Depression and Willingness to Invest in Risky Financial Assets

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Abstract

This paper seeks to assess whether suffering depression has an impact on the willingness to invest in risky financial assets near retirement. We argue that depression may distort individual's risk attitudes, hence will have an effect on how people evaluate the investment opportunities. In particular, we find that the households whose members suffer depression are less likely to invest in risky assets, as depression increases their risk aversion. This in turn will lower their pension wealth (in the presence of equity premium), and may also indirectly influence financial markets as the elderly population possesses a significant share of total population wealth. Further, we argue that the effect of depression on households' risky asset investments would also depend on the combination of spouses' risk attitudes and their relative bargaining power in the household. In particular, when the wife, who on average is more risk averse, has relatively more bargaining power, a change in her risk attitudes (which are affected by depression) would determine whether the household buys risky assets. While if the husband has relatively more bargaining power and the household already possesses risky assets, a change in his risk attitudes would determine whether the household sells them.

JEL classification: D8, E2, I0

Keywords: Depression, Stockholding, Perception, Reporting heterogeneity, Vignettes, Bargaining

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1 Introduction

With the ageing of baby boomers, the economists dedicate increasing attention to the household financial decision making of people around retirement. As reported by United Nations in 2011, in the most developed regions, 22% of population is already aged 60 years or over and that proportion is projected to reach 32% in 2050.[1] Increasing life expectancies raises policy makers' doubts about sustainability of pension arrangements, and some countries have already introduced an increment in the normal retirement age (OECD, 2009). Another pension reform strategy is to adopt defined contribution (DC) scheme along with (or instead of) defined benefit (DB) pension scheme.[2] In the DC investment risk and investment rewards are assumed by each employee and not by the employer, hence it becomes extremely important for the policy maker to know whether individuals are able to invest their pension contributions optimally. Accordingly, older generations possess more wealth than younger ones who have had less time to save. For instance, in 2009 the typical U.S. household headed by people aged 65 and older had 47 times more net wealth than the typical household headed by people aged 35 and younger ($\$170,494$ versus $\$3,662$ in 2010 U.S. dollars).[3] Hence the investment choices made by the elderly can significantly affect relative returns among the various asset markets.

On the other hand, as health tends to deteriorate with age, with the aging, more households become predisposed to health shocks, both physical and mental, which might lead them to revise their portfolio decisions.[4] In this paper we focus on the effect of shocks to mental health, in particular suffering depression, on the decision to hold risky financial assets. We provide evidence that depression changes individual's perception of reality, hence the ability to evaluate investment opportunities.

Several studies have investigated the impact of physical health on portfolio choice, and found that poor health is associated with a safer household portfolio allocation. Rosen and Wu (2004) show that households in poor health are less likely to hold all classes of financial assets, and hold smaller shares of their wealth in risky assets. Likewise, Berkowitz and Qiu (2006) find that a physical health shock significantly reduces household total financial wealth (as it is more liquid compared to non-financial wealth) which in turn leads the household to decrease its holding of risky financial assets. Fan and Zhao

[1] By 2050, the share of the European population aged 60 years and over would rise from 22% in 2011 to 34% in 2050, and Northern America's population from 19% to 27% over the same period (United Nations Population Division, 2011).

[2] Defined contribution (DC) pension scheme is a retirement plan in which the amount of the employer's annual contribution is specified. These contributions are then invested, for example in the stock market, and the returns on the investment (which may be positive or negative) are credited to the individual's account. Only employer contributions to the account are guaranteed, not the future benefits, which fluctuates on the basis of investment earnings. Defined benefit (DB) pension scheme is a retirement plan where employee benefits are sorted out based on a formula using factors such as salary history and duration of employment. Unlike DC plan, investment risk and portfolio management of DB plan are entirely under the control of the employer.

[3] Pew Research Center report (2011).

[4] Awareness of future shocks to physical health, which lead to higher medical expenditures, rises background risk and this shifts investments toward safer portfolios. The other effects of physical health shocks acknowledged in the literature are the effect on marginal utility of consumption (which might be negative if health and consumption are complements and positive if health shocks increase the marginal value of labor-saving consumption, such as taxi rides or cleaning services) and the effect on life span or planning horizon.

(2009) and Love and Smith (2010) have criticized the above studies which rely on random effects specification and propose to use fixed effects instead. Nevertheless, Fan and Zhao (2009) support the evidence suggesting that adverse health shocks discourage risky asset holdings, and Love and Smith (2010) find a negative effect of being in poor health on the probability of owning any stocks or mutual funds for married households. Yet, only one paper, by Bogan and Fertig (2012), explicitly considers the role of mental health in household portfolio choice decisions of U.S. population. Broadly speaking, they find that households affected by mental health issues decrease investments in risky instruments.

However, all studies above lack a mechanism to uncover a plausible channel through which health affects portfolio choice. In this paper we aim to address this issue. Edwards (2010) develops a theoretical model in which health shocks prompts individuals to lower their risky portfolio shares as they become more risk averse. We argue that depression distorts individual's perception. E.g. a study by Smoski et al. (2009) finds that depression yields individuals to have fear about taking risks, which would have an impact on their risk aversion. On the other hand, people suffering depression may have more difficulties with managing their everyday life, hence are more likely to avoid choices that involve (an additional) high cognitive effort, such as taking actions about financial portfolio. The first channel suggests that if people suffering depression become more risk averse they are more likely to sell assets (when they have some) and not to buy them (when they have none).[5] While via the second channel, depressed people become passive, thus they are less concerned about either selling or buying assets. Therefore, in the case of buying they are less likely to buy risky assets, whereas in the case of selling they are less likely to sell them.[6] Our aim is to disentangle which of the two has more importance. For this purpose we consider sub-samples of people who held or did not hold risky assets at some point in time, and look at the probability of holding assets in the next period. The key identification is the sign of the effect of suffering depression on the probability of holding risky assets conditional on having them in the previous period. If the sign is negative, we speculate that individuals who suffer depression decide to sell their assets due to increase in their risk aversion, while if the sign is nonnegative, we argue that people with more depression symptoms become passive about risky asset holding.

We consider risky asset holding at the household level. This is not problematic as elderly couples pool their financial assets to a significant degree.[7] As noted by Rosen and Wu (2004), husbands and wives can have different time horizons, because of different life expectancies. Further, it is a well-established fact that men and women differ with respect to risk aversion (Barber and Odean, 2001; Lott and Kenny, 1999; Sunden and Surette, 1998). These considerations suggest that men and women favor different portfolio

[5] Another concern is that individuals who suffer depression might evaluate investment opportunities differently. Several researches (Fehr-Duda et al., 2011; Alloy et al. 1987) have shown that individuals with worse than normal mood weigh gain and loss probabilities more pessimistically compared to people without such problems. As behavioral response due to either increase in risk aversion or more pessimistic evaluation of probabilities of gains and loses are similar, to simplify the exposition, henceforth we would refer to "more risk averse" for both.

[6] It is noted in Love and Smith (2010), that a life-cycle model also suggests that health shocks affect portfolio choice by altering life expectancy. One of the symptoms of depression is suicidality, and we argue that changes in a horizon length due to depression would correspond to a "passivity" response rather than to a "risk aversion" response.

[7] Most data for the elderly are designed as household surveys, and financial questions are asked at the household level.

strategies and that the impact on the family's portfolio might differ when one or the other of spouses suffers depression. Hence, there is a reason to expect effects of depression on risky asset holding for the two spouses to be asymmetric. To allow for that, we introduce one measure for the husband's depression and another for wife's. As for the identification strategy we distinguish between two actions with risky assets, buying and selling, we propose an intuitive explanation why the effects of depression for the two spouses might be asymmetric between these two decisions.

To summarize, first we test whether there is a difference in perception due to suffering depression. Second, we aim to show whether being depressed has an impact on the willingness to invest in risky financial assets. Third, we provide some intuition about the asymmetry of husband's and wife's suffering depression on household decisions about holding of risky assets. For this purpose we use The Survey of Health, Ageing and Retirement in Europe (SHARE). The results suggest that depressed individuals have distorted perception compared to those who are not depressed. Moreover, suffering symptoms of depression lowers the probability of acquiring risky financial assets, as stocks and shares. We provide evidence that risk aversion is a plausible mechanism behind this association. We also find that wife's depression level is a significant determinant of the probability to buy assets, while husband's depression level is important for the probability to sell assets.

The rest of the paper is organized as follows. Section 2 describes the dataset. Section 3 provides some insights about the relation between depression and perception. Section 4 sets out the intuition regarding the model applied in this work. Section 5 provides the results and the robustness check, and Section 6 concludes.

2 Data

Vast datasets were designed and financed to study the determinants of the economic choices in elderly population (English Longitudinal Survey of Ageing (ELSA), US Health Retirement Survey (HRS), The Survey of Health, Ageing and Retirement in Europe (SHARE)). [8] Our source of data are the first two waves SHARE data[9] that took place in $2004-05$ (wave 1) and $2006-07$ (wave 2) in 11 countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, The Netherlands, Spain, Switzerland, Sweden).[10] Based on probability samples, SHARE represents the non-institutionalized population aged 50 and older (including spouses, irrespective of age), and contains information on demographics, physical and mental health, housing, employment, income, assets and cognition

[8] SHARE is modelled closely to the Health and Retirement Study (HRS) conducted in the United States and the English Longitudinal Survey of Ageing (ELSA) in the United Kingdom. There are other studies that follow SHARE model: China Health and Retirement Longitudinal Study (CHARLS), Indonesia Family Life Survey (IFLS), Japanese Study on Aging and Retirement (JSTAR), Korean Longitudinal Study of Aging (KLoSA), Longitudinal Aging Study in India (LASI), Mexican Health and Aging Study (MHAS), Study on Global Ageing and Adult Health (SAGE), The Irish Longitudinal Study on Ageing (TILDA). For more information see https://mmicdata.rand.org/meta/?section=studies

[9] For more information about SHARE see http://www.share-project.org/

[10] Additional data came from Israel in 2006, however this country was not surveyed in the wave 2, hence we exclude it from the analysis. The second wave took place also in Czech Republic, Poland, and Ireland, but given we need to work with variables available also in the wave 1, we do not use the information from these countries.

(Börsh-Supan et al, 2005).[11] We would refer to wave 1 as $t-1$ and to wave 2 as t.

In order to analyze whether suffering depression has an impact on individual's perception we use vignettes' sub-sample of SHARE. Vignettes are short descriptions of characteristics of hypothetical persons (e.g. suffering depression), which respondents are asked to evaluate on the same scale on which they assess they own suffering depression. Only a sub-sample of the main SHARE sample ($4,544$ participants) was asked to answer the vignettes questionnaire (which we describe in details in Section 3). We use data from the first wave, since it has three vignettes per item. One of two versions of the vignettes module (different gender of hypothetical person and vignettes' ordering) was randomly assigned to respondents.[12]

The key variable for our analysis is a measure of household risky asset holdings. We use the information about risky assets of couples only, which are defined as being married and living together with a spouse or having registered partnership and living with a partner. As a proxy of risky asset holding we use total household stockownership, and define it as stocks held directly plus stocks held through mutual funds and investment accounts (likewise in Christelis et al., 2010, Love and Smith, 2010). For this purpose we combine two questions: "Do you [or you partner] currently have any money in stocks or shares (listed or unlisted on stockmarket)?" and "Do you [or you partner] currently have any money in mutual funds or managed investment accounts?[13] with the option of answering "yes" or "no". We construct a binary variable $A_{i,t}$, which equals 1 if the household financial respondent answers "yes" in either question in period t and zero otherwise. We create a risky asset transition by conditioning on households' possessing of risky assets in $t-1$, where $A_{i0,t} = \{0,1\}$ states for holding assets in t conditional on $A_{i,t-1} = 0$, while $A_{i1,t} = \{0,1\}$ states for holding assets in t conditional on $A_{i,t-1} = 1$.

For measuring depression we use the EURO-D depression scale according to Prince et al. (1999). This scale is a recognized measurement of mental health (Castro-Costa et al. 2008). It was introduced by the 'EURODEP Concerted Action Programme', a collaboration of 14 research groups and was originally developed to harmonize data on late-life depression throughout Europe. The EURO-D is a 12-item scale that indicate the presence of depression, pessimism, suicidality, guilt, sleeping problems, loss of interest, irritability, loss of appetite, fatigue, concentration difficulties, enjoyment, and tearfulness.[14] The individuals' answers for each item are coded as 1 when the symptom is 'present' and 0 if it is 'not present', and then are summed up. The total score ranges from 0 (not depressed) to 12 (very depressed). Prince et al. (1999) show in a validation study that the EURO-D scale is internally consistent and provides a good assessment of developing clinical depression or anxiety disorders. Since several optimal cut-off points are suggested in the literature, thus we use this measure as a score. The index is constructed using EURO-D information from the first wave, $D_{i,t-1}$.

As suggested by Berkowitz and Qiu (2006) health shocks have an impact on household total financial wealth, leading them to restructure the composition of their financial assets.

[11] The questionnaire has been translated according to a protocol ensuring functional equivalence.

[12] You can find more detailed information about the vignettes on www.compare-project.org

[13] Mutual funds in SHARE are defined as "pool of money belonging to many investors who trust a manager to invest in stocks and/or bonds". One can sort on the weight of stocks in mutual funds, using information about whether mutual funds are mostly stocks or mostly bonds, however as we are interested in holding stocks per se, we assume that whoever hold mutual funds has some stock in them.

[14] For a detailed description see in the Appendix.

Therefore, household wealth is an important determinant of risky asset holding, which also might be related to suffering depression. We define total net household wealth, as the sum of real assets (value of primary residence net the mortgage on it, the value of other real estate, the owned share of own business and the owned cars) and net financial assets (gross financial assets net financial liabilities).[15] We control for net household initial wealth in $t-1$, as richer households had more resources to deal with consequences of depression compared to households with less wealth. On the other hand, household which dispose of more wealth are also more likely to acquire risky assets in t (or less likely to sell them) compared to household that had less wealth.

Finally, we include controls for both spouses, such as age in years and its square, five categorical variables for education attainment (according to the international standard classification of education ISCED−97):[16] "tertiary" for ISCED $5-6$, "upper secondary" for ISCED $3-4$, "lower secondary" for ISCED 2, "primary" for ISCED 1, and reference "no education", household controls, such as number of children, and eleven countries' dummies (for reside in Austria, France, Belgium, The Netherlands, Switzerland, Greece, Italy, Spain, Denmark or Sweden) with reference Germany. While many studies (for more details see Bago d'Uva et al. 2011*a*) suggest that for older populations, education is a better indicator of long-term socioeconomic status than income, we include household income as well, since it is a strong determinant of the financial market participation. People who have more disposable income could be more willing to invest in the risky assets.[17] Following Christelis et al. (2010) we also include a measure of cognitive ability (numeracy) of each spouse. This indicator measures the ability to perform basic numerical operations, which, in turn, affects how people make investment and saving decisions. SHARE respondents are asked to perform the following calculations: *i*) find 10 percent of a number; *ii*) find one half of a number; *iii*) find two thirds of a number; *iv*) calculate a simple interest rate. Each of the questions is asked in a specific economic or financial context. On the basis of these four questions, following Dewey and Prince (2005), we construct a numeracy indicator, which ranges from 1 to 5.[18]

Descriptive statistics are presented in Table 1.

[15] Gross financial assets are the sum of the seven categories of financial assets: bank and other transaction accounts, government and corporate bonds, stocks, mutual funds, individual retirement accounts, contractual savings for housing and life insurance policies owned by the household. Financial liabilities are the sum of all household debts.

[16] United Nations Educational, Scientific and Cultural Organization, 1997.

[17] It worth noting that all financial variables are adjusted for the purchasing power parity (PPP), using Germany as basis. The reasons for using PPP adjustments are explained in Christelis et al. (2005), who also outlines how the PPP adjustments should be performed. All amounts are in Euro, for countries that use a different currencies (Denmark, Switzerland, Sweden) we divide the amounts by the exchange rate. Any missing income and wealth information due to item-nonresponce has been imputed according to Christelis et al. (2011)

[18] If a person answers (*i*) correctly she is then asked (*iii*) and if she answers correctly again she is asked (*iv*). Answering (*i*) correctly results in a score of 3, answering (*iii*) correctly but not (*iv*) results in a score of 4 while answering (*iv*) correctly results in a score of 5. On the other hand if she answers (*i*) incorrectly she is directed to (*ii*). If she answers (*ii*) correctly she gets a score of 2 while if she answers (*ii*) incorrectly she gets a score of 1.

Table 1. Summary statistics

	No assets in t-1				Assets in t-1				Mean	p-value
Variable	Mean	Std.dev.	Min	Max	Mean	Std.dev.	Min	Max	Diff	
Assets in t%	12.82	0.33	0	1	71.41	0.45	0	1	-58.6	0.000
Husband's Depr in t-1	1.68	1.88	0	11	1.42	1.55	0	9	0.26	0.000
Wife's Depr in t-1	2.49	2.27	0	11	2.11	1.91	0	12	0.38	0.000
Ln(Income) in t	10.15	1.12	2.95	13.55	11.28	1.16	5.40	14.86	-1.13	0.000
Ln(Net Worth) in t-1	11.74	1.98	0	17.25	13.34	1.28	7.62	18.14	-1.60	0.000
Husband's Cogn Abil in t	3.49	1.11	1	5	3.99	0.99	1	5	-0.50	0.000
Wife's Cogn Abil in t	3.21	1.11	1	5	3.65	1.03	1	5	-0.45	0.000
Retirement %										
Husband Retired	66.75	0.47	0	1	61.29	0.49	0	1	5.46	0.000
Wife Retired	37.73	0.48	0	1	43.05	0.50	0	1	-5.32	0.001
Husband's Age	66.37	9.08	41	98	65.23	8.63	45	95	1.14	0.000
Wife's Age	62.86	9.34	33	91	62.42	8.55	37	89	0.44	0.132
Children	2.33	1.32	0	12	2.24	1.16	0	9	0.09	0.020
Education %										
Husband's No Education	5.05	0.22	0	1	0.80	0.09	0	1	4.25	0.000
Husband's Primary	29.82	0.46	0	1	16.14	0.37	0	1	13.68	0.000
Husband's Lower second	16.52	0.37	0	1	14.25	0.35	0	1	2.27	0.056
Husband's Upper second	32.19	0.47	0	1	33.14	0.47	0	1	-0.95	0.532
Husband's Tertiary	16.42	0.37	0	1	35.67	0.48	0	1	-19.25	0.000
Wife's No Education	6.40	0.24	0	1	1.88	0.14	0	1	4.52	0.000
Wife's Primary	32.39	0.47	0	1	15.56	0.36	0	1	16.83	0.000
Wife's Lower secondary	20.98	0.41	0	1	20.33	0.40	0	1	0.65	0.625
Wife's Upper secondary	28.17	0.45	0	1	33.80	0.47	0	1	-5.63	0.000
Wife's Tertiary	12.07	0.33	0	1	28.43	0.45	0	1	-16.36	0.000
N	3032				1382					

The mean probability of holding assets in t is higher for those holding assets in $t-1$. The means of depression symptoms of both spouses in $t-1$ are higher for those not owning assets in $t-1$. The second subgroup (those who possessed assets in $t-1$) is slightly younger, wealthier than the first subgroup (those who did not posses assets in $t-1$), the larger proportion of its husbands and wives have upper secondary and tetriary education. Cognitive abilities of both spouses are also higher for the second subgroup. We also calculate the transition matrix for risky asset possessing between $t-1$ and t to ensure that we have enough transitions from holding to not holding assets and vice versa (see Table $A1$ in the Appendix).

3 Depression and perception

3.1 Motivation

Economic consequences of heterogenous perception of the reality involve differences in risk-attitudes, believes and expectations about the future. The way people form perceptions is extremely important to understand the individuals' decision making. Perception is a cognitive process that organizes our interpretation of the reality. People's behavior is based on their perception of what reality is, not on reality itself. Our personality, past experiences, background and attitudes influence how we understand ourselves and those around us. Differences in perception explain why two people can see the same thing but interpret it differently. Stock traders disagree about expected profits of different financial

assets, investors about the rates of return, real estate brokers about the value of houses in the future. When a person thinks about some event as very likely, another may perceive the same event as unlikely.

Heterogeneity of perception might be state dependent. There may be a structural bias in the perception through one's own circumstances, which could involve mental health status. Empirical evidences (Smoski et al., 2008) highlighted that people who experience depression have bias with regard to information processing, and evaluate the potential outcomes in a more pessimistic way compared to non-depressed. Kirk et al. (2000) also noted that people who had previously experienced depression avoid taking risks in professional life or personal relationships for fear of be unable to meet those demands.[19] According to Beck's (1967) cognitive theory of depression, it consists of a cognitive triad: negative view of self, of the world, and of the future. Hence it might be the case that depressed individuals perceive reality as more pessimistic which could have an impact on their economic behavior.

Let us consider a situation when one is asked: "Overall in the last 30 days, how much of a problem did you have with feeling sad, low, or depressed?" with response categories "none", "mild", "moderate", "severe", and "extreme". Next, she has been provided with some examples of persons who suffer serious and less serious depression problems, and asked to evaluate the health of these persons, assuming that they have the same age and background as she has.

The hypothetical situations are:

1. An individual A feels depressed most of the time. She weeps frequently and feels hopeless about the future. She feels that she has become a burden on others and that she would be better dead. Overall in the last 30 days, how much of a problem did an individual A have with feeling sad, low, or depressed?

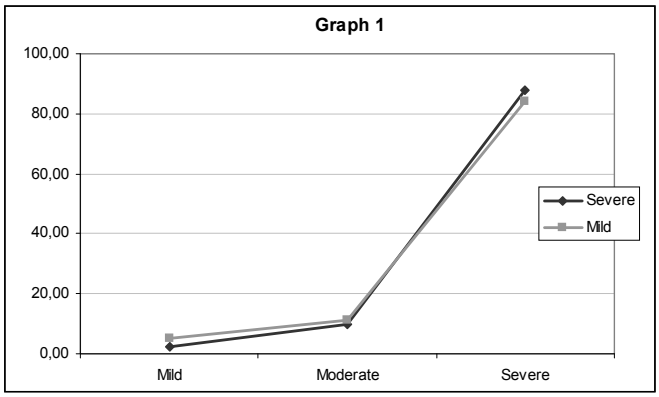
2. An individual B feels nervous and anxious. She worries and thinks negatively about the future, but feels better in the company of people or when doing something that really interests her. When she is alone she tends to feel useless and empty. Overall in the last 30 days, how much of a problem did an individual B have with feeling sad, low, or depressed?

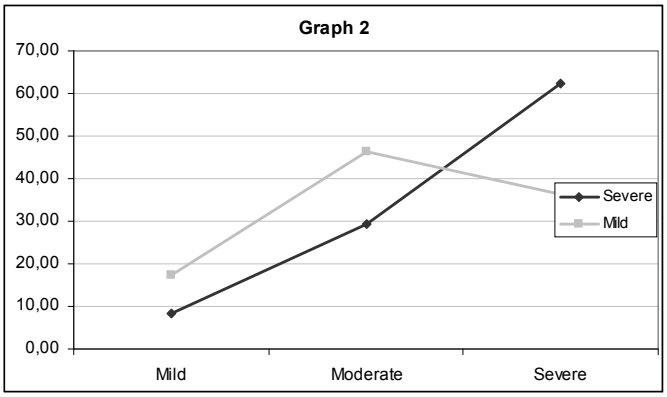
3. An individual C enjoys her work and social activities and is generally satisfied with her life. She gets depressed every 3 weeks for a day or two and loses interest in what she usually enjoys but is able to carry on with her day-today activities. Overall in the last 30 days, how much of a problem did an individual C have with feeling sad, low, or depressed?

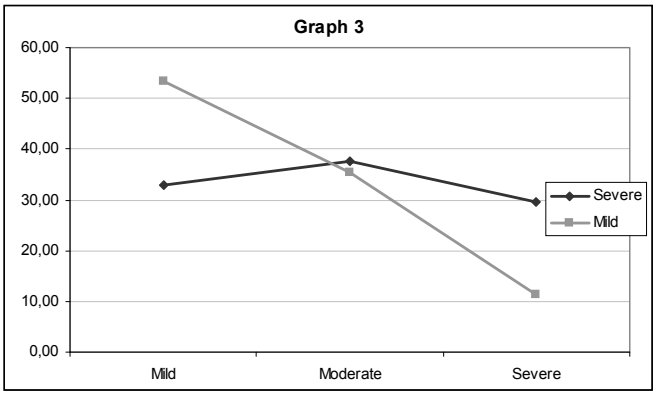
Would her answers about feeling depressed of these hypothetical individuals depend on her own suffering depression? We arrange responders into three groups according to self-reports: people with mild (answer "none" or "mild" in self-reported depression question), moderate (answer "moderate") and severe (answer "severe" or "extreme") self-reported depression. Similarly we organize their responses about hypothetical individuals'

[19] The other experienes of depression involve feeling more loss of energy, being a burden on others, need to hide depression symptoms, strength drawn from depression, need to maintain a balance in life, fear of relationships, fear of taking risks, fear of recurrence of depression, and sense of stigma (Coyne et. al. 1998).

depression. Graphs 1, 2, and 3 present the answers to corresponding questions that are grouped by individuals' self-reported suffering depression. These graphs report the percentage of people who placed the hypothetical individual into one of three categories ("mild", "moderate", and "severe"). The grey curve corresponds to people who in their self-reports say that suffer "mild" problems, while black curve represents the "severe" self-reported group.







We observe that there are differences in evaluation of the others' depression based on own suffering depression, in particular people who report suffering severe or extreme depression evaluate others' depression problems as more severe compared to people who report suffering mild or no depression. E.g. on the graph 3, people from the "severe" self-reported group report that the described depression problem is severe about 3 times more frequently than people from the "mild" self-reported group, i.e. they are likely to report a problem where it shouldn't be any. The evidences we considered so far are descriptive, and can be attributed either to differences in perception (depressed individuals perceive described problems in a more pessimistic way) or just to differences in reporting behavior. Below we shall address these issues.

3.2 Empirical specification

In order to analyze whether individuals perceive things differently when they are depressed, we use an approach based on vignettes (Bago d'Uva et al., 2011*b*). Since the health states described in vignettes are the same for all individuals, the systematic association between being depressed and vignette ratings can be attributed to differential perception of a given state of health.

Let us consider a particular vignette which represents a latent health level H_i^*. We allow the perceived health, H_i (measured on 5-level ordinal scale, with higher values for worse state) to depend on suffering symptoms of depression (D_i) and other personal characteristics (X_i). D_i is measured by EURO-D depression scale as described in Section 2.

$$H_i = \alpha_0 + \alpha_1 D_i + \alpha_2 X_i' + \epsilon_i \tag{1}$$

If individuals' perception of described health does not depend on suffering depression, α_1 should be zero. While α_1 different from zero left the model unidentified, as it might be the case, that the response scale of depressed individuals is different from that of not depressed. That is, depressed and non-depressed individuals may perceive H_i^* in the same way, however the first group call it "severe", while the other group call it "mild". Hence with only one vignette question we can not identify whether observed difference in the rating is due to differences in perception or to differences in the reporting thresholds.

However, when at least two vignettes describing different states within the depression domain are available, we can identify the effect of suffering depression on H_i^*. Thus, we estimate

$$H_{i1}^* = \alpha_0^1 + \alpha_1^1 D_i + \alpha_2^1 X_i' + \nu_i^1 \tag{2}$$

and

$$H_{i2}^* = \alpha_0^2 + \alpha_1^2 D_i + \alpha_2^2 X_i' + \nu_i^2 \tag{3}$$

A necessary condition of no difference in perception of health between depressed and non-depressed is $\alpha_1^1 = \alpha_1^2$, while $\alpha_1^1 = \alpha_1^2 \neq 0$ indicates that there is a difference in reporting behavior, but not in perception of the health status, and $\alpha_1^1 \neq \alpha_1^2$ indicates that there is a difference in perception of health status described by a vignette.[20] In particular if $\alpha_1^1 \neq \alpha_1^2$, $\alpha_1^j > 0$ indicates that depressed people perceive one's problems as more severe compared to non-depressed people.

The dataset we use in this paper has three vignettes describing different states within the depression domain. We use dummies for each vignette V_i^1, V_i^2, and V_i^3 and consider the model:

$$H_{ji}^* = \alpha_0^1 V_i^1 + \alpha_0^2 V_i^2 + \alpha_0^3 V_i^3 + \alpha_1^1 V_i^1 D_i + \alpha_1^2 V_i^2 D_i + \alpha_1^3 V_i^3 D_i + \alpha_2 X_i' + \nu_i^j \tag{4}$$

Where H_{ji}^* with $j = 1, 2, 3$ are perceived depression of each of the three vignettes, $V_i^j D_i$ are the interactions of the vignettes' dummies and suffering depression. Since vignettes' answers are on an ordinal scale, we estimate an ordinal probit model, and omit $\alpha_0^1 V_i^1$. We test $\alpha_1^1 = \alpha_1^2 = \alpha_1^3$. If we reject this hypothesis, we conclude that there is a difference

[20] This is equivalent to say that we test the 'vignettes' equivalence' assumption (the perceived difference between the levels of health represented by vignettes does not vary systematically across individuals (Bago d'Uva et al., 2011*b*; King et al., 2004). The alternative is that the cut-points are also affected by depression, i.e. 'severe' or 'mild' does not mean the same for people who suffers depression and who does not. This is the standard approach for which scholars use vignettes' method. However if the vignettes' equivalence assumption fails we can not test it explicitly. Indeed, rejecting vignettes' equivalence assumption is sufficient to conclude that individuals who suffer depression perceive described health differently.

in perception due to suffering depression. While if we can not reject it, but we reject $\alpha_1^1 = \alpha_1^2 = \alpha_1^3 \neq 0$, then depressed people have just different reporting behavior.

3.3 Results

If depressed individuals perceive described health state differently compared to non-depressed, and this difference varies across the three vignettes, we conclude that depressed people have a distorted perception compared to non-depressed. We estimated (4) and presented the results in Table 2.

Table 2. Perception of depression

Variable	Coeff
Vignette 2	-1,28008***
	(0,03255)
Vignette 3	-2,10210***
	(0,04610)
Vignette 1 * Depression (α_1^1)	0,00417
	(0,01017)
Vignette 2 * Depression (α_1^2)	0,03443***
	(0,00781)
Vignette 3 * Depression (α_1^3)	0,03887***
	(0,00855)
Log(Income)	-0,03609**
	(0,01812)
Log(Net wealth)	0,01514*
	(0,00896)
Cognitive ability	0,04907***
	(0,01503)
Age	-0,02066
	(0,01765)
Age2	0,00011
	(0,00014)
Male	0,02672
	(0,02519)
Married	0,02699
	(0,04971)
Children	0,00695
	(0,01278)
Primary	-0,03042
	(0,06767)
Lower secondary	-0,01721
	(0,07098)
Upper secondary	-0,00694
	(0,07039)
Tertiary	0,05902
	(0,07438)
Cut1	-3,92750***
	(0,60492)
Cut2	-2,71309***
	(0,60224)
Cut3	-1,60290***
	(0,60100)
Cut4	-0,38251
	(0,59908)
N	10,983

Note: *** p<0.01, ** p<0.05, * p<0.1
The equation includes countries' dummies

The main variables of interest are the coefficients of the interactions of the level of depression with vignettes dummies (α_1^1, α_1^2, α_1^3). They are not the same, suggesting that people suffering depression differ in their interpretation of health status described by vignettes. We reject $\alpha_1^1 = \alpha_1^2 = \alpha_1^3$ (p-value is almost 0). The positive signs of α_1^i suggest that people who themselves suffer depression perceive other people as having more severe problems compared to people who themselves do not suffer depression. As more symptoms of depression an individual has, more severe the vignettes' problems seem to her. If we

concern the described health problems as some objective reality, then individuals perceive this reality in a more pessimistic way when they are depressed. Which impact could it have on the economic behavior? We shall consider situations where individuals' attitudes toward reality matter for economic choices, e.g. the decision to participate in the financial market. As we explained in Section 1, depressed people might have more pessimistic expectations about future rewards or become more risk averse, which are likely connected to the decision of investing in the risky assets and could translate into less willingness to acquire stocks or shares.[21] Another consideration is that suffering depression may also lead them to become passive on the financial market. To disentangle which of two channels is more important we consider sub-samples of people who do and do not hold risky assets at some point in time, and look at the probability of holding assets in the future.

4 Depression and holding of risky assets

As suffering depression affects individual's perception of reality, which might be associated with some determinants of financial asset holding, depression may also affect the decision to acquire risky financial assets. Suppose there is an unobservable and continuous latent variable, $A^*_{i,t}$, that reflects the willingness to hold risky financial assets, such as stocks or shares.[22] Suppose also there is an unobservable index of couple's depression, $D^*_{i,t}$. To minimize the possibility of reverse causality, as negative experience of asset holding might also affect depression, we use this index lagged one period.[23]

$$A^*_{i,t} = \beta_0 + \beta_1 D^*_{i,t-1} + \beta_2 X'_{i,t} + \varepsilon_{i,t} \tag{5}$$

Where $X'_{i,t}$ are some household control variables. We are interested in the sign of β_1. One may expect $\beta_1 < 0$, which means that the household has lower willingness to hold stocks or shares if its members suffer depression. However with this specification we are not able to identify via which channel suffering depression influence asset holding. Observing a negative sign for β_1 might indicate that households whose members suffer depression are more risk averse, but it might also indicate that they are not concerned about their financial portfolio. In both cases depressed households will be less willing to buy risky assets and therefore, no matter whether they became more risk averse or just passive, their willingness to hold assets will be smaller. In order to disentangle which of the two channels, risk aversion or passivity, is more influential we are going to consider the decision of buying and selling assets separately. In the case of buying both channels suggest a negative sign: if being depressed rises one's risk aversion, people are less likely to buy assets, likewise if they become passive due to depression. But, in the case of selling the signs would be different: people would be more likely to sell assets when risk aversion

[21] When people are clinically depressed, they hold a pessimistic view of the future and unrealistic expectations. Depression is associated with behavioral avoidance of potentially rewarding environmental contexts (Smoski et al. 2009). Depressed individuals' predictions of the likelihood of future outcomes are more pessimistic than those of non-depressed individuals given identical information and identical conditions for forecasting (Alloy et al. 1987).

[22] Henceforth under the name of financial assets we mean stock and shares.

[23] However if depression was affected by some factors prior to $t-1$, which could incluence holding of risky assets throughout the entire period, this would not be captured in the model.

increases (a negative sign), while if they become passive they are not concern about any actions with their assets compared to non depressed people who may or may not sell them, hence the sign should be non negative. It is important to distinguish between these two channels, as they are fundamentally different, and have different consequences for the financial markets.

We consider two sub-samples. The first is comprised of households who did not hold assets at time $t-1$, and the second of those who held assets at $t-1$. The problem might arise when the unobservables (to the econometrician) of the initial condition of asset holding in $t-1$ are correlated with the unobservables of asset holding in t, causing current asset holding to be endogenous with respect to holding assets in $t-1$. In the literature this problem could be solved by allowing errors between the conditional and conditioning risky asset holding to be correlated (Lokshin and Glinskaya, 2009; Aakvik et al., 2004; Cappellari, 2002; Carrasco, 2001). We implement this strategy utilizing a bivariate probit model with endogenous switching.[24]

Consider the following model, which describes willingness to possess risky financial assets in t under two regimes: having or not them in $t-1$. Consider also a latent variable $A^*_{i,t-1}$ that determines whether a household hold risky assets in $t-1$:

$$No\ assets\ in\ t-1 \quad : \quad A^*_{i0,t} = \beta^0_0 + \beta^0_1 D^*_{i,t-1} + \beta^0_2 X'_{i,t} + \varepsilon_{i0,t} \tag{6}$$

$$Some\ assets\ in\ t-1 \quad : \quad A^*_{i1,t} = \beta^1_0 + \beta^1_1 D^*_{i,t-1} + \beta^1_2 X'_{i,t} + \varepsilon_{i1,t} \tag{7}$$

$$A^*_{i,t-1} = \gamma Z'_{i,t-1} + u_{i,t-1} \tag{8}$$

Here, $A^*_{i0,t}$ and $A^*_{i1,t}$ are the continuos latent variables, $D_{i,t-1}$ is the depression index, $X'_{i,t}$ is a vector of household characteristics that is thought to influence holding assets in t, and β^j_k and γ are vectors of parameters. Z'_i is a vector of characteristics that influences the decision regarding holding assets in $t-1$.

The observed dichotomous realization $A_{ij,t}$ of a latent variable $A^*_{ij,t}$ of whether the household i possesses risky assets in t has the following form:

$$A_{ij,t} = I\left[A^*_{ij,t} \geq 0\right] = I\left[\beta^j_0 + \beta^j_1 D^*_{i,t-1} + \beta^j_2 X'_{i,t} + \varepsilon_{ij,t} \geq 0\right], \qquad j = 0, 1 \tag{9}$$

The observed dichotomous realization $A_{i,t-1}$ of a latent variable $A^*_{i,t-1}$ of whether the household i had risky assets in $t-1$ has the following form:

$$A_{i,t-1} = I\left[A^*_{i,t-1} \geq 0\right] = I\left[\gamma Z'_{i,t-1} + u_{i,t-1} \geq 0\right] \tag{10}$$

Where $I[\cdot]$ is the indicator function. Error terms u_i, ε_{i0} and ε_{i1} are assumed to be jointly normally distributed, with zero-mean vector and correlation matrix:

$$\Omega = \begin{bmatrix} 1 & \rho_{u0} & \rho_{u1} \\ & 1 & \rho_{01} \\ & & 1 \end{bmatrix}$$

[24] Endogenous switching equations models for continuous variables are set out in Lee (1978). See Maddala (1983) for a comprehensive survey of this model.

where ρ_{u0} and ρ_{u1} are the correlations between u_i and ε_{i1}, and u_i and ε_{i1} respectively. The correlation between ε_{i0} and ε_{i1} is ρ_{01}. Since A_{i0} and A_{i1} are never observed simultaneously, the joint distribution of $(\varepsilon_{i0}, \varepsilon_{i1})$ is not identified, and consequently ρ_{01} cannot be estimated. The model is identified through the functional form by nonlinearities even if the variables in X_i' and Z_i' overlap completely. To make estimates more robust to alternative functional assumptions, stronger identification restriction is imposed on the model. As exclusion restriction, we include variables that are believed to influence holding of risky assets in $t-1$, but not directly affect holding assets in t, such as income in $t-1$, which will not affect asset holding in t once income in t and net wealth in $t-1$ are taken into account. Given the assumption with respect to the distribution of the disturbance terms, the logarithmic likelihood function for the system of $(4-5)$ is:

$$\begin{aligned}
\ln L \;=\; & \sum_{A_i=1,I_i=1} \ln\left\{\Phi(\beta_0^1+\beta_1^1 D_{i,t-1}^*+\beta_2^1 X_{i,t}', \gamma Z_{i,t-1}', \rho_{u1})\right\} \\
& + \sum_{A_i=0,I_i=1} \ln\left\{\Phi(-\beta_0^1-\beta_1^1 D_{i,t-1}^*-\beta_2^1 X_{i,t}', \gamma Z_{i,t-1}', -\rho_{u1})\right\} \\
& + \sum_{A_i=1,I_i=0} \ln\left\{\Phi(\beta_0^0+\beta_1^0 D_{i,t-1}^*+\beta_2^0 X_{i,t}', -\gamma Z_{i,t-1}', -\rho_{u1})\right\} \\
& + \sum_{A_i=0,I_i=0} \ln\left\{\Phi(-\beta_0^0-\beta_1^0 D_{i,t-1}^*-\beta_2^0 X_{i,t}', -\gamma Z_{i,t-1}', \rho_{u0})\right\}
\end{aligned}$$

Where Φ is the cumulative function of a bivariate normal distribution. We test whether correlation coefficients ρ_{u0} and ρ_{u1} are significant.

We are interested in the parameter β_1^j. For the sub-group of those who did not hold risky assets in $t-1$, the sign of β_1^0 is not informative, as for this group both channels predict a negative effect of depression on the probability of holding assets in t: if depression involves either passivity (Kahneman et al. 1999) or rises risk aversion (Smoski et al. 2009), people are less likely to buy assets. However we are able to identify the underlying relationship between depression and risky asset holdings using the sub-group of those who had assets in $t-1$, β_1^1. For this group, if the first channel dominates, one expects β_1^1 to be non negative in t: depressed individuals will stand aside and do nothing about their assets compared to non-depressed who may or may not sell their assets. While if the second channel dominates, individuals suffering depression becomes more risk averse therefore more willing to sell their assets, thus one expects $\beta_1^1 < 0$. Therefore, we conjecture that if $\beta_1^1 < 0$ for the sub-group of people having assets in $t-1$, risk aversion is a channel through which depression affects risky asset holdings in t, while if $\beta_1^1 \geq 0$, then depression leads to passivity about risky asset holdings.[25]

5 Results

One of our main goals is to show whether suffering depression has an impact on the willingness to participate in the risky financial assets. As it is difficult to say how spouses'

[25] The other concern is that in the case of couples, we should consider estimated coefficients of both spouses simultaneously, since a bargaining process underlying purchase or selling of risky assets usually takes place. We would address this issue further in Section 5.

depression levels are combined into one household depression index, we proxy $D^*_{i,t-1}$ with a linear combination of husband's and wife's depression indexes, $HD_{i,t-1}$ and $WD_{i,t-1}$ respectively. With this approach we allow for the different effects of each spouse's depression on the probability of household buying and selling of risky assets.[26] Thus, we estimate:

$$A_{ij,t} = \beta^j_0 + \beta^j_{1H} HD_{i,t-1} + \beta^j_{1W} WD_{i,t-1} + \beta^j_2 X'_{i,t} + \varepsilon_{ij,t}, \qquad j = 0, 1 \tag{11}$$

and

$$A_{i,t-1} = \gamma Z'_{i,t-1} + u_{i,t-1} \tag{12}$$

The results are summarized in Table 3.

The first three columns correspond to the probability of owning assets in t conditional on not having them in t. The next three columns correspond to the probability of owning assets in t conditional on having them in $t-1$. As it has been discussed in Section 4, unobservables of the initial asset holdings in $t-1$ might be correlated with unobservables of asset holdings in t, causing current asset holdings to be endogenous with respect to holding assets in $t-1$. In order to ensure that estimating of asset holdings in t conditional on having them or not in $t-1$ did not affect the results, we allow the error terms between the conditional and conditioning risky asset holding to be correlated, and estimate the model using the Endogenous Switching probit model ((1) and (3)). We compare its estimated coefficients with those from the standard probit model in (2) and (5), and conclude that both results are very similar. Furthermore, the correlation coefficients ρ_{u0} and ρ_{u1} are not significant, suggesting that unobservables of asset holdings in $t-1$ are not correlated with unobservables of asset holdings in t , hence we may rely on the convenient probit model, and its marginal effects in (3) and (6).

When the household wife experienced one more depression symptom in $t-1$, the probability of household holding assets in t conditional on not having them in $t-1$ decreases by 0.54 pp. The coefficient of the husband is positive however is not significant and much smaller in magnitude than that of his spouse. Hence we conclude that wife's depression is a significant determinant of household probability of buying assets when they did not have any. When we turn to the probability of household holding assets in t conditional on having them in $t-1$, it looks that husband's depression determine whether the household maintain risky assets. More precisely, when the husband reports one more depression symptom in $t-1$, the probability of selling the asset in t increases by 1.7 pp. The sign of the effect of husband's depression is negative which according to our identification means that risk aversion could be the explanation for the lower probability of risky asset holding.

The results above suggest that households whose members suffer depression in general are less likely to hold the risky financial assets. In particular, when the household wife reports one more depression symptom it decreases the probability to acquire risky assets when the household had none. While, when the husband reports one more depression symptom, in decreases the probability of maintaining risky assets. A plausible explanation for this asymmetry could involve differences in men's and women's risk aversion, a stylized

[26] We do not run separate regressions for two partners, because we are interested in the simultaneous effects of each spouse's depression on the risky asset holding decision.

Table 3. Holding of risky assets

	No assets in t-1			Assets in t-1		
	(1) Switching Probit Coefficients	(2) Probit Coefficients	(3) Probit Marginal Effects	(4) Switching Probit Coefficients	(5) Probit Coefficients	(6) Probit Marginal Effects
Husband's Depression in t-1	0,01106	0,01081	0,00157	-0,05075**	-0,05335**	-0,01720**
	(0,01892)	(0,01898)	(0,00276)	(0,02448)	(0,02533)	(0,00816)
Wife's Depression in t-1	-0,03684**	-0,03684**	-0,00536**	0,01839	0,01995	0,00643
	(0,01622)	(0,01623)	(0,00240)	(0,02004)	(0,02091)	(0,00674)
Ln(Income) in t	0,07476*	0,07160*	0,01042*	0,20644***	0,17584**	0,05670**
	(0,04057)	(0,03994)	(0,00582)	(0,07199)	(0,07260)	(0,02346)
Ln(Net Worth) in t-1	0,18394***	0,18286***	0,02662***	0,15725***	0,15645***	0,05045***
	(0,02609)	(0,02608)	(0,00356)	(0,03783)	(0,03899)	(0,01252)
Husband's Cognitive Ability in t	0,05696*	0,05485*	0,00799*	0,03311	0,02420	0,00780
	(0,03320)	(0,03323)	(0,00483)	(0,04112)	(0,04279)	(0,01381)
Wife's Cognitive Ability in t	-0,04974	-0,05262	-0,00766	-0,02080	-0,03172	-0,01023
	(0,03303)	(0,03314)	(0,00482)	(0,03927)	(0,03992)	(0,01287)
Husband's Age	0,10625	0,10419	0,01517	0,02729	0,01300	0,00419
	(0,06478)	(0,06472)	(0,00944)	(0,07796)	(0,07906)	(0,02549)
Husband's Age2	-0,00085*	-0,00084*	-0,00012*	-0,00020	-0,00010	-0,00003
	(0,00049)	(0,00049)	(0,00007)	(0,00057)	(0,00058)	(0,00019)
Wife's Age	-0,08184	-0,08409*	-0,01224*	0,12132*	0,11782	0,03799
	(0,05027)	(0,04990)	(0,00735)	(0,07134)	(0,07262)	(0,02343)
Wife's Age2	0,00062	0,00064	0,00009	-0,00096*	-0,00093*	-0,00030*
	(0,00040)	(0,00039)	(0,00006)	(0,00056)	(0,00057)	(0,00018)
Children	-0,00812	-0,00529	-0,00077	0,00593	0,02065	0,00666
	(0,02451)	(0,02409)	(0,00351)	(0,03439)	(0,03470)	(0,01119)
Husband's Primary	0,22459	0,21345	0,03306	0,09748	0,01875	0,00602
	(0,26294)	(0,26374)	(0,04316)	(0,39022)	(0,40482)	(0,12945)
Husband's Lower secondary	0,31677	0,29956	0,05018	0,32959	0,22531	0,06864
	(0,27216)	(0,27312)	(0,05170)	(0,39830)	(0,41203)	(0,11791)
Husband's Upper secondary	0,54389**	0,52496**	0,08765*	0,30124	0,18831	0,05940
	(0,26485)	(0,26539)	(0,04976)	(0,39411)	(0,40557)	(0,12496)
Husband's Tertiary	0,68069**	0,64372**	0,12537*	0,43521	0,24526	0,07714
	(0,27695)	(0,27538)	(0,06714)	(0,40863)	(0,41046)	(0,12564)
Wife's Primary	0,26340	0,26138	0,04069	0,21103	0,21286	0,06520
	(0,21116)	(0,21102)	(0,03477)	(0,26524)	(0,27543)	(0,07976)
Wife's Lower secondary	0,26180	0,25280	0,04083	0,28773	0,25680	0,07846
	(0,21986)	(0,21895)	(0,03868)	(0,26662)	(0,27569)	(0,07938)
Wife's Upper secondary	0,30135	0,28766	0,04583	0,32168	0,26674	0,08341
	(0,22032)	(0,21826)	(0,03757)	(0,26523)	(0,27315)	(0,08260)
Wife's Tertiary	0,32469	0,30387	0,05190	0,30130	0,22505	0,07015
	(0,23689)	(0,23254)	(0,04552)	(0,27471)	(0,28062)	(0,08432)
ρ	0.02129			0.29537		
	(0.10724)			(0.15621)		
N	3032	3032	3032	1382	1382	1382

Note: *** p<0.01, ** p<0.05, * p<0.1. All regression equations are estimated with robust standard errors and include countries' dummies.

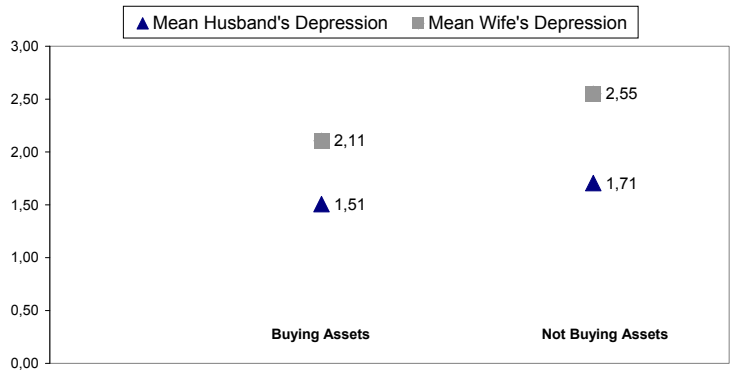
fact acknowledged in the literature (Neelakantan, 2010; Barber and Odean, 2001; Lott and Kenny, 1999; Sunden and Surette, 1998; Jianakopolos and Bernasek, 1998; Barsky, Juster, Kimball, and Shapiro, 1997).

Since couples pool their assets to a significant degree, they should coordinate the investment decision as well. On the other hand, if depression influence this decision via risk aversion channel, then a difference between spouses' risk aversion should be considered. On average, women exhibit relatively more risk aversion in financial decision making than men. In particular, women are less likely to invest in risky assets and hold smaller portfolio shares in the risky assets (Bajtelsmit and Bernasek, 1996; Sunden and Surette, 1998). Holding other factors constant, we consider that husband's and wife's risk aversion (define respectively γ^h and γ^w, with $\gamma^h < \gamma^w$) would determine their willingness to hold assets. We also define a threshold value $\bar{\gamma}$, below which individuals want to possess risky assets. Suppose that, in order to make a decision, a couple should reach an agreement. If a couple does not have any risky assets, they should agree to buy it, otherwise they continue not having it. While when they have an asset, they should agree to sell it, otherwise they continue having it. Suppose also that in order to buy or to sell, risk aversion of both should be either below or above $\bar{\gamma}$.

First, we consider the situation when two household members decide whether to buy or not a risky financial asset. The baseline is not having any risky asset. In order to buy it, household risk aversion should decrease. Consider there is a positive shock that affects risk aversion of either spouse in such a way that risk aversion decreases. Because wife's background risk aversion is higher than husband's, on average she would be less willing to buy the asset (on average γ^w would be above $\bar{\gamma}$, while γ^h might be below $\bar{\gamma}$). If the shock affects γ^w, such that it approaches $\bar{\gamma}$, the household decides to buy the risky asset, while if the shock affects γ^h, as $\gamma^h < \gamma^w$, it will not affect the buying decision. Therefore, changes in risk aversion of a wife (which to some extend are driven by depression) would determine whether the household buys the risky asset or not.

In order to provide descriptive evidences for this explanation, we plot on Graph 4 the unconditional means of depression of husband and wife when they buy and do not buy risky assets in t, conditional they did not have them in $t-1$:

Graph 4. No Assets in t-1



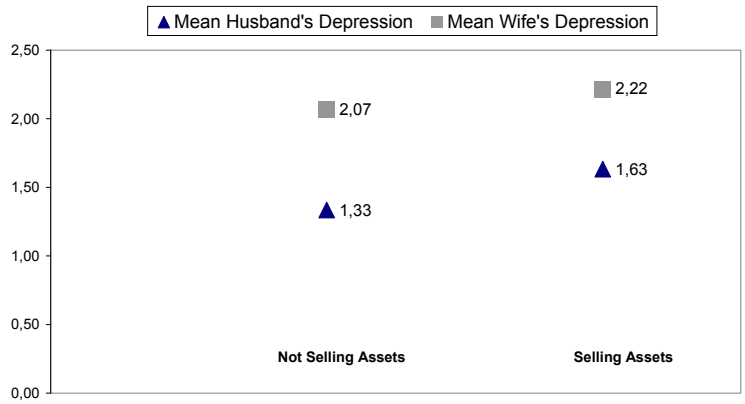
On Graph 4, the means of depression for the households who decide to buy assets in t are smaller in magnitudes compared to the means of those who decide not to buy assets, suggesting that these households' risk aversion has decreased. The difference in means

of wives is twice as their husbands (0.45 vs. 0.20), suggesting that risk aversion of wives decreased in order to buy assets.

Next, we consider the situation, when the household had a risky asset in $t-1$, and decides whether to sell it or not. The baseline state is not selling the asset. In order to sell the asset, household risk aversion should increase. Consider there is a negative shock such that it increases risk aversion. Because husband's background risk aversion is lower than wife's, on average he would be less willing to sell the asset (on average γ^h would be below $\bar{\gamma}$, while γ^w could be above $\bar{\gamma}$). If the shock affects γ^h, such that it crosses $\bar{\gamma}$, the household decides to sell risky assets, while if the shock affects γ^w, as $\gamma^h < \gamma^w$, it will not affect selling decision, as γ^w is already above $\bar{\gamma}$. Therefore, now changes in risk aversion of the husband (which to some extend are driven by depression) would determine whether the household sells the risky asset or not.

In order to provide descriptive evidences for this explanation, we plot on Graph 5 the unconditional means of depression of husband and wife when they sell and do not sell risky assets in t, conditional they had it $t-1$:

Graph 5. Assets in t-1



On Graph 5, the means of depression for the households who decide to sell assets in t are larger in magnitudes compared to the means of those who decide not to sell assets, suggesting that these households' risk aversion has increased. The difference in means of husbands is twice as their wives (0.30 vs. 0.15), suggesting that risk aversion of husbands increases in order to sell assets.

To summarize, we consider the following household decision rule:

$$\begin{cases} (A_{i,t} = 1 \mid A_{i,t-1} = 0) \text{ if } max(\gamma^h, \gamma^w) \leq \bar{\gamma} \\ (A_{i,t} = 0 \mid A_{i,t-1} = 1) \text{ if } min(\gamma^h, \gamma^w) > \bar{\gamma} \end{cases}$$

Where $(A_{i,t} = 1 \mid A_{i,t-1} = 0)$ is decision of buying, $(A_{i,t} = 0 \mid A_{i,t-1} = 1)$ is decision of selling. This rule ensures that both spouses agree on the decision: in the case of buying the degrees of risk aversion of both are on or below the threshold, in the case of selling both are above the threshold. In the first situation, the change in risk aversion of wife will determine whether the household buys the asset, while in the second situation, in order to sell the assets, a change in husband's risk aversion makes a difference. For example, consider a situation when a couple decides whether or not to buy a heavy yellow

vehicle.[27] The wife, who is on average more risk averse, will be last to say, since she might lack confidence on the road, have doubt about affordability and garaging, or excess road pollution. So in order the household buys this car, her risk preferences have to adjust. However, in the situation when they already own this vehicle, the husband most probably takes care of the car, does all technical examinations and repairs it. Hence, changes in his preferences determine whether the household sells this vehicle or not.

5.1 Differences in bargaining power

Another dimension that can help us to explain the asymmetry of results for buying and selling decisions between wife's and husband's changes in depression is bargaining power. Scholars analyzing bargaining power in the household consumption-saving framework (Browning, 2000; Lundberg at el., 2003) suggest that when the husband loses his bargaining power, the household decisions might be changed toward wife's preferences. The problem arises because wives, who are on average younger and have longer life expectancy, prefer to save more than their husbands. Lundberg at el. (2003) found that household consumption falls after the husband retires, which one may interpret as husband's bargaining power decrease after his retirement. As wives are more risk averse, they might prefer to save in non risky assets. Hence we would observe that households are less willing to acquire risky assets when wife's depression increases and husband is retired (i.e. when wife's risk aversion increases and she has more bargaining power). While husband's depression would be a significant determinant of household willingness to sell assets only if he is not retired (i.e. when husband's risk aversion increases and he has more bargaining power). To do so we include the dummies for husband's and wife's retirement status, $HRet_i$ and $WRet_{i,t}$ respectively, equal 1 if s/he is retired and 0 otherwise, and interact them with each spouse's depression, $HD_{i,t-1} * HRet_{i,t}$ and $WD_{i,t-1} * WRet_{i,t}$. Furthermore, we allow the impact of each spouse's depression to depend not only on whether s/he is retired, but also on whether her/his partner is retired as well. Thus, we include the interactions of each spouse's depression and her/his partner retirement status: $HD_{i,t-1} * WRet_{i,t}$ and $WD_{i,t-1} * HRet_{i,t}$:

$$\begin{aligned} A^*_{i0,t} &= \beta^0_0 + \beta^0_1 HD_{i,t-1} + \beta^0_2 WD_{i,t-1} + \beta^0_3 HRet_{i,t} + \beta^0_4 WRet_{i,t} \\ &\quad + \beta^0_5 \left[HD_{i,t-1} * HRet_{i,t}\right] + \beta^0_6 \left[WD_{i,t-1} * WRet_{i,t}\right] \\ &\quad + \beta^0_7 \left[HD_{i,t-1} * WRet_{i,t}\right] + \beta^0_8 \left[WD_{i,t-1} * HRet_{i,t}\right] + \beta^0_9 X'_{i,t} + \varepsilon_{i0} \end{aligned} \tag{13}$$

$$\begin{aligned} A^*_{i1,t} &= \beta^1_0 + \beta^1_1 HD_{i,t-1} + \beta^1_2 WD_{i,t-1} + \beta^1_3 HRet_{i,t} + \beta^1_4 WRet_{i,t} \\ &\quad + \beta^1_5 \left[HD_{i,t-1} * HRet_{i,t}\right] + \beta^1_6 \left[WD_{i,t-1} * WRet_{i,t}\right] \\ &\quad + \beta^1_7 \left[HD_{i,t-1} * WRet_{i,t}\right] + \beta^1_8 \left[WD_{i,t-1} * HRet_{i,t}\right] + \beta^1_9 X'_{i,t} + \varepsilon_{i1} \end{aligned} \tag{14}$$

The results are summarized in Table 4:[28]

[27] Insurance companies rate yellow cars as having significantly higher car accident risks. From the other side, big vehicles, as vans, are safer than small cars.

[28] We present here only the coefficients of interest. Table $A2$ in the Appendix contains the whole set of estimated coefficients.

Table 4. Differences in the impact of spouse's depression due to retirement

		No assets in t-1	Assets in t-1
Husband's Depression			
Husband NotRetired, Wife NotRetired	(β_1^c)	0,03949	-0,07730*
Husband NotRetired, Wife Retired	(β_1^c+β_7^c)	0,03609	–0,11649*
Husband Retired, Wife NotRetired	(β_1^c+β_5^c)	-0,00620	-0,01561
Husband Retired, Wife Retired	(β_1^c+β_5^c+β_7^c)	-0,00960	-0,05480
Wife's depression			
Husband NotRetired, Wife NotRetired	(β_2^c)	-0,01335	0,01841
Husband NotRetired, Wife Retired	(β_2^c+β_6^c)	0,01479	0,01021
Husband Retired, Wife NotRetired	(β_2^c+β_8^c)	-0,06950**	0,03002
Husband Retired, Wife Retired	(β_2^c+β_6^c+β_8^c)	-0,04136	0,02182

As before, wife's depression is a significant determinant of whether the household buys the assets, however it is significant only when the husband is retired and she is not (hence she has more bargaining power). While husband's depression is a significant determinant of whether the household sells the assets, when he is not retired (with larger effect when his wife is retired).

5.2 Robustness check

One concern is whether there is a selection into who is the household financial respondent. At the beginning of the interview the couple is asked the following: "Which of you would be the most able one to answer questions about your finances?" It might be the case that the spouse who suffer depression problems is less likely to be the financial respondent, in particular because s/he has lost interest in household financial activities (passivity). Likewise, because of mental problems s/he could be not able to participate in financial decisions anymore or take responsibility for financial operations, thus has been removed from financial planning (voluntary or forcibly). Briefly speaking, it might be more costly for the household (in terms of time, effort, and likelihood of wrong financial choice) that depressed person is in charge for household finance. Therefore, if a spouse with less depression problems is more likely to be selected, his/her preferences would be acknowledged in the household decision about risky asset holding which makes our intuitive explanation about asymmetry not correct.

We analyze the possibility of this kind of selection by regressing the dummy of financial respondent (husband or wife) on the household characteristics and indexes of husband's and wife's depression. The marginal effects are summarized in Table 5:

Table 5. Selection to be financial respondent

	No assets in t-1	Assets in t-1
Husband's Depression in t-1	-0,00794	0,00791
	(0,00521)	(0,00909)
Wife's Depression in t-1	0,00320	0,00440
	(0,00438)	(0,00738)
N	3032	1382

Note: *** p<0.01, ** p<0.05, * p<0.1.
Regressions are probit with robust standard errors

The results suggest that neither spouse is more or less likely to be selected to answer financial questions if s/he suffers more depression symptoms. The marginal effects of depression index either of husband or wife are not significantly different from zero. To

summarize, the selection issue does not seem to affect our findings, and we conclude that the results are robust.

6 Conclusion

In this paper we evaluate the impact of a possible change in individual's risk attitudes due to depression on the economic choices (e.g. willingness to invest in risky financial assets) near retirement. In particular, we intended to answer three questions: whether depressed people might have distorted perception, whether suffering depression has an impact on willingness to hold risky financial assets, and how spouses' depression levels are combined for the household decision to possess risky assets. For this purpose we use The Survey of Health, Ageing and Retirement in Europe (SHARE). In overall, the empirical results support the conjectured hypothesis: depressed people have differences in perception and are less likely to hold risky assets. We also conclude that risk aversion is the plausible channel for the association between depression and household risky asset holding. From a policy perspective, these findings are very important. Given that many countries are considering a change of a pension system, it is of interest to know that suffering depression may affect economic decisions. As individuals who suffer depression have different perceptions about the states of the world, they may favor different investment scenario compared to those who do not suffer depression. Hence, creating effective economic incentives for this group of people could be challenging.

Concerning couples' decisions about risky asset holding, the effect of depression would depend on the combination of spouses' risk attitudes and their relative bargaining power in the household. The wife, who is on average more risk averse, would incline the household towards not buying risky assets, when she suffer more depression symptoms and has relatively more bargaining power (the husband is retired, and she is not). While, if the household already has risky assets, husband is more likely to be responsible for decisions about its maintenance. Hence changes in his risk attitude (which might be affected by depression) would determine whether the household sell or not the assets, when he has relatively more bargaining power (he is not retired).

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A Appendix

List of symptoms

1. Depression.

   Q In the last month, have you been sad or depressed?

   A Yes/ No

2. Pessimism.

   Q What are your hopes for the future?

   A Any hopes mentioned/ No hopes mentioned

3. Suicidality

   Q In the last month, have you felt that you would rather be dead?

   A Any mention of suicidal feelings or wishing to be dead/ No such feelings

4. Guilty

Q Do you tend to blame yourself or feel guilty about anything?

A Obvious excessive guilt or self-blame/ No such feelings

5. Sleep

Q Have you had trouble sleeping recently?

A Trouble with sleep or recent change in pattern/ No trouble sleeping

6. Interest

Q In the last month, what is your interest in things?

A Less interest than usual mentioned/ No mention of loss of interest

7. Irritability

Q Have you been irritable recently?

A Yes/ No

8. Appetite

Q What has your appetite been like?

A Diminution in desire for food/ No diminution in desire for food

9. Fatigue

Q In the last month, have you had too little energy to do the things you wanted to do?

A Yes/ No

10. Concentration

Q How is your concentration? For example, can you concentrate on a television programme, film or radio programme?

A Difficulty in concentrating on entertainment/ No such difficulty mentioned

11. Enjoyment

Q What have you enjoyed doing recently?

A Fails to mention any enjoyable activity/ Mentions ANY enjoyment from activity

12. Tearfulness

Q In the last month, have you cried at all?

A Yes/ No

Table A1. Transition Matrix

	No assets in t	Assets in t	N
No Assets in t-1	2643	389	3032
Assets in t-1	395	987	1382
N	3038	1376	4414

Table A2. Holding of risky assets and retirement. Coefficients.

	No assets in t-1	Assets in t-1
Husband's Depression in t-1	0,03949	-0,07730*
	(0,03063)	(0,04234)
Wife's Depression in t-1	-0,01335	0,01841
	(0,02720)	(0,03373)
Husband Retired	0,36872***	0,21180
	(0,12840)	(0,16289)
Hus.Dep * Hus.Ret.	-0,04569	0,06169
	(0,04126)	(0,05718)
Hus.Dep * Wife Ret.	-0,00339	-0,03919
	(0,04131)	(0,05753)
Wife Retired	0,00436	0,10897
	(0,11446)	(0,15511)
Wife Dep. * Wife Ret.	0,02814	-0,00820
	(0,03656)	(0,04642)
Wife Dep. * Hus.Ret.	-0,05616	0,01161
	(0,03723)	(0,04619)
Ln(Income) in t	0,06991*	0,17011**
	(0,04032)	(0,07208)
Ln(Net Worth) in t-1	0,18620***	0,15849***
	(0,02654)	(0,03908)
Husband's Cognitive Ability in t	0,05467*	0,02463
	(0,03319)	(0,04296)
Wife's Cognitive Ability in t	-0,05378	-0,03012
	(0,03334)	(0,04051)
Husband's Age	0,06452	-0,06127
	(0,06672)	(0,08449)
Husband's Age2	-0,00059	0,00036
	(0,00050)	(0,00061)
Wife's Age	-0,09777**	0,09459
	(0,04980)	(0,07362)
Wife's Age2	0,00073*	-0,00077
	(0,00039)	(0,00057)
Children	-0,00089	0,02815
	(0,02427)	(0,03473)
Husband's Primary	0,20431	0,00467
	(0,26638)	(0,40566)
Husband's Lower secondary	0,27977	0,22677
	(0,27578)	(0,41273)
Husband's Upper secondary	0,51709*	0,18803
	(0,26728)	(0,40587)
Husband's Tertiary	0,63297**	0,24361
	(0,27743)	(0,41060)
Wife's Primary	0,23619	0,18026
	(0,21306)	(0,27961)
Wife's Lower secondary	0,23042	0,24522
	(0,22003)	(0,27942)
Wife's Upper secondary	0,26608	0,25890
	(0,21916)	(0,27652)
Wife's Tertiary	0,28436	0,22662
	(0,23260)	(0,28377)
Const	-3,30584	-4,75978*
	(2,12209)	(2,75122)
N	3032	1382

Note: *** p<0.01, ** p<0.05, * p<0.1.
Countries' dummies are included.
Regressions are probit with robust standard errors.

Table A3. Selection to be financial respondent

	No assets in t-1	Assets in t-1
Husband's Depression in t-1	-0,00794	0,00791
	(0,00521)	(0,00909)
Wife's Depression in t-1	0,00320	0,00440
	(0,00438)	(0,00738)
Ln(Income) in t	0,00509	0,03108
	(0,01046)	(0,02536)
Ln(Net Worth) in t-1	0,00112	0,00479
	(0,00482)	(0,01338)
Husband's Cognitive Ability in t	0,05828***	0,08324***
	(0,00975)	(0,01479)
Wife's Cognitive Ability in t	-0,04873***	-0,07018***
	(0,00991)	(0,01429)
Husband's Age	0,07670***	0,03098
	(0,01722)	(0,02846)
Husband's Age2	-0,00054***	-0,00022
	(0,00013)	(0,00021)
Wife's Age	-0,07230***	-0,05643**
	(0,01481)	(0,02627)
Wife's Age2	0,00055***	0,00041**
	(0,00012)	(0,00020)
Children	0,00684	-0,00243
	(0,00710)	(0,01203)
Husband's Primary	-0,03981	-0,15472
	(0,04918)	(0,16112)
Husband's Lower secondary	0,01555	-0,13880
	(0,05368)	(0,16360)
Husband's Upper secondary	0,02307	-0,11108
	(0,05245)	(0,15736)
Husband's Tertiary	0,08264	0,02727
	(0,05488)	(0,15477)
Wife's Primary	-0,01161	-0,01263
	(0,04460)	(0,10664)
Wife's Lower secondary	-0,03981	-0,08014
	(0,04985)	(0,10985)
Wife's Upper secondary	-0,04193	-0,13323
	(0,04942)	(0,10720)
Wife's Tertiary	-0,06874	-0,18325*
	(0,05694)	(0,11034)
N	3032	1382

Note: *** p<0.01, ** p<0.05, * p<0.1
Regressions are probit with robust standard errors