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Stock Markets or Saving Accounts?

The Effects of Liabilities on Households' Risk Appetite

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Abstract

Several researchers have asked themselves the question of why households do not diversify enough as according to theory, and why some households do not even enter the stock markets. This study looks further into this puzzle through a new angle where the focus is on households' risk appetite – their investment in stocks compared to funds stored in saving accounts. The study asks the question of what affects households to prefer more risk and increase their investments in stocks in relation to savings. In doing so, the emphasis is on the effect of changes in liabilities of the households' balance sheet, more specifically the study observes the effects of variables related to households' mortgages, uncollateralized loans and credit- and lease payments. The study focuses on a large data set based on Euro countries and investigates whether there are any differences between wealthier and poorer countries. Lastly, it is also examined whether an increase in stock investment necessarily decreases funds in saving accounts or if these two components move together. The author finds results implying that several of these liabilities do have an effect on households' risk appetite. The results supplement previous findings. It is also found that some differences exist between the Euro countries both when it comes to risk appetite, how they are affected by the different variables and in the movement between stock investment and investment in saving accounts.

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1 Introduction

Most of us have heard the saying “do not put all eggs in one basket” and the intuition is easy to grasp and could perhaps be applied to most things in life and nevertheless to portfolio diversification. Even though this might seem obvious, it is still observed that households in many countries do not diversify enough and hold only a few stocks, if any, in their asset portfolio. These observations are mentioned by Hochguertel, Alessie and Soest (1997) in their study where they investigate the effect of taxation on households’ choice between safe and risky assets. Further, Statman (2004) presents, according to the mean-variance portfolio theory, the optimal level of diversification as exceeding 300 stocks but showing that the average investor in US only holds 3-4 stocks, stating that the equity portfolios of US investors present a puzzle. Investing efficiently is of important manner since it affects growth and economic welfare (Danthine and Donaldson, 2005, p. 79). Hence the problems of under-diversifying and the lack of investment in riskier assets, as in stocks, are quite significant.

As presented further on in the literature review, several studies show that stock investment increases with financial wealth. In other words, there is proof that households become more risk loving when their wealth increases. This paper investigates further which factors affect households to become more prone towards investing in stocks. In order to isolate risky investments the author defines a concept of risk appetite, which measures the proportional investment in stocks compared to funds put in saving accounts. By using a Tobit regression, the author looks at countries in the Euro area and how households’ liabilities affect risk appetite. As independent variables, the author has included some of the larger liabilities in households’ balance sheet that potentially affect their risk appetite. These variables are built on households’ mortgages, uncollateralized loans and credit- and lease obligations. Further, this study investigates whether there are any differences in these results between the Euro countries by dividing them into two groups of wealthier countries with higher education level and larger financial markets, and poorer Euro countries with lower education level and smaller financial markets. Lastly the author also tries to find a pattern between investment in stocks and saving accounts by taking the correlation.

Countries depend on the development of its financial markets and thus the investment choice of households. Further, households’ investment choices affect their private budget and consumption both today and in the future. These two implications of households’ choice of enter-

ing the stock market and level of engagement motivate for the importance and interest for studying this topic to a larger extent than it has been until today.

As far as is known to the author, previous research has barely investigated the structure of households' finances and its effects on the share invested in risky assets. Moreover, most of the research within the topic of Household Finance has been made on US, Swedish or Japan specific data where this study will contribute by looking at fifteen countries in the Euro-area. The data used in this study is newly collected from a highly detailed, household specific survey from 18 Euro countries, composed by the European Central Bank through The Eurosystem Household Finance and Consumption Survey (ECB, 2015). The paper therefore adds to current research through examining other potential explanatory variables as well as observing a collection of European countries instead of looking at only US, Japan or a single European country.

From the perspective of studies focusing on equity premium as by Mankiw and Zeldes in 1991, the author does not pool assets such as bonds and stocks in order to measure risky assets, but instead focuses only on stocks as risky assets. In a similar study, Hochguertel, Alessie and Soest (1997) choose to pool bonds with stocks since they examine the households' total financial wealth. In this study the author finds it more appropriate to not include bonds in the risky asset measure since holdings in some government bonds could almost be seen as safe as storing funds in saving accounts. Since the purpose is to separate between "safe" investments and more risky investments only investments in saving accounts and stocks are included in the measure of risk appetite. In this way, the risky part of the measure risk appetite is isolated, otherwise the measure might be diffuse if it included bonds as well. This risk appetite of households is then examined by using a Standard Tobit model.

This paper differs from other, previous studies by not directly looking at the puzzle of underdiversification but instead looks at the underlying factor of the proportion that households choose to invest in stocks. It also differs in the manner that the independent variables focus on liabilities of households' balance sheet and are ratios based on households' mortgage, uncollateralized loans, outstanding credit and leasing. Another difference from many other studies in this field is that this paper investigates households' investment in stock markets and not the level of diversification as many of the other studies that are presented in the literature review do.

1.1 Purpose and Research Questions

The purpose of this paper is, as mentioned above, to investigate different components of households' liabilities and their effect on risk appetite. The term risk appetite is here used as the proportion of funds invested in stocks compared to funds put in saving accounts. More specifically, this paper aims to investigate the effect of the main parts of households' liabilities in their balance sheet, which focus on households' mortgages, uncollateralized loans and credit- and leasing obligations, on their appetite to invest in stocks compared to storing funds in a saving accounts. Further, this paper compares if there are any differences in these results between the Euro countries. Here the Euro countries are divided in groups by the common component of wealth, education and size of financial markets, and the same regression is run for these groups of countries as for the whole sample. Lastly, the author looks at the relation between stock investments and saving accounts in order to see if there is a positive pattern where they increase together or if investment in one decreases investment in the other. The purpose can be summarized in the following research questions:

- I. How is risk appetite affected by households' mortgages, uncollateralized loans and credit- and lease obligations?
- II. Are there any differences between the Euro countries?
- III. Does stock investment and investment in saving accounts move together?

1.2 Main Findings

One of the main findings of this study supplements previous research by showing that risk appetite does not increase with income in all cases, the source for the change in income is critical for the effect on risk appetite and hence stock investment. The author further finds proof that supports findings within behavioural theory, where the author of this paper shows that the effect on risk appetite of changes in households' liabilities is much affected by the proportions of liabilities in respect to their wealth, which leads to some households being more cautious in the case of an increase in mortgage payments while other households react with increasing their risk appetite in an attempt to compensate for loss in wealth. This study also shows that there exist some differences between wealthier and poorer countries in the Euro area both when it comes to proportions of liabilities in respect to assets as well as the

effect of changes in liabilities on the households' risk appetite. Another finding is that the wealthier Euro countries tend to decrease their funds in saving accounts when increasing stock investment, to a larger extent than the poorer Euro countries that more often tend to increase or decrease both investments in stocks and saving accounts.

2 Theoretical Background

2.1 Risk Aversion

As stated above, the main purpose of this paper is to investigate households' risk appetite, in other words, their willingness to invest in stocks compared to putting funds in saving accounts. This, to understand if some households prefer risk more than other, obviously the variable observed in this study is connected to risk aversion and the problem of investing in risk-free versus risky assets.

It has been found proof that stock investment or so to say, investment in risky assets, increases with wealth level of the investor. These studies are presented in the literature review that follows this chapter. Obviously some investors are more risk averse than others and some investors might even be risk lovers and this can be applied to households as well as individual investors.

The theorem of DARA – Decreasing Absolute Risk Aversion, supports these findings by showing that investors become more willing to accept higher risk when they become wealthier. This theorem also says that the actual amount invested in risky assets also increases when wealth rises. (Danthine and Donaldson, 2005, p. 78)

The theorems of CARA – Constant Relative Risk Aversion, and IARA – Increasing Relative Risk Aversion, contradicts these findings. Under CARA, the investor does not change its risk aversion when becoming wealthier and the amount invested in risky assets is unaffected. On the other hand under IARA, the investor becomes more risk averse when wealth rises and chooses to invest less in risky assets. The last theorem does not make sense in practice and is therefore not often used or investigated. The common theorems to assume are therefore DARA and CARA. (Danthine and Donaldson, 2005, p. 79)

In this paper, the author assumes based on previous findings, that households have a Decreasing Absolute Risk Aversion. By assuming this, the author allows for an increase in risk appetite, which is the purpose of this study.

2.2 The Euro Countries

As a part of this paper's purpose is to examine if there are any differences in risk appetite between the Euro countries, the author has to divide the countries in groups that have factors in common that makes the results economically interesting. Therefore this part presents some economical similarities and differences between the countries included in the study. In order to find common components between the countries, indicators from the World Bank are used. Since the data used in this paper is based on a survey from 2010/2011, these numbers are also collected for that period when possible. The country statistics are summarized in the first table for the countries included in the survey that are provided in the household data set. The first indicator used is GDP per capita as an important economical indicator and is therefore included. Furthermore, studies show that stock investment increases with income and financial wealth, which is a second argument for using this indicator. The other indicator measures the countries' gross school enrolment on tertiary level. Since previous research shows that there exist a correlation between education level and household's choice of investing in stocks, including an indicator for education seems therefore appropriate. The third indicator shows the percentage of the market value of listed companies of the countries' GDP. Even though this study does not investigate the size of financial markets in these countries, this indicator could give guidance for how the countries could be divided in order for the result to have an economically interesting interpretation.

Table 1a. Country Statistics

Country	GDP/capita*	Education**	Financial Markets***
Austria	51 131	71	19,2
Belgium	47 801	69	43,5
Cyprus	31 836	47	10,5
Germany	45 867	60	31,6
Spain	31 973	83	69
Finland	50 787	96	52,3
France	43 810	57	54,8
Greece	25 962	114	11,7
Italy	38 364	64	18,9
Luxembourg	113 731	20	114,7
Malta	22 347	40	36,8
Netherlands	53 537	76	66,5
Portugal	23 194	69	25,2
Slovenia	24 964	85	12,3
Slovak Republic	18 065	55	4,9

* *Rounded values in current US dollars (World Bank)*

** *Gross school enrolment on tertiary education level, measured in percentage as of the total population of the five-year age group that follows on from leaving school at the secondary level (World Bank)*

*** *Market value of listed companies measured as percentage of GDP (World Bank)*

From the table above it appears that for most countries, there is a positive covariance between GDP per capita, education level and the size of the financial markets. To see this pattern more clearly, actual covariances are calculated and summarized in the table below, which confirms this observation.

Table 1b. Covariances Between Indicators

Indicator	GDP/capita	Education	Financial Markets
GDP/capita	-	74479	135028
Education	-	-	127
Financial Markets	-	-	-

The values for Luxembourg and Malta are left out in order to avoid misleading results since they contain extreme values for some of the indicators and are not representing in this manner

3 Literature Review

3.1 The Puzzle

To the author's knowledge, the study closest to this paper is the one by Hochguertel, Alessie and Soest in 1997 where the researchers investigate for households in Netherlands, their total

financial wealth and their choice between risky assets – defined as stocks and bonds, and risk free assets – defined as funds in saving accounts. They assume that households are risk averse and study the effects of taxation on risk taking and demand for assets. One similarity to this paper is that the authors also look at the choice between risky assets and risk free assets. They ask the question of why households do not diversify more and if governments are trying to influence households' asset holdings, then what is the effect of taxation? In other words, how is households' risk taking and demand for different assets affected by taxation? The authors mention previous studies by Goldsmith (1976 and Mayshar (1981) that have found proof for fixed costs as holding or monitoring costs, being large obstacles for diversification. They also present the study by Paxson (1990) that shows that capital market imperfections, such as liquidity constraints or borrowing, can also have a large, negative impact on diversification. The findings of Paxson makes it interesting to further look into how the liability side of households' balance sheet affects their investment choices. Further, Hochguertel, Alessie and Soest (1997) find a strong relationship between diversification and financial wealth where they show that the wealthiest households diversify their portfolios to a greater extent than other households. They therefore conclude that households' investment behaviour, strongly depends on the marginal tax rate. In their paper, they address the problem they have with heavily skewed distributions of asset amounts by logging these variables. Their findings confirm that if financial wealth is significant for diversification then there might be a connection between the amount invested in stocks and diversification as well. This makes it interesting to further look at which factors affect and how they affect households' decision to invest in stocks.

The under-diversification of investors is not the single issue puzzling researchers. In 1991, Mankiw and Zeldes addressed the issue of households not even participating in stock markets. They stressed that only one-fourth of the households in US owned stocks at that time. In their study they focus on the consumption of non-stockholding and stockholding households and investigate whether the consumption differs between these two categories of households. Even though their data has serious limitations due to quite large measurement errors and a short time period as well as only including food consumption, they were at least according to the researchers themselves, the first ones to examine this relationship between consumption and investment behaviour of households'. In other words, the researches attempt to find a pattern in consumption behaviour between households that own stocks and households that do not own stocks. One of their explanations for households refraining from stock investments is

simply that they lack liquid wealth. Nevertheless, they also show that even for households with substantial wealth the issue of absence in the stock markets still holds. Consistent with information costs, they find that the fraction of households that choose to invest in stocks, increases with labour income, holding education constant, and also increases with education, holding income constant.

Mankiw and Zeldes (1991) stress that the question of why many wealthy households still choose to not invest in stocks remains. Their most interesting results show that the consumption between households owning and not owning stocks differs substantially – consumption of households owning stocks is more volatile and has a higher correlation with the excess return on the stock market. The households that own stocks also spend approximately twenty-five percentages more per capita on food than households not owning stocks, they also spend more on food consumed outside of their home. (Mankiw and Zeldes, 1991) This implies that since consumption differs between households that choose to invest in stocks and households that refrain from it, there might also exist differences in other types of assets and liabilities of the households. This opens up for more questions, for example whether households investing more in risky assets have a different balance sheet structure and whether this could potentially explain why some households invest more in stocks than other.

Thus, researchers have tried to find answers for this puzzle and irrational behaviour of households. Some proof has been found for different variables explaining this under-diversification and hesitation of investing in risky assets but questions still remain. One of these possible explanations was presented in a recent study where financial wealth is shown to have a large positive impact on the risky share of a household's portfolio meaning that households with a larger financial wealth will invest more in risky assets. (Calvet and Sodini, 2014) This is cohesive with previous findings showing that more developed countries, consisting of households with a larger financial wealth and a more educated population, will also invest more in financial markets (Calvet, Campbell and Sodini, 2009). Corresponding to financial theory, human capital is also strongly and positively correlated with the riskiness in households' investment choice (Calvet and Sodini, 2014).

Statman made a different approach in 2004, focusing on behavioural theory, trying to explain why some investors are more prone to refrain from investing in stocks. The researcher questions the explanatory power of the mean-variance portfolio theory for the diversification puz-

zle and instead tries to find an explanation through behavioural portfolio theory. He explains that investors are not necessarily risk averse and that instead their aspiration is to avoid poverty and accomplish becoming wealthy. He describes investors' portfolios as layered pyramids where the investor divides his or her funds into two layers. The first one is a so-called downside protection layer with the purpose to protect the investor from poverty and falling into lower social classes and consists of safer investments. The further up you come in the portfolio pyramid the more you reach the other layer – the upside-potential layer where the investor takes on more risk by investing in stocks and other riskier assets, in order to acquire more wealth and climb to higher social classes. As the mean-variance portfolio theory states, it is beneficial to increase diversification in terms of decreasing the portfolio risk. Consequently the potential gain also decreases with diversification. Since the upside-potential layer's purpose of the portfolio pyramid is to reach the investor's aspirations and increase wealth, this layer of the portfolio is thus less diversified in order to increase the potential reward. The downside-protection layer on the other hand, is a more diversified and safer invested part of the portfolio with the purpose to act as a safety barrier of falling below a certain wealth level.

Statman (2004) thus argues that behavioural portfolio theory and this portfolio pyramid model contributes to the explanations of why investors and households tend to under-diversify. He shows that even though decreasing risk is always beneficial according to the mean-variance portfolio theory, it may be the opposite in the context of behavioural portfolio theory. The researcher's findings suggest that investors and households have a risk appetite due to their aspirations of acquiring more wealth. A question arising is, what affects this risk appetite that encourages investments in stocks?

Most research in this topic has been made on US data; although a study focusing on households in Japan shows similar results as the studies made on US households. The researches find that for households with a higher income level, the risk aversion is also substantially smaller and they also own larger investments in stocks. Further, they systematically find different levels of risk aversion for different income levels of households. This is not surprising since it is cohesive with previous findings for households in US. Further, the percentage holding stocks has been found to be much higher for US investors than European investors (Houchguertel, Alessie and Soest, 1997), which makes it appealing to further investigate this puzzle by looking at observations in European countries.

As presented above, researchers try to, with different theories, to find explanations for households' and investors' choice of entering the stock market and their choice of not fully diversifying their portfolios. What connects most previous research within this topic is that it typically focuses solely on financial assets and does not include illiquid assets in the empirical research. One exception is the study by Mankiw and Zeldes (1991) as mentioned above, another one, mentioned by Pelizzon and Weber (2008) is the study by Heaton and Lucas in 2000 where the researches include own businesses in order to explain this investment behaviour. Pelizzon and Weber (2008), state that in a household's portfolio, the most important illiquid asset is housing. In their study they consider illiquid housing wealth as well when investigating the efficiency of households. They find that housing wealth has a key role in determining whether households are being efficient in the investments. There is a large lack in theory due to this focus on financial wealth and this opens up for further research within this topic. By focusing on the liability side of the households' balance sheet, one might find more explanations for households' choice of investment.

3.2 The Liabilities of Households' Balance Sheet

As described above, most research investigating households' decision whether they are investing in stocks and if they are diversifying, focuses on households' financial wealth and other parts of their assets. To the author's knowledge, there are no studies investigating this issue with the liability side in aspect. In order to find relevant components of liabilities in households' balance sheet to use as independent variables, following part presents studies showing the distribution of households' liabilities. (Barwell, May and Pezzini, 2006)

In a survey by NMG Research that was performed on households in UK in 2005, it was found that the distribution of debt across households is quite unevenly distributed. Only 40 percent of the households in the survey have debt and between households that are indebted, the debt varies widely. Around 43 percent of the households having debt have a mortgage and around 42 percent have uncollateralized debt, making these two liabilities the largest components of debt. (Barwell, May and Pezzini, 2006)

Another study from 2000 on households in New Zealand shows a rapid increase in households' credit card debt making it a larger component of households' liabilities. This study also

compares the credit card debt as a ratio of disposable income, with these ratios in UK, US and Australia, and finds that the ratios are on similar levels. (Thorp and Ung, 2001)

As known by many, buying a car can be a large liability for the household and studies show a large increase for households choosing to lease cars instead of financing it through a loan. Therefore the liability side for households' has seen some restructuring where some parts that previously has consisted of loans are now leasing liabilities. (Mannering, Starkey and Winston, 2001) This highlights that also leasing payments may have become more significant in households' decision since it has become a larger part of many households' balance sheets.

4 Methodology

This section firstly describes the data used in more detail; secondly the variables used are described and; thirdly the model and tests are presented; lastly the weaknesses and strengths of this paper and some suggestions for future research are mentioned.

4.1 Data

The data is a micro data set collected by Eurosystem Household Finance and Consumption Survey (HFCS). Each participating institution, which can be national central banks and in some cases national statistical institutes, conducts its own survey, here HFCS is a decentralized survey effort of the Eurosystem. Then HFCS provide Eurosystem with micro-level data on the households in the euro-area and their finances and consumption. In 2008 it was decided that a survey would be made on all the euro area countries within the field of households finance and consumption. The survey consist of approximately 54 000 completed interviews where the main part of the data set, the one used in this paper, is answered for the household as whole and by only one person in the household. In the survey, a household is defined as either a person living alone or together with a group of people where they live in the same dwelling and share expenditures. Employees such as servants and au-pairs are not considered to be a part of that household but a separate household. (ECB, 2015)

Adjustments have been made by the HFCS to avoid issues with missing variables. The method applied for this is stochastic imputation, meaning that missing observations have been estimated conditional on observed variables that can reasonably explain the missing observa-

tion. In order to take into account uncertainty – since otherwise the estimated variance could be underestimated, five imputed values are provided for each missing value. These adjustments enable analysis with complete-data methods. The multiple imputation procedure for each missing value, results in a full data set that comprises of a number of observations that is five times the actual number of respondents, which should be taken into account when testing and analysing the data. Advantages using multiple imputation rather than single imputation are that it provides for more efficient estimation since you include a random process, and that it allows for more straightforward estimates of the uncertainty degree in regard to the missing information. They refer to Rubin (1997) to support the choice of a multiple imputation procedure for missing values. (ECB, 2015)

The countries included in the survey and that data is provided for on household level are the following fifteen countries: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia and Spain (ECB, 2015). In order to answer the second research question of this study, these countries are divided into two groups, a wealthier country group (GDP/capita is above 40 000 USD) including: Austria, Belgium, Finland, France, Germany, Luxembourg and Netherlands; and a second group including the poorer countries (GDP/capita is below 40 000 USD): Cyprus, Greece, Italy, Malta, Portugal, Slovak Republic, Slovenia and Spain.

4.2 Variables

Before any estimation or categorization of the variables included in the survey, the multiple imputation for missing values should be accounted for. In order to do so, this paper follows the guidance provided by the HFCS (ECB, 2015). As described above, every observation Y has five values, denoted \hat{Y} , and in the first step the mean value for each observation is calculated using the following equation:

$$\bar{Y} = \frac{1}{5} \sum_{i=1}^5 \hat{Y}_i$$

As stated above, risk appetite is in this paper described by the proportional amount invested in stocks instead of in saving accounts, where the risk appetite is assumed to grow as the proportion invested in stocks grows. This endogenous variable is presented in table 2a.

Table 2a. Dependent Variable

Variable	Measurement
risk_appetite	<p>Measured as the proportion of the amount of the household's stock investment of the total sum of the household's investment in stocks and saving accounts:</p> $risk\ appetite = \frac{stocks}{(savings + stocks)}$

The following table presents all of the independent variables used in the regressions. They are chosen either for having a potential to explain risk appetite or as control variables in order to avoid having omitted variables. The variables are all on household level and are measured in the same units for each question and country.

Table 2b. Independent Variables

Variable	Measurement and Motivation
mortgage_paym	<p>Measured as the monthly amount paid for the mortgage on the household's main residence divided by the household's monthly total gross income. The monthly mortgage payment includes both interest and repayment.</p> <p><i>Since mortgage is one of the largest parts of households' liabilities, there is a possibility that it affects households' choice of investing in stocks and hence their risk appetite.</i></p>
loan_paym	<p>Measured as the monthly amount paid for uncollateralized loan divided by the household's monthly total gross income. The monthly loan payment includes both interest and repayment.</p> <p><i>Since uncollateralized loans are also one of the largest parts of households' liabilities, there is a possibility that it affects households' choice of investing in stocks and hence their risk appetite.</i></p>
mortgage	<p>Measured as the amount still owned on mortgage for the household's main residence, divided by the current market price of the household's main residence.</p> <p><i>This is another variable included in order to try to catch the effects from mortgages on households' risk appetite. This variable describes the effect of having a larger debt compared to a lower one and its effect on risk appetite.</i></p>

add_mortg_D	<p>A dummy variable where the variable is equal to 1 if the household has an additional mortgage on other properties.</p> <p><i>A third variable for capturing the effect of mortgages, here the variable shows if an additional mortgage other than mortgage on household's main residence has a significant influence on the household's risk appetite.</i></p>
<hr/>	
credit_D	<p>A dummy variable where the variable is equal to 1 if the household has an outstanding balance on credit cards.</p> <p><i>Since credit is a liability that has been increasing in proportion over the years, it seems appropriate to investigate whether it affects households' willingness to invest in stocks.</i></p>
<hr/>	
lease_paym	<p>Measured as monthly lease payments divided by the household's total gross income.</p> <p><i>Also leasing is a liability that has been increasing and should therefore be considered in this study.</i></p>
<hr/>	
hmembers	<p>A control variable for the number of members in the household.</p> <p><i>Since a larger amount of household members might imply a higher income for the household this variable is included.</i></p>
<hr/>	
hmembers_employ	<p>A control variable for the number of how many of the household members, above 16 years, that are employed.</p> <p><i>Since income and education has been found to affect households' investment in stocks, these variables should be controlled for. The data provided does not include these figures on household level and therefore the variable for employed members is included as a proxy.</i></p>
<hr/>	
income	<p>A control variable for the yearly total gross income.</p> <p><i>With the same motivation as above, income should be controlled for as there are proof for its effect on households' choice of stock investment.</i></p>
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In the tables in the following pages the summary statistics of the dependent and the independent variables are presented. The values displayed in these tables are all measured in euros and the independent variables are not yet transformed in the ratios as explained above.

Table 3a. Summary Statistics of Dependent Variable – All Countries

Variable	Mean	St. dev.	Min.	Max.	Skewn.	Nobs.	Nobs.>0
Savings	14 878	72 857	0,000	7 000 000	33,009	62 508	27 648
Stocks	14 714	235 564	0,000	35 000 000	79,560	62 508	10 222
Savings+stocks	29 593	253 699	0,000	35 000 000	66,557	62 508	32 369
Risk appetite	0,111	0,294	0,000	1,000	2,482	62 508	10 222

As observed above, almost half of the households included in the survey have neither savings nor investments in stocks and about three times as many of the households own funds in saving accounts compared to stocks. Due to the large amount of households lacking both stocks and funds in saving accounts, the standard deviation is large for both savings and stocks as well as for the dependent variable risk appetite. As observed in this table, around one sixth of the households included in the survey have investments in stocks.

Table 3b. Summary Statistics of Independent Variables – All Countries

Variable	Mean	St. dev.	Min.	Max.	Skewn.
mortgage_paym	8,276	190,090	-0,030	36 000	126,644
loan_paym	3,929	50,064	-6,046	4 293	26,438
mortgage	113,219	4106,738	0,000	363 000	53,762
add_mortg_D	0,0003	0,0187	0,000	1,000	53,280
credit_D	0,032	0,176	0,000	1,000	5,303
lease_paym	0,923	96,179	-7,258	20 000	177,011
hmembers	2,467	1,295	1,000	16,000	0,993
hmembers_employ	0,980	0,915	0,000	6,000	0,515
income	3446,136	6632,620	-37 437,83	761 447,7	34,005

The table 3b in the previous page, summarizing the statistics for the independent variables, and as the previous table it shows a similar pattern of high skewness for almost all of the variables. As applied by Houchguertel, Alessie and Soes (1997), the variables are logged in the regression in order to lessen this problem. The variables that are logged before running the regressions is the independent variable of risk appetite as well as all of the independent variables except for the Dummy variables since it will make no sense doing so, and the control variables since they do not have the same problem with skewness. The numerical independent variables are all calculated in ratios before regressing them in order to make them more comparable across households as well as more meaningful when interpreting the results.

In order to analyse the results from the Tobit regression for the separate country groups the above statistics is summarized for the two groups as well. The first tables show the statistics for group 1 including the wealthier Euro countries, followed by tables showing statistics for group 2 that includes the poorer countries of the Euro area.

Table 3c. Summary Statistics of Dependent Variable – Group 1

Variable	Mean	St. dev.	Min.	Max.	Skewn.	Nobs.	Nobs.>0
Savings	16 961	62 686	0,000	5 000 000	28,191	36 518	21 530
Stocks	16 649	199 750	0,000	22 180 000	57,444	36 518	7 747
Savings+stocks	33 610	213 187	0,000	22 236 000	48,598	36 518	24 867
Risk appetite	0,142	0,324	0,000	1,000	2,055	36 518	7 747

The table above shows that the mean for funds in saving accounts and investment in stocks are almost the same, although the standard deviation for stock investment is around three times as high. The number of households owning stocks compared to having funds in saving accounts is nearly three times as low. Table 3d on the next page shows the statistics for the independent variables of group 1.

Table 3d. Summary Statistics of Independent Variables – Group 1

Variable	Mean	St. dev.	Min.	Max.	Skewn.
mortgage_paym	6,463	218,123	-0.013	36 000	134,259
loan_paym	0,993	33,491	-6,046	4 293	75,753
mortgage	92,359	4 328,905	0,000	363 000	59,005
add_mortg_D	0,000	0,020	0,000	1,000	49,310
credit_D	0,011	0,107	0,000	1,000	9,073
lease_paym	0,686	105,145	-7,258	20 000	188,529
hmembers	2,379	1,298	1,000	15,000	1,196
hmembers_employ	0,960	0,901	0,000	6,000	0,457
income	4 561	6 355	-37 437	291 033	13,474

Table 3e. Summary Statistics of Dependent Variable – Group 2

Variable	Mean	St. dev.	Min.	Max.	Skewn.	Nobs.	Nobs>0
Savings	11 951	85 035	0,000	7 000 000	34,113	25 990	6 118
Stocks	11 996	278 179	0,000	35 000 000	86,322	25 990	2 475
Savings+stocks	23 948	301 476	0,000	35 000 000	71,280	25 990	7 502
Risk appetite	0,067	0,239	0,000	1,000	3,464	25 990	2 475

Comparing the statistics for the dependent variable of group 2, with the statistics of group 1, it can be observed that both investment in stocks and saving accounts is in general higher for most countries belonging to the wealthier countries of the Euro area, although maximum investments belong to the poorer countries, explaining the higher standard deviation as well. The mean value of risk appetite appears to be higher for the wealthier countries, more than twice as high.

When observing the statistics for the independent variables for the two country groups both loans and lease payments as well as mortgage appears to in general be higher for the poorer countries than for the wealthier Euro countries.

Before running the Tobit regression for each country group, the numerical variables are transformed in ratios as explained in the variable tables and the variables with high skewness are logged, the same way as when regressing the full sample with all countries included.

Table 3f. Summary Statistics of Independent Variables – Group 2

Variable	Mean	St. dev.	Min.	Max.	Skewn.
mortgage_paym	10,822	141,611	0,000	10 512	47,560
loan_paym	8,052	66,498	0,000	2 500	13,395
mortgage	142,514	3 772,594	0,000	266 000	41,560
add_mortg_D	0,000	0,16	0,000	1,000	60,923
credit_D	0,060	0,239	0,000	1,000	3,673
lease_paym	1,257	81,948	0,000	12 000	128,824
hmembers	2,589	1,282	1,000	16,000	0,727
hmembers_employ	1,008	0,935	0,000	6,000	0,581
income	1 879	6 696	-2 490	761 447	63,342

4.3 Econometric Approach and Model Specification

In this paper, risk appetite is investigated and is treated as the dependent variable. Further, risk appetite is here defined as the proportional difference between investing in stocks compared to storing funds in a saving's account – in other words, the more the household invests in stocks, the higher risk appetite it has. The distribution of the dependent variable is continu-

ous with a probability mass of one and thus a standard Tobit model is used as recommended by econometric literature (Verbeek, 2012, p. 206). The Tobit model is further described in appendix A1.

The regression that is estimated with the Tobit model is specifically:

$$\begin{aligned} risk\ appetite_H = & \beta_0 + \beta_1 income_H + \beta_2 hmembers_H + \beta_3 hmemembers_employ_H \\ & + \beta_4 mortgage_paym_H + \beta_5 loan_paym_H + \beta_6 mortgage_H \\ & + \beta_7 add_mortgage_d_H + \beta_8 credit_d_H + \beta_9 leas_paym_H + \varepsilon_H \end{aligned}$$

This regression is firstly run for the whole sample in order to answer the first research question. Based on the country statistics, the author then, as described previously, divides the countries into two groups where the first one includes the countries with a GDP/capita that is higher than 40 000 USD, including: Austria, Belgium, Germany, Finland, France, Luxembourg and Netherlands; and the other group where the countries have a GDP/capita lower than 40 000 USD includes the countries: Cyprus, Spain, Greece, Italy, Malta, Portugal, Slovenia and Slovak Republic. The regression above is then run for the two separate country groups as well.

In order to correct for heteroskedasticity due to differences in country size, the equation is estimated with White's robust error terms. Further, this model is tested for omitted variables where the test results show that the model does not suffer from omitted variables. For the variables being rejected as significant for households' risk appetite, the author performs a Wald test in order to see if these variables are jointly zero.

Lastly, in order to answer the third research question, the correlations between stock investments and funds in saving accounts are calculated both for the full sample and for the two country groups. This shows if there is any correlation between the stock investment and savings in saving accounts.

4.4 Weaknesses and Strengths

One of the strengths with this study is the included data set, which provides a very large sample over the Euro countries. It is also beneficial that multiple imputation has been applied in

order to avoid having missing values. Another benefit of this study is that the author focuses on the liability side of households' balance sheet and not the assets, in order to avoid endogeneity problems through simultaneity. Even though the data set is of great advantage in its current form it would have been of even great advantage if the survey had been done for previous years as well in order to work with time series data instead and observe if there has been any change or development of the findings.

4.5 Future Research

The survey will be made continuously and for future research it might be interesting to performed the same or similar test but on the time series data. It might also be interesting to perform this study on other countries, for example in the US. Another interesting viewpoint could be to investigate how households' liabilities affect investments in other assets as well and not only look at stocks and savings in saving accounts.

5 Results

The table below shows the regression output when running the regression for all countries and the two groups separately. When testing for all countries together, the variables that seem to have a significant effect on households' risk appetite is the monthly mortgage payment, monthly payment on uncollateralized loans, amount still owned on current mortgage, if there is outstanding balance on credit as well as the control variable for income. When looking at the two country groups separately there are some differences in the results. For both groups mortgage payments and loan payments has a significant effect, although loan payments are only significant on a 10% level for the wealthier country group compared with the other. When looking at the mortgage it is only significant for the poorer country group, whereas for the wealthier country group, the result show no significance for outstanding mortgage on the households' risk appetite. For both country groups, the control variable shows significant effect. Outstanding credit, as well as the other two control variables household members and household members in employment, show a significant effect only for the wealthier country group. The coefficients that show a significant effect for both country groups have the same effect – either positive or negative, for both groups.

Table 4a. Regression Output – Dependent Variable: Risk Appetite

Independent Variable	(1) All Countries	(2) Group 1	(3) Group 2
mortgage_paym	0,117333*** [0,012243]	0,407819*** [0,030934]	0,057972*** [0,015559]
loan_paym	0,107026*** [0,013784]	0,095033* [0,052338]	0,067068*** [0,014458]
mortgage	-0,099707** [0,045679]	-0,147700 [0,153158]	-0,056683** [0,027670]
add_mortg_D	-0,007326 [0,092431]	-0,128694 [0,099595]	0,182090 [0,187055]
credit_D	-0,056582*** [0,012334]	-0,112299*** [0,024259]	0,011064 [0,016677]
lease_paym	0,006866 [0,046575]	0,005125 [0,050507]	-0,012143 [0,059418]
hmembers	0,001355 [0,001804]	-0,009532*** [0,002132]	0,006396 [0,003921]
hmembers_employ	0,002555 [0,002746]	-0,018592*** [0,003363]	0,004225 [0,005726]
income	0,160568*** [0,005781]	0,366712*** [0,014798]	0,103331*** [0,004670]
_cons	-0,850789*** [0,018660]	-1,493853*** [0,049420]	-0,824291*** [0,015995]
<i>N</i>	62 474	36 475	26 003

p* < 0,1; p** < 0,05; p*** < 0,01

When interpreting the results from the regression, one must bear in mind that the coefficients may have two interpretations: a specific coefficient can be interpreted as the effect of a change in the independent variable on the probability of a nonzero risk appetite; the coefficient may also be interpreted as the effect of a change in the independent on the level of risk

appetite. (Verbeek, 2012, p. 241) Further, except for the Dummy and control variables, the independent variables are in ratios in order to make them more comparable across households, and are also logged in order to mild their skewness. The dependent variable, risk appetite is also a ratio. Thus, the coefficients are to be interpreted as the percentage change in risk appetite with regard to a one-unit change in the independent variable.

The second table in this chapter shows the tests for omitted variables. As seen from the results neither of the regressions performed seem to suffer from omitted variables.

4b. Omitted Variables Tests

	(1) All Countries			(2) Group 1			(3) Group 2		
	Value	df	Probability	Value	df	Probability	Value	df	Probability
Likelihood ratio	203.3558	4	0.0000	210.3798	4	0.0000	29.38940	4	0.0000

Null hypothesis: the model has omitted variables

As described in the methodology chapter, the insignificant variables in each regression are tested with a Wald test in order to see if they are all equal to zero. The results are summarized in the table below, showing that the null hypothesis cannot be rejected. This means that the insignificance of these variables is confirmed.

4c. Wald Tests

	(1) All Countries			(2) Group 1			(3) Group 2		
	Value	df	Probability	Value	df	Probability	Value	df	Probability
F-statistic	0.014027	(2,624)	0.9861	0.878354	(3,3646)	0.4514	0.46991	(3,2598)	0.7033

Null hypothesis: insignificant variables from the Tobit regression are all equal to zero

The last table, 4d shows the correlation between funds in saving accounts and stock investments for all three samples that are used in this study. In all three cases there is a positive correlation between investment in stocks and saving accounts, although the correlation is around twice as high for the poorer Euro countries than the wealthier.

Table 4d. Correlations Between Savings and Stocks

Indicator	Stocks (all)	Stocks (group 1)	Stocks (group 2)
Savings (all)	0,1038	-	-
Savings (group 1)	-	0,0646	-
Savings (group 2)	-	-	0,1325

6 Analysis

6.1 Driving Forces of Risk Appetite

By assuming that households have a Decreasing Average Risk Aversion and that their increase in risk appetite is represented by a higher investment in stocks compared to saving accounts, this study tests if the liability side of households' balance sheet can partially explain increase in risk appetite. As shown by table 4a, when testing for all countries, the significant variables are monthly mortgage and loan payments in relation to income, mortgage amount in relation to market value of the property, and outstanding credit.

When looking at monthly mortgage payments to the households' monthly gross income, it shows that on a 1% significance level, a one-unit increase in mortgage payments with respect to the household's income increases that household's risk appetite with almost 12%. At first, it might seem odd that when mortgage payments take a larger part of the household's income, the household actually becomes more willing to take on risk and invests more in stocks compared to saves funds in saving accounts. The explanation to this behaviour might be a parallel to Statman's study, in other words, this increase in risk appetite might be due to households' fear of becoming poorer and in their aspiration to compensate for the loss in income, they invest more in stocks hoping to receive a higher return. The same discussion can be made for the monthly loan payments.

One question that can be asked– are these findings contradicting to the previous findings that show that an increase, not a decrease, in wealth increases stock investment? When comparing to the results that a higher marginal tax rate decreases stock investment, the results from this study are the opposite, although this is a bit ambiguous. Higher mortgage and loan payments do not necessarily have a prolonged decrease on the income as the marginal tax rate has and

thus the increase in risk appetite by a higher monthly payment may be an attempt to not decrease in wealth. Concurrently, it is not feasible to ignore the contradiction in these results.

A following result presented in the table is that when the amount still owned for the mortgage in relation to the market value of the property, increases with one unit, the risk appetite decreases with almost 10%. This means that there is a higher possibility, than in the case above, that future income streams will decrease than expected in the case of a selling of the property, there might even be a risk of losing wealth if the property is worth less than the mortgage that is left to payoff. These findings are more cohesive with previous ones saying that the income affects households so that their risk appetite decreases when income or expected income is lower. The result is also cohesive with Statman's findings as it may be interpreted as cautiousness for not falling below a certain wealth level. If there is a risk that the household will have a large income decrease then a drop in risk appetite may be an effort to invest in safe assets as saving accounts in order to not add more risk to their income.

The last independent variable that shows significance for risk appetite when regressing all countries in the sample is outstanding credit. If the household has an outstanding balance on their credit then the household's risk appetite decreases. Since credit is a direct liability without any underlying asset as in the case of a mortgage and has to be paid off, this is a plain decrease of the household's income and the result is therefore not surprising.

The reason for an additional mortgage not showing any significance on the risk appetite of households, might be due to that it is not the number of mortgages that affects the risk appetite but the size of the mortgage that has an influence.

For the regression including all countries, the only control variable showing significance is income. That income shows significance and an affect that leads to an increase in risk appetite when income increases is not surprising since it is in line with other previous studies.

6.2 Differences Between the Euro Countries

The second purpose of this paper is to investigate whether there are any differences between the Euro countries. From table 4a, it is observable that the results regarding mortgage and loan payments are the same for the two country groups as well as when testing for all coun-

tries together in the terms of having the same type of effect on risk appetite. Although, monthly loan payments in relation to monthly gross income, show only significance on a 10% level for the wealthier country group, while it is significant on a 1% level for the other one. Another difference in the variables is that the increase in risk appetite due to an increase in mortgage payments in relation to income is almost 41% for the wealthier countries while barely 6% for the poorer countries. As seen in the summary statistics, the mean mortgage payment is quite higher for households in the poorer Euro countries, meaning that for the households that in general have lower mortgage payments, although this can vary largely, the risk appetite increases much more when this ratio increases. It is also observed that the mean income is much higher for the households in the wealthier countries, indicating that these households have a lower ratio of mortgage payments of gross income. This could mean that they therefore will not fall under a certain wealth level and instead of being a bit more cautious as the households in the poorer Euro countries, their risk appetite increase largely in order to increase the wealth. The risk appetite of the households in the poorer country group does only increase marginally since they, according to previous reasoning, want to compensate for the lost income due to the proportional decrease in income.

The difference in increase in risk appetite between the country groups is not as pronounced when looking at the results for the loan payments. The same pattern exist for the two groups as when it comes to mortgage, but since loan is uncollateralized as credit, there is not a high increase for any of the country groups in risk appetite.

The effect on risk appetite of a one-unit increase in the mortgage in relation to market value of properties is negative when looking at the two country groups, which is in line with the result from the regression with all countries together. Although, this results is only significant for the poorer country group, meaning that for the wealthier country group there is no significant effect on risk appetite of an increase in this variable. The country statistics show the mean value of mortgages is quite higher for the households in the poorer countries, making them more vulnerable to increases in mortgages since the mortgage represents a larger part of their wealth than for the households in the wealthier countries.

Further, having an outstanding credit has as when looking at all countries together, a negative effect on the risk appetite of household when looking at the country groups separately. Although, this effect is only significant for households in the wealthier country group. The credit

amount might be higher for the wealthier countries, which makes this result in line with previous findings and discussion.

6.3 Stock Investments and Saving Accounts

The last part of this paper's purpose is to further examine the relationship between stock investment and investment in saving accounts. Are they increasing together or does one of them increase when the other decreases? The table 3g summarizes the correlations taken in order to answer this question. Both when looking at all countries together as well as when observing the two country groups separately, it is observable that there is a slight, positive correlation between savings and stock investment, meaning that increasing investment in stocks does not always have to mean that funds put in saving accounts decreases. This correlation is strongest for the sample including households in the poorer countries. This result can be interpreted as that the households in the wealthier Euro countries, since they in general have a higher level of risk appetite, are more prone towards switching funds in saving accounts too investments in stocks in an aspiration towards higher wealth levels, this is in line with previous discussion and the findings by Statman. It also follows that the poorer countries, in an attempt to not fall below a certain wealth level are more cautious in their investments and therefore not only have a lower risk appetite but also refrain to a larger extent to shift between investments.

7 Conclusions

It seems that a fear of becoming poorer when the mortgage payments rise in relation to the households' income, increases the risk appetite of households as an attempt to compensate for lower income by investing in stocks where the expected return is higher than when saving funds in saving accounts.

The author finds a contradicting result from previous research that shows that even though income decreases as mortgage or loan payments in relation to income increase, risk appetite increases, as stated above, a conclusion is that this is due to an aspiration for not loosing wealth or so to say, to compensate for the decrease in income. This leads to a second conclusion that the cause for the decrease in income is crucial for the household's decision whether their risk appetite will increase or decrease.

A third conclusion is that when there exists a risk that the household may lose wealth in their property investment, the household's risk appetite decreases since this might be a factor that affects their income quite largely and for a longer time. This decrease in risk appetite also follows from cautiousness of adding more risk to their income. This is true for households in poorer countries where the mean mortgage value is shown to be higher while income is lower, than for households in wealthier Euro countries. The result is not significant when looking at the wealthier countries only.

Consistent with previous findings, credit liabilities decrease household's risk appetite since it is a decrease of the household's income. This conclusion supports the previous one made by the author, that it is not solely the decrease in income that lowers households' risk appetite, but also the source to the decrease in income.

The smaller the proportion of mortgage payments to income is, the larger the increase in risk appetite when the mortgage payments increase in relation to income. This, since the larger this proportion is, the riskier it is for the household that an increase will lead the household to reach an undesired wealth level. Thus, the increase in risk appetite is smaller at higher levels of mortgage payments to income. Even though the same loan and income patterns are observed for uncollateralized loans, a large increase in risk appetite for the households in the wealthier countries is not observed. This result can be explained with the same reasoning as for credit, namely that there is no underlying asset and thus is a direct decrease in wealth.

Households in wealthier Euro countries are more prone towards changing between the two investments of stocks and saving accounts since they already have higher income levels and they focus more on achieving even higher wealth than protecting themselves of too low levels. The households in the poorer Euro countries are instead more cautious and therefore also more careful with changing between investing in stocks and storing funds in saving accounts.

8 References

- Barwell, R., May, O., & Pezzini, S.** (2006). The distribution of assets, income and liabilities across UK households: results from the 2005 NMG Research survey. *Quarterly Bulletin, Spring*.
- Calvet, L. E., & Sodini, P.** (2014). Twin Picks: Disentangling the Determinants of Risk-Taking in Household Portfolios. *The Journal of Finance, 69*(2), 867-906.
- Calvet, L. E., & Campbell, J. Y. Paolo Sodini.** (2009). Measuring the Sophistication of Households. *American Economic Review, 99*, 393-98.
- Danthine, J. P., & Donaldson, J. B.** (2005). *Intermediate financial theory*. academic press.
- ECB.** (2015). *Household Finance and Consumption Network (HFCN)*. [Online]. Available from: https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_hfcn.en.html.
- Hochguertel, S., Alessie, R., & Van Soest, A.** (1997). Saving accounts versus stocks and bonds in household portfolio allocation. *The Scandinavian Journal of Economics, 99*(1), 81-97.
- Mankiw, N. G., & Zeldes, S. P.** (1991). The consumption of stockholders and nonstockholders. *Journal of Financial Economics, 29*(1), 97-112.
- Manning, F., Winston, C., & Starkey, W.** (2002). An exploratory analysis of automobile leasing by US households. *Journal of Urban Economics, 52*(1), 154-176.
- Pelizzon, L., & Weber, G.** (2008). Are household portfolios efficient? An analysis conditional on housing. *Journal of Financial and Quantitative Analysis, 43*(02), 401-431.
- Statman, M.** (2004). The diversification puzzle. *Financial Analysts Journal, 60*(4), 44-53.
- The World Bank.** (2015). *Data – GDP Per Capita*. Available from: <http://data.worldbank.org/indicator/NY.GDP.PCAP.CD>
- The World Bank.** (2015). *Data – School enrolment, tertiary*. Available from: <http://data.worldbank.org/indicator/SE.TER.ENRR>
- The World Bank.** (2015). *Data – Market Capitalization of Listed Companies*. Available from: <http://data.worldbank.org/indicator/CM.MKT.LCAP.GD.ZS>
- Thorp, C., & Ung, B.** (2001). Recent trends in household financial assets and liabilities. *Reserve Bank of New Zealand Bulletin, 64*.
- Verbeek, M.** (2012). *A guide to modern econometrics*. John Wiley & Sons.

9 Appendix

9.1 A1 - The Standard Tobit Model

The intuition behind the Standard Tobit model is based on the standard assumption that the household desires to maximize its utility (Verbeek, 2012, p. 238). In this case, the household wants to maximize its utility from investment and savings where the proportion invested in stocks represents the household's risk appetite, which in turn might depend on the independent variables included in regression. As described by Verbeek (2012, p. 238-239) this could be displayed as a simple utility maximization problem for the household:

$$\max_{s,y} U(s, y) \quad (1)$$

$$s + y \leq x \quad (2)$$

$$s, y \geq 0 \quad (3)$$

Applied to this paper's topic, s is the amount invested in stocks while y represents amount of funds put in saving accounts, and x is the total of the household's assets, liabilities and consumption. If the constraint in (4) is not considered, s is denoted as s^* and the solution to the maximization problem for (2) – (3) will be linear in x . As all factors affecting households' risk appetite – such as tradition, family culture, other household specific and emotional factors, are not observable, it has to be accounted for by allowing for unobserved heterogeneity in the solution as well. Therefore the solution can in general be written as:

$$s^* = \beta_1 + \beta_2 x + \varepsilon \quad (4)$$

Here ε represents the unobserved heterogeneity. This shows that if there are no restrictions, households' will choose to invest the amount s^* in stocks. Given the original constrained maximization problem, the solution is therefore:

$$\begin{aligned} s &= s^* & \text{if } s^* > 0 \\ s &= 0 & \text{if } s^* \leq 0 \end{aligned} \quad (5)$$

This leads to the formulation of the Standard Tobit model (Verbeek, 2012, p. 239), which is used in this paper:

$$s_H^* = x_H' \beta + \varepsilon_H, \quad H = 1, 2, \dots, N$$

$$s_H = s_H^* \quad \text{if } s_H^* > 0 \quad (7)$$

$$s_H = 0 \quad \text{if } s_H^* \leq 0$$

Here, ε_H is assumed to be $NID(0, \sigma^2)$ and independent of x_H . Applying the Standard Tobit Model in this study, thus describes the probability that households do not invest in stocks at all, as well as, given that the investment in stocks is positive, the distribution of the amount invested in stocks.

As the usual approach when estimating with a Standard Tobit model (Verbeek, 2012, p. 241), this paper estimates it through maximum likelihood. Using the notations from the equation above, the loglikelihood function can be written as:

$$\begin{aligned} \log L_1(\beta, \sigma^2) &= \sum_{H \in I_0} \log P\{s_H = 0\} + \sum_{H \in I_1} [\log f(s_H | s_H > 0) + \log P\{s_H > 0\}] \\ &= \sum_{H \in I_0} \log P\{s_H = 0\} + \sum_{H \in I_1} \log f(s_H) \end{aligned}$$

In the expression above, I_0 and I_1 represent the observations that either corresponding to households with a positive value of stocks and households that are not owning stocks. When using the normal distribution, the following expression is obtained:

$$\log L_1(\beta, \sigma^2) = \sum_{H \in I_0} \log \left[1 - \Phi \left(\frac{x'_H \beta}{\sigma} \right) \right] + \sum_{H \in I_1} \log \left[\frac{1}{\sqrt{2\pi\sigma^2}} \exp \left\{ -\frac{1}{2} \frac{(s_H - x'_H \beta)^2}{\sigma^2} \right\} \right]$$

The maximum likelihood estimates are yielded from maximizing the equation above with respect to β and σ^2 . By doing so and assuming that the model is correctly specified, the estimates should be consistent and asymptotically efficient. (Verbeek, 2012, p. 241)

When estimating with this method, β yields to interpretations where the first one is the measure of the impact of a change in an independent variable x_H on the probability of the household owning no stocks; and the second interpretation is the impact of a change in an independent variable x_H on the level of the expenditure of stocks. (Verbeek, 2012, p. 241)

Depending on one's interest, the coefficients from the Tobit model can be interpreted differently. In this paper, it is of interest to examine the share of stock owning depending on different variables. The marginal effect on the expected value of s_H of a change in x_H is given by:

$$\frac{\partial E\{s_H\}}{\partial x_{Hk}} = \beta_k \Phi(x'_H \beta / \sigma).$$