Wealth Shocks and Portfolio Choice

Dimitris Christelis, Dimitris Georgarakos, Tullio Jappelli, Geoff Kenny

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Abstract

We use new euro area representative data from the Consumer Expectations Survey (CES) to elicit household-specific propensities to invest and consume out of positive wealth shocks. Using a randomized assignment of hypothetical lottery gains ranging from 5,000 to 50,000 euros and a realistic menu of consumption, saving and asset choices, we estimate the causal effect of wealth shocks on risky asset ownership and conditional asset shares. Wealth shocks have a positive effect on stockholding (about a 10 percentage points increase for the largest wealth shock). The majority of households in the sample do not participate in the stock market, even after a large increase in wealth. The conditional asset share invested in stocks does not depend on the size of wealth shocks, with the small exception of very high values of the latter, for which the conditional risky asset share slightly increases. This result is consistent with the notion that preferences are characterized by constant relative risk aversion for the vast majority of risky asset investors.

JEL Classification: D14, G11, G51

Keywords: Household finance; Stock market participation; Risk aversion; Consumer Expectations Survey

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1. Introduction

The relation between household resources and portfolio decisions has been a subject of intense empirical investigation in the last two decades, as this relation speaks to the importance of transaction and information costs for accessing financial markets, as well as to the nature of attitudes towards risk. For example, abstracting from the role of human capital, when preferences are characterized by constant relative risk aversion (CRRA), changes in financial wealth should not affect the portfolio share of risky assets.

However, deriving causal estimates of the effect of wealth on stock market participation and the share of resources invested in risky assets is very challenging when using observational data. For instance, causality could run from participation and amounts invested in risky assets to resources, as households that participate in financial markets may hold better diversified portfolios and be successful in securing high returns, thus ending up with higher wealth.[1] In addition, there could be a correlation between wealth and household unobserved characteristics that affect the decision to invest in risky financial assets. For instance, wealth and risky asset investment could be both correlated with unobservable preferences, such as patience and the length of the investment horizon. Therefore, the observed positive correlation between risky asset investment and wealth might be due to the fact that people who have chosen to participate in the stock market independently of wealth also end up with higher wealth. A further complication in the analysis of the link between wealth and portfolio choice is that one needs to distinguish changes in wealth that directly cause changes in portfolio allocations through

[1] In a different context, Carroll et al. (2011) explains the importance of exogenous wealth shocks pointing out that identifying the "pure" housing wealth effect is hard, because "one would want data on spending by individual households before and after some truly exogenous change in their house values, caused for example by the unexpected discovery of neighborhood sources of pollution."

their effect on the household budget set, from situations in which changes in wealth predict changes in portfolio allocations because they signal changes in future resources.

To overcome these challenges affecting observational studies, we designed a randomized Control Trial (RCT) in a survey of households in the six largest euro countries that involves asking them how they would allocate randomly assigned lottery gains of different size between spending, debt repayment and investment in various financial assets. This RCT thus allows us to estimate the causal effect of household resources on stock market participation and on the share of financial assets invested in stocks and mutual funds.

Our experimental approach extends recent literature that has used questions in household surveys to elicit information about the consumption responses to scenarios involving income or wealth shocks.[2] A key advantage of this approach is that it provides household-specific estimates of the marginal propensity to consume out of possible transitory income changes and of the consumption effect induced by the response to wealth shocks. By suitable experimental designs, these estimates apply to the population at large, allow comparisons under different shock scenarios, and are not confounded by the unobserved characteristics of the selected sample that is subject to a realized shock (and in most cases, by the business cycle context in which the shock occurs).

We use data from the new Consumer Expectations Survey (CES), an ongoing panel administered by the ECB that interviews every month, since April 2020, about 10,000 households in the six largest euro area economies (Germany, France, Italy, Spain, the Netherlands and Belgium). This survey, which is described fully in Georgarakos and Kenny (2022) and ECB (2021), is representative of the underlying populations and collects via the

[2] See contributions by Shapiro (2003), Jappelli and Pistaferri (2014), Christelis et al. (2019), Fuster et al. (2018), Christelis et al (2021).

Internet fully harmonized information on demographics, income, consumption, portfolios and several expectations variables. In June 2021, we implemented a special set of questions on the way that households would spend, save and invest windfall gains from lotteries of five randomly assigned amounts that vary from 5,000 to 50,000 euro. More specifically, respondents indicate how much of the lottery prizes they would consume, save or use to repay debt , and how much of the amount saved they would invest in five asset categories (transaction accounts, bonds, stocks, mutual funds, retirement accounts). We randomize the five different lottery amounts, and thus we can estimate the causal effect of the lottery-induced changes in wealth on stockholding and risky asset shares.

The design of our RCT allows us to contribute both in substance and methodologically to the household finance literature. In terms of substance, we derive causal estimates of the effect of wealth on stock market participation and the share of resources invested in risky financial assets, which in turn allows us to present robust evidence on households' attitudes towards risk. Moreover, by suitable sample splits, we can also analyze the heterogeneity of portfolio responses to wealth shocks, distinguishing between various population groups. For instance, we can study the relation between stockholding and wealth for different levels of financial literacy, which indicates whether more sophisticated investors face lower information costs when choosing their portfolio allocations.

From a methodological point of view, we propose an experiment in which the wealth shock is exogenous, and not the result of the amount saved or consumed in previous periods, or of the particular portfolio allocation chosen by individual investors in the past. Therefore, we fully address the issue that portfolio choice may spuriously respond to endogenous changes in wealth, induced for instance by the fact that some households have been particularly successful in their asset allocation, avoiding market crashes. or exploiting market booms. Moreover, our experimental design allows the estimation of the causal effect of wealth shocks on portfolio choices not only in the whole sample, but also for specific population subgroups defined by predetermined characteristics, as treatment randomization obtains within all such subgroups. Finally, our survey design enables a more detailed analysis of households' responses to wealth shocks as respondents can choose from a realistic menu of choices that is not restricted to spending but also includes saving and portfolio allocation across various asset options.

Our main results can be summarized as follows. On participation, we confirm previous literature reporting a positive gradient between wealth shocks and the decision to invest in stocks; see Guiso and Sodini (2013) for a review. Evaluated at sample means, for every 10 thousand euros increase in wealth, participation increases by 1.5 percentage points. Going from the lowest to the highest lottery, we find an increase in participation of about 6 percentage points for stocks, and 8 percentage points for stocks and mutual funds combined. The increase in participation is about 2 percentage points larger for relatively more sophisticated investors, who are likely to face lower information costs. A further finding is that even for relatively large wealth shocks (50,000 euros) the majority of investors chooses not to invest in the stock market. This finding is again consistent with previous literature.

The change in the asset share is rather insensitive to changes in wealth, with a small exception for highest value of the shock (equal to 50,000 euros), lending support to the notion that preferences are characterized by CRRA. The result holds for both stocks held directly, and stocks held directly combined with mutual funds, and applies equally well to investors with different levels of financial sophistication.

The paper is organized as follows. Section 2 reviews briefly the household finance literature, and in particular empirical studies that have estimated the relation between wealth and participation in the market for risky financial assets, and how the risky asset share invested varies with wealth once the participation decision has been taken. Section 3 describes the ECB Consumer Expectations Survey (CES) and the experimental framework. Section 4 provides a first description of the data. Sections 5 and 6 report, respectively, econometric estimates of the participation decisions in stocks and other risky assets, and of the asset share invested in stocks. Section 7 summarizes our findings.

2. Stockholding, portfolio choice and wealth

A clear finding across many studies and countries is that participation in stockholding, direct or indirect, is stronger among wealthier households, and that there are often huge differences in participation rates between households in the lower relative to the upper parts of the wealth distribution. This is typically estimated via binary choice models regressing stock ownership status on wealth and other demographics.[3] The positive relation between stockholding and wealth is largely interpreted as evidence that fixed entry costs, information costs, minimum investment requirements and participation fees limit severely stock market participation, (see for instance the surveys by Guiso et al. (2001) and Guiso and Sodini 2013).

The literature also points out that many households do not participate in the stock market even at high levels of wealth and that, at any given level of wealth, households with higher financial sophistication tend to participate more to the stock market. The correlation between participation and financial sophistication suggests that information costs are also relevant to the participation decisions. More sophisticated households are able to process information more efficiently and more cheaply, and therefore face lower entry and

[3] These are reduced-form specifications that do not explicitly take other choices, such as spending and saving, into account.

participation costs than less sophisticated households, even at the same level of wealth. Furthermore, wealth and financial sophistication often go hand-in-hand, as wealthier households have higher incentives to invest in financial information when choosing their portfolios. Other studies suggest that non-participation, especially among the wealthy, is due to lack of trust in financial markets and pessimistic beliefs about stock market returns (Guiso et al., 2008), and/or psychological barriers, such as status quo bias, loss aversion, and present bias.

A second area of empirical studies in household finance focuses on portfolio allocations in various asset categories. Portfolio shares (including non-participants) do not distinguish the effects of relevant variables on the participation decision from those on the portfolio share, conditional that the asset is held. The literature has therefore focused on portfolio shares, considering that many households do not invest in risky assets. Econometrically this amounts to estimating models that allow for censoring, sometimes distinguishing variables that affect the participation decisions from those that affect the asset shares (as in the Heckman selection model, subject to the caveat of using valid exclusion restrictions).

Estimating the relation between wealth and the asset share is useful to test some of the implications of portfolio models. A classic prediction of these models is that in the absence of human capital and when preferences are characterized by CRRA, the portfolio share of risky assets, conditional on holding them, should be independent of the level of wealth. However, when human capital is riskless and tradeable, it induces poorer households (those who have a lower ratio of financial wealth to labor income) to invest more in risky assets to take advantage of the equity premium, while richer households (with relatively high financial wealth relative to labor income) should prefer to hold a higher share of riskless assets. This classical prediction of Merton (1971) in a complete market setting has been refined by many papers in life-cycle settings and incomplete markets (a prominent example is Cocco et al. 2005). Also models with habit persistence, consumption commitments, or background risk lead to the prediction that relative risk aversion is not constant.

One possible approach to solve the problem of obtaining causal estimates of the effect of wealth or risky assets shares is to use panel data. Chiappori and Paiella (2011) use panel data, and after taking first differences find that the (log) change in the risky asset share is rather insensitive to (log) wealth, as suggested by utility functions with CRRA. Using first differences is only a partial solution of the issue, because this approach still requires distinguishing genuine variations in asset shares from variations due to changes in asset valuation. Furthermore, past wealth is likely to be correlated with the error term, due to portfolio inertia, and time-varying unobservable variables that affect both asset shares and wealth. Measurement error in wealth poses an additional problem, as it can lead to the usual attenuation bias of the estimated elasticity of the risky asset share with respect to wealth. Calvet and Sodini (2014) have proposed an ingenuous alternative to OLS and first difference estimates, controlling for unobserved fixed effects using Swedish data on the portfolios of twins. In contrast to Chiappori and Paiella, they find that the risky asset share increases with financial wealth, lending support to the notion that preferences are characterized by decreasing relative risk aversion.

At the end of the day, even in panel data, one needs to identify wealth shocks that are exogenous to the portfolio decision, which is very difficult. One could also control directly for the propensity to take risk if such propensity is observable. This would provide information on risk aversion, but would of course not solve the causality problem.

A promising route to overcome the identification problems is to exploit random wealth shocks due to unexpected inheritances or lottery prizes. Andersen and Nielsen (2010) use

Danish inheritances from sudden deaths to study the effect of a financial windfall on stock market participation. They find that unexpected inheritances increase stock market participation (by 21 percentage points for those who receive 134,000 euro), but the majority of households do not enter the stock market even after receiving a large inheritance. Briggs et al. (2021) using administrative Swedish data exploit randomly received lottery prizes to estimate the causal effect of wealth on stock market participation. They find that a $150,000 windfall gain increases the stock market participation probability by 12 percentage points among pre lottery gain non-participants but has no discernible effect on pre lottery stock owners.

Our paper is closely connected to these two studies using administrative data. However, rather than using such data, we rely on a RCT that allows us to estimate the causal effect of exogenous wealth shocks on stock market participation. In addition to these studies, our RCT allows us to study the effect of windfall gains also on risky asset shares. Moreover, our experimental approach allows the individual estimation of the marginal propensity to invest in risky asset for every household in our sample. Importantly, our RCT also allows us to consistently estimate heterogeneous effects for subgroups of interest, defined using predetermined characteristics such as financial literacy, financial resources, expectations and trust. Finally, our survey data allow the estimation of the causal effects of interest using population representative data for the six largest euro area countries.

3. The Consumer Expectations Survey and the experimental design

In our analysis, we use the ECB's Consumer Expectations Survey (CES) - a new online high frequency panel survey of euro area consumer expectations and behavior. Building on recent international experiences and advances in survey methodology and design, as reflected, for example, in the Federal Reserve Bank of New York's Survey of Consumer Expectations (Armantier et al., 2016), the CES was launched in pilot phase in January 2020. The CES has several important and innovative features that help facilitate rich analysis of economic shocks and their transmission via the household sector. Below we provide a brief summary of these main features – see Georgarakos and Kenny (2022) for a more detailed description of the CES and ECB (2021) for a first evaluation of the survey.

The CES covers the six largest euro area economies (Belgium, Germany, Italy, France, Spain, and the Netherlands) with a sample size of approximately 10,000 consumers during the period covered by our analysis. In this paper, we use mostly data from a special-purpose survey that was fielded in June 2021. The sample is comprised of anonymized individual-level responses from approximately 2,000 survey participants from each of the four largest euro area countries (Germany, Italy, France, Spain) and 1,000 in each of the two smaller countries (Belgium, the Netherlands). Three out of four participants in the four largest euro area countries were recruited via random dialing while the remaining are drawn from existing samples. The survey provides sample weights that we use to make descriptive statistics representative of the adult population in each country.

The large sample size helps ensure the survey's overall representativeness of population structures at both the euro area and component country levels. Respondents are invited to answer online questionnaires every month and must leave the panel between 18 and 24 months after joining. Each respondent completes a background questionnaire upon entry into the panel. This provides a range of important background information that changes very little month by month (e.g., education, family situation, household annual income, measures of financial literacy). More time-sensitive information is collected in a series of monthly, quarterly and ad hoc topical questionnaires. Detailed questions about household consumption expenditures are asked every quarter, while questions on consumption and asset choices in response to wealth shock scenarios like the one we utilize in the present paper can be asked in ad hoc special-purpose modules. The survey's online nature is particularly important for allowing the questionnaires to reflect evolving economic developments. For example, as described further below, it was possible to introduce the RCT in June 2021.

Last, the CES is an incentivized survey with respondents receiving a gratuity with a relatively modest monetary value in recognition for their participation. These incentives signal the important value of the data supplied by respondents and strengthen the CES's overall quality by promoting high overall survey response rates, strong panel retention and minimal skipping of individual questions by participants.

In June 2021 we asked respondents in the CES to report how they would allocate a lottery, distinguishing between spending, saving and investing in financial assets, and repaying debt. The question randomly assigns five different lottery prizes(<*Amount*>: 5, 10, 20, 30 and 50 thousand euro):

Imagine you win a lottery of <Amount> today. How would you use this unexpected windfall over the next 12 months? Please allocate the <Amount> over the following three categories.

(1) Buy goods and services (including food, housing costs and rent, utility bills, clothing, and long-lasting goods such as home improvements, furniture and electronics, etc.).
(2) Save and invest in financial assets.
(3) Repay debts.

In a follow up question, respondents who indicated that they would save <*A*> were asked:

You said that you would save or invest in financial assets € <A>. Please indicate in which of the following asset categories you would save/invest this amount.

where financial investment categories consist of: (i) current accounts and saving accounts; (ii) stocks and shares; (iii) mutual funds; (iv) retirement and pension products (including life insurances); and (v) bonds.

Respondents were also given specific instructions about the meaning of the various financial asset categories and received error messages if the sums of their reported amounts were different from <*Amount*> and <*A*> in the first and second stages, respectively. The Appendix reports the survey questions and format of the questionnaire, and sample statistics showing that the sub-samples are well balanced in terms of key demographic and economic variables.

In contrast to questions that elicit qualitative information, as in the "mostly save/mostly spend" format used in early studies by Shapiro and Slemrod (1995; 2003), the responses to the questions we posed provide quantitative metrics for a proposed scenario (people are asked how much of the lottery they would spend, save, or use to repay debt). The advantage of quantitative survey responses is that they overcome problems related to comparing responses across individuals who might interpret the statement "mostly save/mostly spend" in different ways.

A number of recent studies use survey data and quantitative responses to transitory income and wealth shock scenarios to elicit MPCs, see for example, Christelis et al. (2019) and Jappelli and Pistaferri (2020), amongst others. We extend this literature by asking respondents to indicate their choices out of a realistic menu that includes not only consumption and saving, but also asset investment choices and portfolio allocation. Another novel feature of our approach is that it randomly assigns lottery wins of different size to survey participants which enables the clear identification of the causal relationships of interest.

Three additional features of the survey questions are noteworthy. First, consumers are asked by how much they would increase or save "in the next 12 months". This allows us to rule out that differences in the amounts consumed, saved and invested arise from differences in the timing of planned spending. Of course, further adjustments in subsequent years cannot be ruled out. In principle, it would be useful to posit similar questions with other time horizons (e.g., how consumption, saving and financial investments) would change in the following years, but this would considerably increase the complexity of the questionnaire. Second, the questionnaire was administered in June 2021. Even though the COVID-19 period cannot be regarded as a normal period, June 2021 did not coincide with any of the major waves of the pandemic. Finally, since median financial wealth in the sample is 15,105 euro, we experiment with a wide range of shocks, whose amounts are realistic for median households. Indeed, the largest lottery (50,000 euros) amounts to roughly the financial wealth of respondents at the 75th percentile of the financial wealth distribution (53,657 euro).

4. Descriptive analysis

Table 1 reports sample statistics on the randomized questions and on the main variables used in the estimation. Means and standard deviations are computed using sample weights. We exclude 538 respondents (approximately 5% of the sample) who completed the survey (which for a typical respondent should take about 10 minutes) in less than 2.5 minutes, so that the resulting sample includes 9,668 observations.[4]

[4] Results are almost identical if we keep these observations in the estimation sample.

We formally test whether lottery values are randomly assigned across households in the sample. To this end, we estimate a multinomial logit model that associates the five lottery windfalls with an extended set of household socio-economic characteristics and country fixed effects.[5] The LR test on the joint significance of the covariates from this regression is 88 (p-value 0.16) suggesting that the assignment of lottery windfalls is orthogonal to household characteristics.

To compute the marginal propensity to consume (MPC), to save (MPS) and to repay debt (MPD) we standardize the reported amounts by the randomly assigned lottery gains. On average, the MPC out of the wealth shock is 34.5%, the fraction of wealth used to repay debt is 17.3%, and the remaining 48.1% is saved. These estimates are broadly in line with similar propensities estimated for other countries with direct survey questions. For instance, Jappelli and Pistaferri (2014) use Italian survey data from the 2010 Survey of Household Income and Wealth where consumers were asked to report the fraction of a positive income shock (a hypothetical unanticipated tax rebate) that they would consume or save and find an average MPC equal to 48% and average MPS of 52%. Christelis et al. (2019), using similar questions, find that the average respondent would allocate 19.6% of the additional wealth to non-durable consumption, 19.2% to durable consumption, 14.7% to debt reduction and save the remaining 46.5%.[6]

[5] We condition on the following set of variables also used in our analysis below, including sample splits: age; gender; household size; education; occupation; cash on hand; trust to other people; stock market expectations; investment horizon; and risk preferences.

[6] Notice however that the MPC in Jappelli and Pistaferri (2014, 2020) and Christelis et al. (2019) are not directly comparable, because they are computed using smaller underlying positive shocks compared to the ones used in the present paper.

4.1. Allocation of the lottery prize between consumption, saving and different assets

The upper left graph in Figure 1 plots the MPC, the MPS and the MPD by the size of the lottery prize, and in Table 2 we report Tobit regression results related to the same variable. The baseline specification includes four dummies for lottery gains (the omitted gain is 5K) and country dummies. The extended specification controls also for demographic variables (gender, age and family size). We use Tobit models because by construction the MPC, MPD and MPS are constrained to vary from 0 to 1 (for instance, in the case that the entire prize is allocated to consumption, MPS and MPD are both equal to zero).

Standard intertemporal models with perfect markets predict that the MPC should not vary with the size of income shocks, while models with liquidity constraints predict a negative relation between MPC and shock size (and conversely, a positive relation between MPS and shock size). The reason is that if consumers receive a large and positive windfall, they are more likely to overcome the constraint, and therefore, the associated MPC is lower than in the case of small changes (Christelis et al., 2019).

The regression results show that there is a negative gradient between the MPC and lottery gains: going from the smallest to the largest gain reduces the MPC by 5.5 percentage points. Results are essentially identical if we control for demographic variables (as in the second specification of Table 2), cash-on-hand and other variables (such as education or occupation). This evidence is in line with results reported in Christelis et al. (2019) for the Netherlands, where they find that the MPC from a small positive income shock (one-month income) is larger than the MPC from a larger shock (three-months income). A similar finding is reported in Surico et al. (2021) using Italian data. We take this evidence about the MPC as suggestive that the questions are informative, and responses comparable with previous evidence.

$$\Delta\alpha_{it} = \frac{A_{it}}{W_{it}} - \frac{A_{it-1}}{W_{it-1}},$$

One novelty of the present paper is that we also collect information on how respondents would allocate the amount saved (if positive) between stocks and other assets for varying levels of the wealth shock. The assets are classified in five categories: savings and current accounts, stocks and shares, mutual funds and collective investment, retirement and pension products, bonds (short-term and long-term).

We use a narrow and a broad definition of risky assets. The narrow definition includes only stocks. The broad definition includes also mutual funds and collective investments. Notice that this broad definition is likely above the combined amount of direct and indirect stockholding, as parts of mutual funds will also be invested outside the stock market. Even in this case, however, mutual funds are risker than bank accounts.

Using this directly elicited information for asset allocation out of wealth shock scenarios we create dummy variables for direct and total stock market participation. Notice however that this dummy does not distinguish between those who would increase stock investment (because they already have stocks), and those who would enter the market due to the lottery gain. For this, we use additional survey information on actual household portfolios (collected prior to fielding the wealth shock question) and report results for the two groups in the next Section.

It is also important to examine how asset shares change because of the lottery gains, and also whether such exposure depends on whether respondents already own stocks, conditional on participation. For this purpose we need to use actual wealth data in combination with data from the hypothetical lottery, and compute the change in the risky asset share after the lottery questions:

$$\Delta\alpha_{it} = \frac{A_{it}}{W_{it}} - \frac{A_{it-1}}{W_{it-1}}, \quad (1)$$

where A_{it} is the amount of stocks, W_{it} total gross financial wealth, and α_{it} the asset share invested in stocks all measured in period t (i.e. after the lottery gain). The change in W_{it} equals the lottery gain minus the amount consumed and the amount used to repay debt. Importantly, all magnitudes at *t-1* (i.e., before the lottery gain) are predetermined, and thus their distributions are the same across all five lottery groups due to the random assignment of lottery gains. The change in the asset share is equal to zero for individuals who do not invest in the stock market before and after the lottery (51% of the sample), but can be either positive or negative for individuals who choose to invest in stocks (38% and 12%, respectively). Asset shares for stocks and mutual funds combined are defined in a similar way.

4.3. Participation

On average (across all lotteries) the propensity to invest in stocks is 26.1 percent and the propensity to invest in stocks and mutual funds combined is 39 percent (see Table 1). Actual portfolio data indicate that stockholding before the lottery was 23.7 and 37.5 percent, respectively. Therefore the lottery increases direct stockholding by 13.8 percent (17 percent including mutual funds) on average. We can investigate in detail these changes as the randomization allows us to estimate the causal impact of different lottery gains on stockholding. The top-right picture in Figure 1 displays the proportion of those that intend to invest in stocks and stocks and mutual funds for each of the five lottery gains. There is a clear positive relation between participation and lottery prize, with the difference in participation between the smallest and the largest lottery prize being equal to about 10 percentage points. The other important finding is that even after receiving a 50,000 euros lottery prize, the large majority of respondents would not invest in stocks or mutual funds.

In Figure 2 we see that the positive relation between lottery gains and stock market participation applies to each of the six countries of our sample. There are also country-specific differences in the intention to invest in stocks, as Spanish and French respondents have lower propensities to hold stocks at any given level of the lottery size, while in Germany and Belgium the propensity is higher. In some countries the positive association between wealth and stockholding seems to be stronger at low levels of wealth (e.g., in Belgium, Italy and the Netherlands). In our baseline regressions we use the pooled sample and introduce country dummies to absorb this variability.[7] In the Appendix we report also individual country results.

As we shall see, the descriptive statistics on the effect of windfall gain scenarios are confirmed by our regression analysis, and are consistent with estimates of Andersen and Nielsen (2001) for Denmark and Briggs et al. (2021) for Sweden which are both derived using actual inheritances or lottery gains. In Denmark those who receive an unexpected inheritance of 372.8 Danish Crowns (equivalent to 50,000 euro) increase stockholding by 12.9 percent (Andersen and Nielsen, Table 4). In Sweden winning a lottery prize in the 15-150,000 USD range, increases participation by 8.2 percent (Briggs et al., p. 63). These numbers are broadly consistent with the statistics in Table 1 and Figure 1. Both studies also find that most households do not enter the stock market even at high levels of wealth. In addition, using a structural life-cycle model, Briggs et al. find that the model predicts much larger rates of entry following a lottery windfall, unless one is willing to assume implausibly large entry costs.

[7] These dummies are also needed as randomization of lottery gains is done separately in each country.

In the lower part of Figure 1 we also plot the reported propensity to invest in stocks (narrow and broad definitions) distinguishing between stockholders and non-stockholders before the lottery.[8] In the lower-left graph of Figure 1 the two slopes are positive, but the effect of the windfall gain scenarios is rather small. Going from the smallest to the largest lottery prize, for those who do not invest in stocks before the lottery, stockholding would increase by 8 percentage points (6 points for those who were already stockholders). As shown in the bottom-right graph, the increase in participation using the broader definition of stockholding is larger (14 and 12 points, respectively).

4.4. Asset shares

In Figure 3 we plot the part of the lottery gain invested in stocks and mutual funds, standardized by the total amount of the lottery gain invested in financial assets (if positive); otherwise, the asset share is set to zero. The slope of the share of the lottery gain invested in stocks is flat (at approximately 11 percent), with no relation with the lottery size. For stocks and mutual funds combined, the relation is increasing for lotteries up to 30,000 euros (from 20 to 25 percent) and then approximately linear. However, these figures do not distinguish between stockholders and non-stockholders before the lottery.

The lower part of Figure 3 plots the change in the risky asset share, unconditional and conditional on actual stockholding reported before the experiment (bottom-left and bottom-right graphs, respectively). Comparing the two figures, one can see that the moderate increase in the unconditional risky asset share (between 2 and 4 percentage points, depending on the definition of the share) is entirely driven by the increase in participation,

[8] We note that, due to randomization and to the fact that stockholding pre-lottery is a predetermined magnitude, the distribution of lottery gains is the same in the two subsamples.

rather than by an increase in the share, conditional on participation. In fact, the change in the conditional asset share is rather flat (i.e., no change for stocks; a 1 percentage point increase for stocks and mutual funds for the largest lottery gain). As we shall see, these results are confirmed using regression analysis.

5. Regressions for stock market participation

In Table 3 we use probit regressions to estimate the decision to invest in stocks (or in stocks and mutual funds):

$$Prob(P_{it}) = Prob(\beta_0 + \beta_1 L_{it} + \beta_2 X_{it} + \varepsilon_{it} > 0) \quad (2)$$

where P_{it} is the probability of increasing participation, L_{it} is the hypothetical windfall gain, X_{it} a set of additional variables (including country dummies), and ε_{it} is an error term. Rather than a single lottery gain variable, we use a flexible specification with separate dummies for each lottery gain.

The baseline regression is reported in column (1) of Table 3. The right-hand-side variables include only four dummies for lottery gain (the 5K lottery dummy represents the base category), and country dummies. The table reports marginal effects, with robust standard errors in parenthesis. Other things equal, participation increases by 8.6 percentage points going from the lowest to the highest lottery prize. The results of our randomized experiment therefore confirm the positive causal effect of wealth on stockholding participation found in previous studies, which has been often interpreted as evidence of the importance of entry and participation costs in stockholding.

Given the randomized nature of our treatment, even such a parsimonious specification allows us to identify genuine causal wealth effects, while adding more covariates should mainly improve the efficiency of our estimates, without affecting the effect of the treatment (i.e., the wealth shocks). In column (2) we include age dummies, a dummy for gender and family size. Results are unaffected as expected and remain unchanged when we expand the set of regressors to include cash-on-hand, an indicator for liquidity constraints, proxies for risk aversion and trust to others, as well as various expectational and preference variables (investment horizon, expectations about stock market prices and their uncertainty).

In columns 3 and 4 of Table 3 we split the sample by pre-lottery, and thus predetermined, stock market participation. [9] The effect of windfall gains is stronger for relatively small lotteries in the sample of non-stockholders, but overall the pattern of effects of the various lottery gains are similar in the two groups (at least in the range of gains that we are considering). Briggs et al. (2021) find a stronger effect of wealth shocks on stockholding among households that did not participate in equity markets. They also point out that entry costs alone (even broadly defined) cannot explain why only 8% of households intends to invest in the stock market after receiving 50,000 euros, unless one is willing to assume that entry costs are extremely high (e.g. median entry costs would need to exceed 30,000 euros).[10] The intuition of their result is that even for conservative estimates of the equity premium the expected benefit of investing in the stock market exceeds realistic entry costs.

[9] Since pre-lottery stock market participation is a predetermined characteristic, treatment randomization holds in all subsamples defined using this variable. The same holds for all the subsequent sample splits based on predetermined characteristics that we discuss in this Section.

[10] They estimate with Swedish data a multiperiod life-cycle portfolio, with a risk-free asset and a risky asset, labor income risk and Epstein-Zin preferences.

In Table 4 we check if the effect of lottery gains are confirmed using a broader definition of stockholding. Results indicate that the increase in participation due to the lottery is larger than using the narrow definition of stockholding. Going from the smallest to the largest lottery, the increase in participation is 12.8 percentage points (12.6 adding demographic variables to the regression). Results distinguishing between pre-lottery ownership of stock and mutual funds are similar.

One recurrent argument in the literature is that information costs, above monetary costs, limit stockholding, see the survey by Guiso and Sodini (2013). One way to gauge the relative importance of information and transaction costs in determining the participation decisions is to split the sample by the level of financial sophistication (or education in general). Less sophisticated investors face higher information costs, and therefore should be less sensitive to the hypothetical lottery, while more sophisticated investors should increase participation more at any given level of the lottery.

The CES asks four questions on financial literacy. We take the count of correct responses as a measure of financial literacy and consider as highly literate those answering correctly three or (all) four questions (roughly 50% of the sample). The wording of the questions is reported in the Appendix. Table 5 shows that participation after receiving the largest lottery increases by 6.2 percentage points for those with relatively low financial literacy, as opposed to 11.2 points in the high literacy sample. One way to interpret this result is that the relatively lower information costs faced by more financially literate investors make it easier to invest in risky assets once pecuniary costs are overcome through the positive wealth shock The pattern is similar using the broad definition of stocks, but the difference between the two samples is smaller (13.4% against 11.4% for the largest lottery), possibly because investing in stocks directly requires more attention and information processing than investing in mutual funds where information processing is delegated to a financial manager.

In Table 6 we split the sample by education and find the same pattern of results: the positive wealth shock has a stronger impact on participation in the sample of individuals with college degrees. This is not surprising, given the correlation between financial sophistication and education.

In Table 7 we present a further test, based on the idea that background risk might reduce the incentive to invest in stocks. The reason is that when people face unavoidable risks, they try to limit exposure to risks that can be avoided, such as financial risk. The coefficients of the hypothetical lottery gains in Table 7 are similar in the sample of low and high-income risk individuals, suggesting that background risk considerations do not play a major role for stock market participation in our experiment.

Individuals with low liquid assets might be more reluctant to invest in stocks, even after receiving large windfall gains, because they might feel unprepared for emergencies or unable to borrow in case of need. Accordingly, in Table 8 we split the sample according to a dummy variable ("liquid") that equals one if households' gross financial wealth exceeds six times their monthly income (multiples of three or twelve months deliver similar results). We see in Table 8 that the pattern of stockholding is similar between the two groups for stocks held directly. Using the broader definition of stockholding, we observe a slightly higher propensity to invest in risky assets for prizes exceeding 30,000 euros. Moreover, this effect appears to be quantitatively larger for more liquid investors, although the difference in the coefficients of the two subsamples is not statistically significant.

Overall, results suggest that wealth shocks induce greater stockholding (between 8 and 15 percentage points, depending on the definition of stockholding and the sample used).

Pre-existing stockholders and the financially sophisticated exhibit a stronger increase in participation due to the windfall gains, but it remains the case that a majority of respondents would not invest in stocks even for the highest lottery prize.

In Tables A1-A5 of the Appendix we report probit regressions using different sample splits based on predetermined observables (by a proxy for over-confidence, expected stock prices and their uncertainty, trust to others and investment horizon). We find some evidence that the causal effect of positive wealth shocks is stronger among the overconfident, the optimists about stock market developments and those with more trust. For instance, people who report "high trust" have a propensity to invest in stocks that is 4 to 5 percentage points higher at each level of the wealth gain than those who do not, and this holds for both definitions of stockholding.

We also report in the Appendix separate participation regressions for the six countries of our sample. We find some heterogeneity of responses, but overall, the pattern of results is similar to those of the pooled sample. Stockholding increases with wealth in each of the countries considered, and in none of the countries do we find any evidence that the majority of households invest in stocks, even at the largest lottery prize.

6. Regressions for asset shares

Our randomized assignment provides an ideal setting to test the causal effect of wealth on the share of risky assets and to make inferences about the relation between wealth and risk aversion, a long-standing issue in finance and economics. Consider Merton's (1969) classic model in which investors can choose to allocate wealth between a safe and a risky asset. The expected risk premium of investor *i* at time *t* is Er_{it}^{e} and the standard deviation of the return of the risky asset is σ_{it}. We assume that in some states of the world the return of the risky asset is lower than the return of the safe asset, so that the risky asset does not dominate the safe asset. Each investor is endowed with wealth W_{it} and invests a fraction of wealth α_{it} in stocks. The optimal solution delivers a relation between the asset share, the expected risk premium, and the standard deviation of the return of the risky asset:

$$\alpha_{it} = f[W_{it}, Er_{it}^{e}, \sigma_{it}^{2}, \rho_i, f_{it}] \tag{3}$$

where f_{it} is a potentially varying unobservable, which may include demographic variables, transaction costs, as well as preference traits that affect the optimal risky asset share. In any case, in the time frame of our RCT the only variable that can plausibly change is the lottery gain.

Equation (3) suggests that investors may differ in terms of wealth, expected risk premium Er_{it}^{e}, expected volatility of the risky asset σ_{it}^{2} and unobservables f_{it}.[11] It also suggests that there are several problems in estimating the relation between the asset share and wealth with observational data. For instance, estimating the equation by OLS likely leads to omitted variable and endogeneity bias because households might have become richer because they have invested in the risky asset.

The crucial advantage of our RCT compared to the previous literature is that wealth gains are exogenous by construction, and thus we can cleanly estimate their causal effect on risky asset shares. Moreover, one can safely assume that all other characteristics are constant in the

[11] If the utility function has a constant relative risk aversion coefficient ρ_i, one obtains a closed form solution for the optimal risky asset share, $\alpha_{it} = \rho_i \frac{Er_{it}^{e}}{\sigma_{it}^{2}}$. Assume further, as in Guiso and Sodini (2013), that risk aversion depends on financial wealth according to the expression $\rho_{it} = \frac{\lambda_i}{w_{it}^{\eta}}$. Combining these two relations and taking logs, one obtains a relation between the log of the risky asset share, and the log of wealth: $ln\alpha_{it} = f_{it} + \eta ln w_{it} + \varepsilon_{it}$, where $f_{it} = lnEr_{it}^{e} - ln\lambda_i - ln\sigma_{it}^{2}$.

time interval in which respondents answer the hypothetical lottery questions. In other words, in our experiment the only reason why the asset share can change is the randomly assigned wealth shock.

Our approach is to consider a first-order linear approximation of equation (3). If one takes the first difference of such an approximation and adds an error term, one obtains a regression equation relating the change in the risky asset share to the change in wealth, which is equal to the lottery gain:

$$\Delta\alpha_{it} = \alpha + \eta L_{it} + \varepsilon_{it} \tag{4}$$

Equation (4) allows us to estimate the sensitivity of the risky asset share with respect to shocks of different size. Depending on the value of η, the sensitivity supports decreasing relative risk aversion ($\eta > 0$) or CRRA ($\eta = 0$). Finally, a finding of $\eta < 0$ would support increasing relative risk aversion, which is generally considered implausible.

There are several advantages of estimating (4) with our data. First, we measure the portfolio response to unanticipated and exogenous wealth shocks of different size randomly distributed in the sample. Second, given our randomization, the estimated η measures the causal effect of wealth on the risky asset share, as any omitted variables, including demographics, current wealth and any other unobserved characteristics that enter in the error term, are by design uncorrelated with our treatment variable denoting changes in wealth equal to the lottery gains, that is $cov(L_i, \varepsilon_i) = 0$. Therefore, the omission of these variables from equation (4) should not affect the estimated η.Third, measurement error in wealth shocks is ruled out by our experimental design, which fixes the euro amounts of the lottery prizes.

In practice, we estimate a slightly more general equation, allowing the sensitivity of the change in the asset share to vary with the different levels of lotteries L:

$$\Delta\alpha_{it} = \alpha + \sum_{j=1}^{M} \eta_j L_{jt} + \varepsilon_i \tag{5}$$

where j=1,…,M indicates the increasing levels of the hypothetical gains L, and the η_j coefficients measure their effects on asset shares.

In Table 9 we start by estimating a Tobit model of the share of lottery gain invested directly in stocks (narrow definition of stockholding). Notice that this is not an estimate of equation (4), but rather of the intention to invest the lottery prize in directly held stocks. The results, which can still be interpreted causally due to the randomly assigned the wealth shocks, show that the coefficients of the lottery dummies are very close to zero (and in some cases quite precisely estimated) and that the share increases by only 1.5 percentage points from the smallest to the largest lottery. Column (2) confirms these results adding demographic variables.

The third regression in Table 9 reports OLS estimates of equation (5) using as left-hand-side variable the change in the narrow definition of the asset share, as shown in equation (1) above. To compute this change, we need to make use of information on the pre-existing, and thus pre-determined, level of wealth.[12] The coefficients of the lottery dummy coefficients are again close to zero, and the share increases by only 1.6 percentage points from the smallest to the largest lottery. In the last regression of Table 9 we drop all those who do not invest in stocks before the lottery. We find that also in this restricted sample of 2,191 observations the asset share is hardly affected by the lotteries.

All these results are confirmed in Table 10, where we repeat the estimation using the broader definition of stockholding (stocks held directly or mutual funds). The only appreciable difference with respect to Table 9 is that in the first-difference regression of column (3) the coefficient of the largest windfall gain scenario (50,000 euros) is slightly larger (4.5%). However, focusing on stockholders only (column 4), the coefficient is reduced to 1.7%, so one

[12] Since the change in this risky asset share can be negative, using OLS is appropriate.

can conclude that the asset share is rather insensitive to wealth, even using the broad definition of stockholding.

Tables 11, 12, 13, and 14 provide the same sample splits - by financial literacy, education, income risk and liquidity - we already used in the regressions for participation. Overall, we see that the share of stocks (narrowly or broadly defined) is hardly affected by windfall gains. Even for the case of the large 50,000 euros lottery gain, the asset share invested in stocks increases by at most 2 percentage points. We take this as evidence that our results are consistent with the hypothesis of CRRA ($\eta = 0$), except at most for very high levels of wealth, for which risk aversion is slightly decreasing. As further robustness checks, we report in the Appendix conditional asset share regressions for the six countries of our sample. Table A7 shows that the change in the risky asset share is not affected by the size of the lottery gain (except for the largest lottery in Germany). Notice however that these results are less reliable than the full sample estimates, given the low number of observations in some countries.

7. Summary

We implement a novel set of questions in the ECB Consumer Expectations Survey to elicit household-specific propensities to invest and consume out of positive wealth shocks through a randomized assignment of hypothetical lottery gains ranging from 5,000 to 50,000 euro. This set-up allows us to estimate the causal effect of wealth shocks on risky asset ownership and conditional asset shares and to shed new light on investors' risk preferences.

We find that participation costs limit stockholding, particularly for less sophisticated investors. The effect of wealth on participation is not large, however. Even after receiving a wealth windfall gain of 50,000 euros, stock market participation of non-stockholders increases by only 8 percentage points. Moreover, even after receiving such a large prize, about 70% of respondents would not invest in stocks. Results are broadly similar if we use a broader definition of stockholding, considering the combined investment in stocks held directly and mutual funds (that could be only partly invested in stocks).

These findings suggest that pecuniary entry costs and transaction costs are only partly responsible for limited stock market participation; rather, for many potential investors, reasons for non-participation likely also include informational costs as well as more beliefs about stock prices, lack of trust, inertia, and other behavioral biases. Indeed, consistent with a role for information processing costs, our results clearly demonstrate that the positive effects of lottery prizes on stock market participation are larger among the more financially literate and the more educated.

We also find that the conditional asset share invested in stocks (or stocks and mutual funds), generally does not depend on the size of the wealth shocks, with a quantitatively small exception for the largest lottery prize of 50,000 euros. Hence, this finding is clearly observed for a range of wealth shocks that are realistic for most households. Our results are thus consistent with the notion that preferences are characterized by CRRA for the vast majority of risky asset investors.

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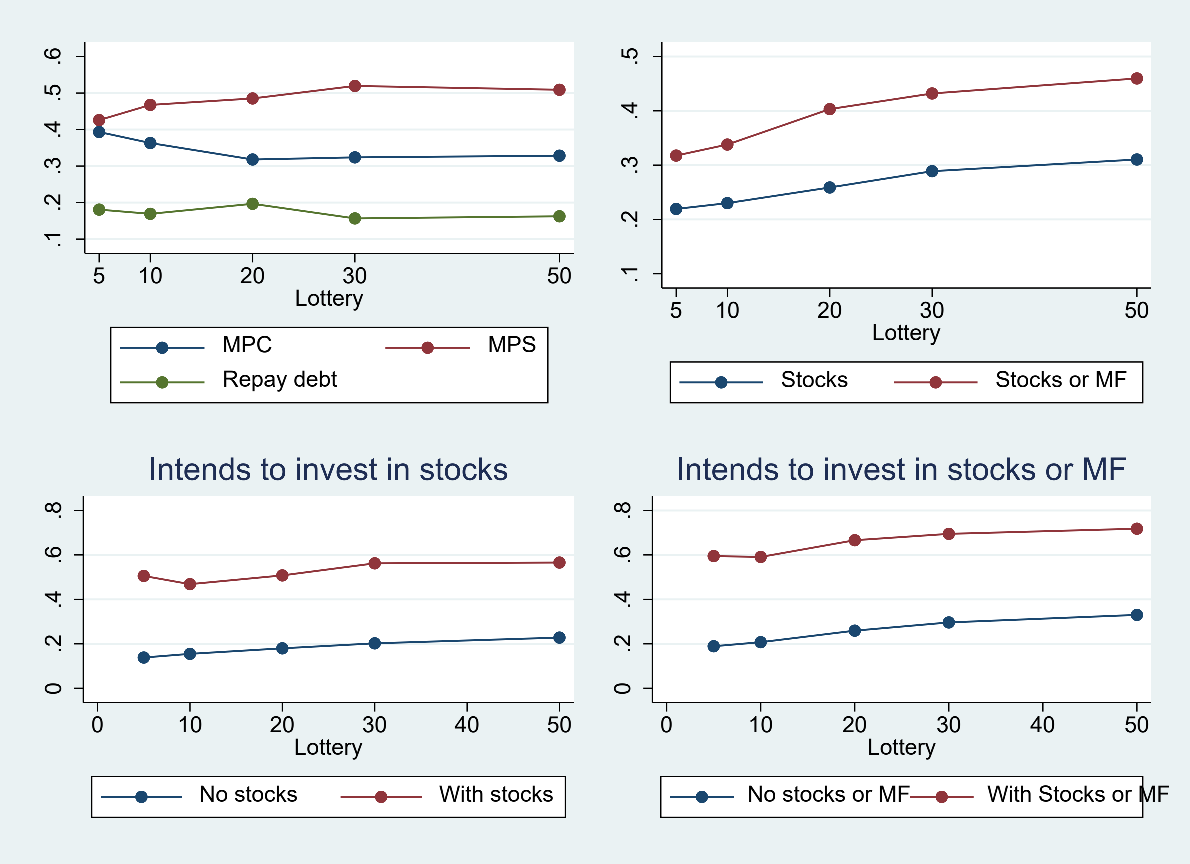
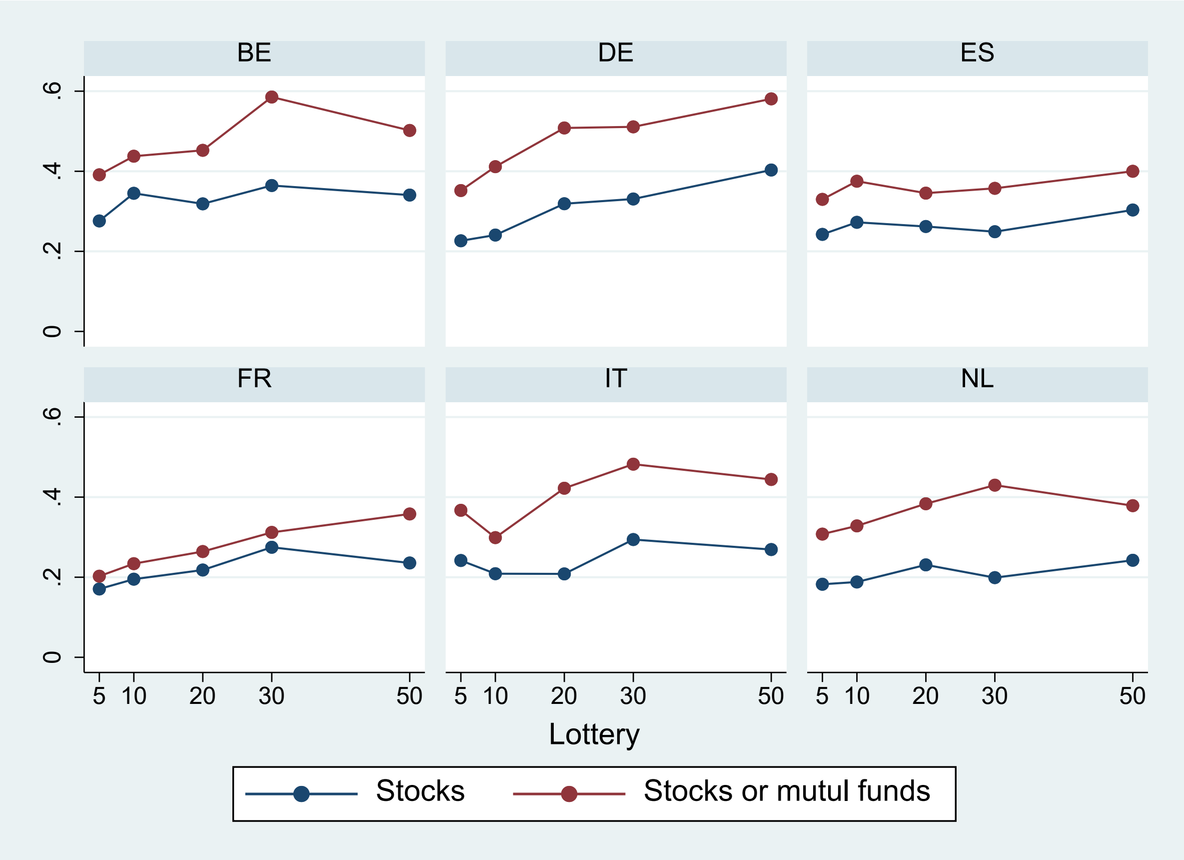
Figure 1. Intention to spend and to invest, by lottery prize



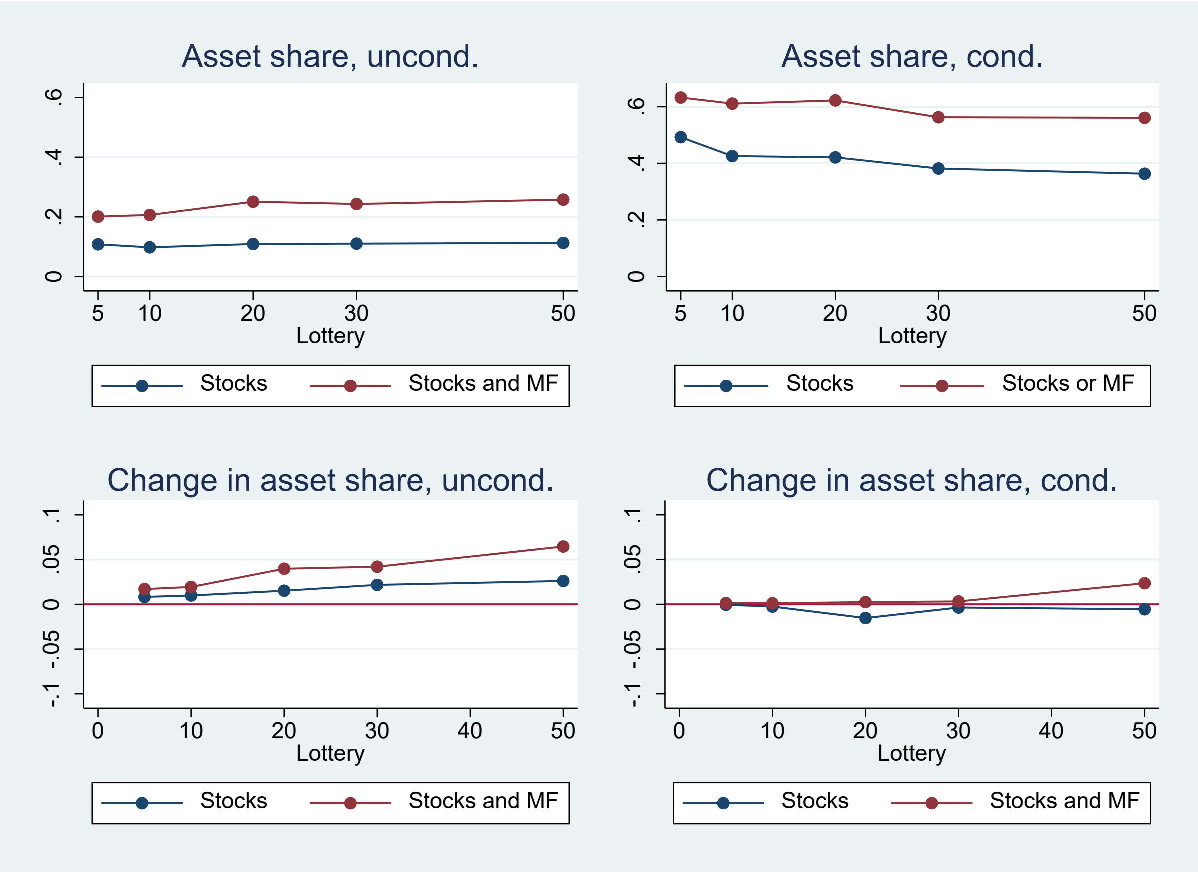
Note. The upper-left graph plots the Marginal Propensity to Consume (MPC), the Marginal Propensity to save (MPS) and the Propensity to Repay Debt (MPD) against the hypothetical lottery gains (in thousand euro). The upper-right graph plots the fraction of respondents who report intention to invest in stocks and in stocks or mutual funds, against the hypothetical lottery prize. The bottom graph plots the asset share which respondents intend to invest in stocks, and in stocks or mutual funds, against the hypothetical lottery prize. Asset shares are computed dividing the hypothetical amount invested by the hypothetical amount saved. Averages are computed using sample weights.

Figure 2. Intention to invest in stocks and mutual funds, by lottery prize and country



Note. The graphs plot, in each of the six countries of the sample, the fraction of respondents who report intention to invest in stocks, and in stocks or mutual funds, against the hypothetical lottery gains (in thousand euro). Averages are computed using sample weights.

Figure 3. Asset shares, by ownership before lottery



Note. In the upper-left graph we plot the intention to invest in stocks separately for non-stockholders and stockholders before the lottery (in thousand euro). In the upper-right graph we plot the intention to invest in stocks or mutual funds separately for non-owners and owners of stocks or mutual funds before the lottery. The change in asset share in the lower-left graph is the change in the asset share of stocks and mutual funds before and after the lottery. The change in the asset share of stocks in the lower-right graph is the difference between the asset share of stocks before and after the lottery, conditional on having stocks before the lottery. The change in the asset share of stocks or mutual funds is defined in a similar way. Averages are computed using sample weights.

Table 1. Descriptive statistics

Variable	**Mean**	**Standard deviation**	**Observations**
MPC (Margjnal Propensity to Consume)	0.345	0.326	9,668
MPS (Marginal Propensity to Save)	0.481	0.355	9,668
MPD (Propensity to Repay Debt)	0.173	0.290	9,668
Intention to invest in stocks	0.261	0.439	9,668
Intention to invest in stocks or mutual funds	0.390	0.488	9,668
Share inv. in stocks in the lottery (unconditional)	0.108	0.236	9,668
Share inv. in stocks or MF in the lottery (unconditional)	0.232	0.346	9,668
Participation in stocks before lottery	0.237	0.425	9,668
Participation in stocks or MF before lottery	0.337	0.473	9,668
Participation in stocks after lottery	0.375	0.484	9,668
Participation in stocks or MF after lottery	0.507	0.500	9,668
Change of participation in stocks	0.138	0.344	9,668
Change of participation in stocks or MF	0.170	0.375	9,668
Share in stocks before lottery (unconditional)	0.065	0.167	9,668
Share in stocks or MF before lottery (unconditional)	0.136	0.250	9,668
Change in share of stocks (unconditional)	0.016	0.185	9,668
Change in share of stocks (unconditional)	0.037	0.271	9,668
Share in stocks before lottery (conditional)	0.412	0.167	2489
Share in stocks or MF before lottery (conditional)	0.594	0.250	3671
Change of asset share in stocks (conditional)	-0.006	0.091	2190
Change of asset share in stocks or MF (conditional)	0.003	0.140	3121

Note. In the table “Stocks” means “Stocks held directly”. Data are drawn from the June 2021 wave of the Consumer Expectations Survey (CES). Statistics are computed using sample weights.

Table 2. Tobit for marginal propensity to consume (MPC), to save (MPS) and to repay debt (MPD)

	MPC	MPC	MPS	MPS	MPD	MPD
Lottery 10k	-0.023	-0.023	0.054	0.053	-0.007	-0.005
	(0.013)*	(0.013)*	(0.015)***	(0.015)***	(0.011)	(0.011)
Lottery 20k	-0.051	-0.050	0.073	0.072	0.011	0.011
	(0.012)***	(0.012)***	(0.015)***	(0.015)***	(0.011)	(0.011)
Lottery 30k	-0.049	-0.049	0.106	0.104	-0.008	-0.005
	(0.012)***	(0.012)***	(0.014)***	(0.014)***	(0.011)	(0.011)
Lottery 50k	-0.040	-0.040	0.086	0.084	0.009	0.010
	(0.012)***	(0.012)***	(0.014)***	(0.014)***	(0.011)	(0.011)
Male		-0.025		0.019		0.010
		(0.007)***		(0.009)**		(0.007)
Age 18-34		-0.009		-0.032		0.089
		(0.014)		(0.016)*		(0.013)***
Age 35-49		-0.037		-0.056		0.120
		(0.013)***		(0.016)***		(0.013)***
Age 50-64		-0.005		-0.046		0.064
		(0.013)		(0.016)***		(0.013)***
Family size		0.000		-0.014		0.015
		(0.003)		(0.004)***		(0.003)***
N	9,677	9,677	9,677	9,677	9,677	9,677

Note. All regressions include country dummies. The table reports marginal effects (unconditional expectations). One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%. The demographic variables include a dummy for gender, family size and dummies for age-groups 18-34, 35-49, 50-64.

Table 3. Probit for participation, stocks held directly

	Baseline	With demographics	Pre-lottery non owners	Pre-lottery owners
Lottery 10k	0.025	0.024	0.026	0.008
	(0.014)*	(0.014)*	(0.014)*	(0.032)
Lottery 20k	0.045	0.044	0.045	0.024
	(0.014)***	(0.014)***	(0.014)***	(0.032)
Lottery 30k	0.083	0.085	0.076	0.127
	(0.014)***	(0.014)***	(0.014)***	(0.033)***
Lottery 50k	0.086	0.086	0.084	0.087
	(0.014)***	(0.014)***	(0.014)***	(0.032)***
N	9,677	9,677	7,433	2,244

Note. All regressions include country dummies. The demographic variables include a dummy for gender, family size and dummies for age-groups 18-34, 35-49, 50-64. All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 4. Probit for participation, stocks held directly or mutual funds

	Baseline	With demographics	Pre-lottery non owners	Pre-lottery owners
Lottery 10k	0.029	0.027	0.028	0.007
	(0.016)*	(0.015)*	(0.017)	(0.026)
Lottery 20k	0.072	0.070	0.066	0.061
	(0.015)***	(0.015)***	(0.017)***	(0.026)**
Lottery 30k	0.120	0.120	0.111	0.130
	(0.015)***	(0.015)***	(0.017)***	(0.026)***
Lottery 50k	0.128	0.126	0.127	0.126
	(0.015)***	(0.015)***	(0.016)***	(0.026)***
N	9,677	9,677	6,479	3,198

Note. All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 5. Probit for participation, splits by financial literacy

	Stocks Low literacy	Stocks High literacy	Stocks or MF Low literacy	Stocks or MF High literacy
Lottery 10k	0.012	0.037	0.041	0.017
	(0.020)	(0.021)*	(0.022)*	(0.022)
Lottery 20k	0.032	0.055	0.060	0.081
	(0.020)*	(0.020)***	(0.022)***	(0.022)***
Lottery 30k	0.058	0.105	0.098	0.133
	(0.019)***	(0.020)***	(0.021)***	(0.022)***
Lottery 50k	0.062	0.112	0.116	0.139
	(0.019)***	(0.020)***	(0.021)***	(0.022)***
N	4,560	5,005	4,560	5,005

Note. The high literacy sample includes those who answer correctly three or four financial literacy questions. All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 6. Probit for participation, splits by education

	Stocks, No college	Stocks, College	Stocks or MF, No college	Stocks or MF, College
Lottery 10k	0.034	0.017	0.026	0.033
	(0.020)*	(0.020)	(0.022)	(0.022)
Lottery 20k	0.044	0.046	0.053	0.088
	(0.020)**	(0.020)**	(0.022)**	(0.021)***
Lottery 30k	0.075	0.090	0.101	0.135
	(0.020)***	(0.019)***	(0.022)***	(0.021)***
Lottery 50k	0.073	0.094	0.114	0.134
	(0.020)***	(0.019)***	(0.023)***	(0.021)***
N	4,436	5,241	4,436	5,241

Note. All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 7. Probit for participation, splits by income risk

	Stocks, Low-income risk	Stocks, High income risk	Stocks or MF, Low-income risk	Stocks or MF, High income risk
Lottery 10k	0.013	0.023	0.018	0.015
	(0.024)	(0.026)	(0.027)	(0.027)
Lottery 20k	0.033	0.032	0.071	0.040
	(0.023)	(0.026)	(0.026)***	(0.027)
Lottery 30k	0.065	0.072	0.112	0.099
	(0.023)***	(0.026)***	(0.026)***	(0.027)***
Lottery 50k	0.078	0.071	0.109	0.114
	(0.023)***	(0.026)***	(0.026)***	(0.027)***
N	3,085	3,273	3,085	3,273

Note. The high-income risk sample includes those with above than median income risk, measured by the standard deviation of the distribution of expected income risk (see Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 8. Probit for participation, splits by liquidity

	Stocks, Illiquid	Stocks, Liquid	Stocks or MF, Illiquid	Stocks or MF, Liquid
Lottery 10k	0.024	0.027	0.025	0.033
	(0.020)	(0.020)	(0.022)	(0.021)
Lottery 20k	0.040	0.049	0.070	0.074
	(0.020)**	(0.020)**	(0.022)***	(0.021)***
Lottery 30k	0.079	0.088	0.097	0.140
	(0.020)***	(0.020)***	(0.022)***	(0.021)***
Lottery 50k	0.088	0.084	0.111	0.136
	(0.020)***	(0.019)***	(0.022)***	(0.021)***
N	4,368	5,309	4,368	5,309

Note. The liquid sample includes those who have sufficient financial resources to make an unexpected payment equal to one month of their household income (see Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 9. Asset share of stocks held directly

	Tobit	Tobit, with demographics	OLS	OLS, Pre-lottery stockholders
Lottery 10k	0.004	0.004	0.003	-0.002
	(0.004)	(0.004)	(0.002)	(0.005)
Lottery 20k	0.008	0.008	0.007	-0.019
	(0.004)**	(0.004)*	(0.003)**	(0.007)***
Lottery 30k	0.016	0.016	0.016	-0.004
	(0.004)***	(0.004)***	(0.003)***	(0.007)
Lottery 50k	0.015	0.015	0.016	-0.013
	(0.004)***	(0.004)***	(0.003)***	(0.007)*
N	9,677	9,677	8,175	2,191
R^2			0.01	0.02

Note. In regressions 3 and 4 the left-hand-side variable is the change in asset share. The demographic variables include a dummy for gender, family size and dummies for age-groups 18-34, 35-49, 50-64. All regressions include country dummies. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 10. Asset shares of stocks held directly or mutual funds

	Tobit	Tobit, with demographics	OLS	OLS, stockholders only
Lottery 10k	0.004	0.003	0.004	-0.000
	(0.003)	(0.003)	(0.003)	(0.005)
Lottery 20k	0.012	0.011	0.023	-0.000
	(0.003)***	(0.003)***	(0.004)***	(0.006)
Lottery 30k	0.019	0.019	0.032	0.009
	(0.003)***	(0.003)***	(0.005)***	(0.007)
Lottery 50k	0.018	0.018	0.045	0.017
	(0.003)***	(0.003)***	(0.005)***	(0.007)**
N	9,677	9,677	8,175	3,122
R^2			0.02	0.01

Note. The demographic variables include a dummy for gender, family size and dummies for age-groups 18-34, 35-49, 50-64. In regressions 3 and 4 the left-hand-side variable is the change in asset share. All regressions include country dummies. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 11. Asset shares, by financial literacy

	Own stocks, low literacy	Own stocks, high literacy	Own stocks or MF, low literacy	Own stocks or MF high literacy
Lottery 10k	0.012	-0.009	0.023	-0.010
	(0.014)	(0.005)*	(0.012)**	(0.006)*
Lottery 20k	-0.036	-0.012	-0.006	0.003
	(0.017)**	(0.006)**	(0.014)	(0.006)
Lottery 30k	-0.003	-0.006	-0.008	0.016
	(0.020)	(0.007)	(0.017)	(0.007)**
Lottery 50k	-0.030	-0.006	-0.004	0.027
	(0.017)*	(0.007)	(0.017)	(0.008)***
R^2	0.03	0.02	0.02	0.02
N	644	1,523	931	2,157

Note. The left-hand-side variable is the change in asset share. The high literacy sample includes those who answer correctly three or four financial literacy questions. All regressions include country dummies. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table 12. Asset shares, by education

	Own stocks, low education	Own stocks, high education	Own stocks or MF, low education	Own stocks or MF high education
Lottery 10k	-0.001	-0.003	-0.010	0.006
	(0.013)	(0.005)	(0.010)	(0.006)
Lottery 20k	-0.034	-0.012	-0.019	0.010
	(0.016)**	(0.006)**	(0.012)	(0.007)
Lottery 30k	-0.007	-0.002	0.000	0.013
	(0.018)	(0.007)	(0.014)	(0.008)*
Lottery 50k	-0.026	-0.007	0.005	0.023
	(0.016)	(0.008)	(0.014)	(0.009)***
R^2	0.03	0.02	0.02	0.02
N	725	1,466	1,080	2,042

Note. The left-hand-side variable is the change in asset share. All regressions include country dummies. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table13. Asset shares, by income risk

	Own stocks, low income risk	Own stocks, high income risk	Own stocks or MF, low income risk	Own stocks or MF high income risk
Lottery 10k	-0.003	0.001	-0.002	-0.002
	(0.007)	(0.008)	(0.009)	(0.008)
Lottery 20k	-0.010	-0.033	0.008	-0.013
	(0.010)	(0.011)***	(0.010)	(0.009)
Lottery 30k	-0.010	-0.002	0.010	0.004
	(0.009)	(0.012)	(0.010)	(0.010)
Lottery 50k	-0.019	0.000	0.026	0.022
	(0.013)	(0.011)	(0.014)*	(0.011)*
R^2	0.05	0.04	0.03	0.02
N	725	909	1,058	1,264

Note. The left-hand-side variable is the change in asset share. The high-income risk sample includes those with above than median income risk, measured by the standard deviation of the distribution of expected income risk (see Appendix for the definition of this variable). All regressions include country dummies. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table14. Asset shares, by liquidity

	Own stocks, illiquid	Own stock liquid	Own stocks or MF, illiquid	Own stocks or MF, liquid
Lottery 10k	0.002	-0.004	-0.002	0.001
	(0.024)	(0.003)	(0.022)	(0.003)
Lottery 20k	-0.091	-0.001	-0.030	0.007
	(0.027)***	(0.004)	(0.026)	(0.004)*
Lottery 30k	-0.041	0.004	-0.007	0.014
	(0.032)	(0.005)	(0.029)	(0.005)***
Lottery 50k	-0.033	-0.008	0.016	0.017
	(0.027)	(0.006)	(0.029)	(0.006)***
R^2	0.07	0.03	0.02	0.03
N	436	1,755	632	2,490

Note. The left-hand-side variable is the change in asset share. The liquid sample includes those who have sufficient financial resources to make an unexpected payment equal to one month of their household income (see Appendix for the definition of this variable). All regressions include country dummies. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Appendix- Survey questions

Hypothetical lottery

In the following questions "Amount" assumes the values €5,000, €10,000, €20,000, €30,000, €50,000 euro, depending on the randomized sample. The randomized questions have two parts. In Part A we ask the allocation of the lotteries to consumption, saving and debt. In Part B we ask how the saving component is allocated between five asset categories.

Part A: Imagine you win a lottery of <Amount> today. How would you use this unexpected windfall over the next 12 months? Please allocate the <Amount> over the following three categories.

Instruction: You can allocate <Amount> by typing an amount in each box. (Note that your answers should sum to <Amount> – if your sum exceeds <Amount>, you should first decrease the amount in one option before you can increase the amount in another).
Coding: [Numeric]

1	Buy goods and services (including food, housing costs and rent, utility bills, clothing, and long-lasting goods such as home improvements, furniture and electronics, etc.)	€ ____
2	Save and invest in financial assets	€ <A>
3	Repay debt	€ ____
	Total (should sum to <Amount>)	€ ___
-888	Skipped	

- Scripting instruction: Randomize order of item 1-3. (Running total, prefilled format)
- Error message: Note that the amounts in the column should sum to <Amount>. Please check your answer, or click "Next" if you are happy with your answer.
- Skipped notification: Please provide an answer to this question. Please be assured that there is no right or wrong answer.
- Soft check: skipping notification shown once, if respondent clicks 'next' again, move to next question

Part B: You said that you would save or invest in financial assets € <Amount>. Please indicate in which of the following asset categories you would save/invest this amount.

1	Savings and current accounts	€ ____
2	Stocks and shares	€ ____
3	Mutual funds and collective investments	€ ____
4	Retirement and pension products (other than a state pension), and whole life insurances	€ ____
5	Bonds (including short-term and long-term bonds)	€ ____
	Total (should sum to <A>)	€ ___

- Scripting instruction: Randomize order of items 1-5.
- Translation instruction: Placement of the euro symbol varies across countries. Please place the euro symbol (before or after value) as customary in the local context.
- Error message: If the amount sums not to €<Amount>. Note that the amounts in the column should sum to €<Amount>. Please check your answer, or click "Next" if you are happy with your answer.
- Skipped notification: Please provide an answer to this question. Please be assured that there is no right or wrong answer.
- Soft check: skipping notification shown once, if respondent clicks 'next' again, move to next question

- Scripting instruction: Show info buttons: Display the following definitions when cursor goes on financial instruments

Stocks and shares	An ownership share in a public or private company
Mutual funds and collective investments	A portfolio of stocks, bonds or other securities
Retirement and pension products (other than a state pension), and whole life insurance policies	A voluntary plan for setting aside money to be spent after retirement; an insurance policy which is guaranteed to remain in force for the insured persons entire lifetime or to the maturity date
Bonds (including short-term and long-term bonds)	A fixed income investment that pays back the principal amount at a future date

The table below shows that the randomized samples by lottery prizes are well balanced in terms of gender, age, family size, education, income and country.

	5k	**10K**	**20K**	**30K**	**50K**	**Total sample**
Male	0.469	0.476	0.495	0.473	0.506	0.484
Age	48.50	49.45	49.18	49.56	49.34	49.21
Family size	2.681	2.600	2.618	2.541	2.548	2.598
College degree	0.534	0.513	0.530	0.543	0.565	0.537
Disposable income	35.583	34.838	34.863	34.022	35.173	34.899
Belgium	0.035	0.044	0.040	0.039	0.043	0.040
Germany	0.312	0.298	0.303	0.283	0.308	0.301
Spain	0.165	0.154	0.173	0.181	0.161	0.167
France	0.219	0.218	0.193	0.214	0.213	0.211
Italy	0.211	0.228	0.228	0.219	0.220	0.221
Netherlands	0.058	0.057	0.064	0.064	0.055	0.060
Observations	**1952**	**1935**	**1932**	**1933**	**1925**	**9677**

Financial literary

Respondents are asked the three standard literacy questions ('big 3') and a more advanced one (correct answers out of possible response options in **bold**):

(i) Suppose you had €100 in a savings account and the interest rate was 2% per year. After five years, how much do you think you would have in the account if you left the money to grow? (**more than 102€**; exactly 102€; less than 102€; DK);

(ii) Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? (more than today; exactly the same; **less than today**; DK);

(iii) Do you think the following statement is true or false? Buying shares in a single company usually provides a safer return than buying shares in a mutual fund. (T; **F**; DK);

(iv) Suppose you owe €1,000 on a loan and the interest rate you are charged is 20% per year, compounded annually. If you didn't pay anything off, at this interest rate, how many years would it take for the amount you owe to double? (years: <2; **[2,5)**, [5,10), >=10; DK).

Overconfidence

Respondents are asked to self-assess their level of financial literacy by means of the following question:

How knowledgeable do you consider yourself on financial matters?

with possible answers ranging from: *not knowledgeable* to *very knowledgeable.* We proxy for overconfidence by taking per respondent the difference between this subjective measure and the financial literacy score deduced from the questions above. Respondents with positive values are classified as overconfident.

Income risk

The CES asks respondents to report their expectations about own household net income changes (in percent) over the next twelve months by means of a probabilistic-bins question (i.e., every respondent is asked to distribute 100 points among several possible ranges of income percentage changes to indicate how likely they are to happen). Based on these responses, we calculate a measure of income uncertainty (standard deviation) that is respondent-specific and distinguish between those with higher or lower than sample median uncertainty.

Liquidity

We distinguish between liquid and illiquid households based on responses to the following question:

Please think about your available financial resources, including access to credit, savings, loans from relatives or friends, etc. Suppose that you had to make an unexpected payment equal to one month of your household income. Would you have sufficient financial resources to pay for the entire amount?

Investment horizon

The CES asks respondents the following question with reference to their preferred investment horizon:

When making your savings and investment decisions, how far in the future do you, or does your household, typically plan?
I/we just plan for the moment; 1 to 3 months; More than 3 months but less than a year; 1 to 2 years; 3 to 5 years; 6 to 10 years; more than 10 years

Stock market expectations
Respondents are asked the following question:

What do you think is the percentage chance that ***12 months from now****, stocks traded in your country, such as those included in the <name of stock index> index, will be worth more than they are now?*

Stock market uncertainty

Following their response to the question about stock market expectations, respondents are further asked to assess their confidence about their response. In particular, respondents are asked:

Which of the following best reflects what you were thinking when answering <x%> to the previous question:

I think that <x%> is a relatively good estimate and I'm pretty sure it's right; I think that <x%> is a relatively good estimate but I'm not quite sure it's right; I was unsure about the chance; No one can really know about the chance

Trust

Respondents are asked about their general level of trust about other people:

Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?
Please indicate your level of trust on a scale from 0 to 10, where 0 means you can't be too careful and 10 means that most people can be trusted.

Additional Tables

Table A1. Probit for stockholding, by over-confidence

	Stocks, Overconfident	Stocks, Not Overconfident	Stocks or MF, Overconfident	Stocks or MF, Not overconfident
Lottery 10k	0.066	0.004	0.078	0.005
	(0.024)***	(0.017)	(0.025)***	(0.019)
Lottery 20k	0.059	0.037	0.081	0.069
	(0.024)**	(0.017)**	(0.025)***	(0.019)***
Lottery 30k	0.085	0.085	0.129	0.119
	(0.024)***	(0.017)***	(0.025)***	(0.019)***
Lottery 50k	0.110	0.072	0.128	0.129
	(0.024)***	(0.017)***	(0.025)***	(0.019)***
N	3,741	5,936	3,741	5,936

Note. The overconfident sample includes those who report positive values for the overconfidence variable (see Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table A2. Probit for stockholding, by stock market expectations

	Stocks, Low expectations	Stocks, High expectations	Stocks or MF, Low expectations	Stocks, High expectations
Lottery 10k	0.045	-0.004	0.046	0.001
	(0.018)**	(0.025)	(0.020)**	(0.027)
Lottery 20k	0.055	0.023	0.087	0.049
	(0.018)***	(0.025)	(0.020)***	(0.027)*
Lottery 30k	0.081	0.086	0.118	0.127
	(0.018)***	(0.025)***	(0.020)***	(0.027)***
Lottery 50k	0.117	0.047	0.159	0.094
	(0.018)***	(0.025)*	(0.020)***	(0.027)***
N	5,566	3,264	5,566	3,264

Note. The high expectations sample includes those who assign more than 50% probability that in the next 12 months the stock market will go up by more than 20% (see Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table A3. Probit for stockholding, by stock market uncertainty

	Stocks, Uncertain	Stocks, Certain	Stocks or MF, Uncertain	Stocks or MF, Certain
Lottery 10k	0.009	0.046	0.019	0.024
	(0.029)	(0.040)	(0.034)	(0.042)
Lottery 20k	0.018	0.093	0.055	0.098
	(0.029)	(0.038)**	(0.033)	(0.040)**
Lottery 30k	0.028	0.074	0.091	0.120
	(0.029)	(0.038)*	(0.033)***	(0.039)***
Lottery 50k	0.071	0.126	0.115	0.110
	(0.029)**	(0.038)***	(0.033)***	(0.040)***
N	1,806	1,468	1,806	1,468

Note. The uncertain sample includes those who report to be highly uncertain about their stock market expectation (see Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table A4. Probit for stockholding, by trust

	Stocks, Low trust	Stocks, High trust	Stocks or MF, Low trust	Stocks or MF, High trust
Lottery 10k	0.002	0.041	0.007	0.043
	(0.020)	(0.020)**	(0.022)	(0.022)**
Lottery 20k	0.030	0.056	0.049	0.089
	(0.020)	(0.020)***	(0.022)**	(0.022)***
Lottery 30k	0.060	0.104	0.087	0.147
	(0.019)***	(0.019)***	(0.022)***	(0.021)***
Lottery 50k	0.065	0.103	0.096	0.151
	(0.020)***	(0.019)***	(0.022)***	(0.021)***
N	4,552	5,125	4,552	5,125

Note. The high trust sample includes those who report a level of "trust about other people" less than 6 (see Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table A5. Probit for stockholding, by investment horizon

	Stocks, Short horizon	Stocks, Long horizon	Stocks or MF, Short horizon	Stocks or MF, Long horizon
Lottery 10k	0.025	0.020	0.019	0.032
	(0.018)	(0.022)	(0.020)	(0.023)
Lottery 20k	0.032	0.060	0.058	0.088
	(0.018)*	(0.022)***	(0.020)***	(0.023)***
Lottery 30k	0.081	0.091	0.117	0.126
	(0.018)***	(0.021)***	(0.020)***	(0.023)***
Lottery 50k	0.093	0.077	0.122	0.129
	(0.018)***	(0.022)***	(0.020)***	(0.023)***
N	5,437	4,240	5,437	4,240

Note. The long horizon sample includes those who typically plan for more than one year when making their savings and investment decisions Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table A6. Probit for participation, stocks held directly or mutual funds, by country

	Belgium	Germany	Spain	France	Italy	Netherlands
Lottery 10k	0.007	0.060	0.058	0.034	-0.028	0.030
	(0.052)	(0.034)*	(0.034)*	(0.033)	(0.034)	(0.054)
Lottery 20k	0.034	0.159	0.024	0.061	0.039	0.113
	(0.053)	(0.034)***	(0.034)	(0.033)*	(0.034)	(0.052)**
Lottery 30k	0.128	0.165	0.070	0.104	0.120	0.143
	(0.054)**	(0.034)***	(0.033)**	(0.032)***	(0.033)***	(0.051)***
Lottery 50k	0.078	0.232	0.082	0.130	0.091	0.104
	(0.052)	(0.033)***	(0.034)**	(0.032)***	(0.034)***	(0.054)*
N	905	2,003	1,982	1,874	2,071	842

Note. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Note. The liquid sample includes those who have sufficient financial resources to make an unexpected payment equal to one month of their household income (see Appendix for the definition of this variable). All regressions include country dummies. The table reports marginal effects. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.

Table A7. Regressions for change in asset shares of stocks held directly or mutual funds, conditional on ownership, by country

	Belgium	Germany	Spain	France	Italy	Netherlands
Lottery 10k	0.004	0.008	0.001	-0.003	-0.010	-0.010
	(0.007)	(0.010)	(0.014)	(0.010)	(0.011)	(0.022)
Lottery 20k	-0.008	0.017	-0.002	-0.006	-0.004	-0.019
	(0.015)	(0.011)	(0.018)	(0.011)	(0.015)	(0.016)
Lottery 30k	0.004	0.013	0.026	-0.014	0.000	0.013
	(0.020)	(0.015)	(0.018)	(0.015)	(0.013)	(0.022)
Lottery 50k	0.012	0.075	-0.019	-0.029	0.014	-0.008
	(0.020)	(0.014)***	(0.020)	(0.018)	(0.014)	(0.028)
R^2	0.00	0.05	0.01	0.01	0.00	0.01
N	392	775	586	438	660	271

Note. One star indicates significance at the 10%, two stars at the 5%, three stars at the 1%.