Home Sweet Home: Home Bias and International Diversification among Individual Investors

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Abstract

A striking feature of international portfolio investment is the extent to which equity portfolios are concentrated in the domestic market of the investor. Many authors have tried to explain this home bias, but so far, this literature has not succeeded in providing a generally accepted explanation for it. Also, there are no previous results regarding home bias on an individual level, i.e. what characterises an individual who show a relatively large reluctance towards international diversification and investments. The purpose of this study is to investigate whether there is a home bias in the portfolios of mutual funds, which are formed as a part of the pension plan in Sweden. While controlling for several reasons for home bias which are found in the previous research, as e.g. transactions costs and risk level of investments, this study analyses the nature of portfolio allocation and the home bias on an individual investor basis. A multinomial logit model is formulated to estimate the likelihood of home bias, where demographical features of the individuals are used as explanatory variables. The results show several significant, statistically and economically, relationships between individual characteristics and the likelihood of home bias. In particular, age, gender, net wealth, occupation and familiarity with risky investments are important. The type of individual with the highest likelihood of home bias is identified as a not so wealthy older man, who works for the government and holds no other risky assets.

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Key words: Home bias; Individual investors; Defined contribution pension plans

1. Introduction

A striking feature of international portfolio investment is the extent to which equity portfolios are concentrated in the domestic market of the investor. French and Poterba (1991) estimate the domestic ownership share of the world's five largest stock markets to be 92.2% for the U.S., 95.7% for Japan, 92% for the U.K., 79% for Germany, and 89.4% for France (figures for 1990). Many authors have tried to explain this home bias, which runs counter to the well accepted benefits from international diversification. Adler and Dumas (1983) as well as Cooper and Kaplanis (1994) suggest that home assets provide better hedges against home country-specific risks, as e.g. inflation or human capital. Black (1974), Stulz (1981) and Kang and Stulz (1997) claim that costs of international diversification exceed the gains, whereas French and Poterba (1991) and Uppal and Wang (2002) argue that there exist systematic differences in return expectations across investors. Other explanations, as reviewed in Lewis (1999) and Karolyi and Stulz (2002), include barriers to international investments, departures from purchasing power parity and information asymmetries between domestic and foreign investors. Also, recently, studies document strong evidence that people prefer to invest in the familiar – while ignoring the principles of portfolio theory, see e.g. Kang and Stulz (1997) and Huberman (2001). Furthermore, Grinblatt and Keloharju (2001) report that Finnish households are more likely to invest in firms which are located close to them. Coval and Moscowitz (1999) find that U.S. fund managers have a strong preference for locally headquartered firms. So far, this literature has not succeeded in providing a generally accepted explanation for the home bias. Also, there are no previous results regarding home bias on an individual level, i.e. what characterises an individual who show a relatively large reluctance towards international diversification and investments.

The main purpose of this study is to investigate whether there is a home bias in the individual portfolios of mutual funds, which are formed as a part of the pension plan in Sweden. The analysis of the portfolio formations, and the home bias issue, in this particular context is unique compared to previous research. First, it is possible to investigate a possible home bias in the portfolio choices for individual investors. Most previous work tends to study the home bias on an aggregate basis. Second, the inclusion of assets in the pension portfolios is made entirely in the interest of future return performance. There is e.g. no control dimension in the investment process, which can be of significant importance when the home bias issue is investigated in a stock market. As Dahlquist et al. (2002) point out, in a country like Sweden where controlling shareholders are economically

important you would expect to see a large home bias. Third, this study analyses the active choices of a large investor group (a large sample from the Swedish work force) with a well defined set of investments available. In addition, all portfolios are formed at the same time, where the investors are provided with the same information brochure regarding the available mutual funds. Hence, the set up is rather close to a laboratory experiment when it comes to choice under uncertainty. Fourth and finally, while controlling for several reasons for home bias, which are found in the previous research, it is possible to venture new grounds. The detailed data enables a division of individuals into groups based on different demographical features as e.g. gender, age, education level, wealth and income. Thus, this study is able to analyse the nature of portfolio allocation and the home bias on an individual investor basis.

For each individual in the sample the share of domestic, and indeed foreign assets, relative the total amount of all assets in the investment portfolio is determined. The share of domestic funds is divided into five categories; 0 – 0.2, 0.2 – 0.4, …, 0.8 – 1, and a multinomial logit model is used to estimate the likelihood for each individual to allocate the investment portfolio according to the different categories. It is argued that an individual with a high estimated probability of ending up with a domestic share of funds in e.g. the interval 0.8 – 1 also has a relatively high likelihood of home bias. Using the demographical features of the individuals as explanatory variables in the analysis enables a characterisation of which kinds of individuals have the largest likelihood of being home biased. Control variables are introduced in the analysis to account for transactions costs, risk level and familiarity with risky investments across individuals.

The results show several significant, statistically as well as economically, relationships between the individual characteristics and the likelihood of home bias. Age, gender, net wealth and occupation are important explanatory variables for the allocation between domestic and foreign assets, whereas disposable income appears to be unimportant. Furthermore, the number of funds chosen and the amount of money put into this part of the pension system also tend to influence individuals' international diversification. Among the control variables, reflecting reasons for home bias found on an aggregate level in previous studies, transactions costs, risk level and familiarity are found to be important for the likelihood of home bias.

In summary, the most striking results are as follows. First, men have a tendency to become more home biased with an increasing age, whereas women do not. Second, more wealthy individuals,

men as well as women, have a relatively higher likelihood of choosing foreign assets. Third, investors employed by the government have a higher tendency for home bias than individuals who are self-employed or work in the private sector. Fourth, the less money individuals have to put into the system, the more likely they are to choose funds with a large share of domestic assets. This tendency is more pronounced for men than for women. Fifth, there is a diversification effect. Individuals investing in five funds show a lower likelihood of home bias than people choosing to invest in a smaller amount of funds. Finally, there is some evidence in favour of the idea that people with previous risky holdings have a relatively lower likelihood of home bias. Consequently, the type of individual with the highest likelihood of home bias can be identified as a not so wealthy older man, who works for the government and who is not familiar with risky investments prior to the participation in the defined contribution pension plan.

The rest of the study is organised into four sections. The following section briefly presents the Swedish pension system, with emphasis on the defined contribution part. This section also contains a description of the data used in the analysis. Section 3 outlines the multinomial logit model as a framework for analysing the likelihood of home bias for individual investors. Section 4 contains an analysis of the empirical results. Finally, the study is ended in section 5 with some concluding remarks.

2. Portfolio choice within the defined contribution pensions system

2.1 Description of the Swedish pensions system

The ageing population in Sweden has come to show the necessity of renewing the Swedish pension system. Pension systems based on the working population financing the retirees among the population will only function as long as the population pyramid is well formed, with high nativity figures. As the demographics of a population seize to take the shape of a pyramid it becomes necessary to link the individuals' pension to the individuals themselves. The previous pension system in Sweden was of a defined benefit type, and it is gradually being phased out by a partially self-financing system. This newer system is designed in particular for individuals born after 1954, and not yet retired.

The new pension system which was introduced in Sweden in the autumn of 2000 is a step towards inducing each individual to take responsibility in financing her own future pension. The new plan

consists of three parts. The first and largest part is the income pension. It is based on 16 percent of the annual income and is used to finance those who are retired today. The amount paid in also serves as a base in calculating future pension payments. The second part, the premium pension, is based on 2.5 percent of the annual income. This amount is allocated at the individual's discretion. Each individual is presented an investment universe of 464 funds[1] and invited to choose between 1 and 5 funds.[2] The resulting investment portfolio can be altered as often as the individual investor wishes. The accrued amount will also be paid out on a monthly basis to the individual at the time of her retirement. The third and final part is a guaranteed pension level designed to ensure that no retirees will be completely without pension payments at the time of her retirement, regardless of her previous income. In total, 18.5 percent of the annual income for each individual is invested to finance this system, and all annual income from the age of 16 is included. There is however, an upper limit. An individual earning more than 7.5 income base amounts[3] per year will only be accredited 7.5 income base amounts although she will still pay 18.5 percent of her income to finance the pension system.

2.2 Individuals' portfolio allocation

It is interesting to study individuals' portfolio allocation. In addition, there is an interest in how to design pension plans that entice individuals to assume responsibility for their own pension. The goal of a pension plan should not be that the participants make active decisions per se, as there is no evidence that an active participation constitutes a better pension plan. However, active participation could possibly serve as an indicator of how involved the participants are in their own pension savings. The major criticism against defined contribution plans such as 401(k) plans in the U.S. and the Swedish premium pension system concerns differences in risk preferences between demographic groups and lack of diversification in portfolio construction. This study discusses the aspects of diversification in general and home bias in particular.

Previous evidence from the U.S. 401(k) plan participation suggests inertia, i.e. a majority of the participants will choose a default alternative rather than to make active allocation decisions (see Madrian and Shea, 2001, and Choi et al., 2002). In the Swedish pension system the opposite

[1] 464 funds were available in the 2000 brochure. The 2003 brochure contains more than 600 funds.
[2] The Swedish pension system is described in further detail at www.ppm.nu and www.pension.nu. See also Engström and Westberg (2003), Karlsson (2003) and Säve-Söderbergh (2003).
[3] For the year 2000, one income base amount equals SEK 38,800.

behaviour is observed. When the pension system was introduced in 2000, a 67 percent majority made an active investment decision. Engström (2003) finds evidence, supporting Huberman (2001), that individuals with previous experience of financial markets are more likely to make active investment decisions. It seems as though the Swedish pension system has managed to involve a majority of the Swedish work force in making active portfolio decisions for their pension savings.

Concerning risk preferences in portfolio allocation, current studies on the Swedish pensions system suggest that the demographic situation of individuals matters. As discussed in Karlsson (2003) and Säve-Söderbergh (2003), portfolio risk is significantly correlated with age, gender, occupation, number of children and previous investments in risky assets. However, although the differences are statistically significant it is not altogether clear that these differences carry economical significance.

2.3 Portfolio choice and individual characteristics

During autumn 2000 all participants in the Swedish pension system were provided with a brochure containing 464 mutual funds with accompanying information on risk, historical returns, fees, and a few words briefly describing each fund. This study investigates to what extent individuals' portfolios from this pension plan consist of foreign investments. Hence, the proportion of foreign assets is assessed for each available fund. Table 1 contains a brief description of the different categories of funds together with the associated average proportion of domestic and foreign assets. The criteria when labelling funds as domestic, foreign or a mixture of the two are based on the brief information given for each fund in the brochure. Unless the information states otherwise, the following criteria are used when categorising the funds: Swedish funds are classified as 100 percent domestic, Regional and Nordic funds are classified as 50 percent domestic and 50 percent foreign. European and Industry funds are classified as 100 percent foreign. Mixed funds and Generation funds are classified as either 100 percent, two thirds or 50 percent domestic. Finally, the Fixed Income funds are generally sorted in the brochure as 100 percent domestic or foreign or a mixture thereof. In the latter case, the fund is classified as 50 percent domestic and 50 percent foreign. The investment universe using these criteria consists of 16.5 percent purely domestic funds, 70.8 percent purely foreign, whereas 12.7 percent of the funds contain a mixture of domestic and foreign assets. When funds containing both domestic and foreign assets are

proportionally categorized as domestic or foreign the investment universe consists of 24 percent domestic assets and 76 percent foreign assets. Consequently, the investment universe is somewhat skewed towards a high proportion of foreign investments.

In order to explain the differences in individuals' shares of domestic holdings, a number of demographic variables are used. The most recent attempts to explain the home bias phenomenon point to familiarity (Kang and Shultz, 1997, and Huberman, 2001) and locality (Grinblatt and Keloharju, 2001, and Coval and Moscovitz, 1999). Hence, individuals tend to invest in the familiar and close to home, thereby ignoring the benefits of a more diversified portfolio. It is close at hand to presume that education, occupation, previous experiences with risky investments, income and wealth may affect individuals' perspectives of what is considered to be familiar and local. Age and gender are also included. Empirically, these variables have proven to have a statistically significant relation with risk level in investment, see e.g. Karlsson (2003). It is plausible that these variables bear significance in explaining the likelihood of home bias. Further, to account for the claim of Black (1974), Stultz (1981) and Kang and Stultz (1996) that costs of international diversification exceeds the gains, transactions costs for the individual portfolios are used as a control variable. Finally, the number of funds chosen and the total amount invested are also considered as explanatory variables. Every portfolio may consist of 1 – 5 funds. The number of funds can be important for the diversification of each individual's portfolio, and might therefore be of importance for explaining home bias as well.

2.4 Data sources and descriptive statistics

The data used in this study represents a cross section of the Swedish work force. The first pension investments in the new pension system, in autumn 2000, involved 4.4 million individuals. Their investment choices are linked with individual demographic data collected by Statistics Sweden for the year 2000.[4] Statistics Sweden surveys 15,000 households which represent a cross section of the whole population in Sweden. This compiled data set makes it possible to study investment behaviour in great detail. For each individual there is information on how much money, which funds and how many funds the individual has invested in. Also, the age, gender, education, occupation, disposable income and net wealth for the same individual is included in the data set.

[4] Data sources from Statistics Sweden are, HEK 2000; a report on household economy, IoF 2000; income report and SUN 2000; educational status. These three reports are for the total population in Sweden. They are linked to a survey on 15,000 households reporting in depth wealth statistics.

From the 15,000 individuals with complete individual information, individuals who did not make an active investment decision, i.e. who was assigned to the default alternative; the seventh general pension fund run by the government, are omitted. The final sample consists of 10,375 individuals.

Using the information regarding the funds, which is summarised in Table 1, it is possible to assign the relative share of domestic funds held by each individual. Table 2a displays average values for the domestic share and the other numerical variables. The relative domestic share *w* is divided into five categories; 0 – 0.2, 0.2 – 0.4, …, 0.8 – 1.0. Since the investment universe is skewed towards a relatively large share of foreign assets, relatively large holdings of foreign assets are expected to be found on an aggregate level. However, the main focus of this study is on differences in home bias on an individual level, and between different demographic groups, and not the total level of home bias. Consequently, this skewness is not considered to be a problem for this study. Across all individuals, the average domestic share equals 0.34, which is slightly higher than 0.24, the average domestic share among all available mutual funds.

In Table 2a, it can be seen that as the average age of the individuals (AGE) increases, so does the proportion of domestic holdings. Disposable income (INCOME) represents income after tax plus government subsidies. Net wealth (WEALTH) is financial wealth plus market value of real estate minus debt. This variable is calculated on a household level. Financial wealth is reported in detail, how much is held in stocks, funds and risk-free assets. Market value of risky assets can be used as a proxy for familiarity. While financial wealth and debt are relatively easy to assess, the market value of real estate is not. An approximate market value for real estate has been calculated by creating an index based on where the real estate is located. All houses have a taxation value. For every house sold a coefficient is calculated to relate the taxation value with the market value in that particular area. In this way an approximate market value for houses is assessed. Market values of condominiums are somewhat more difficult to assess since they do not have a taxation value. The market value is here approximated by taking the average market value of recently sold apartments in the same complex. Of course, the true market value of real estate can by definition only be known when the real estate is sold on the market, but for the purpose this study these approximations are sufficient. As reported in Table 2a, the variables INCOME and WEALTH do not seem to give any clear cut signals regarding the domestic share on an aggregated level. Furthermore, on the aggregate level, the more money invested in the mutual funds (MONEY), the higher the share of foreign investments appears to be. The average transactions cost (FEE) equals

0.75 percent over all individual portfolios of mutual funds. Also, the portfolios which contain the largest proportions of foreign assets, i.e. where *w* is low, are on average more costly. However, the risk level (STDEV), measured as the annualised standard deviation of three-year monthly portfolio returns, is on average the same for all individuals irrespective of chosen domestic share.

In Table 2b, the categorical variables used in the analysis are displayed with respect to the five categories of domestic share *w*. The sample consists of an almost equal amount of men (indicated by the dummy variable MALE) and women (FEMALE). Also, more men than women are represented in the extreme quintiles. Individuals occupation is divided into four groups; employment in the public sector (indicated by the dummy variable OCC_1), private sector (OCC_2), self employment (OCC_3) and unknown (OCC_4), whereas the education level is categorised into three groups; less than, equal to and more than high school education (dummy variables EDU_1, EDU_2 and EDU_3 respectively). Furthermore, familiarity with risky investments is represented by the variable FAM, which is a dummy variable which takes on the value of one if an individual owns shares of stocks or mutual funds, other than the portfolio formed in connection with the premium pension. Almost two thirds of the individuals in the sample are labelled as familiar with risky investments. Finally, the dummy variables FUND_1 through FUND_5 represent the number of chosen mutual funds within the pension system. The inclusion of these dummy variables in the analysis is important as they to some extent reflect the level of diversification of the portfolios of the individuals. For instance, individuals with a portfolio consisting of only one fund are proportionally more represented in the extreme quintiles. Logically, a portfolio consisting of one fund is more likely to end up in the extreme quintiles since 87 percent of the investment universe is either 100 percent domestic or 100 percent foreign.

3. Modelling the likelihood of home bias for individual investors

3.1 Individual share of domestic funds

The main purpose of this study is to investigate the individual share of domestic (or indeed foreign) holdings relative the total holdings of mutual funds within the pensions system. The intention is to relate the share of domestic holdings to a set of explanatory variables, including demographic characteristics of the individuals. Figure 1 illustrates the frequency and cumulative frequency of the relative share of domestic funds for the sample of 10,375 individuals. One striking feature of the distribution is the high frequency of zeros, i.e. individuals with investments

in foreign securities alone. Also, a comparatively high frequency with approximately a 50% share of domestic funds can be observed.

The relative share of domestic funds is by construction between zero and one. Hence, the distribution is truncated. This fact, together with the features observed in Figure 1, complicates the analysis somewhat. The variable is clearly continuous, but the truncation introduces a dichotomous feature as well. However, to treat the relative share as dichotomous in a binary sense, e.g. by defining a dummy variable equal to one if the portfolio contains foreign securities, and zero otherwise, would be too restrictive. On the other hand, investigating the determinants of the relative share of domestic holdings by using the share as a dependent variable in a simple regression analysis would not be appropriate either. As a compromise, the relative share is divided into five categories and the variable is regarded as nominal. When treating an ordinal variable as nominal there will be some loss of efficiency, though the upside is that it is possible to use the multinomial logit model to estimate the likelihood of individuals choosing to allocate the portfolios according to the five different categories. Thereby, the problems due to the truncated distribution illustrated in Figure 1 can be discarded from, and the likelihood of home bias can be evaluated with respect to the explanatory variables.

3.2 The multinomial logit model

Define w as the individual domestic share of invested funds in the pension system. Consequently, $(1-w)$ represents the individual share of foreign securities in the portfolio. Also, let y be the dependent nominal variable with $J = 5$ categories or outcomes defined as $y=1$ if $w<0.2$, $y=2$ if $0.2 \le w < 0.4$, $y=3$ if $0.4 \le w < 0.6$, $y=4$ if $0.6 \le w < 0.8$, and $y=5$ if $w \ge 0.8$. Further, let $\Pr(y=m \mid \mathbf{x})$ be the probability of observing the outcome m given the explanatory variables $\mathbf{x}$, and assume that $\Pr(y=m \mid \mathbf{x})$ is a function of $\mathbf{x}\boldsymbol{\beta}_m$, where $\boldsymbol{\beta}_m = (\beta_{0,m} \cdots \beta_{k,m} \cdots \beta_{K,m})'$ includes an intercept term $\beta_{0,m}$ and coefficients $\beta_{k,m}$ for the effect of variable x_k on outcome m. Following Theil (1969), and using the notation in Long (1997), the probabilities for the ith individual can be written as:

$$\Pr(y_i = m \mid \mathbf{x}_i) = \frac{1}{1+\sum_{j=2}^{J}\exp(\mathbf{x}_i\boldsymbol{\beta}_j)} \qquad \text{for } m = 1 \tag{1}$$

$$\Pr(y_i = m \mid \mathbf{x}_i) = \frac{\exp(\mathbf{x}_i \boldsymbol{\beta}_m)}{1 + \sum_{j=2}^{J} \exp(\mathbf{x}_i \boldsymbol{\beta}_j)} \qquad \text{for } m > 1$$

where the constraint $\boldsymbol{\beta}_1 = 0$ for the first outcome (m = 1) is made to ensure that the probabilities are identifiable.

The model can be estimated by maximum likelihood. From equation (1), let $\Pr(y_i = m \mid \mathbf{x}_i, \boldsymbol{\beta}_2, ..., \boldsymbol{\beta}_J)$ denote the probability of observing $y_i = m$ given $\mathbf{x}_i$, with the parameters $\boldsymbol{\beta}_2$ through $\boldsymbol{\beta}_J$. Furthermore, let p_i be the probability of observing whatever value of y was actually observed for the ith individual. Assuming that the individual observations are independent, the likelihood function is:

(2) $$L(\boldsymbol{\beta}_2, ..., \boldsymbol{\beta}_J \mid \mathbf{y}, \mathbf{X}) = \prod_{i=1}^{N} p_i = \prod_{m=1} \prod_{y_i = m}^{J} \frac{\exp(\mathbf{x}_i \boldsymbol{\beta}_m)}{\sum_{j=1}^{J} \exp(\mathbf{x}_i \boldsymbol{\beta}_j)}$$

where $\prod_{y_i = m}$ is the product over all cases for which y_i equals m.[5]

The partial change in the probability can be computed by taking the derivative of Equation (1) with respect to x_k:

(3) $$\frac{\partial \Pr(y = m \mid \mathbf{x})}{\partial x_k} = \Pr(y = m \mid \mathbf{x}) \left[\beta_{k,m} - \sum_{j=1}^{J} \beta_{k,j} \Pr(y = m \mid \mathbf{x}) \right]$$

Hence, the value of the marginal effect of variable x_k on $\Pr(y = m \mid \mathbf{x})$ depends on the values of all explanatory variables as well as the coefficients for each outcome. Since Equation (3) combines all $\beta_{k,j}$'s the marginal effect needs not have the same sign as $\beta_{k,m}$. Furthermore, as x_k changes the sign of the marginal effect can also change.

A more clear interpretation of the coefficients can be obtained by expressing the multinomial logit model in terms of odds, or relative probabilities of different outcomes. The odds of outcome m versus outcome n, given $\mathbf{x}$, can be expressed as:

[5] For details, see Long (1997).

(4) $$\Omega_{m|n}(\mathbf{x}_i) = \frac{\Pr(y_i = m \mid \mathbf{x}_i)}{\Pr(y_i = n \mid \mathbf{x}_i)} = \frac{\exp(\mathbf{x}_i\boldsymbol{\beta}_m)}{\exp(\mathbf{x}_i\boldsymbol{\beta}_n)} = \exp\left[\mathbf{x}_i(\boldsymbol{\beta}_m - \boldsymbol{\beta}_n)\right]$$

or by taking logs in Equation (4) as:

(5) $$\ln\Omega_{m|n}(\mathbf{x}_i) = \mathbf{x}_i(\boldsymbol{\beta}_m - \boldsymbol{\beta}_n)$$

The partial derivative of the log-odds in Equation (5) with respect to variable x_k equals:

(6) $$\frac{\Delta \ln\Omega_{m|n}(\mathbf{x}_i)}{\Delta x_k} = \beta_{k,m} - \beta_{k,n}$$

Hence, the difference $\beta_{k,m} - \beta_{k,n}$ can be interpreted as a contrast, as for a unit change in x_k, the logit of outcome *m* versus outcome *n* is expected to change with the magnitude of this difference. Also, remembering that $\boldsymbol{\beta}_1 = 0$ for the first outcome, each coefficient $\beta_{k,m}$ can be interpreted as the effect of x_k on the log-odds of outcome *m* relative to the first outcome. In addition to evaluating the marginal effects, in order to examine the impact of a single variable x_k, all explanatory variables except x_k can be fixed at some level and the predicted probability can be plotted as a function of x_k.

4. Empirical results

The results from the estimation of the multinomial logit model according to Equation (1) are presented in Table 3. For each explanatory variable four coefficients are estimated (*m* = 2, 3, 4 and 5), each representing the effect of the variable on the probability of obtaining the outcome *y* = *m* for the individual share of domestic funds, relative to the probability of obtaining *y* = 1, i.e. a share of domestic funds in the range $0 \le w < 0.2$. Table 3 also reports a Wald test statistic for each explanatory variable, which is χ^2-distributed under the null hypothesis that the variable can be excluded from the model.

The age (AGE) of the individual investors is a significant source of explanation for the probabilities of choosing a certain share of domestic pension funds. The Wald test statistic indicates that the null hypothesis of excluding the variable AGE can be rejected at all reasonable

significance levels. Furthermore, the probabilities $\Pr(y=2)$ and $\Pr(y=3)$ are associated with significantly negative coefficients with respect to age, whereas the corresponding coefficients for $\Pr(y=4)$ and $\Pr(y=5)$ are significantly positive. The overall interpretation of the coefficients should be that the probability of the individual choosing a share of domestic funds in the range $0.2 \le w < 0.6$ ($w \ge 0.6$), relative to the probability of choosing a domestic share less than 0.2, is negatively (positively) related to age.

The effects of the variable AGE are further illustrated in Figure 2 through 5. All figures show the estimated probabilities for the five categories, using the model results from Table 3. The continuous variables INCOME, WEALTH, MONEY, FEE and STDEV are set to the overall sample average values according to Table 2a, whereas the occupation, education and familiarity dummy variables are set to zero. Furthermore, in Figure 2, the dummy variable MALE is set to one and FUND_1 through FUND_4 are set to zero. Hence, Figure 2 illustrates the effect of individual age on the probabilities for the part of the sample consisting of males, employed by the government, not familiar with risky investments and investing in five mutual funds.

Evidently, the probability of choosing category 1, i.e. the lowest proportion of domestic funds, is unrelated to age. For all males, with five funds in their portfolios, the probability of investing almost entirely in foreign securities is about 35%. On the other hand, the probability $\Pr(y=2)$ decreases with age, from almost 35% for the youngest to 20% for the oldest males in the sample. The different relationship with respect to age between the probabilities $\Pr(y=2)$ and $\Pr(y=1)$ is reflected in the significantly negative coefficient for AGE in the equation for $\Pr(y=2)$ in Table 3. The probability for outcome 3 appears not to be related to age, as it is virtually constant at 25% for all ages. The coefficient for AGE in the $\Pr(y=3)$ equation in Table 3 is too small to be statistically significant as well. Also, $\Pr(y=4)$ and $\Pr(y=5)$ are increasing with age, confirming the significantly positive coefficients in the two equations from Table 3. Finally, there are no major differences between men and women concerning the age effects on probabilities, given that they invest in five funds. Figure 3 illustrates the difference between the probabilities for males and females, for each category, as a function of age. The differences are small and virtually constant.

In Figure 4 the estimated male probabilities, given that they invest only in one fund (the dummy variable FUND_1 is set to one), are graphed against age. The sensitivities of the probabilities with respect to age appear to be similar to the effects in Figure 2. But the probability levels are closer to

each other, in particular for the oldest individuals. The males closest to retirement have probabilities of ending up in outcomes 1 through 5 roughly equal to 30%, 25%, 20%, 10% and 15%. Also, when comparing the age effects on the probability differences between males and females in Figure 5, it can be discerned that males are more inclined to invest in domestic securities than females, and increasingly so at a higher age. In particular, the difference in $\Pr(y=5)$ is increasing with age whereas the difference in $\Pr(y=1)$ is slightly decreasing. This effect is consistent with the significantly positive coefficient for the MALE dummy variable in the $\Pr(y=5)$ equation in Table 3. Hence, part of the significant difference between males and females can be attributed to a relatively higher probability of the males to become more home biased with older age.

Disposable income (INCOME) of individuals is not a significant explanatory variable for the probabilities of choosing to invest in the different categories, which differ with respect to share of domestic securities. According to the Wald test in Table 3 the null hypothesis that all coefficients associated with the variable INCOME are jointly equal to zero, cannot be rejected at any reasonable level of significance. As a result, this variable is not analyzed any further.

Total net wealth (WEALTH) is a significant explanatory variable, since it is possible to reject the null hypothesis that this variable can be excluded from the model, using the Wald test in Table 3, at the 5% level of significance. The overall significance stems from the equations for the probabilities $\Pr(y=2)$ and $\Pr(y=3)$, where the coefficients for net wealth are significantly negative. In other words, the probability of obtaining outcomes 2 or 3, i.e. of choosing a domestic share in the range $0.2 \le w < 0.6$, relative to the probability of obtaining outcome 1, is decreasing in wealth. These effects can be seen in Figure 6, where the estimated probabilities from the model are plotted against the WEALTH variable. As before, each continuous variable (except WEALTH) is set equal to the corresponding overall sample average, whereas the dummy variables are assigned values to represent a male investor, employed by the government, unfamiliar with risky investments and investing in five funds. Across the chosen range of wealth, between zero and SEK 10 million, $\Pr(y=1)$ is increasing from about 35% to just above 45%. This increase occurs at the expense of a decrease in $\Pr(y=2)$ and $\Pr(y=3)$, wheras $\Pr(y=4)$ and $\Pr(y=5)$ are virtually constant. These results are consistent with the estimated coefficients in Table 3. Note also, in Figure 7, that male and female investors appear only to have small differences in probabilities, and

where the small differences are almost identical for the entire range of wealth. Hence, the patterns in probabilities from Figure 6 can be regarded as representative for both males and females.

Figure 8 considers the sensitivity to wealth of the probabilities for male investors with portfolios of only one fund (FUND_1 = 1). The picture is similar to the one in Figure 6; the significantly negative response of $\Pr(y = 2)$ and $\Pr(y = 3)$ to WEALTH, relative $\Pr(y = 1)$, is once again confirmed. Also, in Figure 9 the differences between males and females are larger than in Figure 7. In particular, the probability of ending up with only domestic securities in the investments portfolio is about 2.5% larger for males than for females. On the other hand, the gender differences are virtually constant with respect to wealth.

The amount of money invested in the pension funds by each individual (MONEY) makes a significant contribution to the model for probabilities. The null hypothesis that the variable MONEY can be excluded from the model without loss of information is rejected at any reasonable level of significance, see Table 3. Analyzing the individual coefficients in more detail, the coefficient for MONEY in the $\Pr(y = 2)$ equation is not significantly different from zero, whereas the corresponding coefficients in the other equations are significantly negative. These effects are illustrated in Figure 10. Once again, the continuous variables (except MONEY) are set to the overall sample averages, and the dummy variables are set to represent a male investor, employed by the government, unfamiliar with risky investments and investing in five funds. For an average male, there is an increase in the probability $\Pr(y = 2)$, from slightly below 25% to nearly 30%, and a slight increase in $\Pr(y = 1)$, over the possible range of money put into the system. These increases are offset by a decrease in the other probabilities as the variable MONEY increases. Hence, individuals who have a small (large) amount of money to enter into the pension system show a relatively higher (lower) likelihood of home bias. Figure 11 also reveals that there seems to be small differences in probabilities between males and females, and the differences are virtually constant over the range of MONEY.

Now turning to Figure 12, where the setting is the same as in Figure 10, except for the number of funds, which is one rather than five. The significant results from Table 3 appear clearly. The probabilities $\Pr(y = 1)$ and $\Pr(y = 2)$ increases with MONEY, whereas the other three probabilities decrease; $\Pr(y = 2)$ increases from approximately 20% to 30% and $\Pr(y = 5)$ decreases from almost 20% to only 5%. Evidently, for males investing in one fund only, there is a

clear tendency for home bias with respect to MONEY. The less money the male individual has to put into the pension system, the more likely he is to choose a fund with a relatively large share of domestic securities. This tendency is not as clear for females. In Figure 13 there is a substantial difference between the $\Pr(y = 5)$ probabilities with respect to gender. Also, this difference diminishes as the variable MONEY increases.

The dummy variables for employment add significantly to the explanatory power of the model. The results in Table 3 show that employment in the private sector (OCC_2) differs significantly from government employment (the base case), at the 5% level. Privately employed individuals have a significantly lower probability of choosing the outcomes 2 and 3 (4 and 5), relative to outcome 1. In other words, individuals in the private sector show a lower likelihood for choosing funds with a large share of domestic securities relative to investors employed by the government. Hence, there appears to be a relatively higher likelihood for home bias among individuals in government employment. On the other hand, the education level of individuals does not contribute significantly to the model, as the Wald tests associated with the dummy variables EDU_2 and EDU_3 can not reject each null hypothesis that the set of coefficient is jointly equal to zero.

Familiarity with risky assets (FAM) is significantly important for the choice of domestic share of funds. Individuals who hold risky assets, other than the ones within the pension system, have a relatively higher probability of ending up in outcome 2 and a corresponding lower probability of ending up in outcome 4. Hence, there is some evidence in favour of the idea that individuals with (without) previous familiarity with risky investments have a comparatively lower (higher) likelihood of home bias. Furthermore, the transactions costs (FEE) add significantly to the model. All coefficients for the variable FEE are significantly negative, where the probability equations for the outcomes with a higher share of domestic assets are associated with negative coefficients with relatively larger magnitudes. This implies that portfolios containing a large share of international assets are more costly than portfolios with predominantly domestic assets. Hence, it is important to control for transactions costs in the analysis.

The risk level of the individual portfolios, as approximated by historical standard deviation of monthly returns (STDEV), is highly significant in the model. All coefficients for the STDEV variable are significantly positive, which indicates that all probabilities, relative $\Pr(y = 1)$, are increasing in the risk level. In Figure 14, where the set up represents a male investor, employed by

the government, unfamiliar with risky investments and investing in five funds, it can be seen that $\Pr(y=1)$ is heavily decreasing in STDEV, whereas in particular $\Pr(y=3)$ is increasing. As is illustrated in Figure 16, restricting the male investors to invest in one fund only, there is also a large increase in $\Pr(y=5)$ as the risk level increases. Evidently, this increasing likelihood of home bias is associated with gender. In Figure 17, as STDEV becomes higher, there is an increasing difference between men and women regarding the $\Pr(y=5)$ probability. Yet again, men appear to have a relatively higher likelihood of home bias than women.

The number of funds chosen by the individuals is also important for the multinomial logit model. From the base case, individuals who choose to invest in five funds, i.e. the maximum allowed, the dummy variables representing fewer funds (FUND_1 through FUND_4) are all significant according to the Wald tests in Table 3. Almost all of the individual coefficients are significantly positive. Furthermore, the coefficients appear to be relatively larger in the probability equation for $\Pr(y=5)$ than in the corresponding equation for $\Pr(y=4)$, and then similarly when comparing the coefficients in the equation for $\Pr(y=4)$ with $\Pr(y=3)$, and $\Pr(y=3)$ with $\Pr(y=2)$. Hence, choosing to invest in less than five securities, rather than five, increases the likelihood to end up in outcomes 2 through 5 relative to the first outcome. Furthermore, the increase in relative likelihood is larger the higher share of domestic funds the outcome represents. This is seen when comparing e.g. the levels of $\Pr(y=5)$ in Figure 2 with Figure 4, Figure 6 with 8 and Figure 10 with 12. The probability of ending up in outcome 5 is always relatively higher for individuals with one fund rather than five funds in the portfolio. Consequently, people investing in one fund show higher likelihood of home bias than people choosing to invest in more than five funds.

5. Concluding remarks

Numerous studies have documented the home bias feature in equity markets all over the world. The common denominator of most studies is to measure and investigate home bias on an aggregated level. The main contribution of this study is to analyse the nature of portfolio allocation and home bias on an individual investor basis.

In the year 2000, the entire work force in Sweden were allowed, or indeed obligated, to allocate 2.5 percent of each individual income into a defined contribution pension scheme. In short, each individual was provided with a choice of 464 mutual funds, of which a maximum of five could be

combined into a portfolio. Information regarding risk level, transactions costs, management and investment allocation of each fund was presented in a brochure distributed to all participating individuals. Hence, each individual could allocate her/his portfolio of mutual funds with the desired proportions of domestic and foreign assets.

The analysis of the home bias issue in this particular context is quite unique with respect to previous research. The portfolio formation within the Swedish premium pension system constitutes a setting where barriers to international investments and information asymmetries are virtually non-existing, and where there is no control dimension in the investments made. In addition, given the detailed set of data, it is possible to investigate what characterises an individual who is relatively reluctant towards international diversification and investments. Also, in this setting it is possible to control for reasons for home bias found in previous studies, as e.g. risk level in investments, transactions costs and the familiarity aspect. Kang and Stulz (1997) as well as Huberman (2001) argue that individuals prefer to invest in what they regard as familiar. In this study, an individual is regarded as familiar with risky investments if he/she owns other risky assets than the ones within the pension system.

The empirical analysis uncovers several significant relationships between individual characteristics and the likelihood of home bias. In particular, age, gender, net wealth, occupation and familiarity with risky investments are important. First, men have a tendency to become more home biased as they grow older whereas this effect is not found with women. Second, wealthier individuals of both genders will typically choose a larger portion of foreign assets. Third, a higher tendency of home bias is found for individuals employed in the public sector than with individuals that are self-employed or work in the private sector. Fourth, the less money that is invested into this pension system the higher the likelihood of choosing domestic assets. This tendency is more pronounced for men than for women. Fifth, there is a diversification effect. More funds in a portfolio lead to a lower likelihood of home bias. Finally, individuals currently owning risky assets are less likely to be home biased.

From the results, it is possible to identify a typical home biased candidate. It would be a less wealthy, older man working for the government and who is not familiar with investments in risky assets, prior to his participation in the defined contribution pension plan.

References

Adler, M. and B. Dumas, 1983, International portfolio choice and corporate finance: a synthesis, Journal of Finance 38, 925-984.

Black, F., 1974, International capital market equilibrium with investments barriers, Journal of Financial Economics 1, 337-352.

Berndt, E., Hall, B., Hall, R., and J. Hausmann, 1974, Estimation and inference in non-linear structural models, Annals of Economic and Social Measurement 3, 653-665.

Choi, J., Labison, D., Madrian, B. and A. Metrick, 2002, Defined contribution pensions: plan rules, participant decisions, and the path of least resistance, in Poterba, J., Ed.: Tax policy and the economy, MIT Press.

Cooper, I. and E. Kaplanis, 1994, Home bias in equity portfolios, inflation hedging, and international capital market equilibrium, Review of Financial Studies 7, 45-60.

Coval, J. and T. Moscowitz, 1999, Home bias at home: local equity preference in domestic portfolios, Journal of Finance 54, 2045-2107.

Dahlquist, M., Pinkowitz, L., Stulz, R. and R. Williamson, 2002, Corporate governance, investor protection, and the home bias, Working paper, Ohio State University.

Engström S. and A. Westberg, 2003, Which individuals make active investment decisions in the new Swedish pension system?, Journal of Pension Economics and Finance 2, 1-21.

French, K. and J. Poterba, 1991, International diversification and international equity markets, American Economic Review 81, 222-226.

Grinblatt, M. and M. Keloharju, 2001, Distance, language, and cultural bias: the role of investor sophistication, Journal of Finance 46, 1053-1073.

Huberman, G., 2001, Familiarity breeds investment, Review of Financial Studies 14, 659-680.

Ingersoll, J., 1987, Theory of financial decision making, Rowman & Littlefield.

Kang, J. and R. Stulz, 1997, Why is there a home bias? An analysis of foreign portfolio equity ownership in Japan, Journal of Financial Economics 46, 3-28.

Karlsson A., 2003, Risk preferences and investment decisions among non-professional investors, Working Paper, School of Business, Stockholm University

Karolyi, A. and R. Stulz, 2002, Are financial assets priced locally or globally?, forthcoming in Handbook of the Economics of Finance, G. Constantinides, M. Harris, and R. Stulz, eds., North-Holland.

Lewis, K., 1999, Trying to explain home bias in equities and consumption, Journal of Economic Literature 37, 571-608.

Long, J., 1997, Regression models for categorical and limited dependent variables, Advanced Quantitative Techniques in the Social Sciences Series 7, Sage Publications Inc.

Madrian, B. and D. Shea, 2001, The power of suggestion: inertia in 401(k) participation and savings behavior. Quarterly Journal of Economics 116, 1149-1187.

Stulz, R., 1981, On the effects of barriers to international investment, Journal of Finance 36, 923-934.

Säve-Söderbergh. J., 2003, Gender, risk and portfolio choices of retirement wealth, Working Paper, The Swedish Institute for Social Research, Stockholm University.

Theil, H., 1969, A multinomial extension of the linear logit model, International Economic Review 10, 251-259.

Uppal, R. and T. Wang, 2002, Model misspecification and underdiversification, Journal of Finance (forthcoming).

White, H., 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, Econometrica 48, 817-838.

Table 1: Summary statistics for the mutual funds

Category 1	Category 2	Category 3	Number of funds	Mean domestic share	Mean foreign share	Mean percentage fee
Equity	Sweden	Sweden (normal)	28	1	0	0.92
		Sweden small cap	6	1	0	1.16
		Sweden index	7	1	0	0.41
	Regional	Swedish equity and foreign equity	11	0.5455	0.4545	0.74
		Norden	12	0.5	0.5	1.27
		Europe	36	0	1	1.11
		Euroland	8	0	1	0.99
		Europe small cap	9	0	1	1.23
		Europe index	7	0	1	0.48
		North America and USA	26	0	1	1.05
		Asia and Far East	18	0	1	1.19
		Global	32	0	1	1.01
		New markets	21	0	1	1.56
	Countries	Japan	20	0	1	1.06
		UK	6	0	1	1.21
		Other countries	19	0	1	1.25
	Industry	IT and Communication	19	0	1	1.15
		Pharmacutical	7	0	1	1.36
		Other industries	16	0.125	0.875	1.17
Mixture	Mixture	Swedish equity and fixed income	3	1	0	1.08
		Swedish equity, Swedish and foreign fixed income	28	0.6577	0.3423	0.74
		Swedish and foreign equity	22	0	1	0.93
Generation	Generation	Pension in less than 10 years	5	0.2	0.8	0.46
		Pension in less than 20 years	6	0	1	0.46
		Pension in more than 20 years	21	0.0714	0.9286	0.46
Fixed inc.	Fixed inc.	Sweden, short maturity	15	1	0	0.46
		Sweden, long maturity	15	1	0	0.45
		Europe and Euroland	18	0	1	0.70
		Others	15	0.0333	0.9667	0.79
All funds			456	0.2399	0.7601	0.85

Table 2a: Summary statistics, average values

	$w < 0.2$	$0.2 \leq w < 0.4$	$0.4 \leq w < 0.6$	$0.6 \leq w < 0.8$	$w \geq 0.8$	All
w	0.0614	0.2945	0.4904	0.6711	0.8544	0.3421
AGE	43.32	41.19	42.64	45.05	47.51	42.86
INCOME	382,061	369,665	349,030	346,909	351,057	364,908
WEALTH	526,928	392,106	403,965	368,031	510,070	438,260
MONEY	13,789	14,298	13,283	13,199	10,736	13,614
FEE	0.8025	0.8226	0.6947	0.6383	0.6252	0.7565
STDEV	0.1659	0.1786	0.1733	0.1623	0.1660	0.1713

Table 2a presents average sample values for the variables; w = the individual domestic share of invested pensions funds, AGE in years of the individual, INCOME = individual's disposable income in SEK, WEALTH = market value in SEK of financial assets and real estate holdings, net of debt for each individual, MONEY = amount in SEK of the total initial investments in pensions funds for each individual, FEE = percentage transactions cost (fee) for the individual investments, STDEV = annualized standard deviation of three-year historical monthly returns for the individual portfolio.

Table 2b: Summary statistics, number of individuals

	$w < 0.2$	$0.2 \leq w < 0.4$	$0.4 \leq w < 0.6$	$0.6 \leq w < 0.8$	$w \geq 0.8$	All
All	3,073	3,119	2,725	984	474	10,375
MALE	1,592	1,541	1,312	504	256	5,205
FEMALE	1,481	1,578	1,413	480	218	5,170
OCC_1	851	950	861	298	129	3,089
OCC_2	1,840	1,843	1,523	579	250	6,035
OCC_3	137	109	118	25	22	411
OCC_4	245	217	223	82	73	840
EDU_1	1,473	1,433	1,262	463	227	4,858
EDU_2	1,015	1,078	924	361	170	3,548
EDU_3	585	608	539	160	77	1,969
FAM	2,070	2,184	1,754	560	292	6,860
FUND_1	845	0	379	106	178	1,508
FUND_2	305	311	510	163	103	1,392
FUND_3	582	643	583	306	95	2,209
FUND_4	460	789	538	209	49	2,045
FUND_5	881	1,376	715	200	49	3,221

Table 2b contains the number of individuals in the sample, categorized with respect to MALE (dummy variable equal to 1 if the individual is male, and zero otherwise), FEMALE (dummy variable equal to 1 if the individual is female, and zero otherwise), OCC_1 (dummy variable equal to 1 if the individual is employed by the government, and zero otherwise), OCC_2 (dummy variable equal to 1 if the individual is employed in the private sector, and zero otherwise), OCC_3 (dummy variable equal to 1 if the individual is self-employed, and zero otherwise), OCC_4 (dummy variable equal to 1 if the individual is unemployed or not registered, and zero otherwise), EDU_1 (dummy variable equal to 1 if the education level of the individual is below high school), EDU_2 (dummy variable equal to 1 if the education level is high school), EDU_3 (dummy variable equal to 1 if the education level is above high school), FAM (dummy variable equal to 1 if the individual has other risky holdings) and FUND_1 through FUND_5 (dummy variables reflecting the number of mutual funds the individual has invested in, 1 through 5).

Table 3: Results from the multinomial logit model

	Pr(y = 2)	Pr(y = 3)	Pr(y = 4)	Pr(y = 5)	χ^2-test
CONSTANT	-0.9574 (0.0000)	-0.6050 (0.0038)	-1.4216 (0.0001)	-3.9445 (0.0001)	-
AGE	-9.23e-3 (0.0007)	-2.24e-3 (0.4280)	0.0222 (0.0001)	0.0303 (0.0001)	100.4 (0.0001)
INCOME	7.17e-9 (0.8836)	-3.82e-8 (0.6526)	-3.68e-9 (0.9741)	1.76e-8 (0.9271)	0.329 (0.9878)
WEALTH	-7.01e-8 (0.0036)	-3.69e-8 (0.0434)	-4.50e-8 (0.2761)	-2.45e-8 (0.5580)	9.836 (0.0433)
MALE	-0.0874 (0.1258)	-0.0253 (0.6722)	0.1233 (0.1468)	0.2979 (0.0090)	14.580 (0.0057)
MONEY	7.10e-6 (0.1036)	-1.18e-5 (0.0101)	-1.28e-5 (0.0607)	-5.36e-5 (0.0001)	53.48 (0.0001)
OCC_2	-0.1674 (0.0078)	-0.2092 (0.0015)	-0.00801 (0.3873)	-0.1926 (0.1345)	12.48 (0.0141)
OCC_3	-0.1996 (0.1655)	-0.0396 (0.7812)	-0.4952 (0.0382)	-0.3570 (0.1833)	6.662 (0.1549)
OCC_4	-0.2081 (0.0611)	-0.1941 (0.0885)	-0.1027 (0.5084)	0.1180 (0.5072)	6.411 (0.1705)
EDU_2	0.0711 (0.2230)	0.0496 (0.4197)	0.1302 (0.1231)	0.1326 (0.2430)	3.506 (0.4769)
EDU_3	0.0397 (0.5699)	0.0890 (0.2235)	-0.0645 (0.5485)	-0.0833 (0.5691)	3.364 (0.4988)
FAM	0.1825 (0.0015)	-4.50e-3 (0.9397)	-0.3363 (0.0001)	-0.1614 (0.1494)	44.21 (0.0001)
FEE	-0.3611 (0.0011)	-2.0107 (0.0001)	-2.5789 (0.0001)	-2.3477 (0.0001)	521.8 (0.0001)
STDEV	7.9021 (0.0001)	11.242 (0.0001)	6.9238 (0.0001)	12.494 (0.0001)	311.6 (0.0001)
FUND_1	-	0.0364 (0.6759)	-0.3952 (0.0061)	1.5669 (0.0001)	95.17 (0.0001)
FUND_2	0.2785 (0.0023)	0.7917 (0.0001)	0.6584 (0.0001)	1.5545 (0.0001)	118.1 (0.0001)
FUND_3	0.3040 (0.0001)	0.3611 (0.0001)	0.8067 (0.0001)	1.0482 (0.0001)	76.55 (0.0001)
FUND_4	0.7117 (0.0001)	0.6266 (0.0001)	0.8719 (0.0001)	0.8466 (0.0001)	121.6 (0.0001)

Table 3 contains results from the estimation of the multinomial logit model in Equation (1). The dependent variable y, has five possible outcomes (m = 1, …, 5), each corresponding to a range of the individual domestic share of invested pensions funds w according to $\{w < 0.2, \quad 0.2 \le w < 0.4, 0.4 \le w < 0.6, 0.6 \le w < 0.8, w \ge 0.8\}$. $\Pr(y = m \mid \mathbf{x})$ is the probability of observing outcome m given $\mathbf{x}$, and is a function of $\mathbf{x}\boldsymbol{\beta}_m$, where $\boldsymbol{\beta}_m$ includes a constant $\beta_{0,m}$ and coefficients $\beta_{k,m}$ for the effect of variable x_k on outcome m. The variables in $\mathbf{x}$ are AGE (in years), INCOME (individual's disposable income in SEK), WEALTH (market value in SEK of financial assets and real estate holdings, net of debt for each individual), MALE (dummy variable equal to 1 if the individual is male), MONEY (total initial

investments in pensions funds for each individual in SEK), OCC_2 through OCC_4 are dummy variables for individuals occupation (OCC_2 represents private sector employment, OCC_3 self-employment, OCC_4 unemployment, whereas the base case represents government employment), EDU_2 is a dummy variable equal to 1 if the education level of the individual is high school, EDU_3 is a dummy variable equal to 1 if the education level is above high school (the base case represents education level below high school), FAM is a dummy variable equal to 1 if the individual has other risky holdings, FEE = percentage transactions cost (fee) for the individual investments, STDEV = annualized standard deviation of three-year historical monthly returns for the individual portfolio. and FUND_1 through FUND_4 are dummy variables reflecting the number of mutual funds the individual has invested in, 1 through 4 (the base case is an investment in 5 funds). The probabilities are modeled as:

$$\Pr(y_i = m \mid \mathbf{x}_i) = \frac{1}{1 + \sum_{j=2}^{J} \exp(\mathbf{x}_i \boldsymbol{\beta}_j)} \quad \text{for } m = 1, \qquad \Pr(y_i = m \mid \mathbf{x}_i) = \frac{\exp(\mathbf{x}_i \boldsymbol{\beta}_m)}{1 + \sum_{j=2}^{J} \exp(\mathbf{x}_i \boldsymbol{\beta}_j)} \quad \text{for } m > 1$$

where $\boldsymbol{\beta}_1 = 0$ for the first outcome. The model is estimated using the maximum likelihood technique outlined in Berndt et al. (1974), and the heteroskedasticity-consistent covariance matrix according to White (1980). The estimated coefficients are presented for each probability and explanatory variable, with *p*-values in parentheses. Each χ^2-test is a Wald test for excluding each explanatory variable, and is χ^2-distributed with four degrees of freedom.

Table 4: Correlation matrix

	w	AGE	INCOME	WEALTH	MALE	MONEY	OCC_2	OCC_3	OCC_4	FUND_1	FUND_2	FUND_3	FUND_4
w	1,0000												
AGE	0,0576	1,0000											
INCOME	-0,0226	0,0518	1,0000										
WEALTH	-0,0290	0,1770	0,3186	1,0000									
MALE	-0,0097	0,0324	0,0058	0,0651	1,0000								
MONEY	-0,0733	-0,1106	0,0923	0,0379	0,2529	1,0000							
OCC_2	-0,0307	-0,1184	0,0512	0,0117	0,3155	0,2333	1,0000						
OCC_3	-0,0158	0,0661	-0,0217	0,0956	0,0749	-0,1084	-0,2395	1,0000					
OCC_4	0,0362	0,0068	-0,0426	-0,0201	-0,0653	-0,2597	-0,3500	-0,0603	1,0000				
FUND_1	-0,0902	0,1705	0,0075	0,0406	0,0227	-0,1449	-0,0317	0,0579	0,0741	1,0000			
FUND_2	0,1035	0,0676	-0,0206	0,0055	0,0100	-0,0987	0,0030	0,0244	0,0376	-0,1623	1,0000		
FUND_3	0,0532	0,0174	-0,0126	-0,0283	-0,0241	-0,0186	-0,0033	-0,0139	-0,0068	-0,2145	-0,2047	1,0000	
FUND_4	0,0239	-0,0646	-0,0108	-0,0180	-0,0048	0,0686	0,0184	-0,0286	-0,0254	-0,2043	-0,1950	-0,2577	1,0000
EDU_2	0,0193	-0,0264	-0,0150	-0,0102	-0,0008	-0,0162	0,0095	0,0151	-0,0062	-0,0096	-0,0054	0,0132	0,0106
EDU_3	-0,0162	-0,0123	0,0335	0,0115	-0,0230	0,0354	-0,0286	-0,0227	-0,0193	-0,0099	-0,0073	-0,0085	-0,0137
FAM	-0,0545	0,1260	0,0817	0,1830	0,0450	0,0706	0,0366	0,0055	-0,0847	-0,0191	-0,0510	-0,0232	0,0061
FEE	-0,1976	-0,0979	0,0571	0,0662	0,0657	0,0516	0,0246	0,0537	0,0053	-0,2348	-0,1191	-0,0514	0,0856
STDEV	0,0176	-0,3113	0,0408	0,0294	0,0645	0,1009	0,0653	0,0057	0,0122	-0,2382	-0,0100	-0,0015	0,0674

Table 4 presents correlation coefficients for the variables; *w* = the individual domestic share of invested pensions funds, AGE in years of the individual, INCOME = individual's disposable income in SEK, WEALTH = market value in SEK of financial assets and real estate holdings, net of debt for each individual, MONEY = amount in SEK of the total initial investments in pensions funds for each individual, MALE (dummy variable equal to 1 if the individual is male, and zero otherwise), OCC_2 (dummy variable equal to 1 if the individual is employed in the private sector, and zero otherwise), OCC_3 (dummy variable equal to 1 if the individual is self-employed, and zero otherwise), OCC_4 (dummy variable equal to 1 if the individual is unemployed or not registered, and zero otherwise), and FUND_1 through FUND_4 (dummy variables reflecting the number of mutual funds the individual has invested in, 1 through 4), EDU_2 is a dummy variable equal to 1 if the education level of the individual is high school, EDU_3 is a dummy variable equal to 1 if the education level is above high school, FAM is a dummy variable equal to 1 if the individual has other risky holdings, FEE = percentage transactions cost (fee) for the individual investments, STDEV = annualized standard deviation of three-year historical monthly returns for the individual portfolio, and FUND_1 through FUND_4 are dummy variables reflecting the number of mutual funds the individual has invested in, 1 through 4.

Table 4: Correlation matrix (cont.)

	EDU_2	EDU_3	FAM	FEE	STDEV
w					
AGE					
INCOME					
WEALTH					
MALE					
MONEY					
OCC_2					
OCC_3					
OCC_4					
FUND_1					
FUND_2					
FUND_3					
FUND_4					
EDU_2	1,0000				
EDU_3	-0,3489	1,0000			
FAM	-0,0133	0,0296	1,0000		
FEE	-0,0129	0,0256	0,1070	1,0000	
STDEV	-0,0027	0,0270	0,0520	0,4818	1,0000

Figure 1: Frequency diagram for w = the relative share of domestic funds

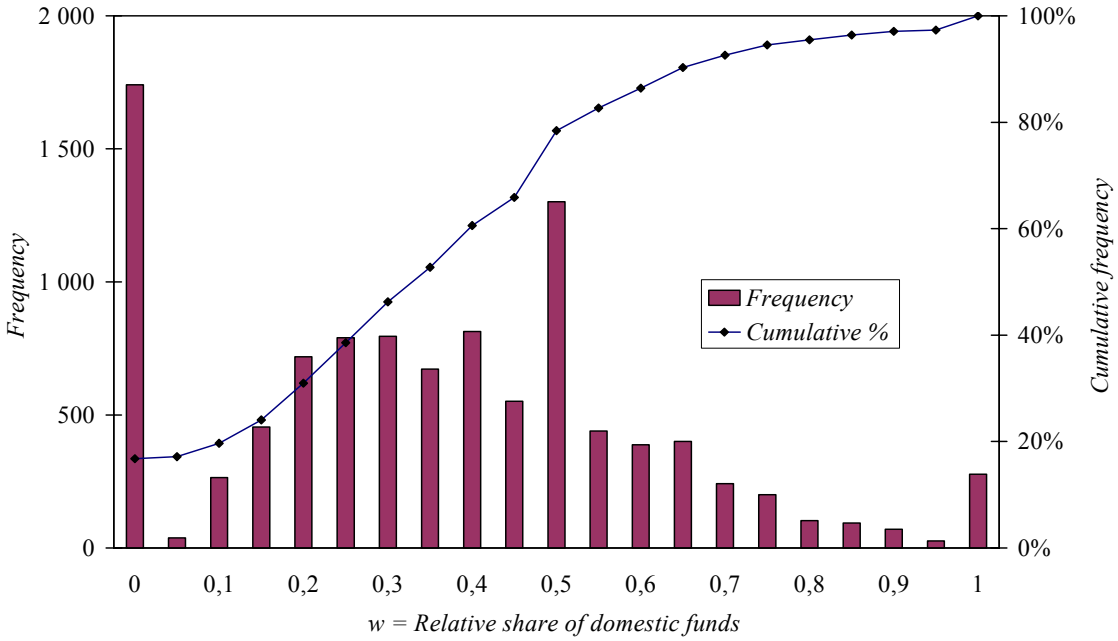

Figure 2: Probability for *y* = category of the relative share of domestic funds, with respect to AGE, for men with number of funds = 5

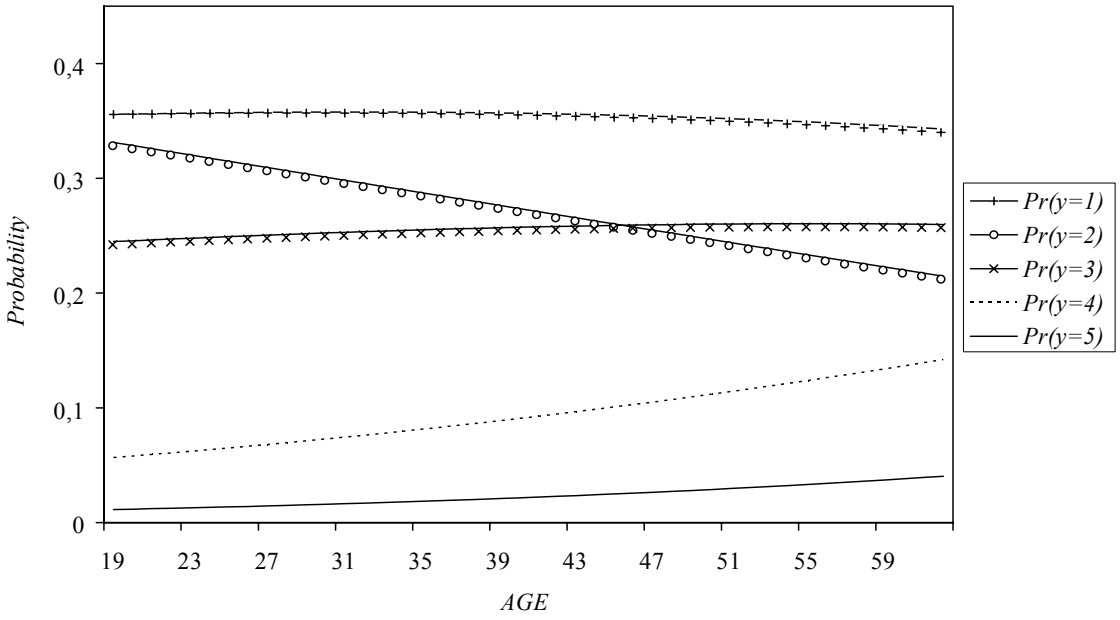

Figure 3: Probability for *y* = category of the relative share of domestic funds, with respect to AGE, difference between men and women with number of funds = 5

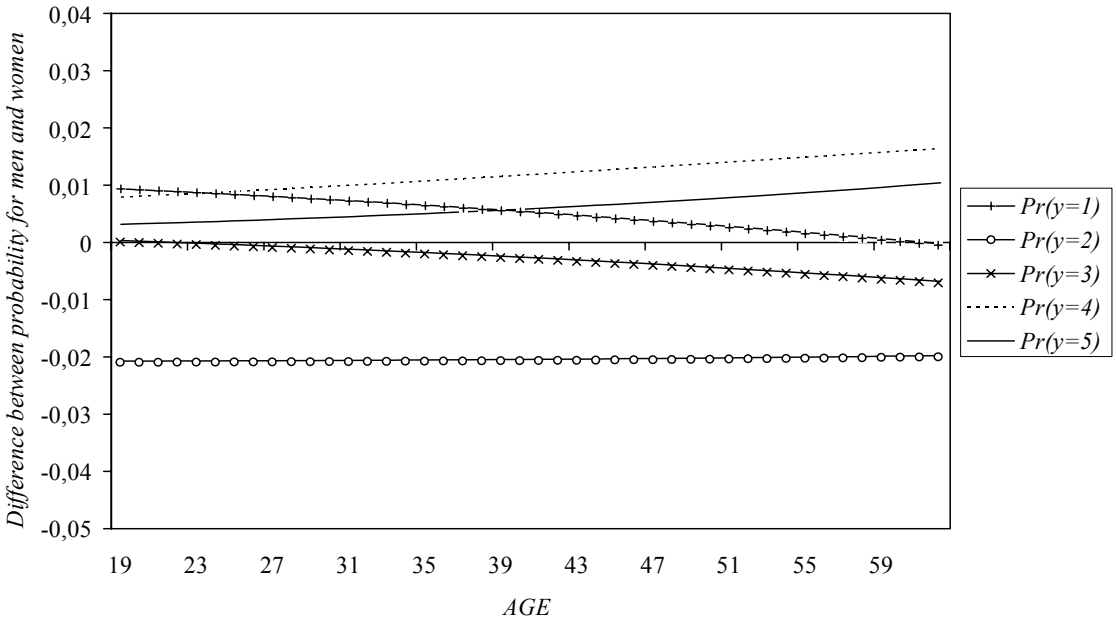

Figure 4: Probability for *y* = category of the relative share of domestic funds, with respect to AGE, for men with number of funds = 1

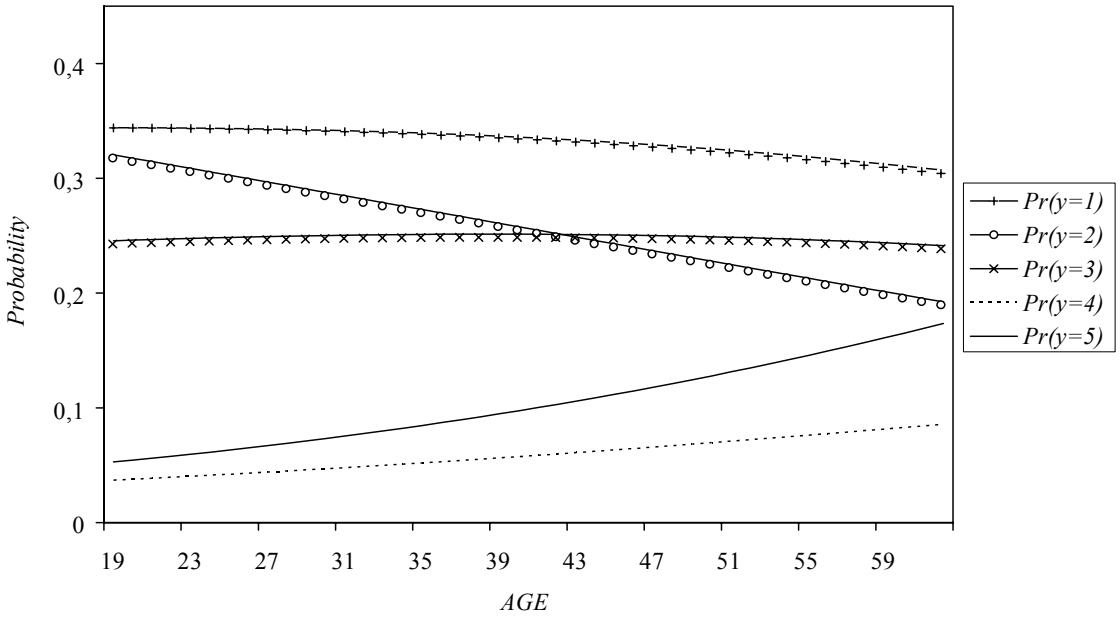

Figure 5: Probability for *y* = the relative share of domestic funds, with respect to AGE, difference between men and women with number of funds = 1

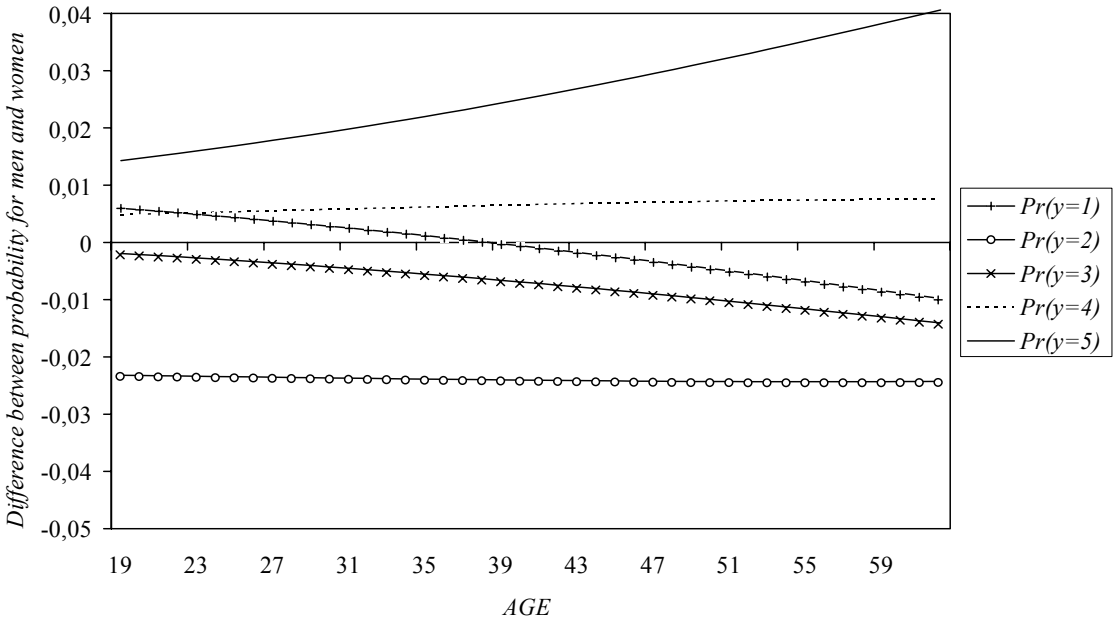

Figure 6: Probability for *y* = category of the relative share of domestic funds, with respect to WEALTH, for men with number of funds = 5

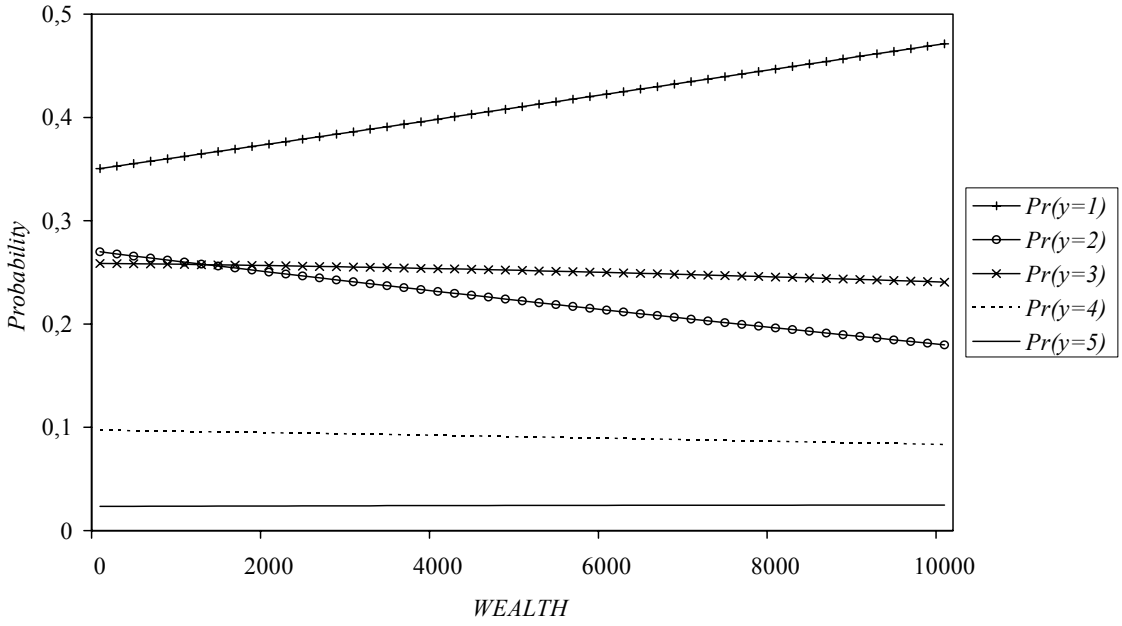

Figure 7: Probability for *y* = the relative share of domestic funds, with respect to WEALTH, difference between men and women with number of funds = 5

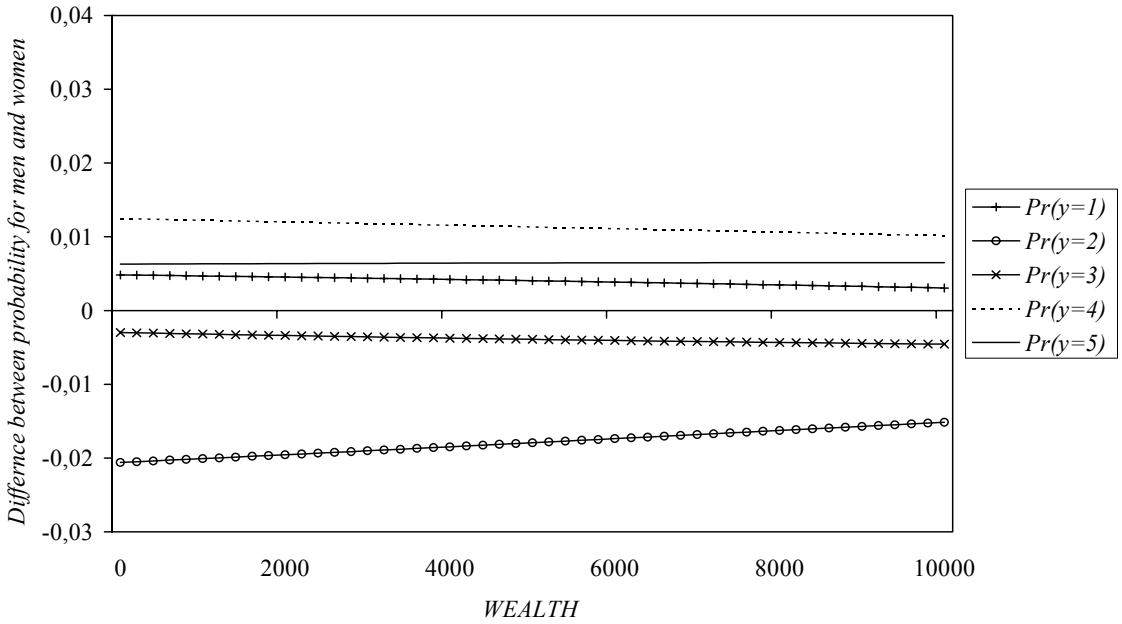

Figure 8: Probability for *y* = the relative share of domestic funds, with respect to WEALTH, for men with number of funds = 1

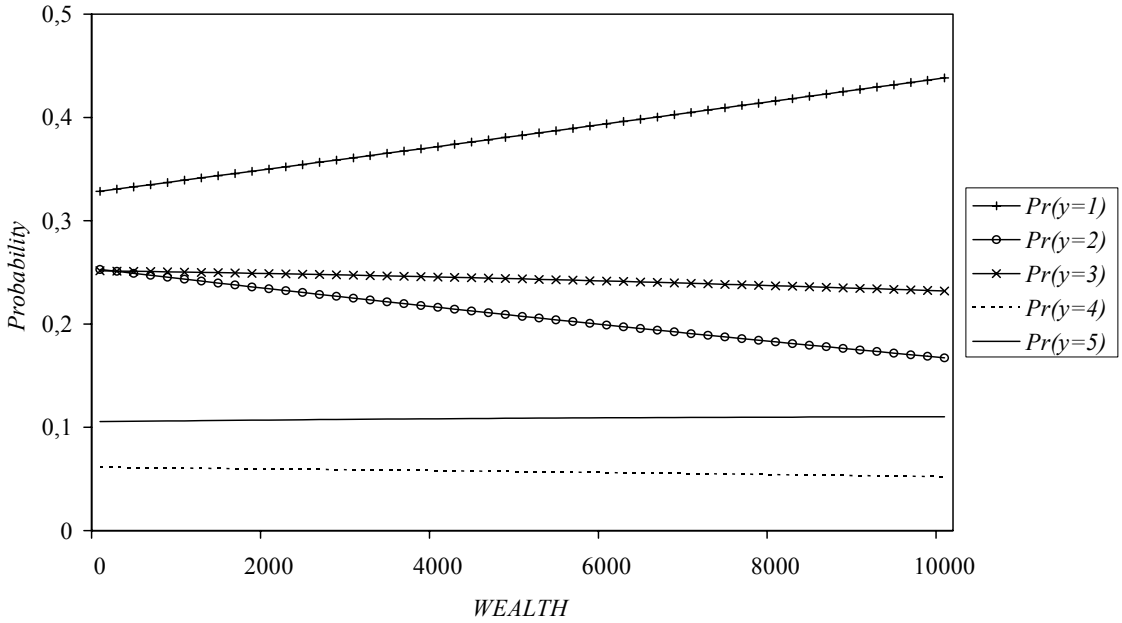

Figure 9: Probability for *y* = the relative share of domestic funds, with respect to WEALTH, difference between men and women with number of funds = 1

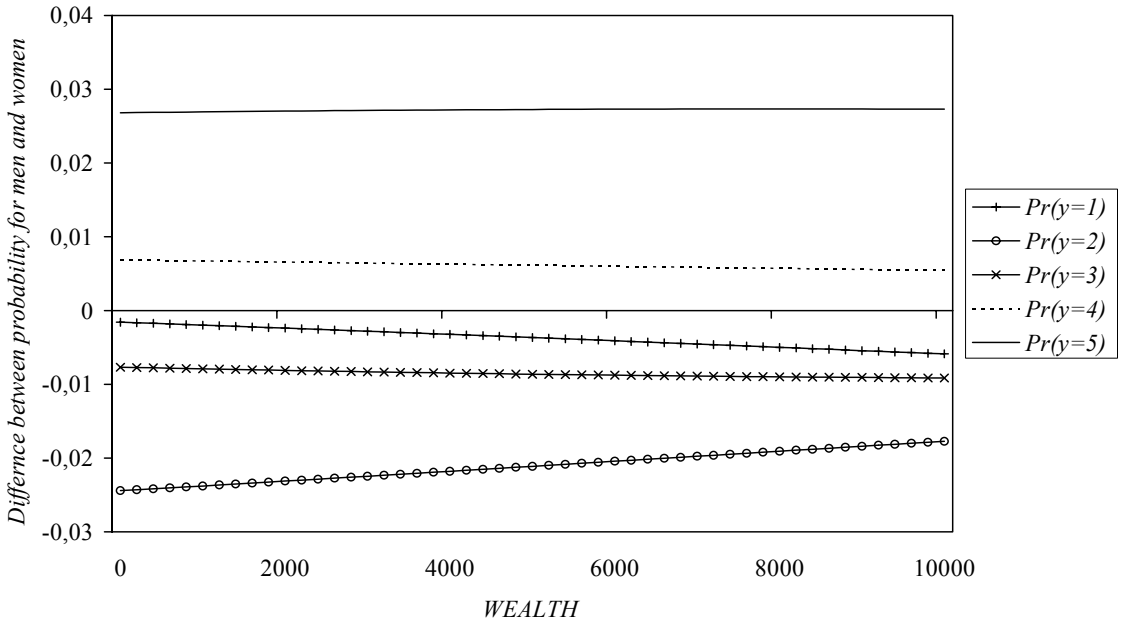

Figure 10: Probability for *y* = category of the relative share of domestic funds, with respect to MONEY, for men with number of funds = 5

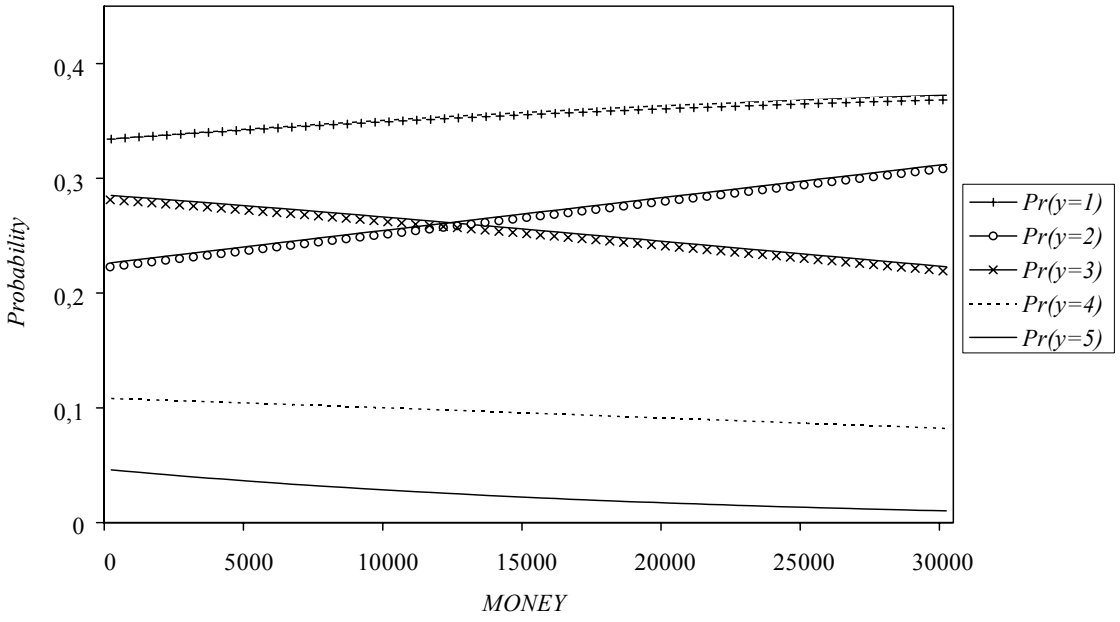

Figure 11: Probability for *y* = category of the relative share of domestic funds, with respect to MONEY, difference between men and women with number of funds = 5

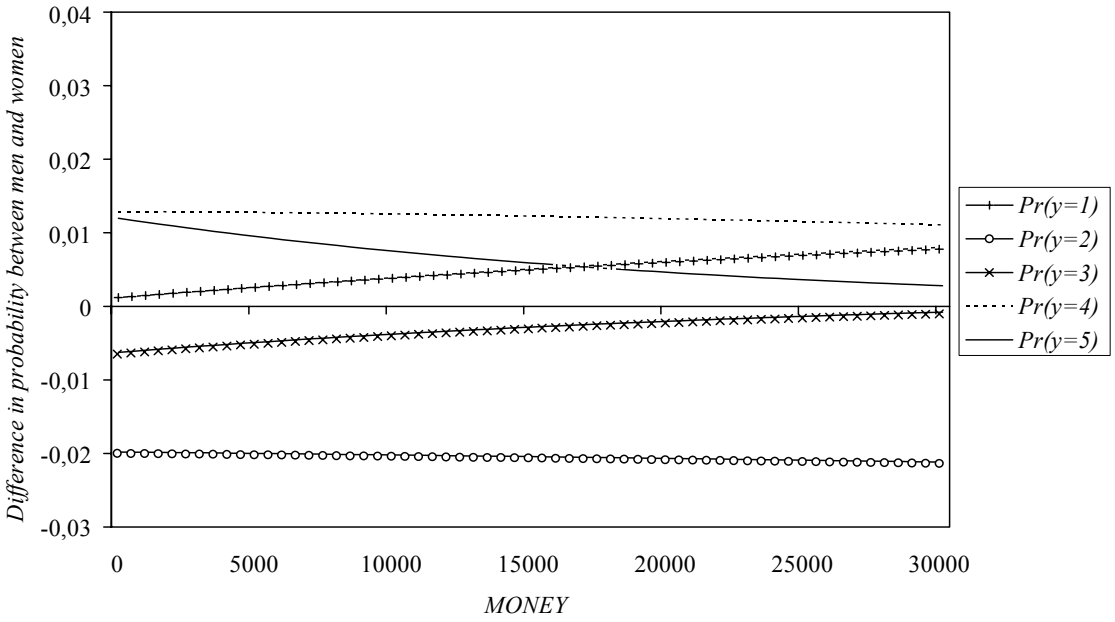

Figure 12: Probability for *y* = category of the relative share of domestic funds, with respect to MONEY, for men with number of funds = 1

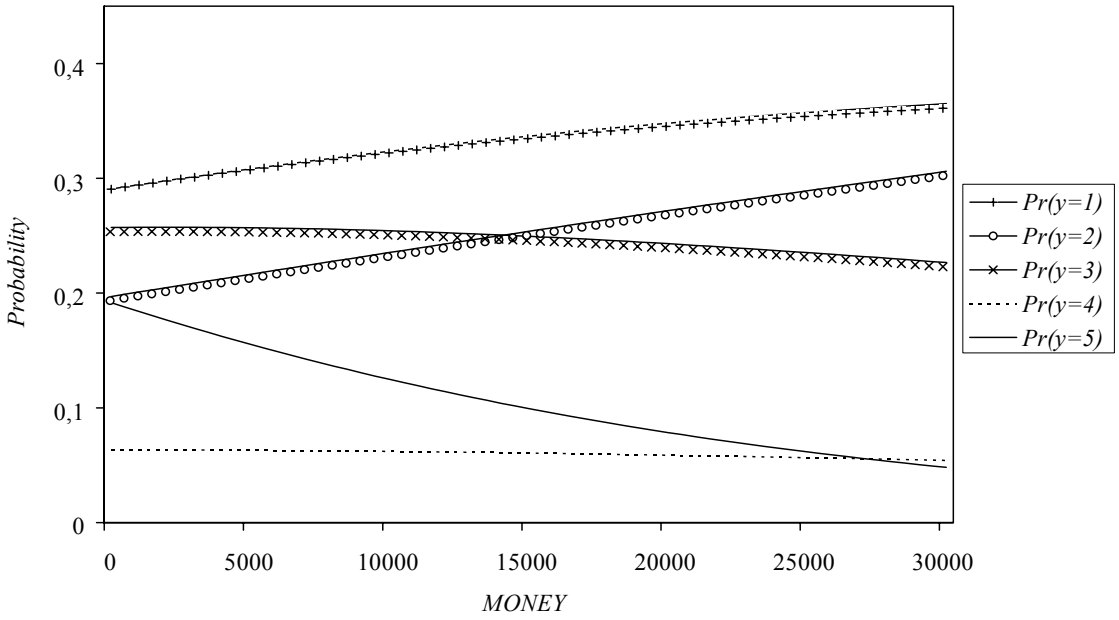

Figure 13: Probability for *y* = category of the relative share of domestic funds, with respect to MONEY, difference between men and women with number of funds = 1

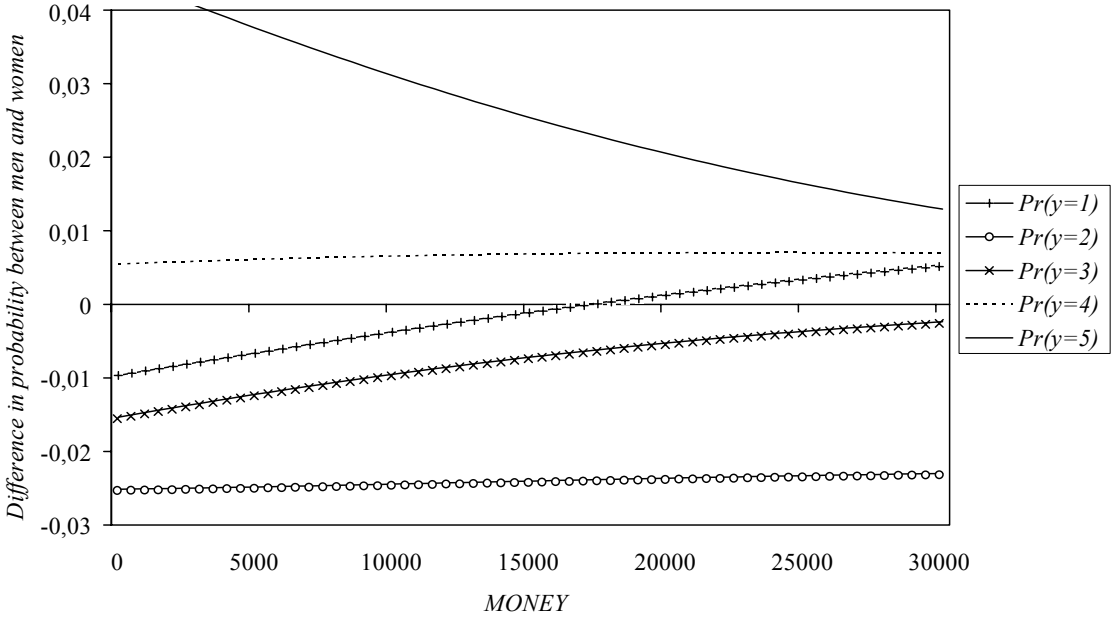

Figure 14: Probability for *y* = category of the relative share of domestic funds, with respect to STDEV, for men with number of funds = 5

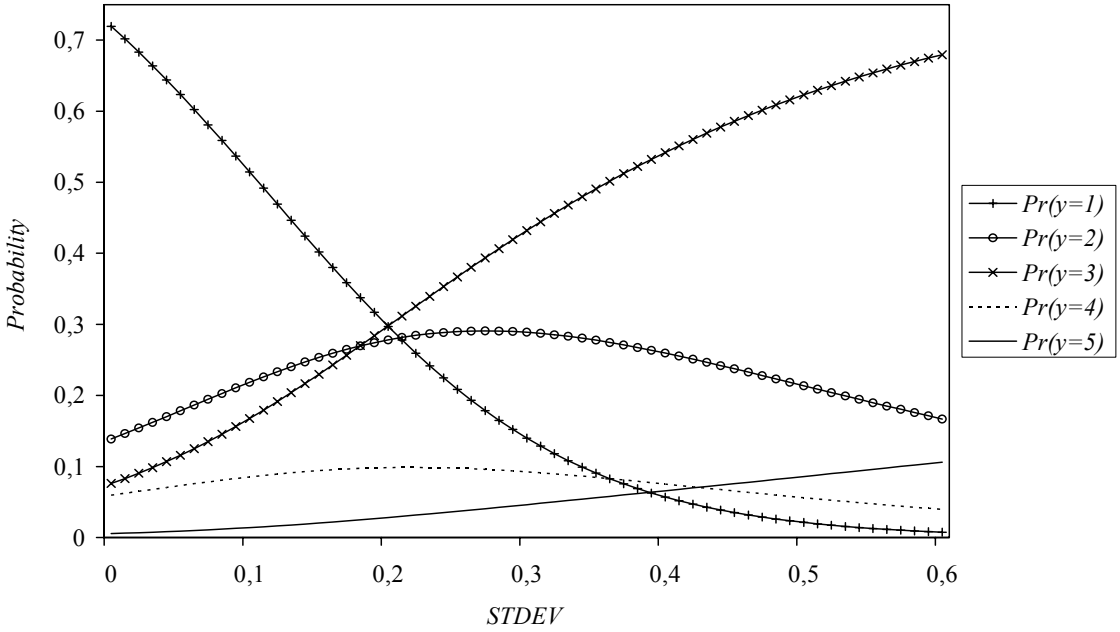

Figure 15: Probability for *y* = category of the relative share of domestic funds, with respect to STDEV, difference between men and women with number of funds = 5

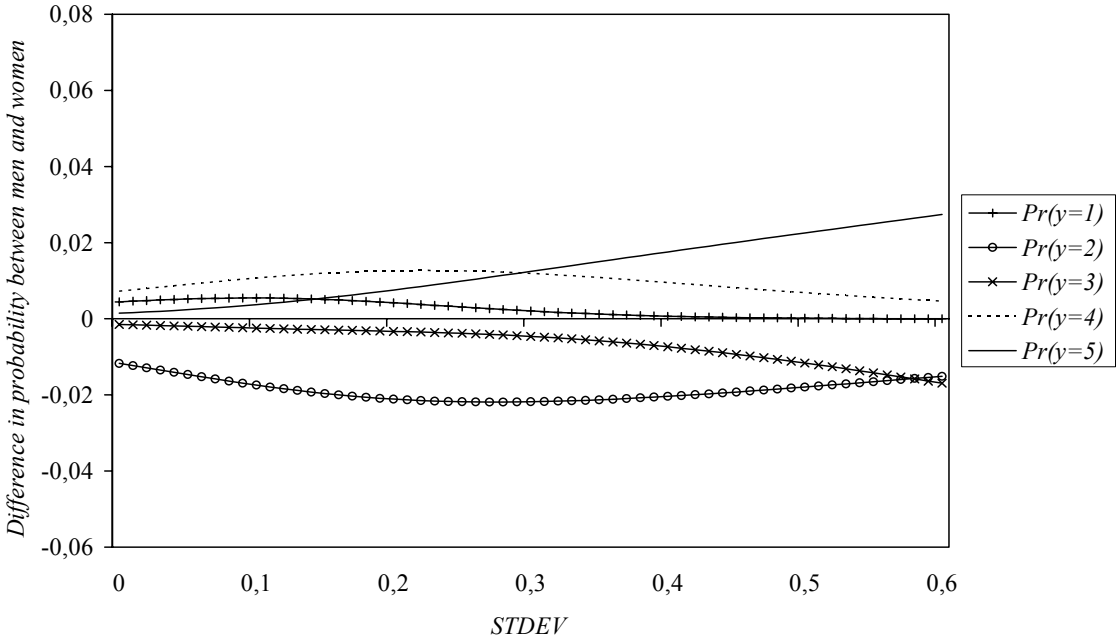

Figure 16: Probability for *y* = category of the relative share of domestic funds, with respect to STDEV, for men with number of funds = 1

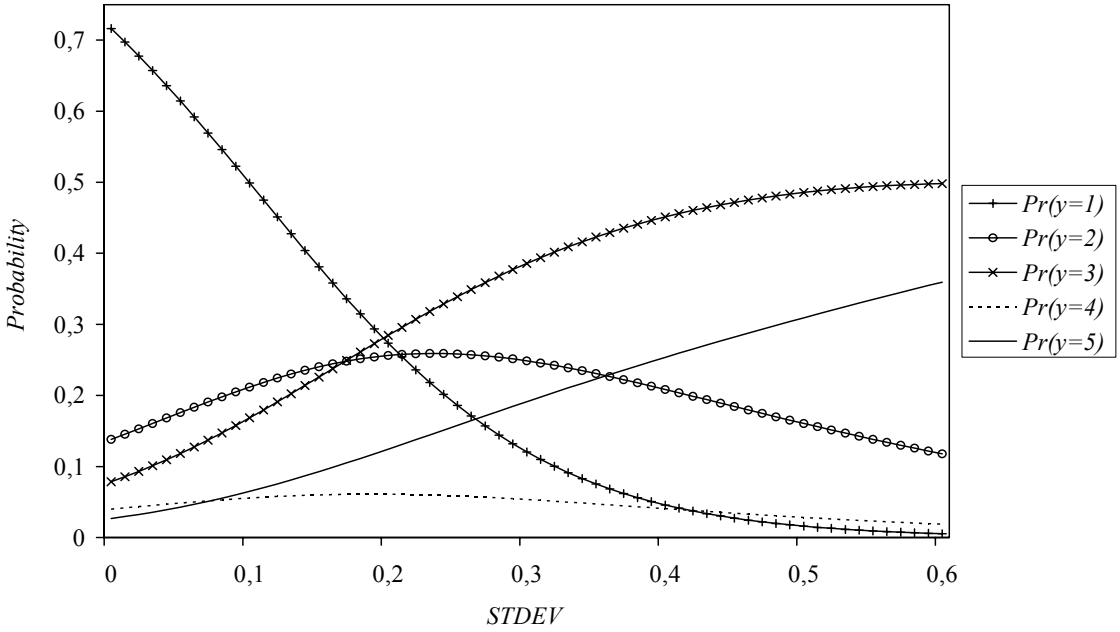

Figure 17: Probability for *y* = category of the relative share of domestic funds, with respect to STDEV, difference between men and women with number of funds = 1