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Gender Differences in Risk Attitudes: An Analysis of the Swedish Premium Pension System

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Abstract

This thesis examines gender differences in investment behavior within the Swedish Premium Pension System for the years 2015-2022. The thesis uses the pension system as a case study to identify possible differences in risk attitude, factors that affect and whether gender has an impact on the level of home bias in investment decisions. Different risk measures are used to formulate equations used in the empirical analysis. Regressions were performed on all research year both pooled and separately; the results gave in general significant evidence of women being more risk-averse than men and that women exhibit home biasness to a greater extent than men. This thesis concludes that men and women differ in investment strategy, a difference explained by theories such as behavioral finance, home biasness and risk-awareness.

Keywords: *decision making, investment behavior, gender differences, risk, risk attitude, PPS, PPS choices, funds.*

1. Introduction

The issue of gender inequality has gained more attention in various fields, including finance. The differences in investment behavior have been shown to have significant effects on investment outcomes, which in turn affects the financial industry. The different behavior by the genders have shown a difference in investment choices including managing retirement savings. This study aims to explore gender differences in investment behavior and their effects on investment outcomes, using the Swedish Premium Pension System (PPS) as a case study.

There are several discussions on this issue, rooted in the inequality that creates a gender gap. The gap can be explained by disparity in wages, women in general have less money available for investment than men, leading to a more cautious decision-making and a more conservative investment strategy, with less or no investments. This finding can in turn result in a significant wealth gap between genders (Almenberg and Dreber, 2015; Lusardi and Mitchell, 2014). One consequence of women not seeking financial knowledge to the same extent as men makes it difficult for women to have the same conditions as men in the financial industry (Barber and Odean, 2001). This lack of financial literacy can further exacerbate the wealth gap between genders, as females may not have the same opportunities as males to make informed investment decisions and grow their wealth.

Investments are important to accumulating wealth and must be equally available to everyone, regardless of gender. Despite that previous studies find that women have lower levels of financial knowledge and investing skill than men (Hessami and da Fonseca, 2020).

It is essential to look at the gender-neutral law of the Swedish Premium Pension System in order to comprehend how gender differences might impact financial judgment, particularly in the context of behavioral finance and investment habits. This approach offers a great chance to examine gender disparities and how they affect financial results. We hope that this study will help to gain a better understanding and shed light on the subject.

The PPS is a part of the public pension system that was introduced in 1999 and per defined as a pension scheme enabling individual-based savings. This new reform was designed to develop into a stable financial system that would not be subject to socioeconomic growth, to provide more flexibility and choice to individuals managing their pension savings (PPM, 2021). As stated prior the PPS is gender neutral as it does not differ in investment options or benefits to either of the genders. The system allows individuals to save their retirement through private pension funds. With a wide range of investment options, individuals can make their own investment decisions

based on investment preferences and risk tolerance. However, for individuals who do not make an active investment decision the Swedish government introduced a preselected fund option AP7Såfa (PPM, 2021).

Prior studies have shown that men take a significantly higher financial risk than women, with the gender gap being explained by factors such as risk tolerance and financial literacy, the knowledge and skills needed to make a financial decision. Furthermore, men are found to have greater risk tolerance and financial literacy compared to women (Lundström and Rapp, 2017). Dholakia and Chang (2021) support this finding by explaining the lower financial knowledge by women being more risk averse. Demonstrating that women are more risk-averse and are more likely to choose lower-risk investments even when they have similar levels of financial knowledge to men.

1.1 Problem discussion

What makes this area of great interest and importance to examine is that despite the equality progress in many fields, gender differences in financial investment behavior have persisted for many years. Gender disparities in investment behavior within this subject can lead to women have lower retirement savings than men, resulting in financial insecurities upon retirement. The gender gap in pensions is 33% lower for women than men according to the Swedish Pensions Agency (2019). This gender difference is due to wage differences, career break for children cares but also investment behavior. Looking at the annual value development from PPS, the development of the male investors is greater compared to the females (PPM, 2022).

The gender gap in investment behavior is a complex, multifaceted issue. All individuals ought to be able to profit equally from financial investments and achieve financial success, however societal and cultural variables might affect an individual's decision-making process, particularly in financial matters. By understanding the causes of the pension gap between the genders and developing strategies to increase gender equality in the Swedish pension system is dominant in solving this issue. We can find strategies to encourage higher financial literacy and investment behavior among women and ensure that everyone has access to a secure retirement by looking at gender differences in risk preferences and investment behavior.

It is essential to address this problem by understanding how both genders view risk and make financial decisions. Examining gender disparities in risk preferences and investment behavior can help close the gender gap by better encouraging financial knowledge among women.

1.2 Purpose

Since women's average pensions are smaller than men's, the gender inequalities in financial investment behavior in Sweden have several negative effects on saving for retirement (PPS, 2021). The study's goal is to analyze the active investment choices made by both genders in the premium pension plan, which is an equally representative sample as it encompasses the whole Swedish population within this study's range. In order to help investors, make sound financial decisions and identify impending hazards, the study aims to further the understanding of how gender influences attitudes toward risk in the investment world. This study's theoretical contribution is to highlight potential gender inequalities in investment decision-making and to provide suggestions on how to advance gender equality in financial decision-making.

The study's main goal is to provide insight on how gender effects investment behavior and returns in this setting, which may lead to steps to promote gender equality in the financial industry and lessen the negative economic repercussions of gender-based inequities.

1.3 Research questions

To address the problem and achieve the purpose of this thesis, the following sub-questions will be addressed:

1. Is there a gender disparity in investment behavior within the Swedish Premium Pension System, and are there gender-specific factors that contribute to this gap?
2. Does gender play a significant role in influencing the extent of home bias in investment decisions within the Swedish Premium Pension System?

1.4 Delimitations

The study is limited to the Swedish population and includes data from the last 7 years (2015-2022) due to time constraints. Only active investors will be included thus all investments in the pre-selected fund AP7Såfa will be excluded as it cannot be determined whatever the investors actively chosen the fund or were assigned the default option.

1.5 Disposition

This thesis is structured into seven chapters. Chapter 1 introduces the research problem and the objectives of the study. Chapter 2 presents a comprehensive literature review, which summarizes relevant previous research and serves to contextualize the research question. Chapter 3, the theoretical framework is developed, drawing on existing models and theories to formulate testable hypotheses. Chapter 4 describes the data used in the study. Chapter 5 presents the methodology employed, including econometric techniques. Chapter 6 presents the results of the analysis, and Chapter 7 concludes the thesis by summarizing the key findings, discussing implications and future research.

2. Literature Review

The Swedish pension system encompasses three main components: occupational pension, income pension, and premium pension, see Appendix 1.

The occupational pension is provided by employers as part of the employment benefits. It involves allocating a portion of an employee's salary towards retirement savings, either through defined contribution or defined benefit plans (PPM, 2023). The income pension and premium pension, collectively referred to as the "state pension," are established by the Swedish pension system. The income pension is income-based and dependent on the individual's earnings during qualifying years of work. It provides a portion of the retirement income (PPM, 2023). The premium pension allows individuals to allocate a portion of their pension contributions to private pension funds. It offers the opportunity to invest and manage one's pension savings according to personal preferences (PPM, 2023).

The Swedish pension system aims to ensure a secure retirement by combining public and private pension provisions. Despite this autonomy, studies have shown that gender differences in investment behavior may result in variations in risk-taking and returns. According to several research, women are often less risk-taking when making investment decisions than males, which might result in poorer investment returns (Brennan et al., 2013; Barber and Odean, 2001). It is important to note that this research focus will be on the premium pension component, as it allows individuals to make their own investment-decisions regarding their pension (PPM, 2023).

The literature review provides a summary of the studies on gender variations in investing behavior and the factors that affect investment risk-taking in order to provide a thorough grasp of this issue.

2.1 Differences in Investment Behavior by Gender

Women are more likely than males to take on low-risk ventures, and they typically choose less risky financial measures. Krauss and Weber (2020) made research on a well-known online investing platform and discovered that women tend to maintain a bigger percentage of their portfolios in cash and low-risk assets and were less inclined to invest in high-risk assets. These findings are in line with Lurtz and Odean (2020) research on a prominent discount brokerage business, were women showed a preference in keeping their portfolios diversified in order to avoid higher risk. Additionally, they concluded that female investors generally exhibit a preference for lower volatility investment strategies and are less inclined to engage in frequent trading. Women in general tend to have a more passive investment strategy whereas men are more active investors, and trade 45% more frequent than women (Barber and Odean, 2001) This can be explained by the fact that women often have longer investment horizons and are more patient. Women also have a more careful way of thinking as they want their financial choices to mirror their ethical and societal values (Kumar and Goyal, 2010; Croson and Gneezy, 2009).

Further the strategies are clearer when looking at preferred investment choices, while men prefer risky investments women are more prone to safer decisions (Statman and Glushkov, 2009). This is in line with Sundén and Surrette (1998), that when choosing how to place assets in their retirement savings accounts, females have higher levels of relative risk aversion than males. This suggests that there is considerable gender-based disparities in investment behavior, which have significant ramifications for retirement and investment planning (Kumar and Goyal, 2010; Croson and Gneezy, 2009).

On the other hand, a study by Schubert et, al. (1999) suggested that the assumption about women being less risk averse than men is false. The author found that women did not make less hazardous financial decisions than males. Further suggesting that variations in opportunity sets may be responsible for gender differences in risk-taking behavior, such as socioeconomic, cultural, and psychological that contribute to gender variations in investing behavior (Bachinger, 1999; Kim and de Vries, 2017).

2.2 Differences in Investment Performance by Gender

Researchers are still debating the relationship between gender and investment performance. While some studies find women to outperform men in the long-run due to their cautious investment strategy, other studies find women to underperform due to the same reason. Barber and Odean (2001) write that the less frequent investing and diversified portfolio result in higher investment returns. Similarly,

Oehler et al. (2015) examines female fund managers under market downturns and find that they outperform men in that aspect. Furthermore, recent studies by Bianchi et al. (2017) and Barber et al. (2018) have found no significant difference in investment performance between genders. These findings suggest that gender alone may not be a reliable predictor of investment success but other personal characteristics such as risk-aversion and investment strategy, are driven factors for gender disparities in investment performance. While Chan and Volpe (1998) imply that these personal characteristics for instance are associated with the different genders, in line with previous section they propose that women are more risk-averse compared to men, and therefore holds lower investment returns. This is supported by the suggestion that men are generally more aggressive investors and yield higher returns due to their choices of higher risk investments (Hirschey and Winters, 1989)

Overall, the relationship between gender and investment performance remains complex. While some studies indicate that women outperform men in the long run, others show no discernible difference. To gain a comprehensive understanding of this relationship, further research is needed, considering factors such as individual characteristics such as risk aversion and investment preferences.

2.3 The Swedish Premium Pension System and Investment Behavior

The Swedish Premium Pension System (PPS) is a mandatory individual account-based pension scheme introduced in Sweden in 1999. It allows participants to make investment choices within a range of approved funds, promoting personal responsibility for retirement savings. The system has garnered significant attention due to its potential impact on investment behavior, particularly regarding risk attitudes.

Research has consistently shown that men and women tend to exhibit distinct risk attitudes when it comes to financial decision-making. Several studies have investigated gender differences in investment behavior within the context of the PPS, shedding light on the variations in risk preferences and investment choices.

A study by Andersson, Malmendier, and Schmidt (2019) found that women generally exhibit lower risk tolerance compared to men. This difference in risk preferences translates into distinct asset allocation patterns within the PPS. For instance, women tend to allocate a larger portion of their pension assets towards fixed-income and low-risk funds, aiming for capital preservation rather than high returns. In contrast, men are more likely to invest in equity-based and high-risk funds, seeking higher potential returns despite the associated volatility.

The investment choices made within the PPS can significantly impact the performance and long-term outcomes of individuals' pension savings. It has been observed that men, due to their higher propensity for risk-taking, may experience greater variability in investment returns. On the other hand, women's more conservative investment approach may lead to relatively stable but potentially lower returns. Elton, Gruber, and Blake (2021) have examined the relationship between risk attitudes and investment outcomes, highlighting the trade-offs between risk and return in the context of the PPS.

Moreover, gender differences in investment behavior within the PPS can also be influenced by behavioral biases. For instance, research by Barber and Odean (2018) suggests that overconfidence and excessive trading are more prevalent among men. These biases can have implications for investment performance, as frequent trading and overconfidence may lead to suboptimal investment decisions.

3. Theoretical background

3.1 Behavioral finance

When examining the difference between how males and females make their investment decisions, it is a question of behavior. Besides knowledge and other aspects that can influence the individual's decision-making there can be psychological and emotional factors that influence the financial decision. Behavioral finance recognizes that individuals as investors are not always rational and may take decisions that are biased and based on emotions rather than objective analysis (Kahneman and Tversky, 2013).

Studies have shown that behavioral biases are of importance to understand the role of behavior in investment decisions. According to Barber and Odean (1999) there are different biases that can be underlying for investment decisions. Regarding gender difference, the authors found men to be more prone to these biases. They found that investors frequently and persistently exhibit overconfidence bias, which causes them to make poor investing choices. Overconfidence is defined as a bias that provokes investors to believe they have more knowledge than they do. This bias causes investors to take on more risk than is appropriate for their investment goals. Looking at overconfidence, it is observed that men tend to exhibit greater overconfidence bias than women in their investment decisions. Men trade more frequently and are more likely to hold on to losing investments for longer periods of time. The authors also suggest that men find a greater interest and more information seeking. The frequent trading and the high information seeking argues that men have a more

overconfident behavior. As the overconfidence bias tends to make investors less risk-averse, it is concluded that women that does not exhibit the bias to the same extent as men, make more rational decisions and does not overestimate their ability (Barber and Odean, 1999).

3.2 Home bias

Home bias is a phenomenon where individuals tend to invest more in domestic assets than foreign assets. Home bias is like "familiarity bias", one of the biases recognized by Barber and Odean (1999). According to Barber and Odean (1999) familiarity bias contributes to home bias, as individuals that exhibit the bias tend to prefer assets that they are familiar with and have greater knowledge about. As a result of greater access to information and understanding of the domestic market, investors prefer domestic assets. They also claim that familiarity bias can lead to overconfidence because investors can feel more confident in their ability to forecast the performance of a familiar asset. The home bias can reduce diversification and lead to a poor investment. However, the authors suggest that by broadening the investment horizon and learning more about the foreign markets one can avoid adopting the bias.

In a study by Caporale and Matousek (2011) examine if there are any differences between men and women in home bias. They mainly study individual investors and to which extent they invest in domestic versus foreign assets. The authors conclude that females exhibit less home bias than men in their investment decisions. The main reason behind it according to Caporale and Matousek (2011) is that women tend to be more risk-averse than men, which leads them to strive after a diversified portfolio and to reduce risk. Then again, other variables such as education level, income, age also contribute to explaining the gender disparities in home bias.

However, women may make investing decisions that are more biased toward domestic assets than males. The "safe choice" referred to women being more likely to make investments that are more familiar and secure to them. As a result, female investors may favor domestic assets over foreign as they are common with the economic and political environment of their home country. Research by Estrada and Park (2017) revealed that women were more likely to invest in safe and commonly known assets than men. This aligns with the findings by Amel- Zadeh and Serafeim (2018), that women were more likely to invest in domestic companies and generally make investments that are home biased due to a desire for the secure option of familiarity.

Although Caporale and Matousek (2011) discovered that women have a lower level of home bias than males, Amel-Zadeh and Serafeim (2018) found that women may favor familiarity and have a higher level of risk aversion. These elements could encourage women to allocate more of their investments into comfortable domestic assets, which would increase the home bias.

3.3 Efficient market hypothesis

According to the Efficient Market Hypothesis (EMH), financial markets are efficient at processing all relevant information to determine asset values. This hypothesis suggests that it is unlikely for publicly available knowledge to be consistently used to outperform the market, and any attempt to do so is more likely to succeed by chance rather than through expertise. This view was originally proposed by Fama in 1970 (Fama, 1970).

The EMH has been widely discussed in the field of finance, with some scholars including Eugene Fama (1970), Burton Malkiel (1973), and Michael Jensen (1968), arguing that it accurately reflects reality, while others like Richard Thaler (2008), Robert Shiller, and Andrei Shleifer (1999) maintain that there are market inefficiencies that can be exploited. This hypothesis is relevant to the discussion of gender-based investment returns since it provides a theoretical framework for understanding how gender might impact investment behavior.

If the EMH is correct, any gender-based differences in investment returns could be attributed to factors such as variations in risk tolerance or investing strategies. However, if the EMH is incorrect, gender-based biases in the market may result in differing returns for male and female investors.

In the context of the EMH, research has been conducted on gender disparities in investment performance. If markets are genuinely efficient, gender should have minimal impact on the success of an investment, and any differences in performance between male and female investors would primarily be caused by luck rather than skill (Sapp and Yao, 2014). Additionally, if markets are efficient, investors should focus on diversification and

long-term investments rather than attempting to play the market or pick individual stocks (Barber and Odean, 2001). Moreover, the study show that women tend to be more patient and cautious investors than men, which can lead to a more diversified portfolio and a longer-term investment strategy. This approach has resulted in women investors outperforming male investors by an

average of 1.8% annually, according to research conducted by Barclays Wealth and Ledbury (2009). While gender may have a minimal impact on investment success, other factors such as investment strategy and market conditions are likely to be more important.

Moreover, the EMH provides a useful framework for understanding financial market behavior and the role of investors within it, although it may not accurately reflect real market activity. The core tenet of modern finance theory is that markets are largely efficient and take in all available information, as proposed by Malkiel (2003). If the EMH holds, it would generally assume that investors hold with the default option of AP7Såfa as it holds the lowest available costs.

4. Data

4.1 Data Collection

The dataset is extracted from the Swedish pension authority between the dates 2015-01-01 and 202212-01. Hence, the monthly data is published first day of every month (PPM, 2022). The research period encompasses a comprehensive dataset to extend previous research. The study is bonded do the Swedish pension fund investments where all active investments are selected. The provided data includes the number of accounts held by both genders, as well as detailed information on investment funds such as their origin, fund type, historical returns, risk and Sharpe ratio.

The dataset contains selected data from all research years. The dataset contains 52,872 observations as a total, from the dataset, the default option has been removed, along with any observation lacking the necessary variables for the analysis and duplicates. This resulted in 10,570 observations being removed. The fund identification numbers have been utilized to identify and determine the funds that require removal from the analysis.

4.2 Choice of data

The choice to use pension system data for this study is advantageous because it represents the entire population for the range of the selected years 2015-2022. Distinct from previous studies and investment data, which mostly represent those who have a vested interest in investing, pension system data provide a more extensive and versatile selection. In addition, pension system data enables us to analyze the retirement behavior of individuals from all income levels and backgrounds, helping to provide a more accurate representation of the population, thus this is not controlled for.

The dataset includes gender specific information on the number of accounts holding each fund and the corresponding values of the accounts. In addition, data concerning the origin of the assets is included in the dataset to test for home biasedness. Risk is a measurement of how much the value of a fund has changed over time. For each fund, there is a risk level that reflects the level of variation in the fund's development over time. Higher risk levels indicate greater variation in development and correspondingly higher risk, while lower risk levels indicate less variation and lower risk. The risk level is measured as the standard deviation, which reflects how much the fund's value has fluctuated over a period of 36 months. There are four risk levels between 0-15, and one risk level for all values greater than 16.

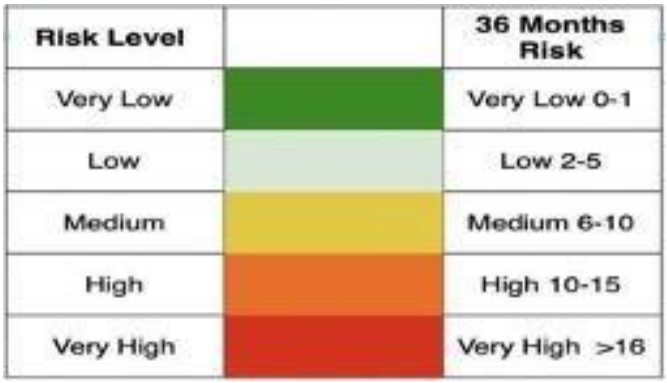

Figure 1. Risk levels in PPM. Source: Authors own illustration

In section 4.3, each fund type is associated with a distinct level of risk. The different fund types of the dataset have been identified and ranked, based on a general statement of the risk level associated with each fund type, ranging from highest to lowest. The Sharpe ratio is also included, Sharpe ratio compares the return of an investment with its risk. The Sharpe ratio in the dataset is between -5 and 7, Sharpe ratio above 1 is considered good indicating a higher return for a given level of risk, meanwhile a negative is considered bad (Sharpe, 1966).

The dataset contains information on the returns as well. The return in the data collection contains return on 36 months period. Including returns in the dataset allows for further testing of riskawareness. Typically, higher returns are associated with higher levels of risk. Conversely, if investment options have lower returns, it can indicate greater risk- awareness.

Table 1. Descriptive statistics

Variables	Mean	Median	Standard-deviation	Variance	Min	Max

Female	0.4492	0.4412	0.0829	0.0068	0.0909	0.7177
Risk	0.8500	13	5.9957	35.9486	0	65
Return	0.3203	0.2900	0.7715	0.0768	-1	2.78
Sharpe ratio	0.5113	1	0.7150	0.5113	-5	7

Table 1 shows the descriptive statistics of the numeric variables in the dataset.

4.3 The funds

In the Swedish premium pension system, every investor can choose to include at most five funds in their premium pension account. The system provides a comprehensive list of various funds, each categorized according to their respective fund type. The funds below range from general highest to lowest risk.

4.3.1 The equity funds

Equity funds invest in shares of public traded companies and have a higher risk and return potential compared to the other fund categories as the return on investment is dependent on the stock market, that can be volatile. The equity funds can be diversified across different industries, geographic regions companies to reduce risk (PPM, 2022).

4.3.2 The sector funds

Sector funds invest in specific industries such as real estate, energy or technology. As the funds are focused on different sectors, they are considered to be higher-risk investments due to the low diversification (PPM, 2022).

4.3.3 The regional funds

Regional funds invest in a specific region, such as Europe or North America. The stocks or bonds invested in are companies in the specific region. These funds are generally high-risk investments due to undiversified focus and the return on investment is dependent on the performance of that specific region (PPM, 2022).

4.3.4 The country funds

Country funds invest in stocks or bonds of a single country. These are considered a high-risk type of fund as the investment return is dependent on the economic or political state of the country. The diversification can be made by allocating in different industries (PPM, 2022).

4.3.5 The mixed funds

Mixed funds are investments in both stocks and bonds, the allocation varies depending on the fund's investment objective. Mixed funds can be conservative or aggressive, with a greater allocation in stocks for the latter (SOU, 2005). The diversification gives a certain protection in volatile markets while still providing some potential for growth. These funds can be more diversified by investing in different regions or sectors (PPM, 2022).

4.3.6 The generation funds

The Generation Funds are created as a life-cycle savings solution with a matching classification and consist of a mix of equity and bond funds. For those who are further from retirement, the investment structure is as follows: mostly equities funds, progressively switching to bond funds as retirement draws near. According to this allocation approach, younger investors are more at risk when using these funds (SOU, 2005).

4.3.7 The bond funds

In these types of funds, 100% is invested in interest-bearing securities, which can be issued by the state, municipality, international organization, or company. These securities are categorized based on their remaining time to maturity and geographical location. Generally, these funds are considered low risk, with short-term bond funds having the lowest risk and lower value development. Long-term bond funds carry slightly higher risk but also offer better value development. However, bond funds with foreign investments are typically associated with higher risk due to fluctuations in exchange rates (PPM, 2021).

4.4 Data Limitations & Risk

The dataset used in the study is representative of the population as it includes individuals who may not typically invest outside the premium pension system. However, there are certain limitations to the

dataset that should be noted. For instance, there is no information about the demographic characteristics of the holders such as age, education level, income, or occupation, which are factors that could potentially influence their risk attitudes. Additionally, the dataset does not provide information of the holders' five fund choices within the premium pension system. While the study has taken steps to minimize limitations such as including multiple years of data and ensuring a representative sample, there are still potential risks that should be acknowledged.

Due to the financial condition brought about by the COVID-19 pandemic, the dataset covering the years 2019-2022 may not be fully representative. During this period, investor behavior may have been influenced by market uncertainty, leading to a preference for safer investment options. This is in line with the "flight to safety" hypothesis, which suggests that investors tend to move their assets to safer investments during periods of market volatility (Zimmermann, 2020). While this trend may not have a significant impact on long-term savings such as retirement accounts, it is still an important aspect to consider. To mitigate the potential impact of the pandemic and market uncertainty, the datasets include several years of observations prior to the onset of the COVID-19 crisis. Each observation is linked to its corresponding year, allowing for a longitudinal analysis that captures potential changes in investor behavior over time. This approach reduces the risk of any temporary or exceptional effects from the pandemic on the datasets.

5. Method

The dataset presented in Chapter 4 is aggregated to fit the regression in the following way, the data have been collected separately for each research year. The data of the number of accounts held is gender-specific, and to fit the data to the regression a percentage of how many females that choose the particular fund have been calculated for the entire dataset.

Table 2. Variables

Variable	Meaning
♀%	% Females for each fund
$D_{Swedishasset}$	Dummy variable as indicator for origin of the fund, $Swedish_1$
R	Risk index (standard deviation)
S	Sharpe ratio
Rn_t	Return of the fund in time t
D_i	Dummy variable as indicator for fund type, $Fundtype_1$……$Fundtype_7$
ε	Error term

Table 2 presents the variables included in the regression equations, along with an explanation of each variable. Note that the variables will be included in separate models.

The dependent variable in the regression analysis is the percentage of women holding each fund. A dummy variable is included to indicate whether the investment is in Swedish or foreign assets, enabling the testing of home bias. The risk level of each investment is measured by its standard deviation. Fund type is also included as dummy variables to identify investments with different risk levels, equity fund is excluded in the regression acting as a reference variable to avoid "the dummy trap" (Wooldridge, 2018). Investment returns have been chosen to a time period of 36 months to align with the risk level calculation, which is based on the standard deviation over the same time frame. In addition, the Sharpe ratio is used as another measure of risk in terms of return. Finally, an error term is included to account for unobserved factors that may affect the dependent variable.

In the regression model, the different fund types have been included as dummy variables to control for potential effects on the dependent variable. The dummy variables represent the different fund types presented in section 4.3. It is important to note that for the years 2020 to 2022 there are three additional fund types, this have been controlled for.

5.1 Regression Models

The models have been constructed using data made available by the Premium Pension Authority. To ensure that all types of risk are captured, all available risk measurements is included. The variables are divided into different models for simplicity of interpretation and to be able to compare risk and Sharpe ratio against return, for a comprehensive evaluation of investment performance. It is important to note that the individuals in our study are provided with the same information as we use, including all data and risk levels, as well as the general risk level for each fund. This ensures that our findings can be compared with the behavior of actual investors in the Premium Pension System and to test the hypotheses. This study aims to test two hypotheses regarding gender differences in investment behavior within the PPM system. The first hypothesis examines whether women in the PPM system exhibit more risk-averse investment behavior compared to men. The second hypothesis is whether women in the PPM system are more home-biased compared to men.

The following models is formulated for the regressions.

Model (1)

$$♀\% = \beta_0 + \beta_1(\text{Risk}) + \beta_2(\text{Dummy}_{\text{swedishasset}}) + \beta_3(\text{Return}_{36m}) + \varepsilon_{it}$$

Model (2)

$$♀\% = \beta_0 + \beta_1(\text{Sharperatio}) + \beta_2(\text{Dummy}_{\text{Bond}}) + \beta_3(\text{Dummy}_{\text{Mixed}}) + \beta_4(\text{Dummy}_{\text{Generation}}) + \beta_5(\text{Return}_{36m}) + \varepsilon_{it}$$

Model (3)

$$♀\% = \beta_0 + \beta_1(\text{Sharperatio}) + \beta_2(\text{Dummy}_{\text{Bond}}) + \beta_3(\text{Dummy}_{\text{Mixed}}) + \beta_4(\text{Dummy}_{\text{Generation}}) + \beta_5(\text{Dummy}_{\text{Regional}}) + \beta_6(\text{Dummy}_{\text{Sctor}}) + \beta_7(\text{Dummy}_{\text{Country}}) + \beta_8(\text{Return}_{36m}) + \varepsilon_{it}$$

All models have been run independently both all years pooled together and all years separately. The latter tests if there has been a change in females risk attitudes and investment preferences over time. The pooled regressions are referred to as Model A (1A, 2A and 3A), and the regression run on the years separately are referred to as Model B (1B, 2B and 3B).

In the regression analysis where all years were combined, the data for each model were pooled together over time and subsequently tested. Pooling the data over time is recommended as it offers several benefits. Pooling the data increases statistical power of the analysis, allowing for more reliable and precise estimation of the regression coefficients (Baltagi, 2008). Moreover, it can reduce potential biases as it controls for time-related factors that may influence the dependent variable and provides greater flexibility in analyzing data that spans multiple time periods, allowing for a more comprehensive understanding of the underlying trends and dynamics (Baltagi, 2008).

When selecting the regression model, it is important to consider that certain factors influence all individuals observed within the same time period and have a persistent effect over time. The random effect model (RE) addresses this by incorporating a disturbance term that accounts for the limited knowledge about the true underlying model. In essence, the model recognizes that the number of individuals fluctuates over time, allowing for variation in the data (Arellano, 2003).

Further, to capture any year specific trends or variations an Ordinary Least Squared (OLS) are run separately for each individual year. The three models are assessed on an annual basis, with the number of observations each year corresponding to the number of funds chosen during that specific year. This approach facilitates the examination of risk preferences and helps determine whether time plays a significant role in influencing the results (Wooldridge, 2018).

Before estimating the regressions, it was ensured that the data satisfies certain assumptions for greater validity and reliability of the results. For OLS regressions, the assumptions include linearity, independence, normality, homoscedasticity, no multicollinearity. In the case of Random Effects regression, in addition to these assumptions, it is also required that there are random intercepts which are uncorrelated with the independent variables (Gujarati, 2009).

5.2 Regression analysis

Several tests are performed to address any potential errors or issues with the chosen method, to ensure the accuracy and reliability conducted in this research. The tests aim to improve the robustness of the conclusion drawn from the results.

One test for Model A is done in order to determine the most appropriate model, a "Hausman test" is performed. This test is commonly employed on panel data analysis to select between the random effects and fixed effects (FE) models. The model assesses whether the individual-specific effects in the FE model exhibit correlation with the independent variables (Baltagi, 2014). If the p-value is less than the chosen significance level (0.05), it indicates that FE model is a preference. Conversely, if the p-value is greater than the significance level, it suggests the RE model (Baltagi, 2014).

Table 3 – Hausman test – Model B

Model	Test statistic	p-value
1	120977.9	0.3163
2	1473281.2	0.4621
3	1482391.3	0.6241

Table 3 presents the T-statistics and p-value from the Hausman test, the test is run our three regression models.

Seen from "Table 3", the RE model is better suited for the panel data used in this research. This can be explained by that the dependent variable represents a percentage of holdings by females, rather than individual-level data.

Further for Model B, three different tests were conducted to ensure that the data does not suffer from heteroskedasticity, multicollinearity and holds a normal distribution.

Firstly, a "White test" is performed to detect heteroskedasticity. OLS assumes that the error terms have a constant variance, homoscedasticity. If the test shows that heteroskedasticity is present in the model it refers to unequal variance of the residuals across the range of independent variables. White test is advocated for as it remains valid with a large sample size, which is in line with the dataset used (Wooldridge, 2018). The test is run on the data for all years separately, see Appendix 4. The model shows no signification of that the data suffer from heteroskedasticity. Hence, no corrections are needed, and the analysis can continue.

For multicollinearity a Variance Inflation Factor (VIF) test was conducted. The test is done to interpret how much the variance of the regression coefficients is inflated due to multicollinearity. A VIF threshold of 5 or 10 is commonly used to identify problematic levels of multicollinearity (Johnson and Wichern, 2007). The model shows no excessive levels of multicollinearity, see Appendix 3. Hence, the analysis can further continue.

Finally, an Anderson-Darling (A-D) test is conducted to evaluating normality of the data. The test measures the disparity between the data and the expected values under the normal distribution. A larger test statistic indicates a greater deviation from the assumed distribution. The table below show that the p-value is higher than the significance level at a five percent level, therefore there is no evidence to reject the null hypotheses: the data is normally distributed.

Table 4 – Anderson-Darling test

Test statistics	p-value
0.30033	0.5751

Table 4 shows the results from the A-D test, to assume the distribution of the dataset.

6. Result and Analysis

6.1 Result of the Regressions

This section presents the findings of the Random effect model and the Ordinary Least Squares regression analysis conducted on the three equations described in Section 5.1. The objective of the regressions is to investigate whether there is a significant difference in risk aversion between women and men in investment decisions. In this part the result will be interpreted along with a deeper analysis.

Table 5 - Random Effect Model – Model 1A – Pooled data

Variable	Coefficient	p-value
Intercept	0.480601	0.0004**
Risk	-0.457603	0.0001**
D(Swedish)	0.3970273	0.0002**
$Return_{36m}$	-0.279003	0.526

Dependent variable: ♀%	R^2: 0.358213
Observations: 52,872	Adj.R^2: 0.345271
Cross-sections included: 8	F-stat: 0.000000
	DW: 1.620001

*Table 5 summarizes the result from the Random Effect run on Model (1), the independent variables is presented as risk level, dummy for Swedish asset and return over a 36-month period. These variables are tested against the dependent variable: percentage of women holding a particular fund. **, denotes significance at the 5% level.*

As can be seen by "Table 5" a rejection of the null hypothesis can be done on a five percent level of both hypothesis; Women are more risk averse than men and Women are more home-biased than men. As for the negative coefficient of risk that describe the negative relationship between risk and women, when risk increases the number of female holdings tend to decrease.

For home biasedness there is a positive relationship, suggesting that the percentage of females holding a particular fund increases when the fund is Swedish. This is significant at a five percent level.

Return is insignificant at a five percent level, meaning that we cannot assume a relationship between return and women holding a particular fund using this model.

Table 6 - Random Effect Model – Model 2A and 3A – Pooled data

Variable	Coefficient	p-value
Intercept	0.429012	0.0002**
Sharpe ratio	0.114202	0.0001**
Return	-0.25158	0.0002**
D(Generation)	0.111301	0.0005**
D(Bond)	0.234802	0.0015**
D(Mixed)	0.642602	0.0001**
D(Regional)	-0.456102	0.0034**
D(Country)	-0.139880	0.0011**
D(Sector)	-0.479307	0.0053**

	R^2: 0.325216
Dependent variable: ♀%	Adj.R^2: 0.316231
Observations: 52,872	F-stat: 0.000000
Cross-sections included: 8	DW: 1.426127

*Table 6 summarizes the result from the Random effect run on equation (2 and 3), the independent variables is presented as Sharpe ratio, dummies for the different fund types are bond, mixed and generation funds for 2015-2019 and bond, mixed, generation, regional, sector and country funds for 2020-2022. The reference variable for the dummies is equity bond. Return over a 36-month period is included as a predictor variable. These variables are tested against the dependent variable: percentage of women holding a particular fund. **, denotes significance at the 5% level.*

From "Table 6" it can be observed that Sharpe ratio has a positive relationship with women holdings, meaning that women invest more in funds holding a higher Sharpe ratio. As the Sharpe ratio holds the adjusted return index, it can be assumed that women choose lower risk investments, hence a rejection of the null hypothesis on a five percent level.

Return is negative in this model, implying that despite the negative return females are still inclined to hold the particular fund. The coefficient is significant at a five percent level.

As for the funds, women holdings increase with generation, bond and mixed funds and decreases with country, regional and sector funds. The increase is associated with lower risk funds, meanwhile the decrease is associated with higher risk funds, see section 4.3. This is significant for all fund types at a five percent significance level; hence the null hypothesis is rejected.

Table 7 – Ordinary Least Squares – Model 1

Variable		**Coefficient**		**p-value**
2015	Risk	-0.0054338	0.0000**	
	D(Swedish)	0.0506235	0.0000**	
	Return36m	0.0003994	0.851	
Dependent variable: %♀				R^2: 0.2706
Observations: 7373	F-stat: 912.7			Adj. R^2 : 0.2706
2016	Risk	-0.002474	0.47198	
	D(Swedish)	0.105748	0.00899**	
	$Return_{36m}$	-0.069335	0.34904	
Dependent variable: %♀				R^2 : 0.0009
Observations: 7361	F-stat: 3.21			Adj. R^2 : 0.009
2017	Risk	-0.0044224	0.0000**	

	D(Swedish)	0.0463168	0.0000**		
	$Return_{36m}$	-0.0067783	0.0855		
Dependent variable: %♀ Observations: 8063	F-stat: 753.4			R^2: 0.2188 Adj. R^2: 0.2188	
2018	Risk	-0.0046703	0.0000**		
	D(Swedish)	0.0413634	0.0000**		
	$Return_{36m}$	-0.0323941	0.0000**		
Dependent variable: %♀ Observations: 8212	F-stat: 686.9			R^2: 0.2004 Adj. R^2: 0.2004	
2019	Risk	-0.0039826	0.0000**		
	D(Swedish)	0.0417865	0.0000**		
	$Return_{36m}$	-0.0345339	0.0000**		
Dependent variable: %♀ Observations: 6156	F-stat: 566.3			R^2: 0.216 Adj.R^2: 0.216	
2020	Risk	-0.0039007	0.0000**		
	D(Swedish)	0.0431921	0.0000**		
	$Return_{36m}$	-0.0438245	0.0000**		
Dependent variable: %♀ Observations: 5150	F-stat: 586.6			R^2 : 0.2486 Adj. R^2: 0.2486	
2021	Risk	-0.0035049	0.0000**		
	D(Swedish)	0.0528822	0.0000**		
	$Return_{36m}$	-0.0134575	0.0002**		
Dependent variable: %♀ Observations: 5321	F-stat: 487.9			R^2 0.2155 Adj. R^2: 0.2155	
2022	Risk	-0.0027077	0.0000**		
	D(Swedish)	0.0507732	0.0000**		
	$Return_{36m}$	-0.0296468	0.0000**		
Dependent variable: %♀ Observations: 5263	F-stat: 424.8			R^2: 0.1946 Adj. R^2: 0.1946	

*Table 7 summarizes the result from the OLS regression run on equation (1), the independent variables are presented as risk level, dummy for Swedish asset and return over a 36-month period. These variables are tested against the dependent variable: percentage of women holding a particular fund. **, denotes significance at the 5% level.*

Looking at "Table 7", for all years 2015-2022 the risk variable has a negative coefficient, which means that an increase in risk is associated with a decrease in the percentage of women holding a particular

fund. This relationship is statistically significant across all years, excluding 2016, at the five percent level as indicated by the p-value of 0.0000. This means there is no statistical evidence for the null hypothesis and therefore we reject it. Generally, 2016 differ from all other years, but the reason is uncertain.

The dummy variable that indicates for holding a Swedish asset has a positive coefficient over the years, indicating that Swedish assets are associated with a higher percentage of women investing in a specific fund. This relationship is significant at the five percent level, as indicated by the pvalue of 0.0000. Meaning that there is enough statistical evidence to reject the null hypothesis at a five percent significance level.

For the first year (2015) the return has a positive coefficient of 0.0004, but it is not significant at the five percent level, as indicated by the p-value of 0.851. For the years 2016-2022 return has a negative coefficient indicating that there is a negative relationship between return and the percentage of females holding the fund. As the level of risk and return increases, the percentage of female holding decreases. This is for the years 2018-2022 significant at a level of five percent, making it overall a significant variable to explain the impact on the female holding.

Table 8 – Ordinary Least Squares – Model 2 and 3

	Variables	**Coefficient**	**p-value**	
2015	Sharpe ratio	0.015382	0.0000**	
	D(Bond)	0.039330	0.0000**	
	D(Mixed)	0.072938	0.0000**	
	D(Generation)	0.104426	0.0000**	
	$Return_{36m}$	-0.004001	0.237	
Dependent variable: %♀ Observations: 7373				R^2: 0.189 Adj.R^2: 0.1884 F-stat: 343.3
2016	Sharpe ratio	0.01299	0.7574	
	D(Bond)	0.08767	0.1843	
	D(Mixed)	0.02658	0.7106	
	D(Generation)	0.19892	0.0399*	
	$Return_{36m}$	-0.04928	0.6222	

Dependent variable: %♀				R^2: 0.00202
Observations: 7361				Adj.R^2: 0.00039
				F-stat: 1.575
2017	Sharpe ratio	0.025913	0.0000**	
	D(Bond)	0.013299	0.0000**	
	D(Mixed)	0.061398	0.0000**	
	D(Generation)	0.108242	0.0000**	
	$Return_{36m}$	-0.051215	0.0000**	
Dependent variable: %♀				R^2: 0.1722
Observations: 8063				Adj.R^2: 0.1717
				F-stat: 335.3
2018	Sharpe ratio	0.008618	0.0000**	
	D(Bond)	0.016107	0.0000**	
	D(Mixed)	0.062890	0.0000**	
	D(Generation)	0.112285	0.0000**	
	$Return_{36m}$	-0.060502	0.0000**	
Dependent variable: %♀				R^2: 0.1659
Observations: 8212				Adj.R^2: 0.1654
				F-stat: 326.5
2019	Sharpe ratio	-0.004170	0.0000**	
	D(Bond)	0.013158	0.0000**	
	D(Mixed)	0.059344	0.0000**	
	D(Generation)	0.109219	0.0000**	
	$Return_{36m}$	-0.667128	0.0000**	
Dependent variable: %♀				R^2:0.2011
Observations: 6156				Adj.R^2: 0.2104
				F-stat: 328.9
2020	Sharpe ratio	0.009895	0.0000**	
	D(Bond)	0.036211	0.0000**	
	D(Mixed)	0.090198	0.0000**	
	D(Generation)	0.105536	0.0000**	
	D(Regional)	0.012184	0.0000**	
	D(Sector)	-0.025380	0.0000**	
	D(Country)	-0.035114	0.0000**	
	$Return_{36m}$	-0.51989	0.0000**	
Dependent variable: %♀				R^2: 0.2528
Observations: 5150				Adj.R^2:0.2516
				F-stat: 217.3

2021	Sharpe ratio	0.020392	0.0000**
	D(Bond)	0.004507	0.357
	D(Mixed)	0.049398	0.0000**
	D(Generation)	0.075968	0.0000**
	D(Regional)	-0.21282	0.0000**
	D(Sector)	-0.065548	0.0000**
	D(Country)	-0.037564	0.0000**
	$Return_{36m}$	-0.037564	0.0000**
Dependent variable: %♀			R^2: 0.2423
Observations: 5321			Adj. R^2: 0.2412
			F-stat: 212.3
2022	Sharpe ratio	0.007257	0.0045**
	D(Bond)	0.020276	0.0000**
	D(Mixed)	0.064533	0.0000**
	D(Generation)	0.090539	0.0000**
	D(Regional)	-0.011906	0.0005**
	D(Sector)	-0.060120	0.0000**
	D(Country)	-0.057379	0.0000**
	$Return_{36m}$	-0.016239	0.0053**
Dependent variable: %♀			R^2: 0.2426
Observations: 5263			Adj. R^2: 0.2415
			F-stat: 210.3

*Table 8 summarizes the result from the OLS regression run on equation (2 and 3), the independent variables are presented as Sharpe ratio, dummies for the different fund types are bond, mixed and generation funds for 2015- 2019 and bond, mixed, generation, regional, sector and country funds for 2020-2022. The reference variable for the dummies is equity bond. Return over a 36-month period is included as a predictor variable. These variables are tested against the dependent variable: percentage of women holding a particular fund. **, denotes significance at the 5% level.*

Observing table "8" , there is a positive association between the Sharpe ratio and the percentage of female holdings in all years, except for 2019. This implies that higher Sharpe ratios are generally associated with more female investments. The relationship is statistically significant at a significance level of five percent for all research years, except for 2016. This implies that women prioritize a better risk-to reward ratio, as a higher Sharpe ratio indicates a better tradeoff between risk and return.

Further the results from the second equation indicates that women tend to have a positive relationship with bond, mixed, and generation funds for all years except for 2016 and 2021, as shown by the dummy variables for fund types. This suggests that women tend to invest more in lower risk funds, consistent with the ranged risk level in part 4.3. The significance level of this relationship is five percent for all years except for 2016 and 2021.

In 2020, where three more fund types were added, the coefficient for regional funds was positive, while for 2021 and 2022, it was negative. For sector and country funds, the coefficients were negative for all three years (2020-2022) with a significance level of five percent. These findings suggest that women tend to invest more in lower risk funds.

A positive coefficient of the dummy suggests that it has a greater relationship to the female holdings than the reference variable "equity funds", meanwhile a negative coefficient means that the outcome is lower for the dummy variable than the reference. Aligning with the previous paragraph.

The coefficient for the return is negative across all years but is only significant for the years 20172022 at a five percent level. During these years, a decrease in return is associated with a decrease in women's holdings. However, the relationship, for the other years 2015-2016 is also negative but not statistically significant. This suggests that for 2017-2022 women hold a strategy of investing more in lower return funds associated with lower risk. In other words, for the significant years it interferes that women are more risk-averse than men, hence a rejection of the null hypothesis.

The high significance levels observed in these analyses can be attributed to factors such as the large sample size or a low variability within the samples. It is important to note that prior tests were performed to ensure an adequate level of statistical power and selection of appropriate statistical tests.

6.2 Analysis

The hypotheses have been analyzed through regressions by testing three different models, firstly pooled with RE and later separately with OLS. Both conducting pooled data analysis and separate year analyses allowed to capture both the average relationship and any variations or trend within each research year.

The first model including risk, origin (dummy), and return as independent variables against the percentage of female investors. The second model tested Sharpe ratio, fund types (dummy), and return

as independent variables against the percentage of female investors. The third model included the same predictor variables with added fund types.

All independent variables included in the models are either risk measurements or associated with risk, providing a comprehensive analysis of the hypotheses.

The hypotheses were proposed to test, whether women and men differ in home biasedness and risk awareness in their investment behavior. The results give enough statistical evidence to reject both null hypotheses.

Using the premium pension system as a case study provides several advantages over other studies. Firstly, the use of a representative sample of the population helps to address issues related to homogeneity and self-selection bias, which can affect the generalizability of the findings. Secondly, the large sample size covering multiple years provides more reliable estimates of the relationship between risk and gender in investment behavior. As such, the results obtained from this study may be considered more generalizable to the risk attitudes of Swedish women and men than those obtained from studies that rely on a homogenous sample. Overall, these methodological strengths enhance the credibility of the findings and contribute to a more robust understanding of investment behavior in the Swedish Premium Pension System.

The findings from model 1A suggest that women in average are generally more risk-averse than men, as indicated by the negative coefficient of the risk variable. This trend persisted trough all years, but with no significance for 2016. This finding aligns with the overconfidence bias within "behavioral finance" that typically makes investors less risk-averse, further suggesting that women do not exhibit this bias to the same extent as men (Barber and Odean, 1999). This finding is also consistent with section 2.2 where it was discussed that women are more likely than men to take on low-risk investments (Chan and Volpe, 1998).

The dummy variable for origin indicates that women are more likely to invest in Swedish assets, this supports the hypothesis that women are more home biased than men. This finding remains through all years. This aligns with previous research suggesting that investors tend to invest in assets that are familiar to them. The result suggests that women may prefer investing in assets that they are familiar with, potentially indicating a higher degree of home bias among female investors.

Further, analyzing the second and third equation the Sharpe ratio variable has a positive relation to the percentage of female holdings expect for 2019, suggesting that women invest in funds with a higher Sharpe ratio. The change of pattern for Sharpe ratio can possibly be explained by the uncertainty of the market due to COVID-19.

The most significant difference between the two regressions is the relationship between the return and the risk, as well as the Sharpe ratio. In regression (1) both risk and return general have negative coefficients meaning that an increase in risk and return leads to a decrease of female holdings. In regression (2) that includes both Sharpe ratio and return as independent variables, the coefficient for return remains negative across all years while the coefficient for Sharpe ratio is generally positive. This can imply that while women tend to avoid high-risk investments with low returns, they find it attractive to invest in funds that offer high returns relative to their level of risk.

The coefficient for return over a 36-month period shows a negative value across all years, except for 2015. The return variable shows no significance at a level of five percent, in model 1A and Model 1B for 2015, 2016 and 2017, as well as in Model 2B and 3B, for the years 2015 and 2016. The result indicates that as the return-on-investment decreases, percentage of female holdings increases. The negative relationship between female holdings and the return could suggest that women invest in times of market downturns, which is consistent with the finding of women being more cautious in their investments (Cronqvist et al., 2018). Also supported by the higher negative coefficients in the years of 2019 and 2020, where the market was uncertain due to COVID-19.

The dummy variables that signal different fund types indicate that women tend to invest more in funds with lower risk levels. Specifically, the findings suggest a positive relationship between women's holdings and bond, mixed, and generation funds for all years except for 2016 and 2021. These fund types were ranked as having the lowest risk levels in section 4.3. In contrast, women's holdings were found to have a negative relationship with regional, country, and sector funds, except for a positive coefficient on regional funds in 2020, the first year it was added to the list. These fund types were ranked in section 4.3 as higher risk funds.

Further, our research supports the idea that the EMH cannot fully explain the gender-based differences. Instead, our results indicate that factors such as risk attitudes could play a role in determining investment decisions.

7. Conclusion

The primary objective of this thesis was to explore potential gender disparities in investment behavior. To accomplish this objective, three equations were formulated and subjected to empirical testing. Each model aimed to examine whether women exhibit higher levels of risk aversion compared to men, using various risk measurements as predictor variables.

To address research question 1, the analysis conducted in Model 1A and 1B demonstrates that both risk and the origin of the asset have a statistically significant influence on the percentage of women holding a specific fund. These findings contradict the null hypothesis, which suggests that there are no gender differences in risk attitudes between men and women.

In relation to research question 2, the analysis reveals that the level of home bias significantly affects the percentage of women holding a specific fund. These findings challenge the null hypothesis, which posits that there is no significant difference in the level of home bias between women and men.

The regressions on Model 1 indicated that women are more risk averse than men, and that they are more home biased. Hence, both hypotheses are rejected with enough evidence that women are more risk-averse and that they also are more home-biased. This aligns with the principles of behavioral finance, which suggest that women tend to be more cautious investors and less rational decisionmakers. It is important to note that risk aversion is not necessarily indicative of irrational decisionmaking. Rather, it reflects a tendency to prefer lower-risk investment options. This can be seen as a rational response to mitigate potential losses and prioritize capital preservation. Therefore, our conclusions do not imply that women make irrational decisions. Instead, they highlight the existence of gender-based differences in risk preferences within investment behavior.

The result of the home biasness aligns with some of the theoretical findings, but enhancing the fact that women are more cautious and invest in assets that are familiar to them.

The different fund types also showed a significant impact on female holdings, supporting the different risk levels determined for the different fund types in section 4.3.

While our study provides valuable insight to investment behavior habits of Swedish men and women, it has some limitations that restrict its external validity, enabling space for further development and investigation of this thesis.

Suggestions for further research would be to control for socioeconomic characteristics such as income, occupation, educational attainment. As stated prior the research, demographical variables do have an impact in the behavior of the individuals. These factors can impact investment preferences and risk tolerance. The fact that these variables are included but not controlled for due to lack of individualspecific data, it was not possible to determine to which extent these factors affect investment behavior along with the gender disparities. While PPS offers a distinctive and extensive dataset for examining the investment behavior within the Swedish Premium Pension System, it is essential to emphasize that the variables that are provided have certain restrictions. To further understand the affect between socioeconomic determinants and investing behavior, more study on the PPS or other datasets including individual-specific variables would be valuable.

Further, investigating whether there are disparities in financial literacy between the genders, can provide insight into how individuals' understanding, and knowledge of financial concepts shape their investment decisions. Therefore, another suggestion is to use financial literacy as a subject for additional research.

With that said, further investigation is necessary for a wider perspective, and to understand to what degree these factors affect the decision-taking when making investment. As there are potentially other driven factors behind the gender gap. Researchers can design treatments to support better informed and successful investment decisions by looking at additional variables in order to build a more thorough knowledge of the factors that affect investment behavior.

In conclusion, the findings of this research shed light on the gender differences in investment behavior and highlight the need for further investigation. By continuing to expand the knowledge in this field, we can work towards bridging the gender gap and fostering a more inclusive and equitable environment.

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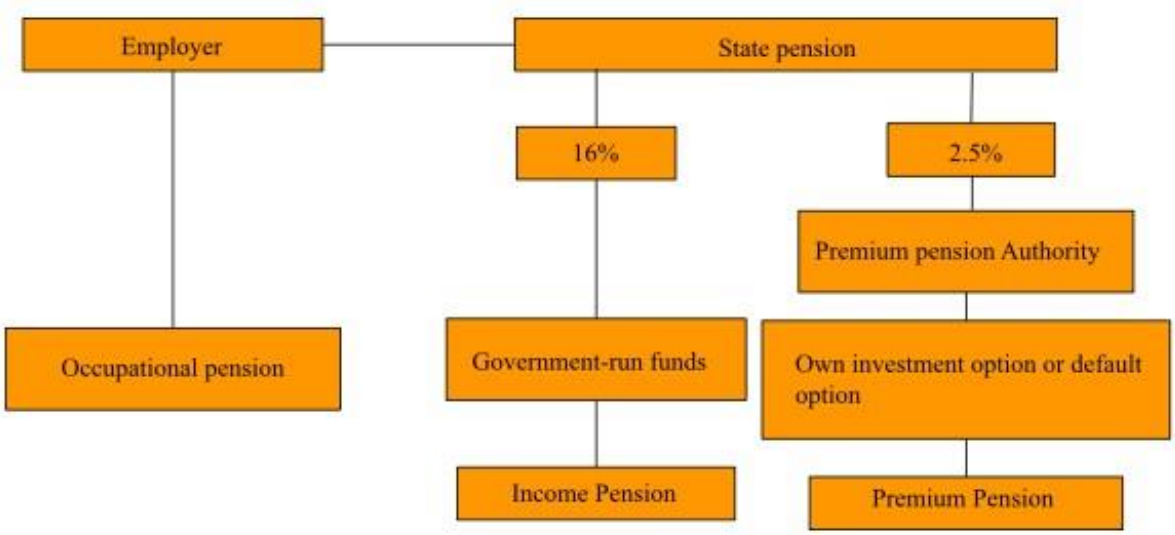
Appendix

Appendix 1 – The Pension System



Appendix 1 show the Swedish pension system with its three deviations. Source: Authors own illustration

Appendix 2 – Correlation Matrix - Dataset

Variabels	Risk	Sharpe ratio	Return	Origin	Bond	Mixed	Generation	Sector	Country	Regional
Risk	1	-0.27	0.19	-0.16	-0.60	-0.23	-0.12	0.18	0.19	0.24
Sharpe ratio	-0.27	1	0.55	0.08	0.09	0.007	0.06	-0.02	-0.08	-0.09
Return	0.19	0.55	1	0.003	-0.37	-0.12	-0.01	0.08	-0.04	-0.008
Origin	-0.16	0.08	0.003	1	0.01	0.05	0.22	-0.05	-0.08	-0.01
Bonds	-0.60	0.09	-0.37	0.01	1	-0.14	-0.09	-0.6	-0.06	-0.13
Mixed	-0.23	0.007	-0.12	0.05	-0.14	1	-0.07	-0.05	-0.04	-0.1
Generation	-0.12	0.06	-0.01	0.22	-0.09	-0.07	1	-0.03	0.03	-0.07
Sector	0.18	-0.02	0.08	-0.05	-0.6	-0.05	-0.03	1	-0.02	-0.04
Country	0.19	-0.08	-0.04	-0.08	-0.06	- 0.04	-0.03	-0.02	1	-0.05
Regional	0.24	-0.09	-0.008	-0.01	-0.13	-0.1	-0.07	-0.04	-0.05	1

Appendix 2 shows the correlation between all variables used in the regression models.

Appendix 3 – VIF – Test for multicollinearity

Model	Sharpe Ratio	Risk	Return	Origin	Fund types
1	-	-	1.263022	1.053773	1.263559
2	-	-	-	1.254015	1.394625
3	1.383872	1.365569	1.542504	-	-
4	1.038658	-	1.038658	-	-
5	-	1.57719	1.57719	-	-

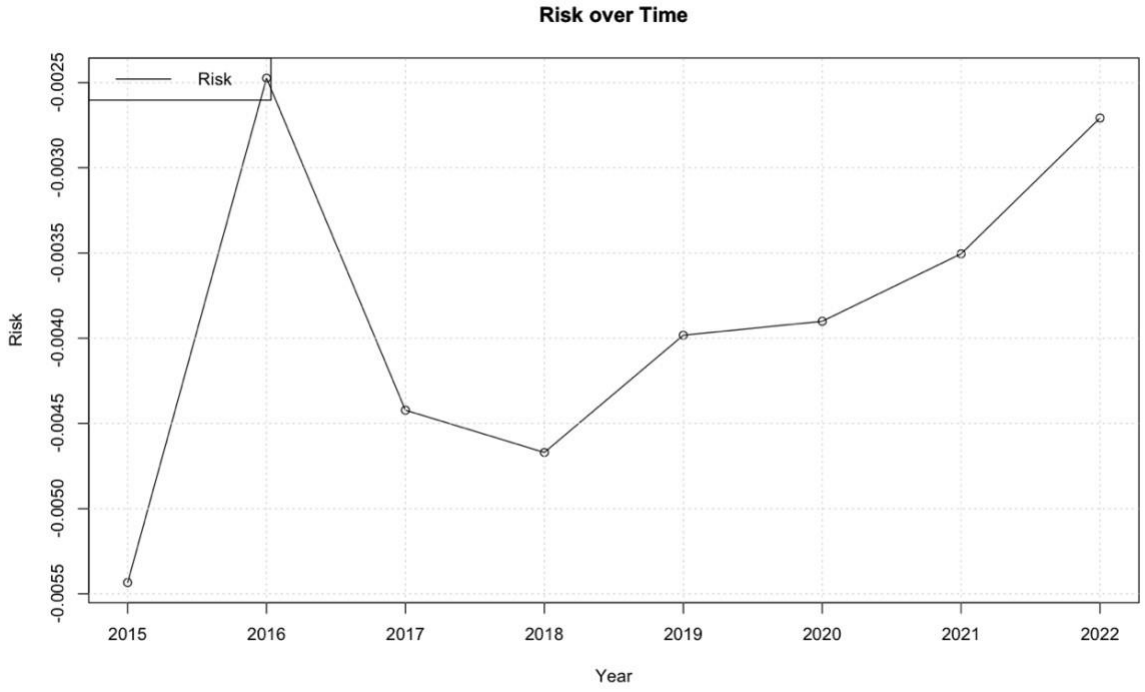
Appendix 3 presents the result from the" VIF" test, the different models represent The variables included are filled in the cells. different inclusion of the variables.

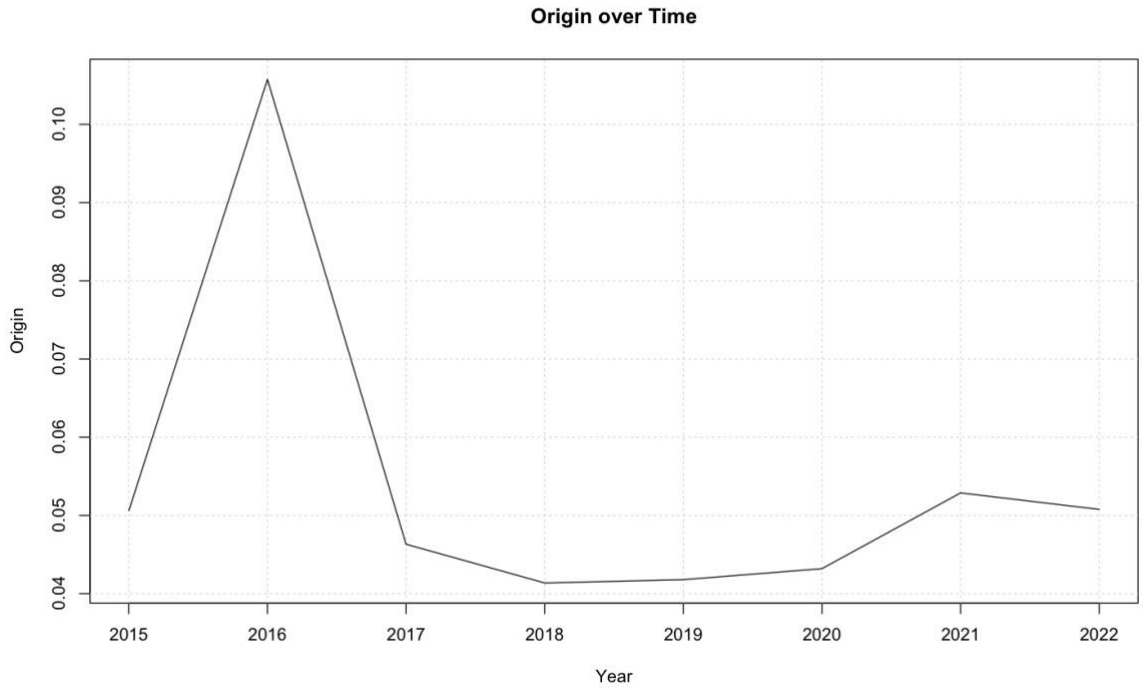
Appendix 4 - White test for heteroskedasticity

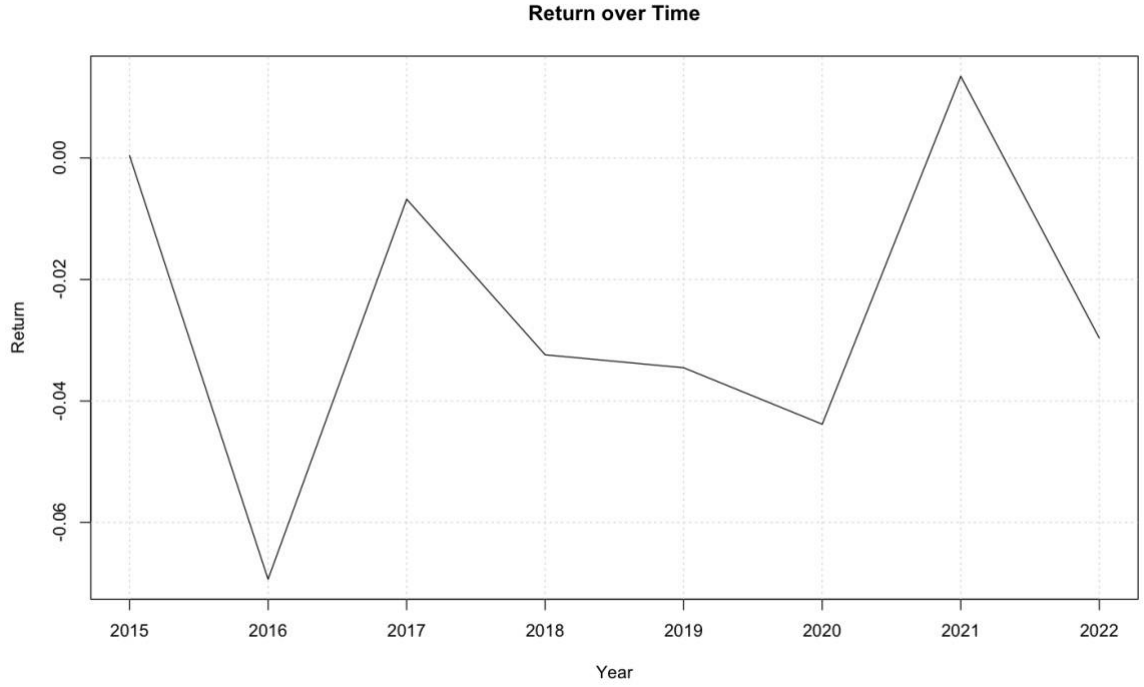
Year	F-value	R_2	p-value
2015	0.836705	2.837432	0.356891
2016	1.672912	4.637121	0.147239
2017	0.987635	3.073873	0.245261
2018	0.652837	1.632738	0.452718
2019	1.682930	4.953168	0.127328
2020	1.253678	3.327189	0.384272
2021	1.872637	4.623181	0.273891
2022	1.026372	2.936729	0.162837

Appendix 4 shows the results from the white test for heteroskedasticity, all years run separately and independently.

Appendix 5 – Graphs – Model 1B

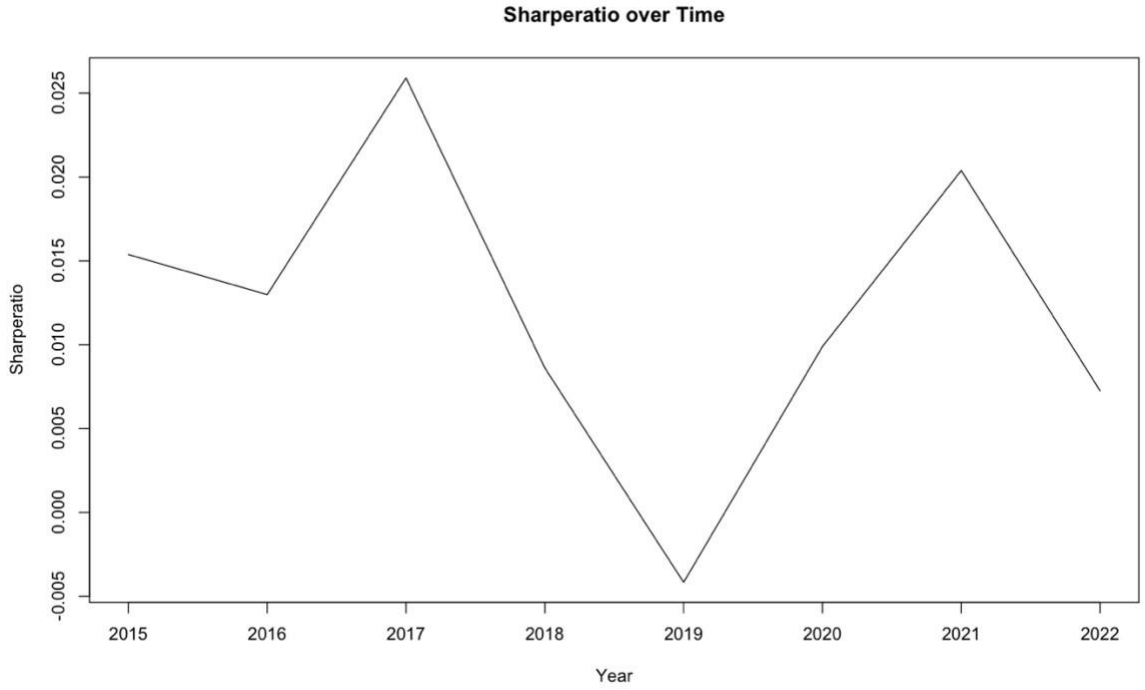


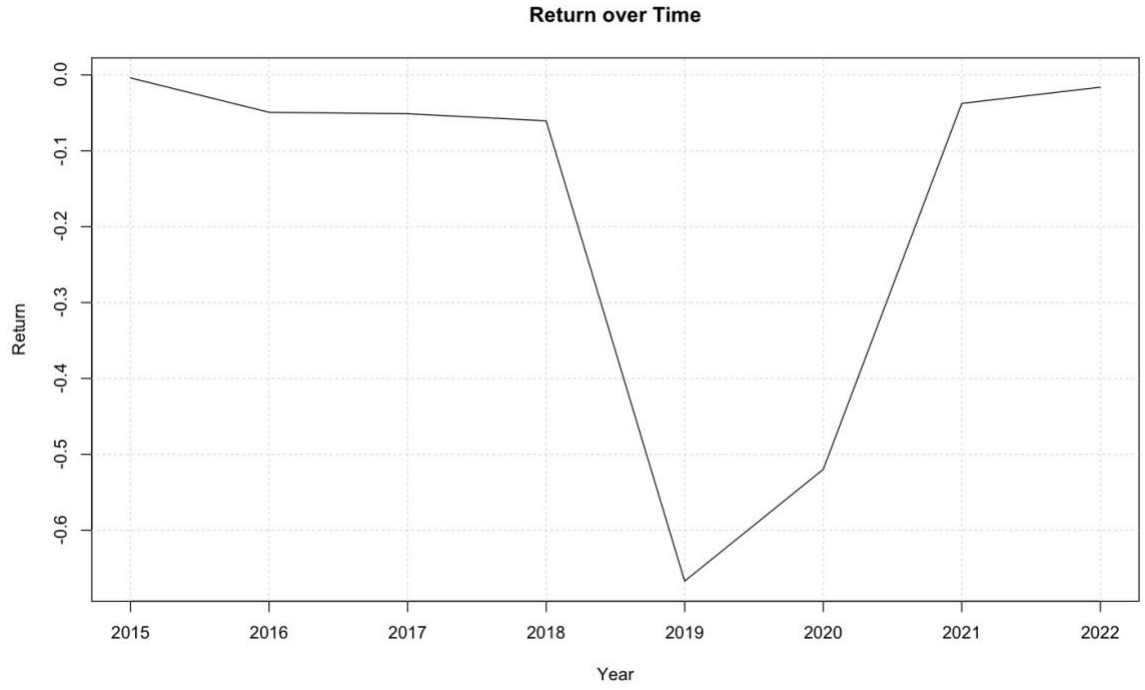


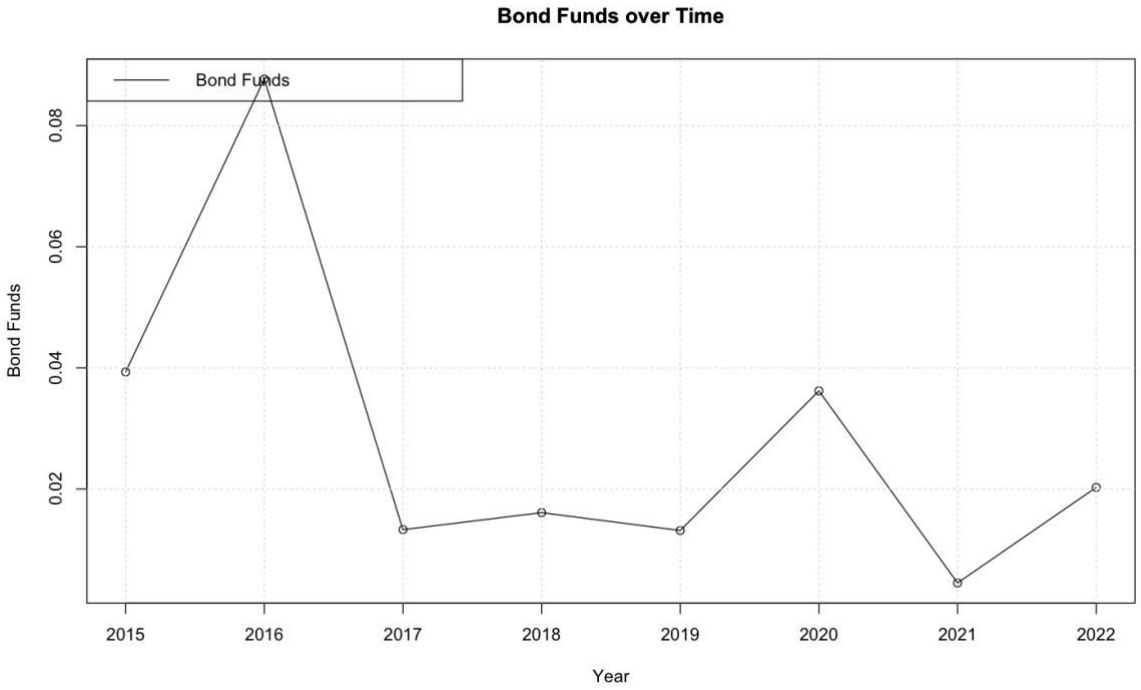


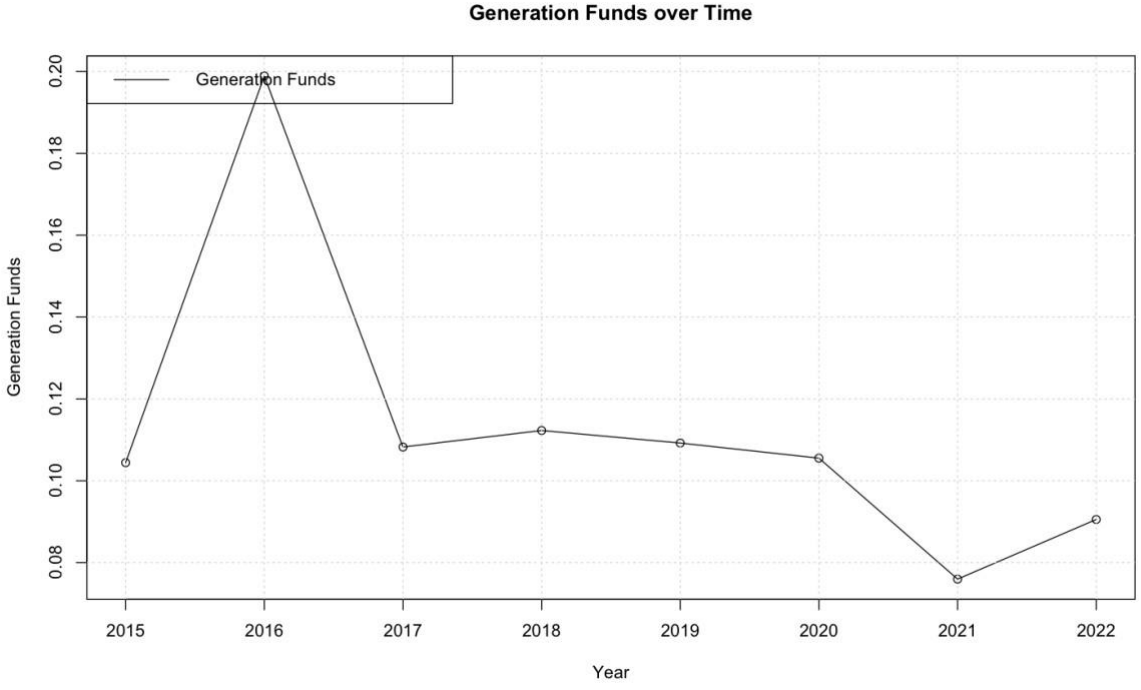
The graphs in Appendix 5 illustrate the trends observed in model 1 of the OLS regression analysis.

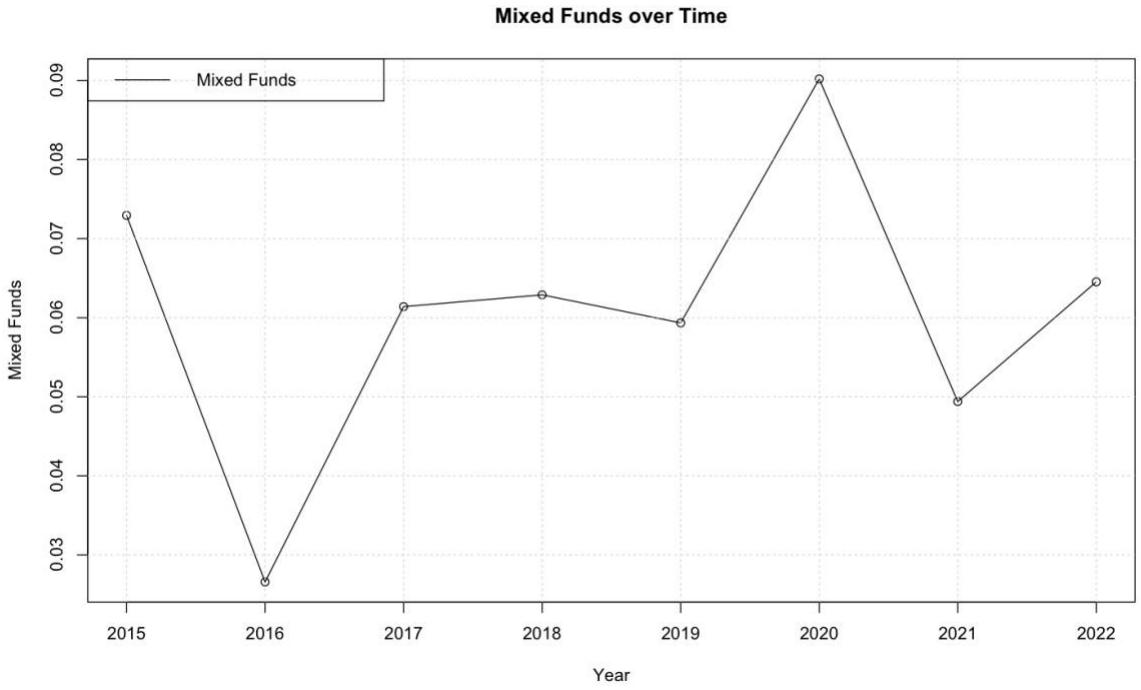
Appendix 6 – Graphs - Model 2B and 3B

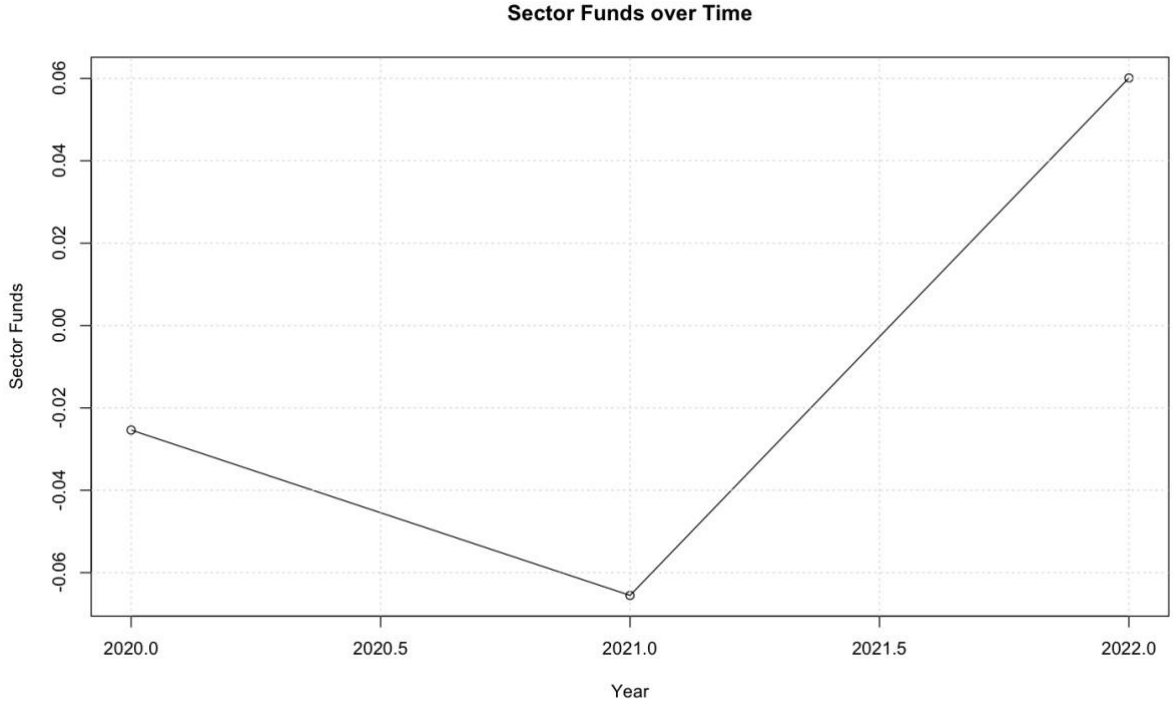


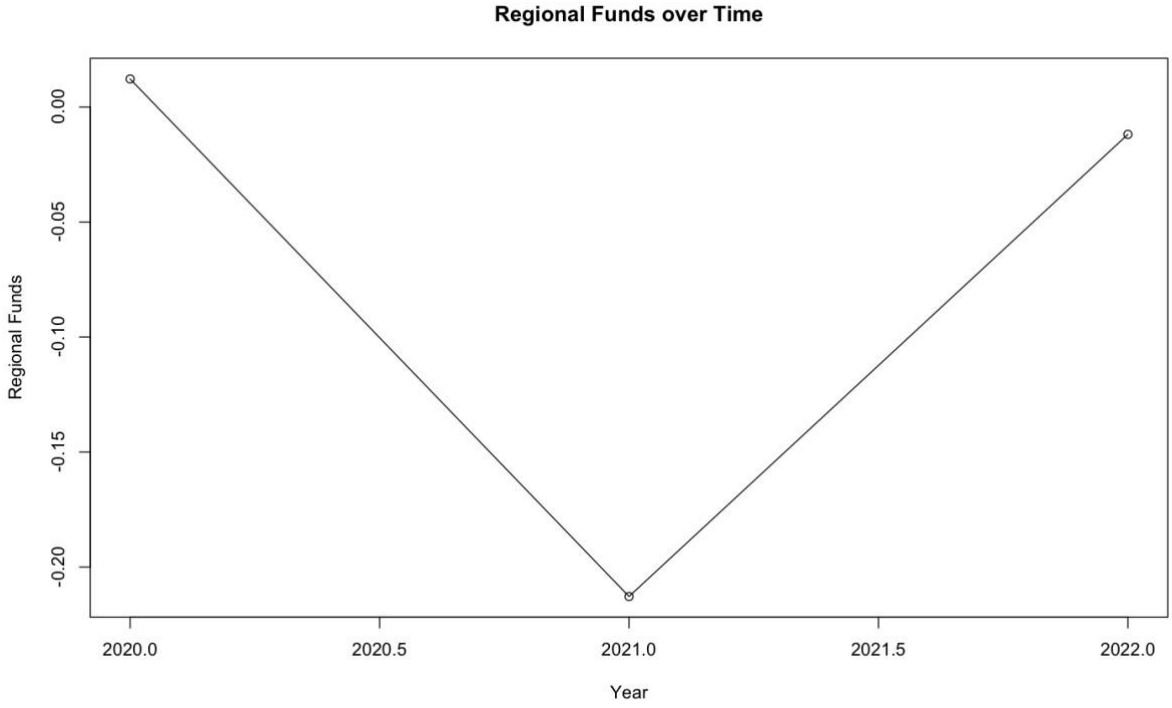


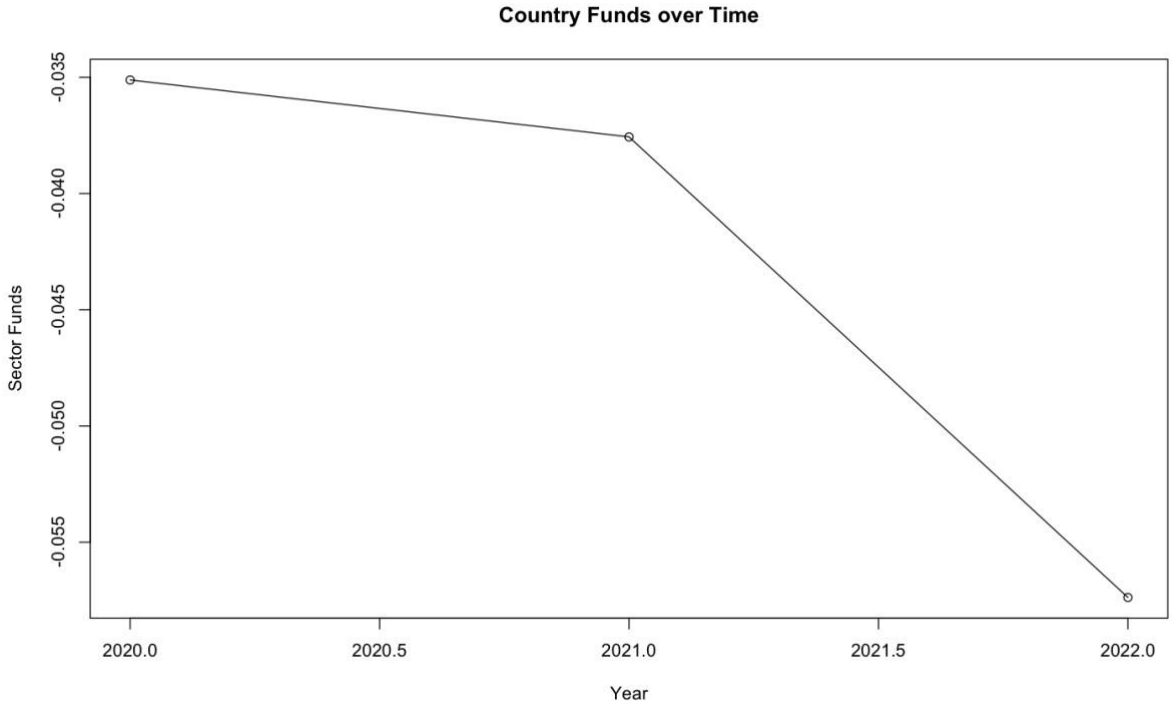

Bond Funds over Time
Bond Funds
Bond Funds
0.02
0.04
0.06
0.08
2015
2016
2017
2018
2019
2020
2021
2022
Year


Generation Funds over Time
Generation Funds
Generation Funds
0.08
0.10
0.12
0.14
0.16
0.18
0.20
2015
2016
2017
2018
2019
2020
2021
2022
Year


Mixed Funds over Time
Mixed Funds
Mixed Funds
0.03
0.04
0.05
0.06
0.07
0.08
0.09
2015
2016
2017
2018
2019
2020
2021
2022
Year


Sector Funds over Time
Sector Funds
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
2020.0
2020.5
2021.0
2021.5
2022.0
Year





The graphs in Appendix 6 illustrate the trends observed in model 2 and 3 of the OLS regression analyses.

Appendix 7 – Total Regression results (OLS Regression) – Model 1

	Variable	Coefficient	t-value	p-value
2015	Constant	0.4837371	208.486	0.0000**
	Risk	-0.0054338	-34.132	0.0000**
	D(Swedish)	0.0506235	30.586	0.0000**

	$Return_{36m}$	0.0003994	0.188	0.851
Dependent variable: %♀ Observations: 7373	F-stat: 912.7			R^2 : 0.2706 Adj.R^2: 0.2706
2016	Constant	0.374577	6.689	0.0000**
	Risk	-0.002474	-0.719	0.47198
	D(Swedish)	0.105748	2.613	0.00899**
	$Return_{36m}$	-0.069335	-0.937	0.34904
Dependent variable: %♀ Observations: 7361	F-stat: 3.21			R^2 : 0.0009 Adj. R^2 : 0.0009
2017	Constant	0.4803458	212.16	0.0000**
	Risk	-0.0044224	-27.88	0.0000**
	D(Swedish)	0.0463168	28.08	0.0000**
	$Return_{36m}$	-0.0067783	-1,72	0.0855
Dependent variable: %♀ Observations: 8063	F-stat: 753.4			R^2: 0.2188 Adj. R 2: 0.2188
2018	Constant	0.4840217	210.381	0.0000**
	Risk	-0.0046703	-26.371	0.0000**
	D(Swedish)	0.0413634	24.623	0.0000**
	$Return_{36m}$	-0.0323941	-6.828	0.0000**
Dependent variable: %♀ Observations: 8212	F-stat: 686.9			R^2: 0.2004 Adj. R^2: 0.2004
2019	Constant	0.4806255	187.229	0.0000**
	Risk	-0.0039826	-16.697	0.0000**
	D(Swedish)	0.0417865	23.382	0.0000**
	$Return_{36m}$	-0.0345339	-6.519	0.0000**
Dependent variable: %♀ Observations: 6156	F-stat: 566.3			R^2: 0.216 Adj.R^2: 0.216
2020	Constant	0.4916694	181.06	0.0000**
	Risk	-0.0039007	-23.71	0.0000**
	D(Swedish)	0.0431921	23.12	0.0000**
	$Return_{36m}$	-0.0438245	-10.44	0.0000**
Dependent variable: %♀ Observations: 5150	F-stat: 586.6			R^2: 0.2486 Adj. R^2 : 0.2486
2021	Constant	0.4778420	159.420	0.0000**
	Risk	-0.0035049	-18.931	0.0000**
	D(Swedish)	0.0528822	24.939	0.0000**
	$Return_{36m}$	-0.0134575	-3.623	0.0002**
Dependent variable: %♀ Observations: 5321	F-stat: 487.9			R^2: 0.2155 Adj. R^2 0.2155
2022	Constant	0.4699844	181.518	0.0000**
	Risk	-0.0027077	-21.277	0.0000**
	D(Swedish)	0.0507732	24.786	0.0000**
	$Return_{36m}$	-0.0296468	-7.848	0.0000**
Dependent variable: %♀ Observations: 5263	F-stat: 424.8			R^2: 0.1946 Adj. R^2: 0.1946

Appendix 7 summarizes the total results from the OLS regression run on equation (1).

Appendix 8 – Total regression results (OLS Regression) – Model 2 and 3

	Variables	Coefficient	t-value	p-value
2015	Constant	0.410591	228.872	0.0000**
	Sharpe ratio	0.015382	12.867	0.0000**
	D(Bond)	0.039330	14.122	0.0000**
	D(Mixed)	0.072938	22.082	0.0000**
	D(Generation)	0.104426	24.703	0.0000**
	$Return_{36m}$	-0.004001	-1.183	0.237
	F-stat: 343.3 Dependent variable: %♀ Observations: 7373			R^2: 0.189 Adj.R^2: 0.1884
2016	Constant	0.34172	8.470	0.0000*
	Sharpe ratio	0.01299	0.309	0.7574
	D(Bond)	0.08767	1.328	0.1843
	D(Mixed)	0.02658	0.371	0.7106
	D(Generation)	0.19892	2.055	0.0399*
	$Return_{36m}$	-0.04928	-0.493	0.6222
	F-stat: 1.575 Dependent variable: %♀ Observations: 7361			R^2: 0.00202 Adj.R^2: 0.00039
2017	Constant	0.423000	203.046	0.0000**
	Sharpe ratio	0.025913	12.703	0.0000**
	D(Bond)	0.013299	4.618	0.0000**
	D(Mixed)	0.061398	20.917	0.0000**
	D(Generation)	0.108242	26.639	0.0000**
	$Return_{36m}$	-0.051215	-9.571	0.0000**
	F-stat: 335.3 Dependent variable: %♀ Observations: 8063			R^2: 0.1722 Adj.R^2: 0.1717
2018	Constant	0.432558	240.128	0.0000**
	Sharpe ratio	0.008618	5.572	0.0000**
	D(Bond)	0.016107	6.147	0.0000**
	D(Mixed)	0.062890	22.092	0.0000**
	D(Generation)	0.112285	28.115	0.0000**
	$Return_{36m}$	-0.060502	-10.586	0.0000**
	F-stat: 326.5 Dependent variable: %♀ Observations: 8212			R^2: 0.1659, Adj.R^2: 0.1654
2019	Constant	0.457510	173.096	0.0000**
	Sharpe ratio	-0.004170	0.00822	0.0000**
	D(Bond)	0.013158	4.199	0.0000**
	D(Mixed)	0.059344	18.097	0.0000**
	D(Generation)	0.109219	28.099	0.0000**
	$Return_{36m}$	-0.667128	-12.346	0.0000**
	F-stat: 328.9 Dependent variable: %♀ Observations: 6156			R^2:0.211 Adj.R^2: 0.2104
2020	Constant	0.436329	244.704	0.0000**

	Sharpe ratio	0.009895	4.416	0.0000**
	D(Bond)	0.036211	12.521	0.0000**
	D(Mixed)	0.090198	21.654	0.0000**
	D(Generation)	0.105536	27.274	0.0000**
	D(Regional)	0.012184	4.372	0.0000**
	D(Sector)	-0.025380	-4.863	0.0000**
	D(Country)	-0.035114	-6.901	0.0000**
	$Return_{36m}$	-0.51989	-8.962	0.0000**
	F-stat: 217.3 Dependent variable: %♀ Observations: 5150			R^2: 0.2528 Adj.R^2: 0.2516
2021	Constant	0.455997	103.905	0.0000**
	Sharpe ratio	0.020392	7.659	0.0000**
	D(Bond)	0.004507	0.922	0.357
	D(Mixed)	0.049398	9.350	0.0000**
	D(Generation)	0.075968	14.089	0.0000**
	D(Regional)	-0.21282	-5.646	0.0000**
	D(Sector)	-0.065548	-14.740	0.0000**
	D(Country)	-0.037564	-13.635	0.0000**
	$Return_{36m}$	-0.037564	-7.736	0.0000**
	F-stat: 212.3 Dependent variable: %♀ Observations: 5321			R^2: 0.2423 Adj. R^2: 0.2412
2022	Constant	0.449282	130.977	0.0000**
	Sharpe ratio	0.007257	2.839	0.0045**
	D(Bond)	0.020276	4.721	0.0000**
	D(Mixed)	0.064533	13.213	0.0000**
	D(Generation)	0.090539	17.750	0.0000**
	D(Regional)	-0.011906	-3.447	0.0005**
	D(Sector)	-0.060120	-13.930	0.0000**
	D(Country)	-0.057379	-12.645	0.0000**
	$Return_{36m}$	-0.016239	-2.787	0.0053**
	F-statistic: 210.3 Dependent variable: %♀ Observations: 5263			R^2: 0.2426 Adj. R^2: 0.2415

Appendix 8 summarizes the total results from the OLS regression run on equation (2 and 3).