Can Security Design Foster Household Risk-Taking?

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ABSTRACT

This paper shows that securities with non-linear payoff designs can foster household risk-taking. We demonstrate this effect by exploiting the introduction of capital guarantee products in Sweden between 2002 and 2007. Their fast and broad adoption is associated with an increase in expected financial portfolio returns. The effect is especially strong for households with low risk appetite ex ante. These empirical facts are consistent with a life-cycle model in which households have pessimistic beliefs or preferences combining loss aversion and narrow framing. Our results illustrate how security design can mitigate behavioral biases to increase mean household portfolio returns.

JEL Codes: I22, G1, D18, D12.

Keywords: Security design, household finance, capital guarantee product, behavioral biases, stock market participation, risk-taking.

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A distinguishing feature of financial markets is that, in every country, a sizable group of households only invest a small share of financial wealth in stocks and equity funds (Calvet, Campbell, and Sodini, 2007).[1] This empirical fact is a challenge to canonical models of portfolio allocation (Campbell and Viceira, 2002; Cocco, Gomes, and Maenhout, 2005; Gomes and Michaelides, 2005; Merton, 1971) because households with low equity holdings forfeit an important source of income over their lives (Haliassos and Bertaut, 1995; Mankiw and Zeldes, 1991), which reinforces wealth inequality (Bach, Calvet, and Sodini, 2020).[2]

Another, and potentially related, challenge to finance theory is the impressive growth over the past two decades of the market for retail *capital guarantee products*, henceforth CGPs, a class of equity-linked contracts offering a capital protection. In 2015, CGPs total more than $4.4 trillion in global outstanding volumes and represent a significant share of household savings in major economies.[3] In Sweden, where precise data on household portfolio holdings are available, CGPs have been adopted quickly and broadly, reaching 14% of the population within five years of their introduction. Rational-choice portfolio theory does not provide a clear economic rationale for the success of CGPs. By contrast, several innovative financial assets prescribed by theory, such as low-cost exchange-traded funds or inflation-indexed bonds, have experienced much slower speeds of adoption (Shiller, 2004).

Taken together, these major stylized facts raise a number of questions. Does the capital protection embedded in CGPs foster financial risk-taking? If so, through which economic mechanism? Are households better off as a result? More generally, can security design mitigate behavioral biases preventing groups of households from making efficient decisions?

In the present paper, we first address these questions empirically by studying the introduction of CGPs in Sweden in the 2000s. We exploit a unique administrative data set containing granular information on the demographics and asset holdings of every Swedish resident, matched with detailed information on all CGPs sold in Sweden. The resulting

[1]See Table I.

[2]See also Gomes, Haliassos, and Ramadorai (2020) and the references therein.

[3]Table II reports the outstanding volumes of CGPs across countries in 2015 and their types.

household panel offers comprehensive coverage of household portfolios at the asset level for the full Swedish population over the 2002-2007 period, the first five years of the development of the retail market for CGPs.

We show that CGPs sold in Sweden allow retail investors to earn a significant fraction of the equity premium. Our asset pricing analysis takes into account all aspects of the design of CGPs, including their exact payoff formula, disclosed fees, credit risk, and the ex-dividend nature of the final payoff. CGPs offer investors an expected excess return equal to 0.49 times the equity premium on average. This result holds even though CGPs in Sweden embed relatively high total markups, amounting on average to 1.5% of invested capital per year. These expected excess returns and markups are comparable in magnitude to the ones we measure for equity mutual funds sold in Sweden over the same period.[4]

Among equity participants, households investing in CGPs increase risk-taking significantly more than households that do not. We define the *risk-taking index* as the expected fraction of the yearly equity premium earned on a household's financial portfolio, net of fees. This risk-taking index amounts to 0.24 on average in 2002 across all equity participants. Over the 2002-2007 period, it increases by 15% for CGP participants on average, while it remained stable for non-participants.

The positive relation between participating in CGPs and risk-taking is more pronounced for equity participants with low portfolio risk ex ante. Therefore, these households, who are wealthier than households that do not participate in equity markets, forfeit significant income by not following the prescriptions of canonical portfolio theory. They also account for a sizable share of the population, hence representing a potentially large source of capital for the corporate sector. Equity participants in the bottom quartile of risk taking ex ante increase their risk-taking index from 0.025 in 2002 to 0.090 in 2007 if they adopt CGPs, and from 0.025 to 0.033 if they do not.

The correlation between CGP investing and increased risk-taking appears to be causal.

[4]Gennaioli, Shleifer, and Vishny (2015) report similar magnitudes for mutual funds in the U.S. once taking into account all types of fees.

Using data on bank-household relationships in 2002, we construct two time-varying instruments for household investment in CGPs: (i) the portion of CGPs in the risky product mix of the household's banks, and (ii) the average participation rate of the CGPs offered by the banks. The participation rate, which we define in Section I, determines the upside potential of the product and is therefore a salient form of price information. When instrumenting CGP investment in a panel regression with household and year fixed effects, we find that a 1 pp increase in the share of financial wealth invested in CGPs leads to a 0.43 pp increase in the risk-taking index. This result is robust to the choice of instrument. Since the mean risk-taking index of a CGP is 0.49, this result implies that there is only limited substitution between CGPs and traditional equity products.

Building on these empirical findings, we then turn to possible theoretical explanations for the positive impact of CGP investing on household risk-taking. We develop a life-cycle model with stochastic labor income that augments standard models (e.g., Cocco et al. (2005), Gomes and Michaelides (2005)) along two dimensions. First, in addition to a stock and a bond, the household can invest in a CGP with the exact same design, embedded markup, credit risk, and illiquidity as the median product in our sample. Second, we go beyond Epstein-Zin utility under rational expectations and investigate a flexible set of preferences and beliefs.

Households with preferences combining loss aversion and narrow framing (Barberis and Huang, 2009) increase risk-taking after the introduction of CGPs, and the effects are stronger among households that are initially less willing to take risk. By contrast, Epstein and Zin (1989) preferences, general disappointment aversion (Gul, 1991; Routledge and Zin, 2010), and preferences combining narrow framing with second-order risk aversion cannot explain the data. The intuition is the following. When risk aversion is second-order, as is the case under Epstein-Zin preferences or smooth forms of narrow framing, the stock offers an attractive trade-off between risk and return, while the welfare benefits from CGPs and the demand for these products are weak. First-order risk aversion is therefore a natural avenue. However, as

Barberis, Huang, and Thaler (2006) explain, the presence of other preexisting risks, such as labor income risk, makes a purely loss averse agent act in a second-order risk-averse manner toward independent, delayed gambles. Therefore, the combination of narrow framing and loss aversion is necessary to explain the empirical results in our life-cycle framework.

Households with pessimistic beliefs about equity markets also increase risk-taking after the introduction of CGPs. We show that this result holds whether pessimism is captured by probability weighting (Prelec, 1998), high subjective volatility, or a high subjective probability of a market crash. CGPs combine the upside potential of equity markets with protection against adverse outcomes, which pessimistic households view as likely. The increase in risk-taking triggered by the introduction of CGPs is therefore the strongest among the most pessimistic households. These results also hold when the household is ambiguity averse (Gilboa and Schmeidler, 1989) and includes a pessimistic belief in the set of beliefs it considers.

Building on these results, we assess the welfare gains associated with the introduction of CGPs. By revealed preference, a household should be better off under the lens of its *decision* utility if it adopts the innovation. Indeed, despite the comfortable markup that banks charge, households obtain a substantial share of the surplus created by CGPs. We also take a conservative approach by assessing household welfare through the lens of *experienced* utility (Kahneman, Wakker, and Sarin, 1997). Assuming that experienced utility exhibit less pronounced behavioral traits than decision utility, we find that households least willing to take risk ex ante still enjoy sizable welfare gains and a dominant share of the total surplus.

This paper contributes to the strand of the household finance literature investigating low risk-taking by a sizable subset of the population (Haliassos and Bertaut, 1995; Barberis et al., 2006; Calvet et al., 2007; Guiso, Sapienza, and Zingales, 2008; Kuhnen and Miu, 2017). Our work identifies that pessimistic beliefs or loss aversion combined with narrow framing can explain both this low risk-taking and the success of securities offering a capital protection.

Our study opens a new direction in the active debate on how to address the frictions households face when making financial decisions. The literature has explored the effects of financial education (Bernheim, Garrett, and Maki, 2001), financial advisors (Gennaioli et al., 2015) or default options (Madrian and Shea, 2001). While evidence on the effectiveness of financial education is mixed (e.g. Duflo and Saez (2003), Lusardi (2008)), Chalmers and Reuter (2020) show that in the context of U.S. retirement plans, default options in target funds are more valuable to households than having access to financial advisors. Due to offsetting household behaviors at longer horizons, however, extrapolating the short-run gains from default option introductions can significantly overstate their lifetime benefits (Choukhmane, 2019). Our findings suggests that security design might be both more effective and more targeted than each of these alternatives by specifically addressing the bias distorting household financial decisions.[5] In this sense, the security design solution has the ability to provide customized efficiency, analogous to the decision process designs advocated by Thaler and Benartzi (2004) and others to encourage higher saving rates.

Our work also contributes to the literature on the costs and benefits of financial innovation. Several studies have underlined potential adverse effects, such as speculation (Simsek, 2013) or rent extraction (Biais, Rochet, and Woolley, 2015; Biais and Landier, 2018), particularly from unsophisticated agents (Carlin, 2009). The present paper illustrates how innovative products can mitigate behavioral biases and thereby benefit unsophisticated investors. This mechanism differs from and complements the more traditional role of financial innovation, consisting of completing markets and improving risk sharing (Ross, 1976; Calvet, Gonzalez-Eiras, and Sodini, 2004).

This study adds to the literature examining how financial institutions tailor security design to fit investor preferences or beliefs. Célérier and Vallée (2017) document how banks design financial products to cater to yield-seeking investors, which allows them to charge larger markups.[6] The present paper further establishes that security design is a powerful tool for changing economic behavior. In contrast to earlier work, however, we focus on

[5]The security design we study does not mitigate a bias by exploiting another one, such as inertia for default options or gambling propensity for lottery-saving accounts (Cole, Iverson, and Tufano, 2018).

[6]Egan (2019), Henderson and Pearson (2011), Li, Subrahmanyam, and Yang (2018), and Vokata (2019) also focus on the dark side of non-linear products.

the bright side of innovation and show that security design can foster actions beneficial to investors. Our paper therefore brings nuance to the prevailing negative view of tailored security design. In this respect, our findings expand the economics literature advocating contract design as a solution to behavioral biases (DellaVigna and Malmendier, 2004).

Finally, our study builds on the rich literature that studies deviation from the neo-classical paradigm through utility functions or beliefs (Barberis et al., 2006; Barberis, 2013; Gul, 1991; Prelec, 1998; Kahneman and Tversky, 1979). We emphasize that this paper focuses on the investment decisions and economic well-being of the sizable subset of households with low levels of risk-taking. We show that the behavior of these households before and after the introduction of CGPs seems consistent with pessimistic beliefs or preferences combining loss aversion and narrow framing. By contrast, an extensive literature documents that other segments of the population are adequately described by more traditional preferences and beliefs (Calvet, Campbell, Gomes, and Sodini, 2021; Fagereng, Gottlieb, and Guiso, 2017; Gomes and Michaelides, 2005). Relatedly, our paper expands the literature that studies portfolio allocation in a life-cycle model (Cocco, Gomes, and Maenhout, 2005; Gomes, Kotlikoff, and Viceira, 2008) by considering non-standard utility functions and beliefs and an enlarged investment set, and their effect on optimal portfolio allocation.

The paper is organized as follows. Section I provides background on retail CGPs and presents the data. Section II measures the expected returns and markups on CGPs and equity funds. Section III shows empirically that the introduction of CGPs induces a causal increase in household risk-taking. Section IV develops a life-cycle model of portfolio allocation in the presence of bonds, stocks, and CGPs. In Section V, we measure the welfare gains from financial innovation and how they are divided between product providers and households. Section VI concludes. An Internet Appendix provides derivations and additional results.

I. Background and Data

A. *Household Risk-Taking*

Table I documents the low levels of household financial risk-taking across countries. We consider a selected set of countries for which data are available and provide summary statistics on household participation in equity markets. In Sweden, as of 2015, equity represents 17% of aggregate household financial wealth (column 1), 68% of households with a head aged 50 or above participate in equity markets (column 2), and the median participating household invests 37% of financial wealth in equity (column 3).[7] These levels, while modest compared to the prescriptions of standard portfolio theory, are relatively high by international standards. Therefore, the effects of innovative security design on risk-taking we identify in Sweden are likely to be stronger in other countries.

While the literature on household financial risk-taking devotes considerable attention to segments of the population that do not participate at all in equity markets, the present study focuses on households that allocate a strictly positive but very low share of financial wealth to equity. The levels of risk-taking of these households are well below the prescriptions of canonical models (Campbell and Viceira, 2002; Cocco et al., 2005; Merton, 1971). On average, non-participating households own very little financial wealth and therefore have limited ability to invest in stocks.[8] By contrast, participants with low risky shares are much wealthier. For instance, in the U.S., participants with an equity share lower than 20% represent 40% of all participants and have a median financial wealth equal to $272,000, compared to $5,000 for non-participants and $370,000 for participants with risky shares above 20%. We observe similar patterns in Sweden.[9] As a consequence, participants with low risky shares forego much higher financial income compared to non-participants. They

[7]Section II of the Internet Appendix provides details on the methodology used to obtain these statistics.

[8]While non-participation is an important issue in many countries, Sweden is not the best country to study this topic because it has one of the highest participation rates in the world in 2002 and nonparticipants have very little wealth to invest.

[9]In Sweden, participants with equity shares less than 20% represent 31% of all participants and have a median financial wealth of $30,000, compared to $3,000 for non participants.

also represent a sizable potential source of capital for corporations.

B. Background on Capital Guarantee Products

Capital guarantee products are retail investments that offer exposure to the upside potential of risky assets and protect a substantial part of invested capital, typically close to 100%. Financial institutions use three main approaches to structure a CGP. They can (i) design a synthetic product, (ii) implement a portfolio insurance strategy, or (iii) build reserves.[10]

In this paper, we focus almost exclusively on synthetic CGPs, also referred to as retail structured products with a capital protection. Synthetic CGPs are passive, limited-horizon products with a non-linear payoff that depends on the performance of an underlying asset (Célérier and Vallée, 2017). The first synthetic CGPs were created in the United Kingdom in the early 1990s and were initially targeted at institutional investors. However, financial institutions quickly rolled out the products to their retail client bases, as they discovered their popularity among individual investors. The technology spread to other European countries over the decade and reached Sweden in the early 2000s.

As of 2015, with total outstanding volumes amounting to $4.4 trillion, retail CGPs are widespread around the world, suggesting that their design strongly appeals to retail investors. Table II provides country-level statistics in billion dollars and as a percentage of GDP across the different formats of CGPs. In the United States, guaranteed variable annuities represent a $1.6 trillion market (Ellul et al., 2018). In France, Euro-life insurance contracts amount to $1.5 trillion, or 57% of GDP (Hombert and Lyonnet, 2020). In China, guaranteed wealth management products account for $854 billion, or 4.8% of GDP. Finally, outstanding volumes of retail structured products with a capital protection exceed $400 billion in the world, and $5 billion in Sweden, or more than 1% of GDP, versus $9 billion in 2007 (in 2015 dollars). The Swedish market is larger than the UK market, relative to its GDP, and comparable to

[10]Portfolio insurance is a dynamic trading strategy aimed at managing downside risk. Reserves are built by the product provider to offset fluctuations in asset returns, as is the case for Euro life insurance contracts in France (Hombert and Lyonnet, 2020).

the German and French markets, with outstanding volumes accounting for respectively 1.2 and 1.1% of GDP.

We exploit the introduction of CGPs in Sweden over the 2002-2007 period to study the impact of security design on household risk-taking for the following reasons. CGPs quickly reached a significant share of the population: 14% of the households had invested at least once in CGPs within 5 years of their introduction. Figure IA.1 in the Internet Appendix illustrates the speed and depth of CGP adoption over the period. The unmatched quality and scope of Swedish data on household financial holdings and demographics, as described in the following section, allows us to identify the effects as precisely as possible. Finally, the dominant role of banks in the Swedish retail CGP market allows us to develop an identification strategy aimed at establishing a causal claim.

C. The Swedish Data

We present our data on the financial products, disaggregated portfolios, and bank relationships of Swedish households.

Capital Guarantee Products and Equity Mutual Funds. The Célérier and Vallée (2017) database on European retail structured products provides the underlying asset, maturity, volume, disclosed fees, and payoff formula[11] of every synthetic CGP sold to Swedish households between 2002 and 2007. Our sample includes 1,511 equity-linked contracts issued over the period with an average volume of 2000 $ 5.2 million (Table III, Panel A), for a total volume $8 billion.[12] More than 50% of CGP volumes are linked to the Euro Stoxx 50 or the OMX Stockholm 30, the main Swedish index (see Table IA.1 in the Internet Appendix).

For every equity mutual fund issued over the period, we obtain from its fact sheet data on historical fees, underlying assets, and volumes. Reported fees include transaction costs, operating costs, and management fees. Our sample contains 1,376 equity mutual funds, with

[11]See Célérier and Vallée (2017) for the description of the textual analysis involved.

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

average yearly fees amounting to 2.0% of invested capital (Table III, Panel D). Moreover, we retrieve the historical returns, volatility, and dividends of assets underlying CGPs and equity mutual funds from Bloomberg, Datastream, and FinBas.[13]

Household Demographics, Income, and Wealth. The administrative panel, described in Calvet, Campbell, and Sodini (2007), contains the demographics, income, and disaggregated financial holdings of every Swedish household between 2000 and 2007. Demographic and income variables include the age, gender, education level, parish of residence, and income of every household member. The panel's distinguishing feature is that it contains the comprehensive disaggregated financial holdings of each household, including positions in cash, equity mutual funds, stocks, and CGPs at the level of each account or security.[14] The security-level information is identified by the International Security Identification Number (ISIN). The panel also provides a unique identifier for the institution where each bank account is held.

The household panel covers the entire population of Sweden and provides the exact portfolio composition of each household. It is highly reliable because the wealth information is collected by Statistics Sweden for tax purposes and is incorporated in tax forms, which households then have an opportunity to correct in case of a mistake. Statistics Sweden collects this information from a variety of sources, including the Swedish Tax Agency, welfare agencies, and private employers. Financial institutions supply to the tax agency their customers' deposits, interest paid or received, security investments, and dividends.[15]

We construct the merged panel as follows. We filter out households with a head younger than 25 years or with financial wealth lower than $200 in 2002. We then keep households that are observable over the whole sample period, consistent with our aim to investigate

[13]FinBas is a financial database maintained by the Swedish House of Finance.

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

[15]The panel does not report defined contribution pension savings. These pension savings include assets in private pension plans and in public defined contribution accounts that were established in a 1999 pension reform. According to official statistics, defined contribution pension savings had an aggregate value of $25.6 billion in Sweden at the end of 2002, whereas aggregate household financial wealth invested outside pension plans amounted to $131.3 billion.

the effects of CGPs on household risk-taking over the 2002-2007 period.[16] The resulting panel contains 3,107,893 households. We merge it with the CGP and equity fund data via the unique ISIN identifier. The high-quality panel covers the launch and subsequent high growth of the market for CGPs in Sweden.

Household-Bank Relationships. We define a household's *relationship banks* as the banks where it holds deposit accounts at the beginning of the sample period. We can measure these relationships because we observe the identity of all the banks from which the household receives interest income. About two thirds of the sample of stock market participants declare an interest income, which generates a sample of 1.4 million households.

D. Summary Statistics

Table IV reports demographic and financial characteristics for the full sample of 3.1 million Swedish households, the subsample of 2.1 million households that participate in equity markets in 2002 (68.5% of the full sample), and the subsample of 430,000 households that invest in CGPs at least once over the sample period (13.8% of the full sample).

Table IV, Panel A, focuses on 2002. While equity participation is quite high in Sweden compared to other economies, the share of financial wealth invested in risky assets conditional on participation is 32.9% on average. Participants mostly take financial risk by investing in equity funds, which represent 22.9% of financial wealth on average (median = 16.9%), and individual stocks, which represent 9.3% of financial wealth on average (median = 1.4%). Moreover, financial wealth, age, and income vary substantially across groups, which motivates the use of precise controls in the empirical analysis.

Table IV, Panel B, illustrates that CGPs quickly gained traction within a few years. At the end of 2007, 13.9% of households had participated at least once in the new asset class, and participants allocated on average 11.9% (median = 7.3%) of financial wealth to

[16] In our data set, a household exits every time the composition of adults of the household changes, due to either death, divorce, marriage or change in partnership.

CGPs. Within the 20 banks catering to Swedish households, CGPs accounted for 8.8% of all fee-generating products on average in 2007 (Table III, Panel C).

II. Design, Expected Return, and Markup

This section develops a no-arbitrage pricing method that captures all features of CGP design. Net of fees, CGPs offer a share of the equity premium that is slightly lower than the share offered by equity mutual funds, the most popular form of household risky investments. Moreover, banks earn comparable gross markups on the CGPs and mutual funds they issue.

A. Product Design

The majority of CGPs in our sample have the following design. At time $t = 0$, a household invests in a contract with face value F and issue price P_0. At the maturity date $t = M$, the household earns a fraction p of a benchmark return R^* applied to the face value. The fraction p is called the *participation rate* in the industry. The contract offers downside protection by guaranteeing a rate of return, g, on the face value, F.

CGPs are typically structured as notes bearing the credit risk of the issuer. Let $\xi \in [0,1]$ denote the random fraction of pledged cash flows that is paid at maturity, commonly called the *payoff ratio* (Jarrow, 2019; Jarrow and Turnbull, 1995). The return on the CGP is

$$1 + R_g = \frac{F}{P_0}\,[1 + \max(p\,R^*; g)]\;\xi \tag{1}$$

between issuance and maturity. The benchmark return R^* is the average ex-dividend performance of an underlying asset, typically an equity index or a basket of stocks, measured at prespecified dates $t_1 < \cdots < t_n$:

$$1 + R^* = \frac{S_{t_1} + S_{t_2} + ... + S_{t_n}}{nS_{t_0}}, \tag{2}$$

where S_{t_0} is the initial reference level of an index or asset at t_0, which is typically the day of issuance or shortly thereafter. We call $t_n - t_1$ the length of the Asian option.

Table III, Panel B, provides summary statistics on the sample of products with this representative design. These products account for 54% of CGPs issued in Sweden during our sample period. The average volume of an issuance is around $5 million. The median maturity M is 4 years, the median net rate of guarantee g is 0%, the median issue price is 111% of face value, and the median participation rate p is 1.10.[17] To this date, no default has occurred on CGPs sold to Swedish retail investors.

B. *Expected Return and Markup: Methodology*

We develop a no-arbitrage pricing method based on the following assumptions. Under the physical measure $\mathbb{P}$, the underlying asset follows a geometric Brownian motion:

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

where μ denotes the drift, q the dividend yield, and σ volatility.[18] The payoff ratio ξ is independent of the underlying asset, consistent with the view that operational risk drives credit risk. Let r_f denote the continuous-time interest rate. Under the risk-adjusted measure $\mathbb{Q}$, the drift of the underlying is $r_f - q$. We consider that the payout ratio's distribution and independence from the underlying are not impacted by the change of measure.

The expected return on the CGP over the life of the contract is given by:

$$\mathbb{E}_0^{\mathbb{P}}(1 + R_g) = (1 - \kappa)\,\frac{F}{P_0}\,\mathbb{E}_0^{\mathbb{P}}[1 + \max(p\,R^*; g)], \tag{4}$$

[17] A product can offer both substantial capital protection and a participation rate higher than unity because of the Asian option feature and the ex-dividend nature of the benchmark return.

[18] The diffusion process could be enriched with various extensions, such as stochastic volatility and jumps. Our simpler approach, however, is more conservative for our purposes. Indeed, expanded dynamics creating higher kurtosis in the returns of the underlying asset would increase the value of the guarantee, bring the expected return on the CGP closer to the risk premium μ, and would lower markups earned by banks.

where $1-\kappa = \mathbb{E}_0^{\mathbb{P}}(\xi)$ is the expected payoff on a \$1 promise. This approach provides conservatively low estimates of expected returns if default is more likely when the underlying is low.[19]

The fair issue price, $P_0^{\text{fair}} = (1-\kappa)\, F\, e^{-r_f\, M}\, \mathbb{E}_0^{\mathbb{Q}}[1+\max(p\, R^*; g)]$, is the price that equates the expected return of the contract under $\mathbb{Q}$ to the return on a riskless bond of same maturity.

The *gross markup* of the contract, $(P_0 - P_0^{\text{fair}})/P_0$, is the difference between the market issue price and the fair issue price divided by the market issue price. To compare it to the stream of fees generated by standard funds, consider a mutual fund company that charges a fraction φ of asset value at the beginning of each year. An initial investment of \$1 generates over M periods a flow of fees worth $\sum_{t=0}^{M-1} \varphi\,(1-\varphi)^t = 1-(1-\varphi)^M$ at date 0.[20] The gross markup on the CGP coincides with the fair value of fund fees if $\varphi_{CGP} = 1-(P_0^{\text{fair}}/P_0)^{1/M}$. This formula allows us to convert a CGP's markup into its yearly mutual fund fee equivalent.

C. *Expected Excess Return and Markup: Results*

We compute the yearly expected excess return on a CGP as the difference between its annualized expected return and the annual yield on an M-year Swedish Treasury bond. As Section III.A of the Internet Appendix explains, we compute the expected CGP return (4) by Monte Carlo simulations of the underlying asset based on the following inputs. We estimate the risk premium of each underlying asset at the monthly frequency, $\mathbb{E}(R_{i,t})$, by applying the World CAPM. We use a world market risk premium of 6% and estimate asset betas over the longest time series available up to the issuance year. We set the CGP pricing model's yearly drift μ_i to $12\,\ln[1+\mathbb{E}(R_{i,t})]$, the volatility σ_i to the historical volatility from 1990 to the year

[19] The expected return

$$\mathbb{E}_0^{\mathbb{P}}(1+R_g) = (1-\kappa)\,\frac{F}{P_0}\,\left\{1+\mathbb{E}_0^{\mathbb{P}}[\max(p\,R^*;g)]\right\} + \frac{F}{P_0} Cov[\xi, \max(p\,R^*;g)]$$

is higher than (4) entails if the payoff ratio ξ and the benchmark return R^* co-move positively, that is if default is more likely in bad times than in good times.

[20] This formula holds if the household invests \$1 at $t=0$, keeps its investment in the fund until $t=M$, and makes no intermediate withholdings or contributions. See Section III.C of the Internet Appendix for the derivation.

of issuance, the dividend yield q_i to its value before the issuance date, the expected default loss κ to the CDS spread of the issuer, and the risk-free rate to the M-year SEK swap rate.

Figure 1, Panel A, displays the distribution of expected excess returns and yearly markups on CGPs sold in Sweden during the sample period. Table III, Panel B, reports corresponding key statistics. There are two take-aways. First, the expected excess return on CGPs is significantly positive and amounts to 2.9% per year on average, or close to half the premium on the world index. More than 90% of products earn a positive risk premium. These results confirm that retail CGPs allow households to earn a significant part of the risk premium. Second, the average markups earned by banks on CGPs are equivalent to an annual fee $\varphi_{CGP} = 1.5\%$. In Tables IA.2 and IA.3 of the Internet Appendix, we verify that these results are robust to alternative choices of the parameters of the asset pricing model.

For comparison purposes, Figure 1, Panel B, displays the expected return and fees of retail equity mutual funds over the 2002-2007 period, and Table III, Panel D, reports corresponding key statistics. We compute expected returns by applying the World CAPM and deducting fees. Beta coefficients are estimated from the historical returns of each fund over the longest period available up to 2002. Equity funds have an average beta of 1.0 relative to the world index and therefore a risk premium before fees of 6% per year. Fees, which include transaction costs, operating costs, and management fees, amount to 2% per year on average during our sample period. The average expected excess return on equity funds is therefore 4.0% in annual units, or about 2/3 of the world equity premium.

Overall, capital guarantee products offer slightly lower expected returns and similar markups than equity mutual funds on average. This finding suggests that banks have equivalent financial incentives to market equity funds and CGPs to retail investors.[21]

[21] Discussions with practitioners also support this hypothesis.

III. Measuring the Impact of Capital Guarantee Products on Household Risk-Taking

This section shows that the introduction of CGPs triggers an increase in household exposure to equity markets, which is more pronounced for households less willing to take risk ex ante.

A. Measuring Household Risk-Taking

Traditional measures of risk-taking are ill-suited for measuring the impact of CGPs' introduction on household risk-taking for a variety of reasons. A portfolio's risky share, defined as the value of risky assets divided by total portfolio value, does not account for fees, product leverage, or systemic risk. The beta coefficient to an equity index would require secondary market prices, which are not available for CGPs in Sweden, and would not account for non-linearities in final payoffs. Volatility and the Sharpe ratio seem inadequate to measure the equity exposure of a portfolio containing derivative contracts with highly skewed distributions. The Black-Scholes delta accurately characterizes a product's instantaneous sensitivity to the underlying asset in continuous time, but it is an imperfect measure of sensitivity for an illiquid product with a maturity of several years. For these reasons, we develop a novel measure that addresses these limitations.

We define the *risk-taking index* of product i as the fraction of the market premium it provides investors:

$$\eta_i = \frac{[\mathbb{E}(1+R_i)]^{\frac{1}{M}} - 1 - R_f}{\mathbb{E}(R_m - R_f)}, \tag{5}$$

where M denotes product maturity, R_i the net arithmetic return on the product over the life of the product net of fees, R_m is the net return on the world index, and R_f is the average arithmetic net yield on Swedish 1-year Treasury bonds.[22] We set $M = 1$ for a liquid product.

[22]The yield R_f is 3.5% on average over the period. The log yield considered in section II is $r_f = \ln(1+R_f)$.

We then define the risk-taking index of household h in period t by

$$\eta_{h,t} = \sum_{i=1}^{n} \eta_i \times \text{Share}_{i,h,t}, \tag{6}$$

where $\text{Share}_{i,h,t}$ is the share of product i in the household's financial wealth in period t. The sum is taken over all CGPs, equity mutual funds, stocks, ETFs, and allocation funds.

The risk-taking index (5) focuses on household compensation for risk-taking. It takes into account the design, fees and underlying asset characteristics of each equity-linked products in household portfolios. In contrast to measures such as the risky share, beta, or volatility, our index controls for all fees and is well suited for nonlinear products.[23] In Table IA.4 of the Internet Appendix, we verify that the key results of the paper are robust to using the risky share. The results are in fact stronger with the risky share since this metric does not distinguish between the equity exposure of an index fund and the equity exposure of a CGP.

We obtain η_i for equity products in our sample as follows. We apply the methodology of Section II to compute the expected return on CGPs and equity mutual funds. For the subsample of CGPs that we do not price, we use the average η_i in the sample of baseline CGPs. For stocks and exchange traded funds (ETFs), we assume management fees of 0.2% and 0.5%, respectively, and a World CAPM β of 1. We also assume that $\eta_i = 0.3$ for allocation funds, which represent around 2% of household financial wealth.[24]

Table III, Panels B and D, report that the average risk-taking index is 0.49 for CGPs and 0.66 for equity funds. Consistent with earlier results, CGPs offer a relatively lower fraction of the equity premium than equity mutual funds. The gap, however, is limited partly because the average beta coefficient is higher for CGPs ($\beta = 1.2$) than for equity mutual funds ($\beta = 1.0$). Table IV, Panel C, shows that the average risk-taking index of

[23] The risk-taking index coincides with the risky share if the portfolio of household h contains only the riskless asset and the world index and there are no fees. Indeed, denoting by w_h the risky share, we obtain that the portfolio return is $R_h = R_f + w_h(R_m - R_f)$, so that $\eta_h = w_h$. The risk-taking index also coincides with the beta coefficient if there are no fees and the World CAPM holds: $\mathbb{E}(R_h - R_f) = \beta_h \mathbb{E}(R_m - R_f)$. In the presence of fees, however, the risk-taking index is *lower* than the risky share or the beta coefficient, as we further discuss in Section V of the Internet Appendix.

[24] Allocation funds are hybrid funds that combine equity funds and money market funds.

households amounts to 0.16 for the total sample in 2002, compared to an average risky share of 0.23, which points to the importance of fees and balanced funds.

B. OLS Results: Capital Guarantee Products and Risk-Taking

Total Change in Risk Taking. We now investigate whether CGP investing is associated with an increase in household risk-taking. Figure 2, Panel A, plots the median *risk-taking index* in 2002 and in 2007 for: (i) households that hold CGPs at least once over the period, and (ii) a control group of equal size containing stock market participants matched based on their 2002 risk-taking index. While by construction the gap between the two groups is close to zero in 2002, it increases to 2.8 pp, or more than 9% of the 2002 index, over the period.

In Figure 2, Panel B, we apply the same analysis to households in the bottom quartile of risk-taking index in 2002. The divergence between CGP participants and the matched control group is significantly more pronounced than in Panel A. The gap in the median risk-taking index reaches 9 pp in 2007, which is large when compared to a baseline index of 2.7 pp for this subsample in 2002. This finding suggests that the extent of the relationship between CGP participation and change in risk-taking depends on the initial level of risk-taking.

In column 1 of Table V, we confirm this result by running a cross-sectional regression of the change in risk-taking index on a CGP participation dummy and household characteristics:

$$\Delta_{2007,2002}(\eta_h) = \alpha + \beta_1 \mathbb{1}_{CGP,h} + \lambda' x_{h,2002} + \varepsilon_h.$$

We estimate this regression in the sample of 2002 equity market participants.[25] In this regression, $\Delta_{2007,2002}$ denotes the Davis and Haltiwanger (1992) growth rate,[26] $\mathbb{1}_{CGP,h}$ is an indicator variable equal to unity if the household purchases a CGP at least once during the

[25] We therefore estimate the effect at the intensive margin. Our results are robust to including the whole population. However, effects on the extensive margin are minimal, which could be due to the high level of stock market participation in Sweden, or to the existence of frictions that are not alleviated by CGPs.

[26] The Davis and Haltiwanger (1992) growth measure, $\Delta_{2007,2002}(\eta_h) = 2(\eta_{h,2007} - \eta_{h,2002})/(|\eta_{h,2007}| + |\eta_{h,2002}|)$, limits the extreme values created by low denominator values in a standard growth rate.

sample period, $x_{h,2002}$ is a vector of household characteristics in 2002, and ε_h is an error term. Characteristics include the percentage change in income and in financial wealth over the period, as well fixed effects for the number of children, household size, gender, locality, years of education, and deciles of financial wealth, income, age and risky share.

The regression confirms that households that participate in CGPs increase their risk-taking index significantly more than households that do not. The index change is 22 pp higher for CGP participants, while the average household does not increase its index over the period. This magnitude is comparable to the increase in risk-taking resulting from gaining access to a financial advisor (Chalmers and Reuter, 2020). However, the effect we document applies to the household's entire liquid financial wealth instead of a single retirement account.

Active Change in Risk-Taking. We now show that the heterogeneous response of risk-taking to innovation is driven by active investment decisions and not simply by the mechanical effect of realized asset returns.[27] To do so, we define the *market neutral index*, $\eta^{\mathrm{MN}}_{h,t+n}$, as the index that the household would achieve at $t+n$ if all asset returns between t and $t+n$ were equal to zero.[28] By construction, $\eta^{\mathrm{MN}}_{h,t+n}$ only differs from $\eta_{h,t}$ as a result of active trading and saving decisions. Figure IA.3 in the Internet Appendix shows that the market-neutral index exhibits diverging trends among CGP participants and the matched control group, consistent with Figure 2.

We define the active change in the risk-taking index of household h between t and $t+n$, $\Delta^A_{t,t+n}(\eta_h)$, as the Davis and Haltiwanger (1992) growth rate between the initial index, $\eta_{h,t}$,

[27] Since active allocation decisions might be in part responses to passive performance, we view both exercises as complementary.

[28] The market-neutral risk-taking index is defined by $\eta^{\mathrm{MN}}_{h,t+n} = \sum_{p=1}^{n} \eta_p \, Share^{\mathrm{MN}}_{p,h,t+n}$, where $Share^{\mathrm{MN}}_{h,p,t+n}$ is the share of product p in year $t+n$, adjusted for the mechanical changes due to realized asset returns from year t to $t+n$. Specifically,

$$Share^{\mathrm{MN}}_{p,h,t+n} = \frac{X_{p,h,t} + \sum_{s=t+1}^{t+n} [X_{p,h,s} - (1 + R_{p,h,s})\, X_{p,h,s-1}]}{FW_{h,t} + \sum_{s=t+1}^{t+n} [FW_{h,s} - (1 + R_{h,s})\, FW_{h,s-1}]},$$

where $X_{p,h,s}$ is the amount invested in product p at date s, $R_{p,h,s}$ is the yearly realized return of product p from year $s-1$ to s, $FW_{h,s}$ is the total financial wealth, and $R_{h,s}$ is the return on financial wealth. Values are winsorized at the 1% level.

and the *market-neutral risk-taking index* $\eta^{\mathrm{MN}}_{h,t+n}$. In column 3 of Table V, we regress the active change $\Delta^{A}_{2002,2007}(\eta_h)$ on CGP participation and household characteristics. The active change associated with CGP participation is comparable to the result obtained with the total change in the index. Hence our key findings do not have a purely mechanical origin.

Panel Model. The following panel specification allows us to measure the sensitivity of the risk-taking index to the purchased quantity of capital guarantee products:

$$\eta_{h,t} = \alpha + \beta_2 \, CGP \ Share_{h,t} + \lambda' x_{h,t} + \gamma_h + \mu_t + \varepsilon_{h,t}, \tag{7}$$

where $CGP \ Share_{h,t}$ is the share of CGPs in household h's financial wealth, $x_{h,t}$ is a characteristics vector, γ_h a household fixed effect, μ_t a time fixed effect, and $\varepsilon_{h,t}$ an error term. If a household funds CGP purchases from bank deposits, the linear coefficient β_2 is approximately equal to the average risk-taking index of CGPs. By contrast, if the household views CGPs as perfect substitutes for traditional equity products, it funds CGP purchases by selling traditional products and β_2 can be negative. We report the results in Table VI. The point estimate of β_2 is 0.21, around half of the average risk-taking index of CGPs. Similar results hold when the market-neutral risk-taking index $\eta^{MN}_{h,t}$ is the dependent variable.[29] Table IA.4 in the Internet Appendix reports the results when using the risky share as a measure of risk-taking. We obtain a larger magnitude, as we expect given that the incremental risk-taking associated with purchasing CGPs is higher and the same as for funds with this measure.[30]

[29]The coefficient β_2 is slightly stronger, consistent with the fact that CGPs are valued at issuance price while traditional equity products are marked to market in our data.

[30]We can reconcile the results of Tables VI and IA.4 as follows. Let ω denote the share of CGPs purchased with bank deposits, the rest being bought by selling other risky assets. We assume for simplicity that all households have the same ω. When the dependent variable is the risky share, the coefficient on $CGP \ Share_{h,t}$ is equal to ω; we impute from Table IA.4 that $\omega = 0.64$. When instead the dependent variable is the risk-taking index, the coefficient β_2 in (7) is approximately equal to $\eta_{CGP} - (1-\omega)\,\eta_{eq}$, where η_{CGP} is the average risk-taking index of CGPs and η_{eq} is the average risk-taking index of equity mutual funds. Heterogeneity in risk-taking indexes is neglected for simplicity. We impute from Tables III and VI that $\eta_{CGP} = 0.49$, $\eta_{eq} = 0.66$, and $\beta = 0.21$, which suggests that the share of CGPs purchased with bank deposits is approximately $\omega = 0.58$. Hence both tables suggest that households finance about 60% of CGP purchases from cash holdings.

C. Heterogeneity along Household's Willingness to Take Risk

We now show that the risk-taking increase associated with CGP investing varies substantially with a household's initial willingness to take risk, as Figure 2, Panel B, suggests. We measure this willingness by filtering out household characteristics from the initial risk-taking index. That is, we write $\eta_{h,2002} = \bar{\eta}_h + b'(x_h - \bar{x}) + e_h$, where $\bar{\eta}_{2002}$ and $\bar{x}$ respectively denote the sample means of $\eta_{h,2002}$ and x_h. Hence $\eta^{\mathrm{F}}_{h,2002} = \eta_{h,2002} - b'(x_h - \bar{x})$ is the household's *initial willingness to take risk* that is not captured by characteristics.[31]

Figure 3 illustrates the relationship between the change in risk-taking index and the initial willingness to take risk for CGP adopters. To construct the figure, we regress the change in the risk-taking index over the 2002-2007 period on the standalone indicator $\mathbb{1}_{CGP,h}$ and on the indicator $\mathbb{1}_{CGP,h}$ interacted with initial willingness to take risk:

$$\eta_{h,2007} - \eta_{h,2002} = \alpha + \beta_3\,\mathbb{1}_{CGP,h} + \beta_4\,\mathbb{1}_{CGP,h} \times \eta^{\mathrm{F}}_{h,2002} + \lambda' x_{h,2002} + \varepsilon_h,$$

where $x_{h,2002}$ includes fixed effects for deciles of wealth, income, and age, as well as the income change over the period. We then plot the relationship between the CGP adopters' initial willingness to take risk and their proportional change in risk-taking, which we define as the predicted incremental change in the risk-taking index of CGP participants vs. non-participants divided by their average index over the period, $(\eta_{h,2002} + \eta_{h,2007})/2$.

The incremental increase in risk-taking of CGP adopters monotonically falls with their initial willingness to take risk.[32] For households with an initial willingness $\eta^{\mathrm{F}}_{h,2002}$ below 0.10, the adoption of CGPs results in an increase in the risk-taking index of more than 30%. By contrast, the effect is close to zero for households with an initial willingness above the median, which is equal to 0.17. In columns 2 to 5 of Table VI, we confirm these results by estimating equation (7) within each quartile of initial willingness to take risk. The coefficient

[31]Figures IA.4 and IA.6 in the Internet Appendix show that similar results hold when we use 1999, 2000, or 2001 as reference years.

[32]We obtain a comparable result when using the ex-ante bank deposit share of the financial wealth as a proxy for household (un-)willingness to take risk.

β_4 decreases across quartiles, as one expects.

In Figure IA.10 in the Internet Appendix, we investigate household demand for CGPs, bank deposits, stocks, and equity mutual funds. We show that the shares of stocks and mutual funds co-move positively with initial willingness to take risk, while the shares of CGPs and bank deposits both co-move negatively. These results confirm that CGP investing is especially attractive to investors with low willingness to take risk.

D. Instrumental Variable Analysis

We have documented a positive within-household correlation between risk-taking and CGP investing, controlling for a comprehensive set of time-varying characteristics. This correlation does not provide sufficient support for a causal claim. For instance, the share of capital guarantee products, $CGP\ Share_{h,t}$, and the error term, $\varepsilon_{h,t}$, in structural equation (7) may both be driven by latent variables driving variation in a household's time-varying idiosyncratic willingness to take risk not predicted by observable characteristics. Our OLS estimates may be biased upward if independently of the introduction of CGPs, the unobserved willingness to take risk of CGP participants increases relative to non-participants over our sample period. Conversely, our OLS estimates may be biased downward if the willingness to take risk of CGP participants decreases over our sample period. For this reason, we develop an instrumental variable estimation strategy of structural equation (7).

D.1. Principle

We exploit the well-documented stickiness in household-bank relationships to instrument the household CGP share, $CGP\ Share_{h,t}$, with one of the following time-varying variables. Our first instrument is the portion of CGPs in the mix of risky products supplied in year t by banks with which household h has a relationship in 2002. Alternatively, our second instrument is the average participation rate offered by the CGPs of these banks in year

t.[33] We measure both variables at the annual frequency and include them in the vector of characteristics in structural equation (7).

These variables vary not only with shocks to the supply of CGPs in the traditional economic sense, i.e., a shift of the supply curve leading to lower prices and higher quantities in equilibrium, but also marketing-induced increases in CGP quantities relative to other risky assets. Bank-level shocks might thus result from marketing campaigns specific to CGPs that raise awareness around their design. Bank-level shocks may also stem from time-varying structuring costs, which may for instance decrease when a bank develops structuring expertise, starts a partnership with an investment bank having such an expertise, or experiences changes in its funding costs.[34]

D.2. Construction of the Two Instruments

Based on these principles, we construct the instruments for panel estimation as follows. Let $\Phi_{b,t}$ denote a measure of bank b's shock at t. Let $\theta_{h,b}$ denote the indicator variable equal to unity if bank $b \in \{1, \ldots, B\}$ has a relationship with household h in 2002, and let $\theta_h = (\theta_{h,1}, \ldots, \theta_{h,B})'$. We instrument the CGP share of household h hold in year t by

$$Z_{h,t} = \Phi'_{b,t}\theta_h.$$

The instrument is valid under the following condition.

Exclusion Restriction *The exogeneity condition* $\mathbb{E}(\Phi'_{b,t}\theta_h\, \varepsilon_{h,t}) = 0$ *holds for every* h *and* t*, where* $\varepsilon_{h,t}$ *is the error term of structural equation* (7)*.*

That is, the shocks must be exogenous to time-varying unobservable characteristics that might drive household risk-taking. While our strategy does not require that the matching between households and banks in 2002 be exogenous, because of the inclusion of household

[33] For instance, according to a Bankrate survey (`https://www.bankrate.com/banking/best-banks-consumer-survey-2020/`), the average U.S. adult has used the same primary checking account for more than 14 years.

[34] CGPs provide funding to Swedish banks, whereas equity mutual funds do not.

fixed effects, it addresses the threat to the validity of the OLS if and only if the shocks we identify from are not correlated with changes in household willingness to take risk unrelated to CGP issuances. We further discuss the exclusion restriction in Section III.D.3.

We now close the construction of the instruments by explaining how bank-level shocks are measured.

Instrument 1 (Portion of CGPs in the Product Mix of a Household's Banks). Our first measure is the proportion of CGPs in bank b's product mix in year t. We obtain it as the ratio of the aggregate outstanding volumes of CGPs held by the bank's clients to the aggregate outstanding volumes of all fee-generating retail products they hold:

$$\Phi_{b,t} = \frac{\sum_{h=1}^{N} CGP_{h,b,t}}{\sum_{h=1}^{N}(CGP_{h,b,t} + MutualFunds_{h,b,t})}, \tag{8}$$

where $CGP_{h,b,t}$ and $MutualFunds_{h,b,t}$ denote, respectively, the outstanding volumes of CGPs and mutual funds held in year t by household h in a relationship with bank b.[35]

To ensure that $\Phi_{b,t}$ produces a valid instrument $Z_{h,t} = \Phi'_{b,t}\theta_h$, we randomly partition the sample of risky asset participants for which we have bank relationship data into two sub-samples of equal size. We calculate $\Phi_{b,t}$ on the first sub-sample, and run the instrumental variable analysis on the other sub-sample. By doing so, we mitigate the concern that unobservable household characteristics drive both the CGP portion in bank product mix, $\Phi_{b,t}$, and the household error term, $\varepsilon_{h,t}$.

Instrument 2 (Average Participation Rate of CGPs of a Household's Banks). Our second measure is the average participation rate of the CGPs offered in a given year by a household's bank. All else equal, a higher participation rate corresponds to a more attractive (lower) price. Since the participation rate is one of the most salient features of a contract, variation

[35] We do not include directly held stocks in the denominator because these assets do not generate fees and are therefore not actively marketed and sold by banks. However, we have verified that our results are robust to including direct stockholdings in the calculation of $\Phi_{b,t}$.

in the participation rate is conceptually close to variation in price.[36]

A potential confounding factor is that the participation rate may differ across products due to heterogeneous volatility of the underlying. To address this concern, we restrict the sample to the participants in the CGPs with the three most frequent underlying assets: Euro Stoxx 50, OMX Stockholm 30 and FTSE 100.[37] These underlying assets are well diversified indexes from the Euro area, Sweden, and the UK, respectively, and have comparable volatility and fundamentals.

D.3. Analysis of the Exclusion Restriction

Our empirical strategy solves OLS endogeneity issues to the extent that our instruments do not correlate with latent variables driving idiosyncratic variation in household willingness to take risk. We expect our identifying assumption to hold for the following reasons. The first instrument, the portion of CGPs in a bank product mix, is relative to the bank clients total holding of risky assets, which absorbs time-varying demand for risky assets within the bank client base. Therefore, our specification is immune from the potential effects of bank-level variation in clientele's willingness to take risk, such as general marketing campaigns.

In addition, an omitted variable that co-moves with both a household's CGP investment and the portion of CGPs in its bank's product mix is very likely to be specific to CGPs for the following reasons. In Table IA.6 in the Internet Appendix, we run placebo first-stage regressions and obtain a small linear coefficient when we regress household investment in equity mutual funds on the portion of equity mutual funds in bank product mix. We also obtain low coefficients when we regress household CGP investment on the portion of equity funds in bank product mix, or, conversely, when we regress household investment in equity funds on the portion of CGPs in bank product mix. Therefore, an economically important omitted variable would have to be specific to the design of CGP, which, as previously discussed, we do not view as a threat to our identification approach.

[36]We do not use markup as a measure of price because households can neither observe nor compute markups and only care about them to the extent that they affect prices.

[37]They account for more than 40% of all CGP participants.

The second instrument, the average participation rate, is specific to the security design of CGPs. Therefore, we do not expect it to co-move with demand unrelated to the design.

The main challenge to our instrumental variable analysis would be if banks intentionally changed their product mix and design of CGP when they identify changes in their clients' willingness to take risks, offering relatively more capital guarantee products or a higher participation rate when their clients' willingness to take risk increases. This is unlikely to be happening because CGP do not offer higher fees than mutual funds, and because everything else constant a higher participation rate means a lower markup for the bank. Banks have therefore no incentive, or even a disincentive, to do so.

D.4. Empirical Results

Table IV, Panel C, provides summary statistics on the portion of CGP in bank product mix and the average participation rate across the 20 Swedish banks of our sample. In 2007, the CGP share of the product mix amounts to 8.8% on average, ranging from 6.2 to 15.2% across banks. The participation rate is 113% on average, and ranges from 100 to 123% across banks. Figure IA.7 in the Internet Appendix shows that these quantities vary significantly within banks over the period.

Table VII, Panel A, reports the results of OLS regression and two-stage least squares regressions based on our first measure of supply variation. We instrument a household's CGP share by the portion of CGPs in the risky product mix of banks with which the household has a relationship in 2002. We focus on the sample of households for which we have bank relationship information, as explained in Section I.C. We use half of this sample to compute the banks' product mix and the other half to run the regressions. Since households have a relationship with two banks on average, we restrict attention to the two banks with which a household has the largest deposits.

Table VII, Panel B, reports OLS and two-stage least squares regressions based on our second measure of idiosyncratic supply variation. That is, we instrument the CGP share by the average participation rate of CGPs offered by the household's two main banks. The sample is restricted to participants in CGPs with the Euro Stoxx 50, OMX Stockholm 30 and FTSE 100 as underlying assets.

Column 1 of each panel displays OLS coefficients of structural equation (7). The point estimate of β_2 is 0.21 in Panel A and 0.18 in Panel B, consistent the value estimated in the full sample of CGP participants.

Column 2 of each panel displays the first stage of the 2SLS analysis. For the main bank, a 10 pp increase in the portion of CGPs in the product mix leads to a 7.5 pp increase in the household's CGP share. A 10 pp increase in the average participation rate leads to a 1 pp increase in the household's CGP share. The F-statistic of each of the first stages, at 141 and 34, are significantly above the threshold for strong instruments (Stock and Yogo, 2005).

Columns 3 provide the coefficients of the second stage of our 2SLS. The positive and significant point estimates of β_2 supports a causal interpretation of our central result : CGP investing generates a significant increase in the risk-taking index of households. The values of the coefficient, 0.43 in Panel A and 0.64 in Panel B, are close to the 0.49 average risk-taking index of CGPs reported in Table III.

In columns 4 to 7, we restrict the sample to quartiles of filtered 2002 risk-taking index. Consistent with the results of the OLS analysis, we find for both instrumental variable analysis that the positive change in the risk-taking index is the most statistically and economically significant for the lowest quartile of willingness to take risk, and overall decreasing with household willingness to take risk.

IV. Can Economic Theory Explain the Impact of Capital Guarantee Products on Risk-Taking?

This section investigates which economic mechanisms can explain the increase in household risk-taking triggered by the introduction of CGPs. In Section IV.A, we develop a life-cycle model in which investors can trade a bond, an equity fund, and a CGP. In Section IV.B, we show that the life-cycle model explains the causal impact of innovation on risk-taking under preferences combining loss aversion and narrow framing (Barberis and Huang, 2009). Pessimistic subjective beliefs, possibly combined with ambiguity aversion, are a powerful complementary explanation, which we investigate in Section IV.C.

A. A Life-Cycle Model with Capital Guarantee Products

Labor Income. The agent lives at dates $t = 1, \ldots, T$, and receives stochastic labor income Y_t every period. Before retirement, labor income is specified by $Y_t = Y_t^P \, Y_t^H$, where Y_t^P is a persistent component of income and Y_t^H is a transitory component. The permanent component is specified by $Y_t^P = e^{f(t;\chi_t)+\nu_t}$, where $f(t;\chi_t)$ is a fixed effect driven by the vector of deterministic characteristics χ_t and the stochastic term ν_t follows a random walk with Gaussian increments: $\nu_{t+1} - \nu_t \sim \mathcal{N}(0, \sigma_u^2)$. The transitory components, Y_t^H, have identical lognormal distributions, are mutually independent, and are also independent from the permanent components Y_t^P. We denote by RA the retirement age. After retirement, income is $Y_t = \lambda \, Y_{RA}^P$, where λ is a replacement ratio.

Financial Assets. The agent can trade two liquid financial securities every period. The riskless asset has constant yield $1 + R_f = e^{r_f}$ on a 1-period investment. The equity fund has random return $R_{eq,t} = (1-\varphi)(1 + R_{m,t})$ between $t-1$ and t, where $R_{m,t}$ is the return on an equity index and φ is a per-period fee.

Before financial innovation, the agent can only trade these two liquid assets. After innovation, the agent can also invest in CGPs of staggered maturities. All CGPs are identical except for the issue date. A CGP issued at date t reaches maturity at date $t + M$, and we denote by $1 + R_{g,t+M}$ the return on the guaranteed product over the life of the contract. The CGP is exposed to credit risk, which we specify as in Section II.A.

We make several conservative assumptions: (i) CGPs are written on the same index as the equity fund, (ii) CGPs are exposed to the risk of default by the issuer, (iii) CGPs are strictly illiquid before maturity, and (iv) the agent can only hold CGPs with the same issue date and maturity at every t. These assumptions ensure that the demand for CGPs is not driven by an artificially strong diversification motive, the neglect of credit risk, early redemption, or rollover strategies that bypass the illiquidity of CGPs.[38] These choices allow us to provide a disciplined assessment of the demand for CGPs and its impact on risk-taking.

In practice, we use CGP contracts that have the median design in our sample: a maturity of 4 years, a full guarantee of face value ($g = 0$), a participation rate p of 112%, an issue price equal to 111% of face value, and an underlying index with a risk premium of 6%, a volatility of 20%, and a dividend yield of 2%. The final payoff is based on the values of the index in the contract's last 13 months. These parameters imply a markup of 1.5% in annual units. The mutual fund also charges a 1.5% annual fee.

Budget Constraint. At the beginning of period t, cash on hand, X_t, is the sum of the period's labor income, the value of holdings in the riskless asset and equity fund, and the value of holdings in the CGP if the contract reaches maturity at t. Capital previously invested in a CGP and still illiquid at date t is denoted by K_t, and time to maturity by τ_t.

The household selects the following variables at t: (i) consumption, C_t, (ii) investment in the CGP issued in the period, I_t, and (iii) the share of liquid wealth invested in the equity fund, α_t. We impose the constraint $I_t = 0$ whenever $\tau_t > 0$, so that the agent only invests in one type of CGP. Therefore, cash on hand at the beginning of period $t + 1$ is

$$X_{t+1} \;=\; Y_{t+1} \;+\; (X_t - I_t - C_t)\,[1 + R_f + \alpha_t(R_{eq,t+1} - R_f)] \;+\; (1 + R_{g,t+1})K_t \mathbb{1}_{\{\tau_t=1\}}. \quad (9)$$

The last term in (9) expresses that the capital K_t becomes liquid at $t + 1$ if $\tau_t = 1$.

Information Structure. The household observes every period the returns on the equity index, the equity fund, and held CGPs reaching maturity. At date t, a sufficient statistic for

[38] The investor could diversify by investing directly in the underlying of the capital guarantee product.

the information available on the held CGP, issued at date $t-s$, is the cumulative return $CR_t = e^{-qs}(1+R_{m,t-s+1})\dots(1+R_{m,t})$. The household receives no information on the payoff ratio of a CGP in periods prior to maturity. Its position at the beginning of period t is therefore summarized by the state vector (X_t, K_t, CR_t, τ_t). We now close the model by considering the specification of preferences and beliefs.

B. The Role of Preferences

This section investigates the preferences that can explain the empirical results of Section III. We assume that the household has rational expectations and recursive utility:

$$V_t(X_t, K_t, CR_t, \tau_t) = \max_{(C_t, I_t, \alpha_t)} \left[(1-\delta)\, C_t^{1-1/\psi} + \delta \pi_t\, (\mu_{t+1})^{1-1/\psi}\right]^{\frac{1}{1-1/\psi}}, \tag{10}$$

where $t \in \{1, ..., T-1\}$, π_t is the probability that the agent is alive at $t+1$ conditional on being alive at date t, and μ_{t+1} is the certainty equivalent of future consumption. We let $V_T = (1-\delta)^{1/(1-1/\psi)}\, C_T$ at the terminal date, which does not include a bequest motive.

We consider below several specifications for the certainty equivalent, μ_{t+1}. For every specification, we solve the model numerically before and after financial innovation. We refer the reader to Section VII of the Internet Appendix for a full description of the model and solution methodology.

Under Epstein and Zin (1989) utility: $\mu_{t+1} = [\mathbb{E}_t^{\mathbb{P}}(V_{t+1}^{1-\gamma})]^{1/(1-\gamma)}$, financial innovation does not generate an increase in the risk-taking index, as we show in Section VIII.A.1 of the Internet Appendix for a battery of risk aversion coefficients. The explanation is that Epstein-Zin preferences entail second-order relative risk aversion, so that the capital guarantee offers only weak utility benefits. Diversification benefits are also limited since CGPs are based on the same underlying as the equity fund. As a result, the life-cycle model with Epstein-Zin utility does not explain the strong increase in risk-taking triggered by CGPs reported in Section III.

The natural next step is to consider preferences with first-order risk aversion. As Barberis et al. (2006) explain, the choice of such preferences requires some care in multi-period environments. The presence of other preexisting risks, such as labor income risk, makes the agent act in a second-order risk-averse manner toward independent, delayed gambles. Therefore, first-order risk aversion alone may be insufficient to explain our empirical results. Section VIII.A.3 of the Internet Appendix confirms this intuition. We report that financial innovation does not substantially increase risk-taking when the household exhibits generalized disappointment aversion, a classic type of loss-averse preferences (Gul, 1991; Routledge and Zin, 2010).

We next consider preferences combining loss aversion with narrow framing, in which investors separately evaluate changes in financial wealth. We consider the recursive specification of Barberis and Huang (2009):

$$\mu_{t+1} = \left[\mathbb{E}_t^{\mathbb{P}}(V_{t+1}^{1-\gamma})\right]^{\frac{1}{1-\gamma}} + b_0 \mathbb{E}_t^{\mathbb{P}}\left[v(W_{t+1} - W_{t+1}^R)\right], \tag{11}$$

where $b_0 \geq 0$ is a constant and W_{t+1} is the value of liquid financial wealth at the beginning of period $t+1$. The function $v(\cdot)$ is piecewise linear: $v(x) = x$ if $x \geq 0$ and $v(x) = \lambda x$ if $x \leq 0$, where $\lambda \geq 1$ is a kink parameter. The reference level, W_{t+1}^R, is set equal to the current value of past investments if the agent only invests in the riskless asset. This reference level offers the benefits of not altering the consumption-saving path when the household does not invest in risky assets.[39]

In Figure 4, we plot the life-cycle profile of an agent with loss aversion and narrow framing. under the preference parameters $b_0 = 0.05$, $\lambda = 3.3$, $\gamma = 4$, $\delta = 0.98$, and $\psi = 0.5$. The agent accumulates substantial amounts of CGPs (Panel A), which induces a considerable increase in the risk-taking index until retirement (Panel B). The higher average returns on savings allow the agent to increase mean consumption during most of the life-cycle (Panel C). The

[39]This specification of the reference level is consistent with earlier life-cycle applications of Barberis and Huang (2009) preferences available in the literature (Chai and Maurer, 2012).

CGP therefore fosters risk-taking and consumption during most of the life-cycle.

The preference parameters used to generate Figure 4 are in the range usually considered in the literature. For instance, Barberis and Huang (2009) report plausible asset allocations for a narrow framing parameter b_0 between 0.01 and 0.20, a kink parameters λ in the 2-3 range, a patience parameter δ equal to 0.98, and a risk aversion coefficient γ between 1.5 and 5, implying an elasticity of intertemporal substitution $\psi = 1/\gamma$ between 0.2 and 0.67. Our values of δ, γ, and ψ are also consistent with the life-cycle simulations in Cocco et al. (2005) and Gomes and Michaelides (2005) .

In Figure 5, Panel A, we plot the Davis-Hualtiwanger change in the risk-taking index triggered by innovation as a function of the agent's initial index. The solid line illustrates model predictions and the dashed line the corresponding values from our empirical analysis. In the model plot, we capture heterogeneity in initial risk appetite by letting the kink parameter controlling first-order risk aversion, λ, vary between 2 and 5, while other preference parameters are the same as in Figure 4.[40] The increase in the risk-taking index is high for households with low initial risk-taking, and also decreases sharply with the initial risk-taking index. The increase in risk-taking predicted by the model is quantitatively close to the increase observed in the data. Interestingly, the increase is slightly stronger in the model than in the data. Preferences combining narrow framing and loss aversion can explain reasonably well the main empirical results of Section III. Interestingly, the increase in risk-taking is slightly weaker in the data than under the model. We do not attempt to match the data more accurately because the empirical curve may be contaminated by measurement error and inertia in the adoption of CGPs that are outside the scope of the model.

One may ask if the same results would hold under preferences combining narrow framing and *second-order* risk aversion. Such preferences can be obtained by letting $\lambda = 1$ in the Barberis and Huang (2009) specification, or more generally by letting $\mu_{t+1} = \left[\mathbb{E}_t^{\mathbb{P}}(V_{t+1}^{1-\gamma})\right]^{\frac{1}{1-\gamma}} + b_0 \left\{[\mathbb{E}_t^{\mathbb{P}}(W_{t+1}^{1-\gamma})]^{\frac{1}{1-\gamma}} - W_{t+1}^R\right\}$, where W_{t+1}^R is the reference level defined earlier in the section.

[40]See Section XI.A of the Internet Appendix for a comprehensive sensitivity analysis of the life-cycle model results to the parameters λ and b_0.

Section VIII.A.2 of the Internet Appendix verifies that such specifications do not explain the data. While these tests are not exhaustive, they strongly suggest that the combination of narrow framing and loss aversion is important to explain our empirical results under rational expectations.

C. The Role of Subjective Beliefs

A complementary explanation for our findings is that households hold pessimistic beliefs about the equity index, which can induce low investment in the equity fund but robust investment in CGPs with upside potential. Prospect theory emphasizes the importance of pessimistic beliefs in decision-making, and one of its components, probability weighting, has emerged as a key building block of behavioral economics (Barberis, 2013). In addition, survey evidence documents that a substantial fraction of households assign a high probability to the occurrence of a large crash (Goetzmann, Kim, and Shiller, 2017).[41]

We incorporate pessimism into the life-cycle model by adopting Prelec (1998)'s probability weighting methodology. Let $F_{\mathbb{P}}(r)$ denote the cumulative distribution function (c.d.f.) of the yearly log return on the equity index, $r_{m,t}$, under the physical probability measure $\mathbb{P}$. The household's subjective belief about $r_{m,t}$ is specified by the c.d.f. :

$$F(r;a,b) = \exp\left\{-b\left[-\ln F_{\mathbb{P}}(r)\right]^{a}\right\},$$

where a and b are strictly positive constants. The transformed c.d.f. $F(r;a,b)$ decreases with b, so a higher value of b implies stronger pessimism. The parameter a controls curvature.

In Figure 6, we plot the life-cycle profile of an agent with Epstein-Zin utility and Prelec probability weighting with $a = 0.5$ and $b = 0.73$. The results are qualitatively similar to the ones obtained in Figure 4 under rational expectations and Barberis-Huang preferences.

[41]Of course other households may be irrationally exuberant about stock market investing. However, optimistic households likely have a high risk-taking index before financial innovation and are less likely to drive the demand for guaranteed products.

The household has a strong demand for CGPs, which is hump-shaped over the life-cycle. This strong demand is associated with an increase in the risk-taking index. The higher average returns on savings triggered by innovation encourage households to slightly reduce consumption in their early years, and then enjoy higher average consumption after 40.

In Figure 5, Panel B, we let the pessimism parameter b vary from 0.6 to 1.3. The proportional increase in the risk-taking index is stronger for households with more pessimistic beliefs and a lower initial risk-taking index, consistent with the data. We again observe that the increase in risk-taking predicted by the model is quantitatively close to the increase observed in the data.

The baseline values $a = 0.5$ and $b = 0.73$ allow us to match an average risk-taking index of about 8%, its 25th percentile in the Swedish panel over the sample period. These values are in the range of values used in the literature, and are close to the estimates in Booij, van Praag, and van de Kuilen (2010) and Fehr-Duda and Epper (2012). The quantiles of the net arithmetic total return on the equity index are -81.3% (1st percentile), -63.9% (5th percentile), -51.6% (10th percentile), -27.6% (25th percentile), and 2.2% (median) under the Prelec transform, compared to -33.3% (1st percentile), -23.3% (5th percentile) -6.5% (25th percentile), 7.2% (median) under the physical measure $\mathbb{P}$. Hence the probability weighting scheme considerably increases the likelihood of negative outcomes. In Figure IA.15 of the Internet Appendix, we plot the Prelec transform and verify that it has the familiar inverse S shape estimated in the literature (Barberis, 2013; Dimmock, Kouwenberg, Mitchell, and Peijnenburg, 2020).

Sections VIII.B.2 and VIII.B.3 of the Internet Appendix show that the results of Figures 5 and 6 are strongly robust to alternative specifications of pessimism, such as subjective crash risk or volatility misperception. Furthermore, in Section IX of the Internet Appendix, we obtain similar results when the investor is ambiguity averse and includes a pessimistic measure in the set of possible probability measures, along with the physical probability measure $\mathbb{P}$.

Overall, the portfolio impact of financial innovation documented in Section III is consistent with a life-cycle model with loss aversion and narrow framing (Barberis and Huang, 2009), pessimistic subjective beliefs (Prelec, 1998), or ambiguity aversion.

V. Implications for Household Welfare

In this section, we use our life-cycle model to estimate the welfare benefits or costs of CGPs. Section V.A measures the total surplus generated by financial innovation and its allocation to households and institutions. In Section V.B, we reexamine these results when experienced utility, which households use to assess economic well-being (Kahneman et al., 1997), differs from the decision utility used to make consumption-portfolio choices.

A. Total Surplus and Its Allocation

We measure the surplus generated by CGPs over the life-cycle when household decision and experienced utilities coincide.[42] Under this assumption, CGPs can only have positive welfare implications for the household, because a consumption-portfolio strategy that is feasible before the introduction of CGPs remains feasible afterward.

Table VIII reports the *household benefit from financial innovation*, which we define as the wealth transfer allowing the household in the pre-innovation economy to attain the same lifetime utility as the one it achieves in the post-innovation economy without the transfer. For simplicity, the transfer takes place in the first period of the life-cycle. Our measure takes into account the optimization of financial resources via asset markets. The table reports our measure for several specifications of preferences and beliefs. In all cases, the parameters are chosen so that the risk-taking index before innovation is 8%, its 25th percentile in the Swedish

[42] Our analysis focuses on households that participate in risky assets but have low levels of risk-taking. Our analysis does not aim at rationalizing non-participation or risk-taking by households with substantial equity holdings in the absence of CGPs. Relatedly, the household we study in our model is neither a representative agent nor the marginal investor, and therefore does not affect security prices. We are also not solving for the optimal contract, but are taking the security design observed empirically in our sample as given.

population. The introduction of CGPs generates a benefit of about $13,000 for households exhibiting loss aversion and narrow framing or pessimistic beliefs. The gains from innovation represent a substantial fraction of average yearly income. Therefore, financial innovation is highly beneficial to households with strong behavioral biases and low initial risk-taking.

The *bank benefit from financial innovation* is defined as the no-arbitrage value in the first year of the life cycle of the change in profit per household:

$$\text{Bank benefit} = \mathbb{E}^{\mathbb{Q}}\left[\sum_{t=1}^{T} \frac{\pi_1 \ldots \pi_{t-1} \Delta(\text{Profit}_t)}{(1+R_b)^{t-1}}\right], \tag{12}$$

where R_b is the funding cost of the bank and π_t denotes the survival probability defined in Section IV. Given the limited information at our disposal, we proxy the change in bank profits by the sum of (i) the change in the fees earned on equity funds sold to the household and (ii) the gross profit margin earned on CGP sales. This approach is conservative because our measures of the bank's benefit and surplus share are upper bounds of actual values. We measure the funding cost R_b by the swap rate, which we take as constant, and we assume that the stochastic variation in profit is not priced, so that we take expectations under $\mathbb{P}$. The analysis therefore incorporates the reduction of profit from mutual funds that can be caused by financial innovation, commonly referred to as crowding out effects.

The *total surplus* is the sum of the household and bank benefits. In Table VIII, we report that the bank receives about 50-60% of the surplus and the household correspondingly receives 40-50% across specifications of preferences and beliefs. Thus, pricing by the bank does not appear to be predatory, consistent with the results of Section III.

B. Sensitivity to Decision and Experienced Utilities

We now establish that households with low initial risk-taking are prime beneficiaries of CGPs. To show this, we focus on two polar cases. In one scenario, the experienced utility used to assess economic well-being coincides with the decision utility used in decision-making. In a second scenario, the experienced utility exhibits constant relative risk aversion (CRRA) and is evaluated under the physical measure $\mathbb{P}$.[43]

For each decision utility and belief, we solve numerically the policy function $(C_t^*, I^*, t, \alpha_t^*)$ and compute by simulation the experienced utility $V^{\text{EXP}} = \mathbb{E}_0^{\mathbb{P}}\left[\sum_{t=1}^{T} \delta^{t-1}\, \pi_1 \ldots \pi_{t-1}\, u(C_t^*)\right]$, where $u(C) = C^{1-1/\psi}/(1-\psi^{-1})$. To map the experienced utility V^{EXP} into yearly units, we define its *constant consumption equivalent* as the time- and state-invariant yearly consumption level C^{EXP} that achieves the same experienced utility: $\sum_{t=1}^{T} \delta^{t-1}\, \pi_1 \ldots \pi_{t-1}\, u(C^{\text{EXP}}) = V^{\text{EXP}}$.

In the left graph of Figure 7, Panel A, we consider households with identical decision and experienced utilities, which are of the Barberis-Huang type. Variation in initial risk-taking is obtained by letting the loss aversion parameter λ vary, while the other preference parameters are set as in Section IV.B. The figure plots the constant consumption equivalent before and after innovation as a function of the initial risk-taking index. The innovation increases the constant consumption equivalent by \$1,500 per year for households with low initial risk-taking, and about \$1,000 for households with high initial risk-taking.

In the right graph of Figure 7, Panel A, we consider households with (i) Barberis-Huang decision utilities with heterogeneous loss aversion parameters λ, and (ii) a common CRRA experienced utility with $\psi = 0.5$ and $\delta = 0.98$. The figure plots the constant consumption equivalent before and after innovation as a function of the initial risk-taking index. While innovation increases the experienced utility of households with low initial risk-taking, it now *decreases* the experienced utility of households with high initial risk-taking. Under our chosen specification, the difference in utility breaks even when the risk-taking index is about 0.25 *ex ante*. Households with high initial risk-taking cater to their behavioral biases by purchasing CGPs, which reduces average consumption and experienced utility.

Figure 7, Panel B, reports similar findings for households with Prelec subjective utilities. The most pessimistic households strongly benefit from financial innovation, while less biased

[43] In both cases, the experienced utility exhibits less behavioral traits in preferences or beliefs than the decision utility. If instead the experienced utility has stronger behavioral traits, financial innovation could trigger an increase in risk-taking that would make the household worse off.

households incur losses in experienced utility.

Overall, households with low initial risk-taking are the prime beneficiaries of the introduction of CGPs across preference and belief specifications. The new products address these households' concerns about very adverse outcomes and allows them to increase their levels of risk-taking, which produces an increase in average consumption. Since the experienced utility is not particularly sensitive to consumption volatility, household welfare improves. By contrast, for households initially more willing to take risk, the introduction of CGPs crowds out equity fund investments, thereby reducing average consumption and experienced utility.

VI. Alternative Explanations

In this section, we consider alternative mechanisms that could drive the adoption of CGPs.

A. Aggressive Marketing to Gullible Clients

A first alternative story is that banks push CGPs to gullible households. Such an explanation implicitly requires that banks have a stronger incentive to sell CGPs than other risky assets. Section II shows, however, that CGPs and mutual funds have similar markups. In addition, the committed holding period of CGPs, while longer than the holding period of mutual funds, is similar to or shorter than the maturity of other popular products such as life insurance or pension funds. Hence, banks appear to have limited incentives to prioritize CGPs in their marketing efforts.

The household evidence also contradicts the gullibility hypothesis. As Figure IA.8 in the Internet Appendix shows, household participation in CGP markets does not vary monotonically with IQ. Figure IA.9 in the Internet Appendix also documents that there is no clear relationship between investor IQ and the markups on held CGPs. These facts further limit concerns about predatory behavior targeting vulnerable segments of the population.[44]

[44]While rent extraction enabled by complex retail structured products has been documented in the literature (Célérier and Vallée, 2017), such phenomenon does not appear to be significant in Sweden, which could

Furthermore, the results of Section III shows that even when all features of product design are taken into account, investing in CGPs leads to a substantial increase in the expected return on household financial wealth. The evidence therefore does not support the view that banks market CGPs to just take advantage of gullible households.

B. Participation Costs

Participation costs are a leading explanation for non-participation in risky asset markets. One may therefore ask if they drive the demand for CGPs. We do not find support for this hypothesis. Empirically, only 7.1% of CGP buyers in our sample did not previously own equity, so it is unlikely that CGPs significantly affect the cost of entering equity markets in our setting. Hence CGPs primarily impact risk-taking at the intensive margin.

We also extend the life-cycle model by considering participation costs as in Gomes and Michaelides (2005). We consider both a fixed entry cost that households pay the first time they enter risky asset markets, as well as a smaller participation cost per period. We report that consistent with section IV, the introduction of CGPs does not affect the risk-taking behavior of Epstein-Zin households at the intensive margin. We refer the reader to the Sections XII and XIII of the Internet Appendix for the full methodology and numerical results.[45]

C. Perception of CGPs as Fully Safe Products

Our results can be interpreted as CGPs alleviating households' mistrust towards risky assets or capital markets in general, consistent with the view that mistrust is a form of pessimism.

come from social norms or regulation. We are not making the case that predatory behavior cannot happen with CGPs, but that the effects we document are not coming from such mechanism.

[45]One might consider mistrust as a participation cost. If investors view CGPs with more trust than other product it could generate our results by lowering their reluctance to participate to stock markets through these products. This is exactly the mechanism we try to micro-found with our theoretical model. We want to identify which types of beliefs or preferences can generate a demand for CGPs that is related to their specific design. We can relate trust with the effects of the guarantee on investors with pessimistic beliefs or loss aversion combined with narrow framing.

Therefore, one may be concerned that households erroneously perceive CGPs as fully safe assets, even though the CGPs sold in Sweden typically include credit risk.

In the empirical analysis of Section III, our estimates of expected returns take credit risk into account, so that the documented increase in expected returns triggered by CGPs does not depend on household views about credit risk. The life-cycle analysis of Sections IV and V also takes credit risk into account. In Section XI.B of the Internet Appendix, we verify that our main results are robust to using a higher or a lower probability of default into the model. Last, we find that even when Epstein-Zin households neglect credit risk when making their investment decision, the introduction of CGPs does not induce a change in risk-taking.[46]

VII. Conclusion

This study provides empirical evidence that security design can help to alleviate low financial risk-taking by a sizable segment of the household population. CGPs provide investors with a substantial share of the equity premium, along with a guarantee typically representing about 90% of invested capital. Using a large administrative data set, we show that the introduction of retail CGPs significantly increases the expected returns of household financial portfolios, especially if the initial willingness to take risk is low.

The present paper illustrates that financial innovation can be used as a laboratory to test theories of portfolio choice. For instance, we show that pessimistic beliefs or preferences combining loss aversion with narrow framing can explain low levels of household risk-taking and the impact of financial innovation, while the combination of second-order risk aversion and rational expectations cannot explain these facts in a standard life-cycle model. Our work also contributes to the literature that assesses the welfare implications of financial innovation. It suggests that CGPs should be primarily marketed to low risk-takers, while low-fee traditional equity products are better suited for other households.

[46]See Section VIII.B.4 of the Internet Appendix.

REFERENCES

Bach, Laurent, Laurent E. Calvet, and Paolo Sodini, 2020, Rich pickings? Risk, return, and skill in the portfolios of the wealthy, *American Economic Review* 110, 2703–2747.

Barberis, Nicholas, 2013, The psychology of tail events: Progress and challenges, *American Economic Review* 103, 611–16.

Barberis, Nicholas, and Ming Huang, 2009, Preferences with frames: A new utility specification that allows for the framing of risks, *Journal of Economic Dynamics and Control* 33, 1555–1576.

Barberis, Nicholas, Ming Huang, and Richard H. Thaler, 2006, Individual preferences, monetary gambles, and stock market participation: A case for narrow framing, *American Economic Review* 96, 1069–1090.

Bernheim, B. Douglas, Daniel M. Garrett, and Dean M. Maki, 2001, Education and saving: The long-term effects of high school financial curriculum mandates, *Journal of Public Economics* 80, 435–465.

Biais, Bruno, and Augustin Landier, 2018, Endogenous agency problems and the dynamics of rents, Working Paper.

Biais, Bruno, Jean-Charles Rochet, and Paul Woolley, 2015, Dynamics of innovation and risk, *Review of Financial Studies* 28, 1353–1380.

Booij, Adam, Bernard van Praag, and Gijs van de Kuilen, 2010, A parametric analysis of prospect theory's functionals for the general population, *Theory and Decision* 68, 115–148.

Calvet, Laurent E., John Y. Campbell, Francisco Gomes, and Paolo Sodini, 2021, The cross-section of household preferences, Working Paper.

Calvet, Laurent E., John Y. Campbell, and Paolo Sodini, 2007, Down or out: Assessing the welfare costs of household investment mistakes, *Journal of Political Economy* 115, 707–747.

Calvet, Laurent E., Martin Gonzalez-Eiras, and Paolo Sodini, 2004, Financial innovation, market participation and asset prices, *Journal of Financial and Quantitative Analysis* 39, 431–459.

Campbell, John Y., and Luis Viceira, 2002, *Strategic Asset Allocation: Portfolio Choice for Long-Term Investors* (Oxford University Press).

Carlin, Bruce I., 2009, Strategic price complexity in retail financial markets, *Journal of Financial Economics* 91, 278–287.

Célérier, Claire, and Boris Vallée, 2017, Catering to investors through security design: Headline rate and complexity, *Quarterly Journal of Economics* 132, 1469–1508.

Chai, Jingjing, and Raimond Maurer, 2012, Experience, loss aversion, narrow framing: Can we explain the empirical evidence on household portfolio choice over the life-cycle?, Working Paper.

Chalmers, John, and Jonathan Reuter, 2020, Is conflicted investment advice better than no advice?, *Journal of Financial Economics* forthcoming.

Choukhmane, Taha, 2019, Default options and retirement saving dynamics, Working Paper.

Cocco, Joao F., Francisco J. Gomes, and Pascal J. Maenhout, 2005, Consumption and portfolio choice over the life cycle, *Review of Financial Studies* 18, 491–533.

Cole, Shawn Allen, Benjamin Charles Iverson, and Peter Tufano, 2018, Can gambling increase savings? Empirical evidence on prize-linked savings accounts, Working Paper.

Davis, Steven J., and John Haltiwanger, 1992, Gross job creation, gross job destruction, and employment reallocation, *Quarterly Journal of Economics* 107, 819–863.

DellaVigna, Stefano, and Ulrike Malmendier, 2004, Contract design and self-control: Theory and evidence, *The Quarterly Journal of Economics* 119, 353–402.

Dimmock, Stephen, Roy Kouwenberg, Olivia Mitchell, and Kim Peijnenburg, 2020, Household portfolio underdiversification and probability weighting function: Evidence from the field, Forthcoming, *Review of Financial Studies*.

Duflo, Esther, and Emmanuel Saez, 2003, The role of information and social interactions in retirement plan decisions: Evidence from a randomized experiment, *Quarterly Journal of Economics* 118, 815–842.

Egan, Mark, 2019, Brokers versus retail investors: conflicting interests and dominated products, *Journal of Finance* 74, 1217–1260.

Ellul, Andrew, Chotibhak Jotikasthira, Anastasia Kartasheva, Christian Lundblad, and Wolf Wagner, 2020, Insurers as asset managers and systemic risk, Kelley School of Business Research Paper No. 18-4.

Epstein, Larry G., and Stanley E. Zin, 1989, Substitution, risk aversion, and the temporal behavior of consumption and asset returns: A theoretical framework, *Econometrica* 57, 937–969.

Fagereng, Andreas, Charles Gottlieb, and Luigi Guiso, 2017, Asset market participation and portfolio choice over the life-cycle, *Journal of Finance* 72, 705–750.

Fehr-Duda, Helga, and Thomas Epper, 2012, Probability and risk: Foundations and economic implications of probability-dependent risk preferences, *Annual Review of Economics* 4, 567–593.

Gennaioli, Nicola, Andrei Shleifer, and Robert Vishny, 2015, Money doctors, *Journal of Finance* 70, 91–114.

Gilboa, Itzhak, and David Schmeidler, 1989, Maxmin expected utility with non-unique prior, *Journal of Mathematical Economics* 18, 141–153.

Goetzmann, William, Dasol Kim, and Robert J. Shiller, 2017, Crash beliefs from investor surveys, NBER Working Paper No. 22143.

Gomes, Francisco, Michael Haliassos, and Tarun Ramadorai, 2020, Household finance, *Journal of Economic Literature* forthcoming.

Gomes, Francisco, and Alexander Michaelides, 2005, Optimal life-cycle asset allocation: Understanding the empirical evidence, *Journal of Finance* 60, 869–904.

Gomes, Francisco J., Laurence J. Kotlikoff, and Luis M. Viceira, 2008, Optimal Life-Cycle Investing with Flexible Labor Supply: A Welfare Analysis of Life-Cycle Funds, *American Economic Review* 98, 297–303.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales, 2008, Trusting the stock market, *Journal of Finance* 63, 2557–2600.

Gul, Faruk, 1991, A theory of disappointment aversion, *Econometrica* 59, 667–686.

Haliassos, Michael, and Carol C. Bertaut, 1995, Why do so few hold stocks?, *Economic Journal* 105, 1110–1129.

Henderson, Brian J., and Neil D. Pearson, 2011, The dark side of financial innovation: A case study of the pricing of a retail financial product, *Journal of Financial Economics* 100, 227–247.

Hombert, Johan, and Victor Lyonnet, 2020, Can risk be shared across investor cohorts? Evidence from a popular savings product, Working Paper.

Jarrow, Robert A., 2019, *Modeling Fixed Income Securities and Interest Rate Options* (Chapman and Hall/CRC).

Jarrow, Robert A., and Stuart M. Turnbull, 1995, Pricing derivatives on financial securities subject to credit risk, *Journal of Finance* 50, 53–85.

Kahneman, Daniel, and Amos Tversky, 1979, Prospect Theory: An Analysis of Decision under Risk, *Econometrica* 47, 263–291.

Kahneman, Daniel, Peter P. Wakker, and Rakesh Sarin, 1997, Back to Bentham? Explorations of experienced utility, *Quarterly Journal of Economics* 112, 375–406.

Koijen, Ralph, and Motohiro Yogo, 2021, The fragility of market risk insurance, *Working Paper* .

Kuhnen, Camelia M., and Andrei C. Miu, 2017, Socioeconomic status and learning from financial information, *Journal of Financial Economics* 124, 349–372.

Li, Xindan, Avanidhar Subrahmanyam, and Xuewei Yang, 2018, Can financial innovation succeed by catering to behavioral preferences? Evidence from a callable options market, *Journal of Financial Economics* 128, 38–65.

Lusardi, Annamaria, 2008, Household saving behavior: The role of financial literacy, information, and financial education programs, NBER Working Paper No. 13824.

Madrian, Brigitte C., and Dennis F. Shea, 2001, The power of suggestion: Inertia in 401(k) participation and savings behavior, *Quarterly Journal of Economics* 116, 1149–1187.

Mankiw, N. Gregory, and Stephen P. Zeldes, 1991, The consumption of stockholders and nonstockholders, *Journal of Financial Economics* 29, 97–112.

Merton, Robert C., 1971, Optimum consumption and portfolio rules in a continuous-time model, *Journal of Economic Theory* 3, 373–413.

Prelec, Drazen, 1998, The probability weighting function, *Econometrica* 66, 497–527.

Ross, Stephen, 1976, Options and efficiency, *Quarterly Journal of Economics* 90, 75–89.

Routledge, Bryan R., and Stanley E. Zin, 2010, Generalized disappointment aversion and asset prices, *Journal of Finance* 65, 1303–1332.

Shiller, Robert J., 2004, Radical financial innovation, Cowles Foundation Discussion Paper.

Simsek, Alp, 2013, Speculation and risk sharing with new financial assets, *Quarterly Journal of Economics* 128, 1365–1396.

Stock, James H., and Motohiro Yogo, 2005, Testing for weak instruments in linear iv regression, in *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, 80–108 (Cambridge University Press).

Thaler, Richard H., and Shlomo Benartzi, 2004, Save more tomorrow? Using behavioral economics to increase employee saving, *Journal of Political Economy* 112, S164–S187.

Vokata, Petra, 2019, Engineering lemons, Working Paper.

Table I
Household Risk-Taking Across Countries in 2015

	National Accounts	Surveys of Households Above 50	
	Share of Equity in Aggregate Financial Wealth in %	**Fraction of Equity Participants in %**	**Median Share of Equity in Financial Wealth of Participants in %**
	(1)	(2)	(3)
Sweden	17.41	68.16	36.64
United States	31.91	32.03	31.61
China	n/a	10.08	19.88
European Union	8.74	25.26	31.25
Selected European countries			
Austria	7.80	18.69	33.33
Belgium	14.24	40.46	33.11
Croatia	n/a	6.93	33.33
Czech Republic	1.18	37.92	21.98
Denmark	28.27	58.31	32.38
Estonia	5.09	8.40	33.26
Finland	15.71	n/a	n/a
France	9.12	30.57	23.37
Germany	6.29	32.91	26.19
Greece	3.14	2.58	27.36
Hungary	3.86	n/a	n/a
Italy	7.13	8.03	30.00
Latvia	3.48	n/a	n/a
Lithuania	4.20	n/a	n/a
Luxembourg	10.98	26.68	36.80
The Netherlands	26.00	n/a	n/a
Norway	15.80	n/a	n/a
Poland	10.12	2.38	36.36
Portugal	3.21	16.36	28.00
Slovakia	0.38	n/a	n/a
Slovenia	8.19	10.97	30.11
Spain	8.90	7.81	31.09
United Kingdom	9.05	25.70	7.06

Notes: This table reports (1) the percentage of aggregate household financial wealth invested in equity, (2) the fraction of households participating in equity markets, and (3) the median share of equity in the financial wealth of participants. The data in column 1 are retrieved from the OECD National Accounts and the US Federal Reserve's Financial Accounts. The statistics in columns 2 and 3 are based on surveys of households representative of the population of people aged 50 years and older, except for China, where the sample is representative of the total population. The surveys are the following: the 2016 wave of the University of Michigan Health and Retirement Study (HRS) for the US, the 6$^{\text{th}}$ wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) for European countries including Sweden, the 7$^{\text{th}}$ wave of the English Longitudinal Study of Ageing (ELSA) for the United Kingdom, and the 2015 China Household Finance Survey (CHFS) for China. Section II in the Internet Appendix describes the precise methodology.

Table II
Retail Capital Guarantee Products Around the World

Region	Product Type	Outstanding Volume (Billion U.S. $)	Outstanding Volume as % of GDP
North America		**1,644**	-
USA	Guaranteed life annuities	1,600	8.77
	Synthetic CGPs	22	0.12
Canada	Synthetic CGPs	20	1.25
Mexico	Synthetic CGPs	2	0.09
Europe		**1,794**	-
France	Euro contracts	1,540	56.65
	Synthetic CGPs	31	1.14
Germany	Synthetic CGPs	47	1.21
UK	Synthetic CGPs	12	0.43
Sweden	Synthetic CGPs	5	1.04
Other countries	Synthetic CGPs	159	-
Asia		**936**	-
China	Guaranteed wealth management products	854	4.80
	Synthetic CGPs	13	0.07
South Korea	Synthetic CGPs	31	1.60
Japan	Synthetic CGPs	17	0.33
Other countries	Synthetic CGPs	21	-
Rest of the World	Synthetic CGPs	**18**	-
Total		**4,393**	-

Notes: This table reports the types and outstanding volumes of retail capital guarantee products in dollars and as a percentage of GDP around the world in 2015. Synthetic CGPs volumes only include contracts offering a capital protection of at least 90% of invested capital. For products other than synthetic CGPs, the guarantee is obtained by using reserves, possibly complemented by hedging. Outstanding volumes are obtained from the following data sources: (i) the National Association of Insurance Commissioners, Ellul, Jotikasthira, Kartasheva, Lundblad, and Wagner (2020), and Koijen and Yogo (2021) for guaranteed life annuities in the United States; (ii) Hombert and Lyonnet (2020) for Euro contracts in France; (iii) the 2015 Annual Report on China Banking Wealth Management Products compiled by the China Central Depository & Clearing Co. Ltd for wealth management products in China, and (iv) the same data provider as in Célérier and Vallée (2017) for synthetic CGPs.

Table III
Design, Markup, and Expected Return of Retail Equity Products

	Mean	p1	p10	p50	p90	p99
Panel A. Full sample of capital guarantee products (1,511 contracts)						
Design parameters:						
- Maturity (months)	40.1	12.0	17.9	37.6	60.5	72.5
- Guarantee (% of face value)	100.5	100.0	100.0	100.0	100.0	109.5
- Issue price (% of face value)	107.1	100.0	101.5	106.0	112.0	122.0
Issuance year	2006	2002	2004	2006	2007	2007
Issuance volume (2000 $ million)	5.2	0.1	0.5	2.6	12.9	29.1
Panel B. Baseline capital guarantee products (810 contracts)						
Design parameters:						
- Maturity (months)	44.5	12.6	24.5	48.0	60.5	72.5
- Guarantee (% of face value)	100.2	100.0	100.0	100.0	100.0	108.0
- Issue price (% of face value)	108.7	100.0	101.5	111.5	112.0	122.0
- Participation rate (%)	113.3	30.0	63.0	110.0	160.0	215.0
- Asian option length (months)	13.5	0.0	4.0	13.0	24.0	60.0
Issuance year	2006	2002	2004	2006	2007	2007
Issuance volume (2000 $ million)	4.7	0.1	0.5	2.6	11.5	25.9
Asset pricing inputs:						
- Yearly historical volatility (%)	20.6	8.5	14.3	20.5	26.1	36.1
- Dividend yield (%)	2.1	0.0	1.0	2.1	3.0	4.5
- CDS premium (bp)	18.8	8.0	11.2	15.4	31.5	47.5
- Underlying beta to world index	1.2	0.5	0.9	1.2	1.5	1.7
Asset pricing outputs:						
- Expected excess return (%)	2.9	-0.8	0.1	2.9	5.6	7.1
- Yearly markup φ_{CGP} (%)	1.5	-0.9	0.1	1.6	2.7	4.0
- Risk-taking index η	0.49	-0.14	0.02	0.49	0.94	1.19
Panel C. Banks providing CGPs (20 Banks)						
2007 outstanding CGP/Total investment funds (%)	8.8	6.2	6.8	8.1	11.1	15.8
Average participation rate (%)	113	100	107	113	121	123
Panel D. Equity mutual funds (1,376 funds)						
Beta to world index	1.0	0.2	0.7	0.9	1.5	2.3
Yearly fees (%)	2.0	0.8	1.5	1.9	2.8	3.5
Fund volume (2000$ million)	21.7	0.0	0.0	0.4	27.2	448
Asset pricing outputs:						
- Expected excess return (%)	4.0	-1.0	1.7	3.6	6.5	11.9
- Risk-taking index η	0.66	-0.17	0.29	0.60	1.09	1.98

Notes: Panel A reports the average characteristics of retail CGPs issued in Sweden between 2002 and 2007. Panel B focuses on the subsample of baseline CGPs with returns of the form $1 + R_g = [1 + \max(p\,R^*; g)]\,\xi\,F/P_0$, where p denotes the participation rate, R^* the average performance of the underlying, g the guarantee, F the face value, P_0 the issue price, and ξ the delivery rate of pledged cash flows. Panel C reports summary statistics on the CGPs supplied by the 20 main Swedish banks. Panel D reports summary statistics on all equity mutual funds available in Sweden between 2002 and 2007. Yearly fees include the management and entry fees paid by retail investors.

Table IV
Household Characteristics and Portfolio Allocation

	Full Sample (1)				Traditional Equity Product Participants (2)				Capital Guarantee Product Participants (3)			
	Number of households: N=3,107,893				Number of households: N=2,128,612 (68.5% of total)				Number of households: N=428,337 (13.8% of total)			
	Mean	Median	p10	p90	Mean	Median	p10	p90	Mean	Median	p10	p90
Panel A: 2002												
Financial wealth (in 2000 $, thousands)												
Total	33.7	11.2	2.5	72.8	44.9	17.7	4.6	92.3	72.9	38.0	8.0	149.6
Traditional equity products	15.3	1.2	0.0	29.6	22.4	4.4	0.2	42.9	36.1	11.8	0.2	79.1
Stocks	7.1	0.0	0.0	6.5	10.4	0.3	0.0	11.3	13.5	0.9	0.0	22.4
Equity mutual funds	8.0	0.5	0.0	19.7	11.7	2.6	0.0	28.5	22.1	7.8	0.0	54.5
Bank deposits	13.1	6.3	2.0	27.4	1.6	7.7	2.6	32.4	22.4	10.5	3.0	48.0
Fixed income securities	4.2	0.0	0.0	11.6	5.5	0.0	0.0	14.9	11.4	2.1	0.0	30.5
Demographics												
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
Disposable income (in 2000 $)	27.5	22.8	10.5	48.0	31.5	28.0	12.3	52.0	35.3	30.9	14.2	57.0
Years of schooling (head)	11.4	11.0	8.0	15.0	11.8	11.0	8.0	15.0	11.9	12.0	8.0	16.0
Male, in % (head)	60.0	100.0	0.0	100.0	63.5	100.0	0.0	100.0	62.9	100.0	0.0	100.0
Age (head)	53.1	52.0	33.0	76.0	52.0	52.0	32.0	73.0	55.2	56.0	37.0	72.0
Equity participants, in %	68.5	-	-	-	100	-	-	-	92.9	-	-	-
Allocation of financial wealth (%, 2002 participants only)												
Traditional equity products	22.5	11.5	0.0	65.0	32.9	27.5	2.5	72.6	37.9	35.9	1.3	76.5
Stocks	6.4	0.0	0.0	20.9	9.3	1.4	0.0	30.2	9.8	2.5	0.0	30.7
Equity mutual funds	15.7	4.3	0.0	48.8	22.9	16.9	0.0	56.3	27.3	23.5	0.0	61.1
Bank deposits	66.5	74.0	17.1	1	54.4	55.0	12.9	95.1	42.9	37.7	8.6	88.1

Table IV (continued)
Household Characteristics and Portfolio Allocation

Panel B: 2007												
Allocation of financial wealth (%)												
Capital guarantee products	1.6	0.0	0.0	2.5	2.1	0.0	0.0	6.2	11.9	7.3	0.0	30.0
Traditional equity products	24.4	11.8	0.0	70.1	34.5	30.5	0.0	76.5	34.4	31.9	0.7	71.0
Stocks	6.4	0.0	0.0	21.8	9.2	0.3	0.0	31.7	9.1	1.6	0.0	30.1
Equity mutual funds	16.5	1.4	0.0	54.5	23.6	15.9	0.0	61.9	23.2	18.7	0.0	55.0
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
Bank deposits	63.8	69.0	14.3	100.0	52.1	49.2	11.2	99.2	36.9	31.6	7.7	75.4
Panel C: Household risk-taking index (η_h)												
Year 2002	0.16	0.08	0.0	0.47	0.24	0.19	0.0	0.54	0.27	0.25	0.01	0.57
Year 2007	0.18	0.07	0.0	0.53	0.27	0.23	0.0	0.59	0.30	0.29	0.02	0.58
2002-2007 % Change					0.0	13.7	-191.6	117.1	15.0	12.4	-76.4	113.6

Notes: This table reports summary statistics on the characteristics, portfolio allocation, and risk-taking behavior of Swedish households. In Panel A, we tabulate the financial characteristics, demographics, equity participation, and share of financial wealth allocated to equity in 2002. Panel B displays equity participation and the equity share of households in 2007. Panel C shows the risk-taking index in 2002 and 2007. The statistics are computed on all households in Sweden in the first set of columns ($N = 3,107,893$ households), participants in traditional equity products in the second set of columns ($N = 2,128,612$ households or 68.5% of the total household population), and participants in capital guarantee products ($N = 428,337$ households or 13.8% of the total population).

Table V
CGP Participation and Financial Risk-Taking: Cross Section Analysis

	2002 -2007 Percentage Change in Risk-Taking Index ($\Delta\eta_h$)			
	Total Change		Active Change	
	(1)	(2)	(3)	(4)
$\mathbb{1}_{CGP_h}$	0.22***	0.40***	0.23***	0.44***
	(0.00)	(0.01)	(0.00)	(0.01)
$\mathbb{1}_{CGP_h} \times$ 2002 risk-taking index		-0.76***		-0.83***
		(0.01)		(0.01)
Fixed effects (2002 value)				
Risk-taking index quartiles	Yes	Yes	Yes	Yes
Financial wealth deciles	Yes	Yes	Yes	Yes
Income deciles	Yes	Yes	Yes	Yes
Age deciles	Yes	Yes	Yes	Yes
Gender	Yes	Yes	Yes	Yes
Years of education	Yes	Yes	Yes	Yes
Family size	Yes	Yes	Yes	Yes
Number of children	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
Control				
2002-2007 change in income	Yes	Yes	Yes	Yes
Observations	2,066,093	2,066,093	2,066,093	2,066,093
R^2	0.098	0.101	0.047	0.050

Notes: This table displays OLS regression coefficients of the change in the risk-taking on an indicator variable for participation in capital guarantee products and control variables. In Columns 1 and 2, the dependent variable is the Davis and Haltiwanger (1992) measure of growth in the risk-taking index from 2002 to 2007. In Columns 3 and 4, the dependent variable is the *active* change in risk-taking index from 2002 to 2007. We compute the active change in the risk-taking index as the Davis and Haltiwanger (1992)'s growth rate between the risk-taking index in 2002 and the 2007 market-neutral risk-taking index, as defined in Section III.B. The indicator variable $\mathbb{1}_{CGP_h}$ is equal to unity if the household invests at least once in capital guarantee products over the 2002 to 2007 period. In Columns 2 and 4, we interact $\mathbb{1}_{CGP_h}$ with the household 2002 risk-taking index, filtered from household observable characteristics as described in Section III.C. The sample is restricted to households participating in stock markets in 2002. Standard errors are clustered at the district level and displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table VI
CGP Investment and Financial Risk-Taking: Panel Analysis

		Quartiles of 2002 Risk-Taking Index			
	All	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)	(5)
Panel A. Dependent variable: Risk-taking index $\eta_{h,t}$					
CGP Share$_{h,t}$	0.21***	0.38***	0.28***	0.12***	-0.03
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Controls and Observations: see Panel C					
R^2	0.84	0.73	0.71	0.67	0.72
Panel B. Dependent variable: Market-neutral risk-taking index $\eta_{h,t}^{MN}$					
CGP Share$_{h,t}$	0.24***	0.36***	0.30***	0.17***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Controls and Observations: see Panel C					
R^2	0.74	0.62	0.59	0.63	0.69
Panel C. Control variables and number of observations					
Fixed Effects					
Household	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
Fixed effects interacted with year fixed effects					
2002 risk-taking index quartiles	Yes	Yes	Yes	Yes	Yes
Financial wealth deciles	Yes	Yes	Yes	Yes	Yes
Income deciles	Yes	Yes	Yes	Yes	Yes
Age deciles	Yes	Yes	Yes	Yes	Yes
Gender	Yes	Yes	Yes	Yes	Yes
Years of education	Yes	Yes	Yes	Yes	Yes
Family size	Yes	Yes	Yes	Yes	Yes
Number of children	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes
Observations	1,913,498	507,750	461,985	472,616	471,137

Notes: This table reports panel regressions of household risk-taking on the share of financial wealth invested in capital guaranteed products, $CGP\ Share_{h,t}$. In Panel A, the dependent variable is the risk-taking index. In Panel B, the dependent variable is the market-neutral risk-taking index defined in Section III.B. Panel C lists the control variables used in the regressions reported in Panels A and B. The sample is restricted to households participating in stock markets in 2002. Standard errors are clustered at the bank times year level and displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table VII
CGP Investment and Financial Risk-Taking: Instrumental Variable Panel Analysis

	OLS	First Stage	Second Stage				
				Quartiles of 2002 Risk-Taking Index			
			All	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Instrument 1 (Portion of CGPs in bank product mix)							
CGP Share$_{h,t}$	0.21***		0.43**	0.55***	0.35*	0.33	0.30
	(0.01)		(0.21)	(0.15)	(0.20)	(0.29)	(0.22)
CGP Portion - Main Bank		0.75***					
		(0.02)					
CGP Portion - Second Bank		0.48***					
		(0.02)					
Controls: see Panel C							
Observations	955,561	955,561	955,561	238,206	239,712	239,160	238,494
R^2	0.84	0.51					
F statistic		141					
Panel B. Instrument 2 (Average participation rate)							
CGP Share$_{h,t}$	0.18***		0.64*	0.85***	0.78**	0.46	0.05
	(0.02)		(0.34)	(0.30)	(0.33)	(0.37)	(0.39)
Average Participation Rate - Main Bank		0.01***					
		(0.00)					
Average Participation Rate - Second Bank		0.01***					
		(0.00)					
Controls : see Panel C							
Observations	411,120	411,116	411,116	107,423	99,330	100,571	103,781
R^2	0.82	0.56					
F statistic		34					
Panel C. Control variables and number of observations							
Fixed Effects							
Household	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects interacted with year fixed effects							
2002 risk-taking index quartiles	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Financial wealth deciles	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income deciles	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age deciles	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gender	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Years of education	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family size	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of children	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes	Yes

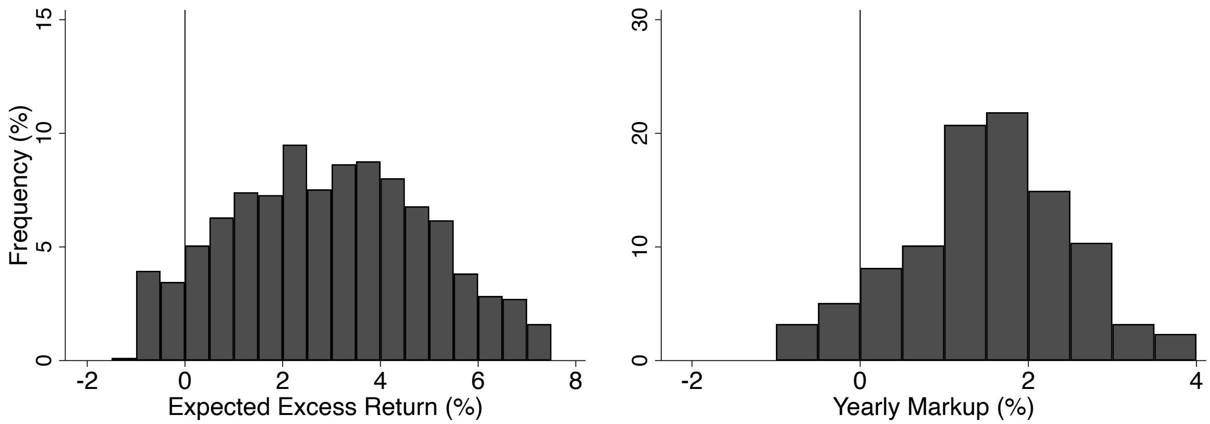
Notes: This table displays the results of the instrumental variable analysis, in which the share of CGPs in the financial wealth of household h in year t, $CGP\ Share_{h,t}$, is instrumented by two measures of CGP time-varying supply by the main bank(s) with which the household has a relationship in 2002. In Panel A, we instrument $CGP\ Share_{h,t}$ by the portion of CGPs in the product mix of household h's two main banks. We restrict the sample to half of the CGP participants, 160,000 households, as we use the other half to build the instrument. In Panel B, we instrument $CGP\ Share_{h,t}$ by the average participation rate of household h's two main banks. We restrict the sample to participants in CGPs with the Euro Stoxx 50, OMX Stockholm 30, and FTSE 100 as underlying, i.e. 68,500 households. Standard errors are clustered at the bank times year levels and are displayed below their coefficient of interest. *, **, and *** represent statistical significance at the 10%, 5%, and 1% confidence levels, respectively.

Table VIII
Household Welfare Gains Predicted by the Models

Models	Loss Aversion with Narrow Framing (1)	Probability Weighting (2)
Key parameter value	Utility kink parameter $\lambda = 3.3$	Pessimism parameter b=0.73
Change in risk-taking (%)	86.4	95.2
Household utility gain, in U.S. $	12,875	12,751
Bank revenue gain, in U.S. $	11,774	17,598
Household share of surplus (%)	52.2	42.0

Notes: This table reports the changes in the household risk-taking index, welfare gains, bank revenue gains, and the household share of the surplus generated by the introduction of capital guarantee products under various specifications of preferences and beliefs. Decision and experienced utilities are assumed to be identical. Under all specifications, the starting value is household with an ex-ante risk-taking index of 8%, which corresponds to the 25^{th} percentile in the Swedish population. In column 1, we consider an investor with Barberis and Huang (2009) preferences, which combines loss aversion with narrow framing, and rational expectations. In column 2, we consider an investor with Prelec (1998) probability weighting. The subjective cumulative distribution function of the investor is given by $F(r; a, b) = \exp\{-b[-\ln F_{\mathbb{P}}(r)]\}$, where $F_{\mathbb{P}}(r)$ denotes the cumulative distribution function of the yearly log return on the underlying under the physical measure $\mathbb{P}$.

Panel A. Baseline Capital Guarantee Products (810 Products)



Panel B. Equity Mutual Funds (1,376 Products)

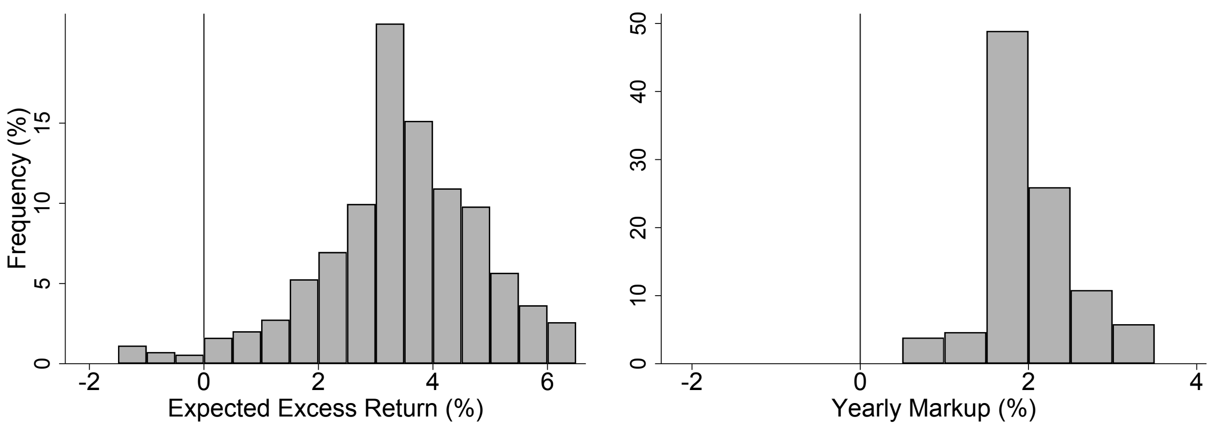


Figure 1. Expected Excess Returns and Yearly Markups of Capital Guarantee Products and Equity Mutual Funds. Panel A shows the histogram of the expected excess return offered by the 810 baseline capital guarantee products issued in Sweden over the 2002-2007 period (left graph) and the histogram of the gross markup of the banks distributing them (right graph). Both measures are computed by following the asset pricing methodology outlined in Section II. Panel B shows the histograms of the expected excess return (left graph) and gross markup (right graph) of the 1,376 equity mutual funds under management in Sweden over the 2002-2007 period.

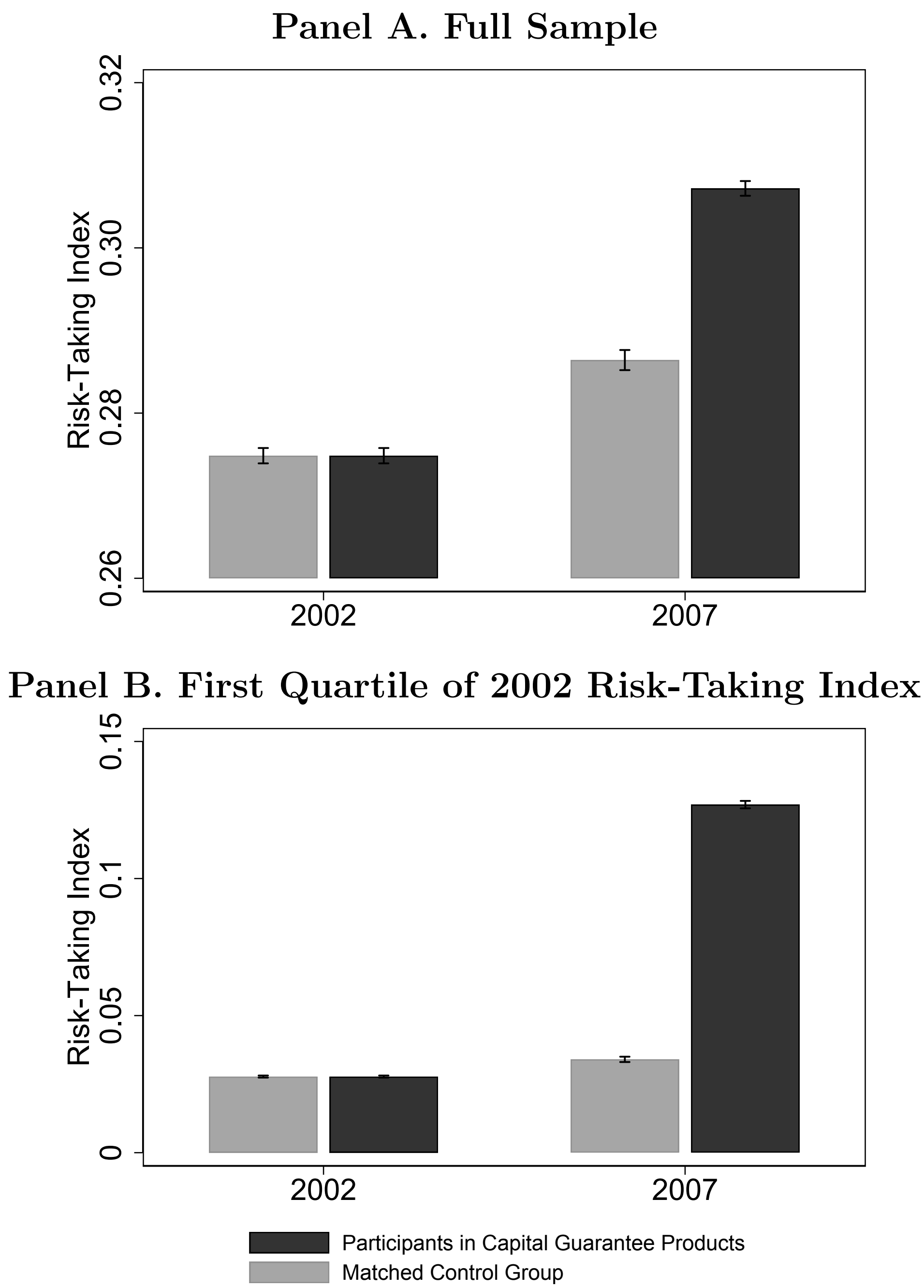


Figure 2. Household Median Risk-Taking Index in 2002 and 2007. Panel A plots the median risk-taking index in 2002 and in 2007 for: (i) capital guarantee product participants, and (ii) a control group of equal size made of stock market participants matched based on their 2002 risk-taking index. Panel B reproduces the same graph when restricting the sample to households in the first quartile of risk-taking index in 2002. The whiskers represent the confidence band at the 95% level.

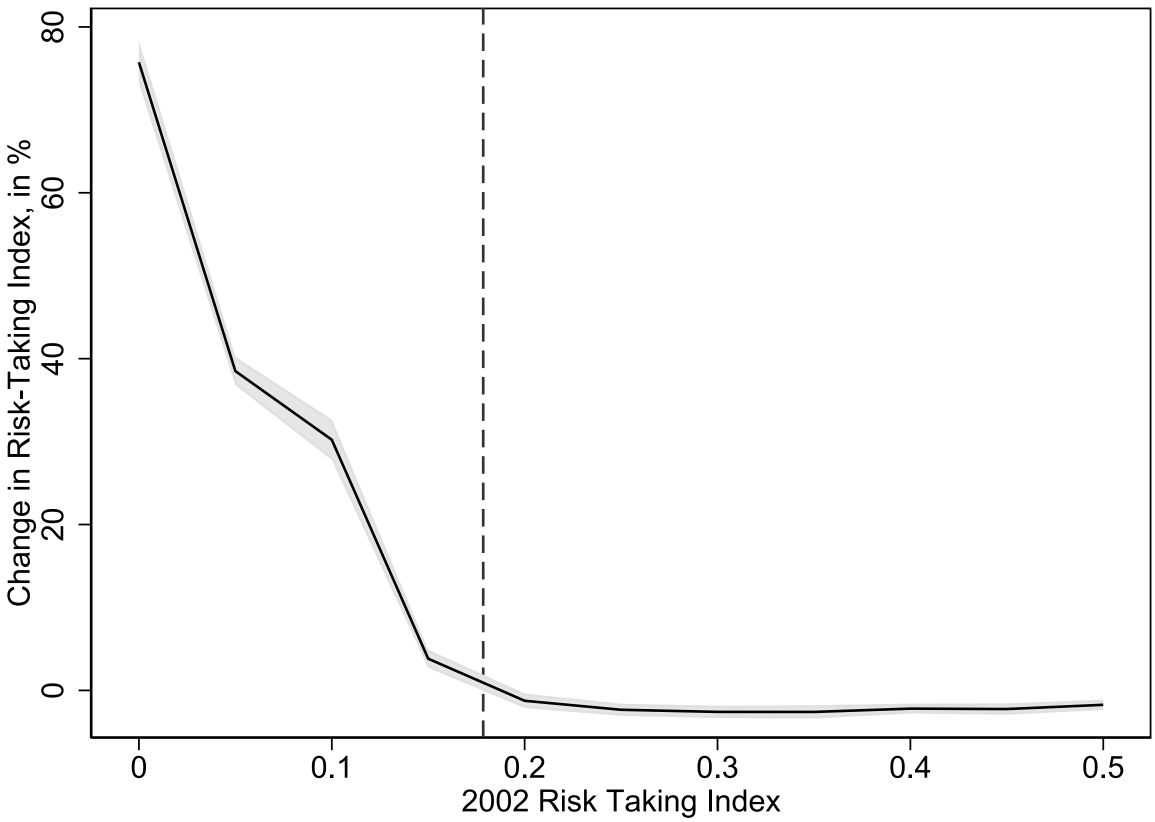


Figure 3. Proportional Change in Risk-Taking Index as a Function of Initial Risk-Taking for Capital Guarantee Product Participants. This figure shows the proportional change in the risk-taking index for CGP participants as a function of their initial willingness to take risk in 2002. As Section III.C explains, the initial willingness to take risk is the 2002 risk-taking index, from which we filter out the effects of household observable characteristics. The proportional change in risk-taking for CGP participants is the ratio of the predicted incremental change in the risk-taking index for CGP participants (vs. non participants) to their period-average of risk-taking index $\frac{\eta_{h,2002}+\eta_{h,2007}}{2}$. The vertical dotted line plots the median 2002 risk-taking index. The shaded area represents the confidence band at the 95% level.

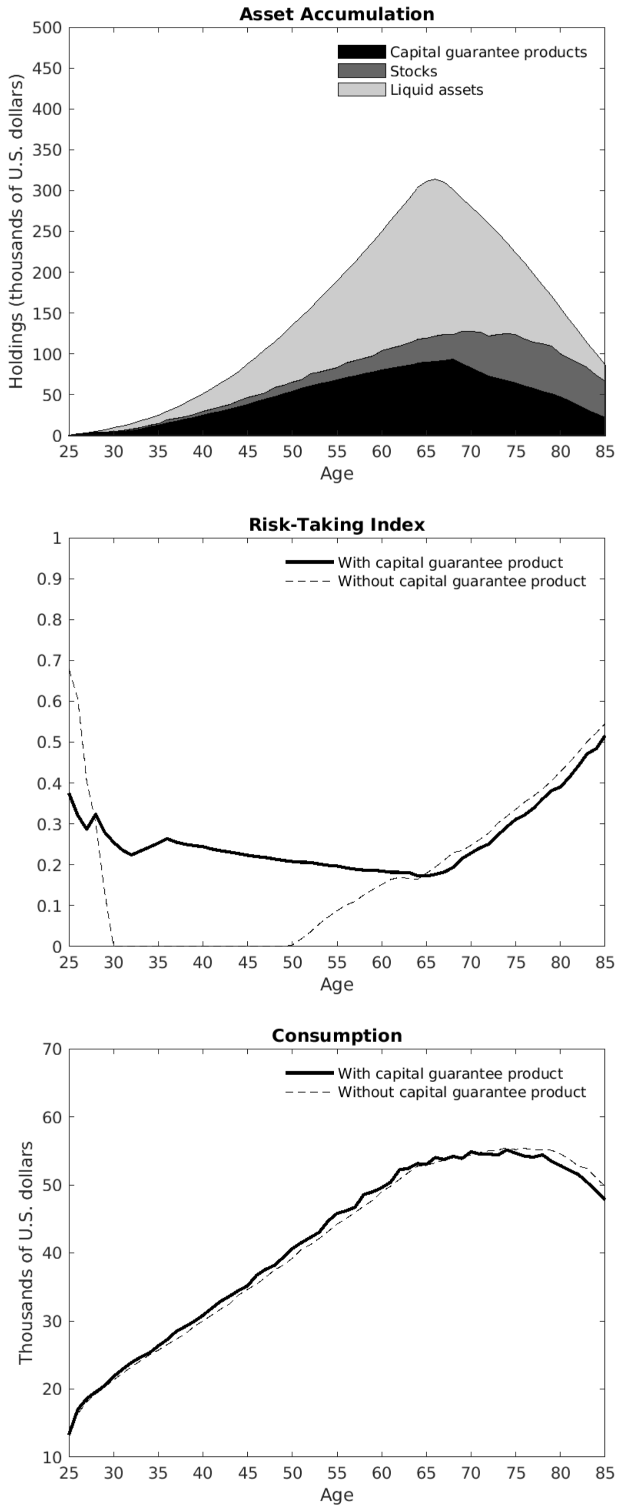
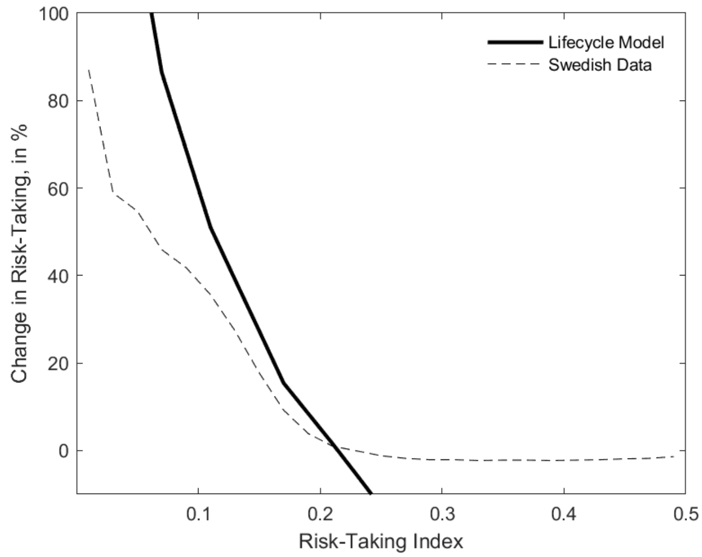


Figure 4. Life-Cycle Model with Loss Aversion and Narrow Framing. This figure displays the average portfolio allocation (Panel A), risk-taking index (Panel B), and consumption (Panel C) in a life-cycle model with equity funds, bonds, and CGPs. The investor has Barberis-Huang utility with parameters $b_0 = 0.05$, $\lambda = 3.3$, $\gamma = 4$, and $\psi = 0.5$. The CGP is exposed to credit risk and is worthless at maturity with probability 1%.

Panel A. Loss Aversion and Narrow Framing



Panel B. Probability Weighting

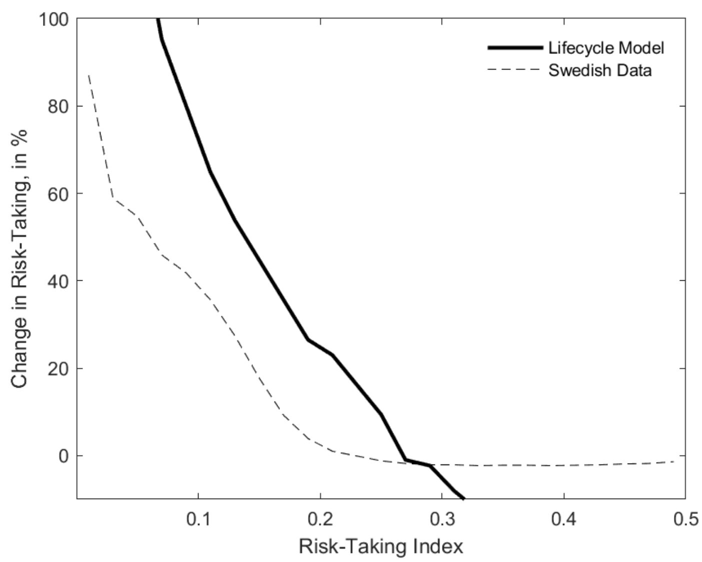


Figure 5. Change in Risk-Taking: Life-Cycle Model versus Data. This figure illustrates the relationship between initial risk-taking and the change in the risk taking index that follows the introduction of capital guarantee products. In each panel, the dashed line corresponds to empirical data, while the solid line plots the value implied by the life-cycle model with Barberis and Huang (2009) utility (Panel A) or Prelec (1998) probability weighting (Panel B). Each point is an average over households with a head between 50 and 60. The solid line is obtained by varying the kink parameter λ (Panel A) or the probability weighting parameter b (Panel B), while all other model parameters are kept constant.

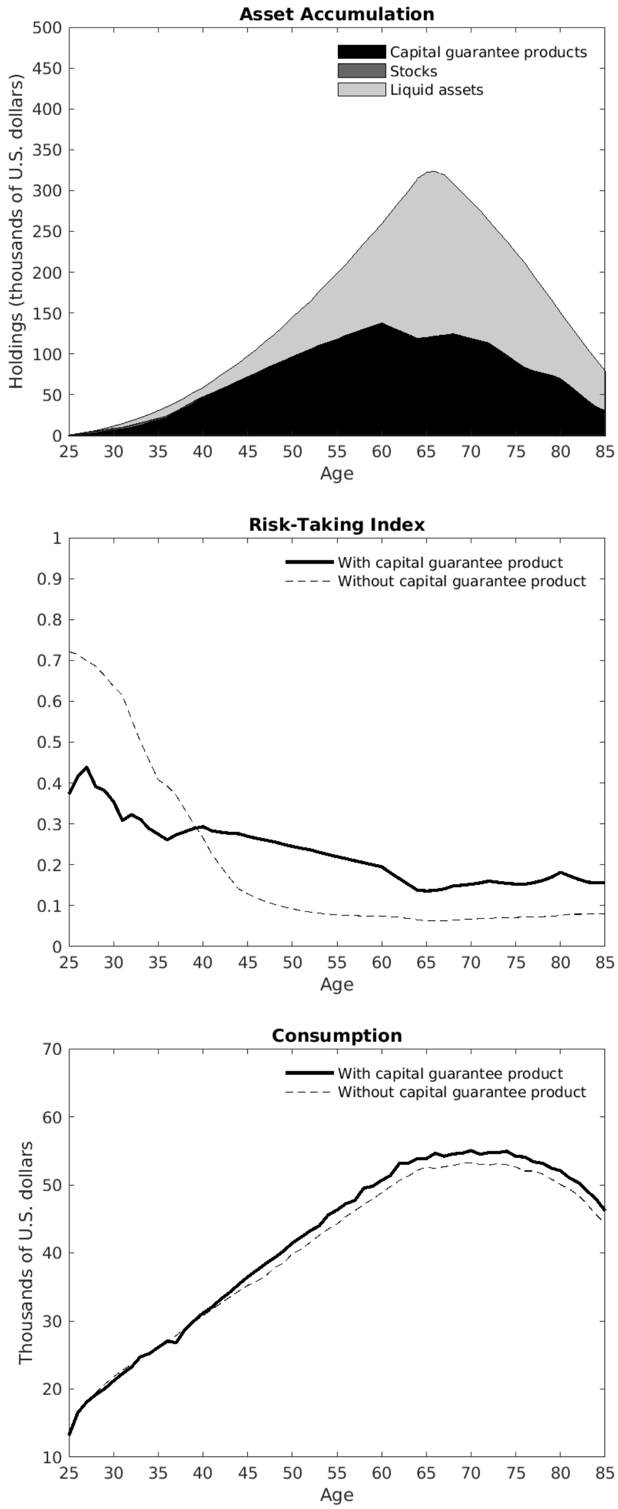
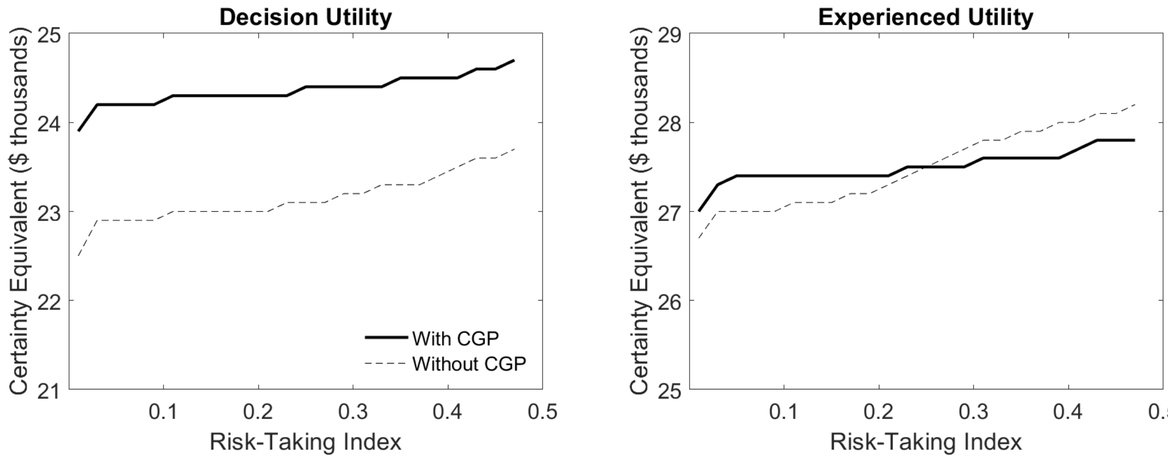


Figure 6. Life Cycle Model with Probability Weighting. This figure displays the average portfolio allocation (Panel A), risk-taking index (Panel B), and consumption (Panel C) in a life-cycle model with equity funds, bonds, and capital guarantee products. The investor has Prelec (1998) utility function with the following parameter: $a = 0.5$, $b = 0.73$, $\gamma = 4$, and $\psi = 0.5$.

Panel A. Loss Aversion with Narrow Framing (Barberis and Huang, 2001)



Panel B. Probability Weighting (Prelec, 1998)

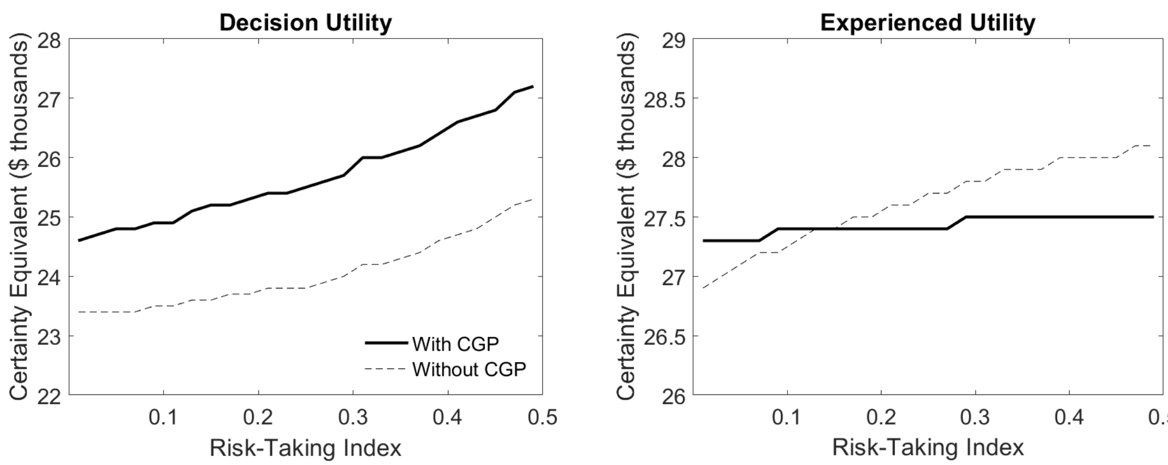


Figure 7. Welfare Implications of Capital Guarantee Products. This figure plots the welfare implications of introducing capital guarantee products under the life-cycle model with Barberis and Huang (2009) utility (Panel A) and Prelec (1998) probability weighting. For each specification, we compute the certainty equivalent before and after the introduction of the product under the decision utility (left subpanel) and the experienced utility (right subpanel). The certainty equivalent is the deterministic level of yearly consumption, assumed for simplicity to be constant over the life-cycle, that provides the same lifetime utility as the lifetime utility predicted by a model.