in EUR, USD and GBP is always hedged 4 months in advance (Annual Report 2005). Hence, it is the easily identified *Transaction exposure*; the contracts to be settled in the future, that are being actively hedged. Thereby, this pattern of hedging seems to be a reasonable explanation for *Holmen's* insignificant coefficients.

6.3.7 Limited information on Hedging

Since information on hedging activities is not publicly available, and most often not as thoroughly described to the investors as in the case of Holmen, this explanation is difficult to verify without private access to the hedging of all 172 firms in our sample. Nydahl (1999) however, who gained exclusive access to hedging activities of the 47 firms in his sample, could verify that hedging significantly dampened the degree of exposure. Hence, the average negative one-month lagged coefficient may be explained by exporting firms being more prone to hedge their positive *Transaction exposure* than domestic firms are to hedge their *Operating Exposure*, resulting in dominating negative exposure. Thereby, this pattern of hedging may help explain the dominance of significant lagged negative exposure and active short-term hedging as found by Nydahl may explain the lack of a higher degree of significant contemporaneous exposure.

Therefore, before concluding that foreign exchange rate exposure is predominantly negative and the lack of more significant results is proof of the non-existence of contemporaneous exchange rate exposure in our sample we should consider the possible existence of hedging. Thereby, firms in our sample may similarly to the firms in Nydahl's sample be hedging their exposure which results in these opposing lagged and insignificant contemporaneous results. Allayanis and Olek also find support for hedging eliminating exchange rate exposure. Thereby, it is of interest to keep the possible importance of hedging in mind when reviewing our results.

6.3.8 The impact of Common shocks

Another workable explanation for the dominating significant negative lagged exposure may be the macroeconomic environment dominating during the studied time period, including common shocks to the economy. This reasoning has been accounted for in the *Theory* Section above, *Joint Determination* (3.3). Dahlqvist and Robertson (2001) present a potential reason for why they find average negative exposure in a sub-set of their results. A depreciating SEK and a general high level of interest rates were, as shown in the appendix II, present during Dahlqvist and Robertson's (2001) examined 1990s time

period. The presented explanation is that depreciation often is followed by a subsequent raise of interest rates, which in general has a negative effect on the stock market. Hence, also export firms, which should have benefited from the depreciation, suffer from a lagged gloomy period in the economy. The bad results for the export firms, produces the lagged negative correlation with the depreciating currency, just as for the import firms and contributes to the overall negative correlation result of the regression.

However, by introducing the local market index in the regression model, one controls for common movements in the stock market. Changes in interest rates and its overall effect on the market, should therefore to a larger extend be accounted for in the model already. Consequently, macroeconomic movements should normally not affect the coefficients in this kind of a regression model. Hence, the argument presented by Dahlqvist and Robertson's (2001) looses some of its validity.

6.3.9 The Macroeconomic environment

Nevertheless, to the extent that the introduction of the local market index does not entirely control for common shocks or account for the impact of these factors for each individual firm, it is worth mentioning that the macroeconomic environment in Sweden during our test period, is found to be quite different form that of the 1990s. The trend of a mostly appreciating SEK, rather low interest rates and a bullish stock market since the slump in 2002, would to a certain extent imply that even if the export firms were hit by the more expensive SEK, the low interest rates as well as increasingly better market settings, inversely diminish the negative impact of the appreciation. With a positive market trend, a time of currency appreciation does not have as a strong negative effect on the exporting firms' results as expected. Hence, an explanation for our dominating negative coefficients may be that an appreciating SEK was followed by a lagged positive impact on company stock performance due to the overall positive market trend.

A suggestion for further research is to test Dahlqvist and Robertson's explanation to negative coefficients by adding the changes in a couple of macroeconomic factors to control further for the impacts of commons shocks, in the event that our local market index is not fully controlling for them all. However, introducing multiple regressors raises the risk of multicollinearity.

6.4 Portfolio level regression

As can been seen from the firm-level analysis, the exposure coefficients lie within a wide range and differ greatly from one another. We shall continue with examining the foreign exchange economic exposure based on portfolios. In order to do this, we have grouped firms together according to specific types of exposure to risk. Thereby, we group together firms that we believe to be homogeneous in their levels of exchange rate exposure and who we thereby expect to respond similarly to changes in the exchange rate.

Hence, we run the regression in Equation [1], with the changes in the contemporaneous and lagged TCW index as regressors, together with the market index in order to control for market movements.

$$R_{it} = \beta_{i0} + \beta_{mi} R_{mt} + \beta_{xi} R_{xt} + \beta_{zi} R_{xt-1} + \varepsilon_{it} \qquad t = 1,\ldots,T \quad [1]$$

Now however, the R_{it} represents the return on the constructed portfolios, instead of the return of the individual firm.

6.4.1 Portfolio based on Sales Abroad

Table 2 shows the results of the exposure coefficients for the *Portfolio based on Sales Abroad*, both equally and value weighted.

Table 2. Exchange Rate Exposure Coefficients for the Portfolio based on Sales Abroad

Portfolio: Average Sales Abroad to Total Sales above 50 %		
	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	-0.00533	0.74489**
β_{zi} (Lagged by one month)	-0.33853***	0.02176
Adjusted R-Square	0.912	0.285
Portfolio: Average Sales Abroad to Total Sales above 70%		
	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.18964	0.80833**
β_{zi} (Lagged by one month)	-0.38481***	0.03113
Adjusted R-Square	0.892	0.247
Portfolio: Average Sales Abroad to Total Sales above 80%		
	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.36585	0.85931**

β_{zi} (Lagged by one month)	-0.40582***	0.03409
Adjusted R-Square	0.819	0.202

This table reports the exposure coefficients of three portfolios with equal weighting and weighted by market capitalisation. These coefficients have been estimated from monthly times-series regressions of portfolio returns on market returns and the contemporaneous and lagged by one-month TCW exchange rate index. Note: All coefficients are obtained from the Newey West SPSS Syntax. (***) Significant at 5% (**) Significant at 10%

Among the results from our portfolio level analysis, the *Portfolio based on Sales Abroad* included the highest expectations. As mentioned in the *Literature Overview* section above, Bartov and Bodnar (1994) suggest that only firms which are heavily exposed to changes in foreign exchange should be included. Hence, a portfolio consisting of firms with a high degree of sales abroad, used as a proxy for exports and thus also foreign exchange rate exposure, naturally appeals. The results however, are asymmetric. The value weighted portfolios contemporaneous exposure is significant and positive, whereas for the equally weighted portfolios the lagged exposure is significant and negative.

All the contemporaneous exchange rate coefficients are significant at the ten percent level for the value weighted portfolios. These coefficients all show positive signs and although they are less significant than the equally weighted lagged portfolio, it is in line with expectations; high sales abroad could be used as a proxy for high export levels[24]. The significant positive and contemporaneous coefficients for the value weighted portfolios are also much larger than the significant negative and lagged coefficients for the equally weighted portfolios i.e. an change in the exchange rate has a larger impact on the value weighted portfolio than on the equally weighted portfolio. Even if the positive coefficients are less significant than the negative ones, and have much lower Adjusted R-Squares than the latter, the results are in line with our expectations and contribute to the results gained from the firm level regressions. Firstly, the value weighted portfolios allow for the larger firms by market capitalisation to account for a proportionally larger part of the combined portfolio coefficient. Thereby, the larger firms which normally have a higher degree of foreign activities and thus positive exposure dominate the portfolio. Hence, in line with our expectations positive exposure is found[25]. Secondly, the equally weighted portfolios reflect the results obtained from the firm level regressions. Since the

[24] Appendix 1 clarifies the interpretation of the coefficients

[25] The largest firms by market capitalisation in the portfolio with more than 80% Sales abroad include *AstraZeneca, Ericsson, H&M, Volvo* and *Electrolux*.

smaller firms, less involved in foreign activities than the larger firms, have the same proportion of the coefficient as the larger firms, the negative exposure which smaller more domestic oriented firms experience is equally weighted. The same is true for the firm level average mean results, which are calculated by equally weighting all firms.

This is further supported by the fact that the negative coefficients are much smaller than the positive coefficients. (-0.39, -0.38 and -0.41 vs 0.74, 0.81 and 0.86). Thereby, a larger effect on stock return due to a change in the exchange rate is found when market capitalisation is taken into account.

In conclusion, we find significant positive exposure in line with our expectations when market capitalisation is considered. However, the positive exposure is not as significant and the number of firms which experience positive exposure is low. In line with our earlier analysis on the impact and pattern of hedging, this low level of positive exposure found in our value weighted portfolios may be explained by large export oriented firms actively hedging their positive *Transaction exposure,* whereas small domestic oriented firms leave their negative *Operating exposure* un-hedged. Thus, this negative exposure can dominate the equally weighted portfolios and active hedging of *Transaction exposure* dampens significance of the positive exposure in the value weighted portfolios.

It is still surprising, however, to find that portfolios constructed by firms with high level of sales abroad, show significant negative exposure. We find some explanations to the negative results among exporting firms, to be especially interesting. First of all, as earlier stated, since import levels are not publicly available sales abroad to total sales makes for a relatively faulty proxy for export levels. The Swedish steel manufacturer SSAB presents a demonstrating example. Initially, one would expect such a firm to be a heavy net exporter of steel, with a high ratio of sales abroad. However, the major input products are iron ore and coal. Both are sold at a market price denominated in US Dollars, meaning that even if it is produced domestically, SSAB still purchases it with a foreign currency (Annual Report 2005). Hence, a foreign exchange rate effect, alike that of imported inputs, operates within the direct effect of cash flows.

Secondly, since we do not correct for import levels, firms that are included in these portfolios need not be net exporters. Therefore, the negative exposure found in these

portfolios need not indicate that exporting firms in our sample experience negative exposure, but simply that our proxy is not optimal. Furthermore, the impact on the firm stock performance will also depend on if exports and imports are denominated in the same currency or not. If they are, the effect of exchange rate exposure may cancel out. If they are denominated in different currencies the exchange rate exposure depends on the correlation between these currencies. Thereby, without knowing the imports level and in which currencies the exports and imports are denominated in., it is difficult to predict the possible exchange rate exposure and its sign.

And thirdly, the level of foreign debt has neither been taken into account; as such data has not been available to us. Therefore, it becomes difficult to define a firms position and hence its expected exposure.

6.4.2 Portfolio of Companies with only Domestic Sales

Table 3 shows the results of the exposure coefficients for the *Portfolio of Companies with only Domestic Sales*, both equally and value weighted.

Table 3. Exchange Rate Exposure Coefficients for the Portfolio of Companies with only Domestic Sales

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	-0.0671	0.1544
β_{zi} (Lagged by one month)	-0.75903**	-0.65734**
Adjusted R-Square	0.555	0.370

This table reports the exposure coefficients of one portfolio with equal weighting and weighted by market capitalisation. These coefficients have been estimated from monthly times-series regressions of portfolio returns on market returns and the contemporaneous and lagged by one-month TCW exchange rate index. Note: All coefficients are obtained from the Newey West SPSS Syntax. (***) Significant at 5% (**) Significant at 10%

The results for our *Portfolio of Companies with only Domestic Sales* show negative signs as expected. However, the contemporaneous coefficients are not significant, whereas the lagged by one-month coefficients are significant at the ten percent level for both the equally and value weighted portfolios. The earlier mentioned impact of common shocks that occur with a lag following a change in the exchange rate may be a possible explanation. Another explanation to why a lag is needed in order to get significant values may be the O*perating exposure* earlier mentioned and described in the *Theory* section. The

Operating exposure is much harder to identify than the direct effect on cash flows which *Transaction exposure* accounts for. *Operating exposure* includes changes in the competitive environment and indirect effect on capital costs, which makes it hard even for the firm itself to understand the extent of the net exposure. Such information may reveal itself in due time and a lag may therefore be needed. The significant coefficients for the lagged exchange rate are fairly substantial (-0.76 and -0.66), showing that the lagged impact on the portfolio is noticeable. Thereby, further support for the *Lagged response hypothesis* is found.

6.4.3 Portfolio based on Size

Table 4 shows the results of the exposure coefficients for the *Portfolio based on Size*, both equally and value weighted.

Table 4. Exchange Rate Exposure Coefficients for the Portfolio based on Size

Portfolio: Total Sales Upper Quartile

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.1011	0.72617**
β_{zi} (Lagged by one month)	-0.16463	0.06153
Adjusted R-Square	0.835	0.337

Portfolio: Total Sales Lower Quartile

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.25921	-0.18561
β_{zi} (Lagged by one month)	-0.83022**	0.045
Adjusted R-Square	0.704	0.453

This table reports the exposure coefficients of two portfolios with equal weighting and weighted by market capitalisation. These coefficients have been estimated from monthly times-series regressions of portfolio returns on market returns and the contemporaneous and lagged by one-month TCW exchange rate index. Note: All coefficients are obtained from the Newey West SPSS Syntax. (***) Significant at 5% (**) Significant at 10%

The results show that the *Total Sales Upper Quartile* portfolio has one significant coefficient. The contemporaneous coefficient in the value weighted portfolio is significant at the ten percent level. Size is used as a proxy for foreign involvement; the larger the size, the higher the foreign involvement. We thus expect a positive exposure from size, as exporting firms gain value when the SEK depreciates. The sign of the

significant coefficient among our results is positive and has a rather high value of 0.73. Hence, it is inline with our expectations. On the other hand, size does not seem to be an optimal proxy for hedging activities, as we would expect no or low significance to be found in all the *Upper Quartile* portfolios. If size would indicate the level of foreign exchange hedging activity, *Upper Quartile* firms would be expected to hedge more than *Lower Quartile* firms. The *Upper Quartile* within the size of firms should then include firms which were relatively hedged and thus rather unexposed to changes in the SEK. However, seeing that we obtain a significant coefficient in the *Upper Quartile* portfolio, size does not seem to be a suitable proxy for hedging activities.

The *Total Sales Lower Quartile* portfolio has one significant coefficient at the ten percent level. It is the lagged by one-month coefficient that is significant and the sign is negative. This is also in line with expectations when we use size as a proxy for foreign involvement. In this case, where the small size works as a proxy for low foreign involvement, the smaller firms would be expected to on average loose (gain) value when the SEK depreciates (appreciates) and hence show a negative exposure. The significant coefficients are fairly large at 0.73 and -0.83, and the adjusted R-Square for the equally weighted portfolio is high at 70.4%

6.4.4 Portfolio based on Foreign Ownership

Table 5 shows the results of the exposure coefficients for the *Portfolio based on Foreign Ownership*, both equally and value weighted.

Table 5. Exchange Rate Exposure Coefficients for the Portfolio based on Foreign Ownership

Portfolio: Foreign Ownership > 3 yrs

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.01036	0.85532**
β_{zi} (Lagged by one month)	0.01927	0.1102
Adjusted R-Square	0.573	0.171

Portfolio: Foreign Ownership at least one year

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous) β_{xi}	0.07873	0.49989

β_{zi} (Lagged by one month) β_{zi}	-0.67848	0.94805
Adjusted R-Square	0.71	0.634

This table reports the exposure coefficients of eight portfolios with equal weighting and weighted by market capitalisation. These coefficients have been estimated from monthly times-series regressions of portfolio returns on market returns and the contemporaneous and lagged by one-month TCW exchange rate index. Note: All coefficients are obtained from the Newey West SPSS Syntax. (***) Significant at 5% (**) Significant at 10%

The results, for the *Portfolios based on Foreign Ownership*, show that only one coefficient is significant. It is the contemporaneous coefficient for the *Foreign Ownership > 3 yrs* value weighted portfolio that is significant at the ten percent level. The sign is positive, which is in line Dahlqvist and Robertson (2001). Thereby, high foreign ownership may proxy for high foreign involvement which explains the positive exposure with a coefficient as high as 0.86. However, the Adjusted R-Square for this portfolio is low at 17.1%, which lessens the validity of this result.

6.4.5 Portfolio of Foreign Registered Firms

Table 6 shows the results of the exposure coefficients for the *Portfolio of Foreign Registered firms*, both equally and value weighted.

Table 6. Exchange Rate Exposure Coefficients for the Portfolio of Foreign Registered firms

Portfolio: Foreign Registered

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	-0.24261	-0.05109
β_{zi} (Lagged by one month)	0.31652	0.47728
Adjusted R-Square	0.791	0.757

This table reports the exposure coefficients of eight portfolios with equal weighting and weighted by market capitalisation. These coefficients have been estimated from monthly times-series regressions of portfolio returns on market returns and the contemporaneous and lagged by one-month TCW exchange rate index. Note: All coefficients are obtained from the Newey West SPSS Syntax. (***) Significant at 5% (**) Significant at 10%

The results show that none of the coefficients in the *Portfolio of Foreign Registered Firms* are significant. This portfolio consists of firms that are also included in the *Foreign Ownership > 3 yrs* portfolio, for which we find significance in one of its coefficients. A workable explanation for the absence of significant exposure for the foreign registered firms may

be that the turn-over on the Stockholm OMX Stock Exchange of the stocks included in this portfolio is low relative to their turn-over on their home exchanges. Hence, investors pay understandably little attention to changes in SEK.

6.4.6 Sector Portfolios

Table 7 shows the results of the exposure coefficients for the *Portfolio based on Sector belonging*, both equally and value weighted.

Table 7. Exchange Rate Exposure Coefficients for the Portfolio based on Sector

Portfolio: Consumer Discretion

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	-0.33424	-0.06515
β_{zi} (Lagged by one month)	-1.20096***	-0.40041
Adjusted R-Square	0.745	0.615

Portfolio: Consumer Staples

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	-0.00083	0.15495
β_{zi} (Lagged by one month)	-0.29386	-0.23593
Adjusted R-Square	0.031	-0.043

Portfolio: Energy

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.10511	-0.02169
β_{zi} (Lagged by one month)	-0.64779	-0.64333
Adjusted R-Square	0.285	0.233

Portfolio: Healthcare

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.69913**	0.931**
β_{zi} (Lagged by one month)	-0.3079	0.07213

Adjusted R-Square	0.494	0.096

Portfolio: Industrials

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.12046	0.47524**
β_{zi} (Lagged by one month)	-0.135	-0.2475
Adjusted R-Square	0.792	0.782

Portfolio: Information Technology

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	-0.30012	0.4045
β_{zi} (Lagged by one month)	-1.0656**	0.20243
Adjusted R-Square	0.781	0.813

Portfolio: Materials

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	0.16659	0.37856
β_{zi} (Lagged by one month)	-0.2617	0.04816
Adjusted R-Square	0.486	0.315

Portfolio: Telecom

	Equally Weighted	**Value Weighted**
β_{xi} (Contemporaneous)	-0.79765**	-0.00447
β_{zi} (Lagged by one month)	0.05683	0.3816
Adjusted R-Square	0.497	0.298

This table reports the exposure coefficients of eight portfolios with equal weighting and weighted by market capitalisation. These coefficients have been estimated from monthly times-series regressions of portfolio returns on market returns and the contemporaneous and one-month lagged TCW exchange rate index. Note: All coefficients are obtained from the Newey West SPSS Syntax. (***) Significant at 5% (**) Significant at 10%

The results for the exchange rate exposure coefficients from the Sector portfolio show that five sector portfolios have significant coefficients: Consumer Discretion, Healthcare, Industrials, Information Technology and Telecom.

We expect the *Consumer Discretion* portfolio to have a negative exposure, as the firms within this sector are mostly import oriented firms. The sector includes, among others, retail and consumer service, and *Lindex* and *Fenix Outdoor* are good examples of typical

firms in that sector. The portfolio has one significant coefficient; the equally weighted portfolio shows a significant lagged by one-month coefficient at the ten percent level. The sign is negative, in line with expectations and rather large indicating that this sector is fairly sensitive to changes in the exchange rate. The Adjusted R-Square for the equally weighted portfolio is high at 75.4% which supports the validity of the significant coefficient. The value weighted portfolio is not significant at all, which could imply that the larger consumer firms in Sweden have a different structure which affects the exposure or that they have hedged away the exposure more efficiently. Considering firms within the consumer sector, which are relying heavily on imported inputs (again, *Lindex* and *Fenix Outdoor* make for good examples), one might suppose that the bigger firms are actively hedging *Transaction exposure* from contacts with foreign suppliers.

The *Healthcare* portfolio has two significant coefficients. Healthcare is one of the stronger industries in Sweden, including a lot of highly export oriented firms. For an example *Q-med* and *Biolin* both generates more than 80% of their revenues aboard[26]. Therefore, we expect to find positive exposure. The contemporaneous coefficients are significant, at the ten percent level, for both the equally and the value weighted portfolios. The signs are both positive, supporting our expectations, and the high coefficients indicates that firms within the Healthcare sector, on average gain (looses) value as the SEK depreciates (appreciates). The Adjusted R-Square however, for which the equally weighted portfolio is fairly high (49.4%), is very low for the value weighted portfolio at 9.6%.

We expect the *Industrials* portfolio to have a positive coefficient, as this sector includes a lot of traditionally strong export oriented firms, such as for an example *Atlas Copco* and *Gunnebo*[27]. The contemporaneous coefficient is significant at the ten percent level in the value weighted portfolio. The sign is positive and the Adjusted R-Square is high at 78.2%, which is in line with our expectations. Again, the significance of the value weighted portfolio may imply that it is the bigger firms, which on average experience a positive exposure.

As well, we expect the *Information Technology* portfolio to have a positive coefficient, due to the fact that Sweden has several strong exporting firms within this sector (example:

26 Appendix IV: Firms included in Portfolio based on Sales Abroad
27 ibid

Audiodev and *Micronic Laser Systems*[28]). However, the one significant coefficient shows a negative sign at the ten percent level opposed to our expectations. Nevertheless, seeing that it is the equally weighted portfolio, one cannot draw strong conclusions regarding the bigger and dominating firms within this sector. These firms may have a different structure of exposure, or they may have hedged it properly, and are hence not showing significant results in the value weighted portfolio. The Adjusted R-Square is high at 78.1%.

We expect he *Telecom* portfolio, alike the *Information Technology* portfolio, to show positive exposure. The results are as well against our expectations, as the contemporaneous coefficient for the equally weighted portfolio is significant negative at the ten percent level. The Adjusted R-Square is fairly high at 49.7%. We believe that the same explanations, as given above for the *Information Technology* sector, could be applied here, as the sectors from an exposure perspective seem comparable.

To summarise the results from the sector portfolios, significance is found only in five out of eight portfolios. Two of the sectors *Healthcare* and *Industrials* show significant positive exposure in the value weighted portfolios whereas the other three show significant lagged negative exposure for the equally weighted portfolios. Hence, the results demonstrate an irregular pattern between significance in the equally weighted and value weighted portfolios. This seems to support our earlier mentioned explanation of a pattern of hedging where the negative *Operating exposure* of smaller/domestic oriented firms dominates the equally weighted portfolios, whereas the positive *Transaction exposure* found in larger/export oriented firms is actively hedging leaving the value weighted portfolios relatively unexposed. However, the negative exposure found in the *Consumer Discretion* portfolio is in line with expectations for this import oriented sector.

It is thus rather unclear whether exposure is especially linked to sector classification. There are evidently import and export oriented sectors, but due to probably mainly differences in type of exposure and hedging activities, it is difficult to draw any valid conclusions. Furthermore, as earlier mentioned Dahlqvist and Robertson (2001) question the validity of constructing portfolios based on sector due the aggregation problems

[28] Appendix IV: Firms included in Portfolio based on Sales Abroad

which this entails; firms within the same sector need not experience homogeneous exposure as levels of imports and exports can vary substantially.

6.5 Determinants of Exposure – Cross Sectional Regression

To identify the determinant factors of exposure to foreign exchange fluctuations, a cross sectional regression is performed. The betas collected from the time series regression are used as a measure of the sensitivity of the firms to the fluctuations. Hence, one of the cross sectional regressions includes the whole firm sample, and the other includes only the firms with betas significant at 10%. Due to the shortage in data available, the only reasonable factor of possible exposure to be examined is the level of Sales Abroad. Therefore, we run the cross sectional regression between the attained firm betas of sensitivity and the level of Sales Abroad in accordance with Equation [2].

$$\hat{\beta}_{ix} = \gamma_0 + \sum \gamma_f F_{fi} + \varepsilon_i \qquad i = 1,\ldots,N \quad [2]$$

The coefficient γ_f is represented in the table below. Four regressions where conducted to include both contemporaneous and lagged variables, as well as one sample with all firms' betas and one with only significant firm betas. The results, from the cross sectional regression, are presented in *table 8* below.

Table 8. Coefficients for a Cross Sectional Regression

	All firms' betas	Only significant firms' betas
γ_{xf}	0.444	2.053
γ_{zf}	0.463	1.136
Adjusted R-Square	0.009	0.015

This table reports the factor coefficients of exposure. These coefficients have been estimated from cross sectional regressions of beta coefficients from the time series regression, measuring firm sensitivity to foreign exchange fluctuations, and the explanatory factor of foreign sales. The table above includes both contemporaneous and lagged by one-month TCW exchange rate index, as well as one sample with all firms' betas and one with only significant firm betas. Note: Sample of all firms includes all firms with available data on foreign sales.

A positive coefficient value was expected as the higher the sales abroad within a firm (independent variable), the higher the foreign exposure, and hence the higher the beta of

the sensitivity of the stock price to changes in foreign exchange (dependent variable). None of the coefficients are however significant, and the adjusted R-square is trivial.

In line with the results in Table 8, no obvious trend is to be found from these diagrams. Sales abroad, as of this data sample, cannot be considered a strong or reliable determinant of foreign exposure.

8 Conclusion

In summary, when analysing the sensitivity of the firm value of 172 non-financial Swedish companies quoted on the Stockholm Stock Exchange (OMX) to exchange rate fluctuations, and a possible pattern between firm characteristics and foreign exchange rate exposure during the period, January 2001 to January 2006, we find that the highest levels of significant exposure through both our firm-level and portfolio-level regressions are predominantly lagged and negative.

Several possible explanations have been discussed. The potential importance of hedging activities, accounting for import levels and foreign debt, accounting for the currency denomination of imports and exports and the existence of a lagged effect on the economy following an exchange rate fluctuation are the most pertinent.

Regarding our portfolio results the equally weighted portfolios demonstrate exposure opposed to expectations. This finding is in line with the results for our firm level regressions where the mean coefficient is negative. On the other hand, we find that when taking market capitalisation into account in the value weighted portfolios, we do obtain the expected positive exposure. This is interesting as it indicates that accounting for market capitalisation results in significant exposure which is contemporaneous and positive. This is in line with expectations for our portfolio-level regressions when we test for the importance of *Sales Abroad, Domestic Sales*, *Sector*, *Size* and *Foreign Ownership*. As earlier stated, all of these portfolios essentially aim to test the importance of a firm's level of foreign involvement and when accounting for market capitalisation it results in a significantly positive foreign exchange rate exposure.

Nevertheless, the value weighted portfolios are less significant and the Adjusted R-Squares are substantially lower than for the equally weighted portfolios. We suggest that this can be explained by a pattern of hedging where the negative exposure of the smaller

firms can dominate the equally weighted portfolios as the larger firms to a greater extent actively hedge their positive exposure. Thus, in the value weighted portfolios the positive exposure of the larger firms is reduced due to active hedging which dampens the level of significance in these portfolios.

Regarding hedging activities we wonder if the dominating negative exposure can be explained more specifically by the fact that exporting firms are more prone to hedge their *Transaction exposure*. This results in that the generally negative lagged *Operating exposure,* which is more complex and thus more difficult to identify, of domestic firms dominates in our firm-level regressions. However, without information on hedging activities we cannot verify if an increase in hedging amongst exporting firms relative to domestic firms has resulted in less significant positive exposure and thus dominating negative exposure, during our testing period compared to earlier data on the Swedish stock market. In addition, accounting for import levels in our portfolio-level regressions would ascertain which firms are net exporters and enable the construction of a proper *Portfolio of exporters*. Moreover, the possible existence of a lagged effect on the economy following a change in the exchange rate together with exporting firms' relatively higher level of hedging, may coexist and explain the dominance of lagged negative exposure.

We find that a high degree of openness and hence of exporting levels such as in small open economy as Sweden's need not ascertain that predominantly significant positive exposure is found, as showed by our firm-level regression results. Our portfolio-level results on the other hand, do also show significant negative lagged exposure. However, we are aware that when market capitalisation is taken into account our results align with expectations and we are also aware that the used proxies may not be optimal.

Thereby, contributing to the scarce research on exchange rate exposure in small open economies we suggest that further research takes information on hedging activities, import levels, foreign debt, the currency denomination of exports and imports and the possible importance of a lagged impact on the economy, following exchange rate fluctuations, into consideration. This would enable the sensitivity of firm value, in small open economies such as Sweden's, to exchange rate fluctuations and the possible pattern between such firms' characteristics and their relative foreign exchange rate exposure to be further investigated.

9 Reference list

Literature References

I. Adler, Michael and Bernard, Dumas, 1980, The Exposure of Long-term Foreign Currency Bonds, *Journal of Financial and Quantitative Analysis* 15, 973-995

II. Adler, Michael and Bernard Dumas, 1984, Exposure to Currency Risks: Definition and Measurement, *Financial Management* 13, 41-50

III. Allayanis, G and Olek, E., 1996, Exchange Rate Exposure, Hedging and the Use of Foreign Currency derivatives, *Working Paper, Stern School of Business, New York University*

IV. Bartov, Eli and Gordon M. Bodnar, 1994, Firm Valuation, Earnings Expectations and the Exchange Rate Exposure Effect, *Journal of Finance* 49, 1755-1786

V. Dahlqvist, Magnus and Göran Robertson, 2001a, Direct Foreign Ownership, Institutional Investors and Firm Characteristics, *Journal of Financial Economics* 59, 413-440

VI. Dumas, Bernard and Bruno Solnik, 1995, The World Price of Foreign Exchange Risk, *Journal of Finance* 47, 445-479

VII. Ferson, Wayne E., and Campbell R. Harvey, 1993, The Risk and Predictability of International Equity Returns, *Review of Financial Studies* 6, 527-566

VIII. Friberg, Richard and Stefan Nydahl, 1999, Openness and the Exchange Rate Exposure of National Stock Markets – a note, *International Journal of Finance and Economics*

IX. He, Jia and Lilian K. Ng, 1998, The Foreign Exchange Exposure of Japanese Multinational Corporations, *Journal of Finance* 53, 733-753

X. Heckerman, D., 1972, The Exchange Risk of Foreign Operations, *Journal of Business* 44, 42-48

XI. Jorion, Philippe, 1990, The Exchange Rate Exposure of U.S. Multinationals, *Journal of Business* 63, 331-345

XII. Jorion, Philippe, 1991, The Pricing of Exchange Rate Risk in the Stock Market, *Journal of Financial and Quantitative Analysis* 26, 363-376

XIII. Lewis, K, 1995, Puzzles in the International Financial Markets, *Handbook of International Economics vol. 3,* North Holland, Amsterdam

XIV. Martinez-Solano, Pedro, 2000, Foreign Exchange Exposure on the Spanish Stock Market: Sources of Risk and Hedging, *University of Murcia, Spain*

XV. Modigliani, Franco Merton H. Miller, 1958, The Cost of Capital , Corporation Finance and Theory of Investment, *American Economic Review* 48, 261-297

XVI. Modigliani, Franco Merton H. Miller, 1961, Dividend Policy, Growth and the Valuation of Shares, *Journal of Business* 34, 411-433

XVII. Nydahl, Stefan, 1999, Exchange Rate Exposure, Foreign Involvement and Currency Hedging of Firms: Some Swedish Evidence, *European Financial Management* 5, 241-257

XVIII. Schnabel, J. A., 1989, Exposure to Foreign Exchange Risk: A Multi-currency Extension, *Managerial and Decision Economics,* vol. 10, 331-333

XIX. Shapiro, Alan, 1977, Defining Exchange Risk, *Journal of Business* 50, 37-39

XX. Shapiro, A. C., 1996, *Multinational Financial Management*, Prentice-Hall

Survey

Bank of International Settlements, 2004, *Triennial Central Bank Survey Foreign exchange and derivatives market activity in 2004*

Textbooks

Eun, Cheol S. and Bruce G. Resnick, 2004, *International Financial Management*, McGraw Hill, Irwin

Bodie, Zri, Alex Kane and Alan J. Marcus, 2005, *Investments,* International Edition 2005, McGraw Hill

Databases

I. Orbis
II. Datastream
III. OMX
IV. ITPS

Internet sources

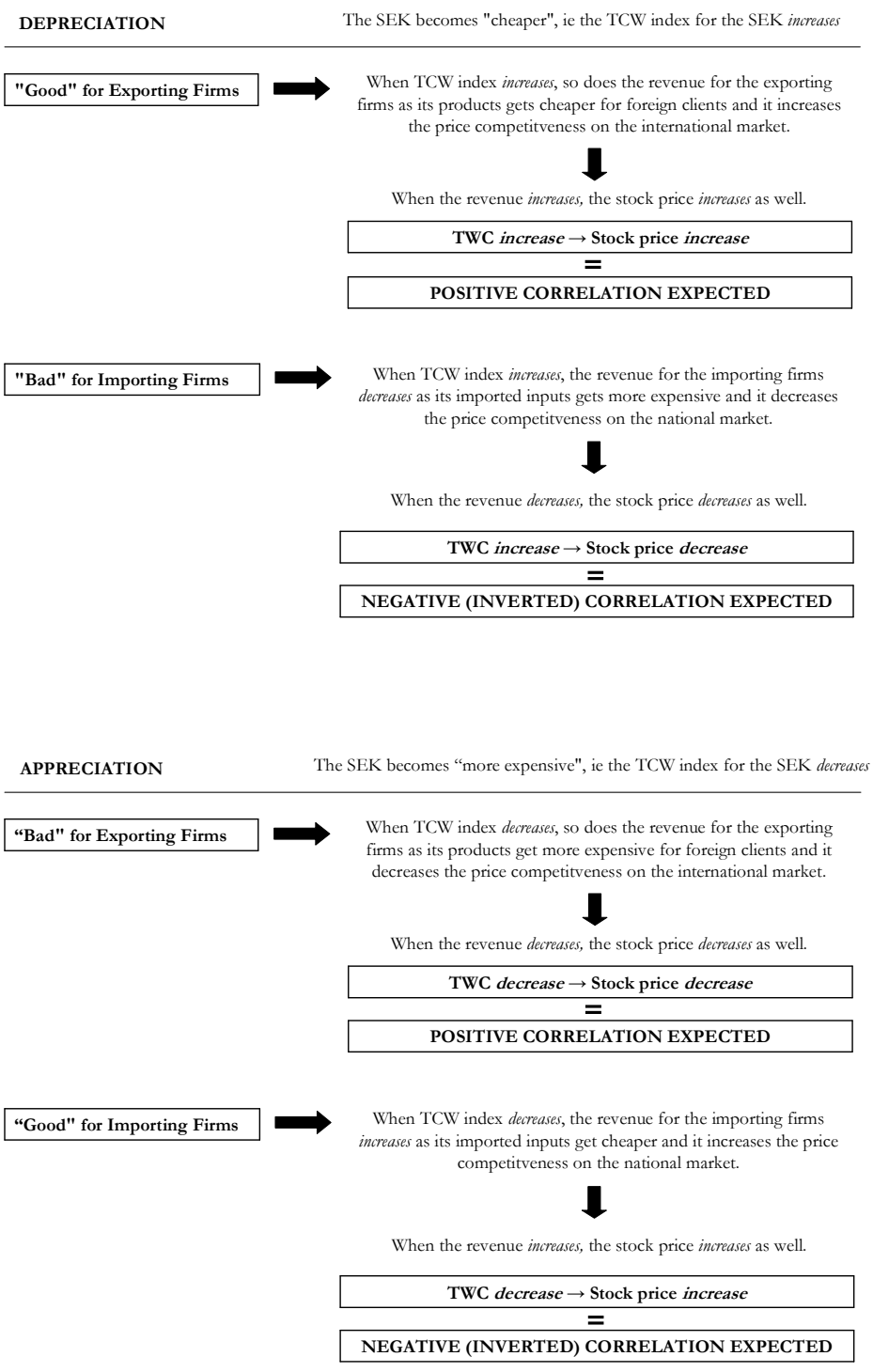
The Bank of International Settlements*, Trennial Central Bank Survey Foreign exchange derivatives market activity* (2004).
Available [online]: http://www.bis.org/publ/rpfx05t.pdf [2007-05-20]

The Swedish Central Bank, *Svensk Ekonomisk och Finansiell Statistik* (2007).

Available [online]: http://www.riksbank.se/svenskstat/#Foot [2007-05-20]

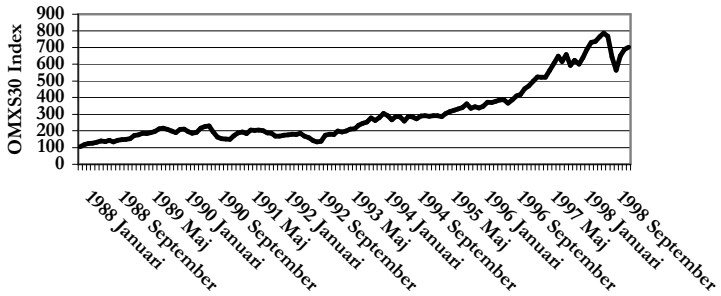
10 Appendix

Appendix I: Foreign exchange – a two way relationship



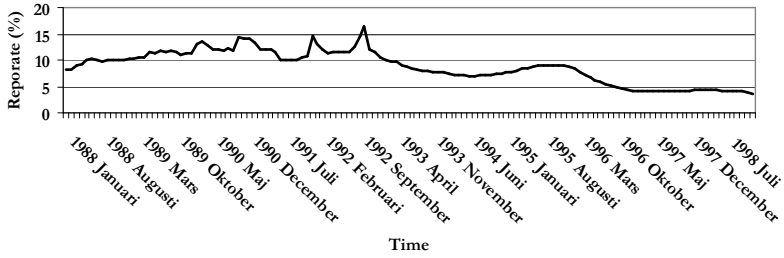
Sweden during the time period 1988 – 1998

OMXS30 1988 - 1998

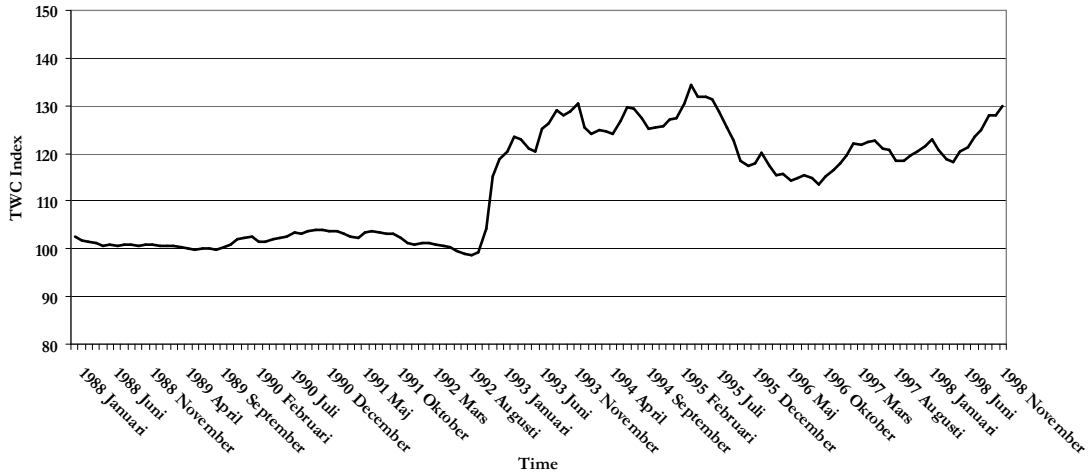


Swedish Reporate 1988-1998*

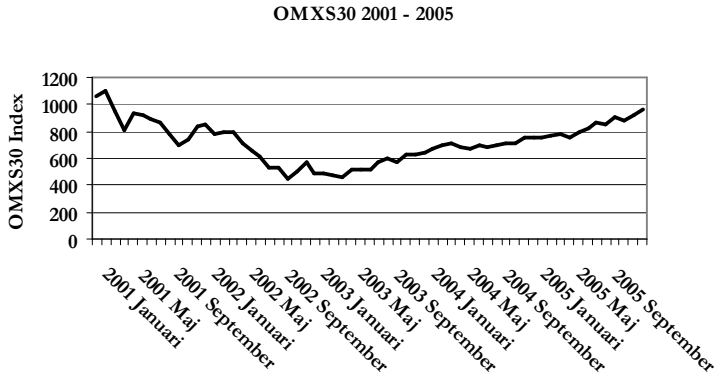
*sorted for outlier in sept 1992 at 79.9%

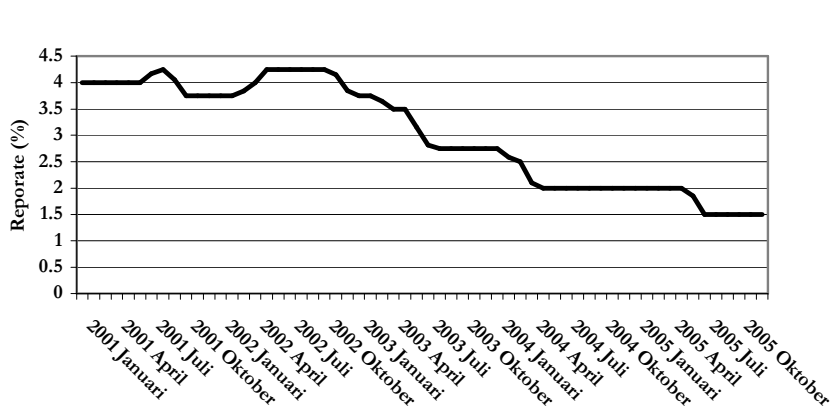


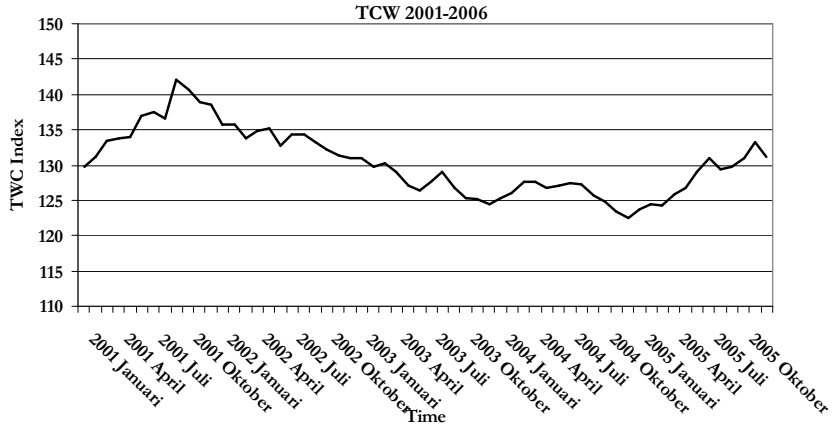
TWC for Swedish Krona 1988-1998



Sweden during the time period 2001 – 2005







Appendix III: Firms (172) included in the sample

1. ABB (OME)
2. ACANDO
3. A-COM
4. ACSC
5. ACTIVE BIOTECH
6. ADDNODE
7. ANGPANNEFORENINGEN
8. ANOTO GROUP
9. ARTIMPLANT
10. ASSA ABLOY 'B'
11. ASTRAZENECA (OME)
12. ATLAS COPCO 'B'
13. AUDIODEV 'B'
14. AUTOLIV SDB
15. AXFOOD
16. AXIS
17. BEIJER
18. BEIJER ALMA 'B'
19. BEIJER ELECTRONICS
20. BERGMAN & BEVING 'B'
21. BIACORE
22. BILIA 'A'
23. BIOGAIA 'B'
24. BIOLIN
25. BIOPHAUSIA 'A'
26. BIOTAGE 'A'
27. BOLIDEN
28. BONGS LJUNGDAHL 'B'
29. BORAS WAFVERI 'B'
30. BOSS MEDIA
31. BRIO 'B'
32. BROSTROM
33. CAPIO
34. CARDO
35. CASHGUARD 'B'
36. CHERRYFORETAGEN/ BETTSON
37. CLAS OHLSON 'B'
38. CLOETTA FAZER 'B'
39. CONCORDIA MARITIME
40. CONSILIUM 'B'
41. CTT SYSTEMS
42. CYBERCOM GROUP EUROPE
43. DIGITAL VISION
44. DORO
45. DUROC 'B'
46. ELANDERS 'B'
47. ELECTROLUX 'B'
48. ELEKTA 'B'
49. ELEKTRONIKGRUPPEN BK 'B'
50. EMPIRE B
51. ENEA
52. ENIRO
53. ERICSSON 'B'
54. EXPANDA 'B'
55. FAGERHULT
56. FEELGOOD SVENSKA
57. FENIX OUTDOOR
58. FINGERPRINT CARDS
59. GAMBRO 'B'
60. GETINGE
61. GLOCALNET B
62. GUNNEBO
63. HALDEX
64. HENNES & MAURITZ 'B'
65. HEXAGON 'B'
66. HIQ INTERNATIONAL
67. HL DISPLAY 'B'
68. HOGANAS 'B'
69. HOLMEN 'B'
70. IBS 'B'
71. IFS B
72. INTELLECTA 'B'
73. JC
74. JEEVES INFO.SYSTEMS
75. KABE HUSVAGNAR 'B'
76. KARO BIO 'B'
77. KAROLIN MACHINE TOOL
78. KLIPPAN
79. KNOW IT
80. LBI INTERNATIONAL
81. LINDEX
82. MALMBERGS 'B'
83. MANDATOR
84. MEDA 'A'
85. MEDIVIR 'B'
86. MEKONOMEN 'B'
87. MICRONIC LASER SYS.
88. MIDWAY HOLDING 'B'
89. MODERN TIMES GP.MTG 'B'
90. MODUL 1 DATA
91. MSC KONSULT 'B'
92. MULTIQ INTERNATIONAL
93. MUNTERS
94. NARKES ELEKTRISKA 'B'
95. NCC 'B'
96. NEFAB 'B'
97. NET INSIGHT 'B'
98. NEW WAVE GROUP 'B'
99. NIBE INDUSTRIER 'B'
100. NILORNGRUPPEN 'B'
101. NOBEL BIOCARE (OME)
102. NOCOM 'B'
103. NOKIA SDB
104. NOLATO 'B'
105. NOVOTEK 'B'
106. OBSERVER
107. OEM INTERNATIONAL 'B'
108. ONETWOCOM
109. OPCON
110. ORC SOFTWARE
111. ORTIVUS 'B'
112. OXIGENE (OME)
113. PARTNERTECH
114. PEAB 'B'
115. POOLIA 'B'
116. PRECISE BIOMETRICS
117. PREVAS 'B'
118. PRICER 'B'
119. PROACT IT GROUP
120. PROFFICE 'B'
121. PROFILGRUPPEN 'B'
122. PROTECT DATA
123. Q-MED
124. RAYSEARCH LABORATORIES
125. READSOFT 'B'
126. REDERI AB TNSAT.'B'
127. RESCO 'B'
128. RORVIK TIMBER
129. ROTTNEROS
130. SAAB 'B'
131. SANDVIK
132. SARDUS
133. SCA 'B'
134. SCAN MINING
135. SCANIA 'B'
136. SCRIBONA 'B'
137. SECO TOOLS 'B'
138. SECTRA 'B'
139. SECURITAS 'B'
140. SEMCON
141. SENEA
142. SINTERCAST
143. SKANSKA 'B'
144. SKF 'B'
145. SKISTAR 'B'
146. SOFTRONIC 'B'
147. SSAB 'B'
148. STORA ENSO 'R' (OME)
149. STRALFORS 'B'
150. SWECO 'B'
151. SVEDBERGS 'B'
152. SWEDISH MATCH
153. SWITCHCORE
154. TELE2 'B'
155. TELECA 'B'
156. TELELOGIC
157. TELIASONERA
158. TELIGENT
159. THALAMUS NETWORKS 'B'
160. TICKET TRAVEL
161. TIETOENATOR (OME)
162. TRELLEBORG 'B'
163. TRICORONA
164. TRIO
165. W SONESSON 'B'
166. VBG
167. WEDINS SKOR & ACCESSORIES
168. WESTERGYLLEN 'B'
169. VOLVO 'B'
170. VOSTOK NAFTA SDB
171. XANO INDUSTRI 'B'
172. ZODIAK TELEVISION 'B'

Appendix IV: Firms included in Portfolio based on Sales Abroad

Average Sales Abroad 2001-2006 over 50%

1. ACSC
2. ANOTO GROUP
3. ASSA ABLOY 'B'
4. ASTRAZENECA (OME)
5. ATLAS COPCO
6. AUDIODEV 'B'
7. BEIJER
8. BEIJER ALMA 'B'
9. BEIJER ELECTRONICS
10. BIOLIN
11. BIOPHAUSIA 'A'
12. BOLIDEN
13. BORAS WAFVERI 'B'
14. CAPIO
15. CARDO
16. CLOETTA FAZER 'B'
17. CONCORDIA MARITIME 'B'
18. CONSILIUM 'B'
19. ELECTROLUX
20. ERICSSON
21. EXPANDA 'B'
22. FAGERHULT
23. FENIX OUTDOOR
24. GETINGE
25. GUNNEBO
26. HENNES & MAURITZ 'B'
27. HEXAGON 'B'
28. HL DISPLAY 'B'
29. HOLMEN
30. IBS 'B'
31. LBI INTERNATIONAL
32. MICRONIC LASER SYS.
33. MODERN TIMES GP.MTG
34. MULTIQ INTERNATIONAL
35. NCC 'B'
36. NEFAB 'B'
37. NET INSIGHT 'B'
38. NEW WAVE GROUP 'B'
39. Q-MED
40. ROTTNEROS
41. SANDVIK
42. SCA 'B'
43. SCANIA
44. SCRIBONA
45. SINTERCAST
46. SKANSKA 'B'
47. STRALFORS 'B'
48. SWEDISH MATCH
49. TELELOGIC
50. TIETOENATOR (OME)
51. VBG
52. VOLVO
53. ZODIAK TELEVISION 'B'

Average Sales Abroad 2001-2006 over 70%

1. ACSC
2. ANOTO GROUP
3. ASSA ABLOY 'B'
4. ASTRAZENECA (OME)
5. ATLAS COPCO
6. AUDIODEV 'B'
7. BIOLIN
8. BIOPHAUSIA 'A'
9. BOLIDEN
10. CARDO
11. CONCORDIA MARITIME 'B'
12. ELECTROLUX
13. ERICSSON
14. GETINGE
15. GUNNEBO
16. HENNES & MAURITZ 'B'
17. HEXAGON 'B'
18. HL DISPLAY 'B'
19. HOLMEN
20. IBS 'B'
21. MICRONIC LASER SYS.
22. NEFAB 'B'
23. NET INSIGHT 'B'
24. Q-MED
25. ROTTNEROS
26. SANDVIK
27. SCANIA
28. SINTERCAST
29. SKANSKA 'B'
30. TIETOENATOR (OME)
31. VBG
32. VOLVO

Average Sales Abroad 2001-2006 over 80%

1. ASTRAZENECA (OME)
2. ATLAS COPCO
3. AUDIODEV 'B'
4. BIOLIN
5. BIOPHAUSIA 'A'
6. CARDO
7. CONCORDIA MARITIME 'B'
8. ELECTROLUX
9. ERICSSON
10. GETINGE
11. GUNNEBO
12. HENNES & MAURITZ 'B'
13. HL DISPLAY 'B'
14. MICRONIC LASER SYS.
15. Q-MED
16. ROTTNEROS
17. SCANIA
18. SINTERCAST
19. VOLVO

Appendix V: Firms included in Portfolio of Companies with only Domestic Sales

1. **BROSTROM**
2. **FEELGOOD SVENSKA**
3. **GLOCALNET 'B'**
4. **MODUL 1 DATA**
5. **MSC KONSULT 'B'**
6. **NARKES ELEKTRISKA 'B'**
7. **SCAN MINING**
8. **SEMCON**

Appendix VI: Firms included in Portfolio based on Size

Portfolio of Total Sales Upper Quartile

1. **ABB (OME)**
2. **ASSA ABLOY 'B'**
3. **ASTRAZENECA (OME)**
4. **ATLAS COPCO**
5. **AUTOLIV SDB**
6. **AXFOOD**
7. **BERGMAN & BEVING 'B'**
8. **BILIA 'A'**
9. **BOLIDEN**
10. **Capio**
11. **CARDO**
12. **ELECTROLUX**
13. **ENIRO**
14. **ERICSSON**
15. **Gambro**
16. **GETINGE**
17. **GUNNEBO**
18. **HALDEX**
19. **HENNES & MAURITZ 'B'**
20. **HEXAGON 'B'**
21. **HOGANAS 'B'**
22. **HOLMEN**
23. **LINDEX**
24. **MODERN TIMES GP.MTG**
25. **MUNTERS**
26. **NCC**
27. **PEAB 'B'**
28. **SAAB 'B'**
29. **SANDVIK**
30. **SCA**
31. **SCANIA**
32. **SCRIBONA**
33. **SECO TOOLS 'B'**
34. **SECURITAS 'B'**
35. **SKANSKA 'B'**
36. **SKF**
37. **SSAB**
38. **STORA ENSO (OME)**
39. **SWEDISH MATCH**
40. **TELE2**
41. **TELIASONERA**
42. **TRELLEBORG 'B'**
43. **VOLVO**

Portfolio of Total Sales Lower Quartile

1. **ACSC**
2. **ACTIVE BIOTECH**
3. **ANOTO GROUP**
4. **ARTIMPLANT**
5. **AUDIODEV 'B'**
6. **BIOGAIA 'B'**
7. **BIOLIN**
8. **BIOPHAUSIA 'A'**
9. **BIOTAGE 'A'**
10. **BOSS MEDIA**
11. **CASHGUARD 'B'**
12. **CTT SYSTEMS**
13. **DIGITAL VISION**
14. **DUROC 'B'**
15. **Empire B**
16. **FINGERPRINT CARDS**
17. **JEEVES INFO.SYSTEMS**
18. **KARO BIO 'B'**
19. **MEDIVIR 'B'**
20. **MODUL 1 DATA**
21. **MSC KONSULT 'B'**
22. **MULTIQ INTERNATIONAL**
23. **NET INSIGHT 'B'**
24. **NOKIA SDB**
25. **NOVOTEK 'B'**
26. **ONETWOCOM**
27. **ORC SOFTWARE**
28. **ORTIVUS**
29. **PRECISE BIOMETRICS**
30. **PREVAS 'B'**
31. **PRICER 'B'**
32. **PROTECT DATA**
33. **RAYSEARCH LABORATORIES**
34. **SCAN MINING**
35. **Senea**
36. **SINTERCAST**
37. **SOFTRONIC 'B'**
38. **SWITCHCORE**
39. **THALAMUS NETWORKS 'B'**
40. **TRICORONA**
41. **VOSTOK NAFTA SDB**

Appendix VII: Firms included in Portfolio based on Foreign Ownership

Portfolio based on Foreign Ownership more than 3 yrs

1. **ABB**
2. **ASTRAZENECA**
3. **AUTOLIV**
4. **CONSILIUM AB**
5. **NOBEL BIOCARE AB**
6. **NOKIA**
7. **OXIGENE**
8. **STORA ENSO OYJ**
9. **TIETOENATOR**
10. **VOSTOK NAFTA INVESTMENT**

Portfolio based on Foreign Ownership for at least 1 yr

1. **ABB**
2. **A-COM AB**
3. **ASTRAZENECA**
4. **AUTOLIV**
5. **AXFOODAB**
6. **CONSILIUM AB**
7. **GLOCALNET AB**
8. **NOBEL BIOCARE AB**
9. **NOKIA**
10. **OXIGENE**
11. **STORA ENSO OYJ**
12. **TIETOENATOR**
13. **WEDINS SKOR & ACCESSOARER AB**
14. **VOSTOK NAFTA INVESTMENT**

Appendix VIII: Firms included in Portfolio of Foreign Registered firms

1. **AUTOLIV INC.**
2. **NOKIA ABP.**
3. **OXIGENE INC.**
4. **STORA ENSO OYJ**
5. **TIETOENATOR ABP.**
6. **VOSTOK NAFTA INVESTMENT LTD.**

Appendix IX: Firms included in Sector Portfolios

Consumer Discretion

1. **A-COM**
2. **AUTOLIV SDB**
3. **BILIA 'A'**
4. **BORAS WAFVERI 'B'**
5. **BRIO 'B'**
6. **Cherryföretagen/Betsson**
7. **CLAS OHLSON 'B'**
8. **ELANDERS 'B'**
9. **ELECTROLUX 'B'**
10. **ENIRO**
11. **FENIX OUTDOOR**
12. **HENNES & MAURITZ 'B'**
13. **JC**
14. **KABE HUSVAGNAR 'B'**
15. **LINDEX**
16. **MEKONOMEN 'B'**
17. **MODERN TIMES GP.MTG 'B'**
18. **Narkes Elektriska B**
19. **NEW WAVE GROUP 'B'**
20. **NILORNGRUPPEN 'B'**
21. **SKISTAR 'B'**
22. **TICKET TRAVEL**
23. **WEDINS SKOR&ACCESSORIES**
24. **ZODIAK TELEVISION 'B'**

Consumer Staples

1. **AXFOOD**
2. **CLOETTA FAZER 'B'**
3. **SARDUS**
4. **SWEDISH MATCH**

Energy

1. **BROSTROM**
2. **CONCORDIA MARITIME 'B'**
3. **VOSTOK NAFTA SDB**

Healthcare

1. **ACTIVE BIOTECH**
2. **ARTIMPLANT**
3. **ASTRAZENECA (OME)**
4. **BIOGAIA 'B'**
5. **BIOLIN**
6. **BIOPHAUSIA 'A'**
7. **BIOTAGE 'A'**
8. **Capio**
9. **ELEKTA 'B'**
10. **FEELGOOD SVENSKA**
11. **Gambro B**
12. **GETINGE**
13. **KARO BIO 'B'**
14. **MEDA 'A'**
15. **MEDIVIR 'B'**
16. **NOBEL BIOCARE (OME)**
17. **ORTIVUS 'B'**
18. **OXIGENE (OME)**
19. **Q-MED**
20. **RAYSEARCH LABORATORIES**
21. **SECTRA 'B'**
22. **W SONESSON 'B'**

Industrials

1. **ANGPANNEFORENINGEN 'B'**
2. **ASSA ABLOY 'B'**
3. **ATLAS COPCO 'B'**
4. **BEIJER**
5. **BEIJER ALMA 'B'**
6. **BERGMAN & BEVING 'B'**
7. **BONGS LJUNGDAHL 'B'**
8. **CARDO**
9. **CONSILIUM 'B'**
10. **CTT SYSTEMS**
11. **DUROC 'B'**
12. **EXPANDA 'B'**
13. **FAGERHULT**
14. **GUNNEBO**
15. **HALDEX**
16. **HEXAGON 'B'**
17. **HL DISPLAY 'B'**
18. **INTELLECTA 'B'**
19. **MALMBERGS 'B'**
20. **MIDWAY HOLDING 'B'**
21. **MUNTERS**
22. **NCC 'B'**
23. **NEFAB 'B'**
24. **NIBE INDUSTRIER 'B'**
25. **OBSERVER**
26. **OEM INTERNATIONAL 'B'**
27. **OPCON**
28. **PEAB 'B'**
29. **POOLIA 'B'**
30. **PROFFICE 'B'**
31. **REDERI AB TNSAT.'B'**
32. **SAAB 'B'**
33. **SANDVIK**
34. **SCANIA 'B'**
35. **SECO TOOLS 'B'**
36. **SECURITAS 'B'**
37. **SINTERCAST**
38. **SKANSKA 'B'**
39. **SKF 'B'**
40. **SWECO 'B'**
41. **SVEDBERGS 'B'**
42. **TRELLEBORG 'B'**
43. **VBG**
44. **WESTERGYLLEN 'B'**
45. **VOLVO 'B'**
46. **XANO INDUSTRI 'B'**

Materials

1. **BOLIDEN**
2. **Empire B**
3. **HOGANAS 'B'**
4. **HOLMEN 'B'**
5. **KLIPPAN**
6. **PROFILGRUPPEN 'B'**
7. **RORVIK TIMBER**
8. **ROTTNEROS**
9. **SCA 'B'**
10. **SCAN MINING**
11. **SSAB 'B'**
12. **STORA ENSO 'R' (OME)**
13. **TRICORONA**

Telecom

1. **TELE2 'B'**
2. **TELIASONERA**
3. **THALAMUS NETWORKS 'B'**

Information Technology

1. **Acando**
2. **ACSC**
3. **ADDNODE 'B'**
4. **ANOTO GROUP**
5. **AUDIODEV 'B'**
6. **AXIS**
7. **BEIJER ELECTRONICS**
8. **BOSS MEDIA**
9. **CASHGUARD 'B'**
10. **CYBERCOM GROUP EUROPE**
11. **DIGITAL VISION**
12. **DORO**
13. **ELEKTRONIKGRUPPEN BK 'B'**
14. **ENEA**
15. **ERICSSON 'B'**
16. **FINGERPRINT CARDS**
17. **HIQ INTERNATIONAL**
18. **IBS 'B'**
19. **JEEVES INFO.SYSTEMS**
20. **KNOW IT**
21. **LBI INTERNATIONAL**
22. **MANDATOR**
23. **MICRONIC LASER SYS.**
24. **MODUL 1 DATA**
25. **MSC KONSULT 'B'**
26. **MULTIQ INTERNATIONAL**
27. **NET INSIGHT 'B'**
28. **NOCOM 'B'**
29. **NOKIA SDB**
30. **NOLATO 'B'**
31. **NOVOTEK 'B'**
32. **ONETWOCOM**
33. **ORC SOFTWARE**
34. **PARTNERTECH**
35. **PRECISE BIOMETRICS**
36. **PREVAS 'B'**
37. **PRICER 'B'**
38. **PROACT IT GROUP**
39. **PROTECT DATA**
40. **READSOFT 'B'**
41. **Resco B**
42. **SCRIBONA 'B'**
43. **SEMCON**
44. **Senea**
45. **SOFTRONIC 'B'**
46. **Strålfors B**
47. **SWITCHCORE**
48. **TELECA 'B'**
49. **TELELOGIC**
50. **TELIGENT**
51. **TIETOENATOR (OME)**