Can Financial Innovation Solve Household Reluctance to Take Risk?

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ABSTRACT

Using a large administrative panel of Swedish households, we document the fast and broad adoption of an innovative class of contracts offering both exposures to equity markets and a capital protection. Households investing in these products significantly increase the risky share of their financial wealth, especially for households with an initially high share of cash investments, lower wealth and IQ, higher reluctance to take financial risk, and of older age. A simple portfolio choice model shows that risk aversion and misperception over the design cannot explain the empirical facts we observe, while loss aversion can. Our results illustrate how security design can mitigate household reluctance to take financial risk.

JEL classification: I22, G1, D18, D12.

Keywords: Financial innovation, household finance, capital-protected investment, behavioral biases, stock market participation, risk-taking.

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I. Introduction

The low share of household wealth invested in stocks and mutual funds is a major challenge of household finance in developed economies (Campbell, 2006). This phenomenon illustrates the reluctance of households to participate in risky asset markets, which has large economic and welfare effects. Households with low exposures to compensated risk forfeit an important source of income over their lives (Mankiw and Zeldes, 1991; Haliassos and Bertaut, 1995), which reinforces wealth inequality (Bach, Calvet, and Sodini, 2017). Furthermore, as household savings are mainly directed toward safe assets, raising external capital might be costlier for firms. Traditional explanations for the low household exposure to risky assets rely on a high risk aversion combined with fixed participation costs, risky human capital, beliefs and behavioral biases such as loss aversion (Gomes, 2005). The issue of low stock market participation is more pronounced for certain sub-groups of the population: households with low-to-median financial wealth (Calvet, Campbell, and Sodini, 2007), low-to-median IQ (Grinblatt, Keloharju, and Linnainmaa, 2011), or loss-averse preferences.

This paper investigates whether financial innovation, in the form of products offering non-linear exposure to risk assets, can increase household portfolio allocation to risky asset markets. If so, through which economic mechanism? And are households better off as a result? To address these questions, we study the introduction of retail capital-protected investment in Sweden and its impact on household portfolio allocation.

By offering a pre-packaged risk profile compatible with household preferences, capital-protected investments may increase household willingness to participate in risky asset markets. Capital-protected investments marketed in Sweden typically offer downside protection, and hence allow households to gain exposure to a risky asset market while capping the maximum loss.[1] Buying downside protection, for instance by buying put options or implementing portfolio insurance, is often difficult or costly to do for households, especially for long investment horizons.

We exploit Swedish micro data with granular information on both household characteristics and financial holdings (see Calvet et al. (2007)) that we merge with a dataset with detailed information on all capital-protected investments sold in Europe since market inception (see Célérier and Vallée

[1]A typical product offers the following cash flows: investor pays 110 initially, and gets 100 times (1 + 80% of the positive performance of an equity index over the period) four years later. See Section II for more details on capital-protected investment design.

(2017)). The combined panel dataset is unique on many dimensions. First, the dataset offers a comprehensive coverage of the first five years of the development of the retail market for capital-protected investments for the whole population of Sweden.[2] Second, the dataset allows us to investigate how a rich set of household characteristics, such as wealth, IQ or age, but also reluctance to take financial wealth, relate to participation in this new asset class. Third, we can observe the whole portfolio composition of households and how the introduction of these innovative products impact household holdings in both safe and risky assets. Last, the data allow us to explore the link between household characteristics and the design of these products. More broadly, our research setting offers a unique opportunity to study how the introduction and the development of a financial innovation can impact retail investors portfolio decisions, while also shedding light on what drives the success of an innovation in household finance.

Our main results are the following. First, we develop an asset pricing methodology and establish several facts about the design of capital protected investments and the implied exposure they offer. We find that the expected returns of capital-protected investments offered in Sweden between 2002 and 2007 are significantly higher than the risk free rate, and that their markups are around 1.4% per year on average, which makes their cost comparable to the one of mutual funds marketed to Swedish households at that time. These results are consistent with capital-protected investments allowing households to share in the risk premium.

Second, we document that the adoption of these products is fast and broad, with 13% of all Swedish households buying at least one of these products within five years of the introduction. For the participating households, retail capital-protected investments represent more than 15% of their financial wealth. The speed of development contrasts with the slow adoption of other innovative financial products offering equity exposure, such as exchange traded funds (ETFs).

Third, participation in retail capital-protected investments is associated with an increase in household risk-taking. We focus on the allocation of household portfolio to the four asset classes that compose financial wealth: cash, equity mutual funds, stocks, and capital-protected investments, and consider the latter three classes as risky assets.[3] We develop an innovating measure of the risky

[2] The market developed from 2002 in Sweden. Since the end of the 1990s, European financial institutions have sold more than 2 trillion euros of capital-protected investments. More recently in the US, equity-linked certificates of deposit, one category of retail capital-protected investments, are becoming increasingly popular.

[3] We do not study corporate bonds as they represent a negligible fraction of household portfolios.

share by weighing the holdings in these assets by their exposure to the risk premium, i.e. the ratio of excess expected return of the investment over the market risk premium, when calculating their risky share. Over the five years following the introduction of capital-protected investments, we find that the risky share increases twice as much for households that participate in these products than for households that do not. The effect is larger for households in the lowest quartile of risky share in 2002: participating in capital-protected investments lead to an additional 10 percentage point increase in their risky share, which amounts to less than 4% in 2002. Guaranteed products, therefore, mostly complement rather than substitute for other risky assets.

We implement an instrumental variable analysis to mitigate potential sources of endogeneity when studying the effect of investing in capital-protected investments. Investment in capital-protected investments over our sample period might be correlated with a higher demand for risky assets over that period that our large set of controls does not capture. We therefore use household proximity to banks offering capital-protected investments to instrument the supply of capital-protected investments. This instrumental variable analysis confirms the positive impact of capital-protected investment supply on the risky share of households.

The increase in the risky share is especially pronounced for households with low financial wealth, a low IQ, of older age, and with a higher reluctance to take financial risk. Households use cash to fund 63% of capital-protected investments: when a household invests 1% percent of their financial wealth in retail capital-protected investments, it therefore increases its risky share by 0.63%. When adjusting for the exposure of capital-protected investments to equity markets, the gain in household exposure to risky assets remains substantial. When investing 1% of their financial wealth in capital-protected investments while selling 0.37% of a traditional risky asset, a household increases its exposure to risky assets by 0.3%.

Fourth, among participants, the share of financial wealth in capital-protected investment is decreasing with wealth and IQ and increasing with age and reluctance to take financial risk, exactly as the share of financial wealth invested in cash. The share of stocks and funds in financial wealth exhibit the reverse relationships: they are both increasing in wealth and IQ, and decreasing in age and reluctance to take financial risk. This mapping between household characteristics and product design suggests an heterogeneity in preferences across households.

Finally, we develop a portfolio-choice model to investigate the theoretical mechanisms possibly explaining our empirical results on the impact of capital-protected investment introduction on household portfolio allocation. In this model, the investor can invest in three distinct assets: a risk-free bond, a stock market index and a capital-protected investment offering a guaranteed return and a participation in the performance of a stock market index. We find that loss aversion about the design of capital-protected investments are the most likely mechanism to explain the data. By contrast, the strong demand for capital-protected investments cannot be explained by a constant relative risk aversion (CRRA) utility alone or misperception.

This paper adds to the literature that documents an interaction between the design of financial products and behavioral biases. Célérier and Vallée (2017) describe how banks design financial products to cater to yield-seeking investors. In this paper, we show that the design can also mitigate household loss aversion and hence increase their participation to the risk premium.

This study contributes to the strand of the household finance literature documenting the limited stock market participation and low risky shares of households (Campbell, 2006; Calvet et al., 2007). While several papers explore possible explanations for low risk-taking (Attanasio and Vissing-Jørgensen, 2003; Guiso and Jappelli, 2005; Guiso, Sapienza, and Zingales, 2008; Haliassos and Bertaut, 1995; Hong, Kubik, and Stein, 2004; Barberis, Huang, and Thaler, 2006; Kuhnen and Miu, 2015), our work focuses on possible solutions that can alleviate it. In this respect, our study relates to papers that explore solutions to the frictions households face in their financial decisions, such as financial advisors (Gennaioli, Shleifer, and Vishny, 2015), default options (Madrian and Shea, 2001), or innovative banking products (Cole, Iverson, and Tufano, 2016).

Our work also contributes to the literature on the cost and benefits of financial innovation. Several studies have underlined potential adverse effects of financial innovation, such as speculation (Simsek, 2013) or rent extraction (Biais, Rochet, and Woolley, 2015; Biais and Landier, 2015), particularly from unsophisticated agents (Carlin, 2009). The present paper illustrates how innovative financial products may also benefit unsophisticated market players. Our paper suggests that innovative security design can mitigate investor behavioral biases, and not merely exploit them (Célérier and Vallée, 2017), thereby having a positive impact on investor welfare. This mechanism differs from and complements the more traditional role of financial innovation to improve risk-sharing and complete markets (Ross, 1976; Calvet, Gonzalez-Eiras, and Sodini, 2004). While recent work has focused on the dark side of retail structured products (Arnold, Schuette, and Wagner, 2016;

Henderson and Pearson, 2011; Hens and Rieger, 2014), the present study offers a more nuanced view of these markets.

The paper is organized as follows. Section II provides background on retail capital-protected investments and presents the asset pricing results. Section III documents the adoption of retail capital-protected investments in Sweden and studies the impact of these products on household risky shares. In Section IV, we explore the relationship between household characteristics and both the likelihood and extent of capital-protected investments. In Section V, we develop a theoretical framework of portfolio allocation for an investor that can access products paying a risk premium while offering a capital protection, and interpret our empirical results in light of the model predictions. Section VI concludes. An Internet Appendix provides additional empirical results.

II. The Swedish Market for Capital-protected Investments

A. The Development of Capital-protected Investments

Capital-protected investments include any investment products marketed to retail investors and possessing a payoff function that 1) varies automatically and non-linearly with the performance of an underlying financial asset, 2) offer a capital protection. Typically designed with embedded options, these products leave no room for discretionary investment decisions during the life of the investment. These products are based mainly on equity indices and individual stocks but may also offer exposure to commodities, fixed income, or alternative indices.

For illustration purposes, we provide below an example of a Swedish best-seller named *Spax Pension 284d* sold by Swedbank in 2004 (ISIN: SE0001242983):

> *The product has a maturity of 8 years and a fee of 1.5% is charged at issuance. The product return is linked to the performance of the OMX 30 index, as follows: at maturity the product offers a minimum capital return of 100% plus 105% of the positive performance of the index over the investment period. The performance of the index is calculated as the average of the index return since inception over the last 13 months, and does not include dividends.*

(Célérier and Vallée, 2017).

B. Characteristics and Design of Capital-protected Investments

The dataset compiled by Célérier and Vallée (2017) contains detailed information on all capital-protected investments issued in Europe since 2002. Comprehensive information on the pay-off structure, distributors, and volume are available at the issuance level. The database also includes all the features embedded in each product, obtained through a text analysis of the pay-off description.[4]

INSERT TABLE I

Our sample includes 1,510 equity-linked capital-protected investments made in Sweden over the 2002 to 2007 period, for a total volume of 8 billion dollars.[5] Table I reports summary statistics on the main characteristics of these products.

The representative contract is defined by:

1. an initial fee *init* charged when the product is originated at date 0,
2. a maturity date T,
3. an underlying asset or index, S_t,
4. a benchmark return R_T^* based on the underlying,
5. a participation rate p,
6. a guaranteed rate of return g.

The benchmark return is the average performance of the underlying measured at prespecified dates $t_1 < \cdots < t_n$:

$$1 + R_T^* = \frac{S_{t_1} + S_{t_2} + ... + S_{t_n}}{nS_{t_0}}, \tag{1}$$

where S_{t_0} is the initial reference level of an index or asset at t_0, typically a few days after issuance. In the empirical section, we refer to $t_n - t_1$ as the length of the Asian option.[6]

The gross return on the capital-protected investment between issuance and maturity is

$$1 + R_{g,T} = \frac{1 + \max(p\, R_T^*; g)}{1 + init}. \tag{2}$$

[4]See Célérier and Vallée (2017) for the precise methodology.

[5]In Sweden, the large majority of products offer equity exposure (87% of the products)

[6]This format can be pensionable through Individual Pension Savings (IPS) status eligibility, and the average term is 3.5 years.

The initial fee is deducted from the initial investment at the initial date. For example if $init = 0.1$, a \$110 investment in the guaranteed product is worth $\$100[1 + \max(p\, R_T^*; g)]$ at maturity.[7]

C. Pricing of Capital-protected Investments

In order to investigate the risk and return properties of the representative contract, we develop a pricing model based on the absence of arbitrage. We assume that under the risk-adjusted measure $\mathbb{Q}$, the underlying follows a geometric Brownian motion:

$$\frac{dS_t}{S_t} = (r_f - q)dt + \sigma dZ_t, \tag{3}$$

where r_f is the continuous-time interest rate, q is the continuous-time dividend yield, and σ denotes volatility.

Let $\mathbb{E}_0^{\mathbb{Q}}$ denotes the expectation operator conditional on the information available at date 0. Under the risk-adjusted measure $\mathbb{Q}$, the mean return on the capital-protected investment is equal to the risk-free rate, $\mathbb{E}_0^{\mathbb{Q}}(1+R_{g,T}) = e^{r_f T}$, which by equation (2) implies the following pricing result.

Proposition 1 (Fair pricing of capital-protected investment). *The fair initial fee is given by:*

$$init = e^{-r_f T}\left[1 + g + p\, M_1^{\mathbb{Q}}\, N(d_1) - (p+g)\, N(d_2)\right] - 1, \tag{4}$$

where $M_1^{\mathbb{Q}}$ and $M_2^{\mathbb{Q}}$ denote the first two moments under $\mathbb{Q}$ of the benchmark return:

$$M_1^{\mathbb{Q}} = \mathbb{E}_0^{\mathbb{Q}}(1 + R_T^*) = \frac{1}{n}\sum_{i=1}^{n} e^{(r_f - q)(t_i - t_0)}, \tag{5}$$

$$M_2^{\mathbb{Q}} = \mathbb{E}_0^{\mathbb{Q}}\left[(1 + R_T^*)^2\right] = \frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} e^{[2(r_f - q)+\sigma^2][\min(t_i,t_j)-t_0]+(r_f-q)|t_j-t_i|}, \tag{6}$$

$(w^{\mathbb{Q}})^2$ denotes the variance of the log benchmark return:

$$(w^{\mathbb{Q}})^2 = \mathrm{Var}_0^{\mathbb{Q}}\left[\ln(1 + R_T^*)\right] = \ln\left[M_2^{\mathbb{Q}}\,(M_1^{\mathbb{Q}})^{-2}\right], \tag{7}$$

[7] Almost all products have a structured bond format (98% of issuances), and therefore bear credit risk. Credit spread are close to zero in the period we study, and no Swedish banks defaulted during the financial crisis, so this issue plays no role in the analysis.

and d_1 and d_2 are Black-Scholes normalized ratios:

$$d_1 = \frac{1}{w^{\mathbb{Q}}}\left[\ln\left(\frac{p}{p+g}\right) + \ln(M_1^{\mathbb{Q}}) + \frac{(w^{\mathbb{Q}})^2}{2}\right] \tag{8}$$

and $d_2 = d_1 - w^{\mathbb{Q}}$. Furthermore, the fair initial fee (4) increases with the participation rate p and the guaranteed return g.

The expected return of the representative contract under the physical measure $\mathbb{P}$ is easily derived when the underlying follows

$$\frac{dS_t}{S_t} = (\mu - q)dt + \sigma\, dZ_t$$

under $\mathbb{P}$.

Proposition 2 (Expected return of under $\mathbb{P}$). *The expected return on the guaranteed product under the physical measure is*

$$\mathbb{E}^{\mathbb{P}}(1 + R_{g,T}) = \frac{1 + g + pM_1^{\mathbb{P}}N(d_1^{\mathbb{P}}) - (p+g)N(d_2^{\mathbb{P}})}{1 + init},$$

where $M_1^{\mathbb{P}}$ and $M_2^{\mathbb{P}}$ denote the first two moments under $\mathbb{P}$ of the benchmark return:

$$M_1^{\mathbb{P}} = \mathbb{E}_0^{\mathbb{P}}(1 + R_T^*) = \frac{1}{n}\sum_{i=1}^{n} e^{(\mu-q)(t_i-t_0)}, \tag{9}$$

$$M_2^{\mathbb{P}} = \mathbb{E}_0^{\mathbb{P}}\left[(1 + R_T^*)^2\right] = \frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} e^{[2(\mu-q)+\sigma^2][\min(t_i,t_j)-t_0]+(\mu-q)|t_j-t_i|}, \tag{10}$$

$(w^{\mathbb{P}})^2$ denotes the variance of the log benchmark return:

$$(w^{\mathbb{P}})^2 = \mathrm{Var}_0^{\mathbb{P}}[\ln(1 + R_T^*)] = \ln\left[M_2^{\mathbb{P}}/(M_1^{\mathbb{P}})^2\right], \tag{11}$$

and

$$d_1^{\mathbb{P}} = \frac{1}{w^{\mathbb{P}}}\left[\ln\left(\frac{p}{p+g}\right) + \ln(M_1^{\mathbb{P}}) + \frac{(w^{\mathbb{P}})^2}{2}\right], \tag{12}$$

and $d_2^{\mathbb{P}} = d_1^{\mathbb{P}} - w^{\mathbb{P}}$.

A subset of contracts include a cap to the return that can be earned on the initial investment net of fee. In the Appendix, we provide the fair initial fee and expected return in the presence of a cap.

D. Summary Statistics on Capital-protected Investments

D.1. Issuance and Design

Panel A of Table I provides summary statistics on the issuance of all capital-protected investments in Sweden during the 2002 to 2007 period, as well as on the sub-sample of products defined by the representative contract. The representative contract represents 55% of the retail capital-protected investments made during our sample period in Sweden, and 60% of the corresponding volumes. Table I also shows summary statistics of the six parameters that define the contract for this sub-sample of products: the maturity T, the capital guarantee g, the initial fee $init$, the participation rate p, the market premium μ and volatility σ of the underlying asset, and the length of the Asian option $t_n - t_1$.

D.2. Pricing

The sub-sample of products described by the representative contract rely on 155 different underlying assets, which are either a stock index, a basket of stock indices, or a basket of stocks. We rely on the following assumptions for each underlying asset.

- We estimate the risk premium of a given underlying asset at the monthly frequency, $\mathbb{E}(R_{m,t})$, by applying the World CAPM over the longest time-series available and a risk premium on the world market of 4%. We then convert it into our model input $\mu = \ln[1 + \mathbb{E}(R_{m,t})]/t$, where $t = 1/12$ if μ is expressed in yearly units.
- We use historical volatility as measured over the 1990 - 2007 period for σ.
- We use the latest dividend yield before the capital-protected investment issuance for q.
- We use the SEK Swap Rate for the product maturity as the risk free rate r_f in the pricing model.

We compute the product markup as the difference between the fair initial fee that we derive from Proposition 1 and the actual initial fee we observe in our data. To obtain a yearly markup that can be easily compared to mutual fund yearly fees, we scale this markup by the product maturity in year. We then derive the excess expected return the investor earns. A product expected return is calculated as per Proposition 2. The excess expected return is obtained by annualizing this expected return and subtracting the risk-free rate (T-bill rate).

Table I reports the product markup and excess expected returns implied by the asset pricing method. There are several important take-aways. First, the cost to households/ the profitability to the banks of retail capital-protected investments represents 1.4% of the invested amount per year on average, which is comparable to the fees of mutual funds available to the same population.[8] This finding suggests that banks have comparable financial incentives to market equity mutual funds and retail capital-protected investments.

Second, yearly excess expected returns for these products are significantly positive with an average of 4.9%. This confirms that retail capital-protected investments allow households to earn part of the risk premium.

INSERT FIGURE 1

In Figure 1, we report the distribution of the expected excess return in the population of capital-protected investments. We observe that about 90% of products earn a positive risk premium, which confirms that these products can benefit retail investors. In Table IA.2 of the Internet Appendix, we conduct a sensitivity analysis that shows that our results are not driven by a particular choice of parameters. Furthermore, Table IA.3 shows that the monotonic relationships between the initial fee, participation rate and guaranteed return implied by Proposition 1 hold in the cross-section of contracts.

Having empirically established that the retail capital-protected investments marketed to Swedish households allow them to share in a large fraction of the risk premium, we turn to their portfolio data to study who buys such products and to which extent.

[8]The average equity mutual fund fee is 1.80% in Sweden over the 2000 to 2007 period.

III. Do Capital-protected Investments Increase Household Risk-Taking?

A. Measuring Household Risky Share

Household risk-taking is a function of the share of their financial wealth invested in equity products and the share of the risk premium they obtain through each equity product.

For guaranteed products, the fraction of the equity premium earned by the household in expectation is the fraction of the excess expected return over the market risk premium:

$$\eta_g = \frac{\mathbb{E}(R_{g,T} - e^{r_f T})}{\mathbb{E}(R_{m,T} - e^{r_f T})}.$$

This definition coincides with the risky share in the case of a portfolio of the stock and the riskless asset. It can also be applied to mutual funds, where the expected fund return is net of fees.

We compute η for each equity product, i.e. both funds and capital-protected investments, and assume $\eta = 1$ for stocks. For funds, the excess expected return is the difference between the market premium and the fund fees. We collect fund fees for each fund in our database. For capital-protected investment, we compute the excess expected return as described in Proposition 2. We find that η amounts to 60% for capital-protected investments versus 70% for equity funds on average. We measure an household risky share as follows:

$$w_h = \sum_{i=1}^{3} \eta_i \times \frac{EquityProduct_{h,i}}{FinancialWealth_h},$$

where i describes the three equity asset classes: capital-protected investments, equity mutual funds, and stocks.

B. Household Risk-Taking: Data and Summary Statistics

We investigate household holdings by merging the capital-protected investment database with the Swedish Income and Wealth Registry. This second dataset, described in Calvet et al. (2007), is a panel of financial wealth and income covering all Swedish households over the 2000 to 2007 period. It provides the detailed breakdown of financial wealth between cash, equity mutual funds, stocks and capital-protected investments.[9] This panel has been used to study household portfolio diversification (Calvet et al., 2007), rebalancing (Calvet, Campbell, and Sodini, 2009a), investor sophistication (Calvet, Campbell, and Sodini, 2009b), financial risk-taking (Calvet and Sodini, 2014) and value and growth investing (Betermier, Calvet, and Sodini, 2017). The data are available because the Swedish government levied a wealth tax over the 2000 to 2007 period. To collect this tax, the government assembles records of financial assets. The records are available at the individual security level and are based on statements from financial institutions that are verified by taxpayers. In addition, the data contains a high diversity of individual socio-demographic and financial characteristics, in addition to a number of proxies for sophistication, such as IQ and educational attainment.

The merge of the two datasets is done using the unique ISIN identifiers of financial assets. Household portfolio data are disaggregated at the security level, with the corresponding ISIN of each security, including retail capital-protected investments. The dataset resulting from merging the two previous sources represents an ideal setting to investigate how the development of capital-protected investments affected household investment decisions, as the overlap of the datasets occurs during the launch and subsequent high growth period of the retail market for capital-protected investments.

Finally, we merge our data with a survey conducted on the population of twins in Sweden that collects information on preferences and behavioral biases. We extract from this survey a measure of household reluctance to take risk for a sub-sample of 11,000 households. Participants answer the following question: "Are you a person who is willing to take financial risks or trying to avoid financial risks?" one a 1 to 10 scale.[10]

INSERT TABLE II

Table II presents demographic and financial characteristics for the different sample used in our empirical analysis. The IQ data, resulting from military tests, is only available for men born after 1945.[11]

[9] Bonds and bond mutual funds, which we can also observe, are infrequent.

[10] While the survey also includes several questions related to behavioral biases, there is unfortunately very little heterogeneity in participants' answers.

[11] Our analysis being conducted at the household level, we use the man's IQ as a proxy of the average IQ in the household.

Despite the usual reluctance of households to invest in equity funds and stocks, the retail market for capital-protected investments developed within a few years in Sweden. At the end of 2007, 11% of Swedish households participated in this new asset class and invested a significant fraction of their financial wealth in these products.

Figure 2 illustrates the massive adoption of capital-protected investments in Sweden over the 2002 to 2007 period. The market is still dynamic in the recent period: 3.2 billion euros of retail capital-protected investments have been issued in 2015 in Sweden, which makes it comparable to 2007.[12] Panel A of Figure 2 shows the evolution of the share of households participating in capital-protected investments and in other stock market products over the 2002 to 2007 period.[13] Household participation in traditional stock market products, while high in Sweden compared to other countries, is slightly declining over the sample period. Conversely, the share of household investing in capital-protected investments significantly increases from 2000 to 2007, reaching 11% in 2007. Retail capital-protected investments, therefore, play an increasing role in households' access to stock markets over the period.

INSERT FIGURE 2

C. Impact of Capital-Protected Investments on Financial Risk-Taking

We now explore whether investing in capital-protected investment products is associated with an increase in the risky share of household financial wealth. This analysis requires one important adjustment when comparing the risky share of households before and after the introduction of retail capital-protected investment products. While we include capital-protected investments in the risky share - as they allow earning a fraction of the risk premium - we adjust the portfolio weight of capital-protected investments, as previously described.

We focus on the subsample of households participating in equity funds or stocks in 2002 and compare the change in the risky share between 2002 and 2007 for households that have invested in capital-protected investment products during that period versus households that have not. The

[12] SRP 2015 annual report

[13] A household is viewed as a participant in a given financial product if it possesses a strictly positive amount of investment in that type of financial products in a given year.

risky share is expressed in percentage points of financial wealth. The exact specification is:

$$w_{h,2007} - w_{h,2002} = \alpha + \beta\,\mathbb{1}_{SP,h} + \lambda' x_h + \varepsilon_h,$$

where $w_{h,t}$ denotes the risky share of household h in year t, x_h is a vector of household characteristics, and ε_h is the measurement error. The vector x_h includes the number of children, household size, an urban dummy, a gender dummy, the change in income over the period, the change in financial wealth, as well as wealth and income decile and IQ or years of education fixed effects.

Column (1) of Table III displays the regression coefficients for the total sample. The coefficient of the variable $\mathbb{1}_{SP,h}$ suggests that capital-protected investment participants increase their risky share by an additional 3.5 pp over the 2002 to 2007 period compared to nonparticipants. This increase represents more than 15% of their initial risky share, and is twice as large as the average increase in the whole population.

Figure 3 shows that the effect of participating in capital-protected investments is higher on households with ex-ante low risky share/a large share of cash in their financial wealth. We split the sample into quintiles cash share in 2002 and interact indicators for each of these categories with the indicator variable for participating in capital-protected investments. The dependant variable is the growth rate in risky share, measured using Davis and Haltiwanger (1992) growth measure:

$$\frac{2 * (w_{h,2007} - w_{h,2002})}{w_{h,2007} + w_{h,2002}}$$

INSERT FIGURE 3

Table III confirms this result: participating in capital-protected investments is associated with an additional active increase in risky share of 10 percentage points for household in the lowest quartile of risky share who initially have less than 4% of risky share. To obtain this result, we split the sample in quartiles of risky share in 2002. Households with a risky share of 3.8% ex ante experienced a growth in their risky share 10 pp higher when they participated in capital-protected investments. The coefficient of the dummy variable $\mathbb{1}_{SP,h}$ is decreasing as household ex-ante risky share increases.

INSERT TABLE III

Finally, we interact the indicator variable for participating in capital-protected investments with financial wealth decile, IQ levels, and age categories to identify heterogeneity in this change along our key characteristics. Figure 4 displays the OLS regression coefficients. This figure illustrates how capital-protected investment participants have increased significantly more their risky share, and how this increase is more pronounced for households with lower financial wealth, and for older households.

INSERT FIGURE 4

Columns (6) to (9) in Table III displays the regression coefficients with linear specifications for the explanatory variables.

D. *Controlling for Endogenous Selection: Restricted Control Group and Instrumental Variable Analysis*

Household decision to invest in capital-protected investment products might correlate with their willingness to increase their risky share, independently of the introduction of capital-protected investment products. In this case, our OLS estimate would be upward biased.

We address this endogeneity issue by restricting the control group to active fund buyers. Hence, the sample includes only households that have decided to increase their risky share. Table IA.6 displays the results. The coefficient of the variable $\mathbb{1}_{SP,h}$ suggests that capital-protected investment participants increase their risky share by an additional 2.6 pp over the 2002 to 2007 period compared to active fund buyers that have not participated in capital-protected investments.The effect is only 25% percent lower compared to the main model. In this specification, we assume that capital-protected investments have an effect on the risky share for participants but does not affect the decision to participate.

Alternatively, the OLS estimate would be downward bias if households that participate in capital-protected investment products are different from households that do not participate in some dimensions that are not perfectly observable and that would induce a lower change in the risky share in the absence of capital-protected investments compared to the control group. For example, participants in capital-protected investment products might be strongly loss averse.

We exploit an exogenous variation in the supply of retail capital-protected investment products in an instrumental variable analysis to address this concern. Some Swedish banks did not market capital-protected investment products to their client base during our sample period, and these banks are unevenly distributed geographically, which generates geographic variation in the supply intensity of retail capital-protected investments. We collect the list of bank branches in each parish and build a proxy for the household exposure to retail capital-protected investment supply by calculating the ratio of branches in their parish that market retail capital-protected investment during our study period. This strategy alleviates concerns that households might have several banking relationships, or could shop around. It relies on the assumption that shopping banking services is a local market. which is supported by the existing literature (Beck, Demirguc-Kunt, and Peria, 2007).

Figure **??** illustrates the geographic distribution of supply intensity. The instrument varies substantially across Sweden, both within and across regions. The figure suggests that the instrument exhibits sufficient heterogeneity to be a plausible instrument. A natural concern is that household from parishes with few or no banks distributing retail capital-protected investments differ fundamentally from the other parishes, which could result in a different trend in the evolution of their portfolio allocation. This concern is mitigated by the richness and the size of our dataset, which allows us to control for a comprehensive set of household characteristics, as well as their evolution, in non-parametric specifications.

INSERT FIGURE **??**

Table IV reports the results of the instrumental variable analysis. Column 1 displays the coefficients of the first stage, and shows that a higher share of branches offering capital-protected investments in a given parish significantly increases the probability to invest in capital-protected investment products for the households of this parish, even when controlling for household characteristics. Column 2 presents the coefficients from the second stage, which regresses change in the risky share on participation in retail capital-protected investments, where participation in retail capital-protected investment is instrumented. The positive and significant coefficient on the indicator variable for participating in retail capital-protected investments confirms our initial result. The larger magnitude of the coefficient suggests that the endogeneity issue is biasing our results downward, which suggests that households participating in capital-protected investments would have actually reduced their risky share in the absence of these products.

INSERT TABLE IV

E. *Controlling for Passive Variation in the Risky Share*

We now verify that the results of the previous sections are not mechanically driven by passive variation in the risky share induced by changes in asset prices. We focus on changes induced by active household behaviour, adjusting for any passive changes in the risky share if the household does not trade over the period.

To adjust for the passive change in the risky share, we define the active change in the risky share between $t-n$ and t by:

$$A_{h,t} = w_{h,t} - w^p_{h,t},$$

where $w_{h,t}$ is the observed risky share in year t and $w^p_{h,t}$ is the passive risky share after an inactivity period of n years. More precisely, $w^p_{h,t}$ is the risky share at the end of year t if the household does not trade between years $t-n$ and t, and is calculated by applying to each asset of the household portfolio the realized returns of this asset between $t-n$ and t.

In Table IA.5 of the internet appendix, we estimate the specification:

$$A_{h,t} = \alpha + \beta\,\mathbb{1}_{SP,h} + \lambda' x_h + \varepsilon_h$$

The effect of capital-protected investment participation on household risky share is almost unchanged when passive variations are taken into account. Thus, our main results are not driven by mechanical variation in portfolio weights caused by time variation in asset prices.

F. *How Does Innovation Change Household Portfolio Allocations?*

In Table V, we now study how households that invest in capital-protected investment products fund these purchases, and more specifically whether they do so with cash or by selling stock market instruments they own. We estimate the rate of substitution between capital-protected investments and cash at the yearly frequency by running the panel regression:

$$CashShare_{h,t} = \alpha_h + \delta_t + \beta\, SPshare_{h,t}\, x_h + \varepsilon_{h,t},$$

where $CashShare_{h,t}$ is the share of financial wealth held as cash by household h in year t, $SPshare_{h,t}$ is the share of financial wealth invested in equity-linked **capital-protected investments**, x_h denotes characteristics, α_h is a household fixed effect and δ_t is a year fixed effect. x_h is either the decile of financial wealth, the level of IQ, or the age category. The coefficient on the interacted term, $SPshare_{h,t} \times x_h$, shows how capital-protected investment products purchase are predominantly funded with cash, with an average substitution rate of 62%. Substitution with cash appears to be even higher for household with lower financial wealth, lower IQ, and younger households, which is consistent with the larger increase in stock market exposure for these sub-groups of the population.

INSERT TABLE V

When we adjust for the return elasticity to the underlying asset performance, the average increase in exposure to risky assets resulting from household investing 1% of their financial wealth in capital-protected investments is therefore around 0.3%. As capital-protected investment participants invest on average 15% of their financial wealth in these products, this translates into an increase in the exposure to risky assets of around 5% of their financial wealth.

G. Does Financial Innovation Drive Risky Asset Market Participation?

We define new participants to risky asset markets as households that were not participating in equity funds or stocks during the four years before 2002 and that start investing in equity funds, stocks or capital-protected investments during the 2003 to 2007 period.

Figure 5 shows the evolution of new participants, and their breakdown between new participants who start investing in equity funds or stocks, and new participants who start investing in capital-protected investment products. We observe that the share of new participants through capital-protected investments substantially increases over time. While new participants through capital-protected investments only represent 3.6% of new participants through traditional products in 2002, this proportion reaches more than 22% in 2007.

INSERT FIGURE 5

Finally, column (3) in Table IV indicates that households are more likely to start participating in stock markets when they live in parishes where the supply of retail capital-protected investments is high.

IV. Who Buys Capital-Protected Investment Products and To Which Extent?

We now zoom in on the characteristics of investors in capital-protected investment products. We investigate the drivers of participation in guaranteed products (extensive margin) as well as the share of wealth invested in these products (intensive margin). We run a similar analysis for cash, stocks, and equity mutual funds. The relationships between guaranteed product investments and household characteristics are strikingly similar to the relationships between cash holdings and household characteristics, while sharply different results hold for equity mutual funds and stocks.

A. Characteristics of Capital-Protected Investment Participants

We study the characteristics of households that invest in retail capital-protected investments. In Table VI, we compare financial and demographic characteristics of households investing in capital-protected investment products with the characteristics of the whole Swedish population, and of households investing in equity funds and stocks.

These unconditional summary statistics points at capital-protected investments participants being wealthier than the overall population and fund and stock participants, but also significantly older, and less invested in risky assets than equity fund and stock participants.

INSERT TABLE VI

To further explore the determinants of capital-protected investment participation, we implement logit regressions to estimate the probability that a household invests in capital-protected investment products at least once during the 2002 to 2007 period. We focus on the three main characteristics that identify households with lower participation in risky asset markets: financial wealth, IQ and age. We run the following specification for participating in retail capital-protected investments:

$$\text{logit}(p_h) = \log\left(\frac{p_h}{1-p_h}\right) = \alpha + \beta' x_h,$$

where p_h is the probability that the household holds capital-protected investments at least once over the 2002 to 2007 period, and x_h is a vector of household characteristics in 2007. We estimate similar logit regressions for participation in stocks and equity mutual funds. Each regression includes financial wealth, IQ, and age fixed effects in this non-parametric specification as explanatory variables as well as controls for the number of children in the household, household size, an urban dummy and a household head gender dummy.

INSERT FIGURE 6

Figure 6 displays the predicted probability of participation for each financial wealth decile, IQ level, and age category. The likelihood to participate increases with financial wealth for all three asset classes. However, there are notable differences between retail capital-protected investments, and equity fund and stocks, on the two other dimensions. The likelihood of participating in retail capital-protected investments is a hump-shaped function of IQ, while it is a monotonically increasing function for equity funds and stock markets. The different pattern is even more pronounced for age: while likelihood of participating in retail capital-protected investments increases with age (except at the end of life), the opposite is true for equity funds and stocks. We also implement the same analysis on years of education, and find results consistent with the ones for IQ that we include in the Internet Appendix.

These differences point to retail capital-protected investments appealing differently than equity funds and stocks to specific sub-groups of the population: these products appear in relative higher demand from mature households, but in lower demand from households with the highest IQs.

B. Who Invests the Most in Capital-Protected Investment Products?

The bottom half of Figure 2 displays the evolution of the composition of the financial wealth of households that participate in retail capital-protected investments as of end 2007. The figure shows how these households build up a significant share of their wealth invested in retail capital-protected investment in a matter of five years: from 0% in 2002 to more than 15% in 2007. This increases contrasts with how they reduce over the same period their share of wealth held in cash, as well as the share invested in stocks and equity funds.

In Table VI, we explore whether household characteristics relate to the extent to which households invest in capital-protected investment products, as well as in other financial assets: cash, equity funds, and stocks. For this purpose, we run cross-sectional OLS regressions on the share of financial wealth invested in a given financial asset at the end of 2007. We use the following specification on the sample restricted to capital-protected investment participants:

$$\omega_{j,h} = \alpha_j + \beta_j' x_h + \varepsilon_{h,j},$$

where $\omega_{j,h}$ is the share of financial wealth invested in asset class j. As previously, the vector of characteristics, x_h, consists of financial wealth, IQ and age, as well as the number of children, household size, an urban dummy, and a household head gender dummy. Figure 7 plots regression coefficients on fixed effects for each financial wealth decile, IQ level, and age category.

There are three key takeaways. First, household with lower financial wealth invest a larger share of their wealth in retail capital-protected investments. Second, older households invest a larger share of their wealth in retail capital-protected investments than younger households. Last, these relationships are the opposite for traditional equity products, but are similar for cash. These results suggest a complementarity between capital-protected investments, and equity funds and stocks. The relationship between IQ and the share invested in capital-protected investment products is nonmonotonic, while it is strongly positive for equity funds and stocks.

INSERT FIGURE 7

C. Product Design and Household Characteristics

In Figure 8, we finally investigate whether and how the design of retail capital-protected investments varies with household characteristics. We explore the four main parameters of the representative design: (i) participation rate p, (ii) initial fee *init*, (iii) length of the Asian option $t_n - t_1$, and (iv) capital guarantee g, as well as our measures of expected return and markup. We run OLS regressions using each of these four parameters as the dependent variable, and financial wealth deciles, IQ levels, and age categories as explanatory variables.

Figure 8 plots the regression coefficients. We observe, first, that the level of the guarantee increases when age and reluctance to take risk increase, and decreases when financial wealth and IQ decrease. There is, however, no significant patterns for the level of markup and the Asian Option. Second, households with lower financial wealth, lower IQ, of older age and more reluctant to take financial risk are more likely to invest in products offering lower participation rate, a lower initial fee, and a lower expected returns, which corresponds to a lower level of risk.

INSERT FIGURE 8

This mapping between household characteristics and product design suggests some heterogeneity in preferences among the population. In addition, this result does not support a predatory view of the market, where one design parameter, such as the initial fee, is shrouded for the low sophistication households.

V. Theoretical Framework for Portfolio Choice

This section investigates the theoretical mechanisms that can explain the impact on household portfolios of the introduction of capital-protected investments we observe in our data. We develop a portfolio-choice model with three assets: a risk-free bond, a stock-market index, and a capital-protected investment based on the index. Capital-protected investment distribution of returns is derived from the methodology in Section II. We compute the portfolio choice of an investor with CRRA, habit formation, or loss aversion preferences.[14] We finally calculate the increase in utility brought by the access to the capital-protected investment, and determine the increase in the risk-free rate that would provide the same utility gain for the agent.

A. ***Portfolio Choice and Corresponding Utility***

We consider an agent endowed with initial wealth W_0 at date 0 and consuming C_T at date T. The agent has expected utility

$$\mathbb{E}_0 \left[u(C_T) \right].$$

[14] We also interact these utility functions with the presence of human capital in the appendix.

The agent can invest her initial wealth in the riskless asset, the stock, and the guaranteed product. Let α denote the portfolio weight of the stock and β the portfolio weight of the capital-protected investment. The budget constraint implies that $C_T = W_0\,(1 + R_{p,T})$, where

$$1 + R_{p,T} = (1 - \alpha - \beta)\, e^{r_f\, T} \;+\; \alpha\,(1 + R_{m,T}) \;+ \beta\,(1 + R_{g,T}).$$

In the Appendix, we derive an approximation of the joint distribution of the log index return $r_{m,T} = \ln(1 + R_{m,T})$ and the log benchmark return $r^*_T = \ln(1 + R^*_T)$ based on an Edgeworth expansion. In applications, the calculation of expected utility can therefore proceed by numerical integration.[15] The agent chooses the portfolio shares α and β that maximize expected utility. We consider several utility specifications.

A.1. CRRA Investor

We consider

$$u(C) = \frac{C^{1-\gamma}}{1-\gamma}.$$

The objective function can be rewritten as $\mathbb{E}[u(C_T)] = W_0^{1-\gamma}\, v(\alpha, \beta)$, where

$$v(\alpha, \beta) = \mathbb{E}\left[u\left(1 + R_{p,T}\right)\right]$$

denotes the expected utility from one unit of initial wealth.

When the investor can only invest in the bond and the stock ($\beta = 0$), the optimal share invested in the stock is closely approximated by Merton's formula:

$$\alpha = \frac{\mu - r_f}{\gamma\,\sigma^2}.$$

[15] That is, we compute

$$\mathbb{E}_0\left[u(C_T)\right] = \iint_{\mathbb{R}^2} u\left\{W_0\left[1 + R_p(r_{m,T}, r^*_T; \alpha, \beta)\right]\right\}\, \phi(r_{m,T}, r^*_T)\, dr_{m,T}\, dr^*_T,$$

where the portfolio return is given by

$$R_p(\alpha, \beta, r_{m,T}, r^*_T) = (1 - \alpha - \beta)\, e^{r_f\, T} \;+\; \alpha\, e^{r_{m,T}} \;+ \beta\, \frac{1 + \max[p(e^{r^*_T} - 1)\,;\, g]}{1 + init} - 1.$$

and ϕ denotes the joint density of $r_{m,T}$ and r^*_T derived in the Appendix.

When the investor can invest in all three assets, the optimal solution can be computed numerically.

The utility gain from financial innovation can be assessed as follows. We derive the increase in interest rate that would correspond to the same gain in utility. A pure bond portfolio achieves the utility level $W_0^{1-\gamma} v(\alpha, \beta)$ if and only if

$$1 + R_f^* = [(1-\gamma)\ v(\alpha, \beta)]^{1/(1-\gamma)} .$$

If the investment period contains T years, the gross yearly interest rate is

$$(1 + R_f^*)^{1/T} - (1 + R_f)^{1/T}$$

in annual units.

A.2. Habit Formation

We now consider an agent with habit formation with utility

$$u(C) = \frac{(C - X)^{1-\gamma}}{1-\gamma}.$$

Let $\xi = X/W$ denote the habit to wealth ratio. The objective function is

$$v(\alpha, \beta) = \frac{1}{1-\gamma} \int_{-\infty}^{+\infty} [1 + R_p(z; \alpha, \beta) - \xi]^{\ 1-\gamma} \phi(z; \mu + r_f, \sigma^2)\ dz.$$

A strategy is admissible if $C - X \geq 0$ for all realizations of the stock return. That is

$$[1 + (1 - \alpha_t - \beta_t) R_f + \alpha_t (e^z - 1) + \beta_t \max[p(e^z - 1); g] \geq \xi$$

for all $z \in \mathbb{R}$, which holds if and only if $1 + (1 - \alpha_t - \beta_t) R_f - \alpha_t + \beta_t \max(-p; g) \geq \xi$. Therefore, a portfolio is admissible if and only if

$$(1 + R_f)\alpha_t + [R_f - \max(-p; g)]\, \beta_t \leq 1 + R_f - \xi.$$

We compute the increase in interest rate that would lead to the same utility gain as follows. A pure bond portfolio achieves the utility level $W_t^{1-\gamma}v(\alpha_t,\beta_t)$ if and only if $(1+R_f^*-\xi)^{1-\gamma}/(1-\gamma) = v(\alpha_t,\beta_t)$, or equivalently

$$1 + R_f^* = [(1-\gamma)v(\alpha_t,\beta_t)]^{1/(1-\gamma)} + \xi.$$

If the investment period contains n years, the welfare gain is quantified by the difference $(1 + R_f^*)^{1/n} - (1+R_f)^{1/n}$.

A.3. Loss Aversion

We now consider an agent with loss aversion. The expected utility becomes

$$u(W;W_R) = \begin{cases} (W-W_R)^{1-\gamma}/(1-\gamma) & \text{if} \quad W \geq W_R, \\ -\lambda(W_R - W)^{1-\gamma}/(1-\gamma) & \text{if} \quad W < W_R. \end{cases}$$

Let $\omega_R = W_R/W_t$ denote the ratio of the reference point to initial wealth.

The objective function is $W_t^{1-\gamma}v(\alpha_t,\beta_t)$, where

$$v(\alpha_t,\beta_t) = \frac{1}{1-\gamma}\int_{-\infty}^{+\infty} u\left[1 + R_p(z;\alpha,\beta);\omega_R\right]\ \phi(z;\mu + r_f,\sigma^2)\ dz.$$

A pure bond portfolio achieves the utility level $W_t^{1-\gamma}v(\alpha_t,\beta_t)$ if and only if $(1+R_f^*-\omega_R)^{1-\gamma}/(1-\gamma) = v(\alpha_t,\beta_t)$, or equivalently

$$1 + R_f^* = [(1-\gamma)v(\alpha_t,\beta_t)]^{1/(1-\gamma)} + \omega_R.$$

If the investment period contains n years, the welfare gain is quantified by the difference $(1 + R_f^*)^{1/n} - (1+R_f)^{1/n}$.

A.4. Misperception on the Fraction of Risk Premium the Investor Receives

We finally consider the misperception of the product design as a potential mechanism for our empirical results. We assume that investors do not understand either the Asian option, or the initial fee, and therefore believe that their return conditional on the guarantee not being exercised is p times the underlying asset positive return of the product maturity. They therefore overestimate the participation rate. We study the demand for such a misperceived product. The rationale for considering such a variation is that retail capital-protected investments design frequently relies on payoff designs that translate into a higher percentage of the index performance the investor receives than a vanilla call option would provide. Asian options, for instance, mechanically reduce the index performance during bullish periods. If household do not distinguish between vanilla call options and Asian options, they misperceive p.

B. ***Model Estimation***

B.1. Assumptions

We take the median parameters of the representative design:

- a maturity of 4 years,
- a capital guarantee of 100%,
- an initial fee of 11%,
- a market premium of 6% and a volatility of 20%,
- a Asian option of a length of 4 years

These inputs translate into a p, the percentage of index performance the investor receives through the capital-protected investment, of 117%.

We use the investment universe with only the risk-free asset as our initial benchmark. For each of the framework specification, we then sequentially introduce the stock index and the capital-protected investment, and study the change in portfolio allocation, in utility levels, and the interest rate increase that would lead to the same increase in utility. We also include quantiles of net portfolio returns.

B.2. Results

Portfolio Allocation

Figures 9 and 10 display the results.

They are several key take-aways. First, we observe that CRRA is unlikely to explain our data, as there is negligible appetite for the guaranteed product in the absence of misperception. We show in the online appendix that this is true for all level of risk aversion.

Second, the misperception of the Asian Option alone can generate some appetite mostly in a model without fees. In the real market conditions, the misperception of the Asian Option generates little appetite. Only the misperception of the initial fee does.

Third, while misperception can generate some appetite for capital-protected investments, it cannot explain the cross section of our results. The effect of capital-protected investments on the risky share is indeed decreasing with risk aversion, while it increases in our data if we use the initial risky share as a proxy for risk aversion.

INSERT FIGURE 9

Fourth, loss aversion generates some appetite for the guaranteed product without fees. The risky share expands significantly under loss aversion, which is consistent with the data. The effect is also increasing with the kink, which maps well our cross-sectional results. Under the loss-aversion mechanism, capital-protected investment would mitigate this behavioral bias and thereby foster households to participate more often and in a larger extent to risky asset markets.

INSERT FIGURE 10

VI. Conclusion

This study provides empirical evidence suggesting that innovative financial products can help alleviate the low participation of households in risky asset markets. We use a large administrative dataset to characterize the demand for capital-protected investments, an innovative class of retail financial products with option-like features.

The micro-evidence in this paper suggests that the introduction of retail capital-protected investments increases significantly stock market participation and the risky share of specific subgroups of the population, in particular households with lower financial wealth, with low to median IQ, and of older age. Both empirical and theoretical evidence is most consistent with these innovative products being successful at alleviating loss aversion among households.

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Figures and Tables

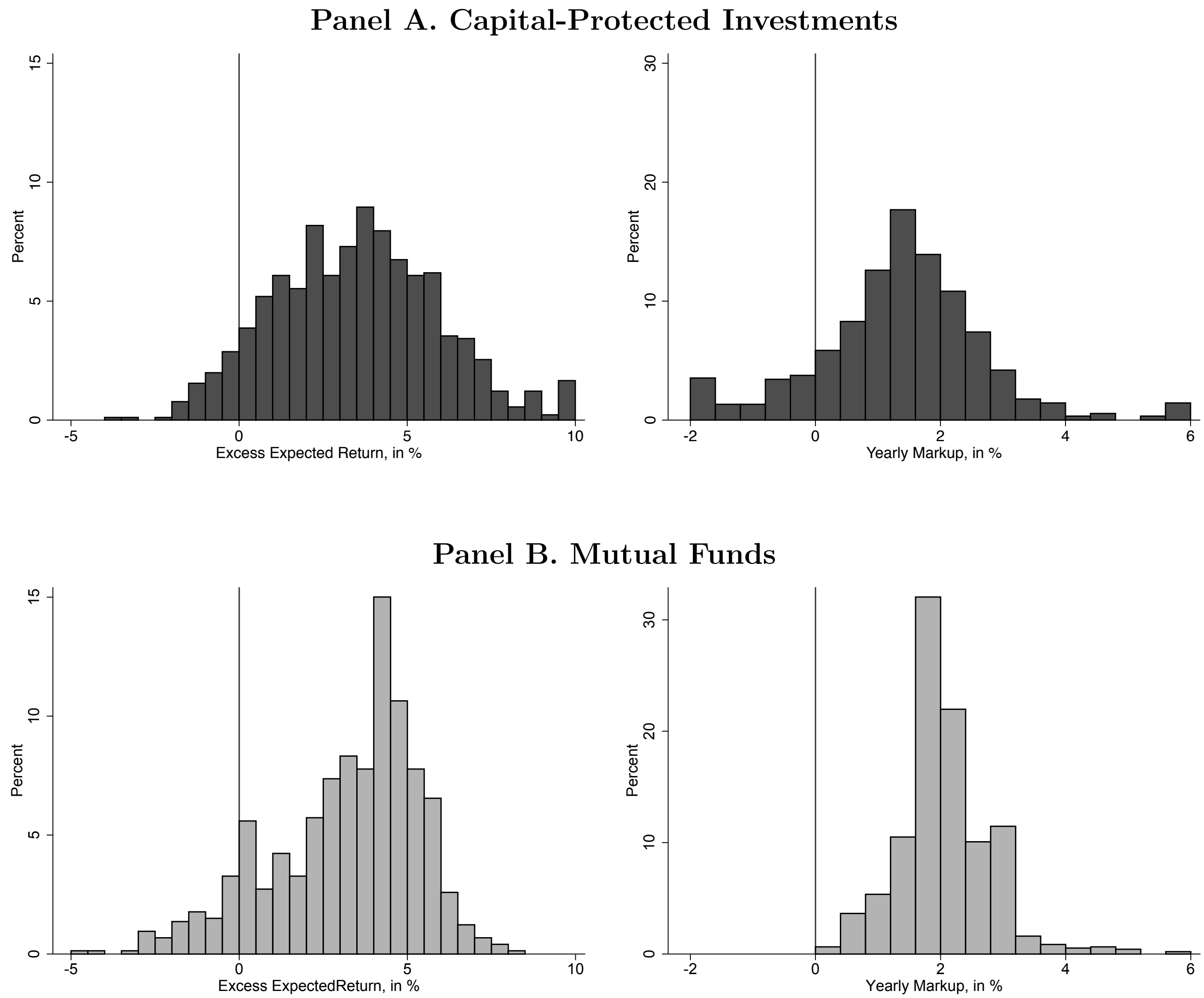


Figure 1. Histogram of the Excess Expected Return and Yearly Mark-up of Capital-protected Investments and Mutual Funds. This figure shows the histogram of the excess expected returns offered by the representative capital-protected investments in our sample (908 products issued from 2002 to 2007) and all the standard equity funds, as well as the mark-up of the banks distributing them.

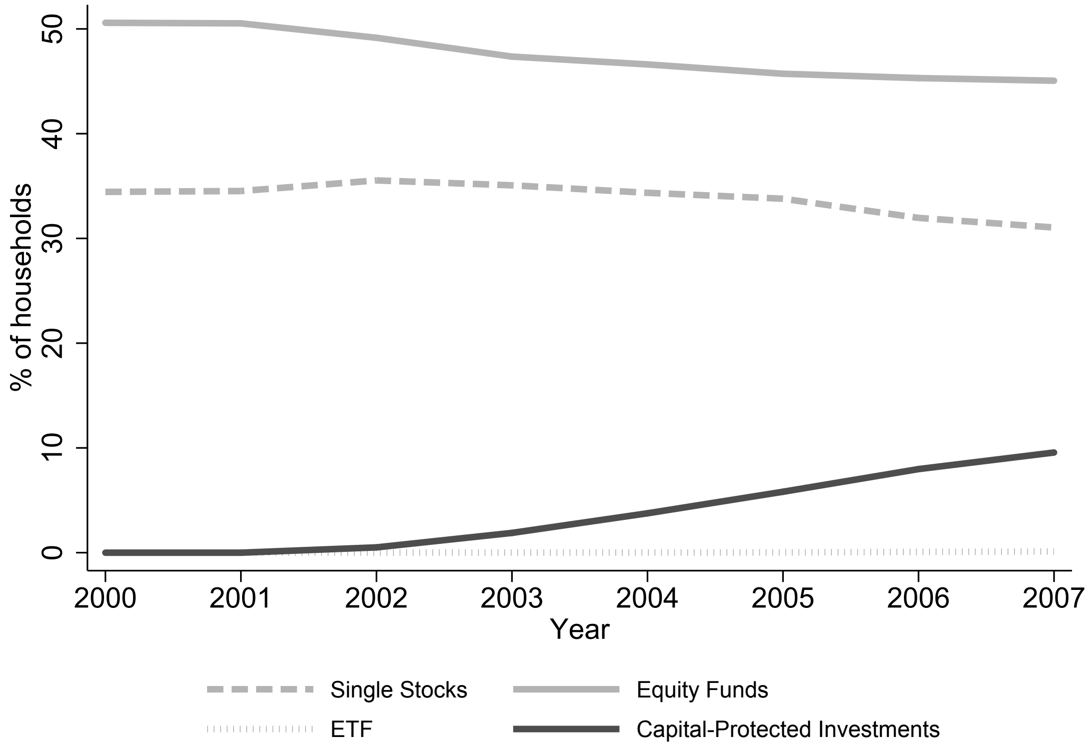


Figure 2. Adoption of Capital-protected Investments in Sweden (2000-2007): Fraction of Households Participating in Capital-Protected Investments, Stocks, and Equity Funds The figure shows the evolution of the share of Swedish households investing in equity markets through capital-protected investments (dark grey line), equity funds (grey line), single stocks (dashed line), and ETFs (dot line). Swedish banks started distributing retail capital-protected investments in 2000, the beginning of our sample period.

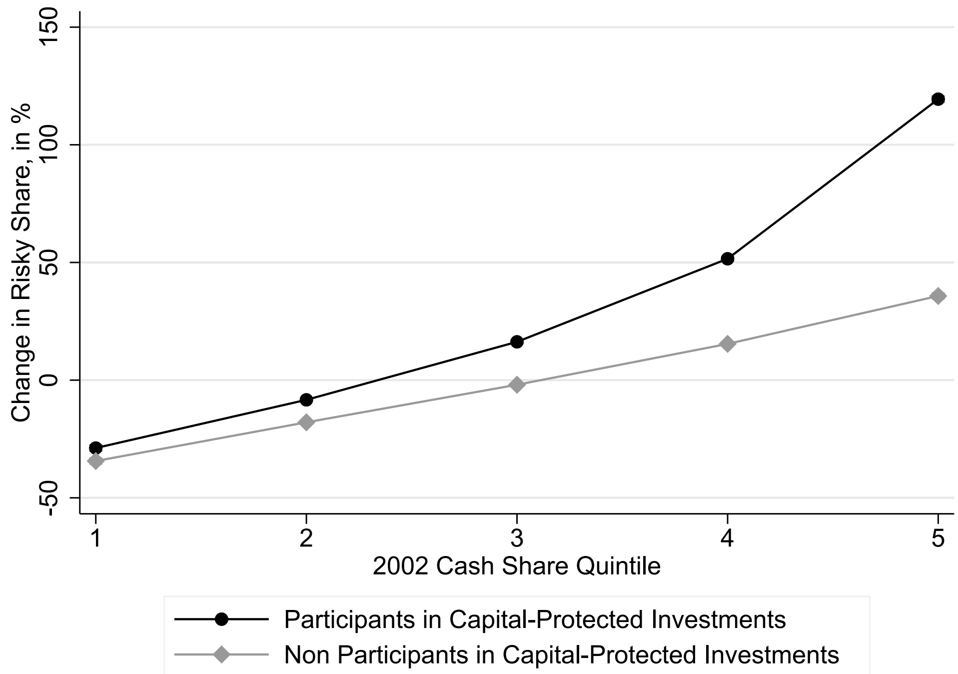


Figure 3. The effects of capital-protected investments on household risky share across quintiles of cash share. This figure shows the change in the risky share, in % of financial wealth, over the 2002 to 2007 period for 2007 capital-protected investment participants versus equity fund or stock participants (that do not participate in capital-protected investments), broken down by cash share in 2002. The cash share of financial wealth is 1-risky share, the risky share including equity funds, stocks and retail capital-protected investments. The sample includes all households that participate in equity funds or stocks in 2002.

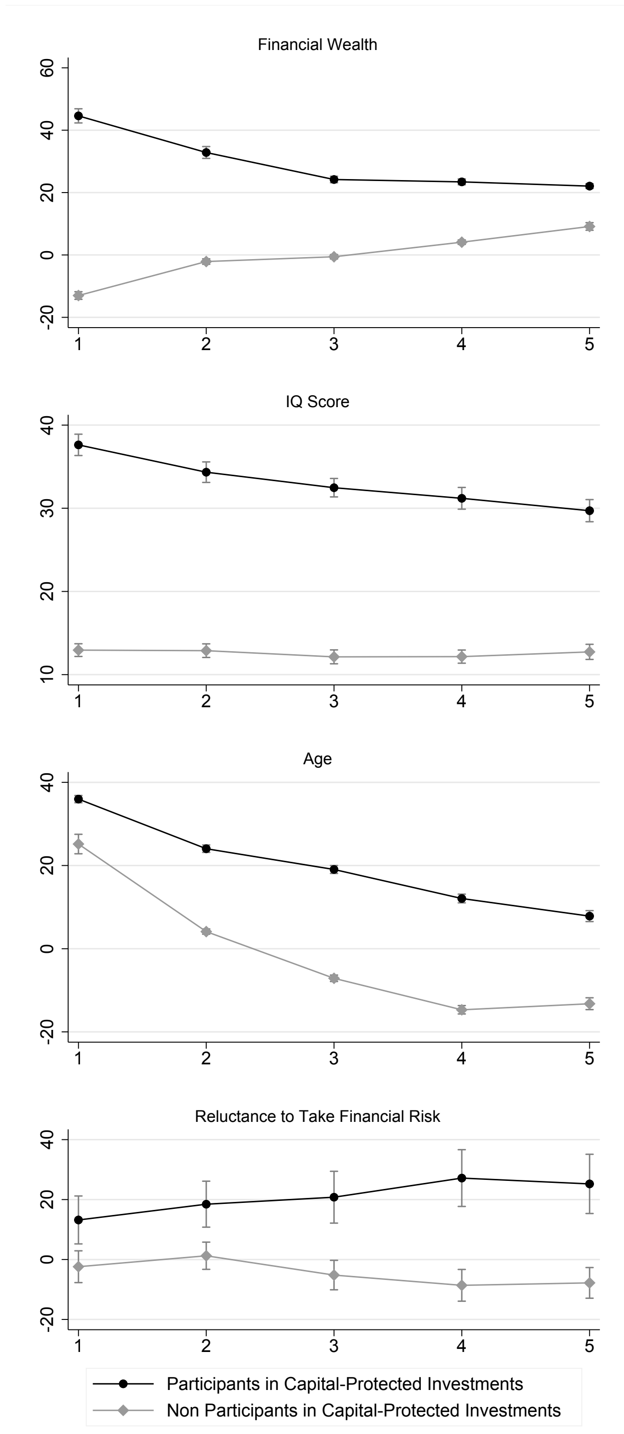


Figure 4. Change in the risky share over the 2002 to 2007 period for participants in equity funds, stocks or capital-protected investments. This figure shows the change in the risky share, in %, over the 2002 to 2007 period for 2007 capital-protected investment participants versus equity fund or stock participants (that do not participate in capital-protected investments), broken down by wealth decile, IQ levels, age categories and reluctance to take financial risk. The risky share includes equity funds, stocks and retail capital-protected investments. The sample includes all households that participate in equity funds or stocks in 2002.

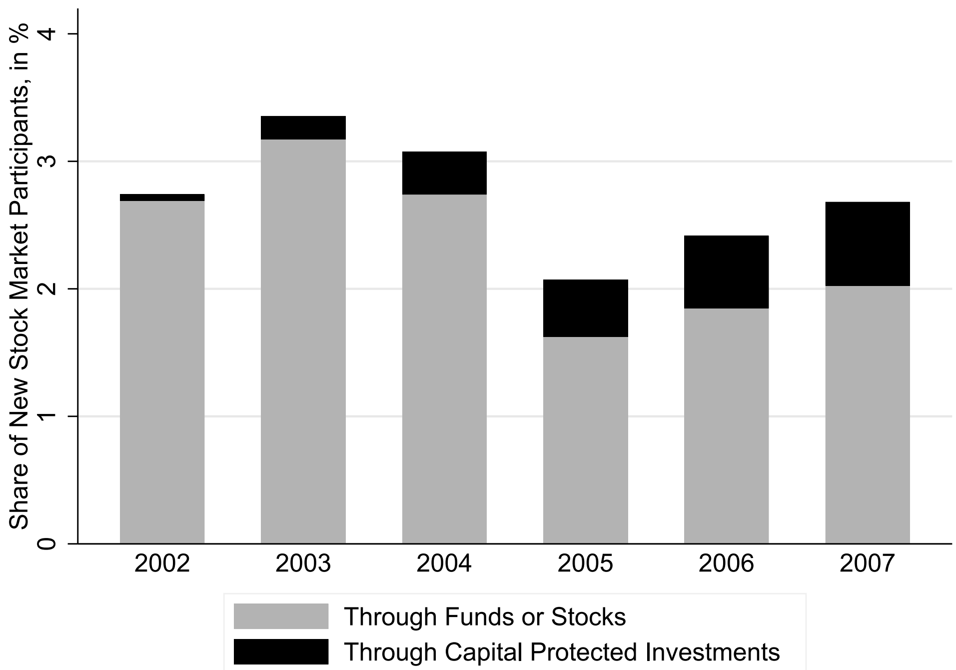


Figure 5. Evolution of the share of new participants through equity funds and stocks, and through capital-protected investments. This figure shows the evolution of the share of households that start participating in risky asset markets. These new participants are broken down between the one that start participating through equity funds and stocks, and the ones that do so through capital-protected investments. New participants are defined as households that were not participating in equity funds, stocks or capital-protected investments during in the four precedeing years.

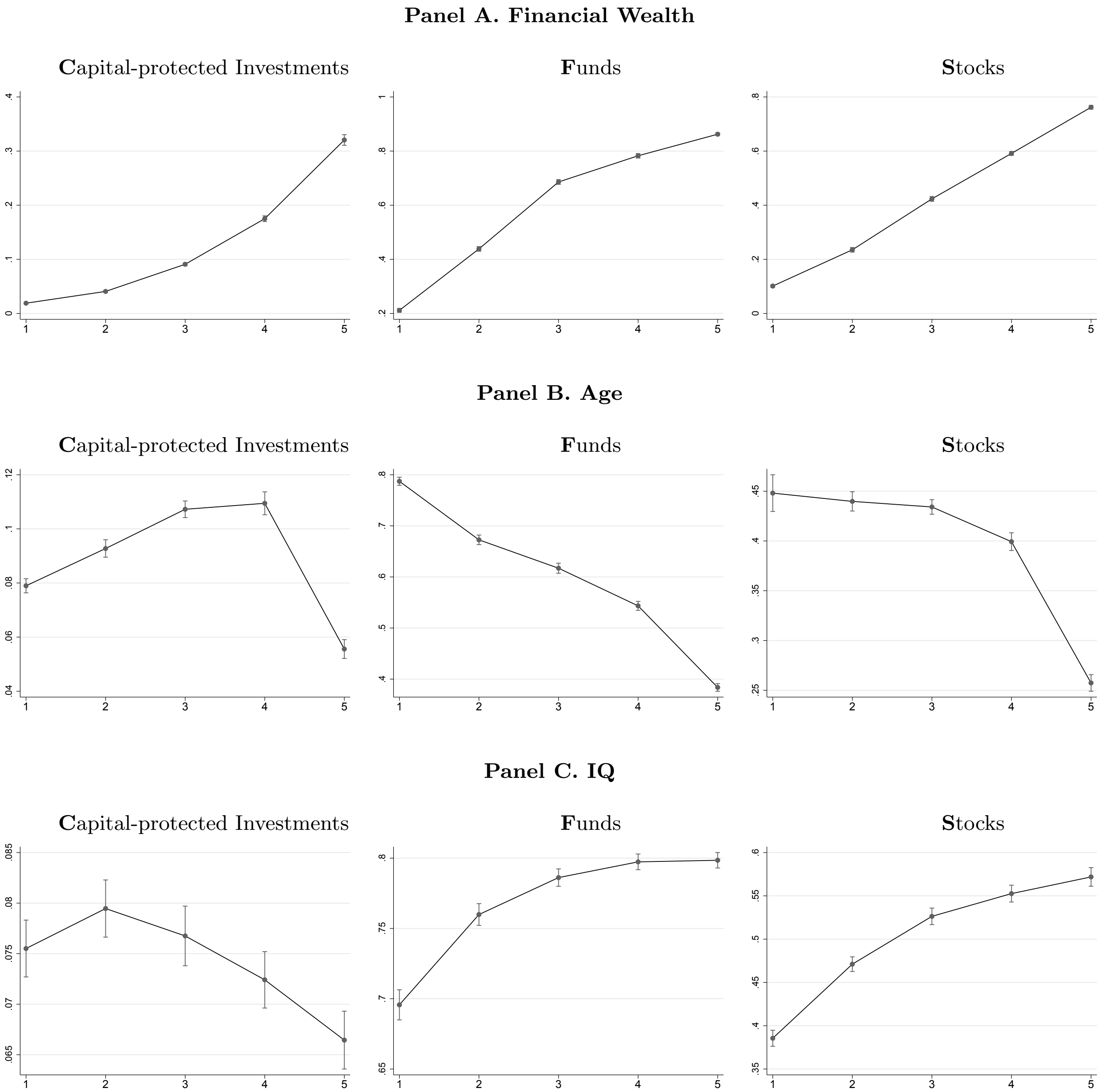


Figure 6. Likelihood of Participation in Capital-protected Investments, Equity Funds and Stocks. This figure shows predicted probabilities estimated from logit regressions, where the dependent variable is an indicator variable for investing in a given investment products at least one year during the 2002 to 2007 period. All regressions include the same explanatory variables: financial wealth deciles, IQ score levels (from 0 to 9), age categories, the number of adults in the household, the number of children in the households, and indicator variable for living in an urban area, and the gender of the household. All explanatory variables are defined in 2002.

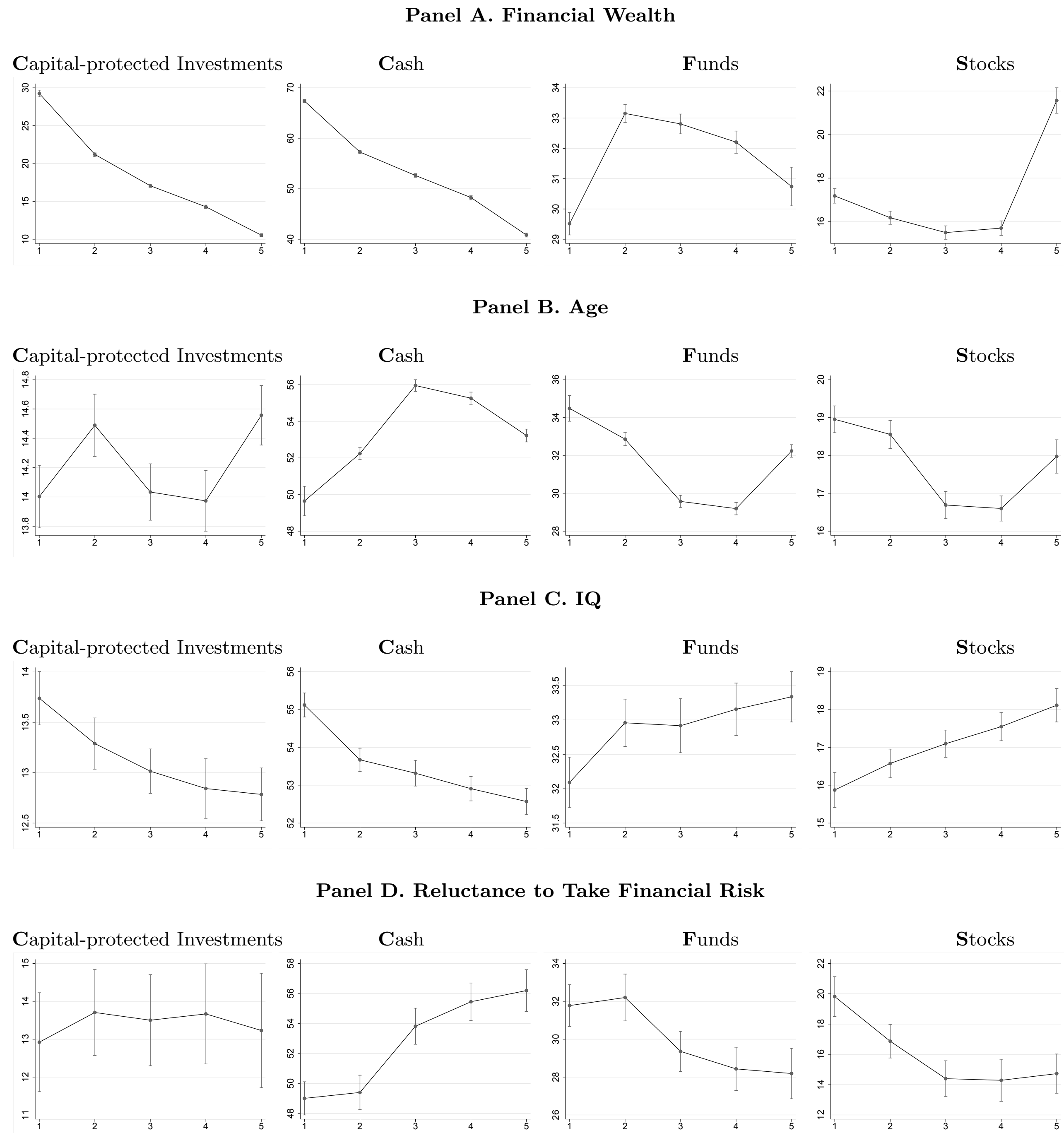


Figure 7. Portfolio Composition: Share of Financial Wealth Invested in Capital-protected Investments, Equity Funds, Stocks and Cash. This figure displays regression coefficients from OLS regressions, where the dependent variable is the share of financial wealth invested in a given investment products as of end of 2007. All regressions include the same explanatory variables: financial wealth deciles, IQ score levels (from 0 to 9), age categories, the number of adults in the household, the number of children in the households, and indicator variable for living in an urban area, and the gender of the household head. The sample is restricted to participants in each asset category.

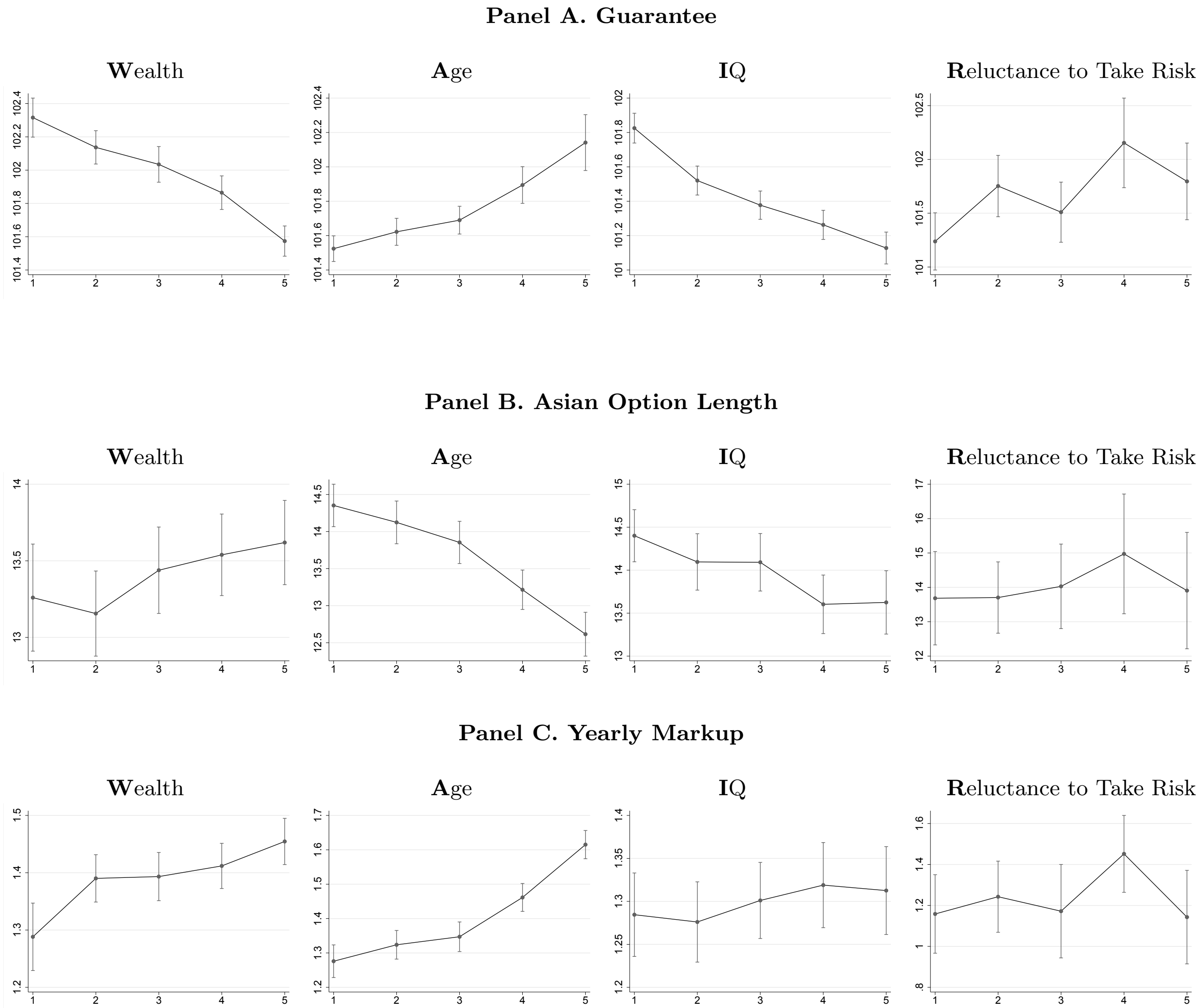


Figure 8. Product Design and Investor Characteristics. This figure displays coefficients from OLS regressions where the dependent variables are the guarantee level g, the length of the Asian Option$t_n - t_1$, and the yearly markup, as defined in section III. All regressions include the same explanatory variables: financial wealth deciles, IQ score levels (from 0 to 9), age categories, the number of adults in the household, the number of children in the households, and indicator variable for living in an urban area, and the gender of the household head. The sample is restricted to capital-protected investment participants.

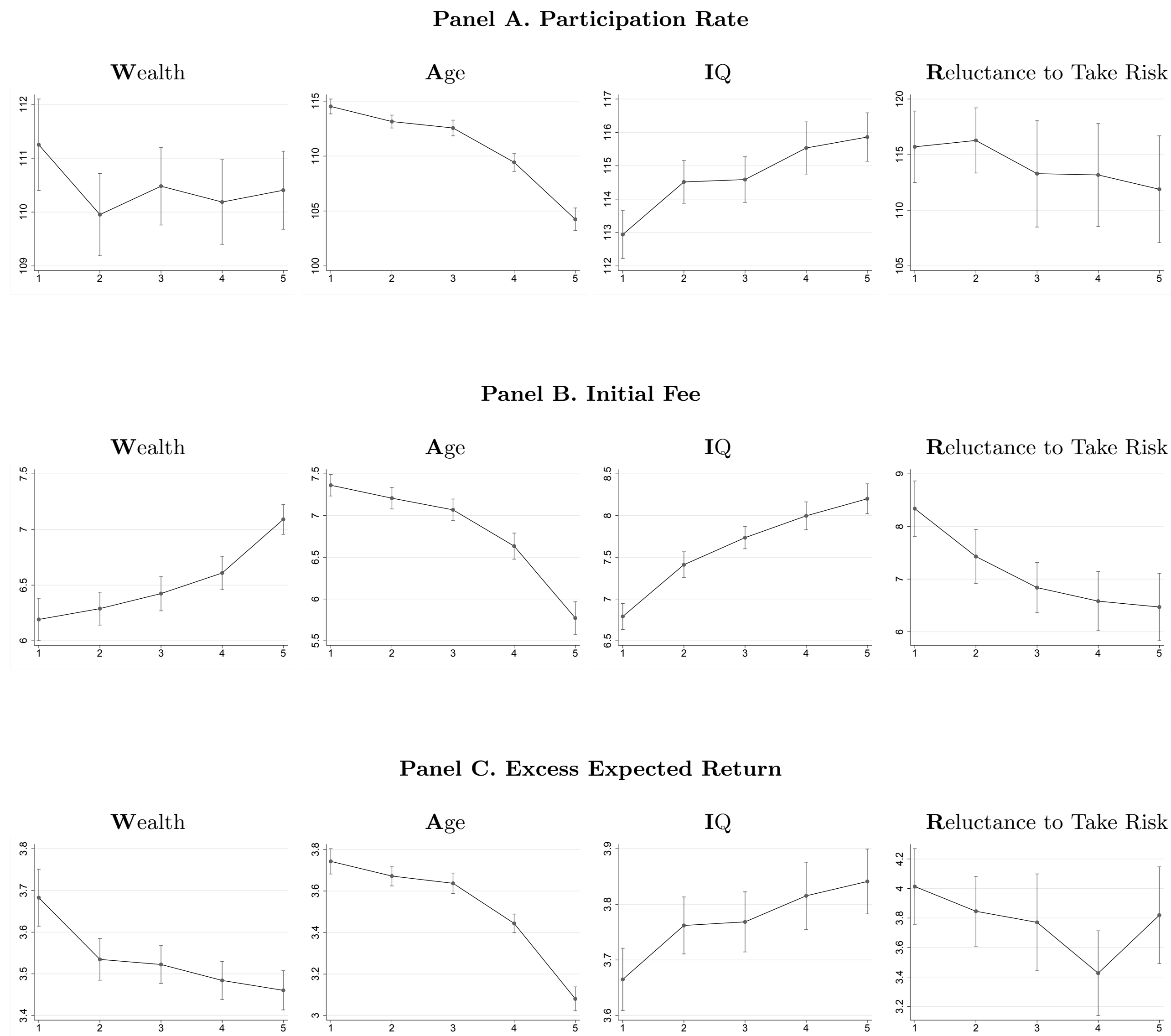
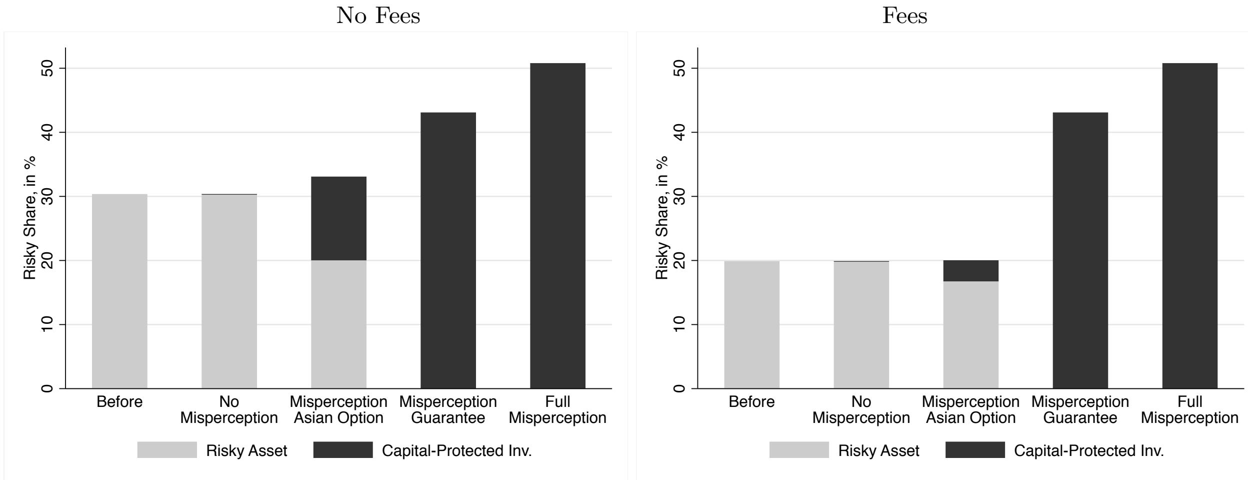


Figure 8. (cont.) Product Design and Investor Characteristics. This figure displays coefficients from OLS regressions where the dependent variables are the participation rate p, the initial fee, and the excess expected returns, as defined in section III. All regressions include the same explanatory variables: financial wealth deciles, IQ score levels (from 0 to 9), age categories, the number of adults in the household, the number of children in the households, and indicator variable for living in an urban area, and the gender of the household head. The sample is restricted to capital-protected investment participants.

Panel A. Demand for Capital-protected Investment and Misperception (RRA=4)



Panel B.The Effects of Capital-protected Investment Participation on the Risky Share and RRA (Full Misperception)

The household does not perceive the effects of neither the Asian option nor the initial fee

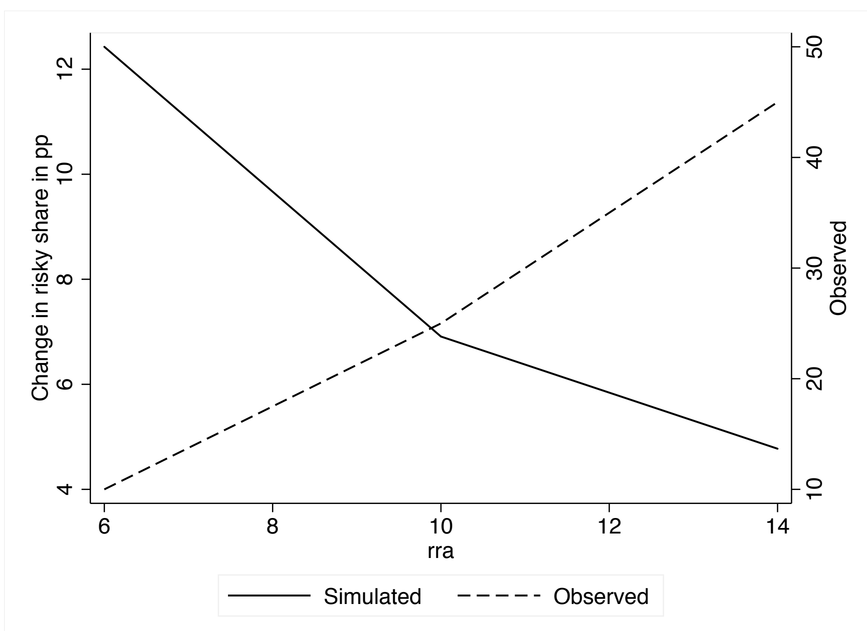
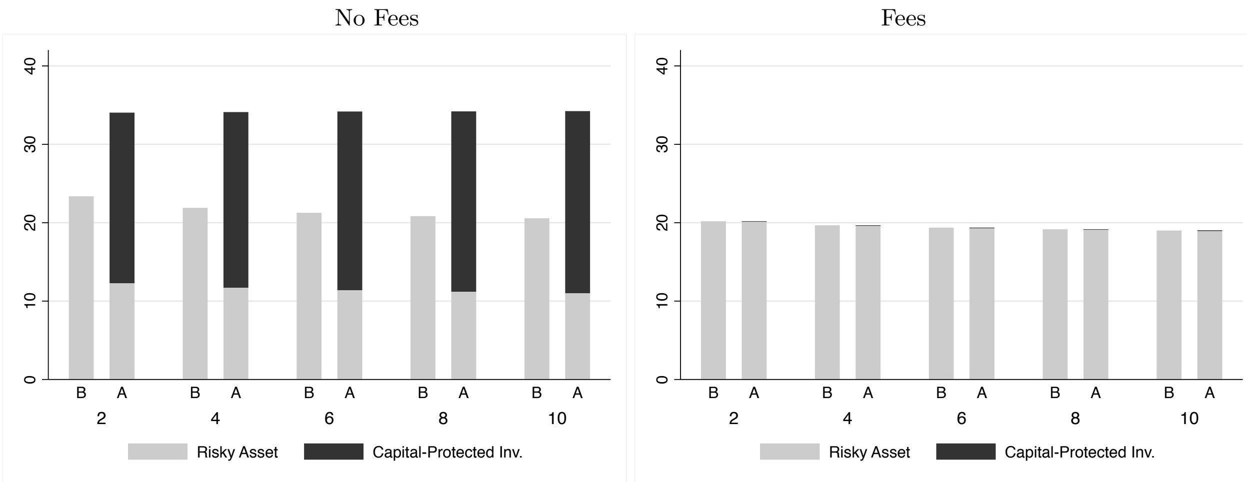


Figure 9. Model Output: CRRA Utility Function.

Panel A. Demand for Capital-protected Investment and Loss Aversion



Panel B. The Effects of Capital-protected Investment Participation on the Risky Share and Loss Aversion

The household does not perceive the effects of neither the Asian option nor the initial fee

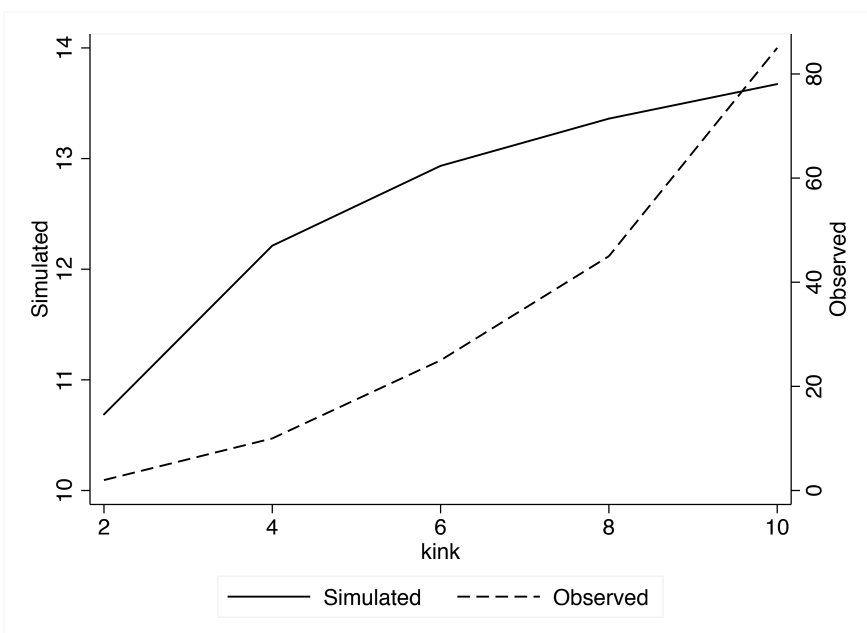


Figure 10. Model Output: Loss Aversion Utility Function.

Table I. Capital-protected Investment Summary Statistics and Pricing Outputs

Panel A: Total Sample (1,505 contracts)						
	Mean	**p1**	**p10**	**p50**	**p90**	**p99**
Issuance year	2006	2002	2004	2006	2007	2007
Volume ($ million)	5.2	0.1	0.5	2.6	13.0	29.1
Design Parameters:						
- Term (months)	40.1	12.0	17.9	37.6	60.5	72.5
- Capital guarantee (%)	100.2	100.0	100.0	100.0	100.0	108.0
- Initial fee (%)	7.0	0.0	1.0	6.0	12.0	22.0
Panel B: Representative Products (906 contracts)						
Issuance year	2006	2002	2004	2006	2007	2007
Volume ($ million)	4.9	0.0	0.4	2.9	12.1	27.5
Design Parameters:						
- Term (months)	44.2	12.5	24.5	48.0	60.5	72.5
- Capital guarantee (%)	100.2	100.0	100.0	100.0	100.0	108.0
- Initial fee (%)	8.5	0.0	1.0	11.0	13.0	22.0
- Participation rate (%)	114.6	30.0	64.0	110.0	160.0	220.0
- Asian option length (months)	14.5	0.0	4.0	13.0	36.0	60.0
Underlying Asset Parameters:						
- Beta to world index	1.1	0.5	0.9	1.1	1.3	1.4
- Historical volatility	0.2	0.1	0.1	0.2	0.3	0.4
- Dividend Yields (%)	2.0	0.0	0.5	2.1	3.0	4.5
Return Properties:						
- Yearly excess expected return (%)	3.5	-1.6	0.4	3.5	6.6	10.9
- Exposure to risk premium (%)	58.4	-26.1	5.9	59.0	110.7	182.0
- Yearly markup (%)	1.3	-4.5	-0.3	1.5	2.8	5.8

Panel A of this table reports summary statistics of the issuances of retail capital-protected investments in Sweden between 2002 and 2007. $Capitalguarantee$ represents the minimum fraction of the initial investment nominal amount that the household is guaranteed to receive at maturity. $InitialFee$ represents the additional amount that the household pay above the principal at issuance, in % of principal, i.e. Issuance price - nominal amount). This fee affects the other design parameters of the product and should not be interpreted as a markup. $ParticipationRate$ represent the coefficient applied to the positive performance of the benchmark asset. $AsianOptionLength$ represents the period over which the underlying asset performance is averaged to define the benchmark asset. These parameters are described in more details in Section 2. Panel B displays the output from the expected returns and markup calculation from Section 2. $YearlyExcessExpectedReturn$ represents the annualized expected return of the capital-protected investment over the maturity of the product, minus the riskfree rate for the same period (Swedish treasury rate). $ExposuretotheRiskPremium$ corresponds to the $YearlyExcessExpectedReturn$ divided by the World index market premium assumed for the calculation of the expected return. $YearlyMarkup$ corresponds to the difference between the issuance price of product (nominal amount + initial fee) minus the fair replication value under the Black and Scholes framework described in Section 2 of a product, divided by the product maturity in years.

Table II. Household Demographics, Financial Characteristics and Portfolio Allocation at the Start (2002) and End (2007) of the Sample Period: Summary Statistics

Sample	All (1) N= 3,112,214				Traditional Equity Product Participants (2) N=2,078,554, 66.8%				Capital-protected Investment Participants (3) N= 428,789, 13.8%			
	Mean	Median	p10	p90	Mean	Median	p10	p90	Mean	Median	p10	p90
					Panel A. 2002							
Financial characteristics (in 2000 $, thousands):												
Financial Wealth	33.8	11.3	2.5	73.0	45.3	17.8	4.6	93.0	73.0	38.1	8.1	149.7
Cash	14.7	6.8	2.1	31.8	17.6	8.4	2.7	37.6	26.8	13.0	3.7	57.7
Traditional Equity Products	15.7	1.4	0.0	30.5	23.1	4.6	0.3	44.3	37.0	12.4	0.4	80.9
Stocks	7.1	0.0	0.0	6.4	10.6	0.3	0.0	11.6	13.5	0.9	0.0	22.4
Equity Funds	8.1	0.6	0.0	19.9	11.8	2.7	0.0	28.7	22.2	7.9	0.0	54.6
Other Financial Wealth	2.7	0.0	0.0	6.9	3.6	0.0	0.0	10.2	7.3	0.0	0.0	20.2
Fixed Income Funds	1.0	0.0	0.0	0.4	1.3	0.0	0.0	1.9	2.6	0.0	0.0	6.9
Bonds	1.6	0.0	0.0	3.0	2.2	0.0	0.0	5.2	4.4	0.0	0.0	12.0
Real Estate Wealth	82.4	41.8	0.0	205.0	107.0	67.8	0.0	241.8	132.8	87.0	0.0	279.8
Total Wealth	116.3	65.1	3.1	263.6	152.4	98.4	7.9	313.7	205.8	141.5	26.5	397.7
Total Debt	33.3	11.1	0.0	88.8	41.2	18.7	0.0	103.2	36.8	13.7	0.0	92.0
Demographics												
Household Head Age	53.1	52.0	33.0	76.0	51.9	51.0	32.0	73.0	55.1	56.0	37.0	72.0
IQ Score	5.2	5.0	3.0	8.0	5.4	5.0	3.0	8.0	5.4	5.0	3.0	8.0
Reluctance to Take Fin. Risk	3.0	3.0	1.0	5.0	2.9	3.0	1.0	5.0	2.8	3.0	1.0	5.0
Family Size	2.1	2.0	1.0	4.0	2.3	2.0	1.0	4.0	2.2	2.0	1.0	4.0
Number of Children	0.2	0.0	0.0	1.0	0.2	0.0	0.0	1.0	0.2	0.0	0.0	1.0
Stockholm Area, in %	18.9	0.0	0.0	100.0	17.5	0.0	0.0	100.0	16.9	0.0	0.0	100.0
Years of Schooling	11.4	11.0	8.0	15.0	11.8	11.0	8.0	15.0	11.9	12.0	8.0	16.0
Household Head Male, in %	60.0	100.0	0.0	100.0	63.9	100.0	0.0	100.0	62.9	100.0	0.0	100.0
Disposable Income (in 2000$)	27.5	22.8	10.5	48.0	31.8	28.3	12.4	52.2	35.3	30.9	14.2	57.0
% Households that participate in												
Traditional Equity Products	66.8	100.0	0.0	100.0	100.0	100.0	100.0	100.0	91.3	100.0	100.0	100.0
Stocks	41.3	0.0	0.0	100.0	61.9	100.0	0.0	100.0	67.7	100.0	0.0	100.0
Equity Funds	55.1	100.0	0.0	100.0	82.5	100.0	0.0	100.0	81.3	100.0	0.0	100.0
% Share of financial wealth invested in (2002 participants only)												
The Risk Premium					23.8	18.3	1.4	54.3	29.2	26.1	4.6	57.7
Traditional Equity Products					34.0	28.9	3.0	74.1	42.4	40.9	8.3	79.0
Stocks					9.5	1.6	0.0	30.9	10.7	3.5	0.0	32.8
Equity Funds					23.0	17.1	0.0	56.4	29.5	26.1	1.3	62.3
Cash					57.5	59.7	16.5	95.1	45.4	42.8	11.7	83.9
					Panel B. 2007							
% Share of financial wealth invested in												
The Risk Premium	18.1	6.7	0.0	53.2	27.2	23.2	0.0	60.1	33.5	31.8	8.3	60.6
Capital-protected Investments	1.6	0.0	0.0	2.5	2.1	0.0	0.0	6.2	11.2	6.9	0.0	27.9
ETFs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Traditional Equity Products	28.1	17.6	0.0	75.5	39.1	37.3	0.2	80.8	49.9	51.0	15.1	82.6
Stocks	6.4	0.0	0.0	21.8	9.4	0.5	0.0	32.3	9.9	2.3	0.0	31.9
Equity Funds	17.3	2.7	0.0	55.7	24.1	16.7	0.0	62.4	24.7	20.7	0.0	56.1
Cash	67.7	75.4	19.0	100.0	56.0	55.4	14.8	99.0	41.8	38.5	11.2	78.1
2002-2007 % change in:												
Risky Share					3.5	14.8	-172.8	120.8	19.7	17.3	-70.5	118.8
Equity Share					34.5	60.3	-167.9	140.8	70.1	78.0	-22.8	159.6
Financial Wealth					31.9	38.8	-61.6	113.8	55.2	56.1	-10.7	124.6
Income					13.7	12.2	-20.5	49.0	15.4	13.3	-22.3	56.4

Table III. Change in Risky Share and Participation in Capital-protected Investments

	Change in Risky Share (p.p.)							
Sample		Quartiles of 2002 Risky Share				All		
	All	Q1	Q2	Q3	Q4	All	IQ Restricted	All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CPInv participation dummy	3.67***	8.53***	5.48***	2.29***	-0.67***	14.30***	4.55***	2.13***
	(0.08)	(0.09)	(0.08)	(0.08)	(0.09)	(0.52)	(0.22)	(0.33)
CPInv participation dummy interacted with:								
- financial wealth						-1.05***		
						(0.05)		
- IQ Score							-0.16***	
							(0.03)	
- Age								0.02***
								(0.01)
Province fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,026,265	506,281	506,752	506,794	506,438	2,026,265	732,141	2,026,265
R^2	0.041	0.085	0.068	0.043	0.075	0.033	0.041	0.033
Summary Statistics	All	Q1	Q2	Q3	Q4			
2002 Risky Share (%)								
- Range	[0;96]	[0;9]	[9;23]	[23;44]	[44;96]			
- Mean	24.06	3.8	15.3	32.4	63.8			
- Median	22.7	3.7	15.1	32.0	60.8			
Change in Risky Share (p.p.)								
- Mean	2.9	6.9	8.1	4.3	-7.4			
- Median	2.2	1.9	5.4	4.2	-7.5			

This table displays OLS regression coefficients. The dependent variable is the absolute change in the risky share from 2002 to 2007, in p.p. of financial wealth. The risky share includes equity funds, stocks and retail capital-protected investments. *Capital-protected Investment Participant* is a dummy variable equal to one if the household invested at least once in capital-protected investments over the 2002 to 2007 period. The sample is restricted to household participating in stock markets in 2002. The coefficient in column 1 means that the increase in stock market exposure over the 2002 to 2007 period was 3.6 percentage points higher for households who participated in capital-protected investments than for the ones that did not. Standard errors are clustered at the kommun level. T-statistics are displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table IV. Instrumental Variable Analysis

	First Stage	IV
	Capital-protected Investment Participant (1)	Change in Risky Share (in p.p.) (2)
Supply Intensity	0.128***	
	(0.022)	
Capital-protected Investment Participant		17.928***
		(0.917)
Individual Controls	Yes	Yes
Observations	735,859	735,859

This table displays the results of our IV analysis. In the first stage, the dependent variable, *Capital-protected Investment Participant*, is a dummy variable equal to one if the household invested at least once in capital-protected investments over the 2002 to 2007 period. The independent variable is a measure of capital-protected investment supply at the parish level, i.e. the share of branches in a given parish that offers capital-protected investment. In the second stage, the dependent variable is the absolute change in the risky share from 2002 to 2007, in p.p. of financial wealth. The risky share includes equity funds, stocks and retail capital-protected investments. The sample is restricted to household participating in stock markets in 2002. Control variables include years of schooling, wealth decile and age category fixed effects, as well as an urban dummy, number of children, household size and household head gender dummy. The coefficient in column 2 means that the increase in stock market exposure over the 2002 to 2007 period was 18 percentage points higher for households who participated in capital-protected investments than for the ones that did not. Standard errors are clustered at the parish level. T-statistics are displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table V. Substitution Effects and Household Characteristics

	Share of Financial Wealth Invested in Cash, in %			
	(1)	(2)	(3)	(4)
CPInv Share of Financial Wealth	-0.620***	-2.115***	-0.738***	-1.147***
	(0.002)	(0.022)	(0.012)	(0.010)
CPInv Share of Financial Wealth × Financial Wealth (log)		0.117***		
		(0.002)		
CPInv Share of Financial Wealth × IQ Score			0.012***	
			(0.002)	
CPInv Share of Financial Wealth × Age				0.010***
				(0.000)
Controls				
Household FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	16,547,797	16,547,797	5,252,612	16,547,797
R^2	0.0470	0.0489	0.0470	0.0471

This table displays OLS panel regression coefficients with household and year fixed effects. The dependent variable is the share of financial wealth invested in cash. Sample period is 2002-2007. Standard errors are clustered at the household level. We display t-statistics below their coefficients of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table VI. Portfolio Allocation across Household Characteristics

	Share of Financial Wealth Invested in:			
	CPInv Products	Stocks	Funds	Cash
	(1)	(2)	(3)	(4)
Financial Wealth (log)	-3.884***	4.238***	0.607***	-3.407***
	(0.053)	(0.117)	(0.064)	(0.097)
IQ Score	-0.252***	0.551***	0.634***	-0.707***
	(0.029)	(0.029)	(0.035)	(0.043)
Age (years)	0.039***	-0.083***	-0.033***	0.071***
	(0.006)	(0.007)	(0.007)	(0.009)
Controls				
Province FE	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes
Observations	115,196	115,196	115,196	115,196
R^2	0.11	0.11	0.03	0.04

This table displays OLS regression coefficients. The dependent variable is the share of financial wealth invested in capital-protected investment products (column 1), stocks (column 2), equity mutual funds (column 3), and cash (column 4) as of 2007. The sample is restricted to capital-protected investment participants as of 2007. Standard errors are clustered at the kommun level. Individual controls include an urban area dummy, a household head gender dummy, the size of the household and the number of children. T-statistics are displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Appendix A. Proofs

We use the following result throughout the Appendix. If V is lognormally distributed and the standard deviation of V is s, then

$$\mathbb{E}\left[\max(V-K,0)\right] = \mathbb{E}(V)\,N(d_1) - K\,N(d_2) \tag{A1}$$

for every $K>0$, where

$$d_1 = \frac{\ln[\mathbb{E}(V)/K] + s^2/2}{s}$$

and $d_2 = d_1 - s$.

A.1. Moments of the Benchmark Return

Since $\mathbb{E}_0^{\mathbb{Q}}(S_{t_i}/S_{t_0}) = e^{(r_f-q)(t_i-t_0)}$ for every i, the first moment of the benchmark return is

$$M_1^{\mathbb{Q}} = \frac{1}{n}\sum_{i=1}^{n}\mathbb{E}_0^{\mathbb{Q}}\left(\frac{S_{t_i}}{S_{t_0}}\right) = \frac{1}{n}\sum_{i=1}^{n} e^{(r_f-q)(t_i-t_0)}.$$

The second moment satisfies

$$M_2^{\mathbb{Q}} = \frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n}\mathbb{E}_0^{\mathbb{Q}}\left(\frac{S_{t_i}}{S_{t_0}}\frac{S_{t_j}}{S_{t_0}}\right).$$

If $i \le j$, then

$$\begin{aligned}
\mathbb{E}_0^{\mathbb{Q}}\left(\frac{S_{t_i}}{S_{t_0}}\frac{S_{t_j}}{S_{t_0}}\right) &= \mathbb{E}_0^{\mathbb{Q}}\left[\left(\frac{S_{t_i}}{S_{t_0}}\right)^2\frac{S_{t_j}}{S_{t_i}}\right] \\
&= e^{(r_f-q)(t_j-t_i)}\,\mathbb{E}_0^{\mathbb{Q}}\left[\left(\frac{S_{t_i}}{S_{t_0}}\right)^2\right].
\end{aligned}$$

Since $\ln(S_{t_i}/S_{t_0})$ is normal with mean $(r_f-q-\sigma^2/2)(t_i-t_0)$ and variance $\sigma^2(t_i-t_0)$, we infer that

$$\begin{aligned}
\mathbb{E}_0^{\mathbb{Q}}\left[\left(\frac{S_{t_i}}{S_{t_0}}\right)^2\right] &= e^{2(r_f-q-\sigma^2/2)(t_i-t_0)+2\sigma^2(t_i-t_0)} \\
&= e^{[2(r_f-q)+\sigma^2](t_i-t_0)}.
\end{aligned}$$

Hence

$$\mathbb{E}_0^{\mathbb{Q}}\left(\frac{S_{t_i}}{S_{t_0}}\frac{S_{t_j}}{S_{t_0}}\right) = e^{[2(r_f-q)+\sigma^2](t_i-t_0)+(r_f-q)(t_j-t_i)}.$$

Thus

$$\mathbb{E}_0^{\mathbb{Q}}\left(\frac{S_{t_i}}{S_{t_0}}\frac{S_{t_j}}{S_{t_0}}\right) = e^{[2(r_f-q)+\sigma^2][\min(t_i,t_j)-t_0]+(r_f-q)|t_j-t_i|}.$$

for all i and j, and equation (6) holds.

By a similar derivation, the first and second moments of the benchmark return under the physical measure $\mathbb{P}$ satisfy (9) and (10).

Specialized Example. Assume that the benchmark is computed f times a month over the last Y months of the product. The frequency is 1 when the index is recorded every month, 2 if this is every two weeks, or 0.5 if this is every two months, etc. In our notation, the number of observations is $n = Y\,f$ and the time interval between two consecutive observations is $t_i - t_{i-1} = 1/(12\,f)$ in annual units. The instants at which the index is recorded are therefore

$$t_i = T - \frac{n-i}{12\ f},$$

where $i = 1, ..., Y f$. We also assume that $t_0 = 0$.

Let

$$\begin{aligned} a &= e^{\frac{r_f-q}{12\,f}}, \qquad b = e^{\frac{2(r_f-q)+\sigma^2}{12f}}, \\ a^{\mathbb{P}} &= e^{\frac{\mu-q}{12\,f}}, \qquad b^{\mathbb{P}} = e^{\frac{2(\mu-q)+\sigma^2}{12f}}. \end{aligned}$$

We easily infer from equations (5), (6), (9), and (10) the following results

$$M_1 = \frac{a^{12fT}}{n}\frac{1-a^{-n}}{1-a^{-1}} \tag{A2}$$

$$M_2 = \frac{b^{12fT}}{n^2\,(a-1)}\left[2a\frac{1-(b/a)^{-n}}{1-(b/a)^{-1}} - (a+1)\frac{1-b^{-n}}{1-b^{-1}}\right] \tag{A3}$$

$$M_1^{\mathbb{P}} = \frac{(a^{\mathbb{P}})^{12fT}}{n}\frac{1-(a^{\mathbb{P}})^{-n}}{1-(a^{\mathbb{P}})^{-1}}$$

$$M_2^{\mathbb{P}} = \frac{(b^{\mathbb{P}})^{12fT}}{n^2\,(a^{\mathbb{P}}-1)}\left[2a^{\mathbb{P}}\frac{1-(b^{\mathbb{P}}/a^{\mathbb{P}})^{-n}}{1-(b^{\mathbb{P}}/a^{\mathbb{P}})^{-1}} - (a^{\mathbb{P}}+1)\frac{1-(b^{\mathbb{P}})^{-n}}{1-(b^{\mathbb{P}})^{-1}}\right]$$

where $n = Y f$.

A.2. Proof of Proposition 1

The gross return on the guaranteed product, defined by (2), satisfies

$$1 + R_{g,T} = \frac{1 + g + \max[p(1+R_T^*) - p - g; 0]}{1 + init}.$$

The mean return on the capital-protected investment, $\mathbb{E}_0^{\mathbb{Q}}(1 + R_{g,T})$, is therefore given by a Black-Scholes type formula.

Lemma A1 (Expected return on the capital-protected investment under $\mathbb{Q}$). The mean return on the capital-protected investment under the risk-adjusted measure is given by

$$\mathbb{E}_0^{\mathbb{Q}}(1+R_{g,T}) = \frac{1+g+pM_1^{\mathbb{Q}}N(d_1)-(p+g)N(d_2)}{1+init}. \tag{A4}$$

Furthermore, the mean return $\mathbb{E}_0^{\mathbb{Q}}(1+R_{g,T})$ strictly increases with the participation rate p and the guaranteed return g.

Proof of Lemma A1. In order to price the capital-protected investment, we approximate the distribution of the benchmark return $1+R_T^*$ as of date $t=0$ under the risk-adjusted measure $\mathbb{Q}$ by a lognormal with mean $M_1^{\mathbb{Q}}$ and second moment $M_2^{\mathbb{Q}}$, as the Edgeworth expansion implies (Turnbull and Wakeman 1991). The variance of the log benchmark return is then given by equation (7), which follows from the properties of the lognormal distribution.

The average return on the capital-protected investment can be written as

$$\mathbb{E}_0^{\mathbb{Q}}\,(1+R_{g,T}) \quad = \quad \frac{1+g+p\,\mathbb{E}_0^{\mathbb{Q}}\,[\max(1+R_T^*-1-g/p;0)]}{1+init}.$$

We infer from (A1) that

$$\mathbb{E}_0^{\mathbb{Q}}\,[\max(1+R_T^*-1-g/p;0)] \quad = \quad M_1^{\mathbb{Q}}\,N(d_1)-(1+g/p)N(d_2),$$

where d_1 is defined by equation (8) and $d_2 = d_1 - w^{\mathbb{Q}}$. . The expected return on the guaranteed product therefore satisfies (A4).

The monotonicity of the expected return, $\mathbb{E}_0^{\mathbb{Q}}\,(1+R_{g,T})$, with respect to g results directly from the definition of the return on the guaranteed product, $R_{g,T}$, in equation (2).

We now derive the monotonicity of the expected return with respect to the participation rate p. The argument used for g does not apply in general because if g and R_T^* are both negative, a contract with a higher participation rate would incur a larger loss. The proof relies instead on the partial derivative of the function

$$\varphi(g,p) = 1+g+p\,M_1^{\mathbb{Q}}N(d_1)-(p+g)N(d_2)$$

with respect to p.

It is useful to show a few preliminary facts. We note that

$$\frac{\partial d_1}{\partial p} \quad = \quad \frac{\partial d_2}{\partial p} = \frac{g}{p\,(p+g)\,w^{\mathbb{Q}}},$$

We also note that

$$N'(d_2) = \frac{1}{\sqrt{2\pi}}\exp\left(-\frac{d_2^2}{2}\right) = \frac{1}{\sqrt{2\pi}}\exp\left[-\frac{(d_1-w^{\mathbb{Q}})^2}{2}\right]$$

and therefore

$$N'(d_2) = N'(d_1)\exp\left[d_1 w^{\mathbb{Q}} - \frac{(w^{\mathbb{Q}})^2}{2}\right].$$

Since

$$d_1 w^{\mathbb{Q}} - \frac{(w^{\mathbb{Q}})^2}{2} = \ln\left(\frac{p}{p+g}\right) + \ln(M_1^{\mathbb{Q}}),$$

we obtain that

$$(p+g)N'(d_2) = p\,M_1^{\mathbb{Q}}\,N'(d_1).$$

Hence

$$\begin{aligned}\frac{\partial\varphi}{\partial p}(g,p) &= M_1^{\mathbb{Q}}\,N(d_1) - N(d_2) + p\,M_1^{\mathbb{Q}}\,N'(d_1)\frac{\partial d_1}{\partial p} - (p+g)N'(d_2)\frac{\partial d_2}{\partial p} \\ &= M_1^{\mathbb{Q}}\,N(d_1) - N(d_2) + \frac{\partial d_1}{\partial p}\left[p\,M_1^{\mathbb{Q}}\,N'(d_1) - (p+g)N'(d_2)\right]\end{aligned}$$

and therefore

$$\frac{\partial\varphi}{\partial p}(g,p) = M_1^{\mathbb{Q}}\,N(d_1) - N(d_2).$$

Since $d_1 > d_2$ and $M_1^{\mathbb{Q}} > 1$, we conclude that

$$\frac{\partial\varphi}{\partial p}(g,p) > 0.$$

The function $\varphi(g,p)$ strictly increases with the participation rate p.[16] We conclude that Lemma A1 holds. ■

Under the risk-adjusted measure $\mathbb{Q}$, the mean return on the capital-protected investment is equal to the risk-free rate, $\mathbb{E}_0^{\mathbb{Q}}(1+R_{g,T}) = e^{r_f T}$, which implies that Proposition 1 holds.

A.3. Pricing of Contracts with a Cap

A subset of contracts include a cap to the return that can be earned on the initial investment net of fee. The return on the capital-protected investment is then given by:

$$1 + R_{g,T} = \min\left[\frac{1+\max(p\,R_T^*; g)}{1+init}; \frac{1+cap}{1+init}\right]$$

where *cap* denotes the cap rate. The cap rate is generally higher than the guaranteed rate.

[16] A similar derivation implies that

$$\frac{\partial\varphi}{\partial g}(g,p) = N(-d_2) > 0.$$

Lemma A2 (Fair price of capital-protected investment with a cap). The fair initial fee is given by

$$init = e^{-r_f T}\left[1 + g + pM_1^{\mathbb{Q}}N(d_1) - (p+g)N(d_2) - pM_1^{\mathbb{Q}}N(e_1) + (p+cap)N(e_2)\right] - 1,$$

where

$$e_1 = \frac{1}{w^{\mathbb{Q}}}\left[\ln\left(\frac{p}{p+cap}\right) + \ln(M_1^{\mathbb{Q}}) + \frac{(w^{\mathbb{Q}})^2}{2}\right] \tag{A5}$$

and $e_2 = e_1 - w^{\mathbb{Q}}$.

The fair initial fee is reduced by the presence of a cap.

Proof of Lemma A2. The return on the guaranteed product with a cap satisfies

$$1 + R_{g,T} = \frac{1 + g + \max(p\,R_T^* - g, 0) - \max(pR_T^* - cap; 0)}{1 + init}.$$

for all realizations of R_T^*. We infer from (A1) that the proposition holds. ■

Lemma A3 (Expected return of the guaranteed product under $\mathbb{P}$). The expected return on the guaranteed product under the physical measure is

$$\mathbb{E}^{\mathbb{P}}(1 + R_{g,T}) \quad = \quad \frac{1 + g + pM_1^{\mathbb{P}}N(d_1^{\mathbb{P}}) - (p+g)N(d_2^{\mathbb{P}}) - pM_1^{\mathbb{P}}N(e_1^{\mathbb{P}}) + (p+cap)N(e_2^{\mathbb{P}})}{1 + init},$$

where

$$\begin{aligned} d_1^{\mathbb{P}} &= \frac{1}{w^{\mathbb{P}}}\left[\ln\left(\frac{p}{p+g}\right) + \ln(M_1^{\mathbb{P}}) + \frac{(w^{\mathbb{P}})^2}{2}\right], \\ e_1^{\mathbb{P}} &= \frac{1}{w^{\mathbb{P}}}\left[\ln\left(\frac{p}{p+cap}\right) + \ln(M_1^{\mathbb{P}}) + \frac{(w^{\mathbb{P}})^2}{2}\right], \end{aligned}$$

$d_2^{\mathbb{P}} = d_1^{\mathbb{P}} - w^{\mathbb{P}}$, *and* $e_2^{\mathbb{P}} = e_1^{\mathbb{P}} - w^{\mathbb{P}}$.

A.4. Joint Distribution of the Underlying and the Benchmark

We derive the joint distribution of the market and the benchmark. Let $r_{m,T} = \ln(1 + R_{m,T})$ and $r_T^* = \ln(1 + R_T^*)$.

Lemma A4 (Joint distribution of the underlying and the benchmark). The vector $(r_{m,T}, r_T^*)'$ is Gaussian with mean $[(\mu - \sigma^2/2)T\,; 2\ln(M_1^{\mathbb{P}}) - 0.5\ln(M_2^{\mathbb{P}})]'$ and variance-covariance matrix

$$\begin{bmatrix} \sigma^2 T & \sigma_{m,b} \\ \sigma_{m,b} & (w^{\mathbb{P}})^2 \end{bmatrix}, \tag{A6}$$

where

$$\sigma_{m,b} = \ln\left[\frac{\sum_{i=1}^{n} e^{(\mu-q+\sigma^2)(t_i-t_0)}}{\sum_{i=1}^{n} e^{(\mu-q)(t_i-t_0)}}\right]. \tag{A7}$$

and $w^{\mathbb{P}}$ *is defined by* (11).

Proof of Lemma A4. The total return on the stockmarket index (with reinvested dividends) has a lognormal distribution:

$$r_{m,T} = \ln(1 + R_{m,T}) \sim \mathcal{N}[(\mu - \sigma^2/2)T; \sigma^2 T].$$

The log benchmark return is approximately normal $r_T^* = \ln(1 + R_T^*) \sim \mathcal{N}\left[\mu^{\mathbb{P}}; (w^{\mathbb{P}})^2\right]$. The covariance of the log market return and the log benchmark return can be computed as follows. We know that

$$\begin{aligned}
\mathbb{E}^{\mathbb{P}}\left[(1 + R_{m,T})(1 + R_T^*)\right] &= \mathbb{E}^{\mathbb{P}}\left[\frac{S_T e^{qT}}{S_0}\frac{S_{t_1} + S_{t_2} + ... + S_{t_n}}{nS_{t_0}}\right] \\
&= \frac{e^{qT}}{n}\sum_{i=1}^{n}\mathbb{E}^{\mathbb{P}}\left[\frac{S_{t_0}}{S_0}\left(\frac{S_{t_i}}{S_{t_0}}\right)^2\frac{S_T}{S_{t_i}}\right], \\
&= \frac{e^{qT}}{n}\sum_{i=1}^{n} e^{(\mu-q)t_0} e^{[2(\mu-q)+\sigma^2](t_i-t_0)} e^{(\mu-q)(T-t_i)},
\end{aligned}$$

and therefore

$$\mathbb{E}^{\mathbb{P}}\left[(1 + R_{m,T})(1 + R_T^*)\right] = \frac{e^{\mu T}}{n}\sum_{i=1}^{n} e^{(\mu-q+\sigma^2)(t_i-t_0)}.$$

Recall that if $X = (X_1, X_2)$ is bivariate normal with mean $(\mu_1, \mu_2)'$ and variance-covariance matrix $\Sigma = (\sigma_{i,j})_{1\leq i,j\leq 2}$, then

$$\mathbb{E}^{\mathbb{P}}(e^{X_1+X_2}) = \exp\left(\mu_1 + \mu_2 + \frac{\sigma_{1,1} + \sigma_{2,2} + 2\sigma_{1,2}}{2}\right) = \mathbb{E}(e^{X_1})\,\mathbb{E}(e^{X_2})\,\exp(\sigma_{1,2}),$$

or equivalently

$$\sigma_{1,2} = \ln\left[\frac{\mathbb{E}(e^{X_1+X_2})}{\mathbb{E}(e^{X_1})\mathbb{E}(e^{X_2})}\right].$$

The covariance of $r_{m,T}$ and r_T^* is therefore

$$Cov(r_{m,T}; r_T^*) = \ln\left\{\frac{\mathbb{E}^{\mathbb{P}}\left[(1 + R_{m,T})(1 + R_T^*)\right]}{\mathbb{E}^{\mathbb{P}}(1 + R_{m,T})\ \mathbb{E}^{\mathbb{P}}(1 + R_T^*)}\right\},$$

which implies (A7).

Appendix B. Additional Figures and Tables

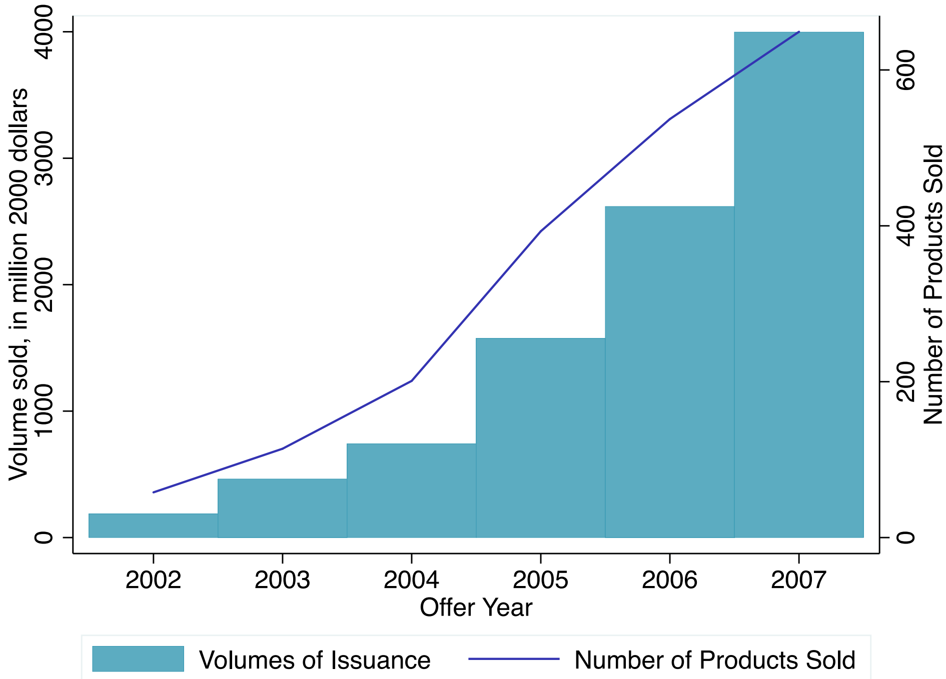


Figure IA.1. Volume and Number of Products Sold per Year. This figure shows volume issuance in millions of 2000 USD of retail capital-protected investments over the 2002 to 2007 period in the Swedish market.

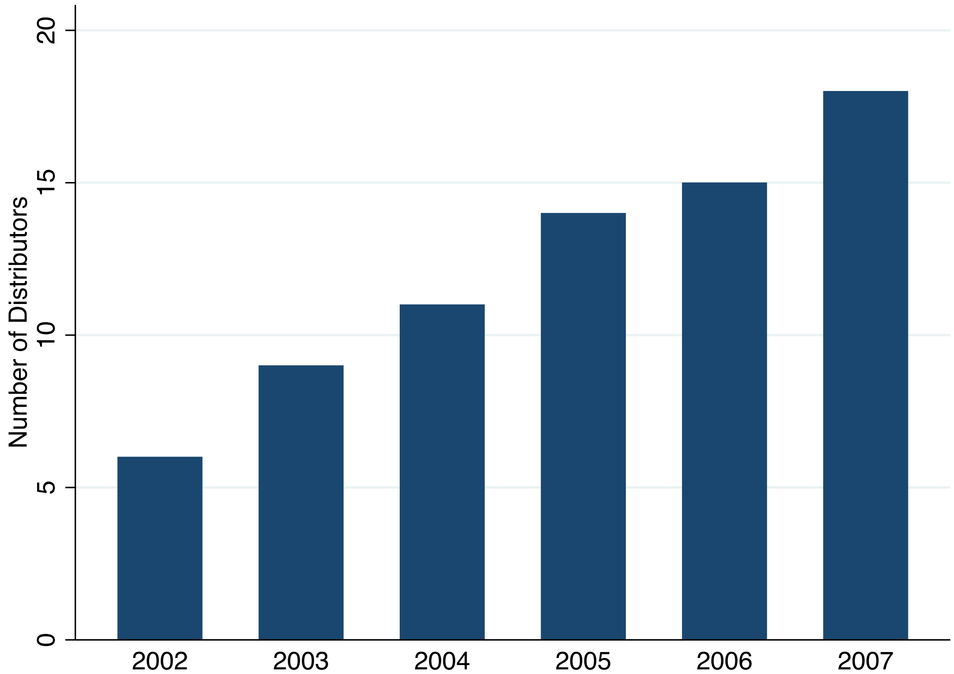


Figure IA.2. Number of Distributors per Year. This figure shows the evolution of the number of capital-protected investment distributors over the 2002 to 2007 period.

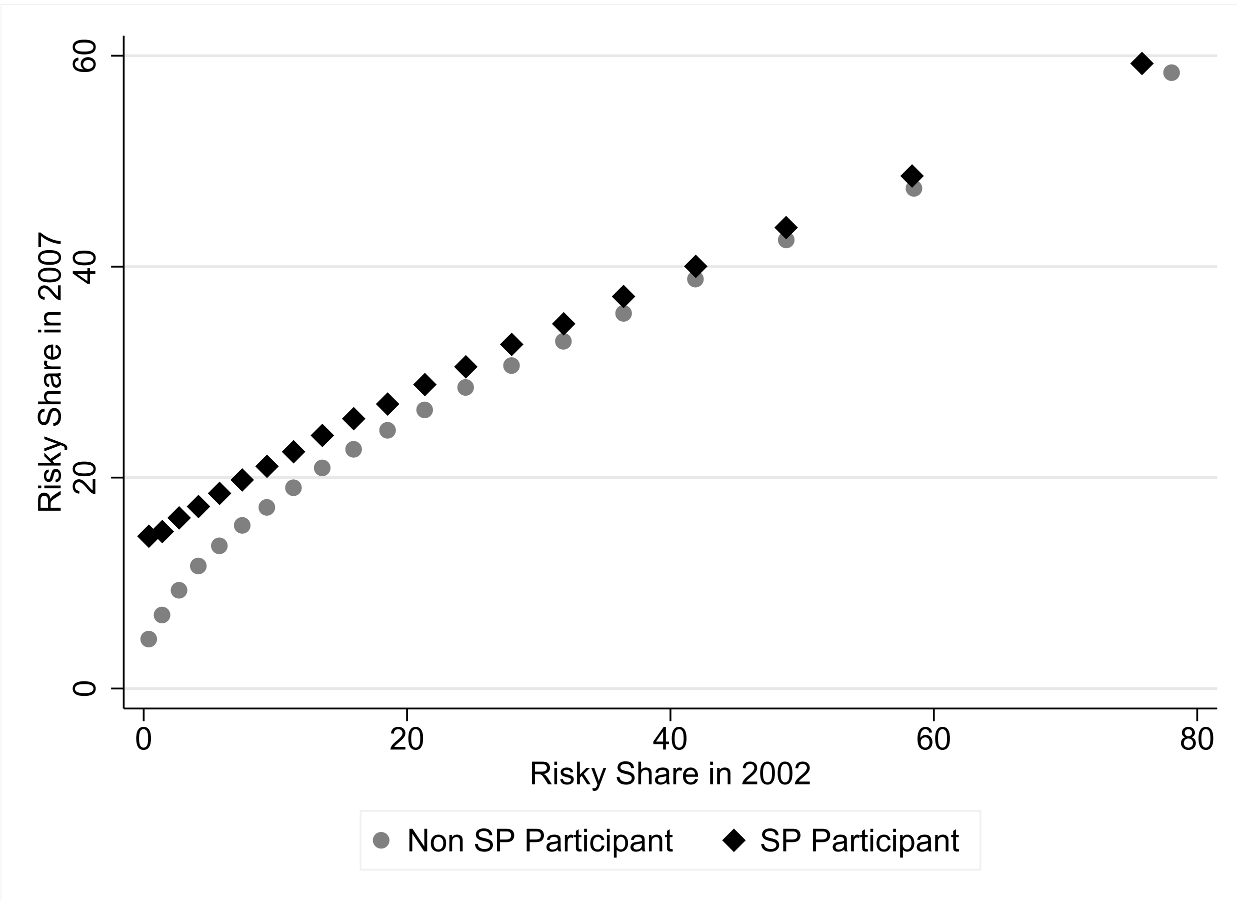


Figure IA.3. The Effect of Participating in Capital-protected Investments or Any New Fund on the Risky Share (2002 - 2007). This figure shows the evolution of the number of capital-protected investment and new fund distributors over the 2002 to 2007 period.

Table IA.1. Market Share (in Volume) of Capital-protected Investment Distributors

	Market Share (1)	Cumulated Market Share (2)	Entry Date (3)
Swedbank	30.5%	30.5%	April 2002
Handelsbanken	20.7%	51.1%	May 2002
Nordea	14.7%	65.9%	September 2002
SEB	14.6%	80.5%	April 2003
Hq bank	5.4%	85.9%	March 2003
Acta	4.4%	90.4%	January 2002
Erik Penser	2.7%	93%	January 2004
Danske Bank	2.6%	95.7%	March 2002
Avanza	1.6%	97.3%	October 2004
Kaupthing Bank	1.1%	98.3%	November 2005
Garantum	0.7%	99%	
E-trade	0.4	99.5%	
Ohman	0.2	99.7%	
Others	0.3%	100%	

This table reports the market share of each distributor, in volumes of product sold, over our sample period.

Table IA.2. Sensitivity Analysis

Upward Adjustment to Underlying Asset Volatility	**+1%**	**+ 2%**	**+3%**	**+4%**	**+5%**
Resulting Average Underlying Asset Volatility	0.19	0.20	0.21	0.22	0.23
Yearly Mark-up (in %)	1.32	1.14	0.96	0.77	0.59
Yearly Excess Expected Return					
with Risk Premium=4%	1.85	2.01	2.16	2.32	2.48
with Risk Premium=5%	2.66	2.80	2.95	3.10	3.25
with Risk Premium=6%	3.50	3.64	3.77	3.91	4.05
with Risk Premium=7%	4.38	4.50	4.63	4.76	4.89
with Risk Premium=8%	5.29	5.40	5.52	5.64	5.76
Exposure to the Risk Premium					
with Risk Premium=4%	46.4	50.2	54.1	58.0	61.9
with Risk Premium=5%	53.2	56.1	59.0	61.9	64.9
with Risk Premium=6%	58.4	60.6	62.9	65.2	67.5
with Risk Premium=7%	62.6	64.3	66.1	68.0	69.9
with Risk Premium=8%	66.1	67.5	69.0	70.5	72.0

Table IA.3. Links between Capital-protected Investment Characteristics

	Participation Rate in % (1)	Yearly Markup in % (2)	Excess Expected Return in % (3)	Exposure to the Risk Premium in % (4)
Participation rate, in %		-0.02***	0.05***	0.75***
		(0.00)	(0.00)	(0.05)
Guarantee , in %	-4.31***	-0.03*	-0.10***	-1.71***
	(0.49)	(0.02)	(0.03)	(0.47)
Initial Fee, in %	5.03***	0.16***	-0.09***	-1.58***
	(0.18)	(0.02)	(0.02)	(0.39)
Length of the Asian Options (in months)	0.31***	0.03***	-0.08***	-1.25***
	(0.09)	(0.00)	(0.00)	(0.08)
Term, in months	0.32***	-0.00	0.03***	0.46***
	(0.08)	(0.00)	(0.01)	(0.10)
Year FE	Yes	Yes	Yes	Yes
Observations	906	906	906	906
R^2	0.552	0.281	0.528	0.528

Note: This table displays coefficients from OLS regressions. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table IA.4. Change in Risky Share and Participation in Capital-protected Investments

Panel A: IQ Sample					
Sample		Quartiles of 2002 Risky Share			
	All	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)	(5)
CPInv participation dummy	3.415***	8.510***	4.739***	1.872***	-0.373***
	(0.079)	(0.142)	(0.123)	(0.129)	(0.127)
Province fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	734,797	177,355	192,865	192,483	172,094
R^2	0.063	0.065	0.069	0.052	0.096
Panel B: Controlling for IQ					
Sample		Quartiles of 2002 Risky Share			
	All	Q1	Q2	Q3	Q4
	(6)	(7)	(8)		
CPInv participation dummy	3.424***	8.514***	4.738***	1.860***	-0.364***
	(0.079)	(0.143)	(0.124)	(0.129)	(0.127)
Province fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	735,276	177,501	192,992	192,590	172,193
R^2	0.062	0.064	0.068	0.052	0.096

This table displays OLS regression coefficients. The dependent variable is the absolute change in the risky share from 2002 to 2007, in p.p. of financial wealth. The risky share includes equity funds, stocks and retail capital-protected investments. *Capital-protected Investment Participant* is a dummy variable equal to one if the household invested at least once in capital-protected investments over the 2002 to 2007 period. The sample is restricted to household participating in stock markets in 2002. The coefficient in column 1 means that the increase in stock market exposure over the 2002 to 2007 period was 4.2 percentage points higher for households who participated in capital-protected investments than for the ones that did not. Standard errors are clustered at the kommun level. T-statistics are displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table IA.5. Active Change in Risky Share and Participation in Capital-protected Investments

Sample	Active Change in Risky Share, in p.p.							
		Quartiles of 2002 Risky Share				All		
	All	Q1	Q2	Q3	Q4	All	IQ Restricted	All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CPInv participation dummy	2.94***	9.73***	5.67***	1.83***	-2.33***	5.79***	2.81***	-2.50***
	(0.10)	(0.15)	(0.17)	(0.15)	(0.16)	(1.01)	(0.44)	(0.53)
CPInv participation dummy interacted with:								
- financial wealth						-0.28***		
						(0.10)		
- IQ score							-0.02	
							(0.07)	
- age								0.11***
								(0.01)
Controls								
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,106,010	273,919	279,289	278,373	274,429	1,106,010	562,324	1,106,010
R^2	0.074	0.080	0.085	0.058	0.077	0.065	0.071	0.065
Corresponding Summary Statistics	All	Q1	Q2	Q3	Q4			
2002 Risky Share, in %								
Range	[0 ; 96]	[0 ; 9]	[9 ; 23]	[23 ; 44]	[44 ; 96]			
Mean	28.8	3.8	15.3	32.4	63.8			
Median	22.7	3.7	15.1	32.0	60.8			
Change in Risky Share, in pp								
Mean	4.1	9.3	11.0	5.9	-9.9			
Median	2.6	2.2	7.2	5.9	-4.5			

This table displays OLS regression coefficients. The dependent variable is the active change in the risky share from 2002 to 2007, in p.p. of financial wealth. The risky share includes equity funds, stocks and retail capital-protected investments. *Capital-protected Investment Participant* is a dummy variable equal to one if the household invested at least once in capital-protected investments over the 2002 to 2007 period. The sample is restricted to household participating in stock markets in 2002. The coefficient in column 1 means that the increase in stock market exposure over the 2002 to 2007 period was 2.9 percentage points higher for households who participated in capital-protected investments than for the ones that did not. Standard errors are clustered at the kommun level. T-statistics are displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table IA.6. Change in Risky Share and Participation in Capital-protected Investments: Control Group Restricted to Fund Buyers

Sample	Change in Risky Share (p.p.)							
		Quartiles of 2002 Risky Share				All		
	All	Q1	Q2	Q3	Q4	All	IQ Restricted	All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CPInv participation dummy	2.616***	5.329***	3.014***	0.752***	-1.201***	0.978	2.746***	-0.854**
	(0.060)	(0.094)	(0.085)	(0.081)	(0.087)	(0.733)	(0.235)	(0.400)
CPInv participation dummy interacted with:								
- financial wealth						0.137*		
						(0.071)		
- IQ Score							-0.024	
							(0.038)	
- Age								0.061***
								(0.008)
Province fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,132,591	202,963	269,798	318,866	340,964	1,132,591	449,814	1,132,591
R^2	0.049	0.048	0.052	0.041	0.068	0.040	0.051	0.040
Summary Statistics	All	Q1	Q2	Q3	Q4			
2002 Risky Share (%)								
- Range	[0;96]	[0;9]	[9;23]	[23;44]	[44;96]			
- Mean	24.06	3.8	15.3	32.4	63.8			
- Median	22.7	3.7	15.1	32.0	60.8			
Change in Risky Share (p.p.)								
- Mean	2.9	6.9	8.1	4.3	-7.4			
- Median	2.2	1.9	5.4	4.2	-7.5			

This table displays OLS regression coefficients. The control group is restricted to households that have bought a fund over the 2002-2007 period. The dependent variable is the absolute change in the risky share from 2002 to 2007, in p.p. of financial wealth. The risky share includes equity funds, stocks and retail capital-protected investments. *Capital-protected Investment Participant* is a dummy variable equal to one if the household invested at least once in capital-protected investments over the 2002 to 2007 period. The sample is restricted to household participating in stock markets in 2002. The coefficient in column 1 means that the increase in stock market exposure over the 2002 to 2007 period was 3.6 percentage points higher for households who participated in capital-protected investments than for the ones that did not. Standard errors are clustered at the kommun level. T-statistics are displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.