Can the CFO Trust the FX Exposure Quantification from a Stock Market Approach?

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May 1, 2009

Abstract

This study examines the sensitivity of detected exchange rate exposures at the firm-specific level to changes in methodological choices using a traditional two factor stock market approach for exposure quantification. We focus on two methodological choices: the choice of market index and the choice of observation frequency. We investigate to which extent the detected exchange rate exposures for a given firm are confirmed when the choice of market index and/or the choice of observation frequency are changed. The percentage of exposures that cannot be confirmed is the defection rate. We apply the sensitivity analysis to Scandinavian non-financial firms and find high defection rates which are robust to alternative specifications of direction, geographical area / currency regime, time period, and significance level. The high defection rates (in the magnitude of 50%) in relation to the choice of market index bear some economic rationale since we are dealing with extra-market exchange rate exposures but the high defection rates (in the magnitude of 80%) in relation to the choice of observation frequency bear no economic rationale and put a serious question mark on the validity of the stock market approach at the firm-specific level. The results of the study are important because corporate managers, stock analysts and stock pickers are primarily interested in the sensitivity – and thus reliability – of detected exchange rate exposures for a specific firm rather than for an aggregate group of firms in an industry or in a country. The latter has been covered extensively in the existing literature while the lack of literature on the former is the raison d'être of this study.

Keywords: Exchange rate exposure quantification, Stock market approach, Observation frequency, Market index, Scandinavia non-financial firms

JEL Classification: F23, F31, G32

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We would like to thank Carsten Vinther for excellent research assistance.

1. Introduction

One of the most important prices in the international economy today is the exchange rate. It simplifies the conversion of prices into different currencies. Since exchange rates can affect cash flows and stock prices of firms, the exposure to this uncertainty is a concern for investors, analysts and managers. The magnitude of the importance of exchange rate variability is also evidenced by the increasing efforts firms place on resource allocation, exchange risk management and business strategy management (Amihud, 1994). The returns of all assets do respond to changes in economic conditions, yet, the responses vary (Fama and French, 1989). The understanding of the impact of foreign exchange risk is an important element of both firm valuation and risk management.

Several studies have investigated the exchange rate exposure of non-financial firms in a US context[1] as well as in an international context.[2] Most of these studies focus on the exchange rate exposure on an aggregated country or industry level. Discussions - if any - on the sensitivity of the detected exchange rate exposures to changes in methodological choices focus on the subsequent change in the aggregated number of firms significantly exposed to changes in exchange rates[3] rather than on *which* firms are significantly exposed to changes in exchange rates under the various methodologies. If a study identifies ten percent of the firms to be exposed to a given exchange rate using monthly data and also identifies ten percent of the firms to be exposed to the same exchange rate using weekly data, this may

[1] Please refer to Jorion (1990), Bodnar and Gentry (1993), Amihud (1994), Bartow and Bodnar (1994), Choi and Prasad (1995), Chow, Lee, and Solt (1997), Ibrig (2001) and Pritamani, Shome, and Singal (2004) among others for studies in a US context.
[2] Please refer to Bodnar and Gentry (1993), He and Ng (1998), Friberg and Nydahl (1999), Nydahl (1999), Iorio and Faff (2001), Dominguez and Tesar (2001), Griffin and Stulz (2001), Doukas, Hall, and Lang (2003), Muller and Verschoor (2006a), Jong, Ligterink, and Macrae (2006), and Bartram, Brown and Minton (2007) among others for studies in an international context.
[3] E.g. Jong, Ligterink and Macrae (2006) on the choice between a trade-weighted index or bilateral exchange rates; Doukas, Hall and Lang (2003) on the choice of time period; and Pritamani, Shome and Singal (2004) on the choice of market portfolio.

reflect a number of realities between two extremes – one extreme being that the firms identified using monthly data are exactly the same as the firms identified using weekly data and the other extreme being that there is no overlap what so ever. The main interest of a stock picker, an analyst following a given firm, and a corporate manager searching for the optimal hedge is to know how sensitive – and thus how reliable – the detection of an exchange rate exposure for a *given* firm is to changes in methodological choices. This latter orientation is the main motivation for the present study and the lack of literature focusing on this subject is the raison d'être.

More specifically, we empirically investigate the sensitivity of detected exchange rate exposures at the firm-specific level for a sample of 157 non-financial firms in Scandinavia[4]. As a positive side effect, the study also replicates other studies at the aggregate level on the quantification of foreign exchange rate exposures using data for corporate Scandinavia.

The Scandinavian countries are small open economies with a considerable exporting activity. While the Swedish krona (SEK) and the Norwegian krone (NOK) are freely floating, the Danish krone (DKK) is pegged to the Euro (EUR). The relationship between the Scandinavian stock markets and exchange rate changes has not been extensively analysed in the past. The aggregate results of the study show that one of four firms has a significant exposure to a national trade-weighted exchange rate index while one of two firms has a significant exposure to one or more bilateral exchange rates

[4] Scandinavia is defined as Sweden, Norway, and Denmark. Some definitions of Scandinavia include Iceland and Finland. We use the narrow definition of Scandinavia in accordance with e.g. Encyclopaedia Britannica.

The Swedish firm, Rottneros AB, is a leading specialist in the development and production of paper pulp. Rottneros AB states in its annual report 2006 that "The risks that have the greatest impact on the Group's earnings are associated with exchange rates, pulp prices and electricity" and it categorizes the sensitivity of its annual result after net financial items to changes in the US dollar exchange rate as being "High". Rottneros AB is listed on the OMX Nordic Exchange in Stockholm. Frontline Ltd is a tanker company listed at the Oslo Stock Exchange. In its annual report 2006, Fronline states that "The majority of our transactions, assets and liabilities are denominated in US dollars, our functional currency." Monberg & Thorsen A/S is a Danish building and civil engineering firm also involved in products for wood care. Monberg & Thorsen states in its annual report 2006 that "The Monberg & Thorsen Group's main financial risks can be divided into currency risk and interest rate risk…. The Group aims to avoid major losses on exchange rate fluctuations. Both realised and budgeted positions are hedged, although depending on the reliability of the budgets." Monberg & Thorsen is listed at the Copenhagen Stock Exchange. These three short excerpts from annual accounts of three Scandinavian firms highlight the importance of investigating whether investors, analysts, and firm managers can use the stock market to detect firms' exposure to fluctuations in exchange rates at the firm-specific level.

The results of the study show that the detection of exchange rate exposures at the firm-specific level is highly sensitive to methodological choices in relation to observation frequency and the specification of the market portfolio. The results put a serious question mark on the validity of the stock market approach for the detection of exchange rate exposures at the disaggregated, firm-specific level. The results of the study are important because corporate managers, stock analysts and stock pickers are primarily interested in the sensitivity – and thus reliability – of detected exchange rate exposures for a

specific firm rather than for an industry or a country as a whole. To the best of our knowledge this is a concern that has not been addressed in the previous literature.

More specifically we find that only one of five detected exchange rate exposures is confirmed at the firm-specific level when we move from an approach using weekly data to an approach using monthly data. This result is surprising for two reasons. First, the aggregate result shows that the number of detected exposures using monthly data is approximately two thirds of the number of detected exposures using weekly data. At the aggregate level (as opposed to the firm-specific level; that is we do not consider which exposures and firms lay behind the aggregate numbers) this corresponds to a defection rate of one third. That is, on the aggregate level one third of the number of detected exposures using weekly data cannot be confirmed when we move to the alternative methodological approach of monthly data. An aggregate defection rate of one third does not justify a firm-specific defection rate of four fifths. Second, there is no economic rationale that the detected exposures at the firm-specific level should change when going from the use of weekly data to the use of monthly data.

In relation to a change in the choice of market index, we find that one of two detected exposures is confirmed by all variations of market indexes applied. Although the choice of market index involves a high defection rate this is at least partly in accordance with economic rationale since we are dealing with *extra-market* exchange rate exposures. Both in relation to observation frequency and market index we find that our results are robust and not unduly dominated by a specific direction, geographical area / currency regime, time period, or significance level.

The paper is organized as follows. The following section reviews the empirical literature on exchange rate exposure quantification using the stock market approach and shows the diversity of research set-ups. Section 3 states the methodology of the study including the sample selection procedure. Section 4 reports descriptive statistics and correlation coefficients. Section 5 provides the empirical results and section 6 analyzes the robustness of these results. Section 7 concludes.

2. Review of Empirical Literature

Using the stock market approach to measure exchange rate exposure was first mentioned by Dumas (1978) and Adler and Dumas (1984). They argued that hitherto, the research on corporate exposure to exchange rate volatility had been based on the firm and its managers. Instead, Adler and Dumas (1984) proposed an alternative perspective which was adjusted to the interest of both stockholders and analysts. Risk and uncertainty is a question concerning randomness or unexpected exchange rate fluctuations; currency risk is not exposure, rather it is the probability that the current domestic purchasing power of the domestic or the foreign currency will differ from its anticipated value at a specific point in the future. Currency exposure on the other hand is defined as what one has at risk. Levi (1990) proposed a principally different view on exposure. He focused on the unpredictability of the value of assets, liabilities and operational incomes due to uncertainty in exchange rates, not on the uncertainty of the exchange rates themselves. This implies that the exchange risk depends on both the exposure and the variation in the exchange rate. After Adler and Dumas (1984), several studies have experimented with sample and model design regarding variable definitions, model specifications, robustness tests and exchange rate index versus bilateral currencies.

The following review of the empirical research on exchange rate exposure is included 1) to show how the aggregate results on corporate Scandinavia fits into the existing empirical literature and 2) to show the diversity of research approaches. The diversity of research approaches emphasizes the need to investigate the sensitivity of exchange rate exposures to methodological choices. The review of the empirical research is divided into studies focusing on US firms and studies focusing beyond the US

US evidence

Estimating the exchange rate exposure began with rather simple models where US firm's stock returns were regressed on the market return and the exchange rate return. In order to investigate the exposure of US multinationals to foreign exchange fluctuations between 1971 and 1987, Jorion (1990) performed a cross-sectional analysis using monthly data. This pioneer study reported an insignificant relationship at the five percent confidence level between the firm value of 287 firms and exchange rate movements. Additionally, Jorion focused on the determinants of the exchange rate exposure where firms with a larger percentage of foreign operations experienced a positive but small correlation between the stock return and the value of the US dollar. In a subsequent paper, Jorion (1991) also presented insignificant exposure for 20 value-weighted industry portfolios.

Amihud (1994) examined the effect of exchange rate changes on 32 US exporting firms' values between 1982 and 1988. Amihud estimated the relative monthly changes in an exchange rate index of fifteen currencies against the US dollar on the equally-weighted return of a portfolio of American

exporting firms and controlled for the return on an equally-weighted market portfolio. The estimation results on the effect of firm value from both nominal and real exchange rate changes were insignificantly different from zero.

Choi and Prasad (1995) found some significant correlations between the values of 409 US firms and exchange rate fluctuations from 1978 to 1989 using monthly data. Choi and Prasad investigated cross-sectional differences in order to link the sensitivity of exchange rate volatility to firm-specific operational variables. The underlying argumentation was that the exchange rate risk factor may not have the same implication for all firms. Instead, the sensitivity depends on the operating profile, the financial strategies and other firm-specific variables. As a consequence, Choi and Prasad suggested that a firm-level based study might be more appropriate since an aggregate-level analysis might not reveal the true exchange rate risk on firm value. In order to avoid an aggregating effect, Choi and Prasad chose to estimate a model of firm valuation under exchange rate exposure built on individual firm characteristics. They found that there was a significant relationship between firm value on both real and nominal exchange rates with varying effects in terms of degree and direction. Choi and Prasad divided their sample into industry portfolios. Consistent with prior conclusions, few industry portfolios had a significant exchange rate exposure as firms within a specific industry group did not necessarily have homogenous operational characteristics or financial strategies.

Pritamani et al. (2004) proposed a dual-effect hypothesis in order to explain the previous insignificant total exchange rate exposure. According to this hypothesis, firms are affected by both domestic and foreign markets which partially are offsetting for exporters and additive for importers. In accordance with this dual-effect hypothesis, Pritamani et al. predicted insignificant total exposure for exporting

firms and positive total exposure for importing firms. Consistent with this hypothesis, Pritamani et al. reported an insignificant total exposure for exporters and a positive significant total exposure for importers using monthly data. In order to correct for biases in the residual exposure estimates caused by the choice of a value-weighted market index as control portfolio, Pritamani et al. proposed an equally-weighted market index of domestic firms. This introduction gave a negative significant exposure for exporters and a positive significant exposure for importers.

Bartram (2007) estimates the foreign exchange rate exposures of US non-financial firms on the basis of stock prices as well as on the basis of cash flows using differing observation frequencies. Bartram finds that several firms are exposed to bilateral exchanges. Most importantly, Bartram finds that the impact of exchange rates changes on stock prices and on cash flows is similar and determined by many of the same economic factors.

Non-US evidence

Bodnar and Gentry (1993), composed industry portfolios in order to find exchange rate exposure for Canadian, Japanese and US firms. Bodnar and Gentry found similar results for all three countries, between 20 and 35 percent of the industries had a statistically significant exchange rate exposure using monthly data. Furthermore, the impact of exchange rate fluctuations was larger for Canada and Japan than for the US

One of the first purely non-US empirical studies on foreign exchange exposure was performed by He and Ng (1998). They argued that the weak US evidence motivated further investigation based on non-US international data. He and Ng found that one fourth of their sample of 171 Japanese multinationals experienced a significant positive exposure effect between 1979 and 1993 using monthly data.

Based on monthly data for 11 industrialized countries for the period between 1973 and 1996, Friberg and Nydahl (1999) found that the more open economy, the stronger is the positive correlation between stock returns and exchange rate changes. Firms in more open economies than the US would on average tend to be more sensitive to international conditions and this could be one explanation why the empirical work from the US had failed to find a significant relationship between exchange rate changes and firm value.

Nydahl (1999) investigated the effects of exchange rate fluctuations on firm value on a sample of 47 Swedish firms between 1990 and 1997 using weekly returns and found a significant relation. Instead of trade-weighted exchange rate indices, Nydahl used single currencies to capture currency movements. Nydahl chose currencies based on the share of the Swedish export market, the share of foreign direct investment and the invoicing currency.

Ihrig (2001) examined the exchange rate exposure of multinationals and constructed a firm-specific exchange rate index by using the number and location of each subsidiary for each firm. The basic Jorion (1990) model was adapted to incorporate firm-specific exchange rates into the analysis and after this correction the amount of firms with a significant exchange rate exposure increased. Ihrig found that

25 percent of 226 multinationals had a significant exchange rate exposure between 1995 and 1999 using monthly data.

Griffin and Stulz (2001) examined the importance of exchange rate changes and industry competition for stock returns between 1975 and 1997 in the US, the UK, Canada, France, Germany and Japan using weekly data. They found that foreign exchange rate volatility was of little economic importance to the relative performance of US industries and small in countries where international trade is more important. The usage of industry portfolio returns is questioned by Allayannis (1997), who showed that aggregation reduces the statistical significance of the results. Similarly, Choi and Prasad (1995), Nydahl (1999) and Ihrig (2001) emphasized that the level of exposure decreases on a portfolio level compared to a firm level.

Doukas et al. (2003) examined the relation between stock returns and unanticipated exchange rate changes at the Japanese market using monthly data and found a significant relationship; 1079 firms in 25 industries between 1975 and 1995 were examined. Multinationals and firms with higher ratios of export to sales had larger exposures than domestic firms and firms with lower export to sales ratio.

Since the weak US evidence warranted additional non-US investigation on individual firms with a substantial international trade, Muller and Verschoor (2006a) constructed a sample of 817 European multinational firms and found an economically significant exposure effect to the Japanese yen, to the US dollar and to the Great British pound between 1988 and 2002 using weekly data. Muller and Verschoor argued that the European market is of large interest and is particularly suitable since it is a very open and active economy. They conducted a firm level analysis within different industries to

avoid the averaging effect; firms in these industry groups had both positive and negative exchange rate exposure which suggested that exposure did not have to be economically significant on an aggregated basis.

Jong et al (2006) examined a sample of 47 Dutch firms from 1994 to 1998 and found that over 50 percent of the firms were exposed to exchange rate changes using bi-weekly data. All firms benefited from a deprecation of the domestic currency which confirms that firms in open economies have a significant exchange rate exposure.

Finally, Makar and Huffman (2008) investigated the exchange rate exposure of 44 UK multinationals using monthly returns for the period 1999-2002. They found that more firms are significantly exposed to exchange rate changes when using firm-specific currency data as opposed to a broader exchange rate index.

3. Methodology of Study

The intention with the methodology section is to create a valid model to measure the relationship between stock returns and exchange rate movements and to test our two primary focus points: the sensitivity of our results to a change in observation frequency and to a change in market index. The methodology section also describes the sample selection procedure.

Stock Market Approach

The study is based on the stock market approach. This approach is a flexible and forward looking approach which is directed towards the overall understanding of the impact of exchange rate changes on firm value. The choice of the stock market approach is made in spite of the fact that the theoretical risk management literature focuses on the impact of exchange rates on corporate cash flows rather than on stock prices – e.g. the financial distress motive as argued by Smith and Stulz (1985) and the underinvestment motive as argued by Froot, Scharfstein, and Stein (1993). The reason why we choose the stock market approach is the same reason that lays behind the overwhelming empirical use of the stock market approach and the very limited empirical use of the cash flow approach[5] for exchange rate exposure detection: the abundance of relevant stock price data and the scarcity of relevant cash flow data (Bodnar and Wong, 2003). Furthermore, since a stock price is the discounted value of future cash flows, changes in stock prices may serve as a proxy for changes in cash flows. Thus, Bartram (2007) finds empirically that "the impact of exchange rate risk on stock prices and cash flows is similar and determined by a related set of economic factors".

Adler and Dumas (1984) argued that exposure is preferable to measure in a regression analysis where the exchange rate exposure is defined as the effect of exchange rate changes on the value of a firm. Depending on the correlation between the exchange rate and the price of an asset, the exposure can be negative, positive or even zero. Levi (1990) proposes a regression equation where the total exchange

[5] For examples of the very scarce use of the cash flow approach for exchange rate exposure quantification please refer to Garner and Shapiro (1984), Oxelheim and Whilborg (1995), and Brown (2001). All these studies are restricted to the analysis of a single firm.

rate exposure is the slope of the univariate regression equation shown below which relates the real asset's value to unanticipated changes in the exchange rate;

$$R_{it} = \alpha_i + \beta_{FXi}R_{FXt} + \varepsilon_{it} i = 1,\ldots,N \qquad t = 1,\ldots, T \tag{1}$$

In the above equation, R_{it} is the rate of return for stock i at time t and α_i is a constant. β_{FXi} is the regression coefficient which describes the systematic relation between R_{it} and R_{FXt}, the exchange rate exposure, at time t. R_{FXt} is the rate of return on the exchange rate in question at time t and ε_{it}, is the random error at time t. Jorion (1990) estimated the exposure coefficient with the same time series regression as in equation (1), with the exception that R_{FXt} is the rate of change in a trade-weighted exchange rate index (TWI). An index avoids the problem of multicollinearity when separate, but positively correlated, bilateral exchanges rates are used in the regression.

Adler and Dumas (1984) and Jorion (1990) suggested the following two-factor model as an alternative specification to the univariate time series regression (1):

$$R_{it} = \alpha_i + \beta_{Mi}R_{Mt} + \beta_{FXi}R_{FXt} + \varepsilon_{it}, \qquad i = 1,\ldots,N \qquad t = 1,\ldots, T \tag{2}$$

To control for market movements, R_{Mt}, the return on a market portfolio is included. R_{FXt} is the return on one unit of a trade-weighted basket of foreign currencies to the local currency conditioned on R_{Mt}. β_{Mi} is a measure of market risk and β_{FXi} is the exchange rate exposure. Including the return on a market portfolio is an additional explanatory variable to improve the power and precision of the estimations. Furthermore, it isolates the firm-specific cash flow exposure since it implicitly controls for

macroeconomic factors. Hence, β_{FXi} measures the residual exposure, or the deviation from the market exposure. A zero exposure does therefore not imply that the firm is unaffected by exchange rate movements, it rather means that the firm value reacts to the same degree as the market portfolio. Bodnar and Wong (2000) demonstrate that the inclusion of a market portfolio in the model specification has a significant impact on the estimated exposure.

The trade-weighted exchange rate index (TWI) is a method of measuring the value of the specific currency against a basket of other currencies. It is hence the nominal effective exchange rate, computed as a geometric index where the weights represent each country's proportion of the total trade with the country in question. An increase in the index means a depreciation of the domestic currency and a decrease in the index implies an appreciation of the domestic currency.

A widely held opinion among researchers is the limited usefulness of a trade-weighted exchange rate index (TWI). Muller and Verschoor (2006a) argue that most exchange rate indices tend to average out the competitive effects from bilateral exchange rate fluctuations. Therefore, a weighted index may underestimate the corporate exposure by excluding variables that capture the deviating movements among different exchange rates. Nydahl (1999) emphasises that a firm can be exposed to a single currency and concurrently be unaffected by the movements in the trade-weighted exchange rate index (TWI). Williamson (2001) calls attention to the fact that the use of a trade-weighted exchange rate index (TWI) may lack power if a specific firm only is exposed to a few currencies and not the index. The results from Jong et al (2006) indicate that the use of a trade-weighted exchange rate index (TWI) and the use of bilateral currencies are complements. This study will use both measures.

Consequently, when the firm value may be influenced by several foreign currencies, a multiple regression can be used;

$$R_{it} = \alpha_i + \beta_{Mi}R_{Mt} + \beta_{FX1}R_{FX1t} + \beta_{FX2}R_{FX2t} + \ldots + \beta_{FXni}R_{FXnt} + \varepsilon_{it}, \quad (3)$$

where the different β_{FXn} gives the sensitivity to unanticipated changes in the specific exchange rates. Equation (2) is used to test the null hypothesis that fluctuations in the trade-weighted exchange rate index (TWI) have no effect on firm value and Equation (3) is used to test the null hypothesis that fluctuations in one ore more of the bilateral exchange rates with the largest weights in the trade-weighted exchange rate index (TWI) have no effect on firm value.

Sample Firms and Data

This study investigates the exchange rate exposure of all Scandinavian non-financial firms listed on their respective domestic stock markets.[6] The period investigated covers eight years, from January 1999 to December 2006. There are three main reasons for limiting the time horizon to 1999 to 2006. Firstly, the Euro was introduced in 1999 and to facilitate comparability, the focus is on the period after the introduction. Secondly, the possible time varying nature of exchange rate exposure may lead to biases when the sample period is extended over longer periods. Thirdly, taking a recent time period facilitates a current and contemporary picture of the exchange rate exposure of corporate Scandinavia.

[6] The domestic stock markets in question are Stockholm Stock Exchange, Oslo Stock Exchange and Copenhagen Stock Exchange. The Stockholm Stock Exchange and Copenhagen Stock Exchange are today a part of the OMX Nordic Exchange.

The sample firms are restricted to firms that have been active and quoted on the stock exchange in question during the whole period from 1999 to 2006. The choice of only active firms during the whole sample period may introduce survivorship bias. However, given the fact that exchange rate risk for the majority of firms is only a (minor) risk among a lot of risk factors facing the non-financial firm, it is not likely that implications from the exchange rate exposure have had a markedly connection with the delisting of a firm. The sample of firms is further restricted to firms with total sales of at least 100 million Euro according to the Amadeus database[7]. All other information was collected from Thompson Datastream database. The total sample consists of 157 Scandinavian, listed, non-financial firms with total sales of at least 100 million Euro.

According to Bodnar and Wong (2000) and Muller and Verschoor (2006b), the efficient market theory suggests that the exchange rate exposure should be independent of the observation frequency and the return horizon. However, both market inefficiencies and the complex relationship between exchange rate movements and the value of the firm will influence the estimated exposure coefficient. The most commonly used observation frequency of the stock return data has been monthly frequency.[8] Bodnar and Wong (2000) explain this tendency with the common practice in asset pricing literature which uses monthly data. However, the optimal observation frequency has been heavily discussed. Iorio and Faff (2000) concluded that the use of daily data is significantly stronger than the use of monthly data. Chow et al (1997) was of a contradictory opinion, they argued that a longer return horizon is appropriate since daily data introduces too much noise relative to low frequency data. However, Bodnar and Wong (2000) found that the lengthening of the return horizon had minimal impact on the exposure estimates.

[7] Amadeus is a comprehensive, pan-European database containing financial information on approaching nine million public and private companies in 38 European countries.
[8] See for example Jorion (1990), Choi and Presad (1995), He and Ng (1998), Ihrig (2001) and Doukas et al (2003).

As in Jong et al (2006), both weekly and monthly data will be used in this study. This choice is made in order to avoid the noise in daily series and non-synchronous trading and in order to avoid few data if extending the observation frequency to more than a month. The weekly returns are calculated from Wednesday to Wednesday in order to prevent end-of-the-week-effect. To circumvent the end-of-the-month effects, data from the 15th day of each month is used (consistent with Williamson, 2001). The total number of monthly observations for each firm are 96, the corresponding number with weekly observations are 416.

As is common in studies on exchange rate exposure, a market index is added to reduce omitted variable bias. Priestley and Odegaard (2004) argue that the inclusion of an additional risk factor is important since it controls for general macroeconomic effects. The resultant conditional exposure estimate, the residual exposure, is hence more stable across horizons and sub-periods according to Bodnar and Wong (2000). However, some essential implications and different aspects of the choice of market index exist. The main aspects are the alternative between a value-weighted or an equally-weighted market portfolio and the choice between a world market portfolio and a domestic market portfolio. Bodnar and Wong (2000 and 2003) confirm that the definition of the stock market risk factor has implications for the estimation of exchange rate exposure. As it is unlikely that the market portfolio has a zero-exposure to exchange rates, the choice of which market portfolio to include in the regression impacts the magnitude and interpretation of the exposure estimates. Muller and Verschoor (2006b) note that the specification of the market risk factor has direct implications on sign, magnitude and significance of the estimated exposure.

A value-weighted portfolio is likely to be dominated by large multinational firms and export-oriented firms which will induce a bias in exposure coefficients. An alternative is the use of an equally-weighted market portfolio as recommended by Bodnar and Wong (2003). In this study, the local equally-weighted market portfolio (OMXS Eq, OMXC Eq, and OSEAX Eq for Swedish, Danish and Norwegian firms respectively) and the local value-weighted market portfolio (OMXS Va, OMXC Va, and OSEAX Va for Swedish, Danish and Norwegian firms respectively) will be applied.[9]

As noted above, the second important aspect regarding market portfolios is the choice between a world market portfolio and a domestic market portfolio. The literature on international asset pricing in the presence of segmented markets is not definitive on whether expected returns on stocks in a given country are driven by the betas with respect to world market portfolio or driven by the betas with respect to the domestic market portfolio. If there are no barriers – whether economical, psychological, cultural, etc. - to international investments, it would seem artificial to restrict the relevant portfolio to a subset (the domestic market portfolio) of the world market portfolio. However, Stulz (1981) argues that the reality lie in the grey area between complete segmentation and no segmentation at all. Models that assume no barriers to international investments fail to explain why investors tend to hold more domestic securities than would be required if they held the world market portfolio. This home country bias is empirically documented by e.g. Lewis (1995 and 1999) and a survey of the literature is given by Karolyi and Stulz (2002).

[9] The value-weighted index data was obtained from Thompson Datastream. The equally-weighted index data was calculated from collecting data for all stock prices on the market in question and thereafter computing the returns, both on a weekly and a monthly basis. The stocks were given an equal weight in calculation of the market return.

Following Sharpe (1964), levels of expected stock returns should vary in accordance with the levels of firm exposure to systematic risk. Thus, Chari and Henry (2004) argue that the relevant source of systematic risk for pricing stocks in a liberalized stock market should be the world stock market index as opposed to a local stock market index. Based on a number of stock market liberalizations in primarily South America and Asia, they empirically support the argument. Nydahl (1999) argues that a world market portfolio is more appropriate than a domestic market portfolio when the local stock market represents only a small fraction of the global market capitalization and foreign investors have full access to the local stock market.[10] Investigating the effects of exchange rate fluctuations on firm value on a sample of Swedish firms, Nydahl applies both a domestic and a world market portfolio but does not find that altering the reference market portfolio changes the exposure coefficients in a significant way. In a Finnish setting, Hietala (1989) shows how segmentation makes the international as well as the domestic beta of a stock relevant in determining cross-sectional differences in the price premium.

For some of the latest evidence, Sorensen, Wu, Yosha, and Zhu (2007) find that the home country bias in equity holdings declined during the period 1993-2003 in the OECD area. Specifically for Sweden, Denmark and Norway the decline was from 0.85 to 0.58, from 0.83 to 0.63, and from 0.83 to 0.48 respectively where 1.00 resembles full home bias (no foreign equity in portfolio) and 0.00 resembles no home bias (domestic equity in portfolio = domestic stock market capitalization / world stock market capitalization). Thus, although the home country bias has declined in Scandinavia, it is far for gone.

[10] This justifies to some extent why US studies use the domestic market index since the US market constitutes a large fraction of the global market.

In this study we include domestic market indices in line with previous studies together with the Morgan Stanley Capital International Europe price index, MSCI Europe, as a proxy for a more international market portfolio. We apply two versions of the MSCI Europe index, one measured in Euro (MSCI Europe (EUR)) and another measured in local currency (MSCI Europe (SEK), MSCI Europe (DKK), and MSCI Europe (NOK) for Swedish, Danish and Norwegian firms respectively)[11].

The Swedish krona and the Norwegian krone are both small, freely floating currencies while the Danish krone is pegged to the Euro.[12] The nominal exchange rate variables in this study are the values of the Swedish, Norwegian and Danish currencies per unit of the foreign currency respectively. Foreign currency is either a single currency or a trade-weighted basket of currencies. Nydahl (1999) argues that using nominal exchange rates is appropriate for low inflation countries because of the high correlation between nominal and real exchange rates. Furthermore, nominal data is more easily available than real data for all variables in the regressions. Bodnar and Gentry (1993), Amihud (1994), Choi and Prasad (1995) and Griffin and Stulz (2001) all argue that the use of real versus nominal exchange rates has a negligible effect on exposure estimates.

[11] The MSCI Europe index is measured in EUR. In a situation where investors are investing in e.g. a Swedish firm in order to get a future cash flow stream not only denominated in SEK but actually born in SEK (referring to the academic literature on functional currency and currency habitat), it makes sense to measure the index in EUR as done above. In such a situation the investment outlay as well as the corresponding future cash flow stream is born in SEK and should not be (too) affected by the SEK per EUR exchange rate. E.g. a general downturn in global consumer confidence should hit the Swedish stock market and the European stock market equally hard and (almost) independent of the development of the SEK per EUR exchange rate. Likewise, a change in the SEK per EUR exchange rate should by itself not affect the Swedish stock market (too much). However, if we go to the other extreme where firms and investors are truly international, one may argue that the index should be measured in the local currency (SEK, NOK, and DKK respectively). If two firms are more or less identical in terms of their geographical distribution of markets and production facilities and in terms of their financial structure and thus also in terms of their expected future cash flow streams, the price of these two firms should be identical no matter if this price is measured in SEK or in EUR. Furthermore, the price of these two firms should stay identical after a change in the SEK per EUR exchange rate. It is difficult to see why the coincidence that these two firms (e.g. for historical reasons) are listed at the Swedish and e.g. the German stock market respectively should mean that the price of these firms could differ. If a price difference occurred, an international investor would realize that two prices existed for the same future cash flow stream and he / she would act accordingly and ultimately eliminate the price difference. We use the MSCI Europe index measured in EUR and measured in local currencies.

[12] For more information regarding the Danish foreign exchange policy please refer to www.nationalbanken.dk.

The trade-weighted exchange rate indexes (TWI) are obtained from the Swedish, Danish and Norwegian Central Bank respectively. Bilateral exchange rates are provided from the Thompson Datastream database. The choice of different bilateral exchange rates for all firms is based on the weights in the trade-weighted exchange rate index for each country respectively. The five exchange rates with the largest weights for each country are selected[13].

4. Descriptive Statistics

Table 1 and Table 2 report descriptive statistics in levels (Table 1) and differences (Table 2) for trade-weighted exchange rate indexes (TWI), bilateral exchange rates, and stock indexes for the period from 1999 to 2006 for weekly observations. For the sake of brevity only descriptive statistics for weekly data (excluding monthly data) are reported in Table 1 and Table 2.

* Table 1 approximately here *

* Table 2 approximately here *

From the trade-weighted exchange rate indexes (TWI) in the tables we can see that the Swedish krona (SEK) and the Norwegian krone (NOK) has experienced an appreciation during the period from 1999

[13] The main trading partners of Sweden are Germany (22%), the US (12%), UK (12%), France (7%), Finland (7%), Italy (6%), Denmark (6%), and Norway 6%) leading to EUR, USD, GBP, DKK and NOK being the most significant currencies (Germany, France, Finland and Italy have all adopted the Euro). The main trading partners of Norway are Sweden (20%), Germany (15%), UK (12%), Denmark (8%), and the US (7%) leading to SEK, EUR, GBP, DKK and USD being the most significant currencies. The main trading partners of Denmark are Germany (21%), UK (10%), Sweden (9%), the US (9%), France (7%), Netherlands (5%), Italy (5%), Belgium (4%) and Japan (4%) leading to EUR, GBP, SEK, USD, and JPY being the most significant currencies (Germany, France, Netherlands, Italy, and Belgium have all adopted the Euro).

to 2006 while the Danish krone (DKK) has been more stable towards the currencies of its major trading partners. Looking at the bilateral exchange rates, we can see that all three currencies have appreciated towards the US dollar (USD) while the Swedish krona and the Norwegian krone have also gained strength towards the Euro and the Danish krone. Finally, the Danish krone has appreciated towards the Japanese yen (JPY) and depreciated towards the Great British pound (GBP).

In terms of volatility, Denmark has experienced the least volatile trade-weighted exchange rate index (TWI) due to its peg to the Euro and Germany being its major trading partner. In terms of bilateral exchange rates, we can see that the volatility of the exchange rate between the Danish krone and the Euro is almost non-existing. All three Scandinavian currencies have experienced a high volatility towards the US dollar.

In relation to the stock indexes, we can see that the Scandinavian stock indexes have generally outperformed the MSCI Europe index in the investigated period. In terms of volatility, there does not seem to be markedly differences among the stock markets (except the low volatility of the equally-weighted Danish stock index).

Table 2 shows that most of the variables are far from being normally distributed. Only in a few cases involving returns on bilateral exchange rates towards the US dollar and the UK pound, the Jarque-Bera test fails to disqualify a standard Gaussian distribution. While the returns on the trade-weighted exchange rate indexes (TWI) and the bilateral exchanges rates have mixed signs in term of skewness, the returns of the stock indexes are consistently skewed to the left with the median higher than the mean and a higher likelihood of large negative returns than large positive returns. The excess kurtosis

shows that the returns of the trade-weighted exchange rate indexes (TWI) and the bilateral exchanges rates tend to be leptokurtic (or mesokurtic) while the returns of the stock indexes are consistently leptokurtic.

Table 3 reports correlation coefficients for differences (dlog) using weekly data for trade-weighted exchange rate indexes (TWI), the five most important bilateral exchange rates for each country, and stock indexes. For the sake of brevity only correlation coefficients for weekly data (excluding monthly data) are reported in Table 3.

* Table 3 approximately here *

Table 3 shows a number of high correlation coefficients between various bilateral exchange rates which may create multicollinearity problems in subsequent regression analysis. This is one of the arguments for using the trade-weighted exchange rate index (TWI). The correlation coefficients between the trade-weighted exchange rate indexes (TWI) and the bilateral exchange rates and the correlation coefficients between the various stock market measures are at times very high. However, this does not pose a problem in relation to our subsequent regression analyses since we 1) use either the trade-weighted exchange rate index (TWI) *or* bilateral exchange rates and 2) use only one measure of the stock market index in each regression analysis.

The high correlation between the SEK per DKK exchange rate and the SEK per EUR exchange rate (0.93) and the high correlation between the NOK per DKK exchange rate and the NOK per EUR exchange rate (0.97) do pose a problem. These high correlation coefficients are caused by the Danish

krone's peg to the Euro as also illustrated by the before mentioned almost non-existing volatility in the DKK per EUR exchange rate (Table 2) and force us to remove the SEK per DKK exchange rate and the NOK per DKK exchange rate from subsequent regression analysis. As a consequence, the number of exchange rates in the regression analyses for Swedish and Norwegian firms is reduced from five exchange rates to four exchange rates. The SEK per EUR exchange rate used in the regression analysis for Swedish firms and the NOK per EUR exchange rate used in the regression analysis for Norwegian firms thus effectively also incorporates the effects from the SEK per DKK exchange rate and the NOK per DKK exchange rate respectively.

For all three national markets, Table 3 shows that the correlations between returns on the value-weighted national stock market indexes and returns on MSCI Europe exceed the correlations between the equally-weighted national stock market indexes and returns on MSCI Europe. This makes intuitive sense since a value-weighted stock market index tend to be dominated by large multinational firms that are more likely to be affected by international market movements than smaller and more domestically oriented firms.

5. Empirical Results

Table 4 reports detected exposures and firms with/without detected exposures using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006 (8 years). Detected exposures and firms with/without detected exposures are reported using weekly data (Panel A) and monthly data (Panel B).

* Table 4 approximately here *

A total of 352 exposures to changes in exchange rates are detected at the 5 percent significance level using weekly data (Table 4, Panel A). These 352 exposures consist of 105 exposures towards the trade-weighted exchange rate index (TWI) and 247 exposures towards a bilateral exchange rate. On average 88 exposures to changes in exchange rates are detected for each of the four alternative specifications of the market portfolio - 26 exposures towards the trade-weighted exchange rate index (TWI) and 62 exposures towards a bilateral exchange rate.

Using weekly data (Table 4, Panel A) a total of 101 firms out of 157 firms (64%) have some kind of exposure to changes in the trade-weighted exchange rate index (TWI) and/or to changes in one or more bilateral exchange rates. These firms have detected exposures in the range of one to ten exposures. The remaining 56 firms (36%) have no detected exposures what so ever. A total of 58 firms out of the 157 firms (37%) are exposed to changes in the trade-weighted exchange rate index (TWI) and a total of 91 firms (58%) are exposed to changes in one or more bilateral exchange rates. A total of 48 firms (58+91-101=48) are exposed to changes in the trade-weighted exchange rate index (TWI) as well as to changes in one or more bilateral exchange rates. The higher number of firms exposed to changes in bilateral exchange rates compared to the number of firms exposed to changes in the trade-weighted index is in line with theoretical arguments and empirical findings in the literature (e.g. Williamson, 2001, and Muller and Verschoor, 2006a).

Using monthly data (Table 4, Panel B) we find a total of 224 exposures to changes in exchange rates at the 5 percent significance level consisting of 45 exposures towards the trade-weighted exchange rate index (TWI) and 179 exposures towards a bilateral exchange rate. On average 56 exposures to changes in exchange rates are detected for each of the four alternative specifications of the market portfolio - 11 exposures towards the trade-weighted exchange rate index (TWI) and 45 exposures towards a bilateral exchange rate. A total of 67 firms out of 157 firms (43%) have some kind of exposure to changes in the trade-weighted exchange rate index (TWI) and/or to changes in one or more bilateral exchange rates. These firms have detected exposures in the range of one to nine exposures. The remaining 90 firms (57%) have no detected exposures what so ever. A total of 22 firms out of the 157 firms (14%) are exposed to changes in the trade-weighted exchange rate index (TWI) and a total of 57 firms (36%) are exposed to changes in one or more bilateral exchange rates. A total of 12 firms (22+57-67=12) are exposed to changes in the trade-weighted exchange rate index (TWI) as well as to changes in one or more bilateral exchange rates.

Table 4 shows the familiar statistical pattern (but without economic rationale) that the number of detected exposures generally declines when going from the use of weekly data to the use of monthly data. The relationship between detected exposures using monthly data and detected exposures using weekly data is 224 to 352 (64%) for all exposures taken together, 45 to 105 (43%) for the trade-weighted index and 179 to 248 (72%) for bilateral exchange rates. The corresponding numbers for exposed firms are 67 to 101 (66%) for all exposures taken together, 22 to 58 (38%) for the trade-weighted index, and 57 to 91 (63%) for bilateral exchange rates. These are, however, aggregate numbers that do not tell us the firm-specific overlap between the exposures using weekly and monthly data. E.g. the 179 exposures that are detected in relation to bilateral exchange rates using monthly data

could be a perfect subset of the 247 exposures detected using weekly data (one extreme) or a set of exposures with absolutely no overlap with the 247 exposures detected using weekly data (the other extreme). As such, Table 4 represents nothing but a replication of other studies to Scandinavian data. The results of this replication are in line with the empirical non-US evidence or at least not surprising when considering Scandinavia as consisting of three small, open economies (e.g. Nydahl, 1999; Muller and Verschoor, 2006a; Jong et al., 2006). This is, however, not the primary purpose of the present study.

The primary purpose is to investigate to what extent e.g. a corporate manager can rely on the detected exposures using a particular methodology. Or put in another way to what extent the detected exposures for a given firm using one methodology can be confirmed by similar results using another methodology. As previously discussed our focus points in this study are two methodological choices: the choice of observation frequency (weekly versus monthly) and the choice of market index (equally-weighted local market index versus value-weighted local index versus European index in Euro versus European index in local currency).

Table 5 reports detected exposures using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by one or more other indexes and/or another data frequency. Panel A reports an index using weekly data confirmed by the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by other indexes using monthly data. Finally, Panel D reports an equally weighted index using weekly data confirmed by the

same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies).

* Table 5 approximately here *

Table 5, Panel A, reports the exact same numbers of detected exposures using weekly data as was reported in Table 4, Panel A, but now the number of detected exposures that can be confirmed by detected exposures using monthly data is placed below the line in question. Table 5, Panel A, shows that that detected exposures using weekly data are only for a minority of exposures confirmed when using monthly data. The average confirmation rate is a meager 18 percent for exposures in general (ranging from 12% to 32% across the four different market portfolios). This is a combination of 21 percent for exposures towards the trade-weighted index (ranging from 16% to 27%) and 16 percent for exposures towards a bilateral exchange rate (ranging from 10% to 33%). The corresponding defection rate shows that on average approximately four out of five (79% for the trade-weighted index and 84% for the bilateral exchange rates) exposures cannot be confirmed when going from a regression analysis using weekly data to a regression analysis using monthly data. This is in sharp contrast to the relative magnitude of monthly exposures to weekly exposures on the aggregate level in Table 4 which was 64 percent for all exposures (224 to 352), 43 percent for exposures towards the trade-weighted index (45 to 105), and 72 percent for exposures towards bilateral exchange rates (179 to 247). As such, detected exposures using monthly data is far from a perfect subset of the detected exposures using weekly data. In fact, it is rather the exception than the rule that a given exposure detected using monthly data is also an exposure detected using weekly data. Of the 224 detected exposures using monthly data (Table 4, Panel B) only 62 exposures are also detected using weekly data (Table 5, Panel A) – a clear minority.

For the corporate manager trying to quantify the particular exchange rate exposure of a given firm the results are disturbing. Although from a statistical point of view it is not surprising that the number of detected exposures is smaller using monthly data than using weekly data, this does not justify the extremely high defection rate in Panel A. In terms of economic rationale there is no justification.

Table 5, Panel B, show the confirmation and the defection rates using weekly data when applying different market portfolios in the regression analysis. We can see that in general 52 percent of the exposures detected by an equally-weighted local index are confirmed by the three alternative specifications of the market portfolio using weekly data. This is a reflection of 43 percent that is confirmed in relation to the trade-weighted index and 55 percent that is confirmed in relation to bilateral exchange rates. This may resemble a high defection rate but as previously noted this bears some economic rationale since we are dealing with extra-market exchange rate exposures due to our use of a two factor stock market model. Furthermore, the defection rate is not nearly as high as the one observed when going from the use of weekly data to the use of monthly data as illustrated in Panel A.

Table 5, Panel C, show the confirmation and the defection rates using monthly data when applying different market portfolios in the regression analysis. The magnitudes of confirmation and defection rates are in line with the results using weekly data. In general, an exposure that is detected using an equally-weighted market index as the market portfolio is confirmed by regression analysis using the three alternative specifications of the market portfolio for approximately one of two exposures whether we use weekly or monthly data.

Finally, the results of Table 5, Panel D, shows that very few exposures are confirmed if we require the exposures to be statistically significant at the five percent level when using weekly *and* monthly data *and* when using the four alternative market portfolio in our regression analysis. The results are far from encouraging for a corporate manager trying to exploit the knowledge inherent in the stock markets in order to quantify the exchange rate exposure – whether in terms of a trade-weighted exchange rate index (TWI) or bilateral exchange rates.

6. Robustness Considerations

In the previous section we showed that the detection of firm-specific exchange rate exposures using the stock market approach is sensitive to methodological choices. In rough terms we showed that 1) only one out of five exposures is confirmed when going from a regression analysis using weekly data to a regression analysis using monthly data and 2) only every second exposure is confirmed when going from a regression analysis incorporating an equally weighted local market portfolio to regression analyses incorporating three alternative market portfolios. By construction ("extra-market exposure"), the second finding bears some economic rationale while there is no such justification for the first finding.

Before suggesting that the usefulness of the stock market approach is severely restricted for a corporate manager, a stock analyst, and a stock picker interested in identifying and assessing the exchange rate exposures facing a *specific* firm, we elaborate on the robustness of our results. Thus, our results could be driven by a specific direction, a specific geographical area, a specific currency regime, a specific

time period, and/or a specific significance level. In order to investigate whether such concerns are justified, we replicate Table 5 but for only positive exposures (Table 6), for only negative exposures (Table 7), for only Sweden / a floating currency (Table 8), for only Denmark / a pegged currency (Table 9), for only Norway / a floating currency (Table 10), for the sub-period 1999-2002 (Table 11), for the sub-period 2003-2006 (Table 12), and for a significance level of 10 percent (Table 13).

Table 6 and Table 7 are replications of Table 5 for which only detected positive exposures (Table 6) and detected negative exposures (Table 7) are reported. Table 5 showed a total of 352 detected exposures using weekly data. These 352 exposures are divided between 165 positive exposures in Table 6 (47%) and 187 negative exposures in Table 7 (53%). In Panel A of Table 6 and 7, we generally see higher confirmation rates for positive exposures (26%) than for negative exposures (10%). More specifically, the confirmation rate for exposures towards the trade-weighted index is 34 percent for positive exposures but only 11 percent for negative exposures and the confirmation rate for exposures towards bilateral exchange rates is 23 percent for positive exposures and only 9 percent for negative exposures. It seems that our low confirmation rates (and consequently high defection rates) are driven more by negative exposures than by positive exposures. Still, none of the confirmation rates are encouraging in terms of magnitude.

* Table 6 approximately here *

* Table 7 approximately here *

Table 8, Table 9 and Table 10 are replications of Table 5 for which only specific geographical areas (and currency regimes) are included. The total number of detected exposures using weekly data is 352

for our Scandinavian firms (Table 5). We divide these 352 exposures into 177 exposures related to Swedish firms in Table 8 (50%), 104 exposures related to Danish firms in Table 9 (30%), and 71 exposures related to Norwegian firms in Table 10 (20%). Table 8, Table 9, and Table 10 resemble a distribution of the 352 detected exposures across geographical areas but also implicitly across currency regimes. Thus, while Sweden and Norway have freely floating currencies, the Danish krone is pegged to the Euro. Furthermore, Sweden and Denmark are EU members while Norway is not a member of the EU.

The average confirmation rate is within the range of 16 to 20 percent for all national markets as shown in Panel A of Table 8, Table 9, and Table 10. The confirmation rate for exposures towards the trade-weighted index fluctuates more, but the confirmation rate for the bilateral exchange rates is also remarkably constant across geographical areas – 15 percent for Denmark and 17 percent for both Sweden and Norway. While there are differences in Panel B, Panel C, and Panel D of Table 8, Table 9, and Table 10, we can conclude that all in all there is no basis for stating that our general results in Table 5 are driven by a specific geographical area and/or a specific currency regime.

* Table 8 approximately here *

* Table 9 approximately here *

* Table 10 approximately here *

Table 11 and Table 12 are replications of Table 5 for which the time frame of 8 year from 1999 to 2006 (Table 5) is divided into two halves, 1999-2002 (Table 11) and 2003-2006 (Table 12). We see a small decline in the total number of detected exposures using weekly data from 352 in Table 5 to 272 in

Table 11 and to 315 in Table 12. However, if we look at the number of exposures towards bilateral exchange we see a small increase from 247 for the whole period (Table 5) to 249 for the last part of the period (Table 12). The numbers of detected exposures in the two periods (Table 11 and Table 12) generally seem to be of the same magnitude. While the confirmation rates in Panel A are of the same magnitude in the whole period (Table 5) as in the last part of the period (Table 12), the confirmation rates are generally higher in the first part of the period (Table 11). Although detected exposures using weekly data seem to be confirmed by monthly data to a higher extent in the period from 1999 to 2002, the confirmation rates are still low (and the defection rates correspondingly high). The confirmation rates in Panel B, Panel C, and Panel D are not markedly different except that the confirmation rates in Panel D again seem to be a bit higher in the first part of the period. All in all we get no indication that the very high defection rates in Table 5 are unduly restricted to the specific time period.

* Table 11 approximately here *

* Table 12 approximately here *

Finally, as our last robustness consideration we investigate whether our previous conclusions are unduly driven by our chosen significance level of five percent. Table 13 is a replication of Table 5 except that the significance level is now set at ten percent. When we lower the barrier for the statistical significance we automatically expect the number of detected exposures as well as our confirmation rates to increase. Table 5 showed us a total of 352 detected exposures using weekly data while Table 13 shows us a total of 545 detected exposures (an increase of 55%). Our average confirmation rate goes from 18 percent in Table 5 to 23 percent in Table 13. More specifically, our average confirmation rate in relation to exposures to the trade-weighted index goes from 21 percent to 30 percent while our

average confirmation rate in relation to exposures to bilateral exchange rates goes from 16 percent to 20 percent. As expected the number of detected exposures and our confirmation rates increase in Table 13 compared to Table 5 but even in Table 13 with a significance level of 10 percent, the confirmation rates are generally fairly low and the defection rates correspondingly high. Thus, the magnitude of increase in detected exposures and in confirmation rates is not so massive that we see any reason to conclude that the very high defection rates found in Table 5 are unduly linked to the specific significance level of five percent. Panel B, Panel C, and Panel D in Table 13 do not change this conclusion.

* Table 13 approximately here *

Table 14 reports a summary of the defection rates found in the previous tables. Specifically, Table 14 reports the very last line in Panel A, Panel B, Panel C, and Panel D of Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, Table 12, and Table 13 respectively. Furthermore, Table 14 reports a simple average and provides a range of defection rates by reporting a minimum and a maximum defection rate. The most interesting columns are the columns for all exposures, trade-weighted index exposures, and bilateral exposures. The columns for the specific bilateral exchange rate exposures are often distorted by small numbers of defected exposures and thus vulnerable defection rates.

Panel A of Table 14 shows a remarkable small range around a high average defection rate. This is true for exposures towards the trade-weighted index as well as for exposures towards bilateral exchange rates in general. In the latter case, on average four detected exposures towards bilateral exchange rates out of five detected exposures toward bilateral exchange rates (82%) using weekly data cannot be

confirmed by monthly data. The average four out of five defection rate is in a fairly small range of 2 out of 3 (69%) and nine out of ten (91%) in spite of our split into positive / negative, different countries / currency regimes, time periods, and an alternative significance level. Panel B and Panel C of Table 14 are fairly robust in saying that on average one out of two exposures cannot be confirmed with the use of three alternative specifications of the market portfolio. As elaborated upon previously this bears some economic rationale. Panel D of Table 14 resembles the ultimate stress test and shows correspondingly high defection rates.

* Table 14 approximately here *

Our robustness considerations have shown that the high defection rates reported in Table 5 do not seem to be unduly driven by specific directions, specific geographical areas, specific currency regimes, specific time periods, or a specific significance level. On purpose we have employed fairly simple and straightforward regression analyses. Thus, the high defection rates in Table 5 cannot be attributed to a very specific and extreme model set-up that lacks general validity. It seems that the existence of high defection rates is a general phenomenon which puts a serious question mark on the validity of the stock market approach for firm-specific exchange rate exposure identification and assessment. Thus, the short answer to the question: “Can the CFO trust the FX quantification from a stock market approach?” is a “No”.

7. Conclusions

Based on a sample of 157 listed, non-financial firms in Scandinavia and using a traditional two factor stock market approach for exchange rate exposure quantification, this study finds 1) very high defection rates when trying to confirm a detected foreign exchange exposure using weekly data with a detection of the same foreign exchange exposure using monthly data and 2) high defection rates when trying to confirm a detected foreign exchange exposure using an equally-weighted, local stock market index with a detection of the same foreign exchange exposure using alternative market indexes. While the latter finding bears some economic rationale because we are dealing with extra-market exchange rate exposures, the former finding bears no economic rationale and the magnitude of the defection rates cannot be justified by the lower aggregate number of detected exchange rate exposures when using monthly data as opposed to weekly data. The high defection rates seem not to be unduly driven by a specific direction, geographical area / currency regime, time period, or significance level.

For a corporate manager, a stock analyst, an investor, etc. interested in the exchange rate exposures for a particular firm, the findings of this study put a serious question mark on the validity of the stock market approach for such exchange rate exposure quantification. Deliberately we have kept this study to a question of changing two basic and fundamental choices in relation to methodology: the observation frequency and the choice of market index. Thus, the question mark posed on the validity of the stock market approach for exchange rate exposure quantification for a given firm does not rely on obscure assumptions or theoretical thinking beyond the limits of practical, industry relevant reasoning.

Our findings are based on a broad set of large, non-financial firms in Scandinavia. Scandinavia consists of three small, open economies and compared to other more closed economies, we cannot expect to be able to transfer our findings in relation to the aggregate number of detected exposures to more closed economies (as also illustrated in the review of the empirical literature). But on our main focus point - the reliability of detected exchange rate exposures for a given firm - we see no reason that the high defection rates should be a particular Scandinavian phenomenon. Until proven wrong we take the liberty to pose a serious question mark on the validity of the stock market approach for exchange rate exposure quantification for a given firm not only in a Scandinavian context but more generally.

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Table 1 Descriptive Statistics - Levels

This table reports descriptive statistics in levels using weekly data for trade-weighted exchange rate indexes (TWI), the five most important bilateral exchange rates for each country, and stock indexes for the period from the beginning of 1999 to the end of 2006. TWIs and exchange rates are obtained from the Swedish, Danish, and Norwegian central banks. DKK = Danish krone, EUR = Euro, GBP = Great British pound, JPY = Japanese yen, NOK = Norwegian krone, SEK = Swedish krona, USD = US dollar. The value-weighted (Va) local stock indexes are obtained from Thompson Datastream. The equally-weighted (Eq) local stock indexes are calculated from all the stock returns on the specific market giving equal weight to each return (start value put at value-weighted local stock index level). OMXS = Swedish stock market index (S=Stockholm), OMXC = Danish stock market index (C=Copenhagen), OSEAX = Norwegian stock market index (O=Oslo). MSCI Europe is a value-weighted stock index obtained from Thompson Datastream.

	Start	End	Avg.	Max.	Min.	(End-Start) /Start	(Max.-Min.) /Min.
TWI Sweden	130.0	122.6	128.5	146.1	119.5	-6%	22%
TWI Denmark	102.6	102.0	99.6	103.7	93.6	-1%	11%
TWI Norway	108.1	95.4	101.5	110.4	91.5	-12%	21%
SEK per USD	8.02	6.79	8.47	10.88	6.58	-15%	65%
SEK per GBP	13.27	13.39	13.78	15.81	12.66	1%	25%
SEK per EUR	9.31	9.02	9.06	9.92	8.06	-3%	23%
SEK per NOK	1.08	1.10	1.13	1.27	1.00	2%	27%
SEK per DKK	1.27	1.21	1.22	1.33	1.09	-5%	22%
DKK per USD	6.33	5.63	6.97	8.96	5.46	-11%	64%
DKK per GBP	10.50	11.05	11.36	12.95	10.33	5%	25%
DKK per EUR	7.44	7.46	7.44	7.47	7.42	0%	1%
DKK per SEK	0.80	0.83	0.82	0.92	0.75	4%	23%
DKK per JPY	0.057	0.047	0.061	0.083	0.047	-18%	77%
NOK per USD	7.43	6.23	7.53	9.50	6.07	-16%	57%
NOK per GBP	11.89	12.21	12.28	13.96	10.96	3%	27%
NOK per EUR	8.49	8.24	8.05	8.82	7.22	-3%	22%
NOK per SEK	0.93	0.91	0.89	1.00	0.79	-2%	27%
NOK per DKK	1.17	1.11	1.08	1.18	0.97	-5%	22%
OMXS Eq (SEK)	204	243	186	395	83	19%	376%
OMXS Va (SEK)	204	377	246	400	126	85%	217%
OMXC Eq (DKK)	179	464	217	464	132	159%	252%
OMXC Va (DKK)	179	430	247	430	146	140%	195%
OSEAX Eq(NOK)	132	239	145	239	60	81%	298%
OSEAX Va (NOK)	132	503	221	503	106	281%	375%
MSCI Europe (EUR)	1262	1515	1183	1598	676	20%	136%
MSCI Europe (SEK)	10883	13789	10700	13789	6825	27%	102%
MSCI Europe (DKK)	8848	11313	8829	11802	5508	28%	114%

MSCI Europe (NOK)	10365	12645	9573	12965	5765	22%	125%

Table 2 Descriptive Statistics - Differences

This table reports descriptive statistics in differences (dlog) using weekly data for trade-weighted exchange rate indexes (TWI), the five most important bilateral exchange rates for each country, and stock indexes for the period from the beginning of 1999 to the end of 2006. TWIs and exchange rates are obtained from the Swedish, Danish, and Norwegian central banks. DKK = Danish krone, EUR = Euro, GBP = Great British pound, JPY = Japanese yen, NOK = Norwegian krone, SEK = Swedish krona, USD = US dollar. The value-weighted (Va) local stock indexes are obtained from Thompson Datastream. The equally-weighted (Eq) local stock indexes are calculated from all the stock returns on the specific market giving equal weight to each return. OMXS = Swedish stock market index (S=Stockholm), OMXC = Danish stock market index (C=Copenhagen), OSEAX = Norwegian stock market index (O=Oslo). MSCI Europe is a value-weighted stock index obtained from Thompson Datastream.

	N	Avg. (%)	Med. (%)	Min. (%)	Max. (%)	Std.D. (%)	Skew.	Kurt.	J-B
TWI Sweden	417	-0.01	0.00	-2.86	2.65	0.74	-0.15	1.31	29.3
TWI Denmark	417	0.00	0.00	-1.12	1.27	0.33	-0.05	1.03	17.0
TWI Norway	417	-0.01	-0.05	-2.22	3.09	0.69	0.43	1.18	35.0
SEK per USD	417	-0.04	0.00	-4.34	3.97	1.44	0.06	0.07	0.2
SEK per GBP	417	0.00	0.00	-3.63	3.13	1.10	-0.07	0.26	1.2
SEK per EUR	417	-0.01	0.04	-3.20	2.35	0.78	-0.19	1.08	21.2
SEK per NOK	417	0.00	0.00	-3.49	3.00	0.85	-0.14	1.66	46.2
SEK per DKK	417	-0.01	-0.04	-4.38	2.51	0.83	-0.51	2.71	138.6
DKK per USD	417	-0.03	-0.02	-4.79	4.26	1.37	-0.06	0.18	0.7
DKK per GBP	417	0.01	0.03	-3.56	2.91	0.94	-0.19	0.67	9.5
DKK per EUR	417	0.00	0.00	-0.20	0.17	0.04	-0.23	3.21	173.3
DKK per SEK	417	0.01	-0.01	-2.62	3.12	0.78	0.15	1.32	29.4
DKK per JPY	417	-0.04	-0.18	-5.84	8.77	1.57	0.41	2.67	128.9
NOK per USD	417	-0.04	0.04	-3.85	4.39	1.41	-0.01	-0.12	0.4
NOK per GBP	417	0.00	0.01	-3.29	3.87	1.04	0.14	0.46	4.4
NOK per EUR	417	-0.01	-0.05	-2.27	2.86	0.78	0.34	0.42	10.6
NOK per SEK	417	0.00	0.00	-3.00	3.49	0.85	0.14	1.66	46.2
NOK per DKK	417	-0.01	-0.08	-2.22	2.87	0.75	0.34	0.54	12.4
OMXS Eq (SEK)	417	0.04	0.39	-14.16	8.78	2.92	-0.80	2.44	141.9
OMXS Va (SEK)	417	0.15	0.50	-15.47	12.37	3.23	-0.52	2.57	127.1
OMXC Eq (DKK)	417	0.23	0.32	-7.01	4.00	1.26	-1.07	4.04	348.8
OMXC Va (DKK)	417	0.21	0.27	-13.34	8.83	2.32	-0.60	3.42	217.7
OSEAX Eq (NOK)	417	0.14	0.48	-10.69	8.68	2.42	-0.94	2.42	156.1
OSEAX Va (NOK)	417	0.32	0.66	-13.15	9.16	2.72	-1.02	2.79	198.5
MSCI Europe (EUR)	417	0.04	0.33	-12.02	14.05	2.59	-0.26	4.48	337.6
MSCI Europe (SEK)	417	0.04	0.30	-10.38	12.79	2.38	-0.45	4.24	312.3
MSCI Europe (DKK)	417	0.04	0.29	-11.96	14.07	2.59	-0.26	4.44	332.0

MSCI Europe (NOK)	417	0.03	0.32	-10.14	14.21	2.57	-0.09	3.62	216.9

Table 3 Correlation Coefficients - Differences

This table reports correlation coefficients for differences (dlog) using weekly data for trade-weighted exchange rate indexes (TWI), the five most important bilateral exchange rates for each country, and stock indexes for the period from the beginning of 1999 to the end of 2006. TWIs and exchange rates are obtained from the Swedish, Danish, and Norwegian central banks. DKK = Danish krone, EUR = Euro, GBP = Great British pound, JPY = Japanese yen, NOK = Norwegian krone, SEK = Swedish krona, USD = US dollar. The value-weighted (Va) local stock indexes are obtained from Thompson Datastream. The equally-weighted (Eq) local stock indexes are calculated from all the stock returns on the specific market giving equal weight to each return. OMXS = Swedish stock market index (S=Stockholm), OMXC = Danish stock market index (C=Copenhagen), OSEAX = Norwegian stock market index (O=Oslo). MSCI Europe is a value-weighted stock index obtained from Thompson Datastream.

Sweden										
(1) TWI Sweden	1.00									
(2) SEK per USD	0.65	1.00								
(3) SEK per GBP	0.74	0.62	1.00							
(4) SEK per EUR	0.89	0.33	0.51	1.00						
(5) SEK per NOK	0.58	0.33	0.45	0.51	1.00					
(6) SEK per DKK	0.85	0.39	0.56	0.93	0.57	1.00				
(7) OMXS Eq (SEK)	-0.24	-0.04	-0.15	-0.31	-0.18	-0.27	1.00			
(8) OMXS Va (SEK)	-0.33	-0.08	-0.19	-0.39	-0.19	-0.32	0.83	1.00		
(9) MSCI Europe (EUR)	-0.35	-0.06	-0.22	-0.42	-0.19	-0.34	0.73	0.85	1.00	
(10) MSCI Europe (SEK)	-0.09	0.04	-0.07	-0.13	-0.04	-0.07	0.70	0.80	0.95	1.00
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Denmark										
(1) TWI Denmark	1.00									
(2) DKK per USD	0.84	1.00								
(3) DKK per GBP	0.73	0.58	1.00							
(4) DKK per EUR	-0.09	-0.09	-0.14	1.00						
(5) DKK per SEK	0.48	0.23	0.21	-0.10	1.00					
(6) DKK per JPY	0.76	0.63	0.48	-0.11	0.17	1.00				
(7) OMXC Eq (DKK)	0.17	0.07	0.02	0.06	0.27	0.11	1.00			
(8) OMXC Va (DKK)	0.21	0.12	0.07	-0.01	0.32	0.09	0.73	1.00		
(9) MSCI Europe (EUR)	0.26	0.19	0.04	0.00	0.41	0.08	0.57	0.72	1.00	
(10) MSCI Europe (DKK)	0.26	0.19	0.04	0.01	0.41	0.08	0.57	0.72	1.00	1.00
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Norway										
(1) TWI Norway	1.00									
(2) NOK per USD	0.63	1.00								
(3) NOK per GBP	0.72	0.61	1.00							
(4) NOK per EUR	0.84	0.30	0.48	1.00						
(5) NOK per SEK	0.62	0.24	0.30	0.47	1.00					
(6) NOK per DKK	0.85	0.31	0.48	0.97	0.47	1.00				
(7) OSEAX Eq (NOK)	0.04	0.08	0.02	-0.09	0.17	-0.09	1.00			
(8) OSEAX Va (NOK)	-0.04	0.04	-0.05	-0.17	0.09	-0.17	0.84	1.00		
(9) MSCI Europe (EUR)	0.00	0.10	-0.07	-0.17	0.19	-0.16	0.58	0.65	1.00	

(10) MSCI Europe (NOK)	0.25	0.19	0.08	0.13	0.33	0.13	0.56	0.60	0.95	1.00
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Table 4 Detected Exposures and Exposed Firms

This table reports detected exposures and firms with detected exposures using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures and firms with detected exposures are reported using weekly data (Panel A) and monthly data (Panel B). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. OMXS/C+OSEAX refer to the Swedish, Danish, and Norwegian stock markets, respectively. Swedish / Danish / Norwegian firms are tested against the following bilateral exchange rates: USD, EUR (incl. DKK), GBP, NOK / USD, EUR, GBP, SEK, JPY / USD, EUR (incl. DKK), GBP, SEK. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Exposures using weekly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
			- number of exposures -						
OMXS/C+OSEAX Eq W	79	23	56	13	15	14	8	5	1
OMXS/C+OSEAX Va W	73	15	58	12	11	16	11	6	2
MSCI Europe (EUR) W	68	18	50	11	12	12	8	5	2
MSCI Europe (local) W	133	49	84	11	46	12	8	5	2
All four indexes above W	352	105	247	47	84	54	35	21	6
Average per index W	88	26	62	12	21	14	9	5	2
			- number of firms -						
Firms with 1 exposure	17	34	34	3	34	2	5	1	0
Firms with 2 exposures	22	11	17	2	10	3	5	1	3
Firms with 3 exposures	15	3	10	0	6	2	0	2	
Firms with 4 exposures	24	10	20	10	3	10	5	3	
Firms with 5 exposures	9		2						
Firms with 6 exposures	3		2						
Firms with 7 exposures	3		1						
Firms with 8 exposures	7		5						
Firms with 9 exposures	0								
Firms with 10 exposures	1								
Firms with exposure (sum of above)	101	58	91	15	53	17	15	7	3
Firms without exposure	56	99	66	142	104	140	142	150	154
Firms in total	157	157	157	157	157	157	157	157	157

Panel B

Exposures using monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
			- number of exposures -						
OMXS/C+OSEAX Eq M	51	11	40	12	9	8	3	7	1
OMXS/C+OSEAX Va M	53	10	43	11	7	11	4	7	3
MSCI Europe (EUR) M	57	10	47	12	5	9	8	7	6
MSCI Europe (local) M	63	14	49	12	7	9	8	7	6
All four indexes above M	224	45	179	47	28	37	23	28	16
Average per index	56	11	45	12	7	9	6	7	4
			- number of firms -						
Firms with 1 exposure	12	10	13	4	10	3	2	0	0

Firms with 2 exposures	15	6	12	7	4	3	7	0	5
Firms with 3 exposures	14	1	11	3	2	4	1	0	2
Firms with 4 exposures	12	5	11	5	1	4	1	7	0
Firms with 5 exposures	3		2						
Firms with 6 exposures	5		5						
Firms with 7 exposures	2		0						
Firms with 8 exposures	3		2						
Firms with 9 exposures	1		1						
Firms with exposure (sum of above)	67	22	57	19	17	14	11	7	7
Firms without exposure	90	135	100	138	140	143	146	150	150
Firms in total	157	157	157	157	157	157	157	157	157

Table 5 Defection Rates in Detected Exposures

This table reports detected exposures using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. OMXS/C+OSEAX refer to the Swedish, Danish, and Norwegian stock markets, respectively. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	79	23	56	13	15	14	8	5	1
∩ OMXS/C+OSEAX Eq M	12	6	6	0	1	3	1	1	0
=> Confirmation rate	15%	26%	11%	0%	7%	21%	13%	20%	0%
OMXS/C+OSEAX Va W	72	15	57	12	11	16	11	6	1
∩ OMXS/C+OSEAX Va M	23	4	19	12	1	4	1	1	0
=> Confirmation rate	32%	27%	33%	100%	9%	25%	9%	17%	0%
MSCI Europe (EUR) W	68	18	50	11	12	12	8	5	2
∩ MSCI Europe (EUR) M	11	4	7	2	0	3	0	0	2
=> Confirmation rate	16%	22%	14%	18%	0%	25%	0%	0%	100%
MSCI Europe (local) W	133	49	84	11	46	12	8	5	2
∩ MSCI Europe (local) M	16	8	8	0	3	3	0	0	2
=> Confirmation rate	12%	16%	10%	0%	7%	25%	0%	0%	100%
All four indexes above W	352	105	247	47	84	54	35	21	6
∩ Respective indexes M	62	22	40	14	5	13	2	2	4
=> Average confirmation rate	18%	21%	16%	30%	6%	24%	6%	10%	67%
=> Average defection rate	82%	79%	84%	70%	94%	76%	94%	90%	33%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	79	23	56	13	15	14	8	5	1
∩ OMXS/C+OSEAX Va W	53	12	41	11	5	13	7	4	1
∩ MSCI Europe (EUR) W	44	12	32	10	4	10	5	3	0
∩ MSCI Europe (local) W	41	10	31	10	3	10	5	3	0
=> Confirmation rate	52%	43%	55%	77%	20%	71%	63%	60%	0%

=> Defection rate	48%	57%	45%	23%	80%	29%	38%	40%	100%
Panel C									
Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq M	51	11	40	12	9	8	3	7	1
∩ OMXS/C+OSEAX Va M	33	6	27	8	3	6	2	7	1
∩ MSCI Europe (EUR) M	24	6	18	5	1	4	1	7	0
∩ MSCI Europe (local) M	23	5	18	5	1	4	1	7	0
=> Confirmation rate	45%	45%	45%	42%	11%	50%	33%	100%	0%
=> Defection rate	55%	55%	55%	58%	89%	50%	67%	0%	100%
Panel D									
Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	79	23	56	13	15	14	8	5	1
∩ OMXS/C+OSEAX Eq M	12	6	6	0	1	3	1	1	0
∩ OMXS/C+OSEAX Va W	10	4	6	0	1	3	1	1	0
∩ OMXS/C+OSEAX Va M	7	3	4	0	0	2	1	1	0
∩ MSCI Europe (EUR) W	5	3	2	0	0	2	0	0	0
∩ MSCI Europe (EUR) M	4	3	1	0	0	1	0	0	0
∩ MSCI Europe (local) W	4	3	1	0	0	1	0	0	0
∩ MSCI Europe (local) M	4	3	1	0	0	1	0	0	0
=> Confirmation rate	5%	13%	2%	0%	0%	7%	0%	0%	0%
=> Defection rate	95%	87%	98%	100%	100%	93%	100%	100%	100%

Table 6 Defection Rates in Detected Positive Exposures

This table reports detected positive exposures using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. OMXS/C+OSEAX refer to the Swedish, Danish, and Norwegian stock markets, respectively. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	39	11	28	10	3	6	4	5	0
∩ OMXS/C+OSEAX Eq M	7	4	3	0	0	1	1	1	0
=> Confirmation rate	18%	36%	11%	0%	0%	17%	25%	20%	NA
OMXS/C+OSEAX Va W	45	12	33	9	8	6	6	4	0
∩ OMXS/C+OSEAX Va M	19	4	15	9	1	3	1	1	0
=> Confirmation rate	42%	33%	45%	100%	13%	50%	17%	25%	NA
MSCI Europe (EUR) W	46	14	32	7	8	7	5	3	2
∩ MSCI Europe (EUR) M	9	4	5	0	0	3	0	0	2
=> Confirmation rate	20%	29%	16%	0%	0%	43%	0%	0%	100%
MSCI Europe (local) W	35	7	28	7	4	7	5	3	2
∩ MSCI Europe (local) M	8	3	5	0	0	3	0	0	2
=> Confirmation rate	23%	43%	18%	0%	0%	43%	0%	0%	100%
All four indexes above W	165	44	121	33	23	26	20	15	4
∩ Respective indexes M	43	15	28	9	1	10	2	2	4
=> Average confirmation rate	26%	34%	23%	27%	4%	38%	10%	13%	100%
=> Average defection rate	74%	66%	77%	73%	96%	62%	90%	87%	0%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	39	11	28	10	3	6	4	5	0
∩ OMXS/C+OSEAX Va W	32	9	23	8	2	5	4	4	0
∩ MSCI Europe (EUR) W	29	9	20	7	2	5	3	3	0
∩ MSCI Europe (local) W	26	7	19	7	1	5	3	3	0
=> Confirmation rate	67%	64%	68%	70%	33%	83%	75%	60%	NA

=> Defection rate	33%	36%	32%	30%	67%	17%	25%	40%	NA
Panel C									
Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq M	27	8	19	7	3	3	2	4	0
∩ OMXS/C+OSEAX Va M	20	6	14	3	3	3	1	4	0
∩ MSCI Europe (EUR) M	13	6	7	0	1	2	0	4	0
∩ MSCI Europe (local) M	12	5	7	0	1	2	0	4	0
=> Confirmation rate	44%	63%	37%	0%	33%	67%	0%	100%	NA
=> Defection rate	56%	38%	63%	100%	67%	33%	100%	0%	NA
Panel D									
Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	39	11	28	10	3	6	4	5	0
∩ OMXS/C+OSEAX Eq M	7	4	3	0	0	1	1	1	0
∩ OMXS/C+OSEAX Va W	6	3	3	0	0	1	1	1	0
∩ OMXS/C+OSEAX Va M	6	3	3	0	0	1	1	1	0
∩ MSCI Europe (EUR) W	4	3	1	0	0	1	0	0	0
∩ MSCI Europe (EUR) M	4	3	1	0	0	1	0	0	0
∩ MSCI Europe (local) W	4	3	1	0	0	1	0	0	0
∩ MSCI Europe (local) M	4	3	1	0	0	1	0	0	0
=> Confirmation rate	10%	27%	4%	0%	0%	17%	0%	0%	NA
=> Defection rate	90%	73%	96%	100%	100%	83%	100%	100%	NA

Table 7 Defection Rates in Detected Negative Exposures

This table reports detected negative exposures using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. OMXS/C+OSEAX refer to the Swedish, Danish, and Norwegian stock markets, respectively. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	40	12	28	3	12	8	4	0	1
∩ OMXS/C+OSEAX Eq M	5	2	3	0	1	2	0	0	0
=> Confirmation rate	13%	17%	11%	0%	8%	25%	0%	NA	0%
OMXS/C+OSEAX Va W	27	3	24	3	3	10	5	2	1
∩ OMXS/C+OSEAX Va M	4	0	4	3	0	1	0	0	0
=> Confirmation rate	15%	0%	17%	100%	0%	10%	0%	0%	0%
MSCI Europe (EUR) W	22	4	18	4	4	5	3	2	0
∩ MSCI Europe (EUR) M	2	0	2	2	0	0	0	0	0
=> Confirmation rate	9%	0%	11%	50%	0%	0%	0%	0%	NA
MSCI Europe (local) W	98	42	56	4	42	5	3	2	0
∩ MSCI Europe (local) M	7	5	2	0	2	0	0	0	0
=> Confirmation rate	7%	12%	4%	0%	5%	0%	0%	0%	NA
All four indexes above W	187	61	126	14	61	28	15	6	2
∩ Respective indexes M	18	7	11	5	3	3	0	0	0
=> Average confirmation rate	10%	11%	9%	36%	5%	11%	0%	0%	0%
=> Average defection rate	90%	89%	91%	64%	95%	89%	100%	100%	100%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	40	12	28	3	12	8	4	0	1
∩ OMXS/C+OSEAX Va W	21	3	18	3	3	8	3	0	1
∩ MSCI Europe (EUR) W	15	3	12	3	2	5	2	0	0
∩ MSCI Europe (local) W	15	3	12	3	2	5	2	0	0
=> Confirmation rate	38%	25%	43%	100%	17%	63%	50%	NA	0%

=> Defection rate	63%	75%	57%	0%	83%	38%	50%	NA	100%
Panel C									
Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq M	24	3	21	5	6	5	1	3	1
∩ OMXS/C+OSEAX Va M	13	0	13	5	0	3	1	3	1
∩ MSCI Europe (EUR) M	11	0	11	5	0	2	1	3	0
∩ MSCI Europe (local) M	11	0	11	5	0	2	1	3	0
=> Confirmation rate	46%	0%	52%	100%	0%	40%	100%	100%	0%
=> Defection rate	54%	100%	48%	0%	100%	60%	0%	0%	100%
Panel D									
Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	40	12	28	3	12	8	4	0	1
∩ OMXS/C+OSEAX Eq M	5	2	3	0	1	2	0	0	0
∩ OMXS/C+OSEAX Va W	4	1	3	0	1	2	0	0	0
∩ OMXS/C+OSEAX Va M	1	0	1	0	0	1	0	0	0
∩ MSCI Europe (EUR) W	1	0	1	0	0	1	0	0	0
∩ MSCI Europe (EUR) M	0	0	0	0	0	0	0	0	0
∩ MSCI Europe (local) W	0	0	0	0	0	0	0	0	0
∩ MSCI Europe (local) M	0	0	0	0	0	0	0	0	0
=> Confirmation rate	0%	0%	0%	0%	0%	0%	0%	NA	0%
=> Defection rate	100%	100%	100%	100%	100%	100%	100%	NA	100%

Table 8 Defection Rates in Detected Exposures for Sweden

This table reports detected exposures for Sweden using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, NOK = Norwegian krone, SEK = Swedish krona. OMXS refers to the Swedish stock market. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	NOK
OMXS Eq W	40	10	30	6	12	7	5
∩ OMXS Eq M	4	1	3	0	1	1	1
=> Confirmation rate	10%	10%	10%	0%	8%	14%	20%
OMXS Va W	32	6	26	7	5	8	6
∩ OMXS Va M	12	2	10	7	0	2	1
=> Confirmation rate	38%	33%	38%	100%	0%	25%	17%
MSCI Europe (EUR) W	28	8	20	5	6	4	5
∩ MSCI Europe (EUR) M	4	2	2	0	0	2	0
=> Confirmation rate	14%	25%	10%	0%	0%	50%	0%
MSCI Europe (SEK) W	77	32	45	5	31	4	5
∩ MSCI Europe (SEL) M	8	3	5	0	3	2	0
=> Confirmation rate	10%	9%	11%	0%	10%	50%	0%
All four indexes above W	177	56	121	23	54	23	21
∩ Respective indexes M	28	8	20	7	4	7	2
=> Average confirmation rate	16%	14%	17%	30%	7%	30%	10%
=> Average defection rate	84%	86%	83%	70%	93%	70%	90%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	NOK
OMXS Eq W	40	10	30	6	12	7	5
∩ OMXS Va W	23	3	20	6	3	7	4
∩ MSCI Europe (EUR) W	17	3	14	5	2	4	3
∩ MSCI Europe (SEK) W	16	3	13	5	1	4	3
=> Confirmation rate	40%	30%	43%	83%	8%	57%	60%

=> Defection rate	60%	70%	57%	17%	92%	43%	40%

Panel C

Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	NOK
OMXS Eq M	21	4	17	4	2	4	7
∩ OMXS Va M	18	4	14	3	1	3	7
∩ MSCI Europe (EUR) M	16	4	12	2	1	2	7
∩ MSCI Europe (SEK) M	15	3	12	2	1	2	7
=> Confirmation rate	71%	75%	71%	50%	50%	50%	100%
=> Defection rate	29%	25%	29%	50%	50%	50%	0%

Panel D

Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	NOK
OMXS Eq W	40	10	30	6	12	7	5
∩ OMXS Eq M	4	1	3	0	1	1	1
∩ OMXS Va W	4	1	3	0	1	1	1
∩ OMXS Va M	3	1	2	0	0	1	1
∩ MSCI Europe (EUR) W	2	1	1	0	0	1	0
∩ MSCI Europe (EUR) M	2	1	1	0	0	1	0
∩ MSCI Europe (SEK) W	2	1	1	0	0	1	0
∩ MSCI Europe (SEK) M	2	1	1	0	0	1	0
=> Confirmation rate	5%	10%	3%	0%	0%	14%	0%
=> Defection rate	95%	90%	97%	100%	100%	86%	100%

Table 9 Defection Rates in Detected Exposures for Denmark

This table reports detected exposures for Denmark using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, JPY = Japanese yen, DKK = Danish krone. OMXC refers to the Danish stock market. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	JPY
OMXC Eq W	26	8	18	3	3	5	6	1
∩ OMXC Eq M	6	3	3	0	0	2	1	0
=> Confirmation rate	23%	38%	17%	0%	0%	40%	17%	0%
OMXC Va W	24	6	18	1	5	5	6	1
∩ OMXC Va M	6	2	4	1	1	1	1	0
=> Confirmation rate	25%	33%	22%	100%	20%	20%	17%	0%
MSCI Europe (EUR) W	27	6	21	2	5	5	7	2
∩ MSCI Europe (EUR) M	5	2	3	1	0	0	0	2
=> Confirmation rate	19%	33%	14%	50%	0%	0%	0%	100%
MSCI Europe (DKK) W	27	6	21	2	5	5	7	2
∩ MSCI Europe (DKK) M	4	2	2	0	0	0	0	2
=> Confirmation rate	15%	33%	10%	0%	0%	0%	0%	100%
All four indexes above W	104	26	78	8	18	20	26	6
∩ Respective indexes M	21	9	12	2	1	3	2	4
=> Average confirmation rate	20%	35%	15%	25%	6%	15%	8%	67%
=> Average defection rate	80%	65%	85%	75%	94%	85%	92%	33%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	JPY
OMXC Eq W	26	8	18	3	3	5	6	1
∩ OMXC Va W	19	6	13	1	2	4	5	1
∩ MSCI Europe (EUR) W	17	6	11	1	2	4	4	0
∩ MSCI Europe (DKK) W	17	6	11	1	2	4	4	0
=> Confirmation rate	65%	75%	61%	33%	67%	80%	67%	0%

=> Defection rate	35%	25%	39%	67%	33%	20%	33%	100%

Panel C

Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	JPY
OMXC Eq M	21	4	17	6	4	3	3	1
∩ OMXC Va M	10	2	8	3	0	2	2	1
∩ MSCI Europe (EUR) M	5	2	3	1	0	1	1	0
∩ MSCI Europe (DKK) M	5	2	3	1	0	1	1	0
=> Confirmation rate	24%	50%	18%	17%	0%	33%	33%	0%
=> Defection rate	76%	50%	82%	83%	100%	67%	67%	100%

Panel D

Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	JPY
OMXC Eq W	26	8	18	3	3	5	6	1
∩ OMXC Eq M	6	3	3	0	0	2	1	0
∩ OMXC Va W	5	2	3	0	0	2	1	0
∩ OMXC Va M	4	2	2	0	0	1	1	0
∩ MSCI Europe (EUR) W	3	2	1	0	0	1	0	0
∩ MSCI Europe (EUR) M	2	2	0	0	0	0	0	0
∩ MSCI Europe (DKK) W	2	2	0	0	0	0	0	0
∩ MSCI Europe (DKK) M	2	2	0	0	0	0	0	0
=> Confirmation rate	8%	25%	0%	0%	0%	0%	0%	0%
=> Defection rate	92%	75%	100%	100%	100%	100%	100%	100%

Table 10 Defection Rates in Detected Exposures for Norway

This table reports detected exposures for Norway using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone. OSEAX refers to the Norwegian stock market. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK
OSEAX Eq W	13	5	8	4	0	2	2
∩ OSEAX Eq M	2	2	0	0	0	0	0
=> Confirmation rate	15%	40%	0%	0%	NA	0%	0%
OSEAX Va W	16	3	13	4	1	3	5
∩ OSEAX Va M	5	0	5	4	0	1	0
=> Confirmation rate	31%	0%	38%	100%	0%	33%	0%
MSCI Europe (EUR) W	13	4	9	4	1	3	1
∩ MSCI Europe (EUR) M	2	0	2	1	0	1	0
=> Confirmation rate	15%	0%	22%	25%	0%	33%	0%
MSCI Europe (NOK) W	29	11	18	4	10	3	1
∩ MSCI Europe (NOK) M	4	3	1	0	0	1	0
=> Confirmation rate	14%	27%	6%	0%	0%	33%	0%
All four indexes above W	71	23	48	16	12	11	9
∩ Respective indexes M	13	5	8	5	0	3	0
=> Average confirmation rate	18%	22%	17%	31%	0%	27%	0%
=> Average defection rate	82%	78%	83%	69%	100%	73%	100%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK
OSEAX Eq W	13	5	8	4	0	2	2
∩ OSEAX Va W	11	3	8	4	0	2	2
∩ MSCI Europe (EUR) W	10	3	7	4	0	2	1
∩ MSCI Europe (NOK) W	8	1	7	4	0	2	1
=> Confirmation rate	62%	20%	88%	100%	NA	100%	50%

=> Defection rate	38%	80%	13%	0%	NA	0%	50%

Panel C

Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK
OSEAX Eq M	9	3	6	2	3	1	0
∩ OSEAX Va M	5	0	5	2	2	1	0
∩ MSCI Europe (EUR) M	3	0	3	2	0	1	0
∩ MSCI Europe (NOK) M	3	0	3	2	0	1	0
=> Confirmation rate	33%	0%	50%	100%	0%	100%	NA
=> Defection rate	67%	100%	50%	0%	100%	0%	NA

Panel D

Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK
OSEAX Eq W	13	5	8	4	0	2	2
∩ OSEAX Eq M	2	2	0	0	0	0	0
∩ OSEAX Va W	1	1	0	0	0	0	0
∩ OSEAX Va M	0	0	0	0	0	0	0
∩ MSCI Europe (EUR) W	0	0	0	0	0	0	0
∩ MSCI Europe (EUR) M	0	0	0	0	0	0	0
∩ MSCI Europe (NOK) W	0	0	0	0	0	0	0
∩ MSCI Europe (NOK) M	0	0	0	0	0	0	0
=> Confirmation rate	0%	0%	0%	0%	NA	0%	0%
=> Defection rate	100%	100%	100%	100%	NA	100%	100%

Table 11 Defection Rates in Detected Exposures for 1999-2002

This table reports detected exposures using a 5 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2002. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. OMXS/C+OSEAX refer to the Swedish, Danish, and Norwegian stock markets, respectively. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	62	13	49	10	10	12	8	6	3
∩ OMXS/C+OSEAX Eq M	18	3	15	3	1	4	4	0	3
=> Confirmation rate	29%	23%	31%	30%	10%	33%	50%	0%	100%
OMXS/C+OSEAX Va W	59	8	51	20	7	13	8	1	2
∩ OMXS/C+OSEAX Va M	34	5	29	20	1	2	4	0	2
=> Confirmation rate	58%	63%	57%	100%	14%	15%	50%	0%	100%
MSCI Europe (EUR) W	59	11	48	15	7	12	8	3	3
∩ MSCI Europe (EUR) M	18	6	12	2	1	3	3	0	3
=> Confirmation rate	31%	55%	25%	13%	14%	25%	38%	0%	100%
MSCI Europe (local) W	92	23	69	15	28	12	8	3	3
∩ MSCI Europe (local) M	16	5	11	0	2	3	3	0	3
=> Confirmation rate	17%	22%	16%	0%	7%	25%	38%	0%	100%
All four indexes W	272	55	217	60	52	49	32	13	11
∩ Respective indexes M	86	19	67	25	5	12	14	0	11
=> Average confirmation rate	32%	35%	31%	42%	10%	24%	44%	0%	100%
=> Average defection rate	68%	65%	69%	58%	90%	76%	56%	100%	0%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	62	13	49	10	10	12	8	6	3
∩ OMXS/C+OSEAX Va W	37	6	31	8	4	9	8	1	1
∩ MSCI Europe (EUR) W	29	4	25	5	4	8	6	1	1
∩ MSCI Europe (local) W	28	3	25	5	4	8	6	1	1
=> Confirmation rate	45%	23%	51%	50%	40%	67%	75%	17%	33%

=> Defection rate	55%	77%	49%	50%	60%	33%	25%	83%	67%
Panel C									
Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq M	42	9	33	8	4	9	6	3	3
∩ OMXS/C+OSEAX Va M	35	8	27	7	4	6	6	3	1
∩ MSCI Europe (EUR) M	24	6	18	4	4	4	4	1	1
∩ MSCI Europe (local) M	21	5	16	4	2	4	4	1	1
=> Confirmation rate	50%	56%	48%	50%	50%	44%	67%	33%	33%
=> Defection rate	50%	44%	52%	50%	50%	56%	33%	67%	67%
Panel D									
Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	62	13	49	10	10	12	8	6	3
∩ OMXS/C+OSEAX Eq M	18	3	15	3	1	4	4	0	3
∩ OMXS/C+OSEAX Va W	14	3	11	3	1	2	4	0	1
∩ OMXS/C+OSEAX Va M	14	3	11	3	1	2	4	0	1
∩ MSCI Europe (EUR) W	9	2	7	1	1	1	3	0	1
∩ MSCI Europe (EUR) M	9	2	7	1	1	1	3	0	1
∩ MSCI Europe (local) W	9	2	7	1	1	1	3	0	1
∩ MSCI Europe (local) M	9	2	7	1	1	1	3	0	1
=> Confirmation rate	15%	15%	14%	10%	10%	8%	38%	0%	33%
=> Defection rate	85%	85%	86%	90%	90%	92%	63%	100%	67%

Table 12 Defection Rates in Detected Exposures for 2003-2006

This table reports detected exposures using a 5 percent significance level for exposure identification for the period from the beginning of 2003 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. OMXS/C+OSEAX refer to the Swedish, Danish, and Norwegian stock markets, respectively. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	74	15	59	20	12	10	7	5	5
∩ OMXS/C+OSEAX Eq M	12	2	10	6	1	1	0	1	1
=> Confirmation rate	16%	13%	17%	30%	8%	10%	0%	20%	20%
OMXS/C+OSEAX Va W	61	7	54	14	13	10	8	6	3
∩ OMXS/C+OSEAX Va M	20	1	19	14	2	1	0	1	1
=> Confirmation rate	33%	14%	35%	100%	15%	10%	0%	17%	33%
MSCI Europe (EUR) W	70	12	58	20	16	11	3	6	2
∩ MSCI Europe (EUR) M	9	2	7	4	1	0	0	1	1
=> Confirmation rate	13%	17%	12%	20%	6%	0%	0%	17%	50%
MSCI Europe (local) W	110	32	78	20	36	11	3	6	2
∩ MSCI Europe (local) M	13	8	5	0	3	0	0	1	1
=> Confirmation rate	12%	25%	6%	0%	8%	0%	0%	17%	50%
All four indexes W	315	66	249	74	77	42	21	23	12
∩ Respective indexes M	54	13	41	24	7	2	0	4	4
=> Average confirmation rate	17%	20%	16%	32%	9%	5%	0%	17%	33%
=> Average defection rate	83%	80%	84%	68%	91%	95%	100%	83%	67%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	74	15	59	20	12	10	7	5	5
∩ OMXS/C+OSEAX Va W	46	5	41	11	9	8	5	5	3
∩ MSCI Europe (EUR) W	33	4	29	11	6	4	1	5	2
∩ MSCI Europe (local) W	30	2	28	11	5	4	1	5	2
=> Confirmation rate	41%	13%	47%	55%	42%	40%	14%	100%	40%

=> Defection rate	59%	87%	53%	45%	58%	60%	86%	0%	60%
Panel C									
Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq M	54	8	46	15	9	6	5	9	2
∩ OMXS/C+OSEAX Va M	35	7	28	9	3	5	2	8	1
∩ MSCI Europe (EUR) M	28	5	23	6	2	4	2	8	1
∩ MSCI Europe (local) M	27	4	23	6	2	4	2	8	1
=> Confirmation rate	50%	50%	50%	40%	22%	67%	40%	89%	50%
=> Defection rate	50%	50%	50%	60%	78%	33%	60%	11%	50%
Panel D									
Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	74	15	59	20	12	10	7	5	5
∩ OMXS/C+OSEAX Eq M	12	2	10	6	1	1	0	1	1
∩ OMXS/C+OSEAX Va W	8	1	7	3	1	1	0	1	1
∩ OMXS/C+OSEAX Va M	7	1	6	2	1	1	0	1	1
∩ MSCI Europe (EUR) W	5	1	4	2	0	0	0	1	1
∩ MSCI Europe (EUR) M	5	1	4	2	0	0	0	1	1
∩ MSCI Europe (local) W	4	0	4	2	0	0	0	1	1
∩ MSCI Europe (local) M	4	0	4	2	0	0	0	1	1
=> Confirmation rate	5%	0%	7%	10%	0%	0%	0%	20%	20%
=> Defection rate	95%	100%	93%	90%	100%	100%	100%	80%	80%

Table 13 Defection Rates in Detected Exposures – 10 percent

This table reports detected exposures using a 10 percent significance level for exposure identification for the period from the beginning of 1999 to the end of 2006. Detected exposures are reported followed by the number of exposures that is confirmed by / intersected with ("∩") one or more other indexes and/or data frequencies. Panel A reports an index using weekly data confirmed by / intersected with ("∩") the same index using monthly data. Panel B reports an equally weighted index using weekly data confirmed by / intersected with ("∩") other indexes using weekly data. Panel C reports an equally weighted index using monthly data confirmed by / intersected with ("∩") other indexes using monthly data. Panel D reports an equally weighted index using weekly data confirmed by / intersected with ("∩") the same and other indexes using both monthly and weekly data. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. OMXS/C+OSEAX refer to the Swedish, Danish, and Norwegian stock markets, respectively. Eq = Equally-weighted, Va = Value-weighted.. W = weekly data, M = monthly data.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	123	32	91	17	24	23	13	11	3
∩ OMXS/C+OSEAX Eq M	27	13	14	2	2	5	2	2	1
=> Confirmation rate	22%	41%	15%	12%	8%	22%	15%	18%	33%
OMXS/C+OSEAX Va W	121	25	96	17	21	25	17	12	4
∩ OMXS/C+OSEAX Va M	38	6	32	17	3	6	2	2	2
=> Confirmation rate	31%	24%	33%	100%	14%	24%	12%	17%	50%
MSCI Europe (EUR) W	115	21	94	13	26	22	14	11	8
∩ MSCI Europe (EUR) M	22	7	15	2	2	6	2	1	2
=> Confirmation rate	19%	33%	16%	15%	8%	27%	14%	9%	25%
MSCI Europe (local) W	186	60	126	13	58	22	14	11	8
∩ MSCI Europe (local) M	36	15	21	0	10	6	2	1	2
=> Confirmation rate	19%	25%	17%	0%	17%	27%	14%	9%	25%
All four indexes W	545	138	407	60	129	92	58	45	23
∩ Respective indexes M	123	41	82	21	17	23	8	6	7
=> Average confirmation rate	23%	30%	20%	35%	13%	25%	14%	13%	30%
=> Average defection rate	77%	70%	80%	65%	87%	75%	86%	87%	70%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	123	32	91	17	24	23	13	11	3
∩ OMXS/C+OSEAX Va W	91	21	70	16	14	20	9	10	1
∩ MSCI Europe (EUR) W	74	16	58	12	13	17	6	9	1
∩ MSCI Europe (local) W	67	12	55	12	10	17	6	9	1
=> Confirmation rate	54%	38%	60%	71%	42%	74%	46%	82%	33%

=> Defection rate	46%	63%	40%	29%	58%	26%	54%	18%	67%
Panel C									
Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq M	98	25	73	17	14	18	12	9	3
∩ OMXS/C+OSEAX Va M	69	15	54	12	9	14	9	8	2
∩ MSCI Europe (EUR) M	51	12	39	7	7	11	4	8	2
∩ MSCI Europe (local) M	41	6	35	7	3	11	4	8	2
=> Confirmation rate	42%	24%	48%	41%	21%	61%	33%	89%	67%
=> Defection rate	58%	76%	52%	59%	79%	39%	67%	11%	33%
Panel D									
Weekly/Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
OMXS/C+OSEAX Eq W	123	32	91	17	24	23	13	11	3
∩ OMXS/C+OSEAX Eq M	27	13	14	2	2	5	2	2	1
∩ OMXS/C+OSEAX Va W	21	10	11	2	1	5	1	2	0
∩ OMXS/C+OSEAX Va M	17	6	11	2	1	5	1	2	0
∩ MSCI Europe (EUR) W	14	5	9	2	1	5	0	1	0
∩ MSCI Europe (EUR) M	10	4	6	1	0	4	0	1	0
∩ MSCI Europe (local) W	9	3	6	1	0	4	0	1	0
∩ MSCI Europe (local) M	9	3	6	1	0	4	0	1	0
=> Confirmation rate	7%	9%	7%	6%	0%	17%	0%	9%	0%
=> Defection rate	93%	91%	93%	94%	100%	83%	100%	91%	100%

Table 14 Summary of Defection Rates

This table reports a summary of the defection rates found in the very last line in Panel A, Panel B, Panel C, and Panel D of Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, Table 12, and Table 13. We refer to the individual tables for the underlying assumptions. Defection rate refers to the percentage of exposures that cannot be confirmed by the subsequent index(/es) and/or data frequency(/ies). TWI = trade-weighted exchange rate index, USD = US dollar, EUR = Euro, GBP = Great British pound, SEK = Swedish krona, NOK = Norwegian krone, JPY = Japanese yen. Maximum / Minimum numbers that are affected by Table 13 (10%) are written in italics.

Panel A

Weekly and monthly data	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
			- (average defection rates) -						
Table 5 (Total)	82%	79%	84%	70%	94%	76%	94%	90%	33%
Table 6 (Positive)	74%	66%	77%	73%	96%	62%	90%	87%	0%
Table 7 (Negative)	90%	89%	91%	64%	95%	89%	100%	100%	100%
Table 8 (Sweden)	84%	86%	83%	70%	93%	70%	NA	90%	NA
Table 9 (Denmark)	80%	65%	85%	75%	94%	85%	92%	NA	33%
Table 10 (Norway)	82%	78%	83%	69%	100%	73%	100%	NA	NA
Table 11 (1999-2002)	68%	65%	69%	58%	90%	76%	56%	100%	0%
Table 12 (2003-2006)	83%	80%	84%	68%	91%	95%	100%	83%	67%
Table 13 (10%)	77%	70%	80%	65%	*87%*	75%	86%	87%	70%
Simple average of above tables	80%	75%	82%	68%	93%	78%	90%	91%	43%
Minimum value of above tables	68%	65%	69%	58%	*87%*	62%	56%	83%	0%
Maximum value of above tables	90%	89%	91%	75%	100%	95%	100%	100%	100%

Panel B

Weekly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
			- (defection rates) -						
Table 5 (Total)	48%	57%	45%	23%	80%	29%	38%	40%	100%
Table 6 (Positive)	33%	36%	32%	30%	67%	17%	25%	40%	NA
Table 7 (Negative)	63%	75%	57%	0%	83%	38%	50%	NA	100%
Table 8 (Sweden)	60%	70%	57%	17%	92%	43%	NA	40%	NA
Table 9 (Denmark)	35%	25%	39%	67%	33%	20%	33%	NA	100%
Table 10 (Norway)	38%	80%	13%	0%	NA	0%	50%	NA	NA
Table 11 (1999-2002)	55%	77%	49%	50%	60%	33%	25%	83%	67%
Table 12 (2003-2006)	59%	87%	53%	45%	58%	60%	86%	0%	60%
Table 13 (10%)	46%	63%	40%	29%	58%	26%	54%	18%	67%
Simple average of above tables	49%	63%	43%	29%	66%	30%	45%	37%	82%
Minimum value of above tables	33%	25%	13%	0%	33%	0%	25%	0%	60%
Maximum value of above tables	63%	87%	57%	67%	92%	60%	86%	83%	100%

Panel C

Monthly data and indexes	All	TWI	Bilat.	USD	EUR	GBP	SEK	NOK	JPY
			- (defection rates) -						

Table 5 (Total)	55%	55%	55%	58%	89%	50%	67%	0%	100%
Table 6 (Positive)	56%	38%	63%	100%	67%	33%	100%	0%	NA
Table 7 (Negative)	54%	100%	48%	0%	100%	60%	0%	0%	100%
Table 8 (Sweden)	29%	25%	29%	50%	50%	50%	NA	0%	NA
Table 9 (Denmark)	76%	50%	82%	83%	100%	67%	67%	NA	100%
Table 10 (Norway)	67%	100%	50%	0%	100%	0%	NA	NA	NA
Table 11 (1999-2002)	50%	44%	52%	50%	50%	56%	33%	67%	67%
Table 12 (2003-2006)	50%	50%	50%	60%	78%	33%	60%	11%	50%
Table 13 (10%)	58%	76%	52%	59%	79%	39%	67%	11%	*33%*
Simple average of above tables	55%	60%	53%	51%	79%	43%	56%	13%	75%
Minimum value of above tables	29%	25%	29%	0%	50%	0%	0%	0%	*33%*
Maximum value of above tables	76%	100%	82%	100%	100%	67%	100%	67%	100%

Panel D

Weekly/Monthly data and indexes	All	TWI	Bilat. - (defection rates) -	USD	EUR	GBP	SEK	NOK	JPY
Table 5 (Total)	95%	87%	98%	100%	100%	93%	100%	100%	100%
Table 6 (Positive)	90%	73%	96%	100%	100%	83%	100%	100%	NA
Table 7 (Negative)	100%	100%	100%	100%	100%	100%	100%	NA	100%
Table 8 (Sweden)	95%	90%	97%	100%	100%	86%	NA	100%	NA
Table 9 (Denmark)	92%	75%	100%	100%	100%	100%	100%	NA	100%
Table 10 (Norway)	100%	100%	100%	100%	NA	100%	100%	NA	NA
Table 11 (1999-2002)	85%	85%	86%	90%	90%	92%	63%	100%	67%
Table 12 (2003-2006)	95%	100%	93%	90%	100%	100%	100%	80%	80%
Table 13 (10%)	93%	91%	93%	94%	100%	83%	100%	91%	100%
Simple average of above tables	94%	89%	96%	97%	99%	93%	95%	95%	91%
Minimum value of above tables	85%	73%	86%	90%	90%	83%	63%	80%	67%
Maximum value of above tables	100%	100%	100%	100%	100%	100%	100%	100%	100%