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Home bias in Danish pension funds

Do Danish pension funds optimize their equity portfolios?

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Executive Summery

Portfolio diversification theory has been known for many years, stating that unsystematic risk can be eliminated by holding the world market portfolio. Thus dispersing ones investments among different industries and different countries will minimize the risk of a portfolio. However the stated benefits of diversifying among different countries many studies still find institutional investors investing too heavily in the domestic equity market than theoretical optimal. Thus home bias should increase risk and lower return according to diversification theory.

One thing is to behave as proscribed by theory, but it would not be rational to expect the institutional investors, represented by the Danish pension sector, to hold a larger proportion of foreign equity than actually optimal. Thus by applying mean-variance framework the historical optimal portfolio allocation was indentified. Because the risk tolerance of the individual pension fund is not known this results in an optimal interval in which to hold foreign stocks. This makes it possible to indentify if the Danish pension funds are optimizing their stock allocation with regards to county allocation. 4 of 26 funds were found to be home biased by investing to heavily in the Danish market. 5 funds were found to invest too heavily in foreign stocks.

Having identified the home biased funds it is interesting to identify the plausible explanations of this inefficient equity allocation. By analyzing several reasonable explanations asymmetric information, investment in domestic multinationals and conservatism seemed to be able to explain the observed bias. When analyzing the performance of the individual funds it turned out that almost all funds performed better on its Danish investments compared to its benchmark than for the foreign investments, thus indicating asymmetric information. It turned out that the home biased funds had been so for a five year period while the industry as a whole had increased their investments within foreign stocks heavily, thus indicating conservatism. Lastly the funds' domestic stock allocation is largely made up by multinational companies that gain the most of their sales outside Denmark. They are therefore heavily exposed to the world market. Thus Danish multinational companies also contribute to foreign diversification. The explanations that were identified as explanations of the foreign bias were currency hedging and liquidity risk.

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1 Introduction

The choice to analyze the equity home bias of Danish pension funds stems from the huge socio-economical status that these have in the Danish society. The pension sector manages a fortune of about 2.700 billion kroner which is 1,5 times the Danish GDP[1]. The extent in whether they fail or succeed do therefore not only affect the individual member by their loss or gain on their individual pension but also affects by the way the pension funds affect the whole society.

One might think of a scenario where a pension fund becomes insolvent and is unable to pay its members' pension. This would not only affect the members of that pension fund, but also the rest of the country through less spending from the people that have now lost their pension. So the pension funds have a huge socio-economic responsibility that makes them very interesting.

Why then analyze whether they optimize their asset allocation by investing properly in foreign stocks? First of all it is not necessary to have a pension fund that becomes insolvent before it is a big loss for the individual member and the society as a whole. If the pension funds can optimize their portfolios further by not being biased towards home equity it will also have a major effect on the Danish society.

Another reason why the equity portfolios of Danish pension funds is interesting to analyze lies in current and future problems that the funds and society face as a whole. Denmark will in the next long period experience retirees' increase as large year groups are leaving the workforce. At the same time there will be fewer people in the workforce to contribute as small year groups are going into the workforce. This mismatch will be one of the biggest challenges facing the pension industry in the years to come, and it is putting extra pressure on the profitability of the funds' investments and especially their equity portfolios[2].

Another very interesting aspect that puts extra emphasis on the equity portfolio, especially because of the low interest rates experienced after the financial crisis hit, is the asset liability management (ALM) of pension funds. ALM is the way the pension funds balance their assets

[1] http://themis.dk/searchinclude/Statistik_vedroerende_pensionsformuen.asp
[2] http://news.bbc.co.uk/2/hi/europe/6937301.stm#denmark

according to their liabilities. In the broad sense it is important, that the duration of the assets match those of the liabilities to mitigate the risk of the liabilities increasing more than the assets. In earlier years pension funds have agreed to pay a guaranteed interest that is a lot higher than the interest at which they can buy bonds at now. This means that they have to rely more on their equity portfolio to pay the guaranteed interest to their members.

The reasons mentioned above are the explanation why the optimization of the equity portfolios of Danish pension funds is extremely interesting. Alongside these interesting aspects of the Danish pension fund industry the pension industry was chosen because of the characteristics of the portfolio managers employed in the industry. These are mostly people with a higher education within the fields of business and finance. This means that they can be expected to know the theoretical framework of portfolio allocation. This is a necessary feature in relation to this thesis. Instead of analyzing individual investors, for who no formal education within the area of portfolio allocation can be expected, the analysis of the thesis will depend on professionals who can be expected to behave in a rational way and in accordance with economic theory.

Why then analyze the equity home bias of pension funds if they perform according to theory? This is because research shows that they are in fact not behaving according to how the theory predicts. Pension funds and institutional investors in general allocate too big a share towards domestic equity and thereby miss out on the benefits of diversification. So although they are expected to behave according to modern portfolio theory, empirical research shows that this is not the case. Instead the managers are heavily overrepresented on the domestic equity market.

1.1 Problem Identification

Empirical research have shown that even institutional investors such as pension funds, that can be expected to have the employees with the right theoretical background within portfolio theory, are investing too big a share in the domestic equity market according to modern portfolio theory[3]. This is what is called equity home bias.

[3] Torben Lütje and Lukas Menkhoff, What Drives Home Bias? Evidence from Fund Managers' Views, Discussion paper No. 296 May 2004 ISSN 0949-9962

According to theory, equity home bias will lead to suboptimal portfolios. As mentioned in the introduction Danish pension funds have a key position in society and are already facing, and will also in the future face, challenges making the optimization of the equity portfolio very important.

For this reason I want to analyze the investment behavior of Danish pension funds to clarify if they are equity home biased and if this is the case, which factors can explain this home bias. This leads to the thesis' main statement and research questions.

Are Danish pension funds optimizing there equity portfolios? Or is it possible to optimize further by diversifying more internationally?

The primary problem raises the following sub questions:

- *How do investors benefit from international diversification?*
- *Why are investors home biased?*
- *How has the optimal equity allocation looked historically?*
- *How have Danish pension funds invested historically and now?*
- *Are Danish pension funds subject to home bias?*
- *What can explain the home bias of Danish pension funds?*

According to the first research question the objective is to explore the benefits of diversification in both a theoretical and empirical framework. Using empirical data I show how an investor can benefit from diversifying between international markets and which markets provide the greatest diversification benefits. These findings are held up against previous research by other researchers to see how the results compare. Additional I explore the reasons proposed by earlier researchers on why investors might be home biased when there seems to be this great opportunity to diversify internationally. I further explore the historical optimal allocation of foreign stocks from the perspective of Danish pension funds to establish a percentage interval in which it is optimal to hold foreign stocks. Holding foreign shares in a proportion smaller than this interval will be perceived as being home biased. Next the asset allocation of Danish pension funds will be analyzed to determine whether Danish

pension funds are in fact biased towards Danish equities and if so what factors can explain this bias and which cannot.

1.2 Delimitations

To keep the focus throughout the thesis and properly answer the research questions, some limitations to the scope of the thesis must be drawn.

1.2.1 Definition and Limitations of Home Bias

In the context of this thesis home bias is referring to equity home bias. Thus the non-equity share of the pension funds' portfolios will not be discussed or considered. Equity home bias is the observation that although investors could obtain both lower risk and greater returns by increasing international diversification in their equity portfolios, they fail to do so.[4]

1.2.2 Definition and Limitation of the Danish Pension Funds

The pension funds analyzed in this thesis will be transverse pension funds, life insurance companies, LD and ATP.

1.2.3 Data

The data used throughout this thesis are the indexes provided by MSCI. These are assumed to be the best representative for a diversified portfolio of the individual markets. This thesis will therefore not go into further discussion about the allocations of the individual indexes.

1.2.4 Theoretical Model

The model used to find the optimal portfolios in this thesis is based on the mean-variance approach first introduced by Markowitz in (1952)[5]. Although other models, e.g. the arbitrage pricing model, have gained attention lately I still find the mean variance model the most appropriate, as it is simple to interpret and because the largest part of earlier research are using the mean-variance model.

1.2.5 Statistical Properties

The mean-variance model assumes that the return time series are normally distributed. Empirical research have shown that equity returns are often not normally distributed but

[4] Hisham S. Foad, Equity Home Bias and the Euro, 2006
[5] Markowitz, H.M. (March 1952). "Portfolio Selection". The Journal of Finance **7** (1): 77–91

instead are skewed to the left[6], meaning that when stock prices fall the markets tend to fall more together than when prizes are rising. I am aware of the implications of this effect on the benefits of diversification, but for the simplicity of this thesis it is assumed that the returns are normally distributed. It is also recognized that other statistical features such as stationarity might not be obtained and since this thesis is not a statistical assignment once again this characteristic along with other statistical requirements are assumed to be fulfilled.

1.2.6 Unit Link

Unit link pension schemes are the ones that leave the most freedom for the individual member. In reality some unit link pensions are completely controlled by the individual member. He or she decides how the portfolio should be allocated and also bears all the risk. If these contracts made up the biggest part of the pension funds' contracts it would be a problem for the analysis and results of this thesis, as one of the big reasons to analyze pension funds are the fund managers' knowledge of the financial markets. I cannot expect the same from non-institutional investors. However it is hard to separate the data from link contracts and the more traditional ones. Since this is still not seen as a big problem it is because most link members only choose a risk profile that they wish their portfolio to be representative of[7]. This means that the managers of the pension funds still choose the stocks, but bundle them to match the individual customers. So although I am aware of how link contracts might influence results, the effect on the final result is perceived to be minor and not significant. Therefore unit link is not considered in the thesis going forward.

1.3 Data Validation

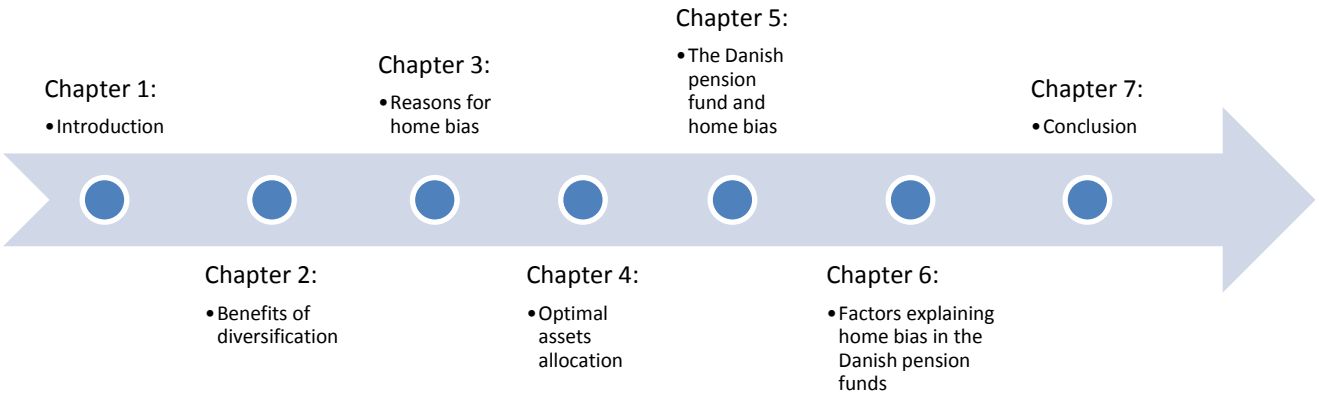
The thesis will rely on much data and many studies by other researchers. For this reason it seems appropriate to devote a section to discussing the validity of data. First of all the analysis of home bias is being performed by introducing explanations proposed and analyzed by other researchers. Many of these analyses are relatively old and one could expect them not to be up to date. I have chosen to rely on these analyses as I did not find other and more compelling explanations in newer literature. Secondly the optimal portfolio found in chapter 4 is by the analysis of MSCI indices. As mentioned in the delimitations these are expected to be

[6] Tokuo Iwaisako, Does International Diversification Really Diversify Risks?, Journal of the Japanese and International Economies 16, 109–134 (2002)

[7] Danica pension, Annual report 2009

correct, but the short period of data could of course pose as a problem. The obtained results could be much different if a longer historical period was applied. But this was not possible and the thesis therefore assumes that the data is representative of the correct relationship among international markets. The number of Danish pension funds is small. This is not optimal by any means. The small number opens the door for results being a coincident, which is unfortunate. But the competition on the Danish savings market is frail and the number of companies is therefore limited. I can only interpret the result that I get, but I am aware of the problem of limited data. Finally the amount of data disclosed by the pension funds is also limited. I therefore had to make assumptions along the way that I had rather been without, but that were necessary to get to a result.

1.4 Structure of the Thesis



Source: Own contribution

Chapter 1 introduces the reader to the objective of the thesis and presents the research question and delimitations. **Chapter 2** discusses the benefits of international diversification. Although this is a well-known concept it is necessary to discuss it to understand how the optimal portfolio is found. The chapter will also explore the benefits by using empirical data and therefore gives a description of the actual benefits obtained today. **Chapter 3** looks into the reasons that might create home bias. The equity home bias is a research question that has been very popular since the first analysis was published by Herbert G. Grubel in (1968). Therefore there have been a vast amount of research on this subject and the proposed reasons for equity home bias have been many. **Chapter 4** analyzes the historical returns of the MSCI Denmark and a vast number of other international indices from a mean-variance perspective to find the optimal historical asset allocation. This historical optimal portfolio will be the basis of determining whether Danish pension funds are equity home biased. **Chapter 5** will analyze the Danish pension sector. But instead of giving a full description of the industry´s workings, the chapter will focus on the asset allocation of funds to determine whether they are home biased. **Chapter 6** analyzes the relevant explanations of home bias to find the reasons why Danish pension funds might underweight foreign stocks in their equity portfolio. Finally **chapter 7** will conclude on the thesis and unify the chapter conclusions to answer the research question.

2 The Benefits of International Diversification

In the explanation of why Danish pension funds should seek international diversification and thereby not show home bias, this section explores the benefits of international diversification. This is done by applying the Markowitz model which assumes that investors choose their portfolio based on only the mean return and the variance. In continuance of the Markowitz model the CAPM is applied.

"Don't put all your eggs in one basket". The old saying applies to equity investment as well as egg carrying. The idea behind this rationale is the non-perfect co-movement between different assets.

In the framework of international equity diversification it implies that the equity prices move differently in different countries. The risk that is diversifiable is the unsystematic risk. This is the idiosyncratic or country specific risk. By investing in stocks of many different countries the country specific shocks experienced by the national investor are offset by shocks in other countries whereby the portfolio return is stabilized and the portfolio risk reduced.

Figure 2.1 shows how the Danish market, represented by the index MSCI Denmark, correlates with other international markets. With a correlation coefficient of approximately 0,78 or less for the period 1999 – 2009 there seems to be big diversification opportunities obtainable by Danish equity investors. Not surprisingly the countries having the highest correlation with the Danish market are other developed countries. This is because these markets are more integrated with each other and are therefore more influenced by the same economic factors. It seems as if the correlation among markets has been increasing. Figure 2.1 shows how the correlation of the Danish and other national markets, here measured by the period 2005 - 2009, seems to have been higher than for the period 1999 - 2009. This lowers the benefits of diversification. The increased correlation can, however, be because of the financial crisis or other short term reasons that make the markets correlate more heavily. The markets that are most correlated with the Danish market still seem to be other developed countries and the greater potential diversification benefits therefore seem to be to invest in emerging markets where the correlation is low.

Figure 2.1

Denmark´s correlation with other international markets
In DKK, monthly returns

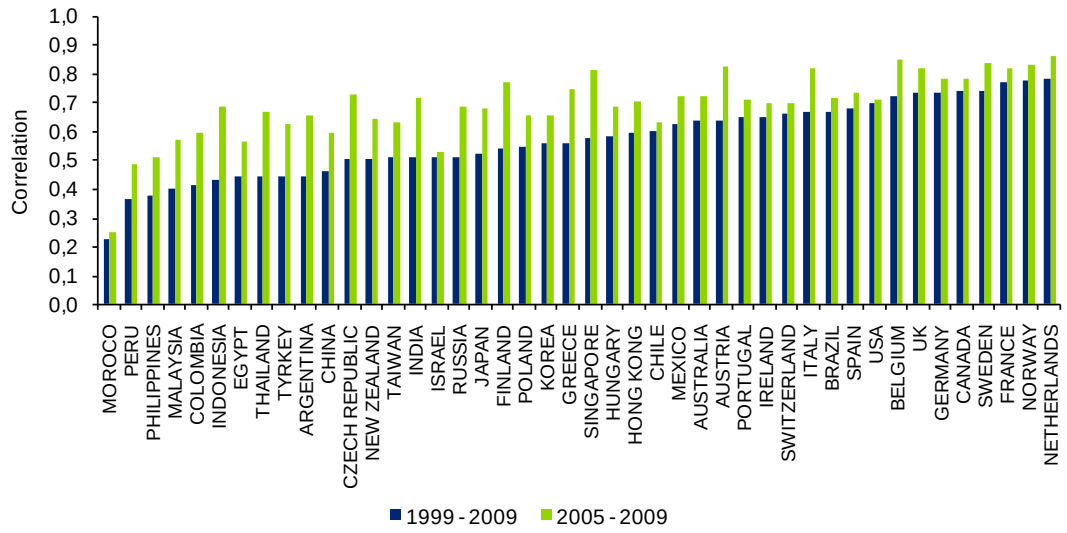


Figure 2.1 shows the correlation between the Denmark and selected international markets in the period from 1999 – 2009 and 2005 – 2009 respectively. Source: MSCI and Own contribution

To further illustrate the benefits of diversification it is necessary to look at how the portfolio risk is measured. This way it can really be shown how investing in different markets, that are not perfect correlated, can contribute to lower portfolio risk. The risk of a portfolio is calculated as:

$$\sigma_P = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\sigma_1\sigma_2\rho_{12}} \quad (2.1)$$

Where $W_1$is the proportion invested in stock 1, $W_2$the proportion invested in stock 2, σ_1 and σ_2 is the individual risk of stock 1 and stock 2 respectively and $\rho_{12}$is the correlation between stock 1 and stock 2.

The 3rd term of the risk calculation is the most interesting one in the context of diversification. It is here the benefits of investing in different markets are accounted for. If the correlation coefficient is equal to one there are no diversification benefits and the optimal portfolio will solely be determined by the return of the individual stocks. But if the correlation among markets is less than one there are diversification benefits to gain from investing in both stocks whereby the portfolio risk can be reduced.

As an example I will show the result of investing 50% in the Danish market and 50% in the market of Morocco. These markets have a historic correlation of 0,22. The yearly standard deviation of the Danish market is 20% and 19% for the Moroccan market.

$$\sigma_P = \sqrt{0{,}5^2 * 0{,}2^2 + 0{,}5^2 * 0{,}19^2 + 2 * 0{,}5 * 0{,}5 * 0{,}2 * 0{,}19 * 0{,}22} = 0{,}152 \qquad (2.2)$$

As can be seen from the example it is possible to reduce the risk of the portfolio by investing in both the Danish and the Moroccan market because of the non-perfect relationship between the two markets. This exercise can be continued by investing in other markets and the portfolio risk can thereby be further reduced. But not all portfolio risk can be diversified away by adding further markets to the portfolio. Only the unsystematic risk is diversifiable.

2.1 The ICAPM and Why People Should Hold the Market Portfolio

This section will concentrate on asset pricing theory and within this subject the international asset pricing model. The ICAPM draws upon the domestic asset pricing model with a few additional assumptions discussed later. For this reason the international asset pricing model will further on be addressed as the asset pricing model (CAPM).

The CAPM will later be used in conjunction with historical data to estimate which proportions have been optimal to invest in foreign equity markets and what proportion have been optimal to invest in the Danish market. From there I will draw some conclusions about the proportions Danish pension funds should invest in Danish and foreign stocks respectively.

But before the theory is used to say something about the asset allocation of Danish pension funds it is crucial to look at the features of the CAPM and how it can be used in the analysis of the Danish pension funds, and furthermore touch upon some of the shortages of the theory and how this might affect the outcome of the analysis.

It was shown how investing in stocks in different markets could lower the risk of the portfolio. Because of the non-perfect correlation the risk reduction of the portfolio can often be done without compromising the expected return of the portfolio. This means that portfolios can be constructed to yield a higher return to risk relationships than obtainable by investing in a single market.

This is how the CAPM is constructed. By constructing different portfolios investors are able to obtain an efficient frontier like shown in figure 2.2. This efficient frontier is superior to any other portfolio of the same risk magnitude. From the figure it can be seen how the return to risk ratios (sharpe ratios) of single markets are inferior to the efficient frontier.

In continuations of the efficient frontier it is assumed that the investors can borrow and lend as they please at a risk free rate. In this paper the risk free rate is assumed to be zero for simplicity. Figure 2.2 illustrates how the inclusion of the risk free rate affects the investment opportunities of the investor. By either borrowing or lending at the risk free rate, the investor is able to obtain an even higher sharpe ratio than otherwise possible. This is done by combining the risk free rate with the tangent portfolio. The tangent portfolio is the portfolio with the highest sharpe ratio. From the figure it is easy to see that an investor will choose a combination of the risk free rate and the tangent portfolio, choosing a proportion in each that will satisfy the risk tolerance of the specific investor.

This is the general features of the CAPM. This could seem like a very simple way of describing the real world which is a little more complicated. But getting to this very simple model of describing the choice of asset allocation, a couple of relatively strict assumptions have been made. I am now going to analyze the assumptions to see if they are violated in a real world context, and how this might influence the results of implementing the CAPM in the analysis of this thesis.

Figure 2.2

Efficient frontier and risk/return of single markets

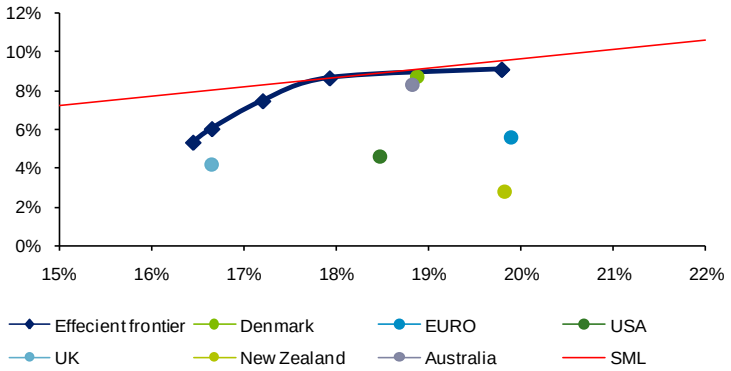


Figure 2.2 shows the efficient frontier and the security market line (SML). The efficient frontier is determined by the use of index data from MSCI. The individual markets are representative of the best obtainable portfolio when only investing in that particular market. Source: MSCI and own contribution

2.1.1 The Assumptions of ICAPM

The ICAPM is just an extension of the domestic CAPM but with one addition, which is that that it assumes that nationals of a country care about the returns and risks measured in their home currency. [8] The assumptions underlying the ICAPM are:

- No transaction costs (costs in general)
- Infinitely diversifiable (investors can invest any proportion in a stock. For instance 1$ in Carlsberg)
- No taxes (Investors do not care if they get returns in dividends or capital gains)
- Investors are price takers
- Investors optimize utility in accordance with risk and return only
- Unlimited short sales allowed
- Unlimited borrowing and lending
- Investors have identical expectations
- All assets are marketable incl. human capital etc.

In a perfect world, where all assumptions are fulfilled, all investors will invest in only two assets. These two assets are the risk free rate and the market portfolio, consisting of all marketable assets. To see why this is, one has to consider the fact that all investors have the same expectations. Because markets have to be at a clear, all assets will have to be invested in. Because of the fact that all investors share expectations they will all hold the market

[8] Bruno Solnik, International investments, 3rd edition. p. 140

portfolio in the proportions that each asset makes up of total assets. To relate it to the earlier section, the market portfolio is in fact the tangent portfolio just made up of all marketable assets. This is of course in a perfect world where all assumptions hold, but looking at the assumptions one might expect a lot of them not to hold in practice. Not all assumptions will be analyzed in details, but rather the ones that are most relevant for the outcome of using the CAPM.

No Transaction Costs

This assumption might be more interesting from a pension funds perspective in an international setting than in a domestic. This is because the transaction costs and other costs in general are expected to be higher in international transactions[9]. Though costs are decreasing due to information technology especially, the fact that international trades are more expensive will be in favor of domestic and in this case Danish stocks. This is of course interesting because this can contribute to pension funds holding more domestic stocks than what is expected when holding the optimal portfolio.

No Taxes

In a domestic setting this assumption is fulfilled when it comes to Danish pension funds. They do not care if they receive dividends or get capital gains as a flat tax is paid on stock gains every year indifferent of whether gains are realized or not. This is another matter in an international setting. This is because some countries impose withholding taxes. In some cases the Danish pension funds can get compensated by the Danish government, but in other situations this is a cost that the fund will have to bear. The same way as higher transaction costs this could further contribute to pension funds holding more Danish stocks than theoretically expected[10].

Investors as Price Takers

Normally this assumption is not at all unreasonable, but in this case the situation might be slightly different. Pension funds are big investors and on small markets, like for instance the Danish, it is not unreasonable to think that they are able to affect prices. It has been shown that in this situation the CAPM still holds, but the price of risk is lowered for institutional

[9] Bruno Solnik, International investments, 3rd edition. p. 119
[10] Bruno Solnik, International investments, 3rd edition. p. 128

investors because the investor are aware of it being a price affecter and are able to utilize on this. This breach of assumption is not expected to have any significant effect on the attractiveness of Danish stocks. On the contrary the fact that institutional investors operate on a small market like the Danish, where they can affect prices, might be a hindrance because it is hard to sell stocks without influencing prizes downwards and buy stocks without pushing prices upwards. This issue will be analyzed later in the thesis.

Short Sales are not Allowed

In theory a failure of this assumption does not really affect the ICAPM as all investors will still hold the market portfolio in equilibrium. In equilibrium no investor short sells. Therefore a breach of the assumption will not change the equilibrium and thereby influence the result[11]. In this thesis it is assumed that short sales are not allowed as pension funds do not practice this.

Identical Expectations

This is an assumption that might be hard to quantify. Theorists have found evidence in the domestic CAPM that despite having different utility functions investors still preferred the same asset allocation. This might be another story in an international perspective. Currency risk for one is different amongst different countries. Investing in Euro markets might not mean any currency risk from a Danish pension funds' perspective, but viewed from an American investor currency risk play a significant role even in stock investments. Information might be another reason for heterogeneous expectations amongst investors. Danish pension funds might perceive the Danish market as less risky because they believe they know the market better than foreign markets. It is shown that domestic investors have a relatively or even absolute[12] optimistic view on their domestic market. This provides evidence against investors sharing the same expectations of markets. This is a very interesting subject as this could mean that Danish pension funds might overweight the Danish market in their portfolio because they have an information advantage. This is a subject that will be extensively analyzed later in the thesis.

[11] Elton, Gruber, Brown and Goetzman, Mordern portfolio and investment analysis, 7th edition, p. 306

[12] Norman Strongy and Xinzhong Xu, Understanding the equity home bias: evidence from survey data, The review of economics and statistics 2003, pp. 307 – 312.

Nonmarketable Assets

Another interesting assumption, that might not seem reasonable, is the assumption that all assets are marketable. It is hard to think of all investors seeing their home as a marketable asset. Another asset that, by law, cannot be considered a marketable asset is human capital. But none the less this asset can have a tremendous effect on the optimal allocation. To see why this is we have to take a look at the CAPM in its mathematical form.

$$R_j = R_F + \frac{R_M - R_F}{\sigma_M^2}\left[cov(R_j R_M)\right] \quad (2.3)$$

R_j= return of asset j, R_F= risk free rate and $cov(R_j R_M)$ = the covariance between asset j and the market portfolio.

From the expression it can be hard to see that the equation is simply a straight line like the one going through the tangent portfolio in figure 2.2. This equation, by assumption, includes all assets as it assumes all assets are marketable. If the world is instead divided into marketable and the nonmarketable assets another simple, however, slightly different equation arises.

$$R_j = R_F + \frac{R_M - R_F}{\sigma_M^2 + P_H/P_M cov(R_M R_H)}\left[cov(R_j R_M) + P_H/P_M cov(R_M R_H)\right] \quad (2.4)$$

R_H = return on nonmarketable assets, P_H = total value of nonmarketable assets and P_M = total value of all marketable assets.

From equation 2.4 it should be noticed that the return risk trade-off, which is the second term in the equation, decreases when the covariance between the market portfolio and nonmarketable assets increases. This is not surprising as human capital is expected to correlate positively with the market. It should also be noted that the return risk trade-off also depends on how big a share the nonmarketable assets make up of all marketable assets. If either the covariance is zero, or the ratio that nonmarketable assets make up of all marketable assets is very low, the simple form of CAPM will be correct[13].

[13] Elton, Gruber, Brown and Goetzman, Mordern portfolio and investment analysis, 7th edition, p. 318

The reason why this assumption is interesting is because the human capital of Danish pension sponsors could have a high correlation with the Danish market. This could imply that the Danish pension funds should invest even less in Danish stocks than normally predicted by the market portfolio.

Some theorists have researched on how human capital correlates with domestic marketable assets and found that it is in fact highly correlated[14]. As mentioned this would mean an overrepresentation of domestic assets in the portfolio. Looking at the high correlation isolated this should make the Danish pension funds invest more heavily in foreign stocks as these are less correlated with human capital in Denmark than the Danish stock market.

2.2 Related Research

Following the last section this section describes the empirical works within international diversification and the benefits the international investor receives. In connection with the documented benefits from international diversification the reader is introduced to the documented preference of domestic equity which is referred to as equity home bias. There are a vast number of articles written on the subject of international diversification and home bias. It is not in the best interest of this paper to explore them all but instead to concentrate on some of the earliest work, which is the cornerstone in the exploration of international diversification.

The most utilized way of investigating the benefits of international diversification have been through the analyses of historical data of risk and return. Hereby a vast number of researchers have documented how the international portfolio systematically outperforms the domestic portfolio.

What the earlier work does, and will also be performed in this thesis, is to solve for the tangency portfolio by an ex post analyses. This implies the use of modern portfolio theory on historical data. As shown in the earlier section the tangency portfolio can be found by maximizing the slope of the risk adjusted risk premium.[15]

[14] Marianne Baxter and Urban J. Jermann, The international diversification puzzle is worse than you think, The American review, vol 87, No. 1, pp. 170-180.

[15] $\underset{\{x_i\}}{Max}\,\theta = \frac{\bar{R}_p - R_f}{\sigma_p}$ subject to $\sum_{i=1}^{N} x_i = 1$. Where $x_i$is the fraction of the wealth invested in stock i.

2.2.1 Correlation of Markets

Although the different authors use slightly different approaches to verify the gains of international diversification, they all have the hypothesis of non-perfect correlation between international stock markets. As was illustrated in the theoretical section about gains of diversification this is a necessity to benefit from diversification. In his article from 1968 Herbert Grubel[16] investigates the correlation between different markets compared to the US market. The correlations of the markets are all under 1 with Canada having the highest correlation with the US with 0.7. This does not come as a big surprise as one might expect Canada to be the country most integrated with the US.

Later research by Patrick Odier and Bruno Solnik[17] also documents a low correlation between international stock markets, which confirms the findings of Grubel and thereby further enhance the beliefs of gains by international diversification.

Recent research[18] suggests an increased correlation between markets, especially among developed countries. They still document gains by international diversification amongst developed countries, but emphasize the opportunities of investing in emerging markets, where the correlation with developed countries are much lower. There is other recent evidence confirming that correlation has increased since Herbert Grubel started the research on international diversification, but the increase has not made international asset allocation unbeneficial.

Though many articles have documented the benefits of international diversification there still seem to be a reluctance to invest in foreign stocks. Domestic investors overweight the domestic stocks in their portfolio compared to what the market portfolio proclaims. This is what theorists call equity home bias. In the context of this thesis it will be analyzed if the Danish pension funds are home biased and if this is the case, which reasons can explain this bias.

[16] Herbert G. Grubel, Internationally diversified portfolios: Welfare gains and capital flows, The American economic review, Vol. 58, No. 5 1968, pp. 1299-1314

[17] Patrick Odier and Bruno Solnik, Lessons for international asset allocation, Financial analyst journal 1993, p. 63

[18] Chiou, Lee and Chang, Do investors still benefit from international diversification with investments constraints?, The quarterly review of economics and finance 2006. pp. 448-483.

2.3 Concluding Remarks

In this section I explored the benefits of international diversification and introduced the theoretical framework of the CAPM and the market portfolio. By using the data from MSCI it was shown how international markets show non-perfect correlation and therefore can be used to diversify equity investments to lower the systematic risk of a portfolio. In the same section it was shown that the correlation amongst the different markets seems to have been increasing the last 11 years. This would of course mean that the benefits of international investment would be decreasing as well. It could however be observed that there are still benefits to be obtained by investing internationally, both among developed countries but especially between the Danish market and emerging markets where the correlation is very low.

The reader was introduced to modern asset pricing theory and the CAPM. This section concentrated on explaining how an investor can optimize the sharpe ratio of a portfolio to obtain the efficient frontier. The efficient frontier dominates all other individual markets and portfolios. It was shown that by adding the risk free rate the investor would optimize by choosing an allocation between the risk free rate and the tangent portfolio. By making some assumptions about the behavior of markets and investors it was shown that the investor would always choose to hold a combination of these two assets. These assumptions where later challenged in the context of how the asset allocation would be affected if some assumptions were not to hold. Adding transaction costs, withholding taxes along with heterogeneous expectations could lead to an overweighting of Danish stocks whereas taking into account the human capital of Danish workers would be expected to lower the share of Danish stocks in the portfolio.

At last related research was touched upon to see how former studies within this area have turned out. Earlier studies have found extensive gains by investing internationally. In spite of these gains researchers have found that investors still overweight the portfolio with domestic stocks compared to the market portfolio. This equity home bias has been researched extensively and several reasons have been suggested to explain this puzzle. These reasons will be described in the next chapter.

3 Reasons for Home Bias

In the previous chapter the benefits of diversification and the theory of the CAPM was discussed. If the CAPM holds investors would hold the international market portfolio where the weights of each country are the same as the countries share of total market capitalization. But as this section will show there can be some abnormalities influencing the assumptions of the CAPM that can result in investors overweighting domestic assets, which as recalled from the previous section is mentioned as equity home bias.

In this chapter I will look at some of the proposed reasons why investors tend not to hold the market portfolio. These so called abnormalities are divided into two groups. The first being institutional factors and the second being behavioral factors. Institutional factors stem from the violation of the main assumptions of perfect markets. No barriers to entry, no transaction cost etc. Behavioral factors are the violation of the second key assumption, which is that investors are rational. Figure 4.1 summarize the explanations within each group.

Figure 4.1

Reasons for home bias

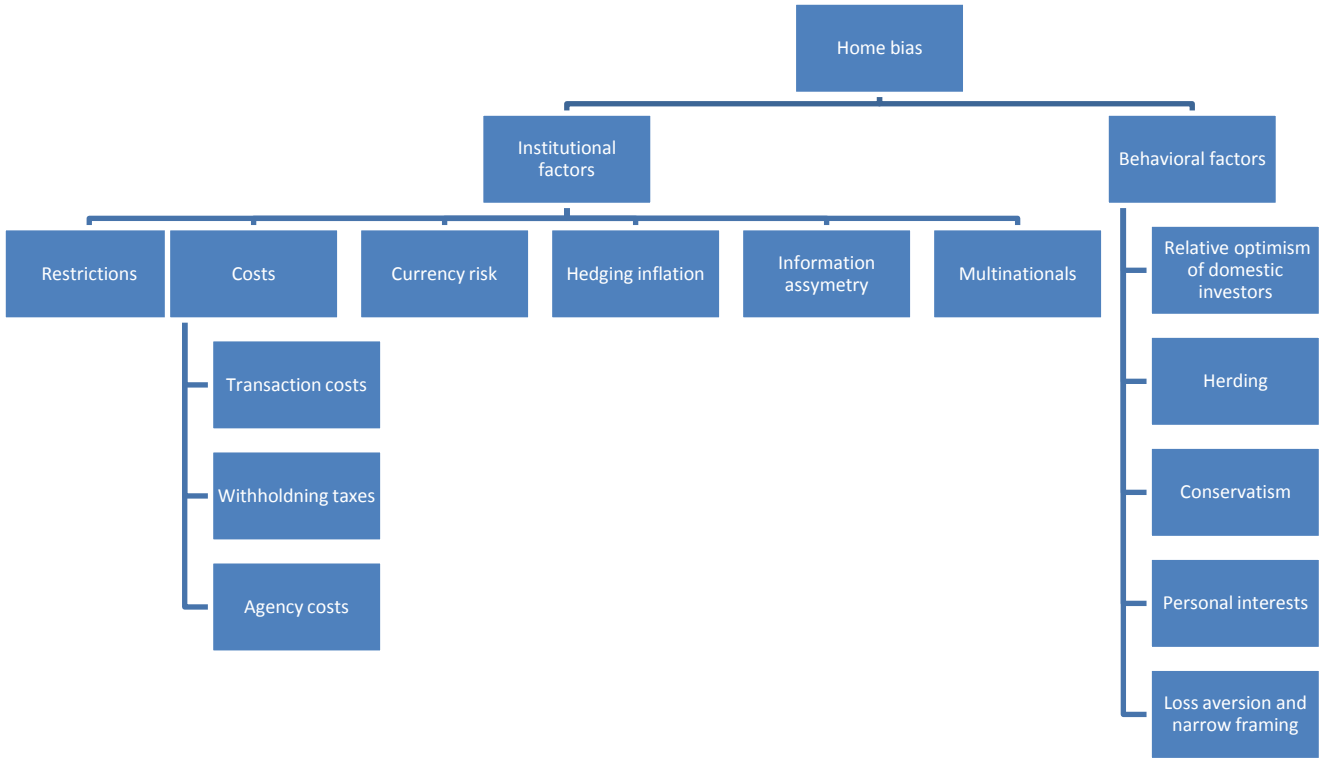


Figure 4.1 illustrates the plausible reasons coursing home bias. Source: Own contribution

3.1 Institutional Factors

3.1.1 Restrictions on Asset Allocation

In the Danish law about the workings of financial institutions there are specific laws concerning the placement and liquidity of the investments of pension funds[19]. This law has been made to minimize the risk of Danish pension funds not fulfilling their commitments to their members.

This law touches upon many restrictions as to how much can be invested in different assets as bonds, stocks, real estate and so on. It also puts restrictions on the amount that can be invested in different currencies. This thesis will only touch upon the paragraphs important in the context of home bias and for instance not concentrate on the restrictions of the share of stocks allowed in the total portfolio.

Paragraph §163 part. 2 states that only 10% of assets, assets being all asset classes (stocks, bonds and real estate), can be from countries outside zone A[20].

Paragraph §165 states that only 20% of assets can be denominated in currencies other than the Danish, which means that only 20% of investments can be in foreign assets, whereof only 50% can be invested in countries outside zone A as stated in §163 part. 2 above. Paragraph §165 Part 2) however states, that 50% of the 80% that has to be invested in the Danish assets can be fulfilled by investing in countries that has the Euro as currency.

Thus 60% of all assets can be placed in currencies different from Danish kroner. Table 4.1 summarizes the important restrictions, to be aware of, when considering home bias in Danish pension funds.

[19] Bekendtgørelse af lov om finansiel virksomhed

[20] Australia, Belgium, Canada, Cyprus, Denmark, USA, UK, Estonia, Finland, France, Greece, Ireland, Iceland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Saudi Arabia, Switzerland, Slovakia, Slovenia, Spain, Sweden, South Korea, Czech Republic, Turkey, Germany, Hungary, Austria. Source: The Danish Financial Supervisory Authority

Table 4.1

Allocation restrictions of Danish pension funds

Assets denominated in	Share	Paragraph
DKK	≥ 40%	165 (2)
EUR	≤ 40%	165 (2)
Other than DKK and EUR	≤ 20%	165 (2)
Whereof currency outside zone A	≤ 50%	163 (2)

Table 4.1 shows the restrictions on the asset allocation of Danish pension funds.
Source: Danish about financial institutions

For LD and ATP there are separate laws with regard to restrictions. Table 4.2 illustrates these restrictions.

Table 4.1

Allocation restrictions of LD and ATP

Assets denominated in	Share	Paragraph
Currencies in Zone A countries	≤ 70%	6d (5)
Currencies in countries outside Zone A	≤ 10%	6d (3)

Table 4.2 shows the restrictions on the asset allocation of LD and ATP.
Source: Law about LD and ATP

The rules about investments in countries outside zone A countries are the same as for other pension funds, but the rules are otherwise very different. LD and ATP can invest up to 70% in countries within zone A compared to the normal 20%.

3.1.2 Information Costs and Asymmetric Information

Asymmetric information is the situation in which one party has more or better information than the other. In the framework of this thesis this would translate to a situation where the domestic investor has superior information relative to the foreign investor on the domestic market and vice versa. Thus leading to a situation where the information costs for the domestic investor are lower on the domestic market than the foreign market. If asymmetric information exists, and obtaining information about foreign companies and markets is more costly than that of domestic companies this will reduce the profitability of international diversification.

The hypothesis of asymmetric or information advantage of domestic investors is a subject that has been examined extensively. Equity investments in foreign companies require knowledge of foreign accounting principles, corporate relationships and legal aspects, just to mention some of the information costs that evidence points to as important.

Kee-Hong Bae, René M. Stulz, and Hongping Tan (2005) analyze the information advantage by the precision in which domestic and foreign analyst predicts the price of stocks. They find a statistically significant advantage of local analysts. They also find that the local advantage is especially high in countries where firms disclose less information and market participation by foreigners are low. In relation to this, Maela Giofré (2009) finds evidence of information asymmetries playing a role in the low allocation into Far East investments of US investors. She concludes that large informational barriers are the cause of the low allocation and is certain that countries like China and India can attract further international investors and enhance the growth of the stock market if lowering information barriers.

Ravi K. Shukla and Gregory B. van Inwegen (1995) analyze asymmetric information on the investments of mutual funds. This is of course of great interest in the context of this thesis as pension funds and mutual funds are both institutional investors. The authors test US stock investments of US and UK mutual funds respectively. What they find is an underperformance by the UK mutual funds, both when measured on return but also when accounting for risk. They explain this result referring to the better information of the US funds and conclude that the underweighting of UK funds is a rational choice. In a similar analysis Joshua D. Coval and Tobias J. Moskowitz 1999 test local information advantage on mutual funds in a domestic setting. They find that funds investing in local businesses earn an abnormal return on nearby investments. The abnormal return is especially high for small funds with a concentrated portfolio. They also find that the average fund shows a modest home bias, but some funds heavily overweighting local assets actually show even higher abnormal returns than the average fund. Torben Lütje and Lukas Menkhoff (2004)[21] also analyze mutual funds to find evidence of information asymmetry. In their analysis they use survey data of fund managers to investigate information asymmetry. Their conclusion is that portfolio managers are seeing themselves as having advantage on the domestic market, but when analyzing the accomplished return there is no empirical evidence of abnormal returns.

[21] Torben Lütje and Lukas Menkhoff, What Drives Home Bias? Evidence from Fund Managers' Views, Discussion paper No. 296 May 2004 ISSN 0949-9962

Recent work investigates why domestic investors have this information advantage as it seems rational and possible to gather the same information about foreign stocks as they have about domestic stocks. What the authors Stijn Van Nieuwerburgh and Laura Veldkamp (2008) find, is that it is rational for the investors to concentrate on the domestic market if they start out with a little advantage on this market to begin with. Investors gain more by specializing in the domestic market in which they have a slight advantage to begin with. This sounds as a plausible theory as this is also what is being seen in other aspects of business. Specialization makes things more valuable which is also the cornerstone of these findings. Giving the domestic investors a slight advantage to begin with just makes it more likely that this is the market they will specialize within. The authors show that the results of the model correspond to the patterns observed in empirical studies.

Jun-Koo Fang and René M. Stulz (1997) investigate which companies in Japan foreign investors invest in. They find that foreign investors primarily invest in large well-known companies that are known internationally and have low unsystematic risk. Thus foreign investors prefer investments which they are better informed about.

Numerous further studies of the subject have been performed (e.g Thomas Gehrig (1993); Michael J. Brennan and H. Henry Cao (1997); Amir A. Amadi (2004); Tomáš Dvořák (2005)). These authors all find evidence of asymmetric information by using different techniques.

Information advantage has been one of the most used explanations of home bias and might be the most analyzed reason in the last ten years. This is probably a result of other and more tangible reasons are being outfaced as the markets gets more integrated leaving less and less explanations of the continuing home bias puzzle.

3.1.3 Hedge Against Inflation

If investors are concerned with inflation they will invest in assets that provide a hedge against it. In the home bias context this would mean that if domestic equity provides a hedge opportunity that is relatively better than that of foreign countries it would not be unreasonable to assume that this would influence investors to hold a bigger share of domestic equity.

This might also be the case in the context of pension funds investments. One of the declared goals of the pension funds is to provide and sustain a high real return. The real return is an important aspect as the retirees leave the work force and have to rely solely on their pension. For this reason the pension funds cannot just concentrate on the nominal return, but have to provide a sound real return that the pensioners can live of when they retire.

If domestic equity provides a superior hedge mechanism against inflation this would be a product that would be very interesting to the pension funds and would probably mean that they would be biased towards Danish equity.

Although hedging inflation seems as a plausible reason for overweighting the share of domestic stocks little evidence has been found that supports this theory. If inflation hedging is to be thought of as a rational reason for overweighting the share of domestic stocks, inflation has to correlate significantly with equity returns. Cooper and Kaplanis (1994) test if inflation hedging can explain the observed equity bias but do not find any evidence that this is the case.

3.1.4 Costs

An area that has been heavily discussed in the academic world is the direct costs of foreign investments, this being transaction costs and withholding taxes. As stated by René M. Stulz in (1981) it is evident that higher costs associated with foreign investments will lower the profitability of diversification and induce an overrepresentation of domestic stocks.

French and Poterba (1991) however argue that withholding taxes is not a plausible reason for the observed home bias. If the countries are withholding taxes these payments can usually be credited against taxes in the investor's home country[22]. Even if this is not the case the cost would only reduce the expected return by 50 basis points p.a. which is not enough to account for the observed home bias.

Transaction costs are also a plausible explanation of home bias at first glance but when analyzed more thoroughly loses its explanatory power. French and Potorba (1991) argue that the transaction costs must be assumed to be lower in more liquid markets as for example New York. This is a very interesting aspect on the basis of Danish investors, as the Danish market

[22] French and Poterba, Investor diversification and international equity markets, 1991, p. 6

is a very small and illiquid market.[23] Added to this is the fact that a lot of stocks of listed companies have a lot of non-floating stocks because of large ownership of few big investors[24]. This further lowers the liquidity of the market.

Other studies support the argument that transaction cost cannot be viewed as a plausible reason for home bias. Tesar and Werner (1995) find evidence of high volumes of cross border capital flows and high turnover rate on foreign equity relative to domestic equity. These findings provide evidence against transaction costs being a plausible reason for home bias.

One of the biggest costs when talking about foreign investments, that are not often mentioned, is the cost of using investments funds when investing overseas. Some of the larger pension funds have the means to perform the investments themselves, but some of the smaller funds ,which represent a substantial share of the market in Denmark, rely on investment funds or foreign asset managers when doing cross border investments. There are of course additional costs related to this. The expense ratio of investment funds are in the range of 1–1,5% annually[25]. This is a cost that is to be recognized and could induce some funds to enhance the share of Danish equity. There are also, in the case of foreign asset managers, additional costs involved. Even if the explicit cost are insignificant there are still greater implicit cost linked to using foreign asset managers in the case of higher agency costs.[26]

3.1.5 Investing in Multinational Companies

Investing in a Danish company or stock would on paper be accounted for when investigating if home bias exists. But for some firms the business achieved on the domestic market accounts for a very little share of the total business. For Multinational companies (MNC´s) sales are much more volatile to global business. Therefore some argue that investing in a domestic MNC and diversifying internationally does not necessarily need to be conflicting actions.

[23] Niels Eberhard and Ricco Hagenflindt, Styring af valutarisici ved internationale investeringer, 1995
[24] Magnus Dahlquist, Lee Pinkowitz, René M. Stulz, and Rohan Williamson, Corporate governance and the home bias, October 2002
[25] Ian Cooper and Evi Kaplanis, Home Bias in equity portfolios, Advisors guide to international financial research, 2000 pp. 25
[26] E. Phillip Davis and Benn Steil, Institutional Investors, MIT Press 2001

Fang Cai and Francis E. Warnock (2005) find that US investors have a preference for large domestic corporations, which of many are diversified internationally. The domestic investor's preference for internationally diversified companies implies that investors might obtain international diversification through investing at home. By using an international factor model the authors show that international diversified companies are definitely more exposed to international stock markets and the exposure are increasing by the share of international sales. By accounting for the home-grown foreign exposure in investor's portfolios the proportion of foreign equity nearly doubles, reducing the home bias greatly.

Patrick F. Rowland and Linda L. Tesar (2004) also investigated the diversification benefits of investing in domestic MNC´s. Though the results is not as convincing as the one presented above the authors still find weak evidence of MNC´s providing diversification benefits in two of the seven countries analyzed.

The hypothesis of MNC´s providing diversification benefits is an interesting aspect, especially in Denmark where big companies like Maersk and Novo Nordisk account for a big share of the total Danish market and thereby also a big share of the pension funds' domestic investments.

3.1.6 Currency Risk

A reason that might influence the reluctance against foreign equity is the increased risk that comes with currency risk. While this risk is less important when investing in equity than bonds it still accounts for up to 30% of the total risk of a stock.[27]

Some researchers argue that this should not be a concern for investors as hedging is possible at little cost[28]. There are however discussions as to how little these costs in fact are. Some argue that if optimal hedging is to be achieved you have to balance the portfolio often and the cost will therefore become significant[29]. Some researchers also show that hedging of currency risk is superior to no hedging[30].

[27] Jesper Rangvid, Afdækning af valutakursrisikoen i porteføljen, 2002
[28] Ian Cooper and Evi Kaplanis, Home Bias in equity portfolios, Advisors guide to international financial research, 2000
[29] Evi Kaplanis and Stephen M. Schaefer, Exchange Risk and International Diversification in Bond and Equity Portfolios.1991
[30] Niels Lorentz Nielsen, Valutarisiko i udenlandske aktieporteføljer, finans/invest 2/96

Several studies find exchange rate risk as a driver for home bias (Michael Fidora, Marcel Fratzscher and Christian Thimann (2007); Anil V Mishra (2007)). These findings could indicate that hedging currency risk, and thereby lowering the risk of foreign stocks, would decrease the share of domestic stocks in a portfolio.

3.1.7 Corporate Governance

Magnus Dahlquist, Lee Pinkowitz, René M. Stulz, and Rohan Williamson (2002)[31] argue that corporate governance has an effect on the size of home bias. They argue that the market portfolio does not consist of all stocks, but only of the ones not controlled by a controlling shareholder. They therefore construct a float market portfolio where they adjust for the holdings of controlling shareholders and find that the home bias of American investors are not as bad as first assumed. In the float market portfolio the US share accounts for 60% compared to the 50% in the world market portfolio. Some of the home bias can therefore be accounted for by subjects of corporate governance. Measuring the home bias according to the world float portfolio could also increase the home bias if the market capitalization accounts for less in the floating portfolio than the regular market portfolio.

3.1.8 Size of the Fund

Jinlan Ni (2009) tests how the size of fund managers' portfolios affects the proportion of equity home bias. The hypothesis is that the larger the size of portfolio is the more eager the manager is to gain information about foreign equity markets and therefore show less home bias. The result of the analysis is a significant positive relationship between the portfolio size and the observed home bias meaning that the home bias decreases with the size of the portfolio.

John M. Barron and Jinlan Ni (2008) also investigate the relationship between portfolio size and home bias. They perform the analysis on pension funds using total assets and total equity holdings as proxies for the size of portfolios. The result of their analysis is also a direct link between the size of the fund and the degree of equity home bias. The theory behind the hypothesis is that an increasing portfolio makes it more advantageous to acquire information on foreign assets, and thus eliminate the asymmetric rationale for home bias.

[31] Magnus Dahlquist, Lee Pinkowitz, René M. Stulz, and Rohan Williamson, Corporate governance and the home bias, October 2002

Another plausible reason for the relationship between the size of the pension fund and the proportion invested is the greater resources that larger funds have. In their analysis on asymmetric information Ravi K. Shukla and Gregory B. van Inwegen (1995) also find that the size of the fund is explanatory for the degree of home bias. They contribute the difference to limited resources of smaller funds.

A final reason that makes the size of the fund interesting is the size of the domestic market. If the domestic market is very small this makes investing illiquid. With an increase in size a fund cannot keep investing the same proportion of total stock in the small domestic market. For this reason a large enough pension fund cannot display home bias as the market will become too illiquid.

3.2 Behavioral Factors

3.2.1 Herding

Herd behavior describes how individuals act in the same way without a planned direction. In the context of home bias and pension funds this would mean that funds are home biased because the other funds are. Helmut Reisen and John Williamson (1994)[32] quote the findings of Coote (1993). They observe a tendency for portfolio managers to conform to industry norms, which is a result of the principal agency problem. To limit personal risk the fund manager does what others do (herding). In this way the manager, by failing, will not be held personally accountable.

Vivek Sharma (2004) analyzes institutional investors in one of the largest bull runs in US history. The methodology of the study is to examine to what extend managers end up at the same side of the market relative to what is expected if they trade independently. The analysis shows clear evidence of herding by the institutional investors that cannot have been based on information.

Min S. Kim and Fernando Zapatero (2009) analyze herding in the context of analyst recommendations, but the results can be easily translated to pension funds. They find that

[32] Helmut Reisen and John Williamson, PENSION FUNDS, CAPITAL CONTROLS AND MACROECONOMIC STABILITY, OECD DEVELOPMENT CENTRE Working Paper No. 98, August 1994

relative performance evaluation explains the herding of analysts. If this finding is viewed in the context of pension funds herding could be expected in pension fund portfolios if the remuneration and reputation depends on the relative performance of fund managers.

Andreas Oehler and Stefan Wendt (2008) analyze German fund managers. They also find evidence of benchmark herding. Their results show that herding is more common in funds that primarily invest in the German market and less in funds that have a global investment focus.

Herding is an issue that could cause home bias especially if managers are remunerated relative to other managers or if they are afraid of losing their reputation by separating from the benchmark. The remuneration schemes should therefore be constructed to act as an incentive for managers to achieve the highest long term return. Herding can cause home bias, but only if the norm is to overweight the Danish market. If instead the norm is to not overweight the Danish market herding would be an argument against home bias.

3.2.2 Conservatism

Conservatism is the tendency to update beliefs too slowly. This means that people overweight their prior beliefs and underweight the sample evidence. Conservatism can also be seen as overconfidence of the person's prior information or beliefs.[33]

Chen-Hui Wu, Chin-Shun Wu and Victor W. Liu (2009) test conservatism bias in the emerging stock market, represented by Taiwan. Their results support a conservative bias in the medium term horizon.

In the same area of research Imtithel Sendi, Chaker Aloui and Makram Bellalah (2007) investigate how behavioral finance can explain the equity home bias. When documenting the home bias they find that the bias maintained the same level throughout the sample period. They explain this by the conservatism and familiarity investors have with their home market.

Conservatism is based on norms, traditions and habits indoctrinated by years of customs. It can therefore be hard to change these habits, which in this case leads the investor to prefer the

[33] Wesley S. Chana, Richard Frankelb and S.P. Kotharib, Testing behavioral finance theories using trends and consistency in financial performance, Journal of Accounting and Economics 38 (2004) 3–50

stocks that are familiar and disregard optimal portfolio theory. If the custom is to invest heavily in domestic stocks this behavioral reason could help explain why the home bias still exists despite the well-known benefits of international diversification.

3.2.3 Personal Interests

This is another behavioral aspect that could be expected to influence the degree of home bias in pension funds. It is not unlikely for union members or politically active persons to be elected for the board of some of the pension funds and wanting them to concentrate some of their investments on the domestic market where it will sustain jobs and sustain the liquidity of the home equity market.

Other investments that could be expected are investments into infrastructure and other economically targeted investments (ETI´s) and social investments (SI) that would have an influence on the domestic economy. M. Wayne Marr and John R. Nofsinger (1995) analyze pension funds to find that ETI´s and SI´s have been growing the recent years. In connection with these findings Auke Plantinga, Bert Scholtens and Nanne Brunia (2000) analyze the social investments of funds managers and find that there is a home bias in these investments.

The observed increase in social investments together with the findings of these being home biased could indicate that personal interests could be a reason for some of the observed equity home bias. This could be a problem in the Danish pension sector. With their close ties to labor unions some pension funds could be expected to take into account these close connections when making their equity investments.

3.2.4 Relative Optimism Towards Domestic Equity

Another behavioral reason for the explanation of home bias is the relative optimism investors have towards the home market. The most well-known research within this area is the one performed by Kenneth French and James Portoba (1991). Investigating the asset allocation of investors in USA, Japan and the United Kingdom Kenneth French and James Portoba uncover the expected return justifying the large holdings of domestic equity.

By applying their analysis the authors come up with very interesting results about the different countries' expectations for the returns of domestic and foreign stock markets. The

different countries have very different expectations for their home market compared to foreigners. As an example the United Kingdom expects the domestic market to outperform the US market by 500 basis points. At the same time the Japanese holdings imply an expectation of a domestic outperformance of the US market by 300 basis points. In general the authors find evidence of every country to have a relative optimism towards domestic equity, which is when domestic investors have greater optimism towards the domestic market than foreigners do.

Norman Strongy and Xinzhong Xuz (1999) find similar results in their analysis of fund managers. By the use of survey data the authors find relative optimism of US, UK and Japanese managers respectively. Torben Lütje and Lukas Menkhoff (2004) conduct the same analysis on German fund managers and also find that these managers show relative optimism towards the domestic market.

3.2.5 Loss Aversion and Individual Framing

In the area of behavioral finance framing refers to the way people perceive risk and outcomes. In their article from (1981) Amos Tversky and Daniel Kahneman[34] conduct different tests of how a sample group responds to different outcomes. Two aspects of this research are very interesting in the context of equity home bias.

First Amos Tversky and Daniel Kahneman suspect that when analyzing different scenarios or outcomes people tend to look at them separately and not combined. In the context of investment theory this is a big flaw because the correlation amongst different equities is thereby not recognized and therefore the diversification benefits are neglected. In the worst case scenario investors would think of diversification as increasing risk because they consider the stocks independently.

The second result of their analysis is the conclusion that people are loss averse. They show greater sensitivity to a loss than a gain of the same magnitude. In the context of international investments this might imply that investors would choose a portfolio of lower risk as the risk of losing money is thereby minimized. As a portfolio of many international stocks are likely

[34] Amos Tversky; Daniel Kahneman, The Framing of Decisions and the Psychology of Choice, Science, New Series, Vol. 211, No. 4481. (Jan. 30, 1981), pp. 453-458

to be less risky than a portfolio of only domestic stocks this would decrease home bias. But if investors are framing individually they do not recognize this risk reduction obtained by diversifying.

Nicholas Barberis and Ming Huang (2005)[35] continue the discussion in the context of the equity market where they define narrow framing as evaluating an investment individually and not considering the investments impact on the total wealth of the investor.

3.3 Concluding Remarks

In this section I looked at the reasons why Danish pension funds could be expected to be home biased. Danish law puts restrictions on how pension funds can allocate their investments. If the pension funds have reached the limit of foreign investments and still overweight Danish stocks this would limit the pension funds in lowering the share of Danish stocks even if they wanted to. Restrictions could thereby lead to home bias.

Information asymmetry is a much discussed reason for home bias since research of the subject first started. If asymmetric information translates into better performance in domestic markets this could explain if not all then some of the home bias still observed in portfolios. The analyses of different researchers have, however, not found a common stand on whether domestic investors actually perform better on the domestic market than on foreign markets.

Greater costs of foreign investments are another reason that could induce home bias by lowering the return that Danish pension funds receive when investing abroad. Together with this the enhanced risk of international stocks caused by the involvement of currency risk might not be compensated enough by the diversification benefits of holding the an international diversified portfolio.

Superior inflation hedging by Danish stocks as opposed to foreign stocks might be a reason for home bias. If this is the case the pension funds can gain the benefits of higher expected return of stocks while also hedging inflation.

[35] Nicholas Barberis and Ming Huang, The Loss Aversion / Narrow Framing Approach to the Equity Premium Puzzle, October 2005

Among behavioral reasons herding could explain home bias, which means that the observed home bias should be a common observation among pension funds. This could be because of remuneration plans badly structured or the fear of managers to lose reputation by being the only one failing. In the same area of explanation conservatism could be a reason for home bias. Sticking to the known domestic stocks instead of exploring new international opportunities could be the reason why home bias is still observed. Conservatism could also be tied to asymmetric information as conservatism could indicate an advantage within the domestic market and therefore reluctance towards investments in foreign markets.

Personal reasons could also affect the proportion of domestic stocks in the portfolio. Pleasing executives at employer unions or alike could be a reason for investing in domestic businesses. This is, however, a reason that is hard to analyze by looking at disclosed data.

Relative optimism has often been mentioned as explanations of home equity bias. The domestic investors have been shown to be thinking more optimistically of their home markets than foreigners do. Portoba and Resnick (1991) show that domestic investors have to believe that their home market will perform way better than foreign investors think to defend the large share of domestic equity in the portfolio.

Finally, narrow framing could be a reason for home bias. It does, however, not seem as a plausible reason in the context of pension funds because of the diversification benefits known by the fund managers. Loss aversion is also not a viable reason for home bias, because portfolios of lower risk are structured through a well diversified portfolio. Loss aversion should therefore rather be a reason for investors holding a well diversified low-risk portfolio. Later on in the thesis, the discussed reasons will be analyzed in the context of Danish pension funds.

4 Optimal Asset Allocation

According to the work of Sharpe (1964) and Lintner (1965) the conclusion is that all investors in equilibrium should hold the market portfolio. As explained earlier the market portfolio is made up of all assets and is weighted in accordance to each countries capitalization. Based on this model it is clear that all Danish pension funds would be home biased as the Danish share of the total market is about 0,41%.[36]

For this reason I prefer to use the mean-optimization process, also used by Lewis (1999), to investigate what proportion has been optimal to invest in foreign markets from the perspective of a Danish pension fund.

Performing the mean-variance optimization should result in an interval wherein it is optimal for Danish pension funds to invest in foreign stocks. A deviation from this interval will therefore, in the remainder of the thesis, be referred to as equity bias.

4.1 Assumptions

The main assumptions are the ones also presented in chapter 2. No transaction costs, no barriers to entry on any market, investors have access to all relevant information, investors are rational and cannot affect prices. It is assumed that it is not possible to invest in any risk free assets and the total wealth will therefore be invested in stocks. Short sales are not allowed. Thus the amount invested will sum to 1 and no negative proportion can be invested in any market. Further it is assumed that returns are normally distributed and stationary.

4.2 The Optimal Equity Portfolio

As mentioned the standard CAPM or mean-variance approach will be used to determine the optimal proportion of foreign stocks. Because the risk tolerance of the different Danish pension funds is not known, the optimal interval will be equivalent to the efficient frontier. The efficient frontier, as also shown earlier, dominates all other portfolios, but the risk aversion of the individual pension fund determines where on the efficient frontier will be. The efficient frontier will be determined through the analysis of historical returns of the MSCI country indices. The returns are monthly and will span from January 1999 to December 2009.

[36] According to the weight in MSCI World

The reason for this period is the introduction of the euro in 1999. All the returns have been converted into Danish kroner. The returns are gross numbers, which indicates that they include dividend payments and reinvestments of these.

4.2.1 Proportion Invested in the Market Portfolio

This section will analyze the optimal proportion to be invested in the market portfolio and the Danish market respectively. The result of this analysis will show if the optimal allocation is close to that predicted by modern portfolio theory, meaning the Danish share should be approximately 0,41%. As a proxy for the market portfolio I have used the MSCI world index. Unfortunately it is not provided excluding the Danish market. But with the Danish market accounting for only 0,41% of MSCI world this is not expected to have any significant effect on the result of the analysis.

Figure 4.1

Proportion invested in the Market portfolio
Monthly returns in DKK, 1999 - 2009

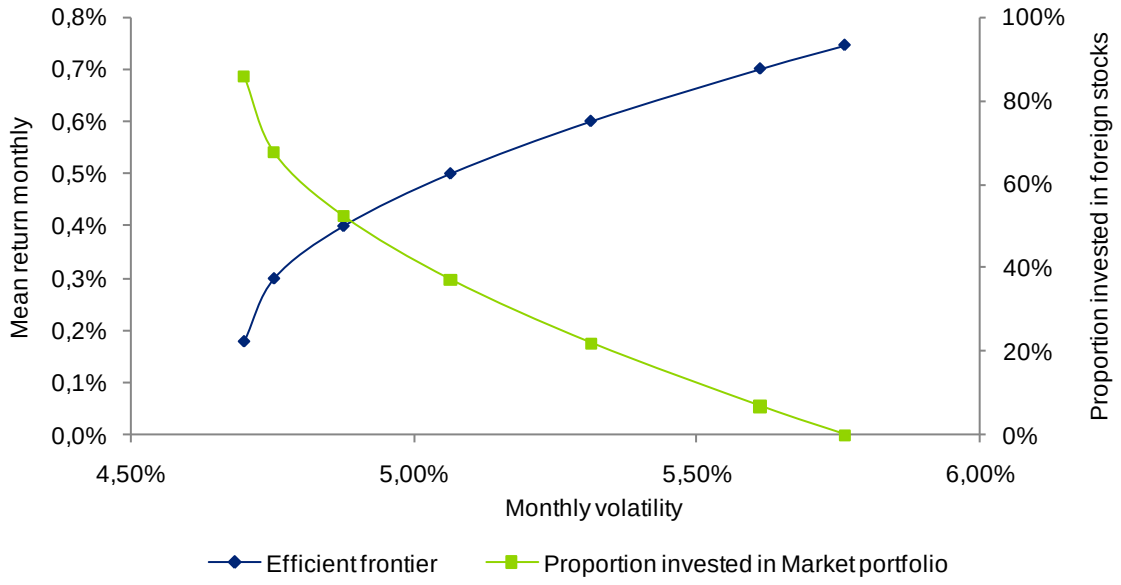


Figure 4.1 shows the efficient frontier obtained by investing in MSCI World and MSCI Denmark (blue line). The green line shows the corresponding proportion invested in the market portfolio (measured on the second y-axis). Source: MSCI and own contribution

Figure 4.1 shows the optimal proportion to invest in the market portfolio. The actual proportion depends, as mentioned, by the risk tolerance of the individual pension fund. The blue line shows the efficient frontier equivalent to the optimal interval. The green line shows the holdings of foreign stocks that make up the efficient frontier. The optimal interval to invest in the market portfolio through the eleven year period from 1999 to 2009 has been

between 0 and 85,6%. This would mean that the least risk averse pension funds could have defended an investments of 100% in Danish stocks. This is a very large interval, and it indicates that a share much larger than advocated by the regular market portfolio has been optimal to invest in the Danish market.

4.2.2 Investments in Individual Markets

The problem with the previous analysis is the inability to deviate from the investment proportions dictated by the market portfolio. Especially in the pension sector active management is assumed to be performed by the fund managers. For this reason I will investigate the efficient frontier by allowing investments in individual markets different from the shares in the market portfolio.

I will allow investments on the markets that the largest Danish pension fund Danica pension is currently operating on. Through the disclosure of their stock investments[37] I have found that Danica is active in 41 countries including Denmark[38]. The reason to investigate this investment universe is of interest and necessity. It is interesting to investigate the optimal interval in an investment universe comparable to the one acted on by the largest Danish pension fund. Secondly the 41 markets are almost the only ones where the historical data goes back until 1999. I have put some restrictions on how much can be invested in the individual market. Some might argue that this limits the usefulness of the analysis, but the reason for the restrictions is to enhance the usefulness of the results. It would not be realistic to defend a situation where 50% is invested in the Indian stock market and 50% in the Swedish. Therefore I have made restrictions for each market based on their weight in the market portfolio. The restrictions are illustrated in appendix A.

[37] DanicaKapitalandele 2009
[38] The countries are listed in appendix A.

Figure 4.2

Proportion invested in foreign stocks
Monthly returns in DKK, 1999 - 2009

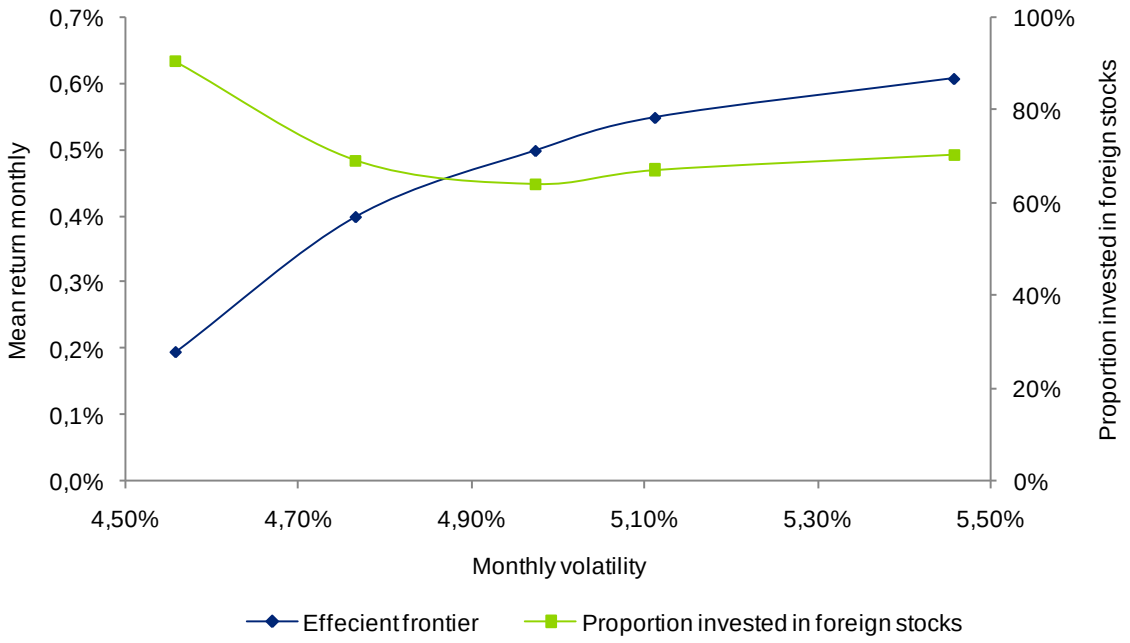


Figure 4.2 shows the efficient frontier obtained by investing in foreign stocks and MSCI Denmark (blue line). The green line shows the corresponding proportion invested in foreign stocks (measured on the second y-axis). Source: MSCI and own contribution

Figure 4.2 shows a completely different picture than figure 4.1. Suddenly there is no risk-level in which it is optimal to invest a 100% in the Danish market. The optimal proportion invested in foreign stocks are between 64% and 90,6%. This is, however, still far more than the 0,41% predicted by the market portfolio. It should be noted that the minimum variance portfolio is obtained by investing 90,6% in foreign stocks. Thus the variance is for the most part decreasing with an increase in foreign investments.

This optimal portfolio is, however, only applicable if the investment horizon of the investor is eleven years. Although pension funds are usually expected to have long investment horizons, because of the nature of their liabilities, it is often seen that the horizon of their stock investments is only five years[39]. For this reason I have also analyzed the efficient frontier for a five year period. I have again used the monthly returns in the period from 1999 to 2009. But to get more than two periods I have made overlapping periods as applied by Eun and Resnick (1994).

[39] E. Phillip Davis and Benn Steil, *Institutional Investors*, MIT Press 2001

Figure 4.3

Proportion invested in foreign stocks (5-year period)
Monthly returns in DKK, 1999 – 2009

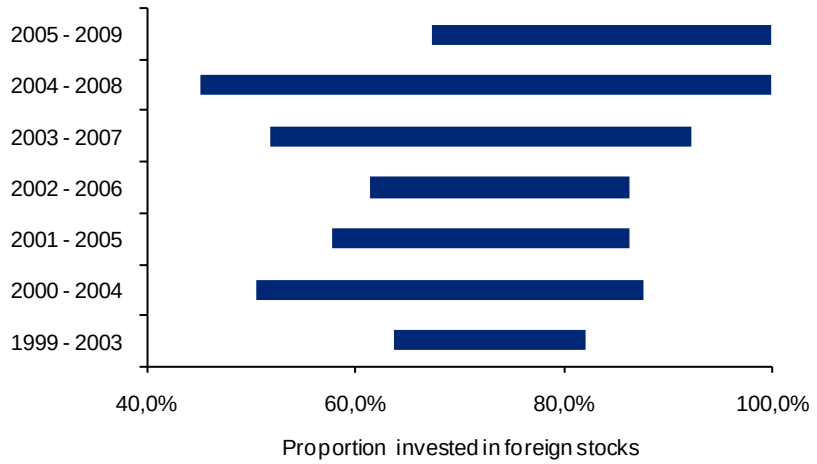


Figure 4.3 shows the optimal proportions of foreign stocks for the 7 overlapping 5-year periods from 1999 – 2009. The intervals correspond to the efficient frontier of each period. Source: MSCI and own contribution

Figure 4.3 shows the optimal interval for the different 5-year periods. The interval has been determined in a similar matter as with the previous analysis. For each period I have estimated the efficient frontier. I have then determined the maximum and minimum proportions invested in foreign assets in a portfolio on the efficient frontier. This means that no portfolio on the efficient frontier has less or more foreign stocks than illustrated by the intervals in figure 4.3.

What the figure shows is an optimal interval that changes significantly through the analyzed period. This is not surprising as the returns of the individual indices changes a lot over time and is very determining for the interval. Like Eun and Resnick (1994) I will take the average of the results to determine the optimal interval. This way I find an optimal interval that span from 56,9% to 90,7%. This interval is very similar to the one determined earlier in upper bound with 90,6% and 90,7% respectively, but deviates a bit on the lower bound at 64% and 56,9% respectively.

4.2.3 Investing in the Whole World

The investing universe of Danica does not include all markets. The question is whether this exclusion affects the optimal interval greatly. For this reason I have performed an analysis that includes all markets provided by MSCI that have historical returns of the necessary

length. The period analyzed is from 2005 to 2009. The markets providing historical returns for this period add up to 55 markets. This increases the investment universe by 14 markets compared to the previous analysis. The following figure compares the results with the result for the same period in section 4.2.2.

Figure 4.4

Proportion invested in foreign stocks
Monthly returns in DKK, 2005 – 2009

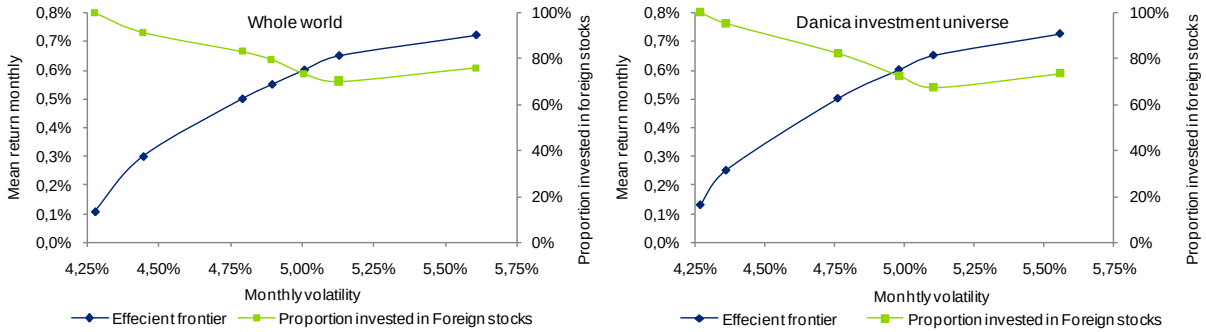


Figure 4.4 shows efficient frontier obtainable by investing in all markets and the efficient frontier obtainable when investing in the 41 markets of the Danica investment universe.Source: MSCI and own contribution

The figure shows a very similar result. The interval invested is not surprisingly a little greater when increasing the investment universe. The lowest proportion invested in foreign stocks is 70% for the greater investment universe compared to 67,5% for the investment universe that Danica maneuvers in. The maximum proportion invested in foreign stocks is 100% for both scenarios. The result of the analysis is therefore that the upper bound of the optimal proportion of foreign stocks is unchanged whereas the lower bound is 3,7% higher.

4.3 The Optimal Interval

Through four analyses I have investigated the optimal proportion in which to invest in foreign stocks through the period 1999 - 2009. The first analysis, that only made it possible to invest in the Danish market and the market portfolio, resulted in an optimal interval of up to 85,6% foreign stocks for the portfolio with the least risk. But the result also supported a position of 100% Danish stocks for the least risk averse investor. I have chosen to disregard the result of this analysis and instead concentrate on the results of the remaining three analyses. The reason for this is the large interval along with the upper bound of 100% Danish stocks. This result seems as an unrealistic optimal interval.

The second analysis made it possible to invest in multiple countries. The chosen countries are the ones invested in by Danica pension. The invested proportions were allowed to deviate from the market portfolio, although with some restrictions. The optimal interval for the whole period from 1999 to 2009 was 64% to 90,6%.

The second analyses analyzed sub periods of 5 years, also for the period 1999 to 2009. The 5-year periods were overlapping so in total there were 7 different intervals. To get an optimal interval the simple average was applied. This resulted in an optimal interval between 56,9% and 90,7%.

The final analysis showed that by adding further countries to the investment universe the lower proportion that is optimal to invest in foreign stocks increased. For the period of analysis this increase was from 67,5% to 70%. This is an increase of 3,7%.

As optimal upper bound for the optimal interval the obvious choice is 90,7%. This result was the same for both the second and third analysis and the fourth analysis including 55 markets did not support an increasing upper bound. The lower bound did deviate a bit, however. If the total period of historical returns was a hundred years instead of eleven it would have been possible to do different sanity checks, but unfortunately this is not possible. To minimize the flaw I will take the simple mean of the second and third analyses. This gives a lower optimal proportion of (59,6 + 64)/2 = 60,45%. I further adjust this by the 3,7% that the lower bound increased with by adding further markets to the investment universe. Finally I end up with an optimal proportion of foreign stocks between 62,7% and 90,7%. This means that the optimal Danish proportion is between 9,3% and 37,3%. Table 4.1 summarizes the findings.

Table 4.1

Optimal intervals

Analysis	Interval	
	Lower bound	upper bound
1st analysis*	0%	85,6%
2nd analysis	64%	90,6%
3rd analysis	56,9%	90,7%
4th analysis**	Increase of 3,7%	No change
Final interval***	0%	85,6%

*Not included in the determination of the final interval

**The factors are relative to the optimal interval for the similar time period of the Danica investment universe

*** Found by averaging the 2nd and 3rd analysis and adjusting by the factors of the fourth analysis

Source: Own contribution

4.4 The effect of human capital

In chapter 2 I mentioned how human capital can have an effect on the asset allocation of an investor. I touched upon the analysis by Marianne Baxter and Urban J. Jermann (1997), which found human capital to be highly correlated with domestic stock returns. In this section I will investigate how the inclusion of human capital will affect the optimal interval. I will apply the factors found by the authors in the analysis of the optimal interval. The assumptions of the analysis will therefore be that human capital will amount to 60% of the portfolio. This is the number that the authors find as the mean capitalization of human capital in an average portfolio. The correlation between the return of the Danish market and human capital will be set to 0,78 whereas the correlation between human capital and the remanding markets will be set to 0,2 for each market. This is the values found by the authors for the German market. By applying these factors into the model I get the result that at no risk-level will it be optimal to invest less than 100% in foreign stocks. This result is similar to the result reached by the authors. In their result the domestic market are actually being shortened, but as mentioned this is not allowed in the model of this thesis. This is a very interesting result as this indicates that all Danish pension funds are home biased.

When the result of this analysis is disregarded in the remainder of the thesis, it is because I do not see it as plausible that the pension funds and other institutional investors for that matter consider human capital when they are investing. Therefore it is not interesting to compare the holdings of Danish pension funds to the optimal interval including human capital as the explanations of home bias will have difficulties explaining the large home bias that every

Danish pension funds displays. The optimal interval found earlier seems therefore more applicable for the analysis of this thesis.

Secondly not all researchers find that human capital is important. Fama and Schwert (1977) find weak correlation between marketable assets and human capital concluding that a simple model produces as good a result as the model including human capital[40].

Finally many Danish companies are multinationals and can therefore be expected to be heavily exposed by international markets. If the international markets on average influence the Danish labor market more than the Danish market it would not be possible to hedge risk of human capital by decreasing the proportion invested in Danish stocks.

4.5 The Danish bond market

The high liquidity and efficiency of the Danish bond market is of great importance for the Danish pension funds and the optimal interval. Opposite the small Danish stock market, the size of the Danish bond market makes is possible for Danish pension funds to almost entirely rely on Danish bonds when constructing their bond portfolio. The effect of this is the funds' opportunity to act more freely when constructing the equity portfolio. If the Danish bond market instead was small and illiquid the funds had to seek investment opportunities abroad, thereby lowering the opportunity to create a well-diversified equity portfolio because the currency restrictions would be affected more heavily by bond investments. For this reason the bond market is of great importance for the optimal interval. When looking at the investments of a large number of funds it is observed that they are, in fact, investing heavily in the Danish bond market. Diversification is much more pronounced in equity investments than bond investments.

One might argue that foreign bond investments should be considered when establishing the optimal interval. The reason why foreign bond investments are not considered in this connection is because the bond investments and equity investments are most often considered

[40] Appendix B shows the return of MSCI Denmark regressed on income growth. For the analyzed 5-year period the relationship is insignificant, thus supporting the result of Fama and Schwert (1977).

separately[41]. This is also the reason why pension funds have separate departments for bond and equity investments.

4.6 Concluding Remarks

The purpose of this chapter was to question the usual method of defining equity home bias. Instead of just accepting that equity home bias is to invest more than the 0,41%[42]in the Danish market as advocated by the market portfolio I used the mean-variance framework to establish a historical interval in which it has been optimal to invest in foreign stocks. This interval is then assumed to be a picture of the future optimal interval and will therefore be used as a way of defining equity home bias in the Danish pension funds.

The optimal interval found was 62,7% to 90,7% in foreign stocks. The reason for the wideness of the interval is because I do not see it as feasible to define a level of risk aversion for the pension funds as a whole. The individual pension fund can for different reasons have a specific risk level for their equity investments. This also means that the optimal interval is the whole efficient frontier, where no portfolio is dominated by another.

The result of this chapter is a definition of when a Danish investor is equity home biased. This is the case if a fund is investing more than 37,3% in the Danish market. On the other hand a proportion invested in foreign stocks of more than 90,7% would indicate a foreign equity bias, which is just as suboptimal and therefore just as interesting as the home bias.

In this chapter I also considered the role that human capital and the Danish bond market play in the determination of the optimal interval. If the result of Marianne Baxter and Urban J. Jermann (1997) is considered correct the optimal interval does not include any investments into Danish stocks. Although the result of this is very interesting, the fact that it is not considered plausible that the pension funds consider the role of human capital when optimizing their portfolio, makes it more interesting to analyze the home bias in the context of the previous found interval of 62,7% to 90,7% foreign stocks.

[41] E. Phillip Davis and Benn Steil, Institutional Investors, MIT Press 2001
[42] According to the weight in MSCI World

The size and liquidity of the Danish bond market is actually making it possible for the pension funds to make a diversified equity portfolio. Because of the size and liquidity of the bond market, the funds can in a large part satisfy the needs for bonds by investments into the Danish bond market. Therefore the large Danish bond market is highly important for the optimal interval.

5 The Danish Pension System and How They Allocate its Stocks

Instead of having a section concentrating on how the Danish pension system works and describing all the different sorts of pension schemes and how they are administered, this section only concentrates on the aspects that are related to the equity home bias puzzle. Amongst the most important aspects are of course the stock allocations of the pension funds. An analysis of this will tell if equity home bias is actually a problem within the Danish pension sector or not.

5.1 The Pension Industry as a Whole

When looking at the pension funds' asset allocation it is interesting to look at the historical development to investigate how the development has been and how one might expect the stock allocation to develop in the future. For this reason, an analysis of the stock allocation for the pension industry as a whole has been conducted resulting in figure 5.1.

As can be seen from the figure the share of Danish stocks has been declining over the last many years going from 62% to 18%. This development can mainly be credited the integration of international markets, lowering transaction and information costs etc. making it more beneficial to invest abroad. But as I will show next, not all pension funds have moved to the same proportion of foreign investments.

From the figure it is also noticeable that the last 5 years the pension funds as a whole have been investing around 20% - 30% of their funds in Danish stocks. Believing in the optimal interval found in the previous chapter this does not come as a surprise as it is within the optimal proportion to invest in the Danish market. As such there does not seem to be home bias in the Danish pension sector as a whole, but as mentioned the shares differs a lot between companies.

Figure 5.1

Development in share of Danish and foreign stocks

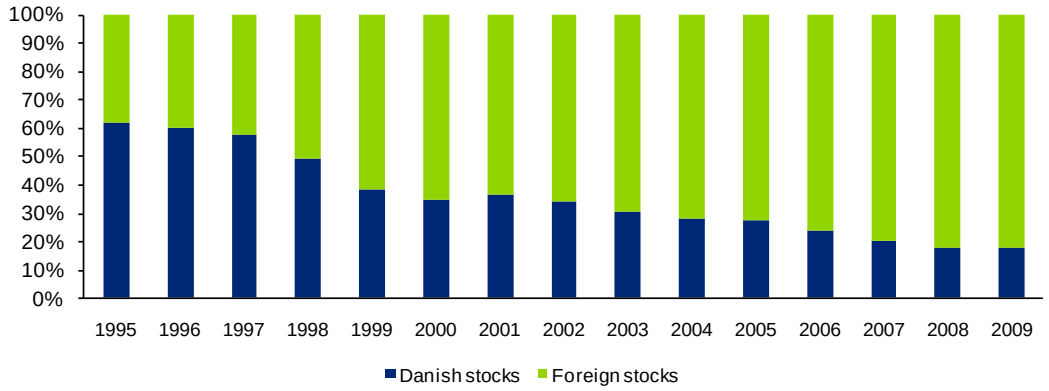


Figure 5.1 shows the proportion invested by all Danish Pension funds in Danish and foreign stocks respectively in the period from 1995 – 2009. Source: The Danish Financial Supervisory Authority

5.2 The Individual Pension Funds

Figure 5.2 illustrates the share of foreign stocks held by individual Danish pension funds. As mentioned earlier the shares vary a lot between the different funds ranging from 0% to 78%. It is interesting to see that there seems to be very large differences amongst the individual firms of the perceived optimal share in which to hold foreign stocks.

Figure 5.2

Share of Foreign stocks of individual pension funds (2009)

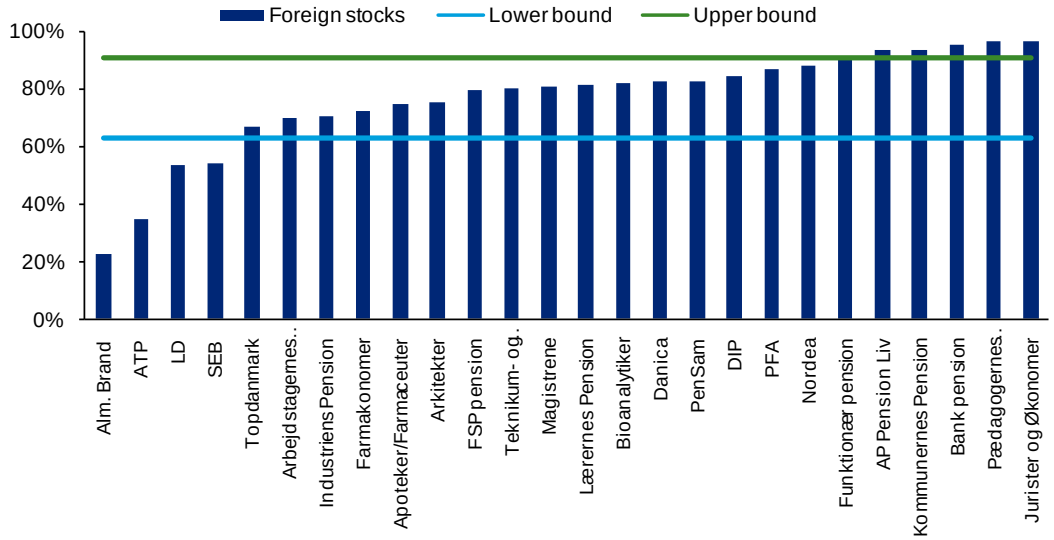


Figure 5.2 shows the proportion invested in foreign stocks by the individual pension funds in 2009. The blue and green line represents the lower and upper bound of the optimal interval found in chapter 4. Source: Annual reports and own contribution

5.2.1 Home Bias

Comparing the actual holdings of individual Danish pension funds with the optimal interval it is obvious that some companies show clear signs of home bias. But for the most part the funds are located within the optimal interval. There are four companies that hold less than 62,7% of foreign stocks as indicated by the blue line in figure 5.2. In the other end of the scale it should be noticed that five companies actually invest more in foreign stocks than found optimal.

In this context it would be interesting to touch upon one of the discussed explanations of home bias. As mentioned earlier the size of the pension funds has been shown to have an influence on the degree of home bias observed. For the most part this hypothesis draws on the larger funds having an increased incentive to explore the foreign markets as the fund size increases. The fund size is here represented by the amounts of premium that the individual pension fund has received in 2009. This is the measure used by the Danish Financial Supervisory Authority to compute the market share of each fund.

Figure 5.3
Relationship between foreign holdings and fund size

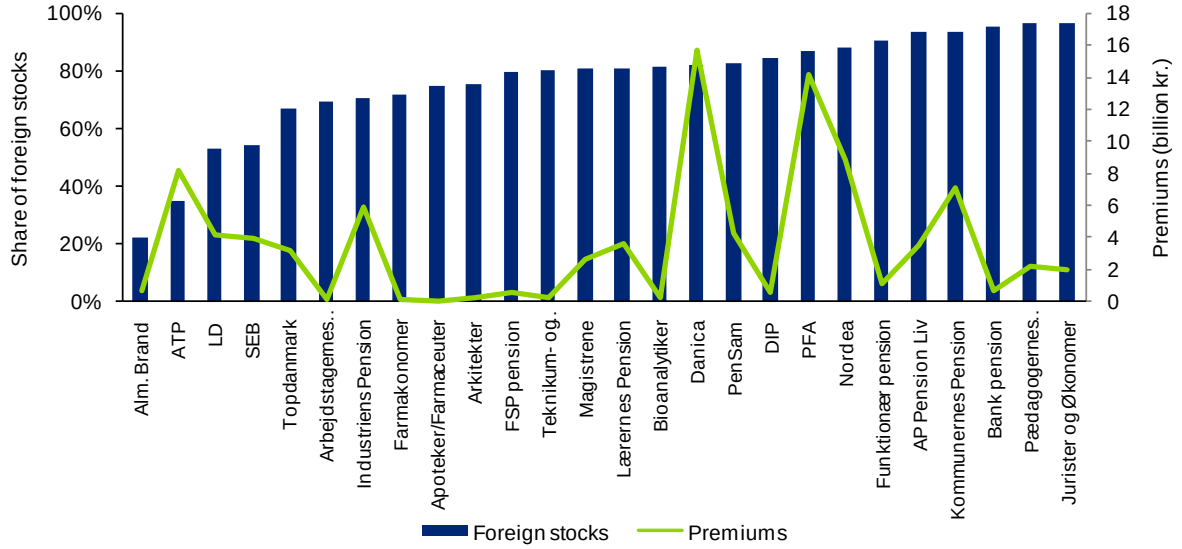


Figure 5.3 shows the size of the individual pension funds (represented by the premiums received by each fund in 2009) alongside the proportion invested in foreign stocks by the individual pension funds in 2009. Source: Annual reports and own contribution

When looking at figure 5.3 there does not seem to be a tendency of the market share increasing with the proportion invested into foreign stocks. The tendency seems rather

random instead. This is also the result when measuring the correlation between the size and foreign investments. The coefficient is 4%, which is very close to zero, which indicate no relationship. The result is, however, a little sensitive to changes in the data. The biggest change occurs if excluding ATP from the dataset. By doing this the correlation coefficient increases to 16%. Thus still low, but now indicating a slight relationship between the size and proportion of foreign stocks. The exclusion of other funds does not have nearly the same large effect as excluding ATP. It is hard to make any conclusions because of the small size of the dataset, but I still believe the data show little relationship between size and bias.

Another way of measuring fund size is to use the balance sheet of the company. Using the size of the balance sheet gives a slightly different result. At first it seems as if the relationship is negative with a correlation coefficient of negative 32, thus indicating that larger funds invest less in foreign stocks. But once again the result is heavily dependent on the inclusion of ATP. Excluding ATP yields the same result as the previous test with a correlation of 16%.

Another characteristic that differs among the different funds are the way in which they invest. Some funds use external portfolio managers whereas others invest themselves. Almost all the largest funds invest themselves. In case of the smaller funds it differs, but most of them use external managers. The characteristic of the home biased funds are that they all use internal managers to invest. For the five funds that are foreign biased three of them use external managers whereas the two others use internal managers. Although the smaller funds use external managers it is often the board of directors choosing the investment strategy of the fund, thus choosing which external managers to use and thereby still influencing the proportion of foreign stocks. It is therefore hard to conclude anything about the bias from the way the different funds invest, but it seems as though home bias is a choice made exclusively by the fund itself as they all mainly use internal managers[43]. An interesting observation is the fact that the small funds that invest through external managers invest such a big share in foreign investments. As discussed in chapter 3 there are rather larger costs involved in using external managers both explicit, but also implicit through agency cost. Thus the large foreign share of these funds is contradicting theory.

[43] Appendix C shows the output of Premiums, Balance and fund management characteristic regressed on foreign proportion and home bias respectively. The result supports the result found above. Thus either premiums or balance has any explanatory power, whereas the use of external managers actually increases foreign investments and lowers the opportunity of home bias.

5.3 Concluding remarks

This chapter focused on determining if any of the pension funds in my sample invest less than prescribed by the optimal interval and thereby is equity home biased. The analysis showed that 4 funds invest less than 62,7% in foreign stocks and according to this criteria are home biased. The analysis also showed that 5 funds are in fact investing more than 90,7% in foreign stocks and are therefore foreign biased in their equity investments.

One of the explanations of home bias from chapter 3 was analyzed in the context of the pension funds to see of it could explain the differences in the proportion invested in foreign stocks. The explanation analyzed was the size of the fund measured by the premiums received by the fund and the total value of its assets. The results were a little ambiguous depending on the data used. In the end the conclusion was that there does not seem to be any relationship between the size of the fund and the proportion of foreign stocks. This was also supported by the regression analysis shown in appendix B.

Another analyzed difference among the pension funds was whether the funds use internal or external investment managers. In contradiction of theory the home biased pension funds all use internal managers whereas a lot of the pension funds investing larger proportions in foreign equity, including 3 of the foreign biased funds, use external managers. Thus there seem to be a small relationship between fund manager characteristic and the proportion of foreign stocks held. This was also supported by the regression analysis shown in appendix C.

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6 Which Factors Can Explain The Home Bias of Danish Pension Funds?

6.1 Institutional Factors

6.1.1 Restrictions on Asset Allocation

When looking at the allocation of the individual pension funds in the last chapter the argument of restrictions being the reason for the observed home bias does not really seem plausible. It was shown that four companies is holding a proportion of foreign stocks smaller than advocated by the optimal interval but seventeen hold a proportion within the optimal interval and five funds even hold a larger proportion.

None the less I will look at the asset allocation of the companies showing home bias to see if restrictions can explain the bias. The following table illustrates the actual allocation of the home biased funds. It has been necessary to make some assumptions about three of the four funds because the relevant information about allocation is not disclosed. The asset allocation of ATP, Alm. Brand and SEB has therefore been approximated by taking the average of the funds that do disclose the information. I have also added a 5% extra to the foreign investments to make sure I do not underestimate them.

Table 6.1

Stock allocation in funds showing home bias

LD	Actual share	Restriction
Zone A stock investments etc.	21%	≤ 70%
Investments outside zone A	5%	≤ 10%

ATP	Actual share	Restriction
Zone A stock investments etc.	15%	≤ 70%
Investments outside zone A	5%	≤ 10%

Alm.Brand	Actual share	Restriction
EUR investments	18%	≤ 40%
Investments in Zone A countries	7%	≤ 20%
Investments outside zone A	5%	≤ 10%

SEB	Actual share	Restriction
EUR investments	24%	≤ 40%
Investments in Zone A countries	6%	≤ 20%
Investments outside zone A	5%	≤ 10%

Figure 6.1 shows the country investment allocation of the home biased funds alongside the restrictions of the funds.
Source: Annual reports and own contribution

As can be seen from the table all of the four pension funds have a long way to go before they reach the restriction-levels. In addition to this all four funds have relatively low levels of stocks relative to total assets, which mean that it would not be a problem to add enough foreign stocks to reach a proportion inside the optimal interval. The restrictions can therefore not explain the observed home bias of the four funds.

6.1.2 Information Asymmetry

As mentioned in section 3.2.1 information asymmetry is one of the most studied explanations of home bias. In this section I will use earlier research to analyze whether this is the reason why some Danish pension funds overweight the Danish market in their portfolio.

6.1.2.1 Pension Funds Mainly Invest in Well-known Stocks

In section 3.1.2 the analysis of Jun-Koo Fang and René M. Stulz was introduced, where they analyze foreign investors' holdings of Japanese companies. Here they find that investors mainly invest in big and well-known Japanese stocks.

I will try to explore whether this is the case for Danish funds by taking a similar, but still slightly different approach. In this analysis I define large well-known stocks as stocks registered on an exchange whereas the counterpart is unlisted stocks.

My hypothesis in relation to the results of Jun-Koo Fang and René M. Stulz is that the share of unlisted Danish stocks is greater as a proportion of total Danish stocks than the share of foreign unlisted stocks as a proportion of total foreign stocks. If the proportion of unlisted Danish stocks is systematically greater than the foreign counterpart this could indicate, that the Danish pension funds have better information about small Danish firms and is therefore more willing to invest in unlisted Danish than unlisted foreign stocks.

6.1.2.1.1 Methodology

The data used is simply the allocation of stocks listed in the annual report of the different pension funds. All pension funds list their stock investments into Danish listed, Danish unlisted, Foreign listed and foreign unlisted.

From here I simply divide the amount invested in unlisted stocks by the total amount invested in stocks. I hereby get the share invested in unlisted Danish and foreign stocks as a proportion of Danish and foreign stocks respectively. This gives me the opportunity to investigate whether there is a tendency to invest a bigger proportion in unlisted Danish stocks as opposed to unlisted foreign stocks.

Figure 6.1 shows the share of funds that invest more in unlisted Danish stocks and unlisted foreign stocks respectively (in the figure indicated by informational asymmetry home or foreign). There has not been discriminated on the amount that is invested in either Danish or foreign stocks but simply recorded whether the proportion invested in one is larger than the other.

The result of the analysis including all pension funds is illustrated in figure 6.1. I have registered when a fund invests a larger proportion in Danish unlisted stocks as well as in foreign stocks. The results show a little bias towards holding Danish unlisted stocks, but the results do not seem conclusive as it is not a large bias. In 2007 the result actually showed a bias towards foreign stocks and in 2008 the bias was neutral. The biggest difference was in

2009 when about 60% of the funds favored Danish stocks. Appendix D show the output of a regression analysis where the characteristic of investing more in Danish unlisted stocks is regressed on proportion of foreign stocks and home bias respectively. The results support the conclusion that this characteristic has no explanatory power about either the proportion of foreign stocks or home bias.

Figure 6.1

Investments in unlisted stocks (as proportion of total Danish and foreign stocks)

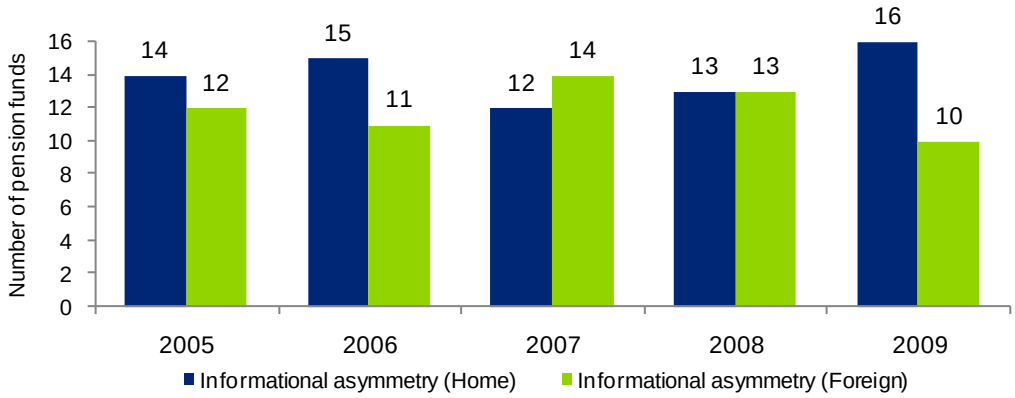

Figure 6.1 shows how many funds invest more in Danish unlisted stocks and foreign unlisted stocks respectively. E.g. 2005 14 funds invested more in unlisted Danish stocks as a proportion of total Danish stocks (indicating domestic informational advantage) relative to unlisted foreign stocks as a proportion of total foreign stocks (indicating foreign informational advantage). The same year 12 funds invested more in unlisted foreign stocks as a proportion of total foreign stocks relative to unlisted Danish stocks as a proportion of total Danish stocks. Source: Annual reports of Danish pension funds and own contribution

Figure 6.2 summarizes the findings of the allocation of unlisted stocks when analyzed on the companies that show bias. When looking at the home biased funds there seem to be a bias towards Danish unlisted stocks. The last three years only ATP has invested a larger proportion in unlisted foreign stocks. When looking at the foreign biased companies the result is more ambiguous. The last three years three funds have invested more in foreign unlisted stocks than Danish while two have been investing more in Danish stocks.

Figure 6.2

Investments in unlisted stocks, Home bias and foreign biased funds

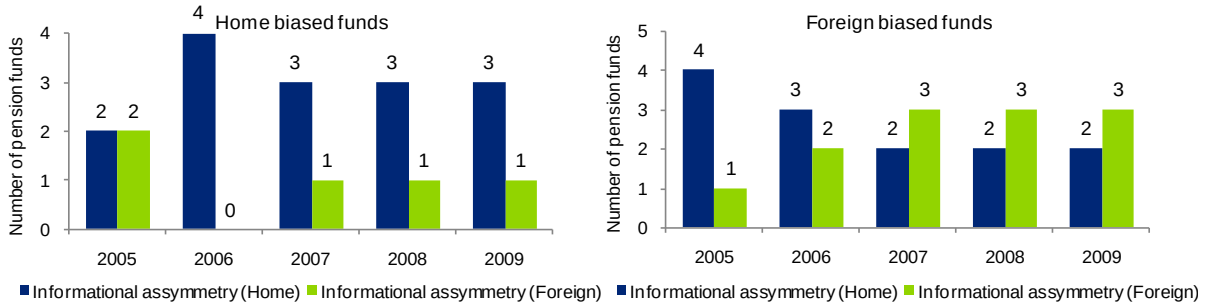

Figure 6.2 is identical to figure 6.1. The only difference is, that the analysis is only performed on biased funds. Home biased and foreign biased respectively. Source: Annual reports of Danish pension funds and own contribution

6.1.2.2 Superior Return

In chapter 3 I discussed some earlier work that empirically showed that informational asymmetry was a reason for home bias. Whether this is a perceived or obtained advantage is, however, a matter of big discussion. Some found a superior performance of local investors whereas others found none.

This section will explore the performance of Danish pension funds to investigate whether asymmetric information and thereby abnormal performance is actually a rational reason for overweighting the Danish market. In extension of this I will also try to look if there is any difference in performances between pension funds dependent on the proportion invested in Danish stocks. I would expect that with increasing proportions of Danish stocks the performance on these would also increase.

I will also look at how the Danish pension funds perform in their foreign investments. Although domestic informational advantage is a plausible reason for home bias, if the Danish pension funds are outperforming the Danish market, it is not a rationale explanation if they at the same time are outperforming the foreign benchmark by even more.

6.1.2.3 Return on Danish Stocks

When benchmarking the pension funds' Danish investments I benchmark it against the MSCI Denmark index. The reason is that the MSCI Denmark index contains investments in both listed and unlisted Danish stocks and because it was used in the determination of the optimal interval.

Figure 6.3 shows how the individual pension fund has performed on its Danish stock investments compared to the MSCI Denmark index. Unfortunately not all funds disclose data going further back than 2005. For this reason the means have been calculated on returns from 2005 - 2009. Although this is only a five year period, and a bigger dataset would be more reliable to base the analysis on, I assume that this five year period is representative for the relative performance of the Danish pension funds.

Figure 6.3

Pension fund performance benchmarked against MSCI Denmark

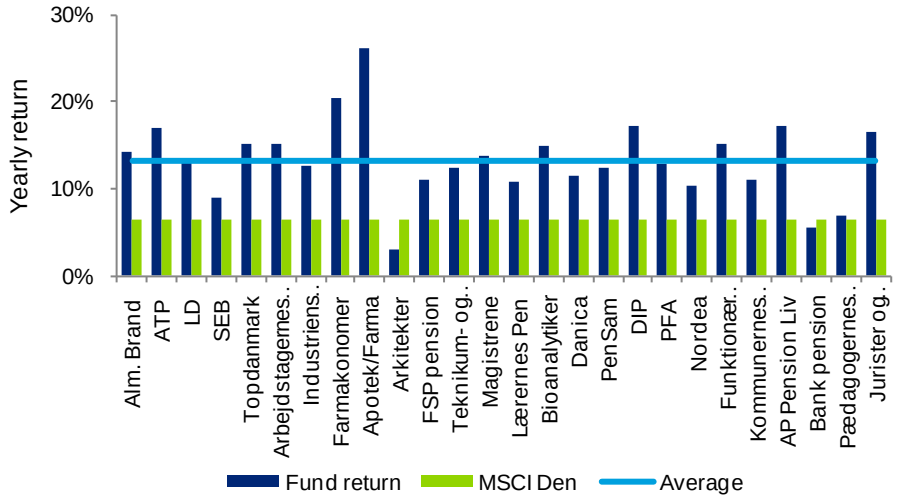

Figure 6.3 shows the individual yearly return of each pension fund on their Danish investments. The green line shows the return of the benchmark (MSCI Denmark). The blue line shows the average return of all pension funds. Source: Annual reports of Danish pension funds and own contribution

The return of the MSCI index is of course fixed, but the return of the individual pension funds vary a lot. The pension funds are arranged from the one with the lowest share of foreign stocks, which is Alm. Brand with only 22%, to the one with the most.

Before looking at the graphs, one might have expected a decreasing return going from the left to the right. The greater the Danish share the better performance might be expected as the explanation of the greater share. When looking at the performance there does not seem to be any relationship between the proportion invested in Danish stocks and the performance obtained by the individual pension funds. This is confirmed when regressing the performance

on Danish investments on the proportion of foreign stocks. The obtained coefficient is insignificant indicating no relationship[44].

When looking at the performance compared to the MSCI index all the individual pension funds outperform the index, except in two cases. The situation of almost all the pension funds outperforming the index is of course highly interesting and could indicate that almost all the pension funds has an informational advantage when investing in the domestic market. This is interesting as it might explain some of the home bias that is shown by the four pension funds. But just as interestingly is the fact that if almost all pension funds have an advantage why are not almost all funds home biased? When measured relative to their peers it turns out that three out of four funds that are home biased outperform the average fund.

One thing is the size of the returns on investments but looking at this isolated, without considering the risk that have been taken to obtain these returns, is not a sufficient way to analyze the performance. Therefore I have calculated the sharpe ratio of the individual funds. Negative sharpe ratios are omitted as they make no real sense. If for instance the return is negative the sharpe ratio will rise with an increasing volatility, meaning that the sharpe ratio will be less negative with an increasing volatility. This is the reason why the y-axis starts at zero.

Figure 6.4

Sharpe ratio on Danish investments

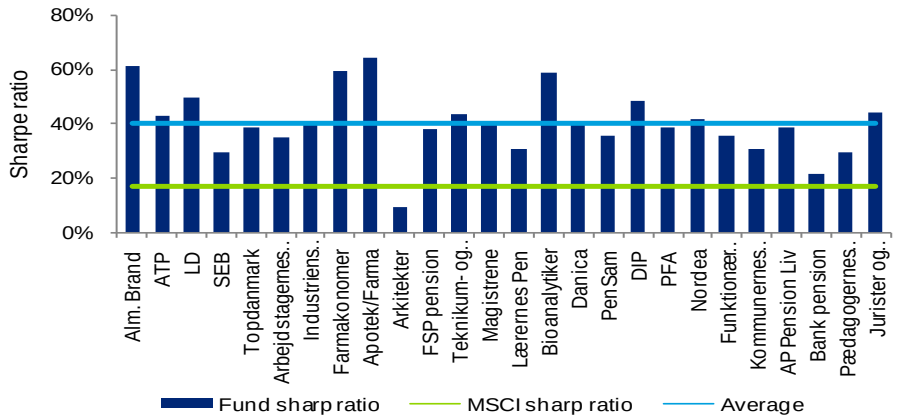

Figure 6.4 shows the individual yearly sharpe ratio of each pension fund on their Danish investments. The green line shows the sharpe ratio of the benchmark (MSCI Denmark). The blue line shows the average sharpe ratio of all pension funds. Source: Annual reports of Danish pension funds and own contribution

[44] See appendix E

When looking at figure 6.4 the results show the same picture as when analyzing the returns explicitly. There does not seem to be anything indicating that the funds perform better with increasing proportions of Danish stocks. Once again three of the home biased are performing better than the average. Thus indicating that the funds on average do no worse, but not that much better either. In the other end of the scale three out of five foreign biased funds are underperforming. This might indicate that they are not that strong on the Danish market which beforehand was to be expected.

When accounting for risk all the pension funds except Arkitekternes Pension outperform the benchmark. The fact that almost all the funds seem to outperform the index, when measured by the sharpe ratio, further contributes to the explanation of the home bias observed by some companies. But the result also make it more difficult to explain why some funds hold a small proportion of Danish stocks.

When looking at the individual pension funds isolated it does not seem as if the home biased funds outperform the average, but accumulating the results of the funds actually show another picture. Analyzed in this way the home biased funds are outperforming the average whereas the foreign biased funds are underperforming. This could indicate that home biased funds on average outperform their peers on Danish investments. The dataset is of course limited so the results can be due to coincidence, but it is an interesting result nonetheless.

Table 6.2

Accumulated performance by funds

	Home biased	Foreign biased	Average
Standard deviation	**30%**	**33%**	**33%**
Return	**13%**	**11%**	**13%**
Sharp ratio	**44%**	**35%**	**40%**

Table 6.2 shows the accumulated average on standard deviation, return and sharp ratio of the home biased, foreign biased and average funds. Source: Annual reports and own contribution

To summarize, the Danish pension funds have been performing very well on their Danish investments for the last five years when measured against MSCI Denmark. When measured by the whole period of five years all funds, except for two, outperform the benchmark on performance explicitly and only one when accounting for risk.

This result adds to the belief that informational advantage might be a reason for the observed home bias of four of the twenty-six analyzed pension funds. It raises the question of why other pension funds hold such a small proportion of Danish stocks. In an earlier section the optimal interval of foreign stocks between 62,7% - 90,7% was established. When considering the results in this section a smaller proportion of foreign stocks would be expected in the optimal portfolio, thus making it hard to understand why some pension funds hold as much as 100% of foreign stocks.

It is hard to draw conclusions on the relative performance amongst funds. Although three out of four home biased funds perform better than the average and the accumulated performance indicates a better performance, the better performance is not consistent across decreasing proportions of Danish stocks. Therefore this section indicates why there is home bias, but the relative performance between funds does not really help explaining the large difference in holdings between funds.

6.1.2.4 Return on Foreign Stocks

Establishing that the pension funds are outperforming the Danish benchmark added to the belief of informational advantage on domestic stocks. But this does not conclude that it is in fact a reason for rationale home bias.

If the Danish pension funds are also outperforming on their foreign investments this could mean that the outperformance on Danish stocks are not enough to justify a larger holding of Danish stocks than prescribed by the optimal interval. If in fact the pension funds are outperforming relatively more on foreign investments this could be an explanation of why some pension funds hold such a small proportion of Danish stocks. In this analysis I will benchmark the foreign investments against the market portfolio. But the market portfolio is not defined by MSCI world but instead the optimal foreign portfolio found when establishing the optimal interval. The reason for this is because the optimal interval was established by using this portfolio and not the MSCI world. Therefore the performance of the funds have to be benchmarked against this portfolio to see if superior performance compared to this portfolio can justify a greater proportion than predicted by the optimal interval. As was shown in chapter 4 about the optimal interval the optimal portfolio depended on the risk

tolerance of the individual pension fund. Because this is primarily an analysis of home bias I will use the minimum variance portfolio as benchmark. Because the minimum variance portfolio has the lowest performance and sharpe ratio on the efficient frontier the result will be, that the pension funds will more easily outperform the benchmark. But if the Danish pension funds still outperform more on their Danish investments this would be a very strong result, namely because the foreign investments was benchmarked in a favorable way.

Before analyzing the data I once again expect the performance of foreign investments to be increasing in the proportion held by the individual pension fund.

Figure 6.5
Pension fund performance against market portfolio

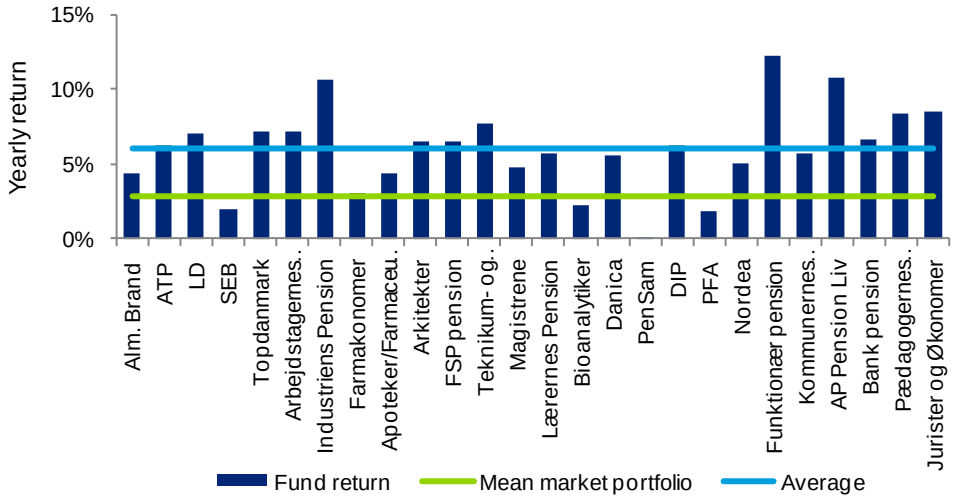

Figure 6.5 shows the individual yearly return of each pension fund on their foreign investments. The green line shows the return of the benchmark (Minimum variance portfolio found in chapter 4). The blue line shows the average return of all pension funds. Source: Annual reports of Danish pension funds and own contribution

What is observed when looking at figure 6.5 is that all but four funds outperforming the market portfolio. This result is as good, however not as good as for the Danish investment where only two funds underperformed the benchmark. Looking at the relative performance between funds the results indicate that the funds with large proportions of foreign stocks are performing well. Four out of five are performing better than the average fund. However, when regressing the performance on foreign stocks on the proportions of foreign stocks, their does not seem to be any relationship.[45]

[45] See appendix E

Figure 6.6
Sharpe ratio of foreign investments

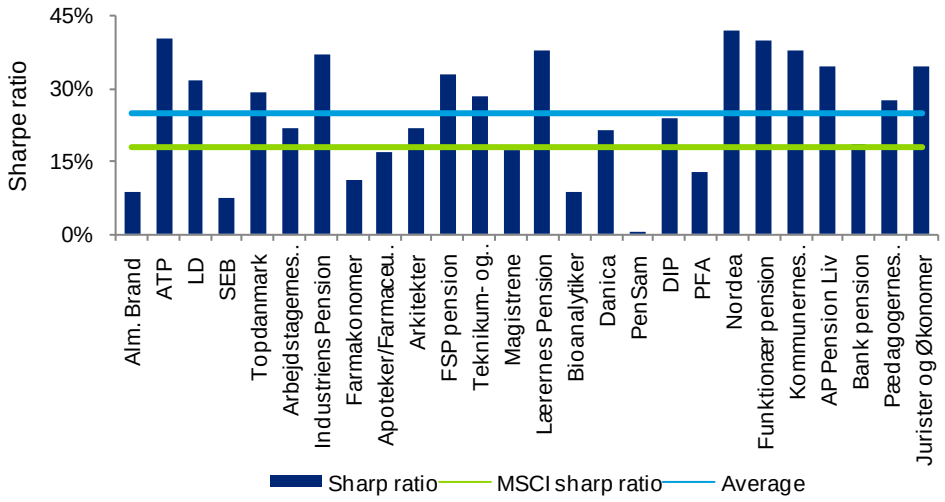

Figure 6.6 shows the individual yearly sharpe ratio of each pension fund on their foreign investments. The green line shows the sharpe ratio of the benchmark (Minimum variance portfolio found in chapter 4). The blue line shows the average sharpe ratio of all pension funds. Source: Annual reports of Danish pension funds and own contribution

Looking at the sharpe ratio illustrated by figure 6.6 the results change somewhat compared to the former result. Now eight funds perform worse than the market. This further indicates that the performance on Danish investments is better than on foreign investments of many funds. When looking at the relative performance of funds it can be observed that there is still four foreign biased funds performing better than the average, though it is not the same four funds a before.

Accumulating the performance of funds shows the foreign biased funds outperforming both the average and home biased funds when measured by the sharpe ratio. At the same time the home biased funds are underperforming the average on all parameters. This could help explaining the large difference in holdings by the funds.

Table 6.3
Accumulated performance by funds

	Home biased	Foreign biased	Average
Standard deviation	**29%**	**27%**	**25%**
Return	**5%**	**8%**	**6%**
Sharpe ratio	**17%**	**29%**	**24%**

Table 6.3 shows the accumulated average on standard deviation, return and sharp ratio of the home biased, foreign biased and average funds. Source: Annual reports and own contribution

The performance of foreign investments is not as good as the Danish investments relative to their relative benchmark. Eight funds underperformed the market on foreign investments measured by sharpe ratio, this was only one in the case of Danish investments. On average the pension funds are, however, still outperforming the market. Although it seems as the funds are performing better on their Danish investments it is not yet possible to conclude on this matter.

6.1.2.5 Danish or Foreign Stocks

To establish whether the superior performance on the Danish investments is a plausible reason for the home bias observed I will analyze the obtained returns of the Danish investments relative to the foreign investments.

The most obvious way to evaluate the performance is to simply compare the returns. In figure 6.7 this has been done.

Figure 6.7

Pension fund performance of Danish and foreign investments

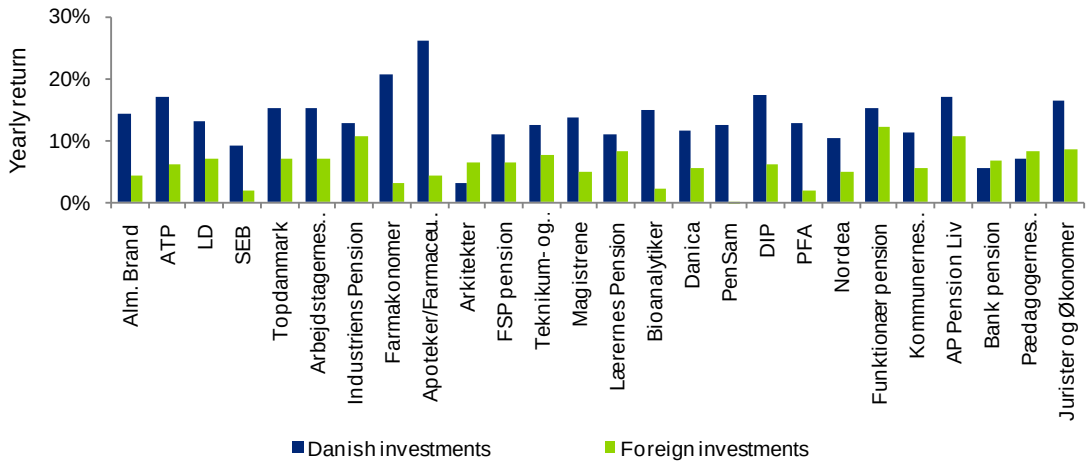

Figure 6.8 shows the individual yearly returns of each pension fund on their Danish and foreign investments respectively. Source: Annual reports of Danish pension funds and own contribution

From the figure it is obvious that the returns on Danish investments are dominating the ones obtained by the foreign investments for almost all funds. All of the pension funds showing home bias are performing better on their Danish investments than on their foreign investments.

Figure 6.8
Sharpe ratio

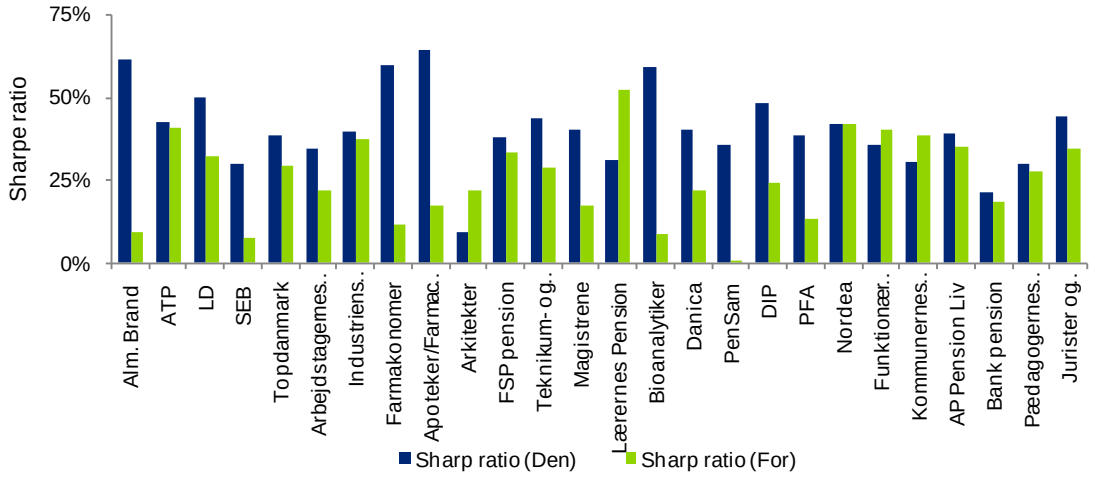

Figure 6.8 shows the individual yearly sharpe ratio of each pension fund on their Danish and foreign investments respectively. Source: Annual reports of Danish pension funds and own contribution

Looking at the sharpe ratios the picture is the same as the one for absolute performance, although more funds now obtain a better result on their foreign investments than on Danish investments.

Accumulating the performance show that both the home biased and the foreign biased funds obtain better performance on their Danish investments when measured by the sharpe ratio. It should though be noticed that the performance measured by standard deviation favors the foreign investments. Another interesting feature is the fact that the difference in sharpe ratio is much smaller for the investments of foreign biased funds than for home biased funds. This is because of better performance of foreign investments and at the same time worse performance on the Danish investments.

Table 6.4
Accumulated performance by funds

	Home biased funds		Foreign biased funds	
	Danish	Foreign	Danish	Foreign
Standard deviation	**30%**	**29%**	**33%**	**27%**
Return	**13%**	**5%**	**11%**	**8%**
Sharp ratio	**44%**	**17%**	**34%**	**29%**

Table 6.4 shows the accumulated average on standard deviation, return and sharp ratio of the home biased and foreign biased funds on their Danish and foreign investments respectively. Source: Annual reports and own contribution

With these results in mind the obvious reasoning would be, that informational advantage and thereby superior performance on domestic investments can explain, if not all, then some of the observed home bias that some pension funds show. At the same time it raises the question of why other pension funds are biased towards foreign investments when they are performing much better on their Danish holdings.

But it is not enough just to look at the Danish and foreign investments isolated without looking at the market they have been obtained on. One would at least hope to obtain the same sharpe ratio on ones investments compared to the benchmark. Therefore I will analyze the relative performance of the funds' Danish investments and foreign investments compared to their individual benchmark. The one performing best measured by sharpe ratio compared to the benchmark will be the best performing investment. This outperformance of either investment would be an explanation of an overweighting of that investment.

Figure 6.9

Performance relative to benchmark (Sharpe ratio)

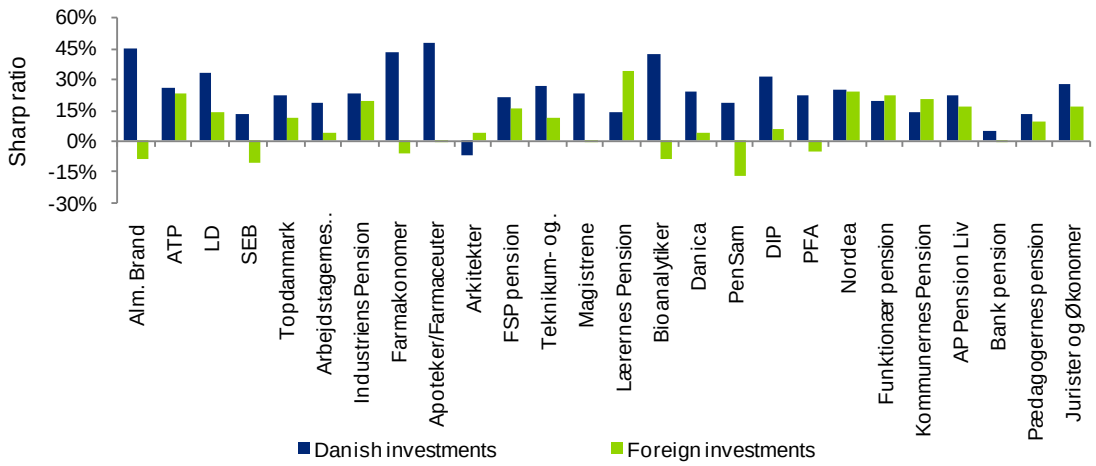

Figure 6.10 shows the individual yearly sharpe ratio relative to the corresponding benchmark of each pension fund on their Danish and foreign investments respectively. The 45% obtained by Alm. Brand on its Danish investments in found by withdrawing the sharp ratio of the benchmark (MSCI Denmark) from the sharp ratio obtained from their Danish investments. Source: Annual reports of Danish pension funds and own contribution

Looking at figure 6.9 it is obvious that almost all funds are performing better on their Danish investments relative to their foreign investments. There are only three funds performing better on their foreign investments, whereof one is foreign biased. As mentioned the foreign investments was actually given an advantage, because the benchmark was the minimum

variance portfolio that has a low sharpe ratio compared to other portfolios on the efficient frontier. I therefore consider these results very robust.

Because of the results above I see relative performance of Danish investments as a good explanation of home bias. These results are further supported by the fact that all but one fund also outperforms the benchmark on Danish investments, looking at the performance on Danish investments explicitly. The results do, however, raises the question as to why other pension funds hold such small proportions of Danish stocks.

6.1.3 Hedge Against Inflation

As mentioned in chapter 3 a reason for overweighting Danish stocks could be the means of hedging inflation risk. This is an interesting aspect when analyzing pension funds as they seek to adjust their assets to match the development of their liabilities (asset liability management). For inflation hedging to be a valid reason for overweighting Danish stocks there has to be a strong enough correlation between inflation and the Danish stock index to obtain a hedging effect. Along with this the Danish stock market has to be a better hedge than foreign markets. If this is not the case inflation hedging would instead be a reason for holding less Danish stocks as better hedging benefits could be obtained by investing abroad.

The methodology of this analysis has been to analyze the correlation between the monthly returns of the individual stock markets and the Danish consumer price index. This is the same methodology as used by Ian Cooper and Evi Kaplanis (1994). The data for the Danish consumer price index have been obtained through statistics Denmark[46]. Figure 6.10 shows the correlation of the price index and the individual stock markets.

[46] www.dst.dk

Figure 6.10

Correlation between stock markets and Danish inflation
Data period 1999 – 2009

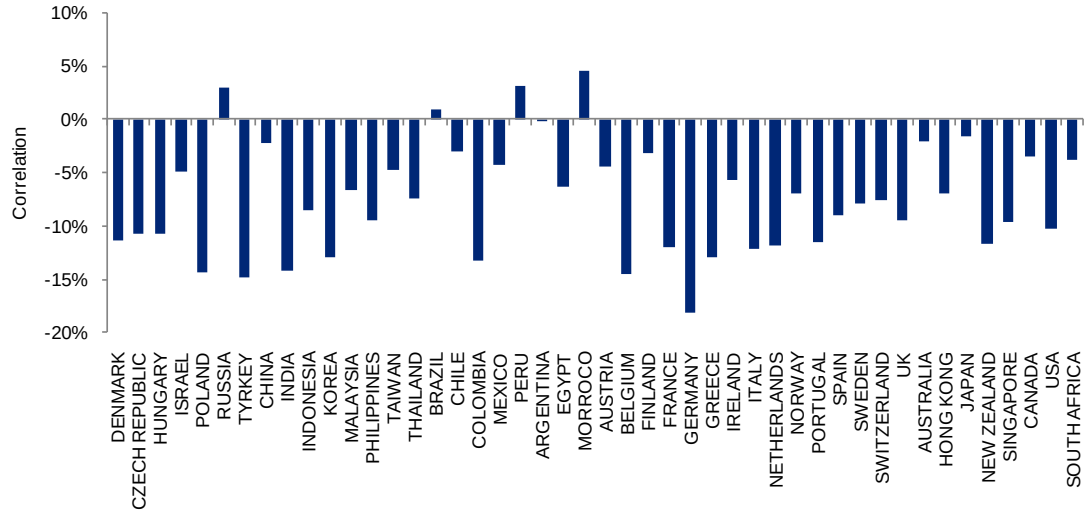

Figure 6.10 shows the correlation between Danish inflation and selected international markets. Source: Statistics Denmark, MSCI and own contribution

From figure 6.10 it can be seen that almost none of the markets move together with inflation. Almost every market seem to move in the opposite direction. The coefficients are for the most part very low and close to zero, meaning no real realtionship between inflation and market return. This is in accordance with earlier research by Ian Cooper and Evi Kaplanis (1994) which also finds insignigicant relationships between inflation and market return[47]. The correlation with the Danish stock market is approximately negative 0,1. If inflation hedging is a reason for the overweigting of Danish stocks the data surtainly does not support it. Inflation hedging is therefore rejected as a plausible reason for the observed home bias.

6.1.4 Investing in Multinational Companies

I believe this is a very interesting and quite important reason for the observed home Bias. Studies show different results within this area. As mentioned in chapter 3 there are studies showing significant diversification benefits by investing in multinational companies (MNC´s)[48], while others conclude that domestic MNC´s do not provide any diversification benefits, but that the price of these are mainly affected by the market they are listed on.[49] The

[47] Home Bias in equity portfolios, Ian Cooper and Evi Kaplanis, Advisors guide to international financial research, 2000 p. 24
[48] Fang Cai and Francis E. Warnock, International diversification at home and abroad
[49] Griffin, J., 2002. Are the Fama and French factors global or country specific? Review of Financial Studies, 15(3):783-803.

conclusion by Fang Cai and Francis E. Warnock was that while the returns of MNC´s were driven mainly by the domestic market the significance of the international market as an explanatory factor was increasing in the share of foreign sales that the company has. The more dependent the company was of the foreign markets the more the price was influenced by it and the bigger diversification benefit it provided.

Unfortunately it is not possible to do the same analysis as Fang Cai and Francis E. Warnock on the Danish market because the data is just not adequate. But I am certain that the result of such an analysis if possible would provide the same interesting results as found by the two authors.

If I look at the listed Danish stock investments of LD, which is one of the home biased funds, I find that almost 50% of their listed Danish stock investments are placed in five companies: Novo Nordisk, Danisco, Vestas, DSV and Maersk. All of these companies have, by far, the largest share of their sales overseas and the Danish market accounts for a very little share of their total sales. In general almost every large Danish company gains most of its sales outside Denmark. Some argues in the context of the study by Fang Cai and Francis E. Warnock that some of the foreign companies also have a big exposure towards the American market and thereby this should be accounted for in the home bias with a negative sign. This should not be a significant issue in the case of Danish pension funds as the Danish market is not of great importance to international companies like the US market is.

I see it as highly possible that Danish investors are able to gain international diversification by investing in Danish MNC´s where the Danish contribution to the total sale is very limited. I further believe that Danish MNC´s are more exposed to international markets relative to the Danish market than American MNC´s are relative to the US market because of relative importance of the home market. I therefore believe that when accounting for Danish MNC´s in the portfolios of Danish pension funds the exposure towards international markets will increase and the home bias will decrease[50].

[50] http://www.oem.dk/sw5435.asp?usepf=true "De store virksomheder bliver allerede i dag handlet og prisfastsat af udenlandske investorer. Det er de helt store virksomheder, såsom A.P. Møller, Tele Danmark, Novo, Danske Bank etc., der udgør over 60 pct. af den samlede markedsværdi af danske virksomheder noteret på Fondsbørsen."

6.1.5 Currency Risk

As mentioned in chapter 3 currency risk can account for up to 30% of the risk of foreign stock investments. Therefore investors should think into hedging these risks to get a more stable cash flow from their investments. If purchasing power parity (PPP) holds the currency risk would not be a problem as the currency fluctuations would just adjust for the inflation differentials between countries. But although PPP has been shown to hold in the long run even pension fund investments that stretch over a period of up to 20-30 years is not enough time for PPP to hold. For this reason this section explores how the optimal proportion invested in foreign stocks would look like if the funds could make a perfect hedge. There will also be a scenario where hedging costs will be applied to see how this affects the optimal proportion of foreign stocks.

The analysis uses the investment universe of Danica pension, which was discussed in chapter 4, to illustrate how hedging will affect the optimal interval. The indices will be the same, but to proxy the hedging of the funds the returns are in local currencies as supposed to Danish kroner. This is of course a simplification of the situation but it will still give an idea of how the optimal interval will change. Figure 6.11 shows the foreign stocks holdings that make up the efficient frontier.

Figure 6.11

Holdings of foreign stocks for portfolios with and without hedging

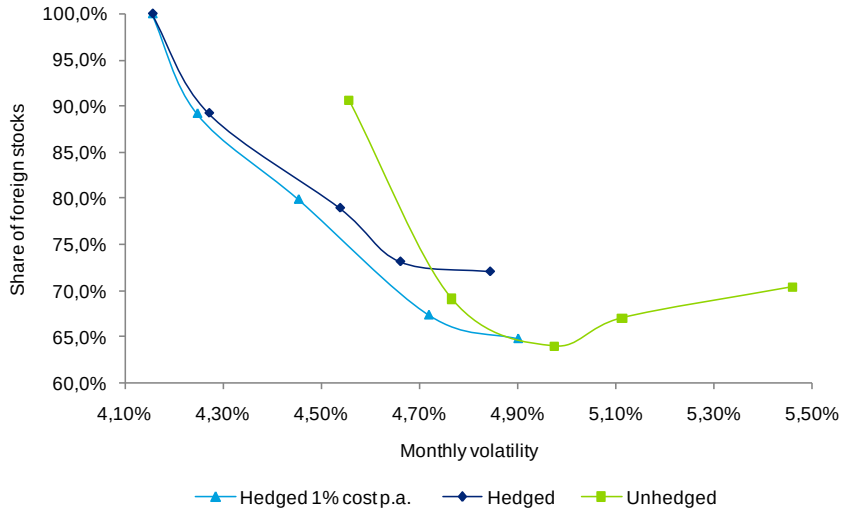

Figure 6.11 shows the optimal proportion to invest in foreign stocks in the case of an unhedged portfolio, hedged portfolio with no costs and a hedged portfolio with yearly costs of 1% on each foreign market. Source: MSCI and own contribution

From looking at the figure it is obvious that it is optimal for a very risk averse investor to put the total wealth in foreign stocks if the portfolio is hedged. But also the minimum proportion to invest in foreign stocks has increased significantly when hedging at no cost. So by hedging the currency fluctuations the optimal interval shifts upwards worsening the observed home bias of the Danish pension funds and introducing further three funds that are home biased. But it is not just as simple as explained above. The reason for this is the costs associated with hedging the investments. By introducing a cost of 1% p.a. on foreign investments the minimum holding of foreign stocks decreases again. This is not a surprise as the cost on foreign investments will make the Danish investments more favorable. It should be noticed that the optimal maximum holding of foreign stocks are the same as it does not depend on returns. It should be mentioned that there are gains to obtain by hedging even when introducing the 1% cost compared to the scenario where no hedging is applied.

Hedging currency fluctuations can be used in the explanation of why we observe pension funds with very low holdings of Danish stocks. By holding a 100% foreign portfolio these investors get the minimum variance portfolio. It is however hard to use hedging as an explanation of home bias because it depends on the cost of hedging. As figure 6.11 shows increased hedging cost will lower the minimum proportion to invest in foreign stocks and could mean that hedging could be used as an explanation of home bias.

A lot of the Danish pension funds are in fact hedging their foreign stock investments. Although their hedging strategy is not totally similar to the perfect hedging showed in figure 6.11, this section still gives a good indication of how hedging influences the optimal portfolio allocation. It is though still hard to say anything conclusive about the individual fund as this would require the costs of hedging, experienced by the individual fund, along with the full hedging strategy. Even if this is attained it is still not possible really to say anything conclusive as this would also require the risk tolerance of the individual fund. Thus this section explains the effect of hedging and can be used in the explanation of bias as a whole.

6.1.6 Costs

In chapter 3 I discussed how the capital flow of investments in foreign countries indicates that there are actually no enhanced costs (transaction and withholding taxes) by investing abroad. If costs are greater on foreign stocks this would affect the optimal proportion of foreign stocks

as described in the previous section about hedging costs. The Danish stocks would become more favorable and the optimal share of foreign stocks would decrease. The opposite would of course be the case if foreign markets are accompanied by lower costs than that experienced on Danish investments. The new Basel rules called solvency II is going to work as an extra cost on foreign stocks, so this should shift the Danish pension funds towards holding less foreign stocks. This issue will be touched upon in a separate section about how solvency II will affect home bias.

A cost that have had a big effect on the way funds have been investing, and is bound to be even greater going forward, is the cost of liquidity. The Danish market is comparatively illiquid[51] which is of particular interest to pension funds who own about 10% of listed Danish stocks[52]. This illiquidity poses as a risk especially in markets of turmoil. The Danish pension funds are investing large sums and if wanting to get out of these investments the markets will have to be very liquid. This is also noticed by the pension funds. Many funds invest in foreign stocks to enhance the liquidity of their portfolio[53]. Liquidity risk therefore provides evidence against home bias an can be a reason why one will see the share of foreign stocks increase further within the stock portfolios of Danish pension funds. Also the fact that the premiums of pension funds grow more than the Danish BNP will put a logical restrain on the proportion of Danish stocks.

6.2 Behavioral Factors

Behavioral reasons might be harder to quantify than the institutional factors. It is for instance clear cut if restrictions on investments are the reason why some funds are not able to invest more in foreign stocks, while it is more difficult to be sure that domestic optimism is the reason why pension funds invest more in the domestic market than shown to be historically optimal. This section will try to analyze the behavioral factors in the context of Danish pension funds and try to figure out if these can be an explanation of the bias observed from some of the funds.

[51] http://www.sydbank.dk/inc/pdf/investering/2008-09/artikel.pdf, Stor konkurrencekraft i danske aktier

[52] The market value of the Danish stock market is about 1000 billion kroner whereof Danish pension funds own about 100 billion. http://borsen.dk/nyheder/investor/artikel/1/179506/danmark_overhaler_finland_paa_markedsvaerdi.html

[53] http://www.isp.dk/isps_imvesteringer.aspx

6.2.1 Herding

In this section I will briefly describe why I do not see herding as plausible reasons for the observed home bias. Revisiting the figure from chapter 5, showing the share of foreign stocks of each fund, helps explain why herding does not seem as a plausible explanation of home bias. As figure 6.12 shows the proportion is different for almost every individual pension fund. In general as explained earlier the biggest proportion of funds lies within the optimal interval and herding should therefore make each fund want to lie within this interval. There is a rather big difference between the foreign holdings of the home biased funds and the rest of the funds. Therefore it would be hard to argue that the home biased funds are in fact simulating the others in the context of foreign holdings and as mentioned herding will therefore be disregarded as an explanation of home bias.

Figure 6.12
Share invested in foreign stocks (2009)

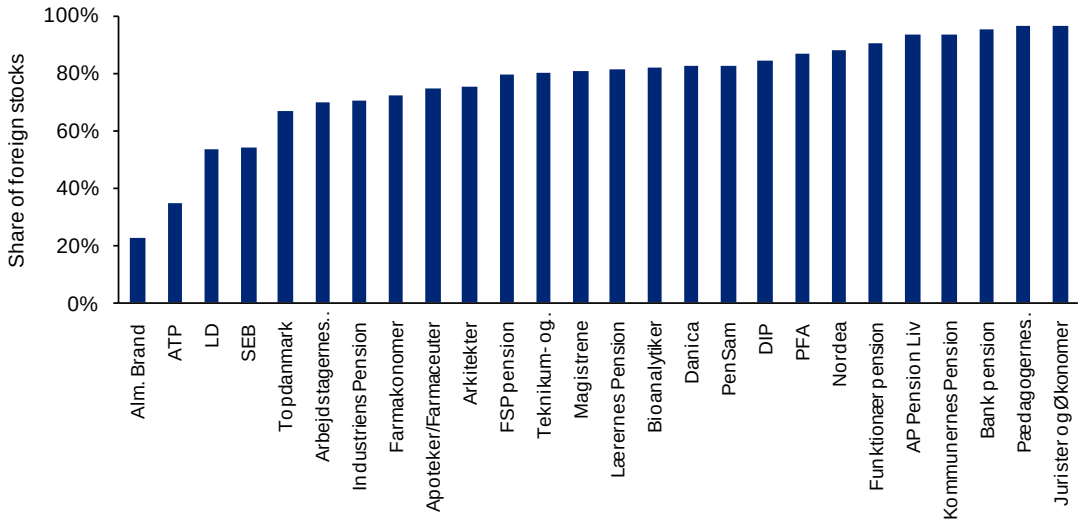

Figure 6.12 shows the proportion invested in foreign stocks of each pension fund. Source: Annual reports and own contribution

6.2.2 Conservatism

As mentioned it can be hard to quantify behavioral factors as an explanation for home bias. This is also the case with conservatism. There can be other reasons why pension funds show home bias, but there is actually justification for conservatism as an explanation.

Figure 6.13

Home biased funds' share of Danish stocks 2005 - 2009

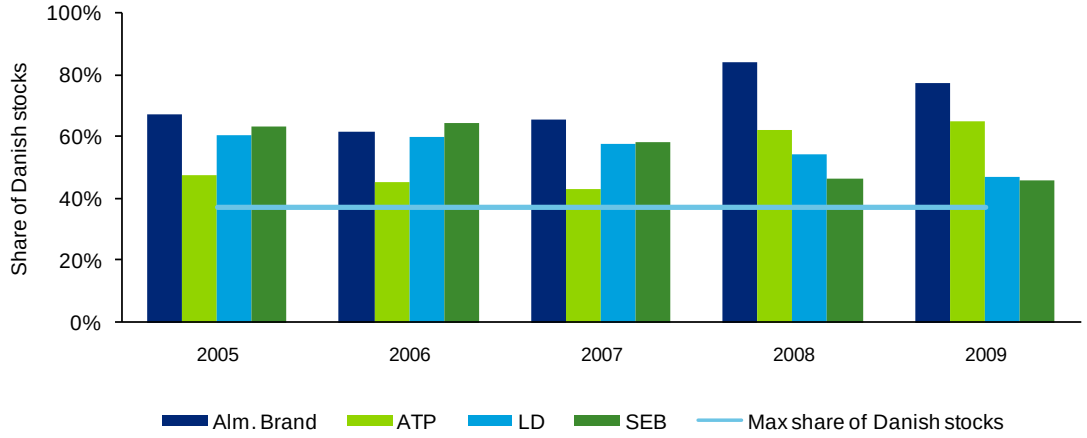

Figure 6.13 shows the proportions invested in Danish stocks by the four home biased funds in the period from 2005 – 2009. The blue line shows the upper bound of the optimal portfolio in which to hold Danish stocks. Source: Annual reports and own contribution

What figure 6.13 shows is the four home biased funds' share invested in Danish stocks the last five years. The horizontal blue line indicates the maximum share of Danish stocks within the optimal interval. Though the share of each fund is volatile during the five year period it is always above the blue line. Thus the home biased funds have been so for the last five years.

Figure 6.14

Foreign biased funds' share of Danish stocks 2005 - 2009

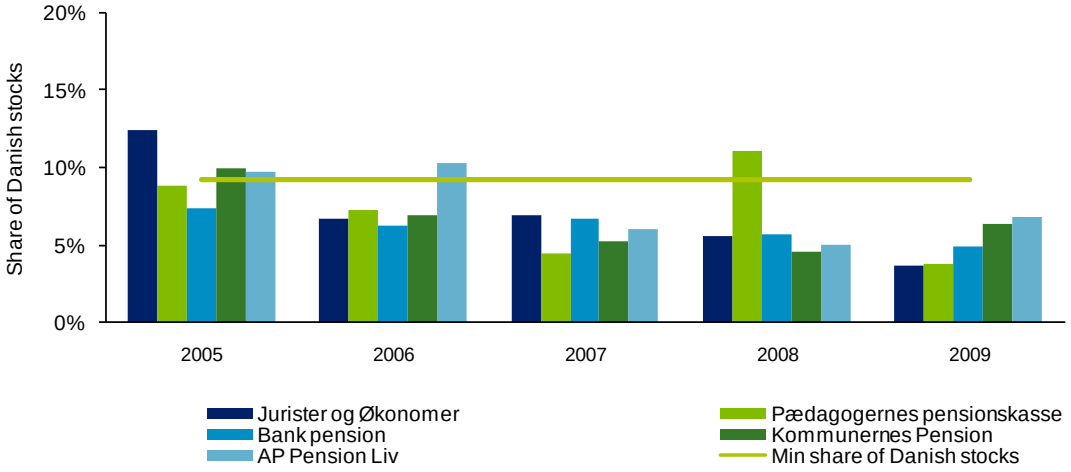

Figure 6.14 shows the proportions invested in Danish stocks by the four foreign biased funds in the period from 2005 – 2009. The brown line shows the lower bound of the optimal portfolio in which to hold Danish stocks. Source: Annual reports and own contribution

Looking at the Danish holdings of the foreign biased funds the picture is different than for the home biased ones. This figure shows three out of five funds having a share of Danish stocks that is within the optimal interval in 2005. The three funds have later lowered their share of Danish stocks and therefore become foreign biased. Also two funds have during the five year period increased their Danish holdings to once again lie within the optimal interval. Conservatism therefore does not seem to rule the same way within these biased funds compared to the home biased funds, that all were home biased in the whole period from 2005 – 2009. In chapter 5 it was also shown that the industry as a whole have been investing more and more in foreign stocks during the past many years, thus also indicating that the industry as a whole have no problem adjusting their beliefs towards the historical evidence supporting international diversification. Conservatism might therefore be an explanation of the home bias of the four pension funds.

6.3 Future Explanations

This section concentrates on issues that are thought to be of future interest in the context of home bias. This is of course interesting as this might have an effect on the results of this thesis because the effects of these future factors are not yet seen in the current behavior of the Danish pension funds.

6.3.1 Solvency II

After the financial crisis many strict rules have been enforced on the financial sector. This has not yet come to the pension sector. But in 2012 Solvency II will be implemented in the pension sector and this could have some implications on the home bias. It is almost impossible to measure what kind of effect Solvency II will have on the proportion invested in foreign stocks but it will definitely have an effect. The capital requirements that the funds have to meet are computed by the stress test parameters which differ according to the individual financial asset. The stress test parameters will as a whole increase, which means one might experience a decreasing amount invested in stocks as these will create a larger capital requirement than, for example, bonds. This might have an implicit effect on the proportion of foreign stocks.

The transition to Solvency II also affects the stress test parameters of different stocks. Before Solvency II the stress test parameters were the same for all stocks. But with Solvency II the

stress test parameters for stocks on emerging markets and markets of similar risk will have larger parameter-values than stocks traded on markets of developed countries. In chapter 2 I showed how the Danish stock market was least correlated with emerging markets as compared to developed markets. The higher parameter of emerging markets is the same as putting an extra cost on the returns of these markets. Therefore it will be less favorable to invest on these markets. Thus, by putting this extra cost on the most favorable markets with regards to diversification benefits this could lead to a decreasing proportion invested in foreign markets as a whole.[54]

6.4 Concluding remarks

This chapter looked into which factors that can explain the observed bias of some of the Danish pension funds. Not all the explanations analyzed in chapter 3 have been analyzed. The reason for this has been because the explanations have not been perceived as plausible ones or the necessary information was not obtainable.

Two of the analyzed explanations of bias were restrictions on capital and hedging of inflation. I analyzed if restrictions on capital could explain the observed home bias of LD, ATP, SEB and Alm.Brand. I found that there was a long way to go before the restrictions would be a problem. The relative low proportions invested in stocks by the companies also left plenty of room to neutralize the home bias. Restrictions are therefore not a viable explanation of home bias.

Previous studies of inflation hedging had rejected this as a reason for home bias. By analyzing the correlation between the different markets and the Danish inflation, measured by the growth in the Danish price index, I also rejected inflation hedging as an explanation of home or foreign bias.

The results of the effect of currency risk were a bit ambiguous. It is a plausible explanation of the observed foreign bias as these funds in fact hedge their investments. It was shown that the minimum variance portfolio when hedging contained 100% foreign stocks. Regarding the

[54] http://www.djoef.dk/Joep-Pension/Investeringer/Solvens-II--og-hvad-det-betyder-for-J-OE-P.aspx

home biased funds the results were harder to interpret as the size of hedging costs decided whether currency was an explanation of home bias or a reason for further puzzling.

Liquidity risk was briefly mentioned as an explanation of the foreign bias of funds. Many Danish pension funds describe the Danish market as small and illiquid. To enhance the liquidity of their stock portfolio they therefore seek towards larger foreign markets. This is a reason that will influence the allocation of stocks even more in the future, especially if the pension funds keep on growing more than the Danish BNP.

In the context of asymmetric information I analyzed if there was any quantitative evidence of the biased funds performing in a way that would make the bias rational. I analyzed the performance of funds on both the Danish and international markets and found that almost every fund outperformed the benchmark on the Danish market whereas the result was less convincing on the foreign markets. Thus this result gave an indication of why home bias might be observed. Thereafter I tested the performance on the Danish market relative to the performance on the international market. Here I found that that the performance on the Danish market outperformed the performance on the international market for most funds. But because the optimal interval already took into account the relative performance of the two markets the outperformance would only be real if the Danish investments outperformed the benchmark more than the foreign investments outperformed its benchmark. The result of this analysis was a picture that showed almost every fund performing better on its Danish investments. Only three funds performed better in its foreign investments and none of these were among the home biased funds. Asymmetric information, and in that context superior performance on domestic investments, is a rational explanation of the home bias according to the analyzed data.

An interesting explanation of the observed home bias, especially in the context of Danish pension funds, is the internationalization of large Danish companies. I showed that about 50% of LD´s listed Danish stock investments were made up by only five multinational companies. These companies gain, by far, the main part of their sales on foreign markets and I therefore argue that they are heavily exposed to international markets. Thus these companies should not only count as a domestic stock but will also contribute to international diversification through its exposure to the international markets.

As behavioral explanations I analyzed the herding behavior and conservatism of the biased funds. I found no evidence that indicated that herding would be a plausible explanation of home bias. The largest proportions of the funds invested within the optimal interval, which mean they invest a far larger proportion in foreign stocks than the home biased funds. Herding behavior should therefore induce funds to invest a proportion in foreign stocks within the optimal interval. Conservatism, though hard to conclude, could be an explanation of home bias. I showed that the industry as a whole had grown their proportion invested in foreign stocks the last many years. I showed that through the last five years the home biased funds had all invested more in the Danish market than advocated by the optimal interval. Thus they have not adjusted their portfolio to the historical evidence of the optimal portfolio as the rest of the industry has.

Last I studied the new rule of Solvency II which is to be implemented by 2012. The reason for this is the effect it might have on home bias. The new rule will work as a cost on especially emerging markets and markets with the same level of risk. These markets stand as the ones offering the greatest diversification benefits to Denmark and the new rule can therefore induce greater home bias.

7 Conclusion

The purpose of this thesis was to explore the optimality of the Danish pension funds' equity investments. More explicitly I wanted to investigate if overweighting of Danish equity was a source of lack of optimality, also referred to as equity home bias. If home bias was observed I further wanted to investigate what reasons that could explain this observation.

To provide an understanding of why one would expect no home bias I started the analysis by investigating the benefits of investing abroad. By verifying the benefits of international diversification I showed why one might expect a well-diversified portfolio. I showed that the correlation between Denmark and international markets confirms the diversification benefits of international investments. Especially emerging markets appeared as highly attractive in the context of diversification with very low correlations with the Danish market. In this chapter I also introduced the aspects of modern portfolio theory and the ICAPM. It was shown that the ICAPM relies on some rather strict assumptions for it to hold in practice. These assumptions were discussed and this lead to the next chapter that discussed the reasons for why home bias might be present.

The equity home bias can in parts be explained by a numerous factors. These factors can be grouped in two categories. These are institutional and behavioral factors. The institutional factors analyzed were restrictions on capital flows, asymmetric information, hedge against inflation, costs, investing in multinationals, currency risk, corporate governance and the size of the fund. Whereas the analyzed behavioral factors were herding, conservatism, personal interest, over optimism towards domestic markets and loss aversion and narrow framing. The institutional factors are external factors that the pension funds are exposed to whereas the behavioral factors are internal factors that affect the behavior of fund managers. The most explaining factors have been used in the analysis of the home bias in Danish pension funds in chapter 6.

Next I applied the mean-variance framework on a vast number of international indices to establish an optimal interval in which to invest in foreign stocks. In this way I questioned the common way of establishing home bias, which is to use the market portfolio as benchmark. Home bias would in this scenario be proportions invested in Danish stocks of more than

0,41%. This would mean that every Danish pension fund would be home biased except for one. Because I have no justification for knowing the risk tolerance of the pension fund the optimal interval is the efficient frontier, which as chapter 2 showed dominates all other portfolios. I split up the analysis in four separate analyses. The first found the efficient frontier by introducing an investment universe of only two assets. These assets were the Danish market and the market portfolio. The reason for this analysis was to see if the allocation would be as described by CAPM. The result was a very large interval that justified a Danish proportion of between 15% - 100%. This is far from prescribed by the CAPM. The unsatisfactory results lead to the next analysis. This investigated the efficient frontier possible to obtain by investing in the markets that represent the current investment universe of Danica. The reason for this analysis was to see the justified proportion of Danish stocks by applying the investments universe of the largest Danish pension fund. Also the data were limited on markets outside this investment universe. This lead to a narrower optimal interval with 64,7% - 90,7% invested in foreign stocks. Studies show that although pension funds have long term liabilities they often invest with a five year horizon in mind. I therefore analyzed overlapping five year periods to see if this had any effect on the optimal interval. I then took the simple average of the results to get an interval. This resulted in a wider interval. The upper limit of foreign stocks was maintained, but the lower limit was decreased to 56,9%.

The final analysis was to see how the introduction of further markets would influence the optimal interval. Normally I would have done this analysis for the whole period (1999 – 2009), but the data are not available for the whole period. I therefore used the analysis to compare it with the optimal interval of the Danica investment universe of the same period. This was done to be able to adjust the optimal interval found earlier by the effect of introducing further markets in the investments universe. The final optimal interval was found by a simple mix of the interval of the last three optimal intervals. This resulted in an optimal interval in which to hold foreign stocks between 62,7% – 90,7%. The first analysis was not used in the final determination of the optimal interval. The optimal interval makes it possible to determine if there are any home biased Danish pension funds.
By analyzing the holdings of the Danish pension funds in my sample I discovered that the main part of the funds lie within the optimal interval. But there were some funds that were biased. Four funds were home biased according to the optimal interval whereas five were foreign biased. I was thereby able to answer the question whether Danish pension funds

optimize their equity portfolio. For the most part they do but as mentioned nine funds overweight either Danish or foreign stocks. In this chapter I analyzed whether the size of the fund or the use of either internal or external managers could be an explanation of the bias. I found some evidence that the choice of using internal managers increases the likelihood of being home biased. The size of the funds did not explain any bias.

After establishing the bias of nine funds the last chapter analyzed the plausible reasons for the observed bias. It was identified that asymmetric information measured by superior performance on Danish investments could be an explanation of the home bias. The analysis showed that all home biased and in general most funds showed superior performance on their Danish investments. Conservatism was another reason that could not be rejected as a reason for the observed home bias, as these funds have been so for a five year period. The fact that the main part of Danish companies represented in the pension funds' portfolios are multinational firms also represented a very plausible explanation of the home bias. The exposure towards foreign markets is far greater than towards the Danish market. Therefore these investments represent an international diversification though registered as a domestic investment. It was shown that five multinational companies represent 50% of the Danish listed stock investments of LD, which indicates that the real bias is lower than indicated by the registered domestic investments.

Currency risk could be an explanation of home bias, but this depends on the cost of hedging. If the costs are "great" this could help explain the home bias as the costs are imposed on the foreign investments. Hedging is a also very plausible explanation of the observed bias towards foreign stocks as the minimum variance portfolio in this simplified analysis justifies a 100% investment in foreign stocks. Lastly liquidity risk seems to be a very plausible reason for the overweighting of foreign stocks in some funds. The low liquidity of the Danish market is an aspect that is recognized by the pension funds which further supports the assumption.

To summarize, not all funds seem to optimize their equity portfolio. The lack of optimization is due to both home and foreign bias. After analyzing different plausible explanations of the bias I have come up with asymmetric information, conservatism and investments into domestic multinational firms as explanations of home bias. I identified currency hedging and liquidity risk as explanations of foreign bias.

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Home pages of all pension funds

8.4 Databases

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Statistics Denmark

Database of the Danish National Bank

Annual reports of all pension funds

9 Appendix

9.1 Appendix A (Restrictions on allocations in optimal portfolio)

Danica investment universe		
Retrictions	Lower bound	upper bound
DENMARK	None	None
CZECH REPUBLIC	0,0%	0,3%
HUNGARY	0,0%	0,4%
ISRAEL	0,1%	1,6%
POLAND	0,1%	0,8%
RUSSIA	0,2%	1,4%
TYRKEY	0,1%	1,0%
CHINA	0,7%	4,2%
INDIA	0,3%	2,0%
INDONESIA	0,1%	1,2%
KOREA	0,6%	3,4%
MALAYSIA	0,1%	1,7%
PHILIPPINES	0,0%	0,3%
TAIWAN	0,5%	3,1%
THAILAND	0,1%	0,9%
BRAZIL	0,6%	3,7%
CHILE	0,1%	0,9%
NORWAY	0,1%	1,9%
SWEDEN	0,4%	2,2%
SWITZERLAND	1,0%	6,1%
UK	2,8%	17,2%
AUSTRALIA	1,1%	6,8%
HONG KONG	0,3%	1,9%
JAPAN	3,0%	18,4%
NEW ZEALAND	0,0%	0,4%
SINGAPORE	0,2%	1,2%
CANADA	1,4%	8,3%
USA	14,1%	85,4%
Mexico	0,2%	1,0%
South Africa	0,3%	1,8%
AUSTRIA	0,1%	1,0%
BELGIUM	0,1%	0,9%
FINLAND	0,2%	1,0%
FRANCE	1,4%	8,5%
GERMANY	1,1%	6,5%
GREECE	0,1%	1,6%
IRELAND	0,1%	1,0%
ITALY	0,5%	3,0%
NETHERLANDS	0,3%	2,1%
PORTUGAL	0,0%	0,7%
SPAIN	0,6%	3,7%

Lower bound is the world share divided by 3. The upper bound is the actual world share times 5 if the actual share is less than 0,4% otherwise times 2.

The whole world		
Restrictions	Lower bound	upper bound
DENMARK	None	None
CZECH REPUBLIC	0,0%	0,3%
HUNGARY	0,0%	0,4%
ISRAEL	0,1%	1,6%
POLAND	0,1%	0,8%
RUSSIA	0,2%	1,4%
TYRKEY	0,1%	1,0%
CHINA	0,7%	4,2%
INDIA	0,3%	2,0%
INDONESIA	0,1%	1,2%
KOREA	0,6%	3,4%
MALAYSIA	0,1%	1,7%
PHILIPPINES	0,0%	0,3%
TAIWAN	0,5%	3,1%
THAILAND	0,1%	0,9%
BRAZIL	0,6%	3,7%
CHILE	0,1%	0,9%
COLOMBIA	0,1%	0,9%
MEXICO	0,2%	1,0%
PERU	0,0%	0,4%
ARGENTINA	0,2%	1,0%
EGYPT	0,0%	0,4%
MORROCO	0,0%	0,2%
AUSTRIA	0,1%	1,0%
BELGIUM	0,1%	0,9%
FINLAND	0,2%	1,0%
FRANCE	1,4%	8,5%
GERMANY	1,1%	6,4%
GREECE	0,1%	1,6%
IRELAND	0,1%	1,0%
ITALY	0,5%	3,0%
NETHERLANDS	0,3%	2,1%
NORWAY	0,1%	1,9%
PORTUGAL	0,0%	0,7%
SPAIN	0,6%	3,7%
SWEDEN	0,4%	2,2%
SWITZERLAND	1,0%	6,1%
UK	2,8%	17,0%
AUSTRALIA	1,1%	6,7%
HONG KONG	0,3%	1,9%
JAPAN	3,0%	18,3%
NEW ZEALAND	0,0%	0,4%
SINGAPORE	0,2%	1,2%
CANADA	1,4%	8,2%
USA	14,1%	84,8%
South Africa	0,3%	1,8%
Croatia	0,0%	0,2%
Estonia	0,0%	0,2%
Slovenia	0,0%	0,2%
Jordan	0,0%	0,2%
Libanon	0,0%	0,2%
Kenya	0,0%	0,2%
Mauritius	0,0%	0,2%
Nigeria	0,0%	0,2%
Tunesia	0,0%	0,2%

Lower bound is the world share divided by 3. The upper bound is the actual world share times 5 if the actual share is less than 0,4% otherwise times 2.

The restrictions have been established on the basis of the allocations in the MSCI World. The lower bound is found by dividing the individual markets' share in the World index by 3. There is no deeper science accompanied with the choice to divide by 3. The upper bound have been found by multiplying the individual market by 5 if its capitalization is lower than 0,4% and otherwise 5. The reason for this difference is to enhance the opportunity t invest more in smaller markets that is expected to be growing and delivers good diversification benefits, as described in chapter 2.

9.2 Appendix B (The relationship between income growth and market return)

Regression Statistics	
Multiple R	34%
R Square	11%
Adjusted R Square	6%
Standard Error	0%
Observations	19

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2E-05	2E-05	2E+00	15,77%
Residual	17	1E-04	7E-06		
Total	18	1E-04			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,0	0,0	13,9	0%	0,0	0,0
Return (MSCI Denmark)	0,0	0,0	-1,5	16%	0,0	0,0

The result of the regression shows that, at least measured on this 5-year period, the relationship between market return and income growth in not significant. In the analysis the market return is regressed on the income growth. In the long run, I however still believe that there is a relationship as the results of companies have de transmit to the development in income.

9.3 Appendix C (The influence of Premium size, Balance size and management style)

Premium size, Balance size and management style on the proportion of foreign stocks

Regression Statistics	
Multiple R	62%
R Square	38%
Adjusted R Square	30%
Standard Error	15%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0,32	0,11	4,58	1,23%
Residual	22	0,51	0,02		
Total	25	0,83			

	Beta	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,80	0,04	18,25	0,0%	0,71	0,89
Premiums	0,00	0,00	2,90	0,8%	0,00	0,00
Balance	0,00	0,00	-2,70	1,3%	0,00	0,00
Management (Internal)	-0,17	0,07	-2,33	3,0%	-0,32	-0,02

Source: Own contribution

Measured at a 5% significance-level all the variables are significant. However, the coefficients of Premiums and Balance are zero. Thus they do not have any explanatory power in the context of held proportions of foreign stocks. The sign of the management variable is negative, thus indicating that the internal management will have a negative effect on the held proportions of foreign stocks.

Premium size, Balance size and management style on the probability of being home biased

Regression Statistics	
Multiple R	64%
R Square	40%
Adjusted R Square	32%
Standard Error	30%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	1,37	0,46	4,97	0,88%
Residual	22	2,02	0,09		
Total	25	3,38			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,04	0,09	0,41	68,9%	-0,15	0,22
Premiums	0,00	0,00	-2,56	1,8%	0,00	0,00
Balance	0,00	0,00	2,57	1,7%	0,00	0,00
Management (Internal)	0,38	0,14	2,66	1,4%	0,08	0,68

Source: Own contribution

This regression indicates the probability of an individual fund being home biased when one of the variables is a characteristic of the fund. Thus the coefficient of 0,38 indicates that a fund with internal management has a 38% greater chance of being home biased. The coefficients of Premiums and Balance are once again zero. All the coefficients are statistically significant at the 5%-level.

9.4 Appendix D (Asymmetric information – Investment in unlisted stocks)

The following two regression analyses show the explanatory power of the proportion invested in unlisted Danish shares on the foreign holdings and home bias.

The relationship between investments in Danish unlisted shares and the proportion of foreign stocks.

Regression Statistics	
Multiple R	25%
R Square	6%
Adjusted R Square	-2%
Standard Error	18%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,05	0,03	0,75	48%
Residual	23	0,78	0,03		
Total	25	0,83			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,79	0,06	13,58	0%	0,67	0,91
2009	0,04	0,11	0,40	69%	-0,18	0,27
2005-2009	-0,11	0,11	-1,08	29%	-0,33	0,10

What the regression shows is whether the proportion invested in unlisted Danish shares can tell anything about the proportion invested in foreign stocks. The analysis uses a dummy variable to indicate if the pension fund have been investing more in Danish unlisted stocks as a proportion of Danish stocks as opposed to investments in foreign stocks. There is two explanatory variables. The 2009-coefficient has been conducted by giving a fund investing more in unlisted Danish stocks in 2009 the number 1 or otherwise 0. The same has been done for the period 2005- 2009. The regression shows that either coefficient has explanatory power of the proportion invested in foreign stocks. Thus investing more heavily in unlisted Danish stocks does not indicate a lower proportion of foreign stocks.

The relationship between investments in Danish unlisted shares and home bias

Regression Statistics	
Multiple R	26%
R Square	7%
Adjusted R Square	-1%
Standard Error	37%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,23	0,12	0,86	44%
Residual	23	3,15	0,14		
Total	25	3,38			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,10	0,12	0,85	40%	-0,14	0,34
2009	-0,10	0,22	-0,46	65%	-0,55	0,35
2005-2009	0,25	0,21	1,17	25%	-0,19	0,69

In connection with the former regression this one show if the same coefficients can increase the likelihood of a fund being home biased. The P-values is insignificant indicating that this is not the case. The likelihood of being home biased is not greater if the fund invest more heavily in unlisted Danish shares.

9.5 Appendix E (Asymmetric information – Superior performance)

Does better performance on Danish investments lower the foreign share?

Regression Statistics	
Multiple R	17%
R Square	3%
Adjusted R Square	-1%
Standard Error	18%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,02	0,02	0,69	41%
Residual	24	0,81	0,03		
Total	25	0,83			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,85	0,11	7,67	0%	0,62	1,08
Fund mean	-0,66	0,79	-0,83	41%	-2,29	0,97

This regression shows the results of the performance on Danish investments on the proportion of foreign stocks. It is not unrealistic to think that the performance on Danish investments in negatively correlated with the proportion of foreign stocks. The result of the regression, however, does not indicate that this is the case. With a P-value of 41% the coefficient is not significantly different from zero. Thus the performance on Danish investments has no influence on the proportion of foreign stocks.

Does better performance on foreign investments increase the foreign share?

Regression Statistics	
Multiple R	21%
R Square	5%
Adjusted R Square	1%
Standard Error	18%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0,04	0,04	1,14	30%
Residual	24	0,80	0,03		
Total	25	0,83			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,68	0,08	8,02	0%	0,5	0,9
Fund mean	1,36	1,28	1,07	30%	-1,3	4,0

This regression shows if the performance on foreign stocks has any influence on the proportion of foreign stocks. The result is the same as for the Danish investments, namely no influence. Thus better performance on foreign investments does not seem to translate into a higher proportion of foreign stocks.

The explanatory power of relative return on the proportion of foreign stocks

Regression Statistics	
Multiple R	36%
R Square	13%
Adjusted R Square	5%
Standard Error	18%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,11	0,05	1,72	20%
Residual	23	0,72	0,03		
Total	25	0,83			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,86	0,08	10,21	0%	0,69	1,03
Relative sharpe-ratio on Danish	-0,47	0,30	-1,58	13%	-1,08	0,15
Relative sharpe-ratio on foreign	0,17	0,28	0,60	55%	-0,42	0,76

The explanatory power of relative return on the Home

Regression Statistics	
Multiple R	21%
R Square	4%
Adjusted R Square	-4%
Standard Error	37%
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,15	0,08	0,54	0,591948755
Residual	23	3,23	0,14		
Total	25	3,38			

	Coefficients	*Stand. Err.*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,04	0,18	0,22	82%	-0,33	0,41
Relative sharpe-ratio on Danish	0,55	0,63	0,88	39%	-0,75	1,85
Relative sharpe-ratio on foreign	-0,20	0,60	-0,34	74%	-1,44	1,04

The two regressions show the explanatory power of the relative sharpe ratio compared to its benchmark on the foreign proportion and the probability of being home biased respectively. Neither regression show any sign of the relative sharpe-ratio having any effect on the proportion of foreign stocks or the probability of being home biased. The P-values are well above the 10%-level. However, the conclusion in the section about superior performance is sustained. The good performance on Danish investments is a plausible explanation of home bias. But the interpretation of the regression actually corresponds to the fact that the good performance makes it hard to explain the small holdings of Danish stocks by most funds.