International Portfolio Choice and Trading Behavior

Göran Robertsson

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to Marie

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Stora Alby, October 2000

Göran Robertsson

Introduction and Summary

This thesis examines a number of different topics related to international portfolio choice, trading behavior and asset pricing. The starting point for the first two chapters is the failure of standard portfolio theory to explain why international investors choose to invest a large fraction of assets in their home countries. This "puzzle" is referred to as the home bias, and several explanations for its existence have been suggested. One important consideration is that international investments involve taking on additional risk, namely, exchange rate related risk. The importance of exchange rate risk at a firm level is analyzed in the third chapter. The final chapter examines whether investors can exploit the predictable component in time-varying expected returns on Swedish stocks and bonds. All four chapters are self-contained and can therefore be read in any order.

In the first chapter, "Direct Foreign Ownership, Institutional Investors, and Firm Characteristics," co-authored with Magnus Dahlquist, we characterize foreign ownership using a dataset of ownership and attributes of Swedish firms. The analysis reveals that foreigners show a preference for large firms, firms paying low dividends, and firms with large cash positions on their balance sheets. When we further analyze the preference for large firms, we find that market liquidity and presence in international markets, measured through export sales or listings on other exchanges, seem to characterize foreign holdings better than firm size alone. Foreigners also tend to underweight firms with a dominant owner. Importantly, we demonstrate that most of the features associated with foreign ownership are driven by the fact that foreign investors typically are mutual funds or other institutional investors. Hence, we identify an institutional investor bias rather than a foreign investor bias. Finally, using ownership data on a country level, we conclude that the results are particularly strong among U.S. investors, who comprise the largest institutions among foreign investors. (This chapter will appear in *Journal of Financial Economics*, vol 59, no 3.)

In the second chapter, "Foreigners' Trades in Risky Asset: An Assessment of Investment Behavior and Performance," co-authored with Magnus Dahlquist, we examine the trading by foreigners in individual Swedish stocks. First, we relate purchases and sales to various firm attributes, and find that attributes explaining foreign ownership also help to characterize trading by foreigners. Interestingly, we find that foreign investors seem to engage in short-term trading more than domestic investors. Next, we investigate the dynamics of flows and returns. The results suggest that foreigners are momentum investors, that is, foreigners increase their net holdings in firms that have recently performed well. This feedback trading stems from purchases of stocks with positive return shocks, and less from sales of stocks with negative return shocks. We also find that the liberalization of the Swedish equity market led to a permanent price increase, corresponding to a reduction in the cost of equity capital in the magnitude of two percentage points on an annual basis. Finally, we analyze the performance of investments by foreigners. Very little evidence of informational trading was found, suggesting that risk sharing is the driving force behind the permanent price increase.

The third chapter, "Exchange Rate Exposure, Risk Premia, and Firm Characteristics," co-authored with Magnus Dahlquist, has its starting point in the failure of several investigations to document significant exchange rate exposure. We argue that this is mainly because too aggregated economic measures have been used. In fact, in a sample of 352 Swedish firms during the period 1988 to 1998, we find significant exchange rate exposure for 40% – 70% of the firms, where the significance increases with the horizon. We also study the cross-section of exposure, across industries and firm attributes, and find that large firms, firms with high export rates, and firms with large foreign ownership are more exposed to exchange rate fluctuations than other firms. Importantly, however, individual firms in these groups show both positive and negative exposure, suggesting that the portfolios of these firms do not necessarily show significant exposure. In line with this, we find that investors are not rewarded for taking exchange rate related risk, and we conclude that exchange rate exposure can be eliminated through diversification.

The final chapter, "Conditioning Information in Tactical Asset Allocation," shows that expected returns in Swedish stock and bond markets present predictable time-varying components. I study the economic significance of predictability by implementing dynamic asset allocation strategies based on a conditioning information set. The realized returns on the dynamic strategies are then compared with the returns on several benchmarks, including unconditional efficient strategies and a value-weighted market portfolio. I find the performance of the dynamic strategies to be superior. Although the statistical significance of the return predictability is only moderate, the economic significance of the superior performance may be large.

Chapter 1

Direct Foreign Ownership, Institutional Investors, and Firm Characteristics

with Magnus Dahlquist

1 Introduction

It is well documented that the proportion of foreign assets held by domestic investors is too small relative to what is implied by standard portfolio theory. This finding, referred to as the "home bias," is typically analyzed by comparing the aggregated holdings of investors in foreign markets with their domestic holdings (see Lewis, 1995, 1999, for overviews of the home-bias puzzle).

Kang and Stulz (1997) take a different route and study the shareholdings of foreigners in individual firms in a specific market. They find that foreigners investing in Japan tend to underweight smaller and highly leveraged firms. Moreover, they find that holdings are relatively large in firms with large export sales. The overall evidence is consistent with the conjecture that foreigners invest in firms that they are better informed about. Thus, it can be argued that the home bias is driven by informational asymmetries.

Recently, a number of articles analyze the trading behavior of various investor categories. Grinblatt and Keloharju (2000), for instance, emphasize that

[0] We would like to thank Campbell Harvey, Bertil Näslund, Peter Sellin, Patrik Säfvenblad, and an anonymous referee for helpful comments and suggestions. SIS Ägarservice has provided us with the data on foreign ownership.

the degree of sophistication matters when studying investors in the Finnish market. They report that domestic investors, presumably less sophisticated, take the opposite position of that of more sophisticated foreign investors. This finding holds for both domestic institutional as well as individual investors. Seasholes (2000) discriminates between domestic institutional and retail investors in Thailand and Taiwan, and documents that both categories trade against the flow generated by foreign investors. However, Choe, Kho, and Stulz (1999) study the trading pattern on the Korea stock exchange, and show that Korean institutions generally behave like foreign investors.

This paper deepens the understanding of holdings of foreign investors and the home bias. By analyzing a rich and detailed dataset of equity ownership, and studying the determinants of foreign ownership in Swedish firms, we identify various firm attributes that are common to foreign ownership. Further, we argue that the type of foreign investor is an important aspect to analyze, with regard to trading and ownership. Our dataset allows us to compare and contrast foreign ownership with the holdings of domestic investors by category. This feature proves to be important for the interpretation of our findings. We are also able to analyze foreign ownership of individual countries and relate foreign ownership to the geographic structure of international investments.

The paper proceeds in three steps. In the first step, we characterize aggregated foreign ownership in individual Swedish firms for the period 1993 to 1997 using firm-specific attributes, such as size, leverage, and current ratio. We further consider various measures of risk as well as the return on the firms' shares on the stock market. We reject the null hypothesis that foreigners invest according to the market portfolio. Foreign ownership seems to be positively related to the market capitalization of firms and the amount of cash on their balance sheets, and negatively related to dividend yields.

The preference among foreign investors for large firms can be seen as a proxy for firm recognition and information asymmetries. For instance, in a domestic setting, Coval and Moskowitz (1999) find evidence of a preference among U.S. investors for geographically close investments. We therefore investigate this preference in more detail by introducing variables that capture firm recognition as well as investor influence. The analysis shows significant links between foreign ownership and the new variables. We find, for example, a positive relation between foreign ownership and the market liquidity of a firm's shares, and to its presence in the international goods and services markets, a negative relation between foreign ownership and ownership concentration, and a positive relation between foreign ownership and firms that are listed on international stock exchanges. This evidence is consistent with Merton's (1987) model, in which rational investors prefer firms about which they are better informed. Huberman (1999) phrases this preference in terms of a behavioral bias, namely that "familiarity breeds investment."

In the second step, we discriminate between foreign and institutional holdings by employing alternative benchmark portfolios. Since the typical foreign investors in Sweden are institutional investors, we focus on domestic institutional holdings as the benchmark. The analysis reveals that foreign and institutional ownership can be characterized by similar attributes. Our findings support the results in Falkenstein (1996) and Gompers and Metrick (1999). Falkenstein (1996) documents that U.S. mutual funds tilt their portfolios towards large firms, and Gompers and Metrick (1999) find that American institutions invest in firms that are larger, more liquid, and have had relatively low returns during the previous year. These findings mirror our study of foreigners investing in Sweden. Hence, we conclude that we do not find a foreigner bias per se, but rather that institutional investors in general deviate from holding the market portfolio.

In the third step, we investigate foreign ownership at a disaggregated level, using ownership data on a country-by-country basis. The analysis suggests that the sensitivity to firm attributes varies across different geographic regions. Our results seem to be most pronounced for the holdings of North American investors, principally from the U.S. Since U.S. institutional investors are the largest foreign investors, this finding supports our view that investor size can determine the extent of the deviation for investors from holding the market portfolio.

In summary, the overall results support the findings in Kang and Stulz (1997), that foreign investors tend to have a preference for firms with certain attributes. It can be argued that many of these attributes are proxies for firm recognition and investor influence. However, our results show that the holdings of foreigners are similar to the holdings of other domestic investor categories. As we are able to compare and contrast ownership categories, this paper provides a new angle on previous results. We conclude, in fact, that the bias we find is actually an institutional investor bias rather than a foreign investor bias. In particular, the results seem to be strong for the large U.S. investors.

The paper is organized as follows. In Section 2 we discuss theoretical arguments for determinants of foreign ownership, and formulate empirical hypotheses to test. Section 3 contains a description of the ownership data, as well as the firm attributes that are used in our analysis. In Section 4 we characterize foreign ownership and document the relation to the various attributes. We also compare the holdings of foreigners with the holdings of domestic investor categories in Sweden. Finally, Section 5 presents our conclusion.

2 Benchmarks and Empirical Hypotheses

In this section, we briefly review some theoretical arguments for the determination of foreign ownership at a country level as well as at the firm level. Furthermore, based on these arguments, we formulate empirical hypotheses to test.

2.1 Benchmarks

The home equity bias, which observes that investors show a preference for investing in their home countries, is well documented. [1] Most empirical studies of the home bias have used ownership data aggregated on a country level. One exception is Coval and Moskowitz (1999), who find a, within-country home bias at a regional level among U.S. investors. However, like Kang and Stulz (1997) we employ a firm-specific dataset of the holdings of foreigners in Sweden in the hope that this information will help us understand equity holdings in general, and the home-bias puzzle in particular.

[1] Although some recent studies (including Bekaert and Urias, 1996, and Errunza, Hogan, and Hung, 1999) suggest that the home bias is not statistically significant, a large part of the literature, starting with Grubel (1968) and Levy and Sarnat (1970), shows that investors gain from holding more internationally diversified portfolios.

In the empirical analysis below, we begin by comparing the portfolio of foreign investors with the Swedish market portfolio. The use of the market portfolio as a benchmark can be justified from an international version of the Capital Asset Pricing Model (CAPM), as considered below. However, when discussing the home-bias puzzle, no obvious reference portfolio, including the market portfolio, exists. For this reason, we complement our analysis by constructing a relevant benchmark portfolio. We compare foreign ownership with the holdings of domestic mutual funds, other institutional investors, and individual investors. This comparison makes it possible to discover the presence of a foreigner bias while controlling for other effects, such as the possibility that institutional investors systematically deviate from holding the market portfolio.

2.2 Home Bias Explanations and Some Empirical Hypotheses

Several potential explanations for the home bias exist. Most arguments fall into one of the following two categories. First, that international investors face barriers in selecting and investing in firms' shares. Second, deviations from the international CAPM affect foreign investment holdings. While many arguments only have implications for the investor's choice of foreign assets across countries, others will also influence the portfolio choice at the firm level. These arguments help us to formulate empirical hypotheses to test.

The first category involves both explicit and implicit barriers. Explicit barriers include foreign exchange control, withholding taxes, and other directly observable obstacles. In developed markets, however, these obstructions have been dramatically reduced over the last twenty years. French and Poterba (1991), Cooper and Kaplanis (1994), and Tesar and Werner (1995) argue convincingly that explicit barriers can no longer explain the observed portfolio allocations. This observed absence of barriers holds true for Sweden during the sample period, since the last investment restriction that applied to foreigners was abolished in 1993. Hence, in this paper, we focus on arguments that are related to implicit barriers.

Implicit barriers include political, or country, risks and informational asymmetries. Aversion to international investments due to political risk can arise if non-resident investors meet problems associated with the repatriations of income and capital. Due to Sweden's political stability, we will not argue that this factor is important when foreign investors allocate their wealth across Swedish stocks.

An aversion towards international investments may also be due to informational asymmetries between foreign and domestic investors. That is, foreign investors may find themselves less informed about a country and its firms. These asymmetries also include the possibility that foreign and domestic investors process information differently due to intellectual or emotional biases. For instance, if investors in general are more optimistic regarding expected returns on the domestic market than on foreign markets, the observed home bias is an implication of this pattern in forming expectations. Merton (1987) and Huberman (1999) argue that investors prefer securities they know about. It seems likely that foreign investors invest in Swedish firms about which they have some knowledge or familiarity.

We test different versions of this hypothesis using various proxies for why some firms are better known to foreign investors. In the first set of hypotheses, we conjecture that large firms, measured by market capitalization, are better known abroad than small firms. This measure represents a coarse proxy, since size could be positively correlated with several other properties that may appeal to foreign investors. Thus, as an alternative, we conjecture that firms with large export sales are recognized abroad. Moreover, firms which are listed on other stock exchanges are more likely to be better known.

We also study whether issues related to influence affect foreign investors. If investors want to influence the management of a firm, they can, in principal, proceed in two ways. Investors can either use their votes at the shareholders' meeting, or sell their shares and thereby signal their opinions. Tesar and Werner (1995) document that the turnover rate on international equity investments is high both when compared with the turnover rate in the investor's home country, and when compared to the market of the foreign security. Their findings suggest that market liquidity is particularly important for foreign investors. For this reason, we check to see whether this implication is supported by our data. Moreover, if foreign investors have an interest in the management, we would expect them to avoid firms with highly concentrated ownership. Therefore, we use a measure of ownership concentration to test whether foreigners want to be able to directly influence the management of a firm.

Finally, we investigate the geographic structure of foreigners' holdings. The conjecture is that investors know more about firms that are geographically close to them. Evidence of this conjecture has been provided by Coval and Moskowitz (1999) in a domestic setting, using data from the money management industry in the U.S. Since our dataset allows us to study the holdings of investors from different countries, we test whether geographic distance is related to ownership.

In the second category of explanations of the home-bias puzzle, deviations from the international CAPM have been put forth. Under the maintained assumption of perfectly integrated markets for capital and goods, the usual CAPM can be extended to an international setting (see, for instance, Stulz, 1981, and Adler and Dumas, 1983). The international CAPM then implies that the world market portfolio is the right benchmark for investors' overall portfolio holdings, and that each local market portfolio is relevant for the holding within a local market. However, the literature has emphasized that investors do not hold the world market portfolio. In extensions of the international CAPM, the optimal portfolio for investors typically also includes a component which relates to a hedging demand.

In principal, it is possible that investors want to hedge against any kind of state variable. However, it is impossible to formally test the implications of a hedging demand without a more precise idea of what investors want to hedge. For example, if investors want to hedge against changes in the return on their human capital, they could invest in securities that are negatively correlated with their human capital. Assets in industries other than the one producing the investor's labor income are then natural candidates. Since correlations typically are lower between countries than between different industries within a country, foreign assets may provide a good hedge against changes in the return on human capital. Baxter and Jermann (1997) support this view and show that U.S. investors should actually short the U.S. market portfolio because of its high correlation with the return on human capital. It can also be argued that foreign investors are better off hedging the return on human capital by investing in industries other than those in their domestic markets. We do not, however, elaborate further on this issue.

3 Data Description

3.1 Foreign Ownership: A First Look

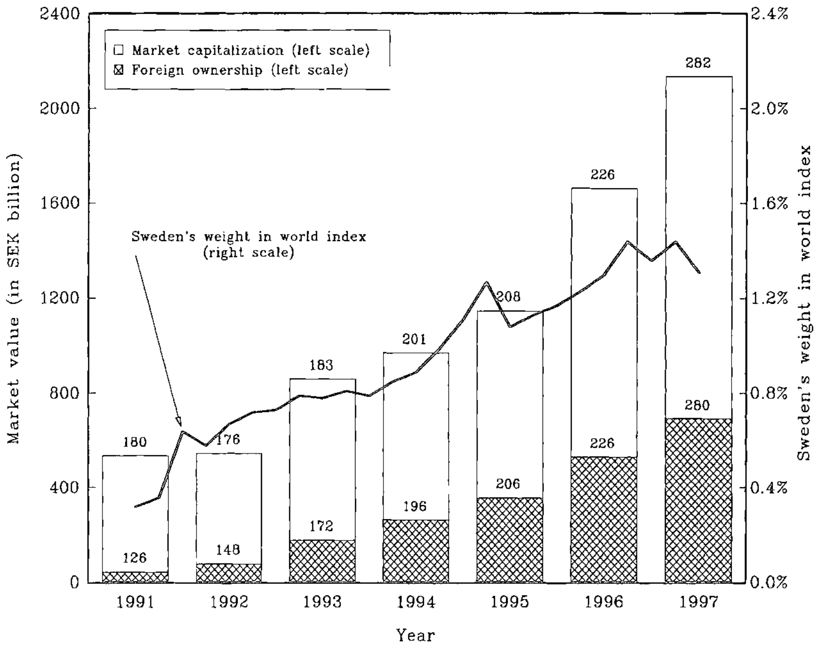
Stockholders of all listed firms in Sweden are registered at Värdepapperscentralen, the Security Register Centre. Since many registered owners are custodian banks, additional research is needed to identify the actual owners. In Sweden, this research has been undertaken by SIS Ägarservice.[2] Our dataset includes all Swedish firms listed from 1991 to 1997. For each firm, we can see the share of total equity held by foreign investors at the end of each year.

In *Figure 1*, the white bars show the aggregate market capitalization of the firms during the period 1991 to 1997. During the sample period, the price of a U.S. dollar (USD) has varied between 6 and 9 Swedish kronor (SEK). The market value increased by a factor of four, from SEK 535 billion in 1991 to SEK 2, 136 billion in 1997. In Figure 1, the cross-hatched part of the bars illustrates foreign ownership. As we can see, during this period foreigners increased their holdings more than 15 times, from SEK 44 billion to SEK 692 billion. In other words, the portion held by foreigners increased from 8.2% to 32.4%. The total number of firms is given above the white bars, while the number of firms with positive foreign ownership appears above the cross-hatched bars. The total number of firms during this period is 352, varying from 176 in 1992 to 282 in 1997. In 1991, 126 firms, or 70% of the total number of firms, had at least one foreign owner. From 1995 onwards, over 99% of the firms had some foreign ownership.

The increased interest from foreign investors, reflected in Figure 1, is partly due to regulatory changes during the period. Before 1993, most Swedish firms had two classes of equity, restricted and unrestricted shares. Only the latter could be held by foreigners. The proportion of unrestricted shares was limited by law to 20% of the voting rights and 40% of the equity. The restrictions were

[2] We thank Daniel Fristedt, Anneli Sundin, and Sven-Ivan Sundqvist at SIS Ägarservice for providing the data, and for sharing their insights on international data collection.

Figure 1: Foreign Ownership on the Swedish Stock Market
The figure shows foreign ownership in Sweden on a year-by-year basis over the period 1991 to 1997. The bars depict the total market capitalization of the Swedish stock market as well as foreign ownership in the Swedish market; both of these measures are reflected on the left scale. The market value and foreign ownership are expressed in terms of SEK billion. The numbers above the white bars represent the number of firms while those above the cross-hatched bars show the number of firms, with positive foreign ownership. The fluctuating line in the figure shows quarterly observations of Sweden's weight in the world market, reflected on the right scale.



formally abolished in January 1993, but many firms were already allowed to convert their restricted shares to unrestricted shares in 1992.

The fluctuating line illustrates Sweden's weight in the Financial Times World Market Index at the end of each quarter. This index only includes stocks that can be bought by foreign investors. Although Sweden's weight in the world index increased by a factor of four in this period, foreign investments grew more than 15 times. Hence, the increased share of foreign ownership in Swedish stocks cannot be explained by investors simply following the world market index.

One potential problem with our measure of foreign ownership is that no information is available on foreigners' use of Swedish-registered investment vehicles. Similarly, we have only limited knowledge of the use of foreign investment vehicles among Swedes. Since we only have access to data on direct ownership in firms we cannot, for instance, discriminate between a domestic and a foreign investor investing in a Swedish mutual fund. If foreigners invest in Swedish mutual funds, we underestimate true foreign ownership. However, the foreign ownership that we cannot observe only affects the results if it is tilted toward investments in specific firms. For the same reason, we can overestimate foreign ownership if Swedes invest domestically through firms located outside Sweden. However, we have quantified the use of foreign investment vehicles among the major Swedish owners and corrected for this in our ownership data. As an example, the Swedish Spendrup family controls the Spendrup brewery through a Dutch foundation. Technically speaking, this holding constitutes foreign ownership, but we have classified it as a holding by a Swedish investor.

We have classified the firms into nine industries using the codes provided by Affärsvärlden. *Table 1* provides a summary of foreign ownership for each industry at the end of 1997. The first two columns present the number and the market capitalization of the firms in different industries. The largest industry category by far is Engineering. It accounts for about 39% of the total market capitalization in our sample. The second and third largest industries are Financials, and Chemicals and Pharmaceuticals, at about 14% and 13%, respectively. Shipping is clearly the smallest industry. Columns three and four report foreign ownership. Engineering is also the largest industry in the portfolio held by foreign investors. Almost 45% of their portfolio consists of Engineering firms, and thus they have a 15% overweight in the portfolio. Foreigners are also overweighted in Chemicals and Pharmaceuticals, and in the Pulp and Paper industry. It appears that foreign investors are not keen on construction firms in Sweden, since they have an underweight of about 50%. One reason for this phenomenon could be that Construction is typically a local business and, as a consequence, foreign investors know little about the firms in this industry. It is also clear that foreigners are underweighted in Retail and Consumer Goods, and Miscellaneous. Our study of the portfolio of foreign investors over time shows that the portfolio mix has been fairly stable during the sample period. The only exceptions are that foreigners were systemati-

Table 1: Foreign Ownership on the Swedish Stock Market, by Industry

	Firms in industry		Firms with foreign ownership		Averages of foreign ownership	
Industry	N	MCAP (in %)	N (in %)	MCAP (in %)	Equally weighted	Value-weighted
Engineering	50	832.9 (39.0)	50 (100.0)	310.2 (44.8)	20.0	37.2
Paper and pulp	13	175.9 (8.2)	13 (100.0)	61.8 (8.9)	28.2	35.3
Retail and consumer goods	37	114.7 (5.4)	37 (100.0)	26.7 (3.9)	19.2	23.3
Construction	32	113.4 (5.3)	31 (96.9)	18.8 (2.7)	13.3	16.6
Shipping	12	13.2 (0.6)	12 (100.0)	3.7 (0.5)	22.2	27.8
Financial	11	309.0 (14.5)	10 (90.9)	93.6 (13.5)	28.6	30.3
Chemical and pharmaceutical	20	283.2 (13.3)	20 (100.0)	106.1 (15.3)	19.6	37.5
IT and services	43	94.4 (4.4)	43 (100.0)	28.9 (4.2)	20.4	30.6
Miscellaneous	64	200.5 (9.4)	64 (100.0)	41.9 (6.1)	18.6	20.9
All	282	2,136.4 (100.0)	280 (99.3)	691.8 (100.0)	19.7	32.4

The table shows foreign ownership by industry on the Swedish stock market for 1997. The first two columns show the total number of firms (N) and the total market capitalization (MCAP), in SEK billion. The percentage of an industry's capitalization relative to total market capitalization is given in parenthesis. The third column shows the number of firms with positive foreign ownership and the corresponding percentage to the total number of firms. The fourth column reports the market capitalization of foreign ownership, with the percentage of total foreign ownership given in parenthesis. The last two columns show the equally weighted and value-weighted averages of foreign ownership in the industries.

cally underweighted in Pulp and Paper until 1996, and that the position in Financials was disproportionately high in 1991 and 1992.

The last two columns of the table present the equally weighted and value-weighted averages of foreign ownership. These columns illustrate an important characteristic of the data. The equally weighted average is computed by taking the percentage of shares owned by foreigners for each firm and then averaging this percentage across firms. This average ranges from 13.3% for Construction to 28.6% for Financials. When calculating the value-weighted averages, we simply summarize the market value of all shares held by foreign investors and divide this number by the total market capitalization of the firms. As seen in the table, the value-weighted average is always larger than its equally weighted counterpart. This pattern indicates that foreign investors seem to hold disproportionately more shares in large firms in terms of market value. We also checked this feature of the data for the period 1991 to 1996, and found the same pattern in each year. Hence, the preference for large firms seems to be robust both over time and over industries.

3.2 Firm Characteristics

In this subsection, we briefly describe a number of firm-specific attributes used in the empirical analysis. To enable easy comparison, we first choose essentially the same attributes as Kang and Stulz (1997). These are:

(*i*) *Size.* This variable is the market capitalization of the firm at the year-end. In the regressions, we consider the log of the market capitalization.

(*ii*) *Dividend yield.* The value of all dividends paid during the year divided by the market value of the firm at year-end.

(*iii*) *Return.* The yearly return on the shares of the firm is calculated as the cumulative compounded return using the 52 weekly returns preceding the year-end. For firms with a shorter listing history than 52 weeks, the dataset contains a missing value.

(*iv*) *Systematic risk.* Systematic risk is the beta coefficient for the market model, estimated using the weekly returns. The market portfolio is the value-weighted portfolio in our sample.

(*v*) *Idiosyncratic risk.* This variable measures the residual variance in the market model regression using weekly returns.

(*vi*) *Book-to-market.* This is a valuation measure of the firm. "Growth firms" typically have low book-to-market ratios, while firms with higher ratios are referred to as "value firms." The ratio is defined as the book value of equity divided by the market value of equity at year-end.

(*vii*) *Current ratio.* We use this as a proxy for short-term financial distress. It is calculated as current assets divided by current liabilities at year-end, and measures the ability of the firm to meet its short-term payment requirements.

(*viii*) *Leverage ratio.* This is a measure of long-term financial distress. It is defined as the ratio of total liabilities to total equity at year-end.

(*ix*) *Return on equity.* Return on equity is measured as net income divided by the book value of equity at year-end.

As mentioned above, we use firm size as a first proxy for how well-known a firm is abroad. When we further analyze the preference for large firms, we consider alternative variables that proxy for firm recognition and investor influence. These variables are:

(x) *Export rate.* Firms with large sales abroad are more likely to be familiar to foreign investors. The export rate is measured as export sales divided by total sales.

(xi) *Turnover rate.* This rate is a measure of the market liquidity of the firm's shares. It is defined as the total value of stocks traded over a year divided by the market value of the firm.

(xii) *Concentration.* This measure of ownership concentration is defined as the proportion of votes held by the largest shareholder coalition.

($xiii$) *Foreign Listing.* This dummy variable takes a value of one if the firm's shares are listed abroad. Otherwise, the value is zero.

Stockholm Information Exchange (SIX) provided the data for variables (i) to (xi), while (xii) and ($xiii$) are from SIS Ägarservice and Stockholm Stock Exchange, respectively.[3]

4 Empirical Results

In this section, we present evidence of foreign ownership in Sweden. We begin by showing the relation between foreign ownership and the different firm characteristics used by Kang and Stulz (1997). We then deepen our understanding of the determinants of foreign ownership by introducing further variables that serve as proxies for firm recognition and investor influence. Next, we demonstrate that most features associated with foreign ownership are driven by the fact that foreign investments are typically made by institutional investors or mutual funds, rather than by foreign individual investors. Finally, we consider geographic aspects of foreign holdings.

[3] We thank Henrik Cronqvist and Mattias Nilsson for putting together the data on ownership concentration.

4.1 Aggregated Foreign Ownership and Firm Characteristics

4.1.1 A Baseline Estimation

To illustrate the binary relations between foreign ownership and firm characteristics, we first construct portfolios based on firm characteristics presented in the previous section, excluding the variations on size, variables (x) and (xi). Specifically, all firms listed at the end of 1997 are ranked according to their characteristics and sorted into quintiles. In *Table* 2 we report the average of the characteristic and the foreign ownership for each quintile. The first ranking in the table illustrates a strong positive relation between foreign ownership and the size of a firm, measured as market capitalization. In the quintile of the smallest firms (Q1), the average market value is about SEK 110 million, and foreign ownership, measured as an equally weighted average, is 10%. However, in the quintile of the largest firms (Q5), the average market value is SEK 34 billion, and foreign ownership is almost 30%. The bias in favor of large firms supports our earlier findings. Moreover, foreign investors own a larger share in firms with low book-to-market ratios and low dividend yields. In other words, foreigners seem to like growth stocks. Recall, however, that our grouping procedure only allows us to make inference on binary relations. Since book-to-market ratios and dividend yields by construction, are likely to be negatively correlated with size, the apparent preference of foreigners for growth stocks may be spurious, and driven by a preference for large firms. It is also noteworthy that foreign ownership is lower in firms with high idiosyncratic risk, and, to some extent, in firms with high leverage. The results from the ranking portfolios are similar to those obtained either by using median values, instead of averages, or by sorting according to ownership instead of the firm characteristics. Furthermore, the results are similar for each year of the sample period.

To analyze the above relations while controlling for the other characteristics, we run multivariate regressions of foreign ownership on the firm characteristics. The estimations are carried out on a year-by-year basis from 1993 to 1997, as well as in a pooled regression. We exclude 1991 and 1992 from our regressions since the restriction on foreign investments were still in place in many of the firms during these years. Let ω_{it}^F and ω_{it}^M denote the weights of

Table 2: Ranking of Firms Based on Characteristics

	Quintiles						
	Q1	Q2	Q3	Q4	Q5	Average	N
Foreign ownership	9.99	17.06	15.16	26.87	29.20	19.66	282
Market capitalization	0.11	0.34	0.90	2.67	34.07	7.62	
Foreign ownership	25.73	20.03	20.41	22.90	17.67	21.35	216
Dividend yield	0.00	0.57	1.67	2.71	5.21	2.03	
Foreign ownership	18.29	18.73	25.80	24.25	18.65	21.14	210
Return	–31.12	–1.61	15.54	33.61	87.69	20.82	
Foreign ownership	24.04	17.82	20.44	17.59	25.84	21.14	210
Beta	0.18	0.46	0.62	0.77	1.13	0.63	
Foreign ownership	21.98	23.89	20.99	22.03	16.83	21.14	210
Residual variance	0.04	0.06	0.09	0.13	0.38	0.14	
Foreign ownership	24.54	17.06	21.33	19.97	15.50	19.68	263
Book-to-market ratio	0.11	0.24	0.40	0.59	1.05	0.48	
Foreign ownership	20.47	20.70	19.32	16.95	20.39	19.57	257
Current ratio	0.63	1.29	1.66	2.10	6.72	2.48	
Foreign ownership	22.71	19.64	21.24	23.54	18.18	21.06	203
Leverage ratio	0.25	0.93	1.36	1.99	3.69	1.64	
Foreign ownership	19.51	22.31	17.70	24.27	17.07	20.17	196
Return on equity	–26.79	5.36	12.75	19.87	34.88	9.21	

The table shows the ranking of firms based on characteristics for 1997. Firms are ranked according to a characteristic, sorted into quintiles, and averages of foreign ownership and the characteristics within each quintile are reported. The five quintiles are labeled Q1 (low) to Q5 (high). Average refers to the equally weighted average of foreign ownership and the characteristics. N is the total number of observations used in the ranking. Foreign ownership is expressed as a percentage of the capitalization of the firm. Market capitalization is expressed in SEK billion. Dividend yield is defined as the ratio between the yearly dividend and the market capitalization of the firm at the end of the year (in %). Return is the yearly return on the shares of the firm (in %). Beta is the slope coefficient from a market model regression. Residual variance is the variance of the error term from the market model regression. Book-to-market ratio is defined as the book value of equity divided by the market value of equity at year-end. Current ratio is the current assets divided by current liabilities at year-end. Leverage ratio is defined as the ratio of total liabilities to total equity at year-end. Return on equity is the net income divided by the book value of equity (in %).

firm i in year t in the portfolio of foreign investors and the market portfolio, respectively. In the regressions, we characterize foreigners' holdings relative to the market portfolio, and employ $y_{it} = \omega_{it}^F/\omega_{it}^M - 1$ as the dependent variable. Note that the ratio of foreign investors portfolio weight in firm i to the weight of firm i in the market portfolio is equivalent to the ratio of the foreign ownership in firm i to the value-weighted average of foreign ownership. A positive y_{it} implies that foreigners invest disproportionately more in firm i relative to the market portfolio, while negative values of y_{it} imply that foreigners invest less in firms relative to the market portfolio. The regressions are given by

$$y_{it} = \alpha_t + \beta' x_{it} + \varepsilon_{it}, \tag{1.1}$$

where x_{it} is a vector of firm characteristics associated with firm i in year t, β is a vector of parameters, ε_{it} is an error term, and fixed year effects are represented in the intercept α_t.

The regression results are reported in *Table* 3, where constants and fixed effects are not shown. The positive relation between foreign ownership, size, as measured by the log of market capitalization, and current ratio, and the negative relation between dividend yields and foreign ownership, are apparent. The regressions for each year reveal that foreigners invested significantly more in large firms, in firms with more cash, and in firms with relatively low dividends. In the pooled regression, there also appears to be a negative relation between foreign ownership and the book-to-market and leverage ratios. However, in the individual years, these results are only statistically significant in a few cases.

In the pooled regression, the estimated current ratio coefficient is about 7, meaning that a unit increase of the current ratio, all else held equal, is related to a 7% higher foreign ownership. The coefficient for the logged market capitalization is about 15. That is, foreign ownership in a firm with a market value approximately 2.7, or e times, larger than an otherwise identical firm is on average 15% higher. Since the magnitude of cross-sectional variability of logged size and current ratio is almost identical (not reported), firm size contributes to about twice the variability in foreign ownership compared with the current ratio, and is clearly the most important determinant of foreign ownership among all the attributes.

We performed several robustness checks on our results. First, we conducted the estimation for each industry separately, as well as in a regression pooled over industries in which dummy variables were included to pick up industry-specific fixed effects. These estimations support our main result, uncovering the positive relation between foreign ownership, firm size, and the current ratio, and the negative relation between foreign ownership and dividend yields. The weak negative relation between foreign ownership and the

Table 3: Regressions of Foreign Ownership on Characteristics

	1993	1994	1995	1996	1997	Pooled
Market capitalization	15.80	17.48	13.23	15.90	16.47	14.57
	(3.14)	(2.52)	(2.61)	(2.68)	(2.76)	(1.17)
Dividend yield	−16.28	−9.29	−3.94	−4.29	−1.88	−4.30
	(4.24)	(3.09)	(1.98)	(1.60)	(0.97)	(0.90)
Return	−0.01	−0.06	−0.19	0.06	−0.22	−0.01
	(0.05)	(0.14)	(0.16)	(0.11)	(0.08)	(0.04)
Beta	−3.66	−26.98	−3.63	−1.42	−36.19	−7.45
	(7.74)	(12.68)	(12.04)	(12.04)	(13.33)	(5.04)
Residual variance	−4.06	19.88	42.82	−21.60	−16.88	2.49
	(5.38)	(45.01)	(25.88)	(16.50)	(26.74)	(5.82)
Book-to-market ratio	−5.85	−8.22	−31.94	−15.14	−14.62	−12.45
	(14.2)	(5.70)	(12.80)	(12.31)	(10.46)	(4.81)
Current ratio	8.92	17.17	9.45	8.58	5.90	7.48
	(5.03)	(4.49)	(2.88)	(2.86)	(1.91)	(1.53)
Leverage ratio	−1.36	−1.05	−3.42	−3.64	−0.41	−1.82
	(1.30)	(1.42)	(2.27)	(3.26)	(2.59)	(0.75)
Return on equity	0.12	−0.00	0.31	−0.37	−0.21	−0.08
	(0.12)	(0.23)	(0.31)	(0.19)	(0.12)	(0.09)
Adjusted R^2	15.59	26.68	20.87	22.16	18.39	20.05
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
N	154	161	184	184	185	868
N_0	10	2	2	0	0	14

The table shows the results of multiple regressions of foreign ownership on firm characteristics on a year-by-year basis, as well as on data pooled over the years from 1993 to 1997. The pooled regression allows for fixed effects by year. Constants and year-dummies in the regressions are not shown. The dependent variable is the ratio of the weight of firm i in the portfolio of foreign investors to the corresponding weight in the market portfolio, minus one. The definitions of the regressors follow the description in Table 2, with the exception that market capitalization is logged. Heteroskedasticity-consistent standard errors are reported in parentheses. The adjusted R-square in the regressions is reported (in %). P-values from a Wald test of the joint significance are given in square brackets. N is the total number of observations available, and N_0 is the number of observations with zero foreign ownership.

book-to-market ratio seems to be related to a tendency for foreigners to underweight construction firms, since the average book-to-market ratio for construction firms is almost twice as high as that of the aggregate market.

We also checked whether our results are affected by outliers in the dependent variable, that is, by firms with zero weights or heavily overweighted firms. Since we are effectively considering a truncated distribution of ownership, the appropriate regression model is a censored regression model, a Tobit model. To limit the impact of highly overweighted firms, we also considered a log transformation of the ratio of portfolio weights as the dependent variable, that is, $y_{it} = \ln\left(1 + \omega_{it}^F / \omega_{it}^M\right)$. The estimated model is thus

$$y_{it}^{\star} = \alpha_t + \beta' x_{it} + \varepsilon_{it}, \tag{1.2}$$

where $y_{it} = 0$ if $y_{it}^{\star} \leq 0$, and $y_{it} = y_{it}^{\star}$ if $y_{it}^{\star} > 0$. The results confirm that foreigners hold a disproportionately large part of their portfolio in large firms, in firms with a high current ratio, and in firms paying low dividends.

The preference for firms paying low dividends can be motivated by the tax advantage foreign investors may fall with regard to the trade-off between capital gains and dividends. In many countries, this case holds, at least for long-term holdings. If foreign investors typically find themselves less informed about firms than domestic investors, they may prefer firms with high current ratios since this is an objective and easily measurable quantity that carries information about the financial strength of a firm. The bias toward large firms has a number of potential explanations since size can be a proxy for many preferred firm attributes. Thus, in the following subsection, we further characterize foreign ownership and analyze why firm size is a preferred characteristic among foreign investors. More specifically, we test hypotheses based on the conjecture that size is a proxy for firm recognition.

4.1.2 Firm Recognition and Investor Influence

Why do foreign investors like large firms? Could it be that large firms are better known, or are other features, such as the market liquidity of the shares, more important? Merton (1987) and Huberman (1999) argue that investors simply prefer firms with which they are familiar, and which they may have more knowledge about. A starting point for our analysis would then be to consider firms that are frequently covered by analysts and media. These firms are likely to be the largest firms in the financial market. An alternative way to recognize a firm is through global markets. Thus, an investor may be more willing to invest in well-known exporting firms, and firms that are listed on foreign exchanges. Furthermore, Tesar and Werner (1995) document that foreign investors trade more than their colleagues investing in domestic markets. This trading pattern demands high market liquidity of the firm's shares. Finally, we consider a measure of ownership concentration as a regressor, to gauge the importance of investor influence among foreign investors.

The results from pooled regressions are presented in *Table 4*. One obstacle that arises when relating the results from these regressions with earlier findings is that we have far fewer observations on the new variables. To limit the impact of this problem and enable comparisons, we re-ran the regressions of foreign ownership on size, dividend yield, book-to-market ratio, and current ratio, which are the most significant variables from the full regressions, on the subset for which we have data for the new variables. Since export rate is the variable with the smallest number of observations, we consider regressions with and without export rate as a regressor.

Size is still significant in most regressions. The current ratio and dividend yield display a significant relation to foreign ownership over all regressions, and the magnitudes of the coefficients are unaffected by the inclusion of new variables. Foreigners seem to have a strong preference for firms with high exports and turnover. Moreover, ownership concentration enters the regression significantly with a negative sign, implying that foreigners avoid firms with a dominant owner. In other words, they seem to attach considerable importance to their influence in the firm. Finally, foreign investors tend to hold firms listed on other international stock exchanges. These variables together seem to diminish the size effect. In the regression where all attributes are included, size exhibits no significant relation to foreign ownership. We also added a dummy variable for the firms listed on the A-list of the Stockholm Stock Exchange. These firms meet the most stringent requirements with respect to verifiable history, free float of equity, number of shareholders, among other criteria. However, the coefficient was insignificant and close to zero in all regressions. In the regression from which the export rate is excluded the additional attributes, including turnover, concentration, and foreign listing, are still significant, both individually and jointly.

To sum up, foreign investors seem to prefer firms with the most liquid stocks, firms with large exports, firms with low ownership concentration, and firms that are listed abroad. The overall evidence is consistent with the conjecture that informational asymmetries is the driving force behind the biases in foreigners' holdings. Below, however, we will document similar deviations from the market portfolio for domestic institutional investors.

Table 4: Regressions of Foreign Ownership on Further Characteristics

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)
Market capitalization	13.72	11.01	15.30	11.08	5.60	4.59	13.93	15.40	12.65	10.39	10.87
	(1.73)	(2.06)	(1.73)	(1.99)	(2.91)	(3.17)	(1.02)	(1.05)	(1.03)	(1.46)	(1.48)
Dividend yield	–4.74	–5.47	–3.16	–4.46	–4.84	–3.95	–4.39	–3.97	–4.27	–4.22	–3.81
	(2.01)	(2.12)	(2.04)	(1.95)	(2.00)	(2.16)	(0.87)	(0.84)	(0.87)	(0.89)	(0.86)
Book-to-market ratio	–41.93	–35.73	–37.87	–37.58	–44.76	–34.52	–15.13	–12.23	–15.17	–14.87	–12.68
	(12.44)	(12.80)	(12.64)	(12.23)	(12.11)	(13.25)	(5.18)	(4.81)	(5.22)	(5.05)	(4.79)
Current ratio	13.47	10.79	13.39	15.06	10.96	11.02	9.30	8.90	8.76	8.95	8.27
	(2.59)	(3.02)	(2.70)	(2.38)	(3.14)	(2.97)	(1.40)	(1.41)	(1.42)	(1.42)	(1.43)
Export rate		38.46				22.40					
		(14.68)				(15.28)					
Turnover rate			46.32			32.05		27.82			21.57
			(10.58)			(10.68)		(5.14)			(5.13)
Concentration				–76.05		–57.52			–44.43		–32.21
				(14.81)		(14.24)			(9.86)		(9.61)
Foreign listing					45.61	37.17				29.60	27.20
					(12.61)	(12.84)				(8.54)	(8.53)
Adjusted R^2	17.73	18.88	22.27	23.52	22.08	29.25	21.78	24.38	23.90	23.20	26.61
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
N	317	317	317	317	317	317	841	841	841	841	841
N_0	1	1	1	1	1	1	12	12	12	12	12

The table shows the results of multiple regressions of foreign ownership on new characteristics pooled over the years from 1993 to 1997. Constants for fixed year effects in the regressions are not shown. Market capitalization, Dividend yield, Book-to-market ratio and Current ratio are defined as in Table 2. Export rate is measured as export sales divided by total sales. Turnover rate is the ratio between the turnover, in SEK, and the market value of the firm. Concentration is defined as the share of votes held by the largest shareholder coalition. Foreign listing is a dummy variable for firms listed on a stock exchange abroad. Heteroskedasticity-consistent standard errors are reported in parentheses. The adjusted R-square in the regressions is reported (in %). P-values from a Wald test of the joint significance are reported in square brackets. N is the total number of observations available, and N_0 is the number of observations with zero foreign ownership.

4.2 Foreign Ownership versus Domestic Investor Categories

We have seen that foreign investors deviate from holding the market portfolio, and that they tend to prefer firms with certain attributes. As stated earlier, the representative foreign investor is an institutional investor. Ideally, we would then like to construct a domestic benchmark investor with characteristics as similar as possible to those of the typical foreign investor. This construction would enable us to compare two groups of investors, foreign and domestic. In addition to analyzing deviations from the market portfolio, we use information from various domestic investor categories and contrast the properties of their portfolios with those of foreigners' portfolios.

An examination of foreign investors reveals that the representative foreign investor is a large institution.[4] These institutions can, in turn, be divided into industrial investors and portfolio investors. Investors in the first group typically have a few large holdings, while investors in the second group hold diversified portfolios. We have access to three aggregates of domestic investors for 1997: mutual funds, other institutional investors, and individuals. We focus on the holdings of the institutional investor categories and use them as domestic benchmarks investors. To complete the picture, we also present results for individual investors.

A first analysis of domestic benchmark holdings in different industries (not reported) shows that domestic institutional investors also hold a disproportionate share of ownership overweighted in Engineering firms. A striking difference, however, is that domestic institutional investors overweight their positions in Construction. The fact that Construction firms are typically local businesses, and therefore likely to be less well-known to foreigners, may explain this difference. An interesting property of domestic institutional ownership is that the value-weighted average of the ownership exceeds the equally weighted counterpart in each industry. This finding indicates that domestic institutional investors also have a disproportionately higher ownership in large firms. Hence, our finding that foreigners prefer large firms may be spurious and driven by the fact that the typical foreigner is a large institutional investor. To check this finding, we begin by running a regression of the hold-

[4] See Sundin and Sundqvist (1998) for details on which foreigners are the largest shareholders.

Table 5: Regressions of Ownership on Characteristics, by Category, 1997

	Foreign ownership	Mutual fund ownership	Institutional ownership	Individual ownership
Market capitalization	11.43	11.72	13.83	–54.87
	(3.31)	(4.90)	(2.52)	(6.40)
Dividend yield	–2.24	3.40	0.15	1.81
	(1.28)	(2.24)	(1.28)	(3.11)
Return	–0.18	–0.09	–0.24	0.88
	(0.09)	(0.16)	(0.07)	(0.19)
Beta	–29.82	21.88	0.85	38.03
	(12.28)	(18.22)	(10.27)	(22.76)
Residual variance	0.21	–88.56	–30.01	109.34
	(27.14)	(37.54)	(23.53)	(55.40)
Book-to-market ratio	–14.41	–41.88	15.86	11.82
	(10.54)	(13.28)	(9.01)	(21.06)
Current ratio	6.52	–0.22	–2.28	–6.37
	(2.06)	(2.23)	(0.94)	(2.70)
Turnover rate	5.55	–20.81	–19.82	41.91
	(7.68)	(10.20)	(6.81)	(16.77)
Concentration	–34.70	–30.83	–41.56	163.55
	(19.98)	(23.72)	(14.76)	(39.18)
Foreign listing	27.77	–42.71	–17.58	10.41
	(16.97)	(16.74)	(11.92)	(22.59)
Adjusted R^2	20.68	14.91	30.81	54.95
	[0.00]	[0.00]	[0.00]	[0.00]
N	173	173	173	173
N_0	0	19	0	0

The table reports the results of multiple regressions of ownership, by category, on characteristics for 1997. The definitions of the regressors follow the description in Tables 2, 3, and 4. Constants in the regressions are not shown. Heteroskedasticity-consistent standard errors are reported in parentheses. The adjusted R-square in the regressions is reported (in %). P-values from a Wald test of the joint significance are reported in square brackets. N is the total number of observations available, and N_0 is the number of observations with zero ownership.

ings by domestic investor categories on the firm characteristics. The model specification is identical to that of Equation (1.1), with the exception that the dependent variable is now $y_{it} = \omega_{it}^D/\omega_{it}^M - 1$, where ω_{it}^D is the weight of firm i in year t in the portfolio of the domestic benchmark investor.

The regression results are presented in *Table 5*. To enable easy comparison, the table also reports the coefficients for foreign ownership. Foreign ownership in 1997 is positively related to size and the current ratio, and negatively related to systematic risk. The regression results also demonstrate that the holdings of domestic mutual funds and other institutional investors are also significantly positively related to the size of the firm. In this year, we find that foreigners and institutional investors invest less in firms with low past returns. However, we find some differences between foreign holdings and those of large domestic institutions. The main differences are that foreigners prefer firms with high current ratios, and that domestic institutions invest relatively more in firms with low turnover and less in firms with high idiosyncratic risk. The latter result suggests that domestic investors seem to more distinctly avoid the most risky firms, as compared to foreign investors.[5] The holdings of all large investor categories are negatively related to ownership concentration, but not always significantly so. Finally, all investor categories deviate from holding the market portfolio as indicated by the p-values from Wald tests of overall significance. The R-squares for the regressions are about 21%, 15%, and 31% for the foreign ownership, mutual fund ownership, and institutional ownership, respectively.

The table also presents the results for individual investors. As this category is residual, we can expect the results to mirror those of the other investor categories. The main result is that individual investors, compared with the market, seem to underweight large firms and firms with high current ratios and low turnover. Instead, they overweight firms with high ownership concentration. Note that, in many small firms, an individual person *is* the dominating owner. With regard to the attributes capturing risk and return, we see that a pattern emerges. Individual investors show a preference for firms that have high past returns, and overweight firms with relatively high risk, both systematic and idiosyncratic.

The results for domestic mutual funds and institutional investors can be compared and contrasted with those found in other studies. Falkenstein (1996) finds that U.S. mutual funds have a significant preference for stocks with high visibility, as measured by coverage in newspaper articles. In particular, funds show an aversion to small firms. Gompers and Metrick (1999) show that large institutions, compared with other investors, prefer to invest in large, liquid stocks that have low past returns. Hence, our results support previous evidence on the holdings of institutional investors.

When comparing the regression result for foreign and large domestic investors, we find, in some cases, that the sign of the coefficients differs across

[5] This behavior is revealed when grouping firms into quintiles according to their firm characteristics. For the sake of brevity, we do not report the findings from this procedure.

the two regressions. However, there is a high degree of uncertainty in the parameter estimates. It appears that the main difference between foreign and domestic institutional investors, with respect to their preference for certain firm characteristics, is that foreigners like cash whereas domestic institutions underweight firms with high idiosyncratic risk. We also see that domestic institutions put less emphasis on firms with high turnover. To formally test whether this is true, we regress the difference of the portfolio mixes for foreign and domestic investors on the firm characteristics. We run Equation (1.1) again, now using $y_{it} = \omega_{it}^F/\omega_{it}^M - \omega_{it}^D/\omega_{it}^M$ as the dependent variable. An alternative specification would be to let $y_{it} = \omega_{it}^F/\omega_{it}^D - 1$, that is, to study the direct ratio between the foreign and domestic portfolio weights. However, this specification introduces a problem when the domestic weights, recorded in the denominator, are equal to zero.

The results are shown in *Table 6*. As expected, the coefficients are equal to the difference between the coefficients in Table 5, but the standard errors allow us to test the equality of the difference in holdings. The most significant coefficients, as compared to the domestic institutional investors, are those that are associated with turnover and foreign listings. These estimates reveal that the main difference between foreign and domestic benchmark investors is that domestic investors hold less in firms with high turnover, and that foreigners have a preference for firms that are listed abroad. The latter result supports our conjecture that asymmetric information may be an important factor when explaining why foreign investors deviate from holding the market portfolio.

We also see some evidence that foreigners have a preference for firms with large cash positions and firms paying small dividends. As previously argued, the preference of foreign investors for firms paying low dividends can be explained by tax advantages in foreign jurisdictions for capital gains to dividends income. In Sweden, both forms of income are taxed at the same level. The bias displayed by foreign investors towards firms with large cash positions on their balance sheets can be understood in terms of asymmetric information, that is, foreigners appreciate firms with a high objective measure of financial strength.

Interestingly, the size effect seems to be common to all three institutional investor categories. While these three categories are fairly similar, the signifi-

Table 6: Regressions of Foreign Ownership versus Other Ownership Categories

	Foreign ownership versus		
	Mutual fund ownership	Institutional ownership	Individual ownership
Market capitalization	–0.29 (6.94)	–2.40 (4.82)	66.30 (8.43)
Dividend yield	–5.63 (2.91)	–2.38 (2.07)	–4.05 (3.74)
Return	–0.09 (0.20)	0.06 (0.13)	–1.06 (0.24)
Beta	–51.70 (26.50)	–30.67 (18.65)	–67.85 (29.86)
Residual variance	89.07 (54.80)	30.22 (40.43)	–109.13 (72.26)
Book-to-market ratio	28.47 (20.05)	–30.27 (15.84)	–26.23 (27.63)
Current ratio	6.74 (3.61)	8.80 (2.69)	12.89 (4.49)
Turnover rate	26.37 (14.15)	25.37 (11.71)	–36.36 (21.48)
Concentration	–3.86 (36.15)	6.86 (28.26)	–198.25 (52.63)
Foreign listing	70.48 (28.20)	45.34 (26.21)	17.36 (33.83)
Adjusted R^2	6.60 [0.00]	8.81 [0.00]	51.13 [0.00]
N	173	173	173
N_0	19	0	0

The table reports the results of multiple regressions of foreign ownership versus other ownership categories on characteristics for 1997. The dependent variable is the weight difference of firm i between the portfolios held by foreign and domestic investors, divided by the its weight in the market portfolio. The definitions of the regressors follow the description in Tables 2, 3, and 4. Constants in the regressions are not shown. Heteroskedasticity-consistent standard errors are reported in parentheses. The adjusted R-square in the regressions is reported (in %). P-values from a Wald test of the joint significance are reported in square brackets. N is the total number of observations available, and N_0 is the number of observations with zero ownership.

cant differences among investors are to be found when comparing them with individual investors. The latter show a much stronger preference for small and risky firms with high past returns. In addition, these investors do not avoid firms with dominant owners. The similarities between the three large institutional investor categories and how they differ from individual investors are confirmed by the R-squares of the regressions. The R-square in the regression of foreign versus individual holdings is as high as 51%, whereas the R-squares for mutual funds and institutions are only about 7% to 9%.

4.3 Disaggregated Ownership and Geographic Structure

In the previous analysis, we found that exports might serve as a proxy for firm recognition in global markets. This finding implies that investors from countries where Swedish firms have large sales potentially know more about the firms compared with investors from other countries. Traditionally, Swedish firms have large exports to the Nordic countries, and to several other European countries. In general, export sales seem to be negatively related to the geographic distance between Sweden and a particular country. In this subsection, we informally explore a corresponding relation between foreign ownership and the geographic distance to the investor.

In addition to the aggregate foreign ownership data, we have access to ownership data at a country level for 1997. The exact distribution of foreign ownership is given in *Table 7*, which shows that foreign ownership is highly concentrated to a few countries where investors from the U.S., followed by those from the U.K., dominate.

In *Table 8* we present statistics on foreign ownership by geographic regions. Investors from North America account for about half the total foreign ownership. The market value of their portfolio is SEK 338 billion. The portfolio of European investors is of the same magnitude with a market capitalization of SEK 283 billion, and the Nordic investors essentially make up the rest of the investment pool. It is noteworthy that for all regions, except the Nordic countries, the value-weighted average of foreign ownership is larger than the equally weighted average. This finding is particularly interesting given Sweden's geographic presence in the Nordic region. This result is in a sense related to Coval and Moskowitz (1999) who find that the closer the investment, the less evident the preference for large firms becomes. We further investigate deviations from the market portfolio in a regression framework in which foreign ownership for separate regions is employed as a dependent variable.

The results from the regressions of foreign ownership for geographic regions are presented in *Table 9*. The regressions are not undertaken for the Far East and Other categories as they include too few observations of positive foreign ownership. Investors from Europe and North America seem to prefer large firms, and firms with large cash holdings. The preference for large firms is significant for European and, especially, North American investors. Since

Table 7: Foreign Ownership on the Swedish Stock Market, by Country

	Foreign ownership				Positive holdings		
	Country	MCAP	in %		Country	N	in %
1	United States	330,002.6	47.7	1	Luxembourg	261	92.6
2	United Kingdom	134,800.4	19.5	2	United Kingdom	238	84.4
3	Luxembourg	32,101.7	4.6	3	United States	232	82.3
4	Germany	31,264.6	4.5	4	Switzerland	227	80.5
5	Switzerland	30,682.7	4.4	5	Denmark	222	78.7
6	Finland	24,542.1	3.5	6	Norway	165	58.5
7	Belgium	23,180.1	3.4	7	Belgium	148	52.5
8	Norway	22,312.3	3.2	8	France	128	45.4
9	Netherlands	18,043.1	2.6	9	Germany	120	42.6
10	Denmark	17,752.0	2.6	10	Finland	85	30.1
11	France	9,616.6	1.4	11	Netherlands	81	28.7
12	Canada	7,658.1	1.1	12	Canada	62	22.0
13	Japan	4,675.4	0.7	13	Spain	35	12.4
14	Ireland	1,524.5	0.2	14	Japan	29	10.3
15	Singapore	768.2	0.1	15	Ireland	29	10.3
16	Austria	752.9	0.1	16	Austria	28	9.9
17	Australia	631.2	0.1	17	Italy	26	9.2
18	Italy	372.4	0.1	18	United Arab Emirates	18	6.4
19	Greece	310.8	0.0	19	Greece	17	6.0
20	Hong Kong	286.3	0.0	20	Gibraltar	14	5.0
21	Spain	137.3	0.0	21	Cyprus	13	4.6
22	Cyprus	80.6	0.0	22	Hong Kong	12	4.3
23	Botswana	68.3	0.0	23	Australia	12	4.3
24	Seychelles	44.1	0.0	24	Singapore	11	3.9
25	Malaysia	41.4	0.0	25	Israel	7	2.5
26	United Arab Emirates	38.5	0.0	26	Seychelles	7	2.5
27	Cayman Islands	38.3	0.0	27	Botswana	4	1.4
28	Bermuda	33.9	0.0	28	Iran	3	1.1
29	Gibraltar	19.5	0.0	29	Ethiopia	3	1.1
30	Portugal	17.8	0.0	30	Portugal	3	1.1
31	New Zealand	6.3	0.0	31	Bermuda	2	0.7
32	Taiwan	3.4	0.0	32	Malta	2	0.7
33	Ethiopia	3.3	0.0	33	Liberia	2	0.7
34	Russia	3.2	0.0	34	Thailand	2	0.7
35	Israel	2.8	0.0	35	Estonia	2	0.7
36	Thailand	2.4	0.0	36	Egypt	2	0.7
37	Estonia	2.1	0.0	37	New Zealand	2	0.7
38	Malta	1.6	0.0	38	Colombia	2	0.7
39	Liberia	1.4	0.0	39	Czech Republic	2	0.7
40	Saudi Arabia	1.2	0.0	40	Russia	1	0.4
41	Iran	1.0	0.0	41	Cayman Islands	1	0.4
42	Egypt	1.0	0.0	42	Iceland	1	0.4
43	Iceland	0.9	0.0	43	Malaysia	1	0.4
44	Czech Republic	0.4	0.0	44	Saudi Arabia	1	0.4
45	Colombia	0.4	0.0	45	Taiwan	1	0.4
	Total	691,829.3	100.0		Total	280	99.3

The table shows foreign ownership by country on the Swedish stock market for 1997. In the left-hand columns, the countries are ranked by the market capitalization of their holdings (in SEK million). The right-hand columns present the rankings of countries by the number of firms in which they have positive holdings.

Table 8: Foreign Ownership on the Swedish Stock Market, by Region

Region	Firms with foreign ownership: N (in %)	Firms with foreign ownership: MCAP (in %)	Averages of foreign ownership: Equally weighted	Averages of foreign ownership: Value-weighted
Nordic	252 (89.4)	64.6 (9.3)	4.2	3.0
Europe	276 (97.9)	282.9 (40.9)	9.2	13.2
North America	234 (83.0)	337.7 (48.8)	6.1	15.8
Far East	46 (16.3)	6.4 (0.9)	0.1	0.3
Other	48 (17.0)	0.2 (0.0)	0.0	0.0
World	280 (99.3)	691.8 (100.0)	19.7	32.4

The table shows foreign ownership by geographic regions on the Swedish stock market for 1997. Market capitalization is expressed in SEK billion. For further details, see Table 1. The regions are the following: the Nordic countries, including Denmark, Finland, Iceland, and Norway; Europe, including Austria, Belgium, Cyprus, the Czech Republic, Estonia, France, Germany, Gibraltar, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Russia, Spain, Switzerland, and the United Kingdom; North America, including Canada, and the United States; Far East, including Australia, Hong Kong, Japan, Malaysia, New Zealand, Singapore, Taiwan, and Thailand; Other, including Bermuda, Botswana, Cayman Islands, Colombia, Egypt, Ethiopia, Iran, Israel, Liberia, Saudi Arabia, Seychelles, and the United Arab Emirates; and World, including all countries.

the average size of the U.S. investors is, by far, the largest among all foreign investors in our sample, this result is not surprising given our finding that the preference for large firms is effectively an institutional investor bias. It is also noteworthy that investors from Europe and North America show a small, insignificant preference for firms with high market liquidity, while the holdings of Nordic investors are negatively related to turnover. The relation to ownership concentration is negative for all regions, but only marginally significant in the World regression.

Regarding the overall significance, the regressions reveal that the results are largely driven by North American, or principally U.S., ownership. Indeed, the R-square for North America is about 30%, which can be compared to 6% for Europe. Interestingly, the holdings of Nordic investors do not significantly deviate from the market portfolio as indicated by the p-value from a Wald test of the overall significance (the R-square is less than 1%).

Table 9: Regressions of Foreign Ownership on Characteristics, by Region

	Nordic	Europe	North America	World
Market capitalization	−18.55	12.98	11.70	9.40
	(23.41)	(5.13)	(2.41)	(3.08)
Dividend yield	−15.31	−0.95	−0.17	−1.93
	(9.65)	(2.02)	(0.91)	(1.33)
Current ratio	5.63	4.70	7.88	6.27
	(10.99)	(2.17)	(3.70)	(1.81)
Turnover rate	−46.21	19.48	3.01	5.24
	(54.85)	(11.54)	(8.89)	(7.37)
Concentration	−230.52	−12.06	−22.93	−38.48
	(115.23)	(32.21)	(17.85)	(20.11)
Foreign listing	121.55	4.80	22.19	24.11
	(153.42)	(25.65)	(14.15)	(16.98)
Adjusted R^2	0.30	5.67	29.93	19.48
	[0.38]	[0.00]	[0.00]	[0.00]
N	173	173	173	173
N_0	13	0	17	0

The table shows the results of multiple regressions of regional foreign ownership on characteristics for 1997. See Table 8 for the countries that are included in the regions. Constants in the regressions are not shown. The definitions of the regressors follow the description in Tables 2, 3, and 4. Heteroskedasticity-consistent standard errors are reported in parentheses. The adjusted R-square in the regressions is reported (in %). P-values from Wald tests of the joint significance are reported in square brackets. N is the total number of observations available, and N_0 is the number of observations with zero regional ownership.

5 Conclusion

By using a rich dataset on equity ownership and firm-specific attributes, we are able to characterize foreign ownership in Swedish firms in great detail. We find that foreign investors allocate a disproportionately high share of their funds to large firms. Further, foreign investors seem to prefer firms with large cash positions on their balance sheet and firms that pay low dividends. Further, we attempt to understand why foreign investors prefer large firms, as size may be a proxy for many underlying sources, including firm recognition. We find that market liquidity seems to be an important driving force for this preference. The evidence also suggests that foreign ownership is related to firms' presence in the international markets, either through export sales or listings on other exchanges. Moreover, foreign investors seem to prefer firms with a widespread ownership, a characteristic which again is most likely to be fulfilled by large firms. The unique dataset that we have utilized has enabled us to compare and contrast foreign ownership with other domestic investor categories. We hence investigate whether the preference for large firms is a pure foreigner bias by relating foreign ownership to that of domestic mutual funds and other institutional investors. Interestingly, these investor groups display similar portfolio preferences as compared to foreign investors. This finding leads us to conclude that the preference for large firms is common to all institutional investors. Finally, our analysis of foreign ownership on a regional level indicates that the results seem to be driven by the holdings of large U.S. investors.

In this paper, we have focused on the characterization of foreign ownership and how it relates to institutional ownership. Further issues that are worth exploring include how foreigners have performed relative to the general market, what determines foreigners' purchases and sales of shares, and how flows are related to returns. We hope to be able to address these issues in the near future.

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Chapter 2

Foreigners' Trades in Risky Assets: An Assessment of Investment Behavior and Performance

with Magnus Dahlquist

1 Introduction

The relation between portfolio flows and market returns has recently begun to receive increased attention. This can be traced to two different, but related, strands in the international asset pricing literature.[1]

The first strand of the literature on international asset pricing deals with the well-documented home bias, which observes that investors prefer to invest in their home countries (see Lewis, 1995, 1999 , for overviews of the home-bias puzzle). Most studies of the home bias use ownership data aggregated on a country level. However, Kang and Stulz (1997) study a specific market, namely the Japanese market, and find that foreigners also reveal preferences for certain firm-specific attributes. In particular, foreign investors pre-

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[1] Articles analyzing the relation between portfolio flows and market returns include Warther (1995), Bohn and Tesar (1996), Brennan and Cao (1997), Bekaert, Harvey, and Lumsdaine (1999), Choe, Kho, and Stulz (1999), Edelen and Warner (2000), Kim and Wei (1999), Froot, O'Connell, and Seasholes (2000), and Seasholes (2000). Stulz (1999b) provides an overview.

fer the large, financially solid, and well-known firms. Dahlquist and Robertsson (2000a) find similar preferences among foreign investors in the Swedish market, but they attribute this to the fact that foreigners are large institutional investors. Seasholes (2000) studies the trading profits of foreigners investing in Taiwan, and finds that the ability of foreign traders to profit is related to the underlying firm's market capitalization, leverage, and the liquidity of its shares. He suggests that the firm-specific preferences of foreign investors described by Kang and Stulz (1997) and others, may simply be due to their desire to own the firms in which they have a comparative informational advantage, in other words, firms which offer them the opportunity to make trading profits.

The second strand of the international asset pricing literature is concerned with the consequences for the domestic equity market when it is opened up to foreign investors. Depending on how new information is perceived, foreign investors could pursue strategies that would result in stock price overreactions to changes in fundamentals. This could lead to excess volatility, and potentially have a destabilizing effect. On the positive side, Stulz (1999a) argues that a stock market liberalization may reduce the country's cost of equity capital by allowing for risk sharing between domestic and foreign investors. Bekaert and Harvey (2000), and Henry (2000) conduct empirical studies of market liberalizations in emerging markets, and find that the cost of capital is reduced when markets are opened up to foreign investors.

In this paper, we attempt to shed further light on the behavior of foreigners investing in Swedish firms. Building on the results in Dahlquist and Robertsson (2000a), we assess the characteristics, dynamics, and consequences of trading by foreigners using a rich dataset of ownership and flows. This dataset enables us to investigate the pattern and impact of purchases and sales by foreign investors in individual firms, and relate them to firm-specific attributes. We study the period from 1993 to 1998 on a monthly basis. This is the period immediately after the liberalization of the Swedish equity market when the restrictions on investments by foreigners were abolished.[2]

[2] The relation between flows and returns in the Swedish market has previously been analyzed by Sellin (1996) and Säfvenblad (1998). Säfvenblad (1998) considers flows and returns in fixed income instruments rather than equity flows and returns. Sellin (1996) focuses entirely on aggregated flows and returns and investigates a very different period when there were severe

We are interested in addressing two main questions. First, how do the characteristics of the domestic market affect foreign investors? In particular, how are foreigners' purchases and sales related to lagged equity returns? A positive relation between past returns and current net purchases can be interpreted as positive feedback trading, meaning that investors purchase assets when prices have risen and sell when they have fallen. This is also referred to as momentum trading or return chasing. Since several studies have found that foreign investors prefer firms with certain attributes, we study whether these preferences imply different trading behavior in firms with different characteristics. Second, how does the presence of foreign investors affect the domestic market? This question can also be addressed in both a time-series and a cross-sectional perspective. Starting with the former, net purchases may raise stock market prices temporarily, reflecting price pressure, or permanently, due to a long-lasting decrease in the cost of equity capital. A permanent price effect can be motivated by risk sharing benefits of a capital market opening, or if foreign investors have access to new (or different) information on Swedish firms that is incorporated into the prices by foreigners trading.[3] If foreigners are better informed, they can earn significant profits by trading on their information. Hence, we study foreigners' trading performance to gauge the relative importance of the risk sharing and informational motives. The cross-sectional effects of the trades made by foreign investors may be quite important since these investors prefer firms with certain characteristics. For instance, the reduction of the cost of equity capital may differ among firms depending on foreigners' preferences.

The main results in this paper can be summarized as follows. We find that attributes that explain foreign ownership also help to characterize trading by foreigners (i.e., purchases plus sales). Interestingly, we find that foreign investors trade much more than domestic investors, as documented in Tesar and Werner (1995) for other international markets. Moreover, our analysis suggests that foreigners are momentum investors, that is, they seem to

restrictions on foreigners' ownership. We relate our results to those obtained in Sellin (1996).

[3] It is often argued that foreign investors have an informational disadvantage compared with domestic investors when analyzing firms (see, for instance, Brennan and Cao, 1997). However, although foreigners may be less informed about the details of a domestic firm, they can be better informed about the general conditions of an industry, or when analyzing international competitors of Swedish firms.

increase their net holding in firms which have recently performed well. This supports the findings of Kim and Wei (1999), Froot, O'Connell, and Seasholes (2000), Grinblatt and Keloharju (2000), and Seasholes (2000), who report that international flows are strongly influenced by past returns. In addition, we find that momentum trading stems from purchases of stocks with positive return shocks, and less from sales of low-performance stocks. We also find contemporaneous effects of flows on prices, namely that net purchases are associated with significant increases in returns. These effects are not purely price pressure effects, since they do not reverse, suggesting that additional net purchases have led to permanent changes in the cost of equity capital. A crude measure of the effects indicates a reduction in the cost of equity capital of about two percentage points on an annual basis. This is in line with the findings of Bekaert, Harvey, and Lumsdaine (1999). In a similar framework, they find that increased capital flows decrease the cost of equity capital in emerging stock markets. We also find that the price effects, and, consequently, the effects of the cost of equity capital, vary across firms. Hence, a deregulation of the equity market directly affects the industrial structure of a country in that it alters the relative cost of capital of firms. Finally, we analyze the performance of investments by foreigners. Very little evidence of informed trading is found, suggesting that risk sharing is the most plausible explanation for the reduction in the cost of equity capital.

The remainder of this paper proceeds as follows. Section 2 presents the data in detail and provides a preliminary analysis of trades by foreigners. This motivates the analysis of how flows are related to returns. Section 3 describes the methodology, discusses the identification assumptions made, and measures the relation between flows and returns. Section 4 presents the analysis of foreigners' performance. Section 5 summarizes the main results and conclusions.

2 Data Description

In this paper, we use monthly stock market data from Sweden. Our sample covers the period from 1993 to 1998, and consists of gross purchases and sales of shares made by foreigners in 322 listed firms. Further, we use returns on individual stocks as well as several firm attributes to explore the determinants of foreign trading, and to characterize the cross-section.

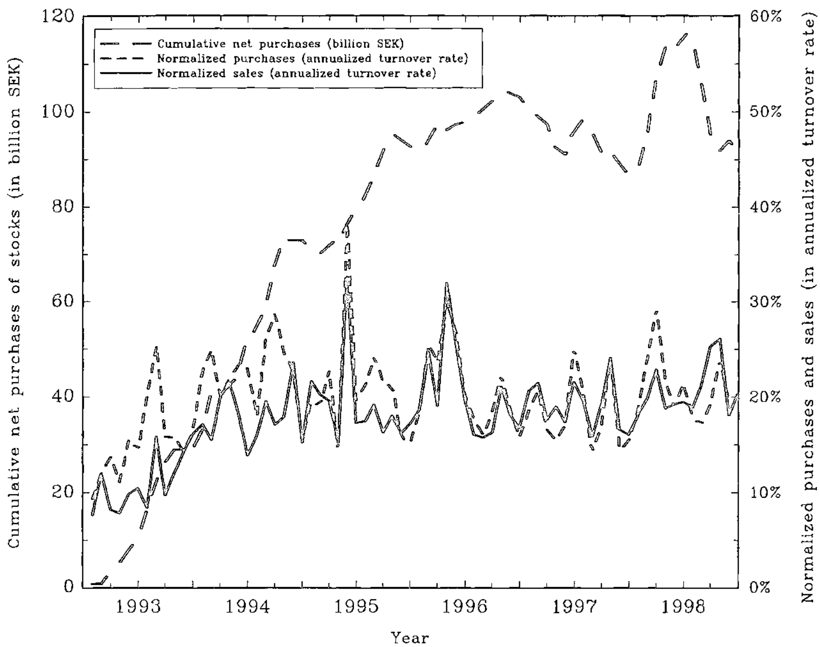
2.1 Foreigners' Trades

On a monthly basis, the central bank of Sweden, the Riksbank, collects reports from all the brokers, banks and other financial intermediaries that are involved in securities trading with foreign counterparts. We employ data referred to as "portfolio investments in Swedish listed stocks," where we have access to gross purchases and sales for all listed firms at an individual basis. Hence, we have the opportunity to analyze trades by foreigners at a disaggregated level.

The flow data, however, present some problems. Portfolio investments include all flows except direct investments, where the latter are transactions made by investors owning 10% or more of the capital or votes in a firm. Hence, if a foreign investor already holds 10% of the equity in a firm, and then decides to increase his ownership, this is not reflected in the portfolio investment data.[4] Unfortunately, firm-specific data on direct investments by foreigners in Sweden are not available. This internationally accepted accounting policy is particularly cumbersome in association with takeovers, since these events imply very large transfers of equity. For instance, if a foreign investor bids on a Swedish firm, the typical response is that a number of other foreigners accept the bid and sell their stocks. These sales are reflected in the data since they are classified as portfolio investments. However, the acquiring firm is by definition making a direct investment, which is not included in the data. Hence, when a Swedish firm is acquired by a foreign investor, the portfolio investment data show (spuriously) that foreigners are net sellers of stocks to Sweden. To limit the impact of this idiosyncrasy, we ignore the observations that we know are biased. Specifically, we discard the last three months of data before a firm is de-listed (taken over). Another problem is that we underestimate the true trading volume for firms listed on multiple exchanges, since our data only include cross-border transactions. However, the trading

[4] At the end of 1997, 43 foreign investors hold 10% or more in a Swedish firm. Together, these holdings have a market value of SEK 64.7 billion, which corresponds to 9.7% of total foreign ownership.

Figure 1: Foreigners' Trades on the Swedish Stock Market
The figure shows monthly trading by foreigners on the Swedish market for the period 1993–1998. The long dashed line shows the cumulative net purchases by foreign investors expressed in SEK billion (reflected on the left scale). The short dashed and solid lines depict normalized gross purchases and sales, respectively (both reflected on the right scale). Normalization is performed by dividing the monthly gross purchases and sales by the contemporaneous market capitalization.



in Swedish stocks on international exchanges is likely to be dominated by foreign investors. Since our main aim is to study the purchases and sales of Swedish stocks made by foreigners as a group, inter-foreigner trading is not immediately relevant.

Figure 1 depicts the purchases and sales of Swedish stocks by foreign investors for the period from 1993 to 1998.[5] The long dashed line shows that there were cumulative net purchases of stocks worth approximately SEK 100 billion during the first half of the sample period. As a reference, total market

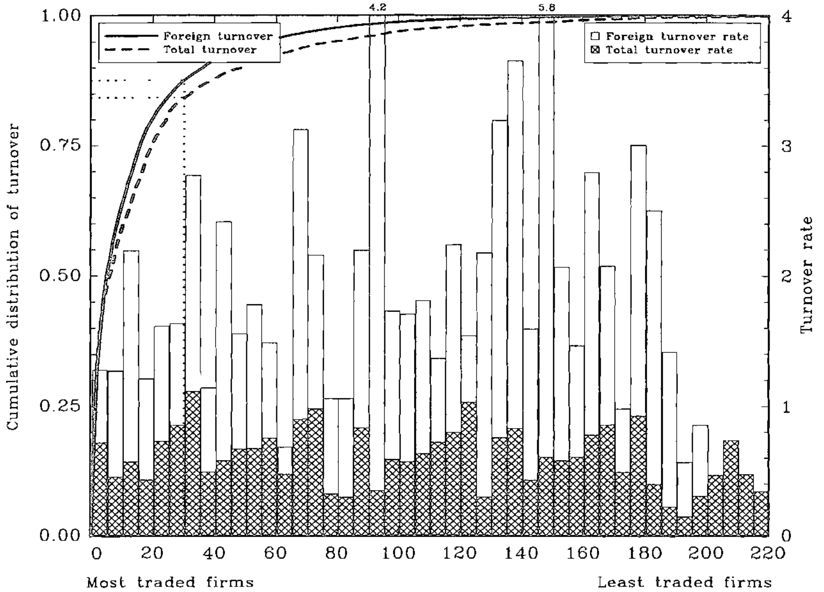
[5] Throughout the paper we use the term *net purchases* as a measure of purchases minus sales, while purchases plus sales are referred to as *trading*. Since purchases and sales are non-stationary variables, we also employ *normalized* measures by dividing the raw variables by the contemporaneous market capitalization.

capitalization was SEK 545 billion at the beginning of 1993. This interest in Swedish stocks reflects the deregulation, or liberalization, that took place in late 1992.[6] Between 1993 and 1995, foreign ownership of Swedish listed firms increased from slightly below 15% to almost 35% of the total market value (not reported). The latter half of the period shows a different pattern. The cumulative net purchases level off, that is, net purchases are close to zero. Hence, the share of foreign ownership in Swedish firms seems to stabilize around 35%. The figure also shows the gross purchases and sales of stocks. To facilitate a comparison of the flows over time, we divide them by the total market capitalization and refer to them as *normalized* purchases and sales. Again, we see that foreigners accumulated Swedish stocks between 1993 and 1995 (when the short dashed line showing purchases of stocks by foreigners is above the solid line that depicts sales by foreigners). On average, foreigners buy and sell stocks for an annualized value equivalent to 20% of market capitalization.

Figure 2 shows the cross-sectional distribution of foreign trading in 1997. The solid line depicts the cumulative distribution when firms are sorted on the basis of foreign trading, with the most traded stocks appearing on the left (reflected on the left scale). The dashed line shows the corresponding measure for the aggregate market. As seen in the figure, the 30 most traded stocks account for about 88% of foreign trading while the same stocks account for approximately 84% of the total turnover on the Swedish market. Hence, foreign trading seems to be slightly more concentrated to fewer stocks when compared with the aggregate market turnover. The bars show the corresponding turnover rates for foreign investors as well as for the aggregate market (reflected on the right scale). Foreigners' turnover rate (white bars) is defined as foreign purchases plus sales divided by foreign holdings at the end of the year; the aggregate turnover rate (cross-hatched bars) is defined as total turnover divided by the market capitalization at the end of the year. The figure reports average turnover rates for groups of five stocks. The first bar from the left shows that the average turnover rate for the five most traded stocks (in absolute value) is about 1.3. The corresponding aggregate turnover rate is around

[6] Before 1993, most Swedish firms issued two classes of equity, restricted and unrestricted shares. Only the latter could be held by foreigners. The proportion of unrestricted shares was limited by law to 20% of the voting rights and 40% of the equity. These restrictions were formally abolished in January 1993, which is the starting point of our sample period.

Figure 2: The Cross-Section of Foreigners' Trades
The figure shows the cross-section of foreign trading in 1997. The 222 firms with complete turnover data are sorted according to the amount traded by foreign investors (most traded firms on the left). The solid and dashed lines depict the cumulative distributions of foreign and total trading, respectively (both reflected on the left scale). The white bars show (in groups of five firms) the distribution of turnover rates by foreign investors, that is, foreign trading divided by the value of foreign holdings at the end of the year (reflected on the right scale). The cross-hatched bars show the corresponding distribution for the total market, that is, total market turnover divided by market capitalization at the end of the year (reflected on the right scale).



0.5. The level of foreign turnover rates seems to be uncorrelated with the absolute amount of foreign trading in a stock. This indicates that foreigners simply trade more in firms with large market capitalization and less in smaller firms. Interestingly, the turnover rates for foreigners exceed the corresponding aggregate rate in all cases except for the four groups with the least trading by foreigners. This finding confirms the results from other markets, reported in Tesar and Werner (1995); they conclude that the turnover rate on international equity investments is high both when compared with the turnover rate in the investor's home country, and when compared with the market of the foreign security.

2.2 Returns and Firm Characteristics

The return data are based on monthly closing prices from the Stockholm Stock Exchange (SSE), with the standard adjustments for splits, stock dividends and cash dividends. Hence, returns are generated by prices from the last trade on the SSE even if a stock is later traded on another exchange, as is typically the case when the stock is listed on the New York Stock Exchange (NYSE) or other later-closing exchanges.

We also use a number of firm-specific attributes to explore the determinants of foreign trading. They are:

(*i*) *Size*. This variable is the market capitalization of the firm at year-end. In the regressions, we consider the log of the market capitalization.

(*ii*) *Dividend yield*. The value of all dividends paid during the year divided by the market value of the firm.

(*iii*) *Book-to-market ratio*. This is a valuation measure of the firm. It is defined as the book value of equity divided by the market value of equity.

(*iv*) *Current ratio*. We use this as a proxy for financial distress. It is calculated as current assets divided by current liabilities.

(*v*) *Export rate*. Firms with large sales abroad are more likely to be familiar to foreign investors. The export rate is measured as export sales divided by total sales.

(*vi*) *Turnover rate*. This is a measure of the liquidity of the firm's shares. It is defined as the annual value of traded stocks divided by the market value of the firm.

(*vii*) *Concentration ratio*. This measure of ownership concentration is defined as the proportion of votes held by the largest shareholder coalition.

(*viii*) *Foreign Listing*. This dummy variable takes a value of one if the firm's shares are listed abroad. Otherwise, the value is zero.

Stockholm Information Exchange (SIX) provided the data for variables (*i*) to (*vi*), whereas variables (*vii*) and (*viii*) are from SIS Ägarservice and SSE, respectively.[7]

Table 1 shows some preliminary regression results of foreign investments in Swedish firms. The two columns related to ownership highlight some of

[7] We thank Henrik Cronqvist and Mattias Nilsson who supplied us with the data on ownership concentration.

Table 1: Foreign Ownership, Trading, Net Purchases, and Firm Characteristics

	Ownership	Trading	Net Purchases	Ownership	Trading	Net Purchases
Market capitalization	4.59	9.73	−0.51	10.9	14.8	0.80
	(3.17)	(2.63)	(0.85)	(1.48)	(1.49)	(0.52)
Dividend yield	−3.95	−2.98	−0.34	−3.81	−2.30	−0.27
	(2.16)	(1.50)	(0.37)	(0.86)	(0.58)	(0.14)
Book-to-market ratio	−34.5	−23.1	−0.94	−12.7	−12.0	−0.78
	(13.2)	(8.18)	(1.98)	(4.79)	(3.50)	(0.96)
Current ratio	11.0	0.74	−0.34	8.27	2.05	0.00
	(2.97)	(1.74)	(0.27)	(1.43)	(1.35)	(0.60)
Export rate	22.4	2.19	−4.05			
	(15.3)	(5.86)	(2.19)			
Turnover rate	32.0	52.7	0.84	21.6	53.4	0.94
	(10.7)	(7.78)	(1.99)	(5.13)	(11.2)	(1.59)
Concentration	−57.5	−12.0	−3.20	−32.2	−3.91	−3.42
	(14.2)	(6.17)	(2.48)	(9.61)	(5.33)	(1.87)
Foreign listing	37.2	0.74	2.01	27.2	−3.46	−1.40
	(12.8)	(3.72)	(1.50)	(8.53)	(3.37)	(1.30)
R^2_{adj}	29.3	33.5	7.9	26.6	34.5	1.6
	[0.00]	[0.00]	[0.08]	[0.00]	[0.00]	[0.14]
N	317	317	317	841	841	841
N_0	1	30	30	12	136	136

The table shows the results of panel regressions of foreign ownership, trading, and net purchases on characteristics pooled over the period 1993–1997. Foreign ownership is defined as the ratio of the weight of a firm in the portfolio of foreign investors to the firm's weight in the market portfolio. Trading is the annual value of foreigners' gross trading (purchases plus sales) in a firm divided by its market value, while net purchases refers to the annual value of foreigners' net trading (purchases minus sales) in a firm, divided by its market value. Constants for fixed (year) effects in the regressions are not shown. Market capitalization is logged. Dividend yield is defined as the ratio between the yearly dividend and the market capitalization of the firm (in %). Book-to-market ratio is defined as the book value of equity divided by the market value of equity. Current ratio is current assets divided by current liabilities. Export rate is measured as export sales divided by total sales. Turnover rate is the value of the annual trading in the firm's stocks divided by the market value of the firm. Concentration is defined as the share of votes held by the largest shareholder coalition. Foreign listing is a dummy variable for firms listed on a stock exchange abroad. Heteroskedasticity-consistent standard errors are reported in parentheses. Adjusted R-squares are reported in %, with P-values from a Wald test of the joint significance in square brackets. N is the total number of observations, and N_0 is the number of zeros in the dependent variable.

the results in Dahlquist and Robertsson (2000a). Foreign ownership, according to their findings, is related to several firm-specific attributes; many of the attributes that characterize foreign ownership also seem to help characterize foreign trading. The table reports a positive relation between foreign trading and the market capitalization of firms, and to the market liquidity of firms' shares, and a negative relation to firms' dividend yields and to the book-to-market ratios. In the regressions with export rate as a regressor, a significantly negative relation is also found between foreign trading and ownership concentration.

The fact that similar attributes characterize ownership and trading by foreigners is not surprisingly. After all, investors typically trade in the stocks that they already own. However, when we try to relate foreigners' net purchases to firm characteristics, we do not find any patterns at all. Even this finding touches upon the trivial, since many attributes have little time-variation, and investors cannot be net buyers or net sellers for a long period of time without exceeding the obvious ownership limits of 0% and 100%. Therefore, when characterizing the net purchases of foreign investors, we take a different route and relate them to the returns of the particular stocks in which foreigners trade.

3 The Dynamics of Flows and Returns

In this section, we employ a vector autoregression (VAR) that allows us to study the dynamics between flows and returns. In this framework, we can measure the effects of an unexpected shock to flows on current returns, and see whether its dynamics have temporary or permanent effects. In other words, can we see price pressures or permanent changes in the cost of equity capital? Further, we can observe whether past returns affect current flows, that is, whether foreigners are feedback traders?

Let r_t denote the return of an investment over a period from $t-1$ to t. The flows (either net purchases, purchases, or sales) over this period are denoted by f_t. Following Froot, O'Connell, and Seasholes (2000) and Bekaert, Harvey, and Lumsdaine (1999), we make the following important identification assumptions. Current flows affect contemporaneous returns, and future flows and returns, whereas current returns only affect future returns and flows. This assumption is consistent with the view that current flows contain information about the value of firms.

3.1 The VAR Model

The dynamics of flows and returns are assumed to follow a bivariate first-order vector autoregression

$$y_t = \mu_A + A_1 y_{t-1} + \varepsilon_t, \tag{2.1}$$

where y_t is a vector of flows and returns at date t, μ_A and A_1 are constants, and ε_t is an independent and identically distributed error term with $\mathrm{E}(\varepsilon_t \varepsilon_s') = \Omega$ for $t = s$, and zero otherwise. This specification could easily be extended to allow for higher-order autocorrelation by writing it in a companion form. However, the results do not change to any significant degree when it is extended, and the first-order VAR specification is also supported by formal statistical lag-length tests. For this reason, we present it in its first-order VAR form.

We estimate the parameters of the VAR by least squares, and calculate impulse-response functions via bootstrapping and the percentile method as described in Hamilton (1994). The functions describe the response of flows and returns to a one-time impulse in orthogonalized flows or returns, with the other variable held constant. To be able to understand the impulse-response functions and interpret the effects in the VAR, we have to make additional assumptions. Consider the following structural model of flows and returns

$$B_0 y_t = \mu_B + B_1 y_{t-1} + \eta_t, \tag{2.2}$$

where

$$B_0 = \begin{bmatrix} 1 & -b_{12}^{(0)} \\ -b_{21}^{(0)} & 1 \end{bmatrix}, \quad B_1 = \begin{bmatrix} b_{11}^{(1)} & b_{12}^{(1)} \\ b_{21}^{(1)} & b_{22}^{(1)} \end{bmatrix},$$

and

$$y_t = \begin{bmatrix} f_t \\ r_t \end{bmatrix}, \quad \mu_B = \begin{bmatrix} \mu_{B1} \\ \mu_{B2} \end{bmatrix}, \quad \eta_t = \begin{bmatrix} \eta_{1t} \\ \eta_{2t} \end{bmatrix},$$

with $\mathrm{E}(\eta_t \eta_s') = D$ (a diagonal matrix) for $t = s$, and zero otherwise. Pre-multiplying each side of Equation (2.2) by B_0^{-1}, the result is the VAR model in Equation (2.1) with $\mu_A = B_0^{-1}\mu_B$, $A_1 = B_0^{-1}B_1$, and $\varepsilon_t = B_0^{-1}\eta_t$. Thus, a VAR can be viewed as the reduced form of a general dynamic structural model. Moreover, if B_0 is triangular, a unique mapping exists from the reduced-form parameters (μ_A, A_1, and Ω) to the structural parameters (μ_B, B_0, B_1, and D), implying that the structural model is exactly identified.

The critical assumption in our model is that we restrict $b_{12}^{(0)} = 0$. In other words, we allow foreigners' net purchases to affect the contemporaneous returns as well as future flows and returns, whereas current returns only affect future flows and returns.

3.2 Results

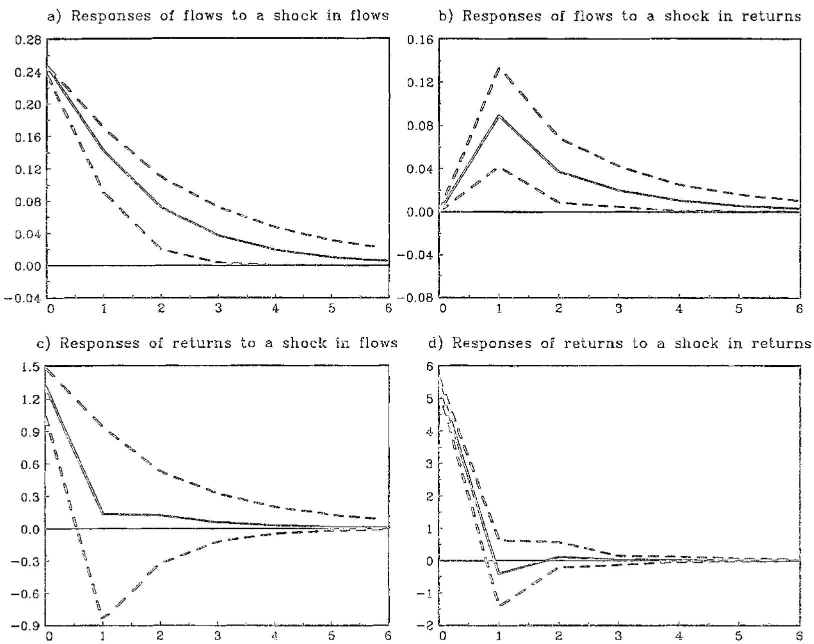
The main results from the VAR analysis are shown in *Figures 3a-d*. The figures depict the impulse-responses to innovations (or shocks) in aggregate net purchases and value-weighted returns when the magnitude of the shocks is one standard deviation. The responses are shown with 90% confidence bands that are derived from a bootstrap simulation. The horizontal axes are expressed in months.

Figure 3a shows the response of net purchases to an impulse in net purchases. A positive flow is followed by another positive flow and a negative flow is followed by another negative flow, and the persistence is significant for up to four months. This finding is consistent with the results found in Froot, O'Connell, and Seasholes (2000), who also report high persistence in the daily portfolio flows of 44 countries from 1994 to 1998.

The response of net purchases to an impulse in market returns is shown in Figure 3b. Foreigners' trades are affected by past returns. There is a positive (and significant) response of net purchases on returns, indicating that foreigners buy stocks when prices have increased and sell stocks when prices have decreased.[8] For instance, a 10% price increase implies that foreigners' net purchases increase by 0.16% of the market capitalization in the subsequent month, which corresponds to about SEK 1.5 billion using the market capitalization at

[8] Foreign investors involvement in positive feedback trading is also documented by Kim and Wei (1999), Grinblatt and Keloharju (2000), Froot, O'Connell, and Seasholes (2000), and Seasholes (2000).

Figure 3: Impulse-Response Functions with Net Purchases and Market Returns
The figures show the impulse-response functions of a one standard deviation shock with 90% confidence bands from a VAR system with aggregate flows (net purchases) and returns on a value-weighted portfolio. The identification assumption is that foreigners' flows affect contemporaneous returns as well as future flows and returns, whereas current returns only affect future flows and returns. The horizontal axes are expressed in months.



the end of 1995. That foreigners are momentum traders also has implications for the behavior of domestic investors, as the aggregate domestic investor then has to be a contrarian. Our data do not enable disaggregation of domestic investor categories, but the fact that domestic non-institutional investors typically are contrarians has been documented by Barber and Odean (2000) and Grinblatt and Keloharju (2000) in the U.S. and Finnish market, respectively.

Figure 3c shows the response of market returns to an impulse in net purchases. A significantly positive contemporaneous correlation is revealed between net purchases and returns. The price effect does not seem to be temporary, as there is no reversal. Instead, all lagged responses are close to zero. This pattern has two implications: First, the shock has a permanent effect on prices, which can be interpreted as a permanent reduction in investors' required rate of return, or equivalently, a reduction in the cost of equity capital. Second, foreigners does not seem to have market timing ability, since positive net purchases are not followed by positive returns.

The effect on prices and cost of equity capital can be measured economically by considering the following simple example. The figure shows that the immediate effect of a one standard deviation shock in flows is a 1.3% increase in prices, while the long-term effect is about 1.7% (not reported). As seen in Figure 3a, a one standard deviation shock in normalized net purchases corresponds to 0.25% of market capitalization. This is equivalent to about SEK 3 billion using the market capitalization at the end of 1995. Recall that the Swedish equity market was liberalized in 1993, and net purchases totaled about SEK 100 billion for the period 1993 – 1996. Given the persistence of flows, SEK 50 billion can be regarded as expected flows, and, consequently, the remaining SEK 50 billion as a shock. Hence, the cumulative effect of these shocks can represent a 28% increase in prices.[9] To measure this in terms of the effect of cost of equity capital, further assumptions are needed. We follow Stulz (1999a) and utilize the dividend discount model with the additional assumption of constant dividend growth rate, that is, the Gordon (1964) model. Hence, the current stock price can be expressed as $P = D/(R - g)$, where D is following period's dividend payment, R is the required rate of return (or the cost of equity capital), and g is the growth rate in dividends. Assuming the same growth rates in dividends before and after the liberalization, we can express the relation between the required rate of return before and after the liberalization according to

$$R^{after} = \frac{1}{1+\Delta} R^{before} + \frac{\Delta}{1+\Delta} g, \qquad (2.3)$$

where Δ is the percentage change in prices before and after the liberalization (i.e., $1 + \Delta = P^{after}/P^{before}$). Assume an annual nominal growth rate in dividends of 6% and a cost of equity capital before the liberalization of 15%. Then, the observed 28% prices increase caused by foreign investments yields a cost of equity capital after the liberalization of 13%. That is, the cumulative net purchases result in a change in the cost of equity capital corresponding to two

[9] This estimate is conservative since we use the end-of-period market capitalization. Using the period average yields a one standard deviation shock of less than SEK 2.4 billion and a price increase of 35%.

percentage points on an annual basis, a non-trivial reduction. Bearing in mind all of the caveats about inferring the change in cost of equity capital, this example is instructive and highlights the economic importance of the effect of foreigners on prices.

The positive correlation between flows and returns is consistent with the evidence provided by Sellin (1996). However, our results differ from his in one important aspect: He concludes that foreign investors tend to be noise traders, affecting prices temporarily, but that they reverse so the long-term effect is zero. What we find is a permanent effect, but no reversal. It is worth noting that Sellin (1996) considers a very different sample period, namely 1983 – 1995. In other words, his analysis covers more than ten years before the deregulation and only two years with significant foreign ownership and trading. This is the most likely reason for the difference in results.

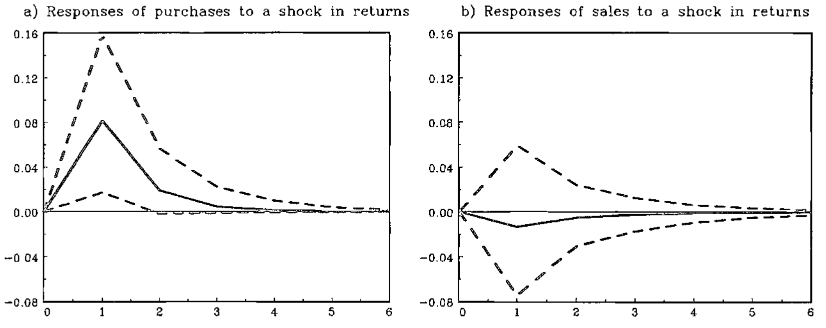
When interpreting the results, it is important to recall that the correlation between flows and returns is measured on a monthly basis. Froot, O'Connell, and Seasholes (2000) explore daily data on flows and returns, and show that the contemporaneous effect using a longer horizon can be broken down into a series of daily effects. They find that the positive contemporaneous correlation between flows and returns on a quarterly horizon is mainly due to the fact that returns lead flows on a daily horizon.

The response of market returns to an impulse on market returns is shown in Figure 3d. After an immediate positive response (measuring the volatility in returns after controlling for the effects of flows), no further effects are found. This basically reflects the low serial correlation in aggregated returns.

The relative importance of the various innovations can be assessed using the forecast error variances (not reported). We find that about 90% of the variance in net purchases is due to the variance in net purchases in itself and 10% is due to returns. The decomposition of the market return shows that about 5% can be attributed to innovations in net purchases, and 95% to returns.

The results above are presented for aggregate net purchases and the return on a value-weighted portfolio of stocks. Our data enable us to consider the effects for gross purchases and sales separately, as well as for individual firms. Some of the effects of analyzing purchases and sales separately are shown in *Figures 4a-b*. The figures show asymmetry in the responses of purchases and

Figure 4: Impulse-Response Functions with Purchases/Sales and Market Returns
The figures show the impulse-response functions of a one standard deviation shock with 90% confidence bands from a VAR system with aggregate flows (either purchases or sales), and returns on a value-weighted portfolio. The identification assumption is that foreigners' flows affect contemporaneous returns as well as future flows and returns, whereas current returns only affect future flows and returns. The horizontal axes are expressed in months.



sales to innovations in returns. Returns affect purchases positively, and statistically significantly, whereas sales are negatively affected, though not significantly. Overall, this gives a positive and significant effect on net purchases. Moreover, persistence is found to vary slightly: it is positive in both purchases and sales, but longer-lived in sales. Froot, O'Connell, and Seasholes (2000) find similar patterns in purchases and sales when using international flow data.

As a complement to the VAR based on aggregate variables, we also consider normalized net purchases and returns for individual firms. This enables us to study cross-sectional patterns in the dynamics of flows and returns. In particular, we investigate whether foreigners' net purchases affect the cost of equity capital differently across firms. We find that the price impact, and consequently the reduction in cost of equity capital, varies across firms. However, we are unable to find any clear relation between the magnitude of the price impacts and any of the firm characteristics in our dataset.

4 Foreigners' Trading Performance

In this section, we study the trading performance of foreign investors. If foreigners have information that is not yet incorporated in the prices, they can potentially earn significant profits by trading on this information. Hence, such informational advantage can explain the permanent effect that foreign investors have on prices. Grinblatt and Keloharju (2000) report that foreign investors outperform the domestic investors in the Finnish stock market, and Seasholes (2000) finds that foreigners investing in emerging markets are better informed about asset values than their local counterparts.

We investigate the relation between foreigners' net purchases in month t and returns of individual stocks s months ahead. This enables us to observe whether foreigners act the way informed investors do, by buying more of future winning stocks than of the losing stocks. We also study the cross-section of foreigners' trading profits by characterizing the firms in which foreigners show superior trading performance. Next, by using the data on foreign ownership reported in Dahlquist and Robertsson (2000a), we are able to calculate monthly returns on the aggregate portfolio held by foreign investors, and to evaluate its performance against benchmark portfolios.

4.1 Do Foreign Investors Buy Winning Stocks?

As a starting point, we follow Grinblatt and Keloharju (2000) and study whether foreigners act the way informed investors act. More specifically, for each month and for each of the 322 firms in the sample, we record the value of foreigners' purchases divided by the value of their total trading (purchases plus sales). This is referred to as the buy ratio. If the buy ratio of a firm is above 0.5, foreign investors are net buyers of the firm's stocks. For example, recall from Figure 1 that foreigners accumulated Swedish stocks during the first half of the sample period while net purchases were close to zero in the second half. This behavior corresponds to aggregate buy ratios of 0.552 in the first half of the period and 0.499 in the second.

We study how foreigners' net purchases are related to future returns by examining whether the buy ratio of future winning stocks exceeds that of future losing stocks. Specifically, we collect the buy ratios for all stocks in month t

and the returns on the stocks in month $t+s$. Thereafter, firms are ranked on the basis of their returns in month $t+s$ and divided in two groups, namely future winning and future losing stocks. Finally, we compute the average buy ratio for the two groups and record their difference. A positive buy-ratio difference (BRD) suggests that, in month t, foreigners buy more of the stocks with the highest returns s months ahead. We repeat this procedure for all months $t = 1, 2, ..., 72 - s$, and calculate the average BRD for various horizons $s = 1, 2, ..., 6$. We also consider the average return difference (RD) as a complementary measure. This measure is computed in a similar spirit as the BRD except that firms are ranked according to their buy ratios (instead of returns), split in two groups—more and less purchased stocks—and the return difference between the two groups is recorded.[10]

In Panel A of *Table 2*, we report the average BRD and RD for various horizons. As seen in the first column, we also show the computations for $s = -6, -5, ..., 0$, in other words, the relation between buy ratios, and the past and contemporaneous returns. Column two shows that the average BRD is close to zero for all horizons except when firms are ranked according to the returns in the contemporaneous month (where $s = 0$), and previous month's return (where $s = -1$). P-values from a test of whether the average BRD is equal to zero are reported in the third column. This result supports the above finding that foreigners seem to be momentum traders. Section 3 reported that foreigners' aggregate net purchases increase following a market rise. Now, we also find that foreigners buy more of the individual stocks that performed best in the previous month. In other words, foreigners are momentum traders even in a cross-sectional perspective.

Studying the forward-looking horizons (where $s > 0$), there is no evidence of informed trading, suggesting that foreigners do not buy more of the future winning stocks. The fourth column reports that, over time, the BRDs are positive in 75% of the months when ranked on contemporaneous month's returns, and 67% of the months when ranked on previous month's returns, indicating that the positive average BRD is not driven buy a few months with very large BRDs. Column five and six report the return differences and the correspond-

[10] As a robustness check, we also run regressions of the buy ratios on the returns for various horizons. The results from the regressions are very similar to those of the ranking. For the sake of brevity, we only report the results from the ranking procedure at this point.

Table 2: Cross-Sectional Performance Analysis Using Buy Ratios

	Buy Ratio Difference			Return Difference	
Lag/Lead	Average	P-value	Proportion of Positive	Average	P-value
Panel A. Buy Ratio Differences and Return Differences					
−6	−0.35	0.57	0.43	0.36	0.44
−5	−0.02	0.98	0.46	0.28	0.29
−4	0.60	0.21	0.58	0.56	0.02
−3	0.38	0.42	0.54	0.38	0.14
−2	0.83	0.15	0.58	0.02	0.95
−1	1.97	0.00	0.67	0.91	0.00
0	3.24	0.00	0.75	1.10	0.00
1	−0.01	0.98	0.44	0.24	0.35
2	0.38	0.42	0.51	0.40	0.13
3	0.77	0.26	0.61	0.30	0.13
4	0.28	0.55	0.53	0.01	0.97
5	0.08	0.90	0.48	0.16	0.32
6	−0.07	0.91	0.42	0.32	0.18
Panel B. Buy Ratio Differences and Cumulative Return Differences					
−6	1.03	0.11	0.61	0.46	0.00
−5	0.91	0.17	0.57	0.51	0.00
−4	1.51	0.00	0.58	0.56	0.00
−3	1.64	0.04	0.64	0.52	0.00
−2	1.75	0.00	0.62	0.56	0.00
−1	1.97	0.00	0.67	0.91	0.00
0	3.24	0.00	0.75	1.10	0.00
1	−0.01	0.98	0.44	0.24	0.35
2	0.66	0.23	0.59	0.33	0.08
3	1.12	0.02	0.62	0.27	0.08
4	0.79	0.19	0.56	0.20	0.14
5	0.40	0.49	0.52	0.17	0.15
6	1.12	0.02	0.53	0.18	0.10

The table shows a cross-sectional performance analysis using buy-ratio differences for the period 1993–1998. Foreigners' buy ratio [purchases/(purchases + sales)] for month t, and the return for month $t + s$ are collected for each stock. The month t buy ratio difference is computed by subtracting the average buy ratio for the stocks with lower than median returns from the average buy ratio for the stocks with higher than median returns. The time-series average of the buy-ratio differences for various horizons are reported in column two, with corresponding p-values in column three. Column four reports the time-series proportion of positive buy ratio differences. The return differences for various horizons are reported in column five, and p-values in column six. The monthly return difference is computed by subtracting the average return for the stocks with lower than median buy ratios from the average return for the stocks with higher buy ratios than the median ratio.

ing p-values, respectively. We find, as we did for the BRDs, that the average RD is close to zero for all horizons except $s = 0$ and $s = -1$. The stocks that foreigners prefer to buy realize on average a 1.10% higher return in the contemporaneous month and 0.91% in the previous month compared with the stocks that foreigners prefer less. Interestingly, though, the average RD is positive for all future horizons suggesting that a positive relation exists between foreigners' purchases and future returns although it is not statistically significant for any individual monthly horizon. Therefore, in Panel B we report the average BRD and RD for the relation between buy ratios and *cumulative* returns on various horizons. Our main result is reinforced: Foreigners are momentum traders. The averages of the BRDs are significantly positive for horizons from -1 to -4, indicating that foreigners buy more of the stocks that did well in the previous four-month period. This is not surprising given that the cumulative returns for all backward-looking horizons include the previous month's returns. The forward-looking horizons now reveal weak signs of informed trading. In particular, when firms are ranked according to their future three and six months cumulative returns, we find that foreigners buy significantly more of the future winning stocks. An analysis of the RDs reveals signs of informed trading. The two to six months cumulative return differences are positive, although only marginally significant in a statistical sense. Our results differ from the findings of Grinblatt and Keloharju (2000), who report that foreigners investing in Finnish stocks outperform the portfolios held by domestic investors. [Here it it tempting to conclude that Swedish investors simply are smarter than Finnish investors.]

The results presented thus far do not display any overwhelming evidence of informed trading by foreign investors. However, one might ask: Are there any particular firms in which foreigners show positive trading profits? To answer this question, we study the relation between buy ratios and returns for individual firms. More specifically, for each firm i, we run a regression of the excess buy ratio at time t on the excess return s periods ahead,

$$BR_{it} - \overline{BR}_t = \alpha_{is} + \beta_{is} \left(r_{it+s} - \overline{r}_{t+s} \right) + \varepsilon_{it}, \tag{2.4}$$

where $\overline{BR}_t$ and $\overline{r}_t$ are the cross-sectional averages of the buy ratios and the returns at time t, respectively.[11] A positive beta estimate $\widehat{\beta}_{is}$ means that foreigners buy relatively more of firm i when its return is higher than the (cross-sectional) average s periods ahead. The average beta $\overline{\widehat{\beta}}_s$ is positive and statistically different from zero for $s = -1$ and $s = 0$ (not reported), which confirms our results based on buy-ratio differences reported in Table 2. We now want to study the relation between the estimated betas $\widehat{\beta}_{is}$ and the characteristics of the firms. Several hypotheses for this relation are plausible. For instance, one can conjecture that foreigners earn more profits in firms in which they frequently trade, or in firms in which they are large owners. Seasholes (2000) studies 332 firms at the Taiwan Stock Exchange and concludes that foreigners' ability to profit from trading is proportional to the amount they trade. We employ $\widehat{\beta}_{is}$ as a measure of trading profits and run the regression

$$\widehat{\beta}_{is} = \gamma_{sk} + \delta_{sk} x_{ik} + \xi_{is}, \tag{2.5}$$

where x_{ik} denotes characteristic k for firm i. In addition to the characteristics presented in Section 2, we also employ foreign ownership and the amount of foreign trading as characteristics. The result from the regressions (not reported) is straightforward: We find no relation between trading profits and any of the characteristics over any horizon. This is in stark contrast to Seasholes' (2000) results on emerging markets.

To sum up, we have only seen weak indications of informed trading by foreign investors when studying the cross-section of Swedish stocks. However, foreign investors may act as informed traders in a broader perspective. Since international investors typically allocate their investments over several national markets, it may be the case that foreigners buy Swedish stocks before the start of a bull market. To study this question, we run a regression of the aggregate buy ratio at time t on the return s periods ahead,

$$BR_t = \alpha + \beta r_{t+s} + \varepsilon_t; \tag{2.6}$$

where BR_t is the aggregate buy ratio at time t, and r_{t+s} is the value-weighted return s periods ahead. The results (not reported) lend support to our finding

[11] We exclude firms with less than one year's listing history, and are therefore left with a cross-section of 257 firms.

that foreign investors are momentum investors. However, we find no evidence of market timing ability among foreign investors; the betas are close to zero for all forward-looking horizons.

We conclude that no clear relation exist between foreigners' net purchases of Swedish stocks and their future returns—neither on an aggregate level nor over individual firms. However, the analysis based on buy ratios is limited to a study of the performance of marginal investments, in other words, changes in the portfolio. To gauge whether foreign investors outperform the Swedish market in a more general context, we need to study the realized return of the aggregate portfolio held by foreigners. This is the scope of the following subsection.

4.2 Foreigners' Portfolio Performance

We employ the data on foreign ownership presented in Dahlquist and Robertsson (2000a) to calculate monthly return series for the aggregate portfolio held by foreign investors. Since we have data on the exact share of Swedish stocks held by foreigners at the end of December each year, we adjust the portfolio weights on a monthly basis using the data on trading by foreigners presented in this paper. However, the data do not include exact trading dates; for this reason, we make the simplifying assumption that the transactions take place in the middle of the month and therefore earn, as an approximation, half the monthly return in the contemporaneous month. For instance, we ignore returns earned on stocks purchased before the middle of the month, but include returns earned on stocks sold before the middle of the month. Moreover, we are unable to account for any intra-month trading, that is, when a security is bought and sold within the same month.

The allocation by foreigners across industries is very stable over the sample period. In short, the portfolio is overweighted in engineering, and in chemicals and pharmaceuticals, but underweighted in construction, paper and pulp, and in the miscellaneous group. The stability in allocations leads us to begin with an analysis of the returns on buy-and-hold portfolios over an annual horizon. The third column of Panel A in *Table 3* reports the portfolio return of the investments by foreigners conditional on the assumption that

Table 3: Performance Analysis Using Portfolio Returns

Year	Rebalanced Portfolio	Buy-and-Hold Portfolio	Market Portfolio
Panel A. Raw Returns			
1993	59.8	56.6	70.3
1994	16.1	15.6	15.1
1995	25.8	22.8	26.6
1996	53.8	49.0	55.4
1997	41.1	34.5	40.8
1998	41.1	19.5	17.1
Panel B. Regression results			
Alpha		–0.02	–0.03
		(0.03)	(0.12)
Beta		1.01	1.00
		(0.01)	(0.03)

Panel A reports three return measures (in %) on the aggregate portfolio held by foreign investors, and for the market portfolio, for the period 1993–1998. The return on the buy-and-hold portfolio is calculated based on the assumption that the allocation as of December 31 in one year is unchanged in the subsequent year. The return on the rebalanced portfolio is calculated when portfolio weights are adjusted to the net purchases on a monthly basis. The return on the market portfolio is calculated as a value-weighted average. Panel B reports the coefficients from the regression of the rebalanced portfolio return on different benchmark portfolio returns.

the allocation as of December 31 in one year is unchanged in the subsequent year. In 1993, foreigners' buy-and-hold portfolios realized a 56.6% return, almost 15% below that of the value-weighted market portfolio of Swedish stocks (column four). The major reason for the poor performance was the extraordinary turn-around experienced by the Swedish economy. The devaluation of the Swedish currency in November 1992 resulted in sharp price increases for firms in cyclical businesses, while non-cyclicals lagged behind. In particular, the construction index outperformed the market portfolio by more than 50% while chemicals and pharmaceuticals underperformed the market by 50%. After 1994, the return deviations from the market portfolio are much smaller. This is not because the allocation of foreigners is closer to that of the market portfolio, but rather because the returns on the different industry portfolios are less disperse. Column two shows the annual returns on the portfolio of foreigners, accounting for monthly rebalancing. The returns are similar to those of the buy-and-hold portfolio yielding relatively low returns in 1993. Interestingly, in all years, the rebalanced portfolio realizes higher returns than the buy-and-hold portfolio, indicating that the trading by foreigners add value to the portfolio performance. To test this formally, we regress the monthly returns on the rebalanced portfolio on the returns on the buy-and-hold portfolio. The estimates, reported in Panel B, do not suggests any superior performance of the rebalanced portfolio. In fact, the alpha is negative although not significantly different from zero. Panel B also reports the result from a test of whether the rebalanced portfolio outperforms the market portfolio; the result is the same—the alpha is negative, although not significantly different from zero. Hence, foreigners do not outperform the Swedish market.

5 Conclusion

By using a rich dataset on cross-border transactions, returns, and firm characteristics, we analyze the investment behavior and performance of trading by foreigners in individual Swedish stocks. We find that the trading (purchases plus sales) of foreign investors is closely related to foreign ownership, and that the firm-specific attributes that help to characterize ownership also help to characterize trading. We find that the turnover rates in foreigners' portfolios are high; in other words, foreigners seem to engage in short-term trading more often than domestic investors. Despite this evidence of short-term behavior, we observe significant persistence in foreigners' net purchases. This persistence is complex in the sense that a shock to purchases (sales) today is associated with higher purchases (sales) over a long period of time. Furthermore, our analysis suggests that foreigners are momentum investors, that is, foreigners increase their net holdings in firms that have recently performed well. In particular, this feedback trading stems from purchases of stocks with positive return shocks, and less from sales of poorly performing stocks. Finally, we conclude that opening up Sweden's stock market to foreign investors has a large positive impact on prices. This effect seems to be permanent, as no price reversals are observed, suggesting that the cost of equity capital for Swedish firms is permanently reduced. A rough measure indicates that the size of the cost reduction is two percentage points on an annual basis. However, the reductions vary across firms and this, in turn, affects the relative competitiveness of firms. Hence, a deregulation of the equity market has a direct impact on the industrial structure of a country in that it alters the relative cost of capital of firms. Foreign investors show almost no signs of being able to outperform the Swedish market, indicating that they do not have access to superior information. Risk sharing, therefore, seems to be the driving force behind the permanently higher prices.

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Chapter 3

Exchange Rate Exposure, Risk Premia, and Firm Characteristics

with Magnus Dahlquist

1 Introduction

In recent years, exchange rate exposure has been under the scrutiny of empirical research. Starting with Jorion (1990), studies have been undertaken on U.S., Japanese, and Canadian data to analyze how stock market values are affected by changes in exchange rates. However, many studies have failed to find significant relations between changes in market values and exchange rates. These studies include Bodnar and Gentry (1993), Amihud (1994), Bartov and Bodnar (1994), Bartov, Bodnar, and Kaul (1996), Chamberlain, Howe, and Popper (1997), and Chow, Lee, and Solt (1997), among others. In Jorion (1990), only 10% of U.S. multinationals show (statistically) significant exposure at the 10% significance level, while He and Ng (1998) find a somewhat stronger link between stock returns and exchange rate changes for Japanese multinationals (for about 25% of the firms).

We argue that the main reason for the apparent lack of exchange rate exposure is the use of too aggregated economic measures. There are at least three potential sources of the aggregation problem. The first source is the use

[0] We have benefited from discussions with Patrik Säfvenblad.

of exchange rate indices to quantify exposure. For instance, the commonly chosen trade-weighted exchange rate index can simply average out relevant information, since firms may have both positive and negative exposures, but to different currencies. The second source is the frequent use of return on industry portfolios to analyze exposure. Why should firms in a broadly defined industry necessarily have the same exchange rate exposure? It seems likely that positive and negative exposures are simply averaged out. The third source stems from the documented time-variation in risk and risk premia. A zero unconditional exchange rate exposure does not imply that the exposure is zero conditionally. Dumas and Solnik (1995), and De Santis and Gerard (1998), for instance, focus on the time-variation properties of exposure to foreign exchange rate risk. Indeed, they find a significant time-variation, and their analysis reveals that exchange rate risk is only priced when time-variation is allowed. Moreover, we argue that the U.S. economy is not necessarily representative, and that an analysis of a small open economy, such as that of Sweden, is warranted. Sweden's total exports and imports, measured as a fraction of the GDP, is about three times higher than that of the U.S. It is obvious that higher exposure is more likely among firms active in a small and globally competitive economy with an integrated stock market.

In the first part of the paper, we start by using these observations to investigate the exposure for a sample of 352 individual Swedish firms to both an aggregated exchange rate index, and to individual currencies.[1] We choose to study the period between 1988 and 1998, which offers the opportunity to analyze exposure during two different exchange rate regimes for the Swedish krona (SEK). On November 19, 1992, the Swedish krona started to float. Before that, it had had a unilateral binding to a basket of currencies in the European Monetary System. Next, we take the exchange rate exposure as given and study its cross-sectional variation. To be able to understand its underlying sources, it is important to identify the determinants, or at least the characteristics, of exchange rate exposure.

We find significant (at the 10% level) exposure to a trade-weighted ex-

[1] Nydahl (1999) studies similar issues in the Swedish stock market. However, his analysis covers only 47 firms over a shorter sample period than the period studied here. Further, we employ industry data and a different set of firm attributes to characterize the exchange rate exposure. Finally, we also study the existence of exchange rate risk premia.

change rate index for 15% – 30% of Swedish firms during the sample period from 1988 to 1998, depending on the return horizon. Decomposing the exposure into the three major currency blocks—the German mark, the Japanese yen, and the U.S. dollar—strengthens our findings even further: 40% – 70% of the firms display significant exposure to at least one of these currencies, and the fraction is positively related to the analyzed return horizon. The magnitude of exposure shows large variations across firms, and we find both positive and negative exposures to the exchange rate index as well as to individual currencies. We sort firms into industry portfolios and find that industries in which a large number of firms show significant exposure do not necessarily show exposure at an industry level. A natural explanation for this is that the degree of homogeneity of an industry determines whether or not we find exposure at an industry level. Within most industries, however, exchange rate exposure is significantly reduced when forming portfolios of firms. We also relate exposure to various firm attributes and find that large firms, firms with high export rates, and firms with large foreign ownership are more exposed to exchange rate fluctuations than other firms. However, within these groups, we find positive as well as negative exposures, suggesting that exchange rate exposure disappears even when forming portfolios of firms with similar attributes.

In the second part of the paper, we gauge the influence of exchange rate exposure on pricing purposes. Based on previous work by Solnik (1974), Sercu (1980), Adler and Dumas (1983) among others, we consider alternative specifications of a linear factor model with exchange rate risk as one of its factors. The results show that equity risk, either against the world or local market, is priced. However, premia associated with exchange rate risk are insignificant and close to zero, that is, exchange rate exposure seems to be eliminated through diversification.

The structure of this paper is as follows. In Section 2 we discuss general hypotheses on exchange rate exposure and hedging, and how to measure exposure. A description of the Swedish institutional setting, as well as the stock and exchange rate data, is given in Section 3, while Section 4 presents the results from the estimation of exposure, and discusses the robustness of the findings. The implications of the exposure for risk premia are analyzed in

Section 5. Finally, Section 6 summarizes the results and offers some concluding remarks.

2 Exchange Rate Exposure

In this section, we give a brief review of different forms of exchange rate exposure, and how they may affect the value of a firm. This provides the basis for our test specifications and interpretations of the results in the empirical work. We also discuss and formulate hypotheses on the cross-sectional variation of exchange rate exposure.

Note that we do not discuss whether or not a firm should hedge the exchange rate exposure. In the spirit of the irrelevance theorems of Modigliani and Miller (1958, 1961), firm values cannot be increased by undertaking actions that investors can perform themselves. This result is, of course, based on the perfect capital market notion. However, it has been argued that firms want to hedge in order to reduce the volatility of earnings because: (*i*) the structure of the tax code makes it profitable (Smith and Stulz, 1985), (*ii*) it prevents the underinvestment problem caused by costly access to external financing (Froot, Scharfstein, and Stein, 1993), and (*iii*) it better conveys information about exposure and operations to shareholders (DeMarzo and Duffie, 1995). With this, we will not elaborate any further on this issue.

2.1 Exposure of the Firm

The theory on exchange rate exposure of a firm is vast. Following a textbook treatment, it can be categorized into economic exposure and translation exposure. Economic exposure is defined as the effect on a firm's cash flows, and can in turn be divided into transaction exposure and operating exposure.

Transaction exposure is the exposure that a firm is subject to when it has entered a contract denominated in a foreign currency but which is to be settled at a future date. A depreciation of the domestic currency means that the value of a future inflow or outflow will increase. This is an unambiguous measure, and does not necessarily reflect the total exposure of the firm. Nevertheless, it is typically this type of exposure that most firms hedge, although it can be far from optimal to hedge only the transaction part of total exposure.

Operating exposure, which is related to the effect that exchange rate changes have on the value of a firm's existing financial (or operational) contracts, is the other type of economic exposure. Since the exchange rate is the price of a currency, it effectively determines the price of domestic products sold abroad. If the domestic currency depreciates, the prices of domestic products abroad will decrease relative to foreign products. Alternatively, a firm can keep the foreign price at the previous level, and thereby achieve a higher margin. The exchange rate, therefore, fundamentally affects the competitiveness of domestic firms abroad. If a firm exports products produced domestically, a depreciation will generally increase its cash flows. If, on the other hand, it sells products domestically that are purchased abroad, its cash flows will suffer from a depreciation. If a large share of production (costs) and sales (revenues) are done in the same foreign currency, the effects may cancel out, and exposure is reduced. If production and sales are denominated in different foreign currencies, exposure is dependent on the relation between these currencies.

Finally, translation exposure (or accounting exposure) arises as a result of translating the financial statements of a foreign subsidiary into the reporting currency of the parent company to prepare consolidated financial statements. Hence, it is the effect that exchange rate changes have on the translation of foreign assets, such as subsidiaries, on the balance sheet of the parent company. This is not a real exposure in the sense that it does not affect the current or future cash flows of the firm. Assuming that investors price stocks according to expected future cash flow, translation exposure should have no effect on the price of a firm's stock.

Even firms with no foreign transactions are subject to operating exchange rate exposure for two reasons. The first reason is that competitiveness is altered when exchange rates change. This affects earnings for firms that have foreign competitors, leading to an increase in firm value when a depreciation of the domestic currency occurs. The second reason is valid even for firms that have no foreign competitors since exchange rate changes may affect the prices of inputs. For example, if the domestic currency depreciates, the export industry does well. This means that exporting firms have a higher demand for inputs, which may result in higher prices. Since firms in protected industries largely share the same sources of inputs, the price of inputs increases for them as well, and profitability declines. This effect means that the operating exposure is negative, that is, a depreciation of the exchange rate has a negative effect on the cash flows of the firm.

2.2 Hypotheses on the Cross-Section of Exposure

If the exposure of firms differs depending on their operations, then categorizing firms according to various attributes could potentially lead to more powerful and interesting results. Therefore, we investigate the determinants, or at least the characteristics, of exchange rate exposure. As a starting point, we follow previous empirical research and study how exposure varies across industries. As an example, most Swedish engineering firms are active on international competitive markets, while firms in the retail business typically act on the (less competitive) domestic market. Hence, these industries may differ in exchange rate exposure. Since our data cover individual firms, we study the exposure of individual firms within different industries, as opposed to average industry exposure, and for this reason, we will not suffer from the aggregation problems as in previous studies.

In the next step, we focus on firm-specific characteristics that may affect exchange rate exposure. For instance, since multinational firms, with potentially high (operating) exposure, typically are large firms, we conjecture that firm size may be related to exposure. Hence, we test whether a positive relation exists between the market value of firms and their degree of exchange rate exposure. A related hypothesis is that firms with a large number of contracts denominated in foreign currencies have higher (transaction) exposure to movements in exchange rates. Unfortunately, detailed data on the origin of production costs are not accessible, and thus, we are restricted to investigating whether the share of foreign sales is positively related to exchange rate exposure. If such a relation does exist, we should expect that firms with large export sales are positively affected by a depreciation of the Swedish krona (SEK) and vice versa. Another interesting question is whether the owners of a firm affect the exchange rate exposure. For example, consider a Swedish export company jointly owned by domestic and foreign investors. An appreciation of the SEK induces a competitive disadvantage for the firm relative to its foreign rivals, and this, in turn, may cause a drop in the price of the firm's stock (in SEK). This is obviously unfavorable for domestic owners of the export company. However, since foreign owners translate the SEK value of the holding to their (depreciating) home currencies, they will not be as badly off as domestic investors. In fact, the firm's exposure may be a hedge against the exchange rate exposure faced by foreigners who invest in Sweden. Alternatively, the foreign investor can hedge the exchange rate exposure using currency derivatives, or by borrowing in the same currency as the investment. Nevertheless, this example illustrates that owners of a firm may want to influence the hedging policy in different ways depending on their national origin. We test the relevance of this argument by investigating the relation between the exchange rate exposure of firms and their fraction of foreign ownership. As a complement, we also test whether firms listed on multiple (international) stock exchanges show different exposure compared with other firms.

3 The Institutional Setting and Data Description

Most studies of exchange rate exposure are undertaken on large economies—most notably the U.S. There are obviously many differences between Sweden's economy and larger economies like that of the U.S.; in particular, Sweden's economy is more open. As a measure of openness, consider the export plus import to GDP ratios during the period 1988 to 1998. Sweden showed an average ratio of about 67%, ranging from 63% in 1988 to 84% in 1998. Compare these figures with the corresponding average values of 49% for Germany, 21% for the U.S., and 19% for Japan. This indicates that Sweden is very dependent on international trade, and is therefore likely to be more exposed to changes in exchange rates than Japan and the U.S.

The use of Swedish data offers the opportunity to study what happens to exchange rate exposure under different exchange rate regimes. The Swedish krona (SEK) was unilaterally fixed to a basket of currencies from the beginning of the 1980s, and unilaterally fixed to the European Currency Unit (another basket of currencies) from May 17, 1991. The SEK was then devaluated on November 19, 1992, and has been floating freely against all currencies since then. By analyzing the periods January 1988 to October 1992, and January 1993 to December 1998, it is possible to see whether there are any significant differences in the degree of exposure under semi-fixed and floating exchange rate regimes. We assume that exchange rate exposure is constant within a period, and therefore analyze the unconditional exposure for each of the sub-periods. Interestingly, the start of the second period coincides with the deregulation of the Swedish equity markets. In particular, investment restrictions for foreigners were lifted. The response of foreign investors to the deregulation is further analyzed in Dahlquist and Robertsson (2000a,b).

We consider weekly data on exchange rates between the SEK and the three major currencies—the German mark (DEM), the Japanese yen (JPY), and the U.S. dollar (USD)—as well as an index based on the Total Competitiveness Weights (TCW) calculated by the International Monetary Fund. The weights are based on the trade balance of manufactured goods and third party effects during the period 1989 to 1991. We also considered a weighting scheme based on the Multilateral Exchange Rate Model. The two indices have a correlation of 0.96 during our sample period, and thus for the sake of brevity, we only report the results based on TCW. The three major currencies account for about 40% of the TCW index, while other European currencies essentially make up the rest. We use the value-weighted market index calculated by Affärsvärlden/Findata as a proxy for the local market portfolio, and the Morgan Stanley World Index as a proxy for the global market portfolio. Both indices include reinvested dividends. To test cross-sectional hypotheses, we consider the following firm characteristics at the end of each year:

(*i*) *Size*. The market capitalization of a firm.

(*ii*) *Export Rate*. The share of export sales to total sales.

(*iii*) *Foreign Ownership*. The fraction of equity held by foreign investors.

(*iv*) *Foreign Listing*. A dummy with a value of one if a firm is listed abroad.

(*v*) *Book-to-Market Ratio*. The book value of equity divided by its market value.

The data on exchange rates, stock returns, and firm characteristics come from the Stockholm Information Exchange; the data on foreign ownership, however, come from Dahlquist and Robertsson (2000a).

Summary statistics of the exchange rates and stock returns are presented

Table 1: Summary Statistics of the Benchmarks

	Local	World	TCW	DEM	JPY	USD
	Panel A. Means and Standard Deviations					
Sub-Period I						
Arithmetic Mean	−7.35	−6.05	−0.66	0.63	0.15	0.24
Geometric Mean	−9.29	−6.98	−0.68	0.58	−0.18	−0.23
Standard Deviation	19.64	13.66	1.87	3.15	8.23	9.70
Sub-Period II						
Arithmetic Mean	18.58	12.38	2.11	1.82	4.46	2.83
Geometric Mean	16.90	11.34	1.85	1.46	3.48	2.29
Standard Deviation	18.56	14.46	7.12	8.48	14.19	10.37
	Panel B. Correlation Structure					
Local	—	0.63	0.07	−0.30	0.03	0.27
World	0.64	—	0.14	−0.28	0.41	0.43
TCW	−0.19	0.32	—	0.53	0.39	0.15
DEM	−0.25	0.17	0.91	—	0.00	−0.40
JPY	0.01	0.45	0.65	0.60	—	0.42
USD	0.15	0.59	0.65	0.43	0.50	—

The table presents summary statistics of excess returns (in Swedish kronor, SEK) on the equity markets and the rate of changes on foreign exchange rates. Local and World refer to the Swedish stock market and the world stock market, respectively. TCW refers to SEK versus a foreign exchange rate index, where currencies are weighted according to the Total Competitive Weights calculated by the International Monetary Fund. DEM, JPY, and USD (the German mark, the Japanese yen, and the U.S. dollar) are individual exchange rates expressed in SEK per unit of foreign currency. Panel A shows means and standard deviations of the benchmarks for two sub-periods. The moments are expressed in % per year. The first sample period covers January 1988 to October 1992, and the second period covers January 1993 to December 1998. Panel B presents correlations between the benchmarks. The numbers above (below) the diagonal refer to the first (second) sub-period.

in *Table 1*. Panel A shows means and standard deviations for the excess return on stocks and the rate of changes for the major currencies. The first sub-period is a bear market for local as well as global equities. The geometric mean of the excess return on Swedish (global) equity is about −9% (−7%) on an annual basis. The DEM appreciates while the USD, JPY and the TCW index depreciate somewhat compared with the Swedish krona. Recall that this is a period of semi-fixed exchange rates and, as a consequence, changes in the "average" exchange rate should be small.[2] The volatility of the TCW index is below 2% on an annual basis, and the DEM also shows a low volatility of about 3%. The second sub-period is a bull market for equities. Local (global) excess return is

[2] The TCW index was mainly affected by the large depreciations of the British pound (GBP), and the Finnish mark (FIM). These currencies taken together lowered the index by about 0.63% on an annual basis.

about 17% (11%). All individual currencies, as well as the TCW index, appreciate, in other words, the SEK is weak during this period. Not surprisingly, the volatility of the exchange rates increases, especially that of the TCW index and the DEM, while the volatility of the USD is less affected. Hence, the semi-fixed regime seemed to effectively tie the SEK more closely to the DEM.

The correlation structures of stocks and currencies are depicted in Panel B. The numbers above (below) the diagonal refer to the first (second) sub-period. The correlation between the local stock market return and the TCW index is close to zero in both sub-periods, that is, 0.07 and −0.19, respectively. This suggests that there is no overwhelming exchange rate exposure in the aggregate. However, there may still be substantial exposure among individual firms. The correlation between local returns and individual currencies is somewhat stronger in magnitude, particularly during the first sub-period. As expected, the correlations between DEM, JPY, and USD are higher in the second period since the SEK is no longer a weighted average of the individual currencies. The correlation coefficient of 0.91 between TCW and DEM in the second period is likely to reflect the effect of the convergence program preparing for the single European currency.

4 Empirical Results

4.1 Measuring Exposure

Adler and Dumas (1984) present the view that exchange rate exposure should be measured as a regression coefficient of the stock price against an exchange rate proxy, since it offers a comprehensive measure of the firm's exposure from the investor's point of view. However, while we are interested in regressing stock returns on changes in exchange rates, we want to control for common movements in the stock market in general as in a Capital Asset Pricing Model (CAPM) world. In a perfectly integrated world, the relevant market portfolio would be the world market portfolio. To allow for at least partial segmentation in capital markets, we follow Ferson and Harvey (1993) and also control for the returns on the local stock market.

Let r_{it} denote the excess return on firm i at time t. Moreover, r_{lt} and r_{wt}

are the excess returns on the local market and world stock markets, respectively. Finally, let s_t^j denote the percentage change in exchange rate j (initially a weighted average of currencies). For each of the N firms, we consider the following time-series regression:

$$r_{it} = \beta_{i0} + \beta_{il} r_{lt} + \beta_{iw} r_{wt} + \sum_{j=1}^{J} \beta_{is}^{j} s_t^j + \varepsilon_{it}, \tag{3.1}$$

where ε_{it} is an error term. The exchange rate exposure is measured as the regression coefficient β_{is}^j. We define the exchange rate in Swedish kronor per unit of the foreign currency. This means that a positive coefficient increases (decreases) the market value of the firm when the krona depreciates (appreciates), and vice versa for a negative coefficient. This regression specification is later augmented to account for exposure to individual currencies.

Chow, Lee, and Solt (1997) argue that the return horizon has an effect on the measured economic exposure. In fact, the choice of a long horizon with few non-overlapping observations may be yet another reason why previous studies have not detected significant exposure. We sample data on a weekly basis, but consider exchange rate exposure over horizons in the range of one week to three months.

Since we are dealing with returns and changes in exchange rates, it is likely that heteroskedasticity is present in the data. Further, we want to analyze exposure for various return horizons using overlapping observations, which induces a moving average process in the error term. We deal with this using the generalized method of moments framework presented by Hansen (1982). We employ the weighting scheme proposed by Newey and West (1987).

4.2 Exposure to an Exchange Rate Index

We first study whether individual firms show any exposure to an exchange rate index (a weighted average of the j currencies). In other words, we run the regression in Equation (3.1) with the percentage changes of the TCW index as the regressor. The results of the estimation are shown in *Table 2*. In the first sub-period, the average exposure coefficient is negative, which means that the average firm loses value when the SEK depreciates against the exchange rate

Table 2: A Summary of Exposure Coefficients for the Exchange Rate Index

	Sub-Period I			Sub-Period II		
	Return Horizon			Return Horizon		
	One Week	One Month	Three Months	One Week	One Month	Three Months
Mean	–0.46	–0.90	–0.38	–0.08	0.03	0.22
Std.Dev.	3.33	2.77	3.30	0.90	1.39	1.50
Minimum	–9.46	–10.04	–11.66	–6.86	–4.65	–6.08
Quartile 1	–2.33	–2.36	–2.50	–0.46	–0.49	–0.55
Median	–0.64	–0.90	–0.40	–0.08	–0.04	0.20
Quartile 3	0.81	0.58	1.62	0.38	0.57	0.95
Maximum	17.18	12.28	9.75	2.94	14.32	5.86
FX	31 (17%)	47 (27%)	54 (31%)	57 (17%)	49 (17%)	70 (30%)
R^2_{adj}	0.16	0.26	0.44	0.15	0.22	0.30
# of Firms	180	176	174	333	287	235

The table summarizes the exposure coefficients for the TCW index (the β^j_{is} in Equation (3.1)), for different return horizons and sub-periods. The reported return horizons are one week, one month, and three months. The first sample period covers January 1988 to October 1992, and the second period covers January 1993 to December 1998. Mean and Std.Dev. refer to the means and standard deviations across firms. The corresponding minima, first quartiles, medians, third quartiles, and maxima are also shown. FX refers to the number of firms (and percentages within parentheses below) where the null hypothesis of zero exchange rate exposure is rejected at the 10% significance level. The last two rows present the average adjusted R-square across firms, and the total number of firms.

index. At first glance, this finding may be surprising given the large number of export companies in Sweden. Recall, however, that the semi-fixed regime did not allow large variations in the exchange rate index. A depreciation of the SEK was typically offset by the central bank increasing interest rates. This, in turn, is associated with lower stock prices. The cross-sectional variation of the betas is high as seen by the standard deviation of about three. Using a one month return horizon, 50% of the firms have coefficients ranging from −2.36 to 0.58. This variation indicates that firms with high (absolute) exposure coefficients (i.e., firms with significant exposure to changes in the TCW index) do, in fact, exist. The row labeled FX reports the number of firms (and percentages within parentheses) where the null hypothesis of zero exposure is rejected at the 10% significance level. At a one-month return horizon, we find 47 firms (i.e., 27% of the total number of firms) with statistically significant exposure. If the coefficients were cross-sectionally independent, this would be almost three times more than we could expect to find by random chance.

Recall from Table 1 that the correlation coefficient between the return on the aggregate stock market and the TCW index was close to zero, despite the fact that 27% of the firms display significant exposure to that index. This illustrates the danger of drawing conclusions for individual firms based on the inference from regressions of portfolio returns. When studying different return horizons, we find a distinct pattern—the longer the horizon, the larger the number of firms showing significant exposure. This can also be seen in the R-squares that ranges from 16% to 44% when moving from horizons of one week to three months. The second sub-period shows less dispersion in the exposure coefficients. With a monthly horizon, 50% of the firms have coefficients ranging from −0.49 to 0.57, and the standard deviation is about 1.4. At 17%, the share of firms with significant exposure is lower; however, this is not the case for weekly and quarterly return horizons, where the figures are 17% and 30%, respectively (i.e., about the same as for the first sub-period). Interestingly, and somewhat surprisingly, the amount of exposure does not change dramatically when going from a semi-fixed to a floating exchange rate regime.

4.3 Exposure to Individual Currencies

We have argued that the lack of significant exposure documented in previous studies may be due to the use of an exchange rate index as a proxy for exposure, while, in practice, firms are exposed to fluctuations in individual currencies. In this section, we analyze to what extent Swedish firms are exposed to the three world currency blocks measured by the DEM, the JPY, and the USD. This analysis may provide new insights into how firms are affected by currency fluctuations. For instance, one of the arguments for joining the European Monetary Union is that it will reduce uncertainty and costs for export and import companies. Establishing firms' exposure to specific currencies is a valuable starting point for a discussion about the gains of such an action.

Sweden's largest non-European trading partners are the U.S. and Japan. Germany is Sweden's most important trading partner, and most other European currencies are closely linked to the DEM. This means that a large part of the systematic exchange rate exposure could be explained by these three exchange rates, and that the DEM potentially has the largest impact.

Now, let s_t^j denote the percentage change of currency j, with $j =$ DEM, JPY, USD. In other words, in the previous regression the exchange rate index is replaced with individual currencies. In this augmented time-series regression, the coefficients β_{is}^{DEM}, β_{is}^{JPY}, and β_{is}^{USD} measure the exposure for an individual firm to exchange rate movements. The regression results are presented in *Table* 3. Panels A, B, and C report the exposure coefficients for the DEM, JPY, and USD, respectively. In the first period, the dispersion of the coefficients is higher for the DEM than for the JPY and USD. For the one-month horizon, the cross-sectional standard deviation of the coefficients is 1.60 for the DEM, and 0.52 and 0.78 for the JPY and USD, respectively. The DEM coefficients are less dispersed during the second period, suggesting that the large variation in the TCW coefficients during the first period is mainly driven by the DEM component of the index.

The share of firms with significant DEM exposure varies from 21% to 38%, depending on the horizon. The DEM exposure has the same order of magnitude as the exposure to the TCW index. The share of firms with significant exposure to the JPY and USD is lower, and ranges from 13% to about 20%, depending on the horizon, for both currencies. The fact that more firms are exposed to DEM fluctuations confirms Germany's importance as a trading partner. When comparing the two sub-periods, we see a clear increase in exposure to both the JPY and USD, when going from a semi-fixed to a floating exchange rate regime. However, the DEM shows a different pattern with a lower fraction of firms significantly exposed to exchange rate changes during the latter regime. This pattern makes sense if the management of Swedish firms regarded the risk associated with the DEM as negligible during the semi-fixed regime, and therefore did not hedge such risk, whereas the switch to floating rates made the management pay attention to, and hedge, DEM-related risks. Again, we find a clear horizon effect in that the number of firms with significant exposure increases when longer horizons are considered. The horizon effect is also supported by the pattern of the R-squares.

Thus far, we have showed that firms seem to be exposed to fluctuations of the three major currencies. However, we have only discussed the results for one currency at a time. A more general question is to what extent firms are exposed to exchange rate fluctuations at all, in other words, to at least one

Table 3: A Summary of Exposure Coefficients for Individual Exchange Rates

	Sub-Period I			Sub-Period II		
	Return Horizon			Return Horizon		
	One Week	One Month	Three Months	One Week	One Month	Three Months
	Panel A. German Mark (DEM)					
Mean	–0.20	–0.68	–0.39	0.04	0.01	–0.49
Median	–0.32	–0.74	–0.41	–0.04	–0.05	–0.43
Std.Dev.	2.23	1.60	2.40	0.85	1.30	1.66
FX	38 (21%)	46 (26%)	66 (38%)	68 (20%)	58 (20%)	73 (31%)
	Panel B. Japanese Yen (JPY)					
Mean	–0.06	–0.12	–0.12	–0.11	–0.03	0.26
Median	–0.11	–0.10	–0.08	–0.10	0.03	0.29
Std.Dev.	1.01	0.52	0.66	0.62	0.79	1.01
FX	23 (13%)	27 (15%)	37 (21%)	96 (29%)	94 (33%)	82 (35%)
	Panel C. U.S. Dollar (USD)					
Mean	–0.01	–0.07	0.10	–0.01	0.14	0.57
Median	–0.05	–0.07	–0.02	0.03	0.14	0.41
Std.Dev.	0.98	0.78	1.18	0.74	0.85	1.22
FX	23 (13%)	34 (19%)	35 (20%)	43 (13%)	74 (26%)	91 (39%)
	Panel D. Overall Results					
FX	69 (38%)	85 (48%)	103 (59%)	160 (48%)	160 (56%)	165 (70%)
R^2_{adj}	0.16	0.27	0.47	0.16	0.24	0.36
# of Firms	180	176	174	333	287	235

Panel A, B, and C summarize the exposure coefficients for individual exchange rates (the β^j_{is} with j = DEM, JPY, USD in Equation (3.1)), for different return horizons and sub-periods. The first sample period covers January 1988 to October 1992, and the second period covers January 1993 to December 1998. Mean, Median, and Std.Dev. refer to means, medians, and standard deviations across firms. FX refers to the number of firms (and percentages in parentheses below) where the null hypothesis of zero exchange rate exposure is rejected at the 10% significance level. Panel D presents the number of firms (and percentages within parentheses) with the null hypothesis of zero exposure rejected for at least one of the individual currencies at the 10% significance level. The last two rows present the average adjusted R-square across firms, and the total number of firms.

currency. The answer to this question is presented in Panel D. Focusing on a monthly horizon, we find that no less than 85 firms show significant exposure to at least one currency in the first period, representing almost 50% of the firms in the sample. During the floating exchange rate regime, exposure is even higher. The share of significantly exposed firms ranges from 48%, using a weekly return horizon, to 70% when a quarterly horizon is analyzed. These figures are considerably higher than those reported in previous empirical research on exchange rate exposure.

4.4 The Cross-Section of Exposure

In this section, we study cross-sectional patterns of exchange rate exposure. Previous studies, including Jorion (1990), Bodnar and Gentry (1993), and Chow, Lee, and Solt (1997), focus on the exposure of industry portfolios. To avoid aggregation problems, we study the exposure of individual firms in different industries, but to enable easy comparison, *Table 4* presents the results from both perspectives. The column referred to as TCW reports the coefficient from the regression of industry-specific portfolio returns on changes in the TCW index, while the next reports the share of firms in an industry with significant exposure to the TCW index at 10% significance level. Paper and pulp is the only industry that shows a statistically significant aggregate exposure to the exchange rate index. A possible explanation for this is that the paper and pulp industry consists of reasonably homogenous firms, and is therefore less affected by the canceling-out effect in an aggregation across firms. However, given the chosen significance level, we should expect to find one industry with significant coefficients by random chance. The FX column reports that in all industries, with the exception of retail and construction, the share of firms with significant exposure to the TCW index is higher than 10%. Not surprisingly, the highest fraction of firms with significant exposure (24%) is reported for the engineering industry. As mentioned previously, many engineering firms sell their products on international competitive markets. On the other hand, only 9% of the retail companies, whose sales typically are on domestic markets, are significantly exposed to the TCW index.

The DEM, JPY, and USD columns report the coefficients from the multivari-

Table 4: Exchange Rate Exposure across Industries

Industry	N	TCW	FX	DEM	JPY	USD	FX
Engineering	46	0.23 (0.18)	24%	–0.08 (0.15)	0.17* (0.10)	0.22* (0.11)	59%
Paper and Pulp	14	0.47* (0.28)	14%	0.13 (0.23)	0.27* (0.12)	0.07 (0.18)	29%
Retail and Consumer Goods	32	0.12 (0.25)	9%	–0.01 (0.22)	0.01 (0.15)	0.20 (0.17)	38%
Construction	38	0.44 (0.69)	8%	–0.90* (0.40)	0.85* (0.28)	0.81* (0.30)	71%
Shipping	12	0.06 (0.36)	17%	–0.50 (0.32)	0.11 (0.20)	0.73* (0.27)	75%
Financial	33	–0.04 (0.17)	18%	–0.05 (0.15)	–0.01 (0.08)	0.21 (0.13)	67%
Chemical and Pharmaceutical	21	–0.24 (0.18)	14%	0.10 (0.16)	–0.34* (0.10)	0.15 (0.13)	38%
IT and Services	33	–0.16 (0.39)	18%	0.43 (0.39)	–0.38 (0.24)	–0.17 (0.24)	73%
Miscellaneous	58	0.18 (0.22)	22%	–0.06 (0.24)	0.00 (0.15)	0.44* (0.14)	47%
All	287	0.17 (0.23)	17%	–0.12 (0.19)	0.11 (0.13)	0.36* (0.11)	56%

The table compares and contrasts the exchange rate exposure of equally weighted industry portfolios with the exposure of individual firms in different industries. All refers to an equally weighted portfolio of all firms in the sample. The return horizon is one month and the sample period covers January 1993 to December 1998. N is the number of firms in each industry. TCW refers to the exposure coefficient in the regression of the portfolio returns on the percentage changes of the TCW index, with the standard error reported in parentheses below. FX (column four) shows the fraction of firms with significant TCW exposure at the 10% level. DEM, JPY, and USD refer to the exposure coefficients in the regression of the portfolio return on the rate of return on individual currencies, with standard errors reported in parentheses below. FX (column eight) shows the fraction of firms with significant exposure to at least one currency at the 10% level. Standard errors are adjusted for heteroskedasticity and autocorrelation as in Newey and West (1987). An asterisk marks a coefficient significantly different from zero at the 10% level.

ate regressions of industry-specific portfolio returns on changes in the individual exchange rates, while the final FX column reports the share of firms in an industry with significant exposure to at least one of the currencies, at 10% significance level. Somewhat surprisingly, the construction industry is the only industry with exposure to all three currencies. The engineering industry is exposed to JPY and USD, while the retail, financial, and IT industries do not seem to be affected by any currency fluctuations in the aggregate. However, a look at the fractions of firms with significant exposure completely changes the picture. No less than 73% of the IT firms are exposed to at least one of the currencies. Shipping and construction firms also show high fractions of exposed firms, 75% and 71%, respectively, while firms within the pulp and paper, and chemical and pharmaceutical industries seem to be less exposed to exchange rate changes.

Once again we illustrate the problems associated with aggregating across firms and currencies. The paper and pulp industry, which is the only industry portfolio with significant exposure to the exchange rate index, shows the lowest share of firms with significant exposure to individual currencies. Conversely, the financial industry has a TCW coefficient close to zero, and still two thirds of the financial firms are significantly exposed to at least one of the three major currencies.

We also study whether exchange rate exposure is related to the firm characteristics introduced in Section 3. More specifically, we rank the firms according to a characteristic, sort them into quintiles, and, for each quintile, we calculate the share of firms with significant exposure to the TCW index. The results from this procedure are reported in *Table 5*. In the quintile containing the smallest firms, the average market capitalization is SEK 100 million, and 12% of the firms show significant exposure to the TCW index. Among the largest firms, the corresponding figures are SEK 25.7 billion and 26%.[3] Hence, a positive relation seems to exist between the size of a firm and its exchange rate exposure. When firms are ranked according to their export rate, the lowest quintile reports that 7% of the firms are exposed to the TCW index, while 22% of the firms in the top quintile show significant exposure. No mono-

[3] Recall that we measure exposure without accounting for hedging activities. Anecdotal evidence suggests that large firms use derivatives for hedging purposes more often than small firms, suggesting an even bigger difference in unhedged exposure between large and small firms.

Table 5: Exchange Rate Exposure and Firm Characteristics

	Quintiles					
	Q1	Q2	Q3	Q4	Q5	N
Market Capitalization	0.1	0.3	0.8	2.4	25.7	287
TCW	12%	17%	12%	17%	26%	
Individual	49%	52%	56%	53%	68%	
Export Rate	18.0	36.9	60.9	80.2	93.4	135
TCW	7%	26%	19%	19%	22%	
Individual	63%	41%	37%	33%	67%	
Foreign Ownership	1.2	4.4	10.2	21.0	47.4	287
TCW	9%	14%	11%	26%	26%	
Individual	44%	50%	68%	60%	56%	
Foreign Listing	0				1	287
TCW	14%				35%	
Individual	55%				60%	

The table shows the fraction of firms with significant exposure at the 10% level for the period January 1993 to December 1998. The return horizon is one month. Firms are ranked according to a characteristic, sorted into quintiles, and the average characteristic within each quintile is reported. Further, the fraction of firms with significant exposure to the TCW index, and to at least one of the individual currencies DEM, JPY, and USD, are reported. The quintiles are labeled Q1 (low) to Q5 (high). N is the total number of firms used in the ranking. Market capitalization is expressed in SEK billion. Export rate is a firm's export sales divided by its total sales (in %). Foreign ownership is the fraction of a firm's equity held by foreign investors (in %). Foreign listing is a dummy with a value of one if a firm's shares are listed abroad. Otherwise, the value is zero.

tonic increase in exposure is observed when moving from the lowest to the highest quintile, but firms with very low export sales seem to be less exposed to exchange rate fluctuations than the rest of the firms. Interestingly, foreign ownership seems to be related to exchange rate exposure. Among the firms with large foreign ownership, 26% show exposure to the TCW index, while the corresponding figure is 9% for the firms with the lowest foreign ownership. This finding seems to support the hypothesis that foreign investors affect the hedging policy of a firm.

Table 5 also reports the share of firms with significant exposure to at least one of the individual currencies, for each quintile. Again, we find that firm size is related to exchange rate fluctuations. The share of firms with significant exposure is 49% for the smallest firms and 68% for the largest firms. However, we find no relation between the exposure to individual currencies and the export rate or foreign ownership. One possible explanation is that the characteristics are not region-specific. If we knew the geographical distribution of export sales and foreign ownership, and ranked according to region-specific sales and ownership, the result might be different.

When interpreting the results of Table 5, recall that we report the share of firms with some exposure, positive as well as negative. A seemingly flat relation between a characteristic and exposure could hide economically interesting patterns, if, for instance, 63% of the firms with the lowest export rates were negatively exposed to at least one currency, while 67% of the firms in the top quintile showed a positive exposure. To check whether any such relations exist, we calculated the average regression coefficient for each quintile (not reported), but found only a weak positive relation between a firm's export rate and the coefficient for the German mark. The general lack of relations between exposure coefficients and the characteristics makes it more difficult to interpret the findings reported in Table 5. According to several of the hypotheses introduced in Section 2.2, we should expect the firm attributes to be related to the exposure coefficients, not only to their magnitude in absolute terms.

4.5 Robustness of the Evidence and Discussion

Using Swedish data imposes a number of limitations, the most notable being the sample size. We include as many firms as possible in both periods in order to enable a more precise estimation, resulting in different sets of firms in the two periods. To verify that any difference in the results from the two periods is not due to firm specific influence, we also perform our analysis on the firms that are included in both periods. The results are virtually unaffected. Hence, we have not misinterpreted our findings by including different firms in the two periods.

Bartov and Bodnar (1994) suggest that investors make systematic errors by not immediately incorporating changes in exchange rates in the stock price. They argue that this is because the relationship between firm value and exchange rates is very complex. Another reason why effects on stock prices should not be contemporaneous—but lagged—is that firms hedge transactions over the near future (normally up to nine months). To test these hypotheses we extended the regressions with lagged exchange rate changes of one week, one month, and three months. The results (not reported) reveal that lagged changes affect stock prices *beyond* that of contemporaneous changes. In other words, adding lagged changes does not affect the share of firms significantly related to contemporaneous changes. This suggests that our results would be even stronger if lagged changes were included in the regressions.

Bartov, Bodnar, and Kaul (1996) find that exchange rate risk is higher under a floating exchange rate regime than under a fixed exchange rate regime. To see if we can find support for this, we calculated the systematic risk that is common to all variables (local, world and exchange), and the unsystematic risk in both periods, using sum of squares as the risk measure. We found that total risk did not increase. On the contrary, systematic risk was slightly lower and unsystematic risk was considerably lower. Using this method, it is difficult to separate the effect of local and world market risk from the effect of exchange rate risk. We have, however, no evidence of any market conditions that would have caused a sharp decrease in local or world market risk (see Table 1). This indicates that the exchange rate risk is slightly reduced, which contradicts the findings in Bartov, Bodnar, and Kaul (1996). Note that since we cannot separate the effect of operations from the effect of hedging transactions, it is possible that the hypothesized increase does not take place if firms find a greater need to hedge under floating exchange rates.

To sum up, we have shown that individual firms in Sweden display a large degree of exchange rate exposure. Although the correlation between the aggregate market return and changes in the exchange rate index is close to zero, we find that up to 30% of the firms have a statistically significant exposure to a trade-weighted exchange rate index at 10% significance level. The main reason for the low exposure of the aggregate market, compared with individual firms, is simply that some firms have positive exposure and some have negative, which cancels out in the aggregate. When we take the disaggregation one step further and study individual currencies, our findings become even more striking. We find that up to 70% of the firms are significantly exposed to at least one of the three major currencies. Again, the reason for the high degree of exposure when individual currencies are considered is that some firms are positively exposed to one currency and negatively exposed to others, which cancels out when the exchange rate index is used as a proxy for exposure. Even when firms are sorted according to firm attributes or industry category, we find that exposure is canceled out for aggregate portfolios. An obvious interpretion of these findings is that exchange rate exposure is truly firm-specific. If that is the case, economic theory suggests that taking exchange rate related risk should not be associated with any risk premia. Whether this is the case is analyzed in the following section.

5 Determinants of Risk Premia

As our findings suggest that a large proportion of Swedish firms are exposed to exchange rate fluctuations, an interesting question is to what extent investors are rewarded for taking exchange rate related risk. If risk associated with exchange rate fluctuations is idiosyncratic, then its premium should be zero. However, if only partial diversification is possible, we should not expect investors to take exchange rate risk without being compensated by a higher average return.

In a world of perfectly integrated capital markets, the standard CAPM can be extended to an international setting. Extensions involve accounting for the fact that the distribution of real returns on a particular investment is not the same for investors from different countries due to the existence of real exchange rate risk. Solnik (1974) and Sercu (1980) develop international asset pricing models under the assumption of deterministic inflation rates; in other words, they ignore the difference between nominal and real returns as well as the difference between nominal and real exchange rates. In their models, the risk premium on an investment is a linear function of the risk premium associated with the world market portfolio and the premium associated with exchange rate risk. Adler and Dumas (1983) develop a model that allows for stochastic inflation. In a continuous time framework, they show how to adjust the models of Solnik (1974) and Sercu (1980) to account for inflation risk. However, their empirical work suggests that this adjustment is not very important because of the low correlations between asset returns and inflation rates.

Based on the empirical findings of Adler and Dumas (1983), we choose to test an asset pricing model without inflation as a factor. As we still wish to allow for at least partial segmentation in the capital markets, we add the returns on the local stock market as a factor. Hence, we test the model

$$\mathrm{E}\left(r_i\right) = \lambda_l \beta_{il} + \lambda_w \beta_{iw} + \sum_{j=1}^{J} \lambda_s^j \beta_{is}^j, \tag{3.2}$$

where λ_l and λ_w are the risk premia associated with the local and world market portfolios, and λ_s^j is the risk premium associated with currency j, where J is the total number of currencies.

The estimation of the model in Equation (3.2) would be straightforward if we knew the true betas. However, the regression is conducted using betas estimated in a first step, which introduces an error-in-variables complication. There are two problems related to this. First, the measurement errors induce a downward bias in estimated risk premia. This bias can be reduced by grouping stocks into portfolios, thereby increasing the precision of the beta estimates. Previous empirical research on exchange rate risk premia has usually examined portfolio returns (see, for instance, Jorion, 1991, Dumas and Solnik, 1995, and De Santis and Gerard, 1998). However, in line with the arguments in previous sections, we take a different route and examine returns and exchange rate exposures of individual firms. Brennan, Chordia, and Subrahmanyam (1998) also use returns on individual firms when studying alternative factor specifications, security characteristics, and the cross-section of expected returns. We choose firm-specific data as we need a large variation in exposure across test assets to facilitate the estimation of the exposure's effect on risk premia (see Black, Jensen, and Scholes, 1972). The drawback is that the standard errors of the beta estimates are larger for individual firms than for portfolios. Nonetheless, given that our findings show that exposure coefficients of portfolios have low cross-sectional variation and are close to zero, we argue that using portfolio returns is not appropriate. A second problem concerns the effect of the error-in-variables on the standard errors of the estimated risk premia, and how to correct for this. Shanken (1992) derives a correction factor under the assumption of homoskedastic and normally distributed asset returns. However, these assumptions are unlikely to be satisfied in practice.

In fact, Jagannathan and Wang (1998) show that when heteroskedasticity is taken into account, corrected test statistics are not necessarily better behaved. Based on these findings, we only report uncorrected standard errors, with the caveat that the test statistics should be used with caution.

We follow the intuitively appealing procedure suggested in Fama and MacBeth (1973), that is, we run a cross-sectional regression at each point in time and then use the time-series to estimate premia and standard errors. Specifically, for each month t, we run the following least square regression

$$r_{it} = \lambda_{0t} + \lambda_{lt}\widehat{\beta}_{il} + \lambda_{wt}\widehat{\beta}_{iw} + \sum_{j=1}^{J} \lambda_{st}^{j}\widehat{\beta}_{is}^{j} + \xi_{it}, \tag{3.3}$$

where λ_{0t} is the intercept at time t; $\widehat{\beta}_{il}$, $\widehat{\beta}_{iw}$, and $\widehat{\beta}_{is}^{j}$ are the estimated exposure coefficients of firm i; and ξ_{it} is the error term of firm i at time t. The risk premia are then calculated as the time-series averages of the estimates, and the standard errors of the estimates are calculated from their time-series variability. We adjust the standard errors for the presence of heteroskedasticity and autocorrelation as suggested in Newey and West (1987). In addition to the appealing intuition of the Fama-MacBeth procedure, it has one important advantage. As we run the cross-sectional regression for each period, we can include all firms available at each point in time. Note, however, that we use constant exposure coefficients within the sample period as in, for instance, Black, Jensen, and Scholes (1972) and Jagannathan and Wang (1996).

We evaluate the model in Equation (3.3) in two ways. First, if the model is true, λ_0 should not be significantly different from zero. Second, we control for the existence of non-risk characteristics that affect the risk premia. That is, we augment the model according to

$$r_{it} = \lambda_{0t} + \lambda_{lt}\widehat{\beta}_{il} + \lambda_{wt}\widehat{\beta}_{iw} + \sum_{j=1}^{J} \lambda_{st}^{j}\widehat{\beta}_{is}^{j} + \sum_{m=1}^{M} \gamma_{t}^{m} C_{it-1}^{m} + \xi_{it}, \tag{3.4}$$

where C_{it-1}^{m} is the m^{th} characteristic of firm i at time $t-1$, and γ_{t}^{m} is the associated premium. Note that the characteristics are dated $t-1$ to ensure that they are known before the returns they are used to explain. We consider size, as measured by the log of market capitalization, and the log of the book-to-market ratio as characteristics (see, e.g. Fama and French, 1992, Jagannathan and Wang, 1996, and Daniel and Titman, 1997).

The standard Fama-MacBeth procedure involves the use of least squares regressions (LS) to estimate the risk premia. While LS have many attractive features, it has the undesirable feature of being sensitive to outliers, in this case outliers in firms' monthly returns, estimated betas, and characteristics. Complications associated with outliers are likely to appear since betas are measured with errors, as well as by the use of size and book-to-market ratios as firm-specific characteristics. Recall from Table 2 that betas estimated on monthly returns vary between −4.6 and 14.3 for the second sub-period, while the betas in the two middle quartiles only vary between −0.5 and 0.6. Therefore, we incorporate a robust regression technique into the Fama-MacBeth procedure that is less sensitive to outliers. Knez and Ready (1997) propose the use of least trimmed squares (LTS), which trims a fraction of the observations and then fits the remaining observations using LS. The estimated coefficients are then used to generate a new set of residuals, which again are trimmed, and the remaining observations are used for estimation. This iterative procedure continues until it converges. We would like to emphasize that we view this approach as a robustness check; in other words, we are not suggesting that non-used observations are incorrect.

The second period results are displayed in *Table 6*.[4] Panel A presents the LS estimates. The results can be summarized as follows: (*i*) equity premia are positive and statistically significant, (*ii*) there is no evidence of exchange rate risk premia, and (*iii*) in the LS regressions, the non-risk characteristics enter significantly and the estimated λ_0 is different from zero. The positive and economically as well as statistically significant equity premia provide some support for a CAPM type of model. Although the magnitude of the premia varies somewhat across the specifications, the premia are in line with the realized excess returns of the local and world market portfolios reported in Table 1. At the same time, the significance of the estimated λ_0 and γ_{Size} is evidence

[4] The first period results are similar to those of the second period. However, since the realized excess return on equity markets was negative and the exchange rate movements were much smaller, the first period results are more difficult to interpret. Hence, for the sake of brevity, we only report the second period results.

Table 6: Estimates of Risk Premia and Characteristic Premia

	Equity Premia		Exchange Rate Premia				Characteristics	
λ_0	λ_l	λ_w	λ_s^{TCW}	λ_s^{DEM}	λ_s^{JPY}	λ_s^{USD}	γ_{Size}	$\gamma_{B/M}$
			Panel A. Least Square Estimates					
0.49 (0.38)	1.52* (0.67)	0.39 (0.54)	−0.09 (0.30)					
2.14* (0.81)	1.22* (0.67)	0.44 (0.57)	−0.01 (0.29)				−0.25* (0.09)	−0.22 (0.19)
0.34 (0.37)	1.74* (0.64)	0.68 (0.54)		−0.02 (0.34)	−0.06 (0.58)	−0.18 (0.44)		
1.98* (0.78)	1.58* (0.63)	0.80 (0.54)		0.08 (0.34)	−0.10 (0.57)	−0.11 (0.44)	−0.24* (0.09)	−0.03 (0.15)
			Panel B. Least Trimmed Square Estimates ($\alpha = 5\%$)					
0.43 (0.33)	0.78 (0.55)	0.82* (0.41)	−0.06 (0.19)					
0.15 (0.67)	0.50 (0.54)	0.66 (0.42)	−0.01 (0.19)				0.05 (0.07)	0.02 (0.13)
0.36 (0.32)	1.00* (0.50)	0.84* (0.42)		0.08 (0.24)	0.51 (0.38)	−0.27 (0.27)		
0.13 (0.66)	0.99* (0.50)	0.99* (0.43)		0.17 (0.24)	0.30 (0.38)	−0.20 (0.28)	0.04 (0.07)	0.17 (0.11)

The table presents estimated risk premia based on monthly returns during the period January 1993 to December 1998. Panel A reports estimates from least square regressions. Panel B reports estimates from least trimmed square regressions, which involves an interative process of trimming a fraction (α) of the observations and then fitting the remaining data using least squares. The table reports the results when the trimmed fraction is 5%. Standard errors, adjusted for heteroskedasticity and autocorrelation as in Newey and West (1987), are reported in parentheses. An asterisk marks a coefficient significantly different from zero at the 10% level.

against the model specification; in other words, risk adjustment is not complete and expected returns are affected by other factors.

Panel B shows the LTS estimates with a trimmed fraction of 5%. Although the results are slightly changed, the non-existence of exchange rate risk premia is robust in that coefficients are close to zero in all regressions independently of whether exposure is measured to an index or to individual currencies, or whether characteristics are entered in the regression. This result supports the findings in previous sections. If it is possible to eliminate exchange rate exposure through diversification, then according to economic theory, we should not expect to find any risk premia. Finally, that the characteristics have significant coefficients in the LS regressions, but not when observations are trimmed, may indicate that the LTS estimates significantly reduce the error-in-variables problem. Alternatively, this could be due to some extreme observations in the characteristics themselves. We considered trimmed fractions up to 25% without obtaining qualitatively different results. In fact, Knez and Ready (1997) found that the premium on size that was estimated by Fama and French (1992) completely disappeared when the 1% most extreme observations were trimmed. Nevertheless, our main conclusion regarding the non-existence of exchange rate risk premia remains valid in both cases.

The conclusion that exchange rate risk is not priced is consistent with other studies of exchange rate risk (see, for instance Jorion, 1991). We consider a relatively short period with the maintained assumption of constant exposure toward fluctuations in foreign exchange markets. For longer sample periods, with changes in the business cycle and economic conditions, we would like to take into account the time-variation in risk exposures and risk premia as in, for instance, Dumas and Solnik (1995) and De Santis and Gerard (1998).

6 Conclusions

In this paper, we show that a large share of Swedish firms are affected by exchange rate fluctuations. By using a disaggregated dataset of stock returns and exchange rate movements, we conclude that the apparent lack of significant exchange rate exposure documented in previous studies is mainly due to the use of too aggregated economic variables. We examine the exchange rate exposure over return horizons of one week, one month, and three months, and find that it increases with the length of the horizon. We also study the cross-sectional pattern of exposure, across industries as well as several firm attributes. When firms are aggregated at an industry level, we do not find significant exposure when the exchange rate index is used as a proxy for exposure. However, when individual currencies are considered, we find some exposure at an industry level, although not of an overwhelming magnitude. We conjecture that the degree of homogeneity of an industry is an important determinant of exchange rate exposure at an industry level. When firms are sorted according to various attributes, we find that large firms, firms with large export sales, and firms with large foreign ownership are more exposed to exchange rate fluctuations than other firms. However, firms in these groups show both negative and positive exposure, suggesting that exposure is reduced through diversification, even among firms with similar attributes. Hence, we conclude that exchange rate exposure is truly idiosyncratic. This conclusion is confirmed in the evaluation of an international asset pricing model, as the exchange rate exposure of a firm does not show any relation to the firm's risk premia.

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Chapter 4

Conditioning Information in Tactical Asset Allocation

1 Introduction

Over the last years, we have seen a strong growth in the Swedish mutual fund industry. Assets under management have increased from SEK 71 billion at the end of 1987 to SEK 897 billion at the end of June 2000. Individual investors have realized that significant performance gains could be obtained by diversifying into portfolios containing a large number of securities. If investors care only about the mean and the variance of the return on their invested wealth, standard portfolio theory suggests that mutual fund managers construct portfolios with the lowest possible risk for a given expected return. As we will see, however, fund managers' ability to create such portfolios depends on their capacity to exploit the predictable component in time-varying expected returns.

Since the birth of financial markets, investors have tried to predict future asset returns. An increasing number of academics have begun to share this interest.[1] However, their interest is usually in issues such as market efficiency

[0] I have benefited from discussions with Hossein Asgharian, Magnus Dahlquist, Björn Hansson, Bertil Näslund, David Smith, Patrik Säfvenblad, Torbjörn Sällström, and seminar participants at the 1999 European Finance Association meeting.

[1] Early examples are Campbell (1987), Chen (1991), Fama and French (1989), Ferson (1989), Ferson (1990), Ferson and Harvey (1991), Ferson and Harvey (1993), Harvey (1989), and Harvey (1991). For evidence on Swedish asset returns, see Hansson and Hördahl (1997), Löflund (1994), and Nummelin (1994).

and implications for optimal consumption, while investors have a more obvious financial interest. In this paper, I describe a number of variables that have the ability to predict security returns. I also test the economic significance of predictability by designing dynamic asset allocation strategies conditional on these variables.

In a Bayesian framework, Kandel and Stambaugh (1996) show that although the return predictability can seem weak when described by standard statistical measures, the current values of the predictive variables can exert a substantial influence on the investor's portfolio decision. They conclude that a moderate predictability can be of large economic importance. Solnik (1993) proposes a test of the economic significance of return predictability by designing dynamic allocation strategies, and finds that the performance of the strategies are superior to several portfolio benchmarks. The difference is not only statistically significant but also economically large. Löflund (1994) finds in a study using Swedish asset returns that dynamic strategies increase the average portfolio return and reduce the standard deviation. Klemkosky and Bharati (1995) study the predictability of U.S. stock returns and conclude that dynamic strategies perform better than buy-and-hold strategies. Cavaglia et al. (1997) and Harvey (1994) produce similar results, when studying the predictability of emerging market stock returns.

The approach of this paper involves constructing conditional allocation strategies and compare their performance with that of unconditionally efficient portfolios and with a buy-and-hold strategy in the market portfolio. If returns are predictable with respect to the information set, the conditional strategies should outperform their unconditional counterparts. I evaluate all strategies on an out-of-sample basis using the (ex-post) Sharpe ratio as the performance measure.

When implementing the asset allocation strategies, I consider two groups of primary assets. The first group includes a small stock portfolio, the market portfolio, and a government bond index, while the second group includes 10 industry-specific portfolios. When applied to the first asset group, the conditional strategies outperform unconditional strategies. Hence, it appears that the conditional strategies succeed in exploiting predictability. The Sharpe ratios for the conditional strategies are up to six times higher than the ratios for their unconditional counterparts. Furthermore, the ratios are between two and three times that of holding the market portfolio. When the second asset group is employed, the conditional strategies do not outperform the unconditional strategies. The reason for this is that virtually no predictability is detected for these assets, and this in turn is due to the lack of industry-specific instruments in the information set.

When predictability is close to zero, the strategies based on the global minimum variance portfolio produce the best performance, since these strategies do not use the information on expected returns. In other words, when trying to exploit very low predictability, the amount of noise in the forecasts becomes so large that the conditional strategies do no better than their unconditional counterparts.

Finally, I consider a strategy based on the maximally predictable portfolio proposed by Lo and MacKinlay (1997). While this portfolio is not ex-ante mean-variance efficient, its superior predictability may potentially cause it to outperform mean-variance efficient strategies when evaluated ex-post. The results show that the strategy based on the maximally predictable portfolio outperforms several benchmarks when the predictability of the primary assets is moderate to high. However, when the primary assets' predictability is low, this strategy performs badly compared with strategies that do not rely on predictability to the same extent.

The paper is organized as follows. In Section 2, the asset allocation strategies are presented. Section 3 describes the data and motivates the instruments used as conditioning information. I also discuss the instrument selection problem. Section 4 reports the empirical results of the asset allocation strategies, and the summary and concluding remarks are offered in Section 5.

2 Asset Allocation Strategies

This section introduces the method used in the paper. In the first two subsections, the difference between unconditional and conditional portfolio choice is presented, while the last subsection describes the allocation strategies.

2.1 Unconditional Models

The starting point in this study is a risk averse investor. Risk is referred to as the volatility in returns and is measured by the standard deviation. Hence, the task is to create a portfolio with the lowest possible volatility for a given expected return. The target expected return is determined by the preferences of the investor. Formally, this can be written as

$$\min_{\{\omega\}} \quad \omega' V \omega \quad \text{subject to} \quad \omega'\mu = \text{target} \quad \text{and} \quad \omega'\iota = 1, \tag{4.1}$$

where ω denotes the $(n \times 1)$-vector of asset weights, V is the $(n \times n)$-matrix of covariances, μ is the $(n \times 1)$-vector of expected returns, ι is the $(n \times 1)$-vector of ones, and n is the number of assets.

The unconditional strategies involve solving the problem in (4.1) at the end of each investment period and holding the portfolio over the next period. The strategies are unconditional because the expected returns used are simply the historical mean returns. More specifically, when deciding upon the first allocation, the expected return is the historical average return up to that point in time. For the next investment period, the sample is expanded to include the last observation of the realized returns, and the portfolio is reallocated. Although this procedure allows the expected returns to change as new observations enter into the estimation sample, using the historical means assumes that the best possible forecast of future returns is their past averages. This strategy is optimal when stock prices follow a random walk, in other words, when returns are unpredictable. In the same way, the covariance matrix includes the historical covariances. Thus, the covariances cannot vary over time in a more complex way.

2.2 Conditional Models

In the conditional asset allocation problem, I use a more sophisticated forecasting technique than the historical average. Let z_t denote the $(k \times 1)$-vector of instrumental variables observable at time t, and consider the following linear regression:

$$r_{it} = \beta_i' z_{t-1} + \varepsilon_{it} \qquad \text{for } i = 1, 2, ..., n, \tag{4.2}$$

where r_{it} is the return on asset i, from $t-1$ to t, β_i is a $(k \times 1)$-vector of coefficients for asset i and ε_{it} is the forecasting error with $E[\varepsilon_{it} | z_{t-1}] = 0$. Consequently, I assume that the conditional expectation of the return on asset i from $t-1$ to t, given the information known at $t-1$, can be written as[2]

$$E[r_{it} | z_{t-1}] = \beta_i' z_{t-1} \qquad \text{for } i = 1, 2, ..., n. \tag{4.3}$$

Similar to the unconditional asset allocation, at each point in time the sample is expanded to include the last observation and the model is re-estimated. Given the parameter values, one-step-ahead forecasts are delivered and the portfolio is reallocated.

The portfolio problem also requires a forecast of the covariance matrix. Consider the conditional covariance between asset i and j:

$$Cov(r_{it}, r_{jt} | z_{t-1}) = E[(r_{it} - E[r_{it} | z_{t-1}])(r_{jt} - E[r_{jt} | z_{t-1}]) | z_{t-1}]. \tag{4.4}$$

Using Equations (4.2) and (4.3), the covariance between asset i and j can be rewritten as

$$Cov(r_{it}, r_{jt} | z_{t-1}) = E[\varepsilon_{it}\varepsilon_{jt} | z_{t-1}]. \tag{4.5}$$

Hence, the conditional covariance is the forecasted value of the product of the residuals from the regressions of asset i and j on the instruments. This specification contrasts with its unconditional counterpart in that it allows the conditional covariances to be explicitly modeled. For example, a GARCH model would include lagged products in the information set.

In principle, a one-step-ahead forecast of the covariance matrix can be calculated in the same way as the forecast of expected returns. Nevertheless, for several reasons I choose an alternative procedure. First, when using a linear forecasting model there is no guarantee that the forecasted variance is positive. Second, without a number of cross-sectional restrictions, the covariance matrix may not be positive definite. Third, a full model of the covariance ma-

[2] If we assume that the joint distribution of asset returns and instruments falls into the general class of spherically invariant distributions, then the conditional expectation of returns will be a linear function of the instruments. Harvey (1992) compares linear models of expected returns with non-linear alternatives and finds that linear models perform as well as non-linear in out-of-sample evaluations.

trix would require a large number of forecasting equations. Since the most important input for asset allocation purposes are expected returns, this forecasting procedure for the covariances is difficult to motivate.

The approach of this paper involves using the unconditional mean of the products of the residuals as the forecasted covariance matrix. The approach implicitly assumes that the products of the residuals are not predictable. This is unfortunate since Harvey (1989), among others, has showed that these products indeed are predictable. To allow for at least some time-variation in the unconditional means it is possible to update the estimates using a moving window average. However, using a simple moving average has its own drawbacks. Since all observations in the sample have equal weight, the average tend to move up sharply when confronted with a shock but then decline just as sharply once that particular observation falls out of the estimation sample. One way to prevent this is to use an exponential moving average where the latest observation carries the highest weight in estimating the mean. This approach has two conceptual advantages. The first one is that the historical average reacts faster to shocks as recent data carry more weight in the estimation. The second is that following a shock, the measure declines gradually as the weight of the shock observation declines. I use the exponential moving average with a decay factor, λ, of 0.9. This means that the cumulative weight for the last 20 observations is approximately 90%.[3]

2.3 The Strategies

I examine four asset allocation strategies of two classes, namely *fully invested* and *market timing* strategies. The first class does not allow positions in cash. In other words, the investor has to invest in risky assets even though she has a negative prior of the market. This situation applies to some equity mutual

[3] Denote by h_{it} the conditional mean of the squared residual from the regresson of the return on asset i on the instruments. The exponential forecast can then be written as

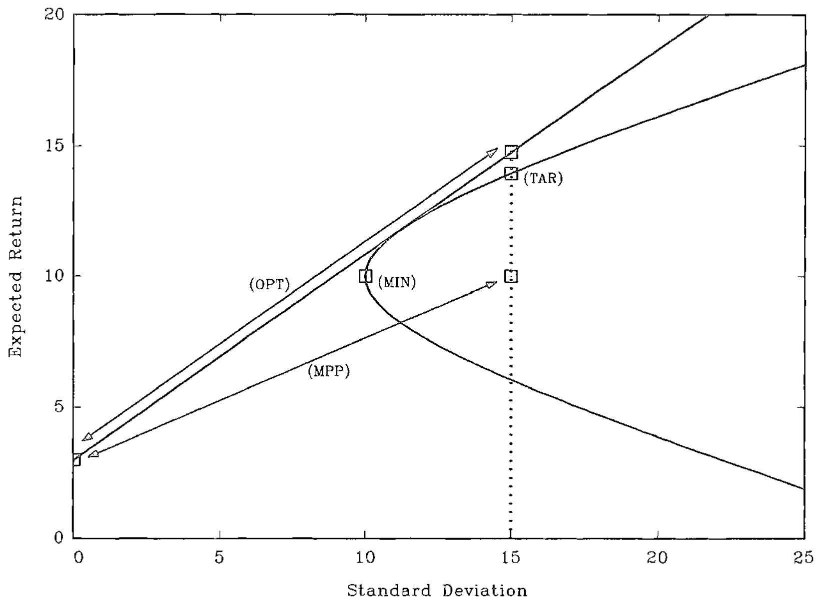
$$h_{it+1} = (1 - \lambda)\,\varepsilon_{it}^2 + \lambda h_{it}$$

where $1 - \lambda$ is the weight carried by the latest observation. This specification can easily be viewed as a special case of the GARCH(1,1) process

$$h_{it+1} = \gamma + \alpha\varepsilon_{it}^2 + \beta h_{it}$$

with $\gamma = 0$ and $\alpha + \beta = 1$.

Figure 1: The Asset Allocation Strategies
This figure illustrates the allocation strategies. MIN refers to the global minimum variance portfolio. TAR is the target volatility portfolio, that is, the portfolio on the efficient frontier with a specified target volatility. The optimal portfolio, OPT, is defined as the combination of the tangency portfolio and the risk-free asset with a given target volatility. MPP refers to the maximally predictable portfolio proposed by Lo and MacKinlay (1997).



funds. The strategies in the second class allow the investor to take a full or partial position in cash if she wishes. She can also borrow funds at the risk-free rate of return to increase the leverage in the portfolio.

The strategies are graphically displayed in *Figure 1*. The fully invested class includes two strategies. In the MIN-strategy, all the funds are invested in the global minimum variance portfolio while the TAR-strategy invests all the funds in the target volatility portfolio. The former is motivated by the fact that it does not require expected returns as input when calculating the asset weights. Thus, it is insensitive to errors in the return forecasts. Also, Haugen and Baker (1991) show that this portfolio has a superior out-of-sample performance when compared to other portfolio choices, particularly when historical returns are used as forecasts of future returns. The TAR-strategy has an obvious role in a study like this. It is the portfolio with the highest possible expected return for a given level of risk, for a fully invested investor. The target volatility is chosen to be 15%, measured as the annualized standard deviation. This corresponds approximately to the volatility of the market portfolio during the evaluation period.

The market timing class also includes two strategies. In the OPT-strategy the funds are invested in the optimal mean-variance efficient portfolio. This means investing in a linear combination of the tangency portfolio and the risk-free asset with a target volatility of 15%. If the risk-free rate of return exceeds the expected return of the global minimum variance portfolio, the tangency portfolio will not be defined on the efficient part of the mean-variance frontier. In this case, all funds are invested in the risk-free asset. Finally, in the MPP-strategy I draw on a result proposed by Lo and MacKinlay (1997). They show that it is possible to create portfolios with higher predictability than that of the individual assets included in the portfolio. More specifically, they construct a maximally predictable portfolio.[4] The MPP is an ad hoc portfolio in the sense of (ex-ante) mean-variance efficiency. However, the construction of a mean-variance efficient portfolio is based on return forecasts driven by the predictability of individual assets, which (by construction) are not as predictable as the MPP. In other words, although many portfolios ex-ante dominate the MPP, superior predictability may cause strategies based on the MPP to outperform other portfolios when evaluated ex-post. If the expected return on the MPP exceeds the risk-free rate, all funds are invested in the combination of the MPP and the risk-free asset that has a target volatility of 15%. Otherwise, all funds are invested in the risk-free asset.

Since many investors are often unable to take short positions in stocks, the portfolios in this study are constrained to have non-negative weights in risky assets. However, short positions in the risk-free asset are allowed for the market timing strategies.

[4] A derivation of the maximally predictable portfolio is presented in the appendix.

3 Data Description

3.1 Return Data

I study weekly and monthly returns for the period from 1988 to 1996. I choose to start my analysis in 1988 since reliable data for bonds and some of the instruments are not available before that date. Two groups of primary assets are considered: (*i*) a three-asset group, consisting of the market portfolio (AFGX), a portfolio of small stocks (SX-OTC), and a government bond index (Datastream's five-year benchmark bond), and (*ii*) a ten-asset group consisting of industry-specific stock portfolios constructed by Affärsvärlden. The two groups are referred to as the SB and SECTOR group, respectively. All portfolios are value-weighted.

Table 1 presents summary statistics of the returns. During the sample period, the unconditional mean return is higher on the aggregate stock market than on the small stock portfolio (15.8% versus 14.2% per year). The same pattern is found for the standard deviations. The market portfolio has higher volatility than the small stock portfolio (18.2% versus 17.6% per year). These figures contrast with most studies based on U.S. data, where the typical pattern is a near-monotonic increase in both mean and standard deviation when moving from portfolios of larger to smaller firms, ranked on market value.[5] The high bond index return of 12.4% is caused by a downward trend in interest rates during the sample period.

Within the SECTOR group, the annual return varies from almost 25% for the retail trade portfolio to about 5% for the portfolio of construction stocks. The miscellaneous portfolio has a low standard deviation of 15.9%, which is even lower than that of the aggregate market. The bank and insurance portfolios are both homogeneous and consist of few firms, and, consequently, have large standard deviations.

The unconditional autocorrelations are also presented. Consistent with other studies on weekly data, the highest correlation is found with the first lag. The small stock portfolio has the highest first-order autocorrelation (0.27) while most portfolios show moderate autocorrelation. The last two columns

[5] See, for example, Harvey (1989) and Fama and French (1992).

Table 1: Summary Statistics of Weekly Asset Returns

	Mean	StDev	Skew	Kurt	$\rho 1$	$\rho 4$	Min	Max
SB Group								
Market Index	15.76	18.20	−0.01	4.13	0.10	0.00	−14.28	13.92
Small Stock Index	14.20	17.58	−0.07	2.64	0.27	0.05	−11.79	8.50
Bond Index	12.43	5.42	−0.05	7.21	−0.10	0.07	−3.44	5.41
SECTOR Group								
Manufacturing	21.54	22.02	0.20	3.26	0.05	0.01	−14.56	16.86
Pulp and Paper	11.82	28.91	1.36	10.89	0.07	0.06	−13.36	33.49
Retail Trade	24.78	22.66	0.81	4.87	0.04	0.01	−11.07	19.04
Construction	5.15	30.67	1.71	13.89	0.13	−0.04	−16.47	36.75
Miscellaneous	18.29	15.90	−0.46	3.54	0.06	−0.02	−13.72	8.13
Mixed Investment	16.98	25.18	1.18	9.92	0.13	0.03	−11.63	28.63
Pure Investment	10.40	27.99	0.28	3.26	0.09	−0.02	−17.29	18.95
Banking	18.03	36.23	1.89	16.16	0.07	0.01	−20.37	45.85
Shipping	7.72	29.10	0.63	4.85	0.02	−0.10	−15.09	23.48
Insurance	7.39	33.86	0.49	3.61	0.08	0.00	−18.30	22.56

The table reports summary statistics of weekly returns from January 1988 to December 1996. Means and standard deviations are annualized and reported in percent. The market index is constructed by Affärsvärlden, the small stock index is the OTC-index calculated by the Stockholm Stock Exchange, and the bond index is the return on a 5-year benchmark bond produced by Datastream. The sector-specific portfolios are constructed by Affärsvärlden.

report the lowest and highest weekly return during the sample period. For most portfolios, the highest return occurred in the week surrounding November 19, 1992 when the Swedish currency was devaluated. In this particular week, banks, the construction sector, and the pulp and paper portfolio show remarkably high returns. This event also explains in part the high standard deviation, skewness and kurtosis for these portfolios.

Table 2 reports the unconditional correlation between asset returns. The highest correlation (0.78) is between manufacturing firms and mixed investment companies, while the lowest (0.22) is between firms in retail trade and banks. The average correlation for the SB and SECTOR groups are 0.47 and 0.51, respectively. I checked whether reported high correlations were driven by large co-movements in connection with the devaluation of the Swedish currency, but found no such relation. In general, higher correlations than those reported in the table were found around the time of the devaluation. However, correlations were also higher for the sample period as a whole when the devaluation period was excluded. This indicates that the correlation pattern was "different" during the devaluation period than during the rest of the

Table 2: Unconditional Correlations of Weekly Asset Returns

SB Group											
Market Index	1.00										
Small Stocks	0.66	1.00									
Bond Index	0.45	0.29	1.00								
SECTOR Group											
Market Index	1.00										
Manufacturing	0.55	1.00									
Pulp and Paper	0.51	0.76	1.00								
Retail Trade	0.41	0.42	0.36	1.00							
Construction	0.62	0.60	0.50	0.34	1.00						
Miscellaneous	0.54	0.73	0.61	0.39	0.56	1.00					
Mixed Investment	0.54	0.78	0.73	0.36	0.65	0.70	1.00				
Pure Investment	0.59	0.67	0.60	0.41	0.70	0.61	0.65	1.00			
Banking	0.53	0.37	0.29	0.22	0.63	0.40	0.39	0.50	1.00		
Shipping	0.42	0.55	0.51	0.28	0.42	0.53	0.50	0.48	0.33	1.00	
Insurance	0.43	0.51	0.43	0.24	0.63	0.54	0.49	0.54	0.54	0.45	1.00

The table reports unconditional correlation coefficients of weekly returns from January 1988 to December 1996. The indices are defined as in Table 1.

sample period.

3.2 Information Variables

I choose instruments that are likely to contain information about the time-series variation in expected risk premia. Ideally, I would like to employ the information that investors use in practice, but unfortunately such an information set is difficult to access.

Recall that the value of a security can be written as the present value of its future cash flows, that is

$$P_t = \sum_{s=1}^{\infty} \frac{CF_{t+s}}{(1+y_{st})^s}, \tag{4.6}$$

where P_t is the current price, CF_{t+s} is the cash flow s periods ahead, and y_{st} is today's s-period required rate of return. A useful instrument predicts changes in either the cash flow generating capacity of a firm, the discount factor, or both. In this study, the following instruments are used:

(*i*) *Bond yield.* The yield to maturity on a 5-year government benchmark bond less its previous 13-week moving average.

(*ii*) *Bill rate.* The weekly change in the bill rate, that is, the rate on 3-month

Treasury bills less the rate of the previous week.

(*iii*) *Maturity spread.* Maturity spread is the yield to maturity on a 5-year government benchmark bond less the rate on 3-month Treasury bills.

(*iv*) *Default spread.* This instrument is defined as the yield to maturity on a 5-year mortgage bond less the 5-year government bond yield.

(*v*) *Exchange rate.* The weekly change in the exchange rate defined as the percentage change in the trade-weighted currency index.

(*vi*) *Interest rate spread.* This is defined as the yield to maturity on a Swedish 5-year government bond less the German 5-year government bond yield.

(*vii*) *Earnings yield.* Next year's earnings forecast for the aggregate market divided by the market capitalization, less the 3-month bill rate.

(*viii*) *Market-to-book ratio.* The market value of equity divided by the book value of equity.

(*ix*) *Inverse relative wealth.* This instrument is defined as the reciprocal of stock market wealth times its 13-week moving average.

3.2.1 Motivation of the Choice of Instruments

Instruments (*i*) to (*vi*) carry information on the aggregate economy. The level of the long-term government bond yield (BOND) is a natural instrument since it is a component of the required rate of return.[6] The long-term bond yield can also be seen as a proxy for anticipated inflation, which is positively correlated with the general economic activity. The economic activity, in turn, affects the size of future cash flows. Thus, it is not obvious whether higher bond yields are positively or negatively related to future asset returns.

The weekly change in the 3-month Treasury bill rate (BILL) is used as a proxy for central bank activity in the money market. The central bank is generally believed to have superior information on the economic activity, which is then used when it acts in the money market to fulfil its monetary policy. Ideally, I would have preferred a more short-term instrument, but data series on instruments with shorter maturity are of low quality since these instruments

[6] To avoid problems associated with data series being close to non-stationary, I study the yield to maturity on a 5-year government bond less its previous 13-week moving average. This method, often referred to as stochastic de-trending, is used in Hodrick (1992), among others.

were extremely illiquid in the period when speculation against the Swedish currency took place.

According to the expectation hypothesis of interest rates, an upward sloping yield curve indicates that investors have expectations of higher rates and vice versa. Hence, an upward sloping yield curve may signal expectations of higher inflation, which is important when forming expectations of asset returns. I use the slope of the yield curve, defined as the yield to maturity on a 5-year government bond less the yield on 3-month Treasury bills, as an instrument to capture such expectations. This instrument is referred to as the maturity spread (MAT).

The default spread (DEF) is defined as the yield to maturity on a 5-year mortgage bond less the 5-year government bond yield. The spread is used as an indicator of future debt service ability of borrowers, which should be positively correlated with the activity in the aggregate economy. Thus, it has the potential of being a good predictor of economic activity.

In a small open economy like the Swedish, international competitiveness is heavily dependent on the price of the Swedish currency. Hence, the percentage change in the trade-weighted currency index (FX) is used as an instrument.

According to the uncovered interest parity condition, the difference in interest rates on bonds denominated in domestic and foreign currency is (approximately) equal to the expected percentage change in the relative price between the domestic and foreign currency. Therefore, I also use the interest rate spread (IRS) between Swedish and German five-year government bonds as an indicator of international competitiveness.

Instruments (*vii*) and (*viii*) are measures of profitability and the value of firms. Recall the constant growth version of the dividend discount model, and let P_t be today's price, D_{t+1} the expected dividend one period ahead, y the required rate of return, and g the constant growth rate in dividends. Let us further assume that dividends are a constant fraction of earnings, $D = k \cdot E$, and decompose the required rate of return into a risk-free rate plus a risk premium, that is $y = i + pr$. This can be written as

$$P_t = \frac{D_{t+1}}{y-g} = \frac{kE_{t+1}}{i+pr-g} \quad \Longrightarrow \quad pr = g + \left[k\frac{E_{t+1}}{P_t} - i \right]. \qquad (4.7)$$

Rearranging terms, the risk premium can be expressed as a sum of dividend growth and (a linear transformation of) earnings yield in excess of the risk-free rate. The second term is captured by the instrument referred to as earnings yield (EY). It is defined as the next year earnings forecast for the portfolio divided by its price, in excess of the yield on a 3-month Treasury bill.

Given that firms apply clean surplus accounting, the dividend discount model can be rewritten even further.[7] Using the same notation as earlier, adding B as the book value of equity and r^E as the accounting measure for return on equity, it can be shown that

$$\frac{P_t}{B_t} = 1 + \sum_{t=1}^{\infty} \frac{B_{t+i-1}\left(r^E_{t+i} - y\right)}{B_t\left(1+y\right)^{t+i}}. \tag{4.8}$$

Hence, the market-to-book ratio (MB) is one when the return on equity, r^E, is equal to the required rate of return, y.[8] A time-varying market-to-book ratio indicates changes in profitability, changes in required return, or both.

Finally, instrument (ix) is a proxy for the risk aversion of investors. Time-varying risk aversion can be as important as time-varying risk for explaining the variation in risk premia. Consider the (extended) power utility function

$$U\left(W\right) = \frac{\left(W-\omega\right)^{1-\gamma}}{1-\gamma}, \tag{4.9}$$

where W is wealth, $\omega > 0$ is a subsistence level, and $\gamma > 0$ is a risk aversion parameter. This function implies that the relative risk aversion, RRA, decreases in wealth, more specifically

$$RRA = \frac{-WU_{WW}}{U_W} = \frac{\gamma}{1-\frac{\omega}{W}}. \tag{4.10}$$

The subsistence level is supposed to be time-varying, as individual consumers may have adaptive tastes.[9] To capture variations in RRA, I follow the spirit of

[7] Clean surplus accounting ensures that the change in book value of equity in a period is equal to net earnings less paid dividends during the same period.

[8] There are other accounting specific reasons for this ratio not being equal to one. Hendriksen (1982) discusses this issue.

[9] Campbell and Cochrane (1999) model an economy where people slowly develop "habits" for higher or lower consumption. They specify that today's level of habit is a function of current and

Table 3: Summary Statistics of the Instruments

	Mean	StDev	Skew	Kurt	$\rho 1$	$\rho 4$	Min	Max
BOND	–0.08	0.56	0.63	1.26	0.92	0.72	–1.77	1.86
BILL	–0.01	0.52	3.01	68.90	0.12	–0.13	–4.25	6.51
MAT	0.16	1.60	–1.52	7.85	0.96	0.79	–10.09	3.30
DEF	0.72	0.38	0.96	0.62	0.98	0.93	0.21	2.14
FX	0.03	0.92	4.64	54.22	–0.05	0.08	–2.45	11.59
IRS	3.35	1.38	0.11	–1.17	0.98	0.93	1.01	6.09
EY	–3.80	3.31	–0.17	0.56	0.98	0.92	–17.33	2.79
MB	1.32	0.23	–0.10	–1.01	0.99	0.94	0.84	1.80
IRW	0.99	0.07	1.16	2.44	0.92	0.65	0.82	1.34

The table reports summary statistics of the instruments based on weekly data from January 1988 to December 1996. The instruments are defined in Section 3.2.

Ilmanen (1995) and use the ratio of the subsistence level to current wealth, ω/W, as an instrument, and refer to it as inverse relative wealth (IRW). The subsistence level is defined as the 13-week moving average of past stock market wealth. Although stock market wealth represents only a small fraction of aggregate wealth, it is positively correlated with most other parts of wealth and is probably the most volatile segment of wealth. Thus, it is suitable as a proxy for aggregate wealth.

3.2.2 Some Characteristics of the Instruments

Summary statistics of the instruments are reported in *Table 3*. The sample period covers some extreme events in the Swedish economy. In November 1992 a speculation took place against the Swedish currency. The central bank defended the fixed currency regime by increasing the overnight interest rate to 500% per year. In one week, the yield of the 3-month Treasury bills rose 6.5 percentage points, just to fall by more than 4 percentage points the week after. In this period, the yield curve had a sharply negative slope with a maturity spread of about -10 percentage points. In the particular week when the central bank eventually abandoned the fixed currency regime, we observe an 11.6% increase in the currency index.

Table 4 reports the unconditional correlation between the instruments. The

past consumption.

Table 4: Unconditional Correlations of the Instruments

BOND	1.00								
BILL	0.24	1.00							
MAT	0.07	−0.11	1.00						
DEF	−0.07	−0.03	−0.58	1.00					
FX	−0.04	−0.10	−0.00	0.16	1.00				
IRS	0.31	0.06	0.23	−0.54	−0.01	1.00			
EY	−0.11	−0.09	0.78	−0.58	−0.09	0.01	1.00		
MB	0.07	0.03	0.63	−0.53	−0.08	−0.09	0.77	1.00	
IRW	0.48	0.12	−0.27	0.18	−0.04	0.10	−0.21	−0.32	1.00

The table reports unconditional correlation coefficients of the instruments based on weekly data from January 1988 to December 1996. The instruments are defined in Section 3.2.

average correlation (in absolute terms) is 0.21. The highest coefficient is between EY and MAT (0.78), while. FX and MAT appear to be uncorrelated as well as EY and IRS.

3.3 Data-Snooping Considerations

Data-snooping refers to the bias in statistical inference that results from using information from data used in prior empirical studies to guide subsequent research with the same or related data. For example, if foregoing studies have shown that lagged stock market returns are able to predict stock returns, we should not be surprised if we draw the same conclusion when a similar predictability test is performed on an identical dataset. Thus, the fact that many studies report similar findings should be interpreted with caution as long as the results cannot be confirmed when tested on different datasets or time periods.

There is no doubt that prior empirical findings have influenced my choice of instruments, although the previous subsection shows that theoretical considerations have played the most important role. Nevertheless, I examined a total of 17 variables, that is, 8 additional variables that I did not include in the final instrument set. These were excluded due to their high correlation with other variables used in the final instrument set. Foster, Smith, and Whaley (1997) show that choosing k out of m potential regressors to maximize R-square can yield seemingly significant R-squares even when no relation exists between the dependent variable and the regressors. Hence, I will take the results of Foster, Smith, and Whaley (1997) into account when reporting the critical values of the adjusted R-squares. A more challenging test for genuine predictability is to measure the model performance out-of-sample. This is done in Section 4.

3.4 Preliminary Regressions

The regression of weekly returns on the instruments is reported in *Table* 5. The bond yield (BOND) has a negative sign for all portfolios. It is significant (at the five-percent level) for the return on the government bond index and for the bank and insurance portfolios. This supports the conventional wisdom that these industries are more sensitive to changes in interest rates than the average portfolio. At a first glance, it seems obvious that the bond yield coefficients have negative sign for all portfolios, as high discount rates correspond to a low present value of earnings. However, high interest rates can also be associated with expectations of higher economic activity, and consequently higher earnings. This effect increases the price of equity. In practice investors seem to react differently to interest rate changes depending on the current phase of the business cycle. I will deal with the problem of time-varying parameters in Section 3.5.

The change in the bill rate (BILL) is positively related to future returns on the government bond index. It is also positively related to three out of ten sector portfolios, namely manufacturing, pulp and paper, and mixed investment companies. Two sectors, construction and banks, have a significantly negative relation to the change in the bill rate. With similar arguments as above, changes in the bill rate can affect returns in two ways and the dominating effect seems to depend on the phase of the business cycle.

The maturity spread (MAT) is positively related to the return on small stocks while the default spread (DEF) shows no significant relation to any return. As expected, a weakening of the domestic currency (an increase of FX) is positively related to the returns on the market portfolio, and is also significant for three of the 10 industry portfolios. The interest rate spread (IRS) is only significantly related to the return on insurance companies.

The valuation measures EY and MB typically do not show any significant relation future returns. The exception is the return on the miscellaneous port-

Table 5: Regression Results of Weekly Asset Returns

	BOND	BILL	MAT	DEF	FX	IRS	EY	MB	IRW	R^2
SB Group										
Market Index	–0.43	0.45	0.05	0.38	0.29	0.16	0.13	–0.01	–3.24	3.5
	(0.31)	(0.30)	(0.15)	(0.74)	(0.13)	(0.17)	(0.08)	(0.01)	(2.53)	[0.01]
Small Stocks	–0.49	–0.18	0.34	–0.58	0.03	–0.19	–0.12	0.00	–6.28	10.6
	(0.29)	(0.18)	(0.14)	(0.57)	(0.13)	(0.15)	(0.08)	(0.01)	(2.23)	[0.00]
Bond Index	–0.21	0.20	–0.02	0.13	0.02	0.07	0.04	–0.00	0.07	3.7
	(0.09)	(0.10)	(0.04)	(0.21)	(0.04)	(0.04)	(0.02)	(0.00)	(0.56)	[0.00]
SECTOR Group										
Manufacturing	–0.38	0.87	0.09	0.54	0.29	0.14	0.11	–0.02	–3.88	2.7
	(0.37)	(0.39)	(0.19)	(0.87)	(0.15)	(0.21)	(0.10)	(0.01)	(3.18)	[0.04]
Pulp and Paper	–0.56	1.58	0.22	1.76	0.07	0.35	0.20	–0.03	–4.49	4.9
	(0.50)	(0.45)	(0.23)	(1.56)	(0.17)	(0.33)	(0.12)	(0.02)	(3.46)	[0.00]
Retail Trade	–0.03	0.49	0.24	0.20	–0.13	–0.26	0.04	–0.01	–7.24	3.4
	(0.36)	(0.29)	(0.18)	(0.60)	(0.16)	(0.15)	(0.11)	(0.01)	(2.55)	[0.01]
Construction	–0.92	–1.29	0.12	–0.34	0.93	0.21	0.01	0.00	–1.98	9.3
	(0.51)	(0.47)	(0.25)	(1.32)	(0.60)	(0.30)	(0.14)	(0.02)	(3.53)	[0.01]
Miscellaneous	–0.28	0.18	–0.05	0.09	0.21	0.15	0.14	–0.01	–1.40	1.8
	(0.27)	(0.25)	(0.12)	(0.53)	(0.10)	(0.12)	(0.07)	(0.01)	(2.30)	[0.01]
Mixed Investment	–0.58	1.09	0.12	0.95	0.40	0.17	0.20	–0.02	–5.89	5.4
	(0.44)	(0.44)	(0.25)	(1.31)	(0.22)	(0.29)	(0.10)	(0.02)	(3.25)	[0.01]
Pure Investment	–0.89	0.17	–0.06	0.34	0.34	0.26	0.13	–0.01	–4.91	2.7
	(0.48)	(0.28)	(0.24)	(0.87)	(0.25)	(0.21)	(0.12)	(0.01)	(3.91)	[0.02]
Banking	–1.27	–1.69	0.21	–0.61	1.42	0.06	0.00	–0.01	–6.57	16.0
	(0.57)	(0.67)	(0.28)	(1.24)	(0.69)	(0.27)	(0.15)	(0.02)	(3.26)	[0.00]
Shipping	–0.57	0.49	0.29	–0.18	–0.13	0.21	0.05	–0.02	–3.10	1.6
	(0.54)	(0.32)	(0.25)	(1.39)	(0.20)	(0.29)	(0.12)	(0.02)	(4.44)	[0.05]
Insurance	–1.27	–0.72	0.05	1.30	0.64	0.60	0.13	–0.00	1.18	4.7
	(0.55)	(0.90)	(0.31)	(1.13)	(0.31)	(0.27)	(0.15)	(0.02)	(4.22)	[0.01]

The table reports the results of regressing weekly returns on the instruments defined in Section 3.2. Constants in the regressions are not shown. Heteroskedasticity and autocorrelation consistent (2 lags) standard errors are calculated as in Newey and West (1987), and reported in parenthesis. R-squares are reported in percent with the p-value from a Wald test of joint significance given in square brackets below.

folio, which is related to the earnings yield.[10] The coefficient of the inverse relative wealth (IRW) has a negative sign for most portfolios, and is significant for small stocks, retailers, and banks.

In the SB group, the adjusted R-square is higher for the small stock portfolio than for the market portfolio: 10.6% versus 3.5%. This is consistent with earlier findings in the empirical literature.[11] For the bond index return the R-square is 3.7%. In comparison, the R-squares from $AR(1)$ regressions, that is, when the returns are regressed on the lagged returns, are 0.8% for the market portfolio as well as for the bond index, while the small stock $AR(1)$ regression yields an R-square of about 7%. Hence, at least the instruments seem to carry more information than is contained in past returns. In the SECTOR group, the R-square for banks is 16.0%, which is a very high figure. The value may be explained by the fact that banks are significantly influenced by four of the instruments. However, a more plausible explanation is that some outliers in conjunction with the devaluation of the Swedish krona strongly affect the estimate.

I also run the regressions with monthly returns.[12] As shown in *Table 6* the (absolute) size of the coefficients typically increases when using monthly returns. In most cases the R-squares also increase with the return horizon. For example, when using weekly returns the R-squares for the market portfolio is 3.5% while when using monthly returns it is 6.1%. This demonstrates that high frequency data often contain a considerable amount of noise and, as a consequence, are difficult to predict.

3.5 Time-Varying Parameters

One complication when estimating a model is the time-variation of the parameters of interest. I ran the above regressions on sub-samples and found

[10] When using industry-specific valuation measures (not reported), the fit of the model increases. The MB is then significantly related to the returns on several portfolios and the adjusted R-squares increase for 9 out of 10 portfolios in the SECTOR group.

[11] For example, Harvey (1989) reports a near-monotonic increase in adjusted R-squares when moving from the portfolio of largest firms to the smallest firms ranked on firm value.

[12] I use non-overlapping returns despite the obvious drawback of losing observations. The motivation is that when the number of overlaps is large, spurious high R-squares can be induced even when no relation exists (see, for example, Richardson and Stock, 1989). I calculated the parameter values using both overlapping and non-overlapping returns and found that some coefficients were sensitive to the choice of method.

Table 6: Regression Results of Monthly Asset Returns

	BOND	BILL	MAT	DEF	FX	IRS	EY	MB	IRW	R^2
SB Group										
Market Index	−2.05	−1.02	−0.42	3.19	1.26	1.24	0.35	0.01	−6.50	6.1
	(1.09)	(0.64)	(0.62)	(2.27)	(0.50)	(0.58)	(0.29)	(0.03)	(11.5)	[0.00]
Small Stocks	−2.91	−0.75	1.19	0.65	−0.05	−0.02	−0.67	0.08	−13.6	16.8
	(1.27)	(0.50)	(0.65)	(2.17)	(0.58)	(0.61)	(0.34)	(0.05)	(10.0)	[0.00]
Bond Index	−1.18	0.37	0.02	0.70	0.14	0.32	0.10	−0.01	4.19	13.1
	(0.32)	(0.18)	(0.13)	(0.56)	(0.14)	(0.14)	(0.08)	(0.01)	(2.41)	[0.00]
SECTOR Group										
Manufacturing	−1.43	−1.24	−0.63	3.54	1.89	1.18	0.33	0.00	−15.9	5.8
	(1.42)	(0.61)	(0.73)	(2.47)	(0.63)	(0.66)	(0.35)	(0.04)	(12.7)	[0.00]
Pulp and Paper	−2.76	−1.06	0.18	7.96	1.23	2.03	0.52	−0.03	2.22	4.6
	(1.95)	(0.81)	(0.92)	(4.57)	(0.91)	(1.03)	(0.45)	(0.06)	(16.4)	[0.00]
Retail Trade	−1.13	−0.69	0.14	2.94	1.83	−0.40	0.31	−0.01	−20.2	12.6
	(1.56)	(0.68)	(0.64)	(2.60)	(0.95)	(0.59)	(0.34)	(0.04)	(11.4)	[0.00]
Construction	−4.04	−2.42	−0.22	3.97	1.54	1.94	−0.02	0.09	1.62	4.9
	(1.60)	(1.69)	(1.07)	(4.41)	(1.19)	(1.20)	(0.50)	(0.06)	(17.1)	[0.00]
Miscellaneous	−1.23	−0.81	−0.59	1.38	0.76	0.97	0.42	−0.01	−0.73	3.0
	(0.87)	(0.60)	(0.55)	(1.57)	(0.49)	(0.40)	(0.24)	(0.03)	(10.7)	[0.00]
Mixed Investment	−2.66	−2.10	−0.34	5.89	1.51	1.63	0.42	0.02	−10.6	8.9
	(1.69)	(0.79)	(0.74)	(4.27)	(0.77)	(0.92)	(0.38)	(0.05)	(13.0)	[0.01]
Pure Investment	−3.60	−2.80	−1.19	2.91	1.03	1.71	0.36	0.05	1.94	5.6
	(1.50)	(1.12)	(0.98)	(3.43)	(0.88)	(0.85)	(0.49)	(0.05)	(16.8)	[0.00]
Banking	−8.86	1.52	2.23	6.63	0.18	1.60	−0.56	0.06	−17.7	16.7
	(2.22)	(0.87)	(1.09)	(4.04)	(1.21)	(1.05)	(0.64)	(0.07)	(15.2)	[0.00]
Shipping	−1.34	−2.71	−0.18	0.29	−0.11	1.39	0.14	−0.03	−16.9	6.8
	(1.73)	(1.17)	(0.95)	(2.63)	(0.88)	(0.68)	(0.45)	(0.05)	(18.6)	[0.00]
Insurance	−4.02	−1.01	0.60	6.89	−0.43	2.85	0.36	0.03	5.52	0.7
	(2.00)	(2.77)	(1.64)	(3.61)	(1.06)	(1.14)	(0.55)	(0.06)	(18.6)	[0.02]

The table reports the results of regressing monthly returns on the instruments defined in Section 3.2. Constants in the regressions are not shown. Heteroskedasticity and autocorrelation consistent (2 lags) standard errors are calculated as in Newey and West (1987), and reported in parenthesis. R-squares are reported in percent with the p-value from a Wald test of joint significance given in square brackets below.

time-variation in the regression parameters. Notably, in recession periods the negative effect of higher bond yields, that is the discount factor effect, dominates the positive effect of higher earnings expectations (see the discussion in Section 3.2). When the economy is booming the situation is the opposite. To capture some of these variations, I tried the following simple model of time-varying betas:

$$\beta_{it-1} = \alpha_i + \delta_i \cdot MB_{t-1} \qquad \text{for } i = 1, 2, ..., n, \tag{4.11}$$

where $\alpha_i = [\alpha_{i1}\ \alpha_{i2}\ ...\ \alpha_{ik}]'$ and $\delta_i = [\delta_{i1}\ \delta_{i2}\ ...\ \delta_{ik}]'$ are $(k \times 1)$-vectors of coefficients. This specification is based on the conjecture that the sensitivity of future returns to the instruments is related to the price level of the stock market as captured by the MB. This is motivated by the positive correlation between MB and economic activity.

Recall from Table 5 that the market return had a bond yield coefficient of -0.43. Allowing for time-variation, as in expression (4.11), the values vary from -1.22 in October 1992 to 1.28 at the end of 1996. This variation is consistent with the results from the sub-sample regressions. Hence, I ran the full regression with expression (4.11) substituted into Equation (4.2). The number of coefficients significantly different from zero increased dramatically as did the adjusted R-squares. However, several diagnostic tools suggested that the model was overspecified. The out-of-sample forecasts generated by the model with time-varying parameters had higher mean square errors and the "hit rates" were lower.[13] Therefore, in the implementation of the asset allocation strategies, I only employ the model with fixed parameters.

3.6 Statistical Inference

When drawing inferences from the R-squares in Tables 5 and 6, we must correct for the fact that I have chosen the "best" $k = 9$ out of $m = 17$ potential regressors. The starting point is to study the R-square from an ordinary least square regression, which is distributed as a $\beta(r, s)$, where $\beta(\cdot, \cdot)$ is the beta den-

[13] The proportion of the forecasts with the correct sign is referred to as the "hit rate." For example, the small stock portfolio had a hit rate of 54% when the fixed parameter model was employed while the model with time-varying parameters produced a hit rate of only 49%.

sity function.[14] The two parameters are $r = k/2$ and $s = (T - k - 1)/2$, where T is the number of observations. Thus, the cut-off value for the R-square can be written

$$R_{\alpha}^{2} = F_{r,s}^{-1}(\alpha), \tag{4.12}$$

where α is the significance level and F^{-1} is the inverse of the cumulative beta distribution function. Table 5 reports an adjusted R-square of 3.5% when the market portfolio is regressed on the instruments using weekly data. Plugging in the relevant parameters in expression (4.12), the 95-percent cut-off level is as low as 1.7%. Thus, our (incorrect) inference might be that the instruments significantly explain future returns.

Foster, Smith, and Whaley (1997) show how to adjust the cut-off value of R-square for data-snooping biases. They use extreme value theory to derive an asymptotic distribution of the maximal R-square. Their specification for the cut-off level is

$$R^{2} \approx F_{r,s}^{-1}\left(1 + \frac{\ln(\alpha)}{\ln(N)^{1.8N^{0.04}}}\right). \tag{4.13}$$

Using equation (4.13), we find that the cut-off level for our example is 5.2%. Hence, the reported R-square of the market portfolio regression is no longer significant. Furthermore, it can be shown that if only 11 potential regressors had been used, the cut-off level would have been 3.4%, and the R-square would have been statistically different from zero. To judge whether the R-squares reported in Tables 5 and 6 are different from zero, I use expression (4.13) to compute 95-percent cut-off levels for m. This cut-off level, denoted m^*, can be interpreted as the maximum number of potential regressors allowed without achieving the reported R-square through random chance. In the regressions where the R-squares are not significant using standard cut-off values (4.12), the value of m^* is reported to be zero.

Table 7 reports the R-squares and the corresponding values of m^*. Using weekly returns, the value of m^* ranges from zero to 308. In only four cases is the m^* value over 17, the number of regressors that I actually choose from. In other words, in 9 cases the R-squares are not statistically different from zero. For monthly returns the situation is even less encouraging, leading me

[14] See, for example, Bickel and Doksum (1977) for an introduction to the family of *beta* distributions.

Table 7: Adjusted R-squares of the Regressions

	Weekly returns		Monthly returns	
	R^2	m*	R^2	m*
SB Group				
Market Index	3.5	11	6.1	0
Small Stocks	10.6	91	16.8	13
Bond Index	3.7	11	13.1	10
SECTOR Group				
Manufacturing	2.7	9	5.8	0
Pulp and Paper	4.9	15	4.6	0
Retail Trade	3.4	10	12.6	10
Construction	9.3	63	4.9	0
Miscellaneous	1.8	9	3.0	0
Mixed Investment	5.4	18	8.9	9
Pure Investment	2.7	9	5.6	0
Banking	16.0	308	16.7	13
Shipping	1.6	0	6.8	0
Insurance	4.7	14	0.7	0

The table reports the adjusted R-squares (in percent) of the regression of asset returns on the instruments. The corresponding 95-percent cut-off levels for m* are also reported. m* is the maximum number of potential regressors allowed without achieving the reported R-square through random chance. In the regressions where the R-squares are not significant using standard cut-off values, m* is reported to be zero.

to conclude that the observed predictability is hardly overwhelming, at least not in a pure statistical sense.

3.7 The Maximally Predictable Portfolios

So far, the focus has been on the predictability of the primary asset returns. In this subsection I maximize predictability in returns by constructing portfolios of the primary assets that are the most predictable. To be more precise, I construct portfolios as in Lo and MacKinlay (1997) that explicitly yield the highest possible R-squares when regressed on the instruments.

The portfolio weights of the MPPs, reported in *Table 8*, are interesting measures in themselves since they tell us which assets are the most important sources of predictability. The MPP of the SB group includes a short position in small stocks and long positions in the market portfolio as well as in government bonds. The MPP of the SB group using monthly returns exhibits a similar pattern. This stability contrasts sharply with the configuration of the

Table 8: Maximally Predictable Portfolios

	Weekly Returns		Monthly Returns	
	Short sales allowed	Short sales not allowed	Short sales allowed	Short sales not allowed
SB Group				
Market Index	1.24	0.00	0.50	0.00
Small Stocks	–2.36	1.00	–0.79	1.00
Bond Index	2.12	0.00	1.29	0.00
$\bar{R}^2$	16.9	10.6	36.1	16.8
SECTOR Group				
Manufacturing	–1.21	0.00	0.39	0.00
Pulp and Paper	–1.47	0.00	–0.86	0.00
Retail Trade	–0.79	0.00	1.57	0.32
Construction	3.10	0.35	–0.09	0.00
Miscellaneous	1.61	0.00	–1.47	0.00
Mixed Investment	–1.03	0.00	2.14	0.00
Pure Investment	–0.78	0.00	–1.99	0.00
Banking	2.16	0.65	2.17	0.68
Shipping	–0.60	0.00	–0.22	0.00
Insurance	0.00	0.00	–0.64	0.00
$\bar{R}^2$	24.4	17.2	37.4	18.8

The table reports portfolio weights of the maximally predictable portfolios of SB and SECTOR assets, based on weekly and monthly data, respectively. The adjusted R-squares from the regressions of MPP returns on the instruments are reported in percent.

MPPs in the SECTOR group, where the portfolio weights change dramatically with the return horizon. For example, using weekly returns, the MPP has a long position in the miscellaneous portfolio but a short position for monthly returns. This indicates that the sources of time-variation in expected returns are dependent on the return horizon. When short positions are not allowed, the MPPs of the SB group include only the small stock portfolio, while the MPP of the SECTOR group consists of banks and construction (retail) stocks using a weekly (monthly) return horizon.

As expected the R-squares for the MPPs are larger than the largest R-square from the individual return regressions. Table 7 reports that, among the SB assets, the small stock portfolio has the largest individual R-square of 10.6% while the MPP with short positions produces an R-square of 16.9%. For weekly SECTOR returns, the individual asset R-squares range from 1.6% to 16.0% while the MPP yields an R-square of 24.4%. The same pattern is found for a monthly horizon. Hence, the construction of MPPs dramatically increases predictability of future returns. However, when the MPPs are constrained to have non-negative weights in the primary assets, the increase of the R-squares are lower.

4 Empirical Results

Section 3 presented the data and preliminary regressions based on the full sample from 1988 to 1996. However, when evaluating the performance of the asset allocation strategies, use can only be made of the information known at the time the portfolios are formed. Therefore, I evaluate the strategies in the sub-period from 1994 to 1996. The time up to December 1993 is used to estimate the model.

4.1 Out-of-Sample Regressions

The out-of-sample predictability of the model is measured by conducting the following experiment: The asset returns are regressed on the instruments of Section 3 using the data for the period from January 1988 to December 1993. The regression result is then used to make a one-step-ahead forecast. This procedure is repeated for each period until December 1996. Finally, the realized returns are regressed on the predicted returns. The coefficient of determination from this regression is referred to as the out-of-sample R-square.

Table 9 reports the out-of-sample R-squares. As expected, these R-squares are lower than their in-sample counterparts. For example, when studying weekly returns in the SB group, Table 5 reports an R-square of 3.5% for the market portfolio while the out-of-sample R-square is only 0.9%. For the small stock portfolio the corresponding figures are 10.6% and 4.7%. However, for the government bond index, the standard R-square is lower than the out-of-sample R-square: 3.7% versus 3.9%. Also the out-of-sample R-squares increase with the return horizon. The measures are 2.3%, 5.1%, and 20.4% for the market, small stocks, and bonds, respectively. Again, the government bond index has a higher out-of-sample R-square than the standard R-square of 13.1%.

For the SECTOR group, the out-of-sample R-squares are significantly lower than the standard R-squares. While the latter range from 1.6% to 16.0%, the out-of-sample R-squares range from zero to 2.0%, with the largest number re-

Table 9: Out-of-Sample R-squares from Predictions

	Weekly Returns	Monthly Returns
SB Group		
Market Index	0.9	2.3
Small Stocks	4.7	5.1
Bond Index	3.9	20.4
SECTOR Group		
Manufacturing	0.2	0.9
Pulp and Paper	0.2	1.0
Retail Trade	0.4	3.5
Construction	0.0	0.1
Miscellaneous	2.0	10.7
Mixed Investment	0.2	0.7
Pure Investment	0.0	0.1
Banking	1.2	0.6
Shipping	0.9	1.6
Insurance	1.0	0.7

The table reports out-of-sample R-squares from regressions of realized returns on predicted returns. The model in Equation (4.2) is estimated using data for the period from January 1988 to December 1993, and a one-step-ahead forecast is generated. This procedure is then repeated for each period until December 1996. Finally, the realized returns are regressed on the predicted returns. The R-square from this regression is referred to as the out-of-sample R-square.

ported for the miscellaneous portfolio. The low figures are most likely the result of the lack of industry-specific instruments in the conditioning information set.

4.2 Strategies using the Market Portfolio, Small Stocks, and Bonds

To evaluate the importance of return predictability, I create portfolios of assets in the SB group according to the allocation strategies described in Section 2. The portfolios are restricted to contain non-negative asset weights, but I do not explicitly account for transaction costs.[15] The strategies are evaluated with the (ex-post) Sharpe ratio as a performance measure. As a reference point,

[15] Strategies not using time-varying expected returns, that is, the unconditional strategies and the conditional MIN strategy, show a low turnover rate. In these cases, transaction costs are low. The conditional TAR, OPT, and MPP strategies show turnover rates from 8 to 12 times a year, when reallocated on a weekly basis. With a one-way transaction cost of 0.2%, this implies that annualized mean returns, on average, would be 4% lower if transaction costs were included in the return calculations. With monthly reallocations, the average turnover rate is 2.5, which would reduce the annualized returns approximately 1%.

Table 10: Results of the Allocation Strategies with SB Assets

	Weekly Returns				Monthly Returns			
	MIN	TAR	OPT	MPP	MIN	TAR	OPT	MPP
Unconditional model								
Market Return	2.59	11.70	5.33	—	2.45	10.83	4.95	—
Standard Deviation	6.05	14.26	16.64	—	6.28	12.86	16.09	—
Sharpe Ratio	0.43	0.82	0.32	—	0.39	0.84	0.31	—
Conditional model								
Market Return	4.35	21.48	36.56	14.29	2.63	20.62	23.87	12.50
Standard Deviation	6.17	14.74	17.26	10.64	6.32	19.39	15.08	12.54
Sharpe Ratio	0.71	1.46	2.12	1.34	0.42	1.06	1.58	1.00
Sharpe Ratio Difference								
P-value	0.00	0.03	0.00	—	0.30	0.18	0.02	—

The table reports annualized excess returns, standard deviations, and Sharpe ratios of the strategies when the assets in the SB-group are employed. The evaluation period covers January 1994 to December 1996. The first (second) panel shows the results for the unconditional (conditional) strategies described in Section 2. The third panel reports p-values from a test of equal Sharpe ratios for the conditional and unconditional strategies. For a graphic illustration of the allocation strategies, see Figure 1.

the buy-and-hold strategy in the market portfolio has an annualized excess return of 11.3% for the period 1994 – 1996. The standard deviation is 14.6%, which implies a Sharpe ratio of 0.77. Buy-and-hold strategies in the small stock portfolio and the government bond index have Sharpe ratios of 1.16 and 0.41, respectively.

The results of the strategies are presented in *Table 10*, where the first panel reports the results for the unconditional strategies. Using weekly returns, the global minimum variance portfolio (MIN) reports an excess return of 2.6%, a volatility of 6.0%, and a Sharpe ratio of 0.43. The portfolio is fully invested in the bond index during almost the entire evaluation period.

The target volatility portfolio (TAR) produces an excess return of 11.7% and a standard deviation of 14.3%. These figures are close to those reported for the market portfolio. An inspection of the asset weights shows that the TAR portfolio is fully invested in the market portfolio with the exception of a small position in bonds at the beginning of 1995 when the stock market remained flat and the bond prices improved. This minor reallocation explains the higher Sharpe ratio of 0.82 for TAR versus 0.77 for the market portfolio.

Over the evaluation period, the optimal mean-variance portfolio (OPT) is approximately a scaled version of the MIN portfolio. The difference is that the OPT portfolio is dynamic in that it changes the fraction of risky assets over time. Comparing the MIN Sharpe ratio of 0.43 with the OPT ratio of 0.32 there is no market timing ability of the OPT portfolio. This is not surprising given that the unconditional strategy is based on historical averages.

With a monthly return horizon, the only difference is that instead of weekly averages, historical averages of monthly returns are used as input. With low autocorrelations in the return series, monthly averages are simply multiples of weekly averages. Hence, the strategies based on a monthly horizon roughly coincide with those of a weekly horizon.

In the second panel of the table, the performances of the conditional strategies are reported. As expected, the MIN portfolio realizes a low return and a low standard deviation of 4.4% and 6.2%, respectively. Since expected returns are not used for calculations of the MIN portfolio weights, the only difference in input, compared to the unconditional strategy, is that an exponential moving average of the volatility is used instead of the simple average.

The calculations of the asset weights of the TAR portfolio are explicitly based on the return forecasts from the regressions. Hence, this strategy should be able to benefit from predictable asset returns. It realizes an excess return of 21.5% and a standard deviation of 14.7%, which implies a Sharpe ratio of 1.46—almost 1.8 times that of the unconditional TAR strategy and 1.9 times that of the market portfolio. This is an indication of genuine predictability, suggesting that it is possible for an investor to improve the allocation process and achieve superior performance. A look at the asset weights supports this argument. Due to the short-sales constraint, the portfolio is usually invested in one asset at a time. Thus, the superior performance is not a result of diversification. Instead, it is driven by the fact that the right assets are purchased and sold at the right time.

Predictability can be more efficiently exploited by employing the OPT portfolio, since this strategy allows leveraged portfolios. The OPT portfolio delivers an excess return of 36.6% with a standard deviation of 17.3%, yielding a Sharpe ratio of 2.12. This is more than six times the ratio of the unconditional OPT strategy and almost three times that of holding the market portfolio. Hence, there is no doubt that predictability of the asset returns is of economic significance. For instance, an investment of 100 in the market portfolio increases to 140 over the evaluation period while the OPT strategy delivers 300 at the end of the same period, with a minor increase in risk.

The MPP alters between holding a combination in small stocks and the risk-free asset and a full position in the risk-free asset. This is no surprise given the composition of the MPP reported in Table 8. The excess return of the MPP is 14.3% with a standard deviation of 10.6%, yielding a Sharpe ratio of 1.34, which is higher than for all unconditional strategies including buying-and-holding the market portfolio.

The last panel reports the results from a test of whether the Sharpe ratios produced by the conditional strategies are significantly higher (in a statistical sense) than the ratios from the unconditional counterparts.[16] I test the null hypothesis of equal Sharpe ratios against the alternative of higher ratios for the conditional strategies. The p-values are 0.00, 0.03, and 0.00 for the MIN, TAR, and OPT strategies, respectively, which is clear evidence of superior performance for the conditional strategies—even in a statistical sense.

When analyzing the strategies that involve monthly updating, only minor deviations are found from what is already reported. Notice, however, that all strategies have lower Sharpe ratios and higher p-values when conducted on a monthly basis. This suggests that the gains from frequent reallocation are larger than the drawbacks of using short horizon data that typically contain more noise.[17] To sum up, the main conclusion is unambiguous. By using dynamic strategies based on return predictability, a considerable improvement in portfolio performance can be obtained. Hence, predictability is economically important.

4.3 Strategies using Industry Portfolios

The strategies based on industry portfolios as primary assets are conducted in the same way as with the assets of the SB group. Interestingly, the figures re-

[16] The standard errors of the Sharpe ratios are calculated using the delta method. See, for instance, Campbell, Lo, and MacKinlay (1997).

[17] This conclusion could be altered if transaction costs were properly accounted for. Transaction costs are, on average, four times higher when re-allocating on a weekly basis compared with monthly updating.

Table 11: Results of the Allocation Strategies with Sector Assets

	Weekly Returns				Monthly Returns			
	MIN	TAR	OPT	MPP	MIN	TAR	OPT	MPP
Unconditional model								
Market Return	17.38	21.61	14.49	—	16.26	12.85	13.41	—
Standard Deviation	14.15	18.08	13.93	—	12.02	21.41	11.46	—
Sharpe Ratio	1.23	1.20	1.04	—	1.35	0.60	1.17	—
Conditional model								
Market Return	12.81	6.70	12.01	1.67	14.97	16.88	23.52	11.30
Standard Deviation	12.82	24.32	19.11	7.23	13.21	26.58	17.19	10.25
Sharpe Ratio	1.00	0.28	0.63	0.23	1.13	0.63	1.37	1.10
Sharpe Ratio Difference								
P-value	0.78	0.94	0.82	—	0.89	0.44	0.26	—

The table reports annualized excess returns, standard deviations, and Sharpe ratios of the strategies when the assets in the SECTOR-group are employed. The evaluation period covers January 1994 to December 1996. The first (second) panel shows the results for the unconditional (conditional) strategies described in Section 2. The third panel reports p-values from a test of equal Sharpe ratios for the conditional and unconditional strategies. For a graphic illustration of the allocation strategies, see Figure 1.

ported in *Table 11* differ in many ways from what was found for the SB assets. With SECTOR assets, the conditional strategies underperform their unconditional counterparts, which suggests that the explicit return forecasts perform worse than simple historical averages. Hence, the instruments are not particularly well suited for forecasting the SECTOR returns. However, this finding should not be surprising given the low out-of-sample R-squares previously reported in Table 9.

Among the unconditional strategies, the MIN portfolio produces the best performance. The Sharpe ratio is 1.23 when reallocations are performed on a weekly basis. This result supports the findings of Haugen and Baker (1991). When return forecasts are bad, it is better not to use them. The TAR and OPT strategies produce surprisingly good performance. They report Sharpe ratios of 1.20 and 1.04, respectively. An examination of the asset weights shows that the MIN, TAR, and OPT portfolios hold similar positions. The MIN portfolio is heavily overweighted in the miscellaneous and retail portfolios, as are the TAR and OPT portfolios. In addition, the latter two are overweighted in manufacturing. Thus, adding historical average returns as input to the allocation program does not seem to change the allocations—at least not over this evaluation period.

A striking indication of the poor predictability of future SECTOR returns is the fact that the MIN portfolio has the best performance even when the conditional model is employed. The mean return is 12.8% with a standard deviation of 12.8%, yielding a Sharpe ratio of one. As expected, the asset weights of the MIN portfolio coincide with those reported for the unconditional model.

A look at the asset weights of the TAR portfolio explains some of the poor performance of this strategy. The weights fluctuate extremely, usually from a 100% holding in a particular industry to a 100% holding in another industry in the subsequent period. However, since the out-of-sample R-squares are poor, the changes in asset weights are driven purely by noise, which explains why the Sharpe ratio of the TAR portfolio is not higher than 0.28.

The OPT portfolio has a Sharpe ratio of 0.63—twice that of the TAR portfolio. This improvement is attributed to the predictability of the aggregate market, which is higher than that of the individual SECTOR returns. Although the asset weights for the different industries fluctuate as wildly as for the TAR portfolio, the OPT portfolio is not always fully invested. Instead, it is leveraged when expected returns are high for all assets, while holding a large portion of the risk-free asset when the general market conditions are poor.

When predictability is low for the primary assets, the MPP should not be expected to produce superior returns, since it is supposed to exploit a predictability that does not exist. Not surprisingly, the Sharpe ratio is only 0.23.

The monthly updated re-allocations produce qualitatively similar results. The unconditional TAR portfolio realizes lower returns than when updated weekly. On the other hand, the conditional TAR and OPT portfolios produce higher returns when re-allocated monthly. Nevertheless, the null hypothesis of equal Sharpe ratios cannot be rejected.

5 Concluding Remarks

The existence of predictable time-varying components in conditional expected returns has been widely reported. This paper adds to the existing literature by investigating expected returns in Swedish stock and bond markets. As expected, I find predictable components in the time-variation of expected returns also in these markets. The lion's share of the predictability literature focuses on the statistical significance of predictability. In this paper, however, the focus is on its economic significance. The idea is to expand the investment opportunity set by adding dynamic trading strategies based on the observed return predictability, and to measure whether the strategies outperform unconditional (buy-and-hold) strategies. This is done for two groups of primary assets: a group of broad stock and bond portfolios, and a group of industry portfolios. Predictability is shown to be lower in the second group due to the high portion of idiosyncratic risk that cannot be forecasted by the instruments used in this study.

The main result shows that, given a moderate predictability, the out-of-sample performance of the conditional strategies is superior to that of unconditionally efficient strategies, as well as to buying-and-holding the market portfolio. However, due to low predictability, the conditional strategies based on the industry-specific portfolios do not perform well. Even with moderate predictability, the economic significance can be important. The forecasts for the aggregate stock and bond portfolios explain less than 5% of the variability in the forecasting regressions. Nevertheless, allocation strategies exploiting this predictability produce risk-adjusted returns almost three times higher that of the market portfolio. Preliminary findings indicate that the predictability of industry portfolios can be substantially improved by including industry-specific instruments in the information set. A full incorporation of such instruments would constitute a natural expansion of this paper and an interesting topic for future research.

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Appendix

This appendix summarizes the result of Lo and MacKinlay (1997). To define the predictability of a portfolio, denote by r_t the $(n \times 1)$-vector of primary asset returns. Assume for convenience that r_t is a jointly stationary and ergodic stochastic process with finite expectation μ and finite autocovariance matrices $\Gamma_k = E[(r_{t-k} - \mu)(r_t - \mu)']$. Suppose that the conditional expectation of r_t with respect to z_{t-1}, $\tilde{r}_t = E[r_t|z_{t-1}]$, is a linear function of the pre-determined economic variables, that is

$$r_t = B \cdot Z_{t-1} + \varepsilon_t, \tag{A1}$$

where $B = [\beta_1' \; \beta_2' \; \ldots \; \beta_n']'$ is a $(n \times k)$-matrix of coefficients. Let γ denote a particular linear combination (portfolio) of the primary assets and consider the predictability of this combination as measured by the R-square:

$$R^2 = \frac{Var\,(\gamma'\tilde{r}_t)}{Var\,(\gamma' r_t)} = \frac{\gamma'\tilde{\Gamma}_0\gamma}{\gamma'\Gamma_0\gamma}, \tag{A2}$$

where $\tilde{\Gamma}_0 = Var\,(\tilde{r}_t)$. Hence, $R^2(\gamma)$ is simply the fraction of the variability in the portfolio return, $\gamma' r_t$, explained by its conditional expectation $\gamma'\tilde{r}_t$. For simplicity, consider the case where there is only one asset. In this case, it is easily seen that the expression $\Gamma_0^{-1}\tilde{\Gamma}_0$ is the R-square of this single asset. To generalize, define the $(n \times n)$-matrix $G = \Gamma_0^{-1}\tilde{\Gamma}_0$. Below, it is shown that the eigenvalues of the matrix G are equivalent to the R-squares of the corresponding eigenvectors. Since a properly normalized eigenvector can be interpreted as a portfolio, the eigenvalues of G are simply the portfolio R-squares. Furthermore, it can be shown that the largest eigenvalue of G is the largest possible R-square of all asset combinations. Hence, the normalized eigenvector corresponding to the largest eigenvalue of G is the maximally predictable portfolio.

Here follows a proof of the result of Lo and MacKinlay (1997). To maximize $R^2(\gamma)$ subject to the constraint $\gamma'\iota = 1$, define the following Lagrangian:

$$L = \frac{\gamma'\tilde{\Gamma}_0\gamma}{\gamma'\Gamma_0\gamma} + \delta\,(1 - \gamma'\iota)\,, \tag{A3}$$

and consider the first-order condition

$$\frac{\partial L}{\partial \gamma} = \frac{2\tilde{\Gamma}_0\gamma^*}{\gamma^{*\prime}\Gamma_0\gamma^*} - \frac{2\gamma^{*\prime}\tilde{\Gamma}_0\gamma^*}{(\gamma^{*\prime}\Gamma_0\gamma^*)^2}\Gamma_0\gamma^* - \delta\iota = 0. \tag{A4}$$

Pre-multiplying by $\gamma^{*\prime}$ and using the constraint $\gamma'\iota = 1$ yields

$$\gamma^{*\prime}\frac{\partial L}{\partial \gamma} = \frac{2\gamma^{*\prime}\tilde{\Gamma}_0\gamma^*}{\gamma^{*\prime}\Gamma_0\gamma^*} - \frac{2\gamma^{*\prime}\tilde{\Gamma}_0\gamma^*}{(\gamma^{*\prime}\Gamma_0\gamma^*)^2}\gamma^{*\prime}\Gamma_0\gamma^* - \delta\gamma^{*\prime}\iota = 0, \tag{A5}$$

that is, $-\delta = 0$, which indicates that the constraint $\gamma'\iota = 1$ is not binding. This is not surprising since we can always rescale γ without affecting $R^2(\gamma)$. Thus (A4) can be written:

$$\frac{\partial L}{\partial \gamma} = \frac{2\tilde{\Gamma}_0\gamma^*}{\gamma^{*\prime}\Gamma_0\gamma^*} - \frac{2\gamma^{*\prime}\tilde{\Gamma}_0\gamma^*}{(\gamma^{*\prime}\Gamma_0\gamma^*)^2}\Gamma_0\gamma^* = 0. \tag{A6}$$

Manipulating (A6) yields:

$$\tilde{\Gamma}_0\gamma^* = \frac{\gamma^{*\prime}\tilde{\Gamma}_0\gamma^*}{\gamma^{*\prime}\Gamma_0\gamma^*}\Gamma_0\gamma^* = \lambda^*\Gamma_0\gamma^*. \tag{A7}$$

From this we have:

$$\Gamma_0^{-1}\tilde{\Gamma}_0\gamma^* = G\gamma^* = \lambda^*\gamma^*, \tag{A8}$$

and since it is easy to verify that the second-order condition for a maximum is satisfied when λ^* is the largest eigenvalue of G, we obtain the result of Lo and MacKinlay (1997).

To constrain the portfolio weights to be non-negative, we simply add the term $\phi'\gamma$ to the Lagrangian and apply the Kuhn-Tucker Theorem, where ϕ is the vector of Lagrange multipliers for the constraints $\gamma \geq 0$.

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