Stock Market Participation and Macro-Financial Trends*

Francesco Saverio Gaudio†

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Abstract

The U.S. stock market participation rate has substantially risen since the 1980s. This paper studies the macro-financial implications of such structural change in a production-based asset pricing model with external habit preferences, which make investors' effective risk tolerance time-varying and increasing with consumption. In this setup, higher participation generates a fall in the risk-free rate and an increase in the equity premium, consistent with recent U.S. trends. These novel results stem from a decline in the *average* participant's risk tolerance, due to the entry of lower-consumption households relative to incumbents. Micro-level evidence from the U.S. Consumer Expenditure Survey supports the main model mechanism.

JEL Codes: E25, E32, E44, G12, G5.

Keywords: Macro-Finance Trends, Stock Market Participation, External Habits, Risk-Free Rate, Equity Premium.

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†Sapienza University of Rome. Email: francescosaverio.gaudio@uniroma1.it.

1 Introduction

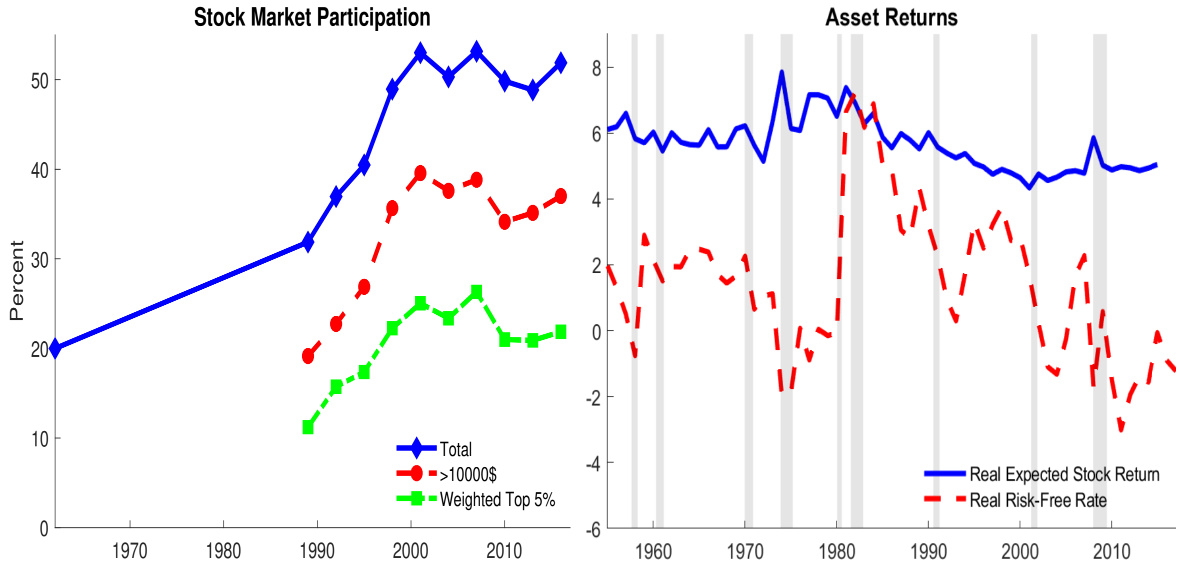
The empirical regularity that only a fraction of households hold stocks in their financial portfolios has spurred numerous studies exploring the potential of limited stock market participation to reconcile key asset-pricing and business-cycle facts (see, e.g., Brunnermeier et al., 2021, for a review). Heterogeneity between stock market participants and non-participants has long been considered a crucial determinant of the equity premium, as stockholders' consumption is more volatile and correlated with stock returns than aggregate consumption (Mankiw and Zeldes, 1991; Malloy et al., 2009). Moreover, recent developments in the macroeconomics literature have brought heterogeneity in households' portfolios at center stage to understand business-cycle fluctuations (Kaplan and Violante, 2018).

Since the late 1980s, the U.S. stock market participation rate has risen dramatically. As depicted in the left panel of Figure 1 (blue diamonds), data from the Survey of Consumer Finances (SCF) shows that while in 1989 only around 30% of families held stocks (directly or indirectly), from the early 2000s this fraction was steadily above 50%. Such a structural change is also evident when acknowledging that many participants invest relatively little in stocks and that stock wealth is concentrated at the top of the wealth distribution. For instance, the share of households investing at least 10000$ in stocks (red dots) and the top-5% wealth-weighted participation rate (green squares) also doubled over the same period.[1]

What are the macro-financial implications of the structural change in stock market participation? I address this question in a novel production-based asset-pricing model integrating limited participation with external habit preferences à la Campbell and Cochrane (1999). Such preferences have two appealing properties for the question at hand. First, they make investors' *effective* risk aversion endogenous and decreasing in wealth, consistent with recent microeconomic evidence supporting the notion of decreasing relative risk aversion (DRRA) (Calvet et al., 2009; Calvet and Sodini, 2014; Meeuwis, 2022; Briggs et al., 2023, among the others). Second, they imply that the elasticity of intertemporal substitution (EIS) increases with wealth (as documented by Atkeson and Ogaki, 1996; Vissing-Jørgensen, 2002; Guvenen, 2006, 2009, among the others). As a result, these preferences reproduce the stylized fact that stockholders, who are on average relatively richer households, tend to be less risk-averse and to have a higher EIS than non-stockholders.

[1] Following Lettau et al. (2019), this is computed as $5\% \times w^{5\%} + (rpr - 5\%) \times (1 - w^{5\%})$, where $w^{5\%}$ is the share of stock wealth held by households falling in the top-5% of the stock-wealth distribution among all families, and rpr is the raw participation rate. Figure A.1 in Appendix A shows that this holds true for different dollar thresholds and the top-1% weighted rate.

Figure 1: Stock market participation and asset returns



Notes: The left panel reports the total stock market participation rate (blue diamonds), the fraction of households investing more than 10000$ in stocks (red dots), and the wealth-weighted participation rate (green squares) in the U.S., from Poterba et al. (1995) and the Survey of Consumer Finances 2016. Following Lettau et al. (2019), the top 5% wealth-weighted participation rate is computed as $5\% \times w^{5\%} + (rpr - 5\%) \times (1 - w^{5\%})$, where $w^{5\%}$ is the share of total stocks held by households falling in the top 5% of the stock-wealth distribution and rpr is the raw participation rate. The right panel depicts the trend in the real expected equity return (blue-solid line) and in the real 90-day T-Bill return (red-dashed line). The former is retrieved from Kuvshinov and Zimmermann (2022). Shaded bands indicate NBER recessions. See Appendix A for all details on data sources and additional stock market participation measures.

When accounting for the abovementioned regularities, a permanent increase in participation generates a decline in the risk-free rate and a widening gap with expected equity returns, as observed during the Great Moderation (see the right panel of Figure 1). These results are the opposite of the predictions in the existing literature and suggest that more widespread participation contributed to shaping recent U.S. macro-financial trends. Therefore, the analysis uncovers a quantitatively relevant and novel interaction between limited participation and intertemporal non-homotheticity introduced by external habits. Through endogenous risk aversion and EIS, the model captures the idea that the institutional developments since the late 1980s facilitated market access to less sophisticated, poorer, more risk-averse households *relative* to incumbents (Guiso et al., 2003; Guiso and Sodini, 2013).[2] Conversely, most previous studies typically examined how the degree of participation influences the quantity of risk faced by the average investor, abstracting from the different attitudes of new

[2]It is important to stress that this is a change in characteristics *relative* to existing stockholders. Indeed, new entrants were still mostly households in the upper end of the wealth and income distribution. For instance, Melcangi and Sterk (2024) show that the participation rate disproportionately increased in the median and above-median, relative to the top, deciles of the income distribution.

entrants and incumbents towards intertemporal substitution and risk.

The baseline economy is populated by two groups of households, workers and capitalists, with only the latter owning firms through stock shares (as in Danthine and Donaldson, 2002; Lansing, 2015). The model is calibrated to match key macroeconomic and financial moments in the 1955-1983 (pre-Great Moderation) sample, with capitalists representing 20% of the population, as in the data. In this setup, I study the effects of an exogenous increase in the fraction of capitalists. Indeed, the permanent shift in the degree of participation was arguably caused by regulatory reforms that facilitated financial investments and were exogenous to business-cycle dynamics and asset prices.[3]

The model features two opposite channels through which participation affects macro-financial moments. The first one, which I label *risk-exposure channel*, is shared with canonical limited participation models (Mankiw and Zeldes, 1991; Basak and Cuoco, 1998; Guvenen, 2009; Favilukis, 2013; Lansing, 2015; Iachan et al., 2021; Morelli, 2021). It holds that, in a limited participation economy, stock market risk is concentrated in the hands of fewer investors compared to its full-participation (representative agent) counterpart. As a result, higher participation reduces the exposure of the average participant's consumption growth to volatile stock returns (i.e., the quantity of risk), as stock market wealth is shared among a larger number of participants. For any given level of risk aversion, the ensuing lower volatility of capitalists' consumption translates into milder fluctuations in investment and asset returns, as well as a larger (more compressed) risk-free rate (equity premium). Based on existing literature, one would conclude that the rise in participation did not contribute to the observed asset-pricing trends.

The second channel, which I refer to as the *surplus-consumption channel*, is novel and stems from endogenous and increasing effective risk tolerance and EIS due to habit preferences. As participation rises, the limited-participation economy converges towards a full-participation one. Thus, the representative capitalist's consumption approaches aggregate (average) consumption, and her surplus consumption—i.e., consumption exceeding habits—shrinks. This effect maps into a higher *effective* risk aversion and a stronger consumption-smoothing motive (i.e., lower EIS) of the average participant. Contrary to the canonical one, this mechanism entails more volatile in-

[3]The cyclical fluctuations in the participation rate during the 2000s are an order of magnitude smaller than the change observed during the 1990s. Thus, the increase in participation is consistent with a decline in both economic and information costs that prevent households from entering the stock market (Vissing-Jorgensen, 2002, 2003), due to the availability of financial information on the Internet, the development of the mutual fund industry, and the growing popularity of defined contribution plans (Duca, 2001; Guiso and Sodini, 2013).

vestment and asset returns, together with a lower (larger) risk-free rate (equity premium), as a consequence of more widespread participation. For standard parameter values, this force dominates and drives the overall relationship between equity ownership rates and macro-financial moments.

To provide intuition on the quantitative relevance of such insights, I simulate a regime shift from the 1955-1983 to the post-2000s period, characterized by a joint drop in the volatility of aggregate shocks—to mimic the Great Moderation—and rise in participation. By construction, the standard deviation of all macroeconomic variables drops. However, the novel channel implies that, despite declining aggregate risk, the average equity premium slightly rises, stock return volatility remains virtually unchanged, while the average risk-free rate drops substantially, as in the data. Although this study abstracts from many other factors underlying the same trends, the key takeaway is that accounting for endogenous and increasing relative risk tolerance and EIS overturns the macro-financial implications of more widespread access to financial markets, and provides predictions consistent with aggregate data.

To assess the empirical plausibility of the novel channel of participation, I employ household-level consumption, income, and wealth data from the U.S. Consumption Expenditure Survey and the Survey of Consumer Finances. I combine the information in the two surveys to construct a quarterly expenditure series for stockholders from 1984 to 2017. The consumption of the average stockholder significantly declined relative to the aggregate, suggesting that new stock market entrants tended to consume less than incumbents. This finding holds both in the time series and the cross-section of the U.S. states. Thus, the empirical relationship between participation and stockholders' surplus consumption (and resulting effective risk aversion) is also found consistent with the model. Finally, I conduct an analysis similar to Mankiw and Zeldes (1991) to show that, in the presence of the *surplus-consumption channel*, the stochastic discount factor is significantly more volatile and correlated with stock returns than comparable alternatives available in the literature. Therefore, the evidence suggests that the main model mechanism not only is consistent with aggregate trends but also bears desirable properties in relation to the well-known equity premium puzzle (Mehra and Prescott, 1985).

Related literature This study builds on extensive literature exploring the potential of limited stock market participation to reconcile key asset-pricing and business-cycle facts.[4] Most of these works typically focus on how participation affects the quan-

[4]For example, Mankiw and Zeldes (1991); Basak and Cuoco (1998); Danthine and Donaldson (2002); Gomes and Michaelides (2007); Malloy et al. (2009); Guvenen (2009); De Graeve et al. (2010); Favilukis

tity of risk faced by the representative investor, for a given attitude toward risk. My analysis differs in that the representative investor's risk tolerance is also tied to the participation rate. To this end, my results relate to Guvenen (2009), who shows how limited participation and (exogenously imposed) heterogeneity in the EIS between participants and non-participants crucially interact in production-based asset-pricing models. In my setup, the investor's effective risk aversion and the EIS endogenously depend on her consumption relative to the aggregate through external habit preferences.[5] In this sense, this work also shares recent efforts to integrate time-varying risk aversion through external habits à la Campbell and Cochrane (1999) in production-based asset-pricing models.[6] While these papers usually retain a full-participation (i.e., representative-agent) perspective, my work sheds light on the interaction between endogenous risk aversion and limited participation in asset markets.

It is worth discussing how my contribution conceptually differs from two influential papers by Gomes and Michaelides (2005, 2007).[7] In their setup, stock market participants are relatively *more* risk-averse households, as stronger prudence motivates greater wealth accumulation and incentivizes the payment of the (fixed) participation cost. Thus, contrary to the predictions of my model, a decline in the cost triggers the entry of *less* risk-averse households, who have lower wealth. However, this mechanism generates a negative correlation between risk tolerance and stock market participation that contrasts with recent empirical evidence on DRRA preferences (as argued by Guiso and Sodini, 2013), which are instead embedded in my framework.

This paper contributes to expanding literature in macro-finance studying the same asset-pricing trends considered here. It is well-known that, since the mid-1980s, the U.S. economy experienced not only a drop in macroeconomic volatility (Stock and Watson, 2003), but also a persistent fall in the real risk-free rate (Holston et al., 2017; Del Negro et al., 2019). In addition, several studies suggest that risky expected returns did not decline proportionally, implying a widening equity premium especially since the early 2000s.[8] Among these, Caballero et al. (2017b) and Farhi and Gourio (2018) point to a decrease in investors' risk tolerance as a key driver of the widening gap between risky and safe returns. My findings complement these studies by relating

(2013); Lansing (2015); Greenwald et al. (2019); Iachan et al. (2021); Morelli (2021), among the others.

[5]Guvenen (2009) briefly discusses how habits can endogenize preference heterogeneity between stockholders and non-stockholders but does not look at the implications of the structural change in participation, which is this work's focus.

[6]For instance, Jermann (1998); Chen (2017); Campbell et al. (2020); Pflueger (2024).

[7]The authors analyze a life-cycle portfolio-choice model with participation costs, heterogeneous Epstein-Zin preferences, and background risk in partial and general equilibrium.

[8]To mention a few, Duarte and Rosa (2015); Caballero et al. (2017a,b); Farhi and Gourio (2018); Corhay et al. (2020); Delle Monache et al. (2020); Eggertsson et al. (2021); Iachan et al. (2021); Marx et al. (2021); Kuvshinov and Zimmermann (2022); Ilut et al. (2024).

lower risk tolerance to a secular decline in the representative stockholder's surplus consumption due to more widespread participation.

Finally, this contribution also speaks to growing literature in macroeconomics exploring the role of limited participation in shaping business cycles and the transmission of aggregate shocks.[9] These works mostly focus on the distinction between "hand-to-mouth" and unconstrained households. Unlike them, this study shares with Morelli (2021) and Melcangi and Sterk (2024) the emphasis on limited participation in the stock market, although my setup abstracts from nominal rigidities and monetary policy and focuses on the structural forces behind observed macro-financial trends.

Structure The rest of the paper is organized as follows. Section 2 reports the key macro-financial facts that motivate the analysis. Section 3 presents the model setup, while Section 4 discusses the results. Several model extensions are considered in Section 5. Section 6 studies how higher participation affects asset returns analytically, while the key model mechanism is empirically tested in Section 7. Section 8 concludes.

2 Macro-financial trends and sub-sample analysis

This section briefly reports key macro-financial stylized facts that motivate this work. Table 1 displays, in the top panel, the standard deviation of annual growth in real per-capita GDP Δy, non-durable and services consumption Δc, and investment Δi over the three sub-samples 1955-1983, 1989-2017, and 2001-2017.[10] As it is well-known from the Great Moderation literature (Stock and Watson, 2003), the volatility of macro aggregates declined substantially since the 1980s, with a relative variation around $40\% - 50\%$ for output and consumption and 25% for investment. Interestingly, moments remain unchanged when focusing on the post-2000s period. In line with previous literature, I also find that the real risk-free rate (R^b) significantly dropped in terms of both mean and standard deviation. In contrast, stock return (R^s) volatility remained stable throughout the sample, while the expected return on equity ($R^{e,s}$) fell, although by less than the safe asset (recall the right panel of Figure 1). As a consequence, the equity premium ($E(R^{e,s} - R^b)$) widened over the last three decades. Such

[9]See Mankiw (2000); Galí et al. (2007); Bilbiie (2008); Debortoli and Galí (2017); Broer et al. (2019); Bilbiie (2020); Cantore and Freund (2021); Gaudio et al. (2023); and Kaplan and Violante (2018) for a comprehensive review.

[10]A detailed description of the data used in this section can be found in Appendix A. The choice of 1983 as a break date for the post-WWII period follows the large literature on the Great Moderation (Stock and Watson, 2003). The choice of the sample 2001-2017 follows instead recent works (Caballero et al., 2017b; Farhi and Gourio, 2018; Ilut et al., 2024) studying similar macro-financial trends.

Table 1: Macro-financial moments and the Great Moderation

	1955-1983	1989-2017	2001-2017
Macroeconomic Variables			
std(Δy)	3.07	1.54 [$-50\%^{***}$]	1.57 [$-49\%^{***}$]
std(Δc)	1.76	1.07 [$-39\%^{***}$]	1.06 [$-40\%^{**}$]
std(Δi)	6.02	4.65 [$-23\%^{*}$]	4.80 [-20%]
Financial Variables			
std(R^b)	2.14	2.02 [-6%]	1.40 [$-34\%^{**}$]
std(R^s)	17.52	17.30 [-1%]	17.77 [1%]
$E(R^b)$	1.58	0.74 [$-53\%^{*}$]	-0.56 [$-135\%^{***}$]
$E(R^{e,s})$	6.21	5.02 [$-19\%^{***}$]	4.88 [$-21\%^{***}$]
$E(R^{e,s} - R^b)$	4.63	4.14 [-11%]	5.38 [16%]

Notes: All values are reported in percent. Lowercase letters denote the logarithm of the variables. The numbers in square brackets are the relative variation from the first sample. * = p-value < 0.1, ** = p-value < 0.05, *** = p-value < 0.01. The p-values refer to the variance-ratio test for the standard deviations, and to the Chow test for the means. In both cases, the null hypothesis is of no structural break in the moment of interest. The data for the expected return on equity ($R^{e,s}$) is taken from Kuvshinov and Zimmermann (2022) and is available only through 2015. See Appendix A for all details on data sources.

a trend resulted in essentially unchanged, or even slightly higher—in the 2001-2017 sample—*average* values compared to the pre-Great Moderation.

Appendix A enriches the investigation along several dimensions. First, it shows in Figure A.2 that, in contrast to the safe return, expected equity returns have been declining ever since 1930. Further, the equity premium was larger during the pre-World War II period compared to the post-1950s, consistent with Fama and French (2002). Therefore, even if upward-trending over the last few decades, the equity premium is still low by historical standards. Second, it verifies that the conclusions do not hinge on the specific asset return series considered here, by employing different expected stock return measures available in the literature or by replacing the risk-free rate with the *natural rate of interest* (r_t^*) estimated by Del Negro et al. (2019) (Table A.1). The latter case shows that financial trends were not exclusively related to the conduct of monetary policy, but also to structural factors. This is important to clarify, as the model framework in Section 3 will abstract from monetary policy and nominal rigidities to focus on the macro-financial consequences of the structural change in stock market participation.[11] Indeed, all results point to a strong decline in the risk-free rate in tan-

[11] As explained in Del Negro et al. (2017), r_t^* is defined as the real return to an asset with "*the same*

dem with a less-than-proportional fall in risky expected returns, resulting in a stable (or slightly higher) average equity premium over the last few decades.

3 A production-based asset-pricing model with limited participation

I now introduce a limited participation, production-based asset-pricing model featuring capitalists, workers, and competitive firms similar to Lansing (2015). Unlike the author's setup, however, households feature external habit preferences à la Campbell and Cochrane (1999). The habit stock is a function of past aggregate per-capita consumption, implying that investors' average effective risk tolerance and EIS are endogenous and increasing in wealth, consistent with the empirical evidence reviewed earlier. In the baseline, capitalists own firms through equity shares and trade one-period bonds. Workers, who constitute a fraction γ of the total population (normalized to 1), are instead excluded from financial markets. Both workers and capitalists inelastically supply their entire time endowment to firms and earn the same wage.

While the benchmark model is kept stylized to clearly identify the key mechanisms, Section 5 provides several model extensions, by letting workers save in bonds, by endogenizing the stock market participation or labor supply decision, and by accounting for a skewed distribution of stock wealth between active and passive (retirement) investors. All these variations do not alter the crucial insights of the main analysis.

3.1 Households

3.1.1 Capitalists

Capitalists have full access to financial markets. The maximization problem of the representative capitalist reads:

$$\max_{C_t^c, Q_{t+1}^s, Q_{t+1}^b} E_0 \sum_{t=0}^{\infty} \beta^t \frac{(C_t^c - \chi H_t)^{1-\sigma} - 1}{1-\sigma}, \tag{1}$$

subject to the constraint

$$C_t^c + P_t^s Q_{t+1}^s + P_t^b Q_{t+1}^b = (P_t^s + D_t) Q_t^s + Q_t^b + W_t N_t^c. \tag{2}$$

[...] attributes as the 3-month U.S. Treasury bill in a counterfactual economy without nominal rigidities" and therefore "*it summarizes the real forces driving the movements in interest rates, abstracting from the influence of monetary policy decisions*".

In the baseline, labor supply is inelastic, $N_t^c = 1$. The budget constraint states that consumption and purchase of equity shares in quantity Q_{t+1}^s at price P_t^s and of one period bonds in quantity Q_{t+1}^b at price P_t^b must be financed by labor income $W_t N_t^c$ and the returns on their financial investments. Shares purchased in the previous period yield a dividend D_t, while the one period-bonds yield a single consumption unit per bond in the following period.

The representative capitalist exhibits external habit preferences such that utility is derived from the distance between her level of consumption and the habit stock H_t, scaled by the parameter $\chi \in [0,1]$. Specifically, H_t evolves according to the law of motion:

$$H_t = mH_{t-1} + (1-m)C_{t-1}, \tag{3}$$

where C_{t-1} denotes *aggregate* per-capita consumption at time $t-1$. The parameter m allows the introduction of a slow-moving component in habit formation, similarly to Campbell and Cochrane (1999), as for $m > 0$ the habit stock does not fully depreciate within the period. On the other hand, the coefficient $(1-m)$ captures the sensitivity of the reference level to changes in aggregate per-capita consumption.[12]

The first-order conditions of the maximization problem are:

$$\Lambda_t = (C_t^c - \chi H_t)^{-\sigma}, \tag{4}$$

$$P_t^s = E_t M_{t,t+1}(P_{t+1}^s + D_{t+1}), \tag{5}$$

$$P_t^b = E_t M_{t,t+1}, \tag{6}$$

where Λ_t denotes marginal utility of consumption and $M_{t,t+1} \equiv \beta E_t(\Lambda_{t+1}/\Lambda_t)$ is the capitalist's stochastic discount factor. The F.O.C.s (5) and (6) govern the asset-pricing dynamics of the model. In particular, the risk-free rate is given by $R_{t+1}^b = 1/P_t^b = 1/E_t M_{t,t+1}$, while the stock return is defined as $R_{t+1}^s = \frac{(P_{t+1}^s + D_{t+1}^s)}{P_t^s}$.

3.1.2 Workers

In the baseline economy, the representative worker consumes labor income hand-to-mouth, entailing that:

$$C_t^w = W_t N_t^w, \tag{7}$$

where W_t is the wage and $N_t^w = 1$, i.e., workers do not value leisure and supply their entire time endowment to firms. Since workers also do not price securities, their

[12]As shown in Section 3.3, limited participation in financial markets implies that, in equilibrium, the representative capitalist consumes more than average, thus ensuring that the utility function is always well-defined.

preferences are irrelevant for equilibrium allocations. This restriction is removed in the model extensions discussed in Section 5, where workers can instead access the bond market or endogenously supply labor.

3.1.3 Discussion

The definition of the habit stock as a function of past *aggregate*, rather than agent-specific, consumption is the key difference compared to Lansing (2015). In this sense, the habit stock can be interpreted as a standard of living in the economy common to all agents.[13] As also noted in Guvenen (2009), a key advantage of introducing a common reference point is that it captures the stylized fact that both risk tolerance and the EIS increase with wealth. Recall that, in the case of habit utility, investors' *effective* relative risk aversion is given by:

$$\mathrm{RRA}_t^c = \frac{\sigma}{S_t^c}, \tag{8}$$

where

$$\mathrm{S}_t^c \equiv \frac{C_t^c - \chi H_t}{C_t^c} \tag{9}$$

is the capitalist's surplus-consumption ratio, i.e. the share of consumption that exceeds habits.[14] By simply manipulating this expression, and evaluating at the steady state (where $H = C$), one obtains:

$$\mathrm{S}^c = 1 - \chi (C^c/C)^{-1}. \tag{10}$$

Equation (10) sheds light on the positive (negative) relationship between the capitalist's *relative* consumption C^c/C and her surplus-consumption ratio (average effective risk aversion, through Equation (8)). This non-homotheticity implies that the capitalist is endogenously less risk-averse *on average* (as long as $\chi > 0$) the more she consumes relative to the average household. Further, given that $\mathrm{EIS}_t^c = (\mathrm{RRA}_t^c)^{-1}$, the capitalist also endogenously features a higher EIS on average, the wealthier she is. As argued later, accounting for these intertemporal non-homotheticities has important implications for the macro-financial consequences of higher participation.

If the habit stock is group-specific (as in Lansing, 2015), the above non-homotheticity

[13] See Chan and Kogan (2002); Xiouros and Zapatero (2010); Bhamra and Uppal (2013); Santos and Veronesi (2022).

[14] Notice that the slow-moving process (3) ensures that risk aversion is countercyclical (Campbell and Cochrane, 1999), as consumption will be mechanically more reactive to shocks compared to the habit stock.

is shut down. To see this, consider the case where:

$$H_t = mH_{t-1} + (1-m)C^c_{t-1}, \tag{11}$$

i.e., the habit stock depends on the group's average consumption, rather than the aggregate per-capita level. Then:

$$\mathrm{S}^c = 1 - \chi, \tag{12}$$

which entails that the *average* surplus consumption—and, consequently, effective risk aversion and EIS—is exogenous. In the remainder, this specification is referred to as the "No Surplus Consumption Channel" scenario.

3.2 Firms

Firms operate in perfect competition and produce according to the standard Cobb-Douglas technology:

$$Y_t = A_t N_t^{1-\alpha_t} K_t^{\alpha_t}, \quad \alpha_t \in (0,1), \tag{13}$$

where $N_t = \gamma N^w_t + (1-\gamma)N^c_t$ is aggregate employment and the total factor productivity productivity A_t evolves exogenously according to the stationary process:

$$\log(A_t) = \rho_a \log(A_{t-1}) + \epsilon^a_t, \quad \rho_a \in (0,1), \tag{14}$$

where $\epsilon^a_t \sim N(0, \sigma^2_a)$. Moreover, the capital share of income α_t fluctuates over time in response to distribution shocks. Specifically:

$$\alpha_t = \alpha exp(\nu_t), \tag{15}$$

where α denotes the steady state capital income share and

$$\nu_t = \rho_\nu \nu_{t-1} + \epsilon^\nu_t, \quad \rho_\nu \in (0,1), \tag{16}$$

is the distribution shock, which follows a stationary AR(1) process in logs, denoted by lower-case letters, and $\epsilon^\nu_t \sim N(0, \sigma^2_\nu)$. As discussed in Lansing (2015), these shocks help match a high equity premium in limited participation economies, by raising the covariance between capitalists' consumption, dividend income, and stock returns.[15]

Following Jermann (1998), capital accumulation follows a law of motion featuring

[15]Moreover, recent works (Lettau et al., 2019; Greenwald et al., 2019; Gaudio et al., 2023) provide evidence that these shocks constitute a key source of risk priced in the stock market.

capital adjustment costs:

$$K_{t+1} = (1-\delta)K_t + \Phi\left(\frac{I_t}{K_t}\right)K_t, \tag{17}$$

where δ is the depreciation rate and:

$$\Phi\left(\frac{I_t}{K_t}\right) = \left[\frac{a_1}{1-1/\chi_k}\left(\frac{I_t}{K_t}\right)^{1-1/\chi_k} + a_2\right], \tag{18}$$

is the standard concave adjustment cost function. In particular, $\chi_k \to 0$ (∞) implies higher (lower) adjustment costs.

Dividends are defined as:

$$D_t = Y_t - W_t N_t - \frac{I_t}{P_t^I}, \tag{19}$$

where P_t^I is the price of investment goods relative to consumption goods which, following Greenwood et al. (1997) and Liu et al. (2013), is interpreted as the investment-specific technological change. It evolves according to the process:

$$\log(P_t^I) = \rho_{p^I}\log(P_{t-1}^I) + \epsilon_t^{p^I}, \quad \rho_{p^I} \in (0,1), \tag{20}$$

where $\epsilon_t^{p^I} \sim N(0, \sigma_{p^I}^2)$ is the investment-specific technology (IST) shock.

The firm's problem is to choose labor, capital, and investment to maximize:

$$\underset{I_t, N_t, K_{t+1}}{max} E_0 \sum_{t=0}^{\infty} M_{t,t+1}\left\{D_t - Q_t[K_{t+1} - (1-\delta)K_t - \Phi(I_t/K_t)K_t]\right\}, \tag{21}$$

subject to the constraints (13), (17) and (18). Q_t is the shadow price of the capital accumulation constraint, equivalent to marginal q.

The first-order conditions are given by:[16]

$$W_t = (1-\alpha_t)Y_t/N_t, \tag{22}$$

implying that dividends can be rewritten as:

$$D_t = \alpha_t Y_t - \frac{I_t}{P_t^I}, \tag{23}$$

[16]Note that capitalists and workers are assumed to be equally productive and therefore earn the same wage. This assumption is quite standard in both macroeconomic and asset-pricing literature, see for example Bilbiie (2008), Guvenen (2009) or Debortoli and Galí (2017).

whereas the F.O.C. with respect to investment is:

$$\Phi^{'}\left(\frac{I_t}{K_t}\right)=\frac{1}{P_t^I Q_t}, \tag{24}$$

with:

$$\Phi^{'}\left(\frac{I_t}{K_t}\right)=a_1\left(\frac{I_t}{K_t}\right)^{-1/\chi_k}. \tag{25}$$

Finally, the firm's optimal decision regarding capital yields:

$$Q_t=E_t\left\{M_{t,t+1}\left[\alpha_{t+1}\frac{Y_{t+1}}{K_{t+1}}+Q_{t+1}\left((1-\delta)+\Phi\left(\frac{I_{t+1}}{K_{t+1}}\right)-\Phi^{'}\left(\frac{I_{t+1}}{K_{t+1}}\right)\frac{I_{t+1}}{K_{t+1}}\right)\right]\right\}. \tag{26}$$

3.3 Equilibrium

The competitive equilibrium in this economy is defined by a sequence of prices and quantities such that the optimality conditions (4), (5), (6), (7), (22), (24) and (26) hold, all constraints are satisfied and markets clear. In the equilibrium, agents take prices as given. Labor market clearing requires that:

$$N_t=\gamma N_t^w+(1-\gamma)N_t^c, \tag{27}$$

implying $N_t=1$, while equilibrium in the good market implies:

$$Y_t=C_t+I_t, \tag{28}$$

where:

$$C_t=\gamma C_t^w+(1-\gamma)C_t^c, \tag{29}$$

is aggregate per-capita consumption. Assuming that the bond market is in zero net supply entails that in equilibrium $Q_t^b=0$, $\forall t$. Moreover, assuming that the stock market is in unit supply yields the stock market clearing condition:

$$(1-\gamma)Q_t^s=1, \tag{30}$$

where the left-hand side is the aggregate demand for stocks since only a fraction $(1-\gamma)$ of the population participates in the stock market. Therefore, the budget constraint (2) for the individual capitalist reads:

$$C_t^c=W_tN_t^c+\frac{D_t}{1-\gamma}, \tag{31}$$

in equilibrium. Using capitalists' and workers' budget constraints in the expression for aggregate consumption yields:

$$C_t = \gamma W_t N_t^w + (1-\gamma)\left[W_t N_t^c + \frac{D_t}{1-\gamma}\right], \tag{32}$$

which, given the assumption that both workers and capitalists supply all their time endowment to firms ($N_t^w = N_t^c = 1$), becomes:

$$C_t = W_t + D_t, \tag{33}$$

that is, aggregate consumption consists of labor income plus dividends.

3.4 Calibration

The model is calibrated to match key macroeconomic and asset-pricing moments for the pre-Great Moderation period (1955-1983). Table 2 summarizes the baseline calibration. A time period in the model is taken to be one year. The fraction of workers γ is set to 0.8, implying a degree of financial market participation of 20%. The parameter β is set to 0.9535 to match an average price-to-dividend ratio of around 26, consistent with the S&P500 stock index mean value for the 1955-1983 sample. The steady-state capital share of income ($\alpha = 0.37$) and capital depreciation rate ($\delta = 0.115$) are set to standard values in the Real Business Cycle literature. Such a combination of β, α, and δ delivers a steady state capital-to-output ratio of 2.26, consistent with the evidence reported in Rios-Rull and Santaeulalia-Llopis (2010) for the sample 1954Q1-2004Q4. The persistence of the technology, distribution shock, and investment-specific technology processes are set to $\rho_a = 0.97$, $\rho_\nu = 0.99$ and $\rho_{p^I} = 0.92$, respectively. The latter is taken from Justiniano and Primiceri (2008), who estimate it over the post-WWII sub-sample. The persistence parameter of the distribution shock follows Greenwald et al. (2019), who document how the capital share of income exhibits a very persistent but still stationary process. The combination of ρ_a, ρ_ν and ρ_{p^I} guarantees a weak and positive autocorrelation in both output and consumption growth, as in the data. The calibrated ρ_ν also helps match a high autocorrelation coefficient and low volatility for the risk-free rate.

I calibrate the standard deviation of the IST shock to replicate that of the growth in the relative price of investment over the sample 1955-1983, by setting $\sigma_{p^I} = 2.58\%$. Regarding the distribution shock, the volatility $\sigma_\nu = 4\%$ is set to roughly match the empirical volatility of macroeconomic dividend growth. Given these values, the local curvature of the capitalist's utility function, σ, and the weight and persistence of

Table 2: Baseline parameter values

Description	Parameter	Value
Fraction of workers	γ	0.8
Discount rate	β	0.9535
Capital share of income	α	0.37
Depreciation rate	δ	0.115
Technology persistence	ρ_a	0.97
Distribution shock persistence	ρ_ν	0.99
IST persistence	ρ_{p^I}	0.92
IST shock volatility	σ_{p^I}	0.0258
Distribution shock volatility	σ_ν	0.04
Technology shock volatility	σ_a	0.017
Local utility curvature	σ	3
Habit weight in utility	χ	1
Habit stock persistence	m	0.8
Capital adjustment cost	χ_k	0.6
Leverage factor	χ_l	1.551

Notes: This table reports the calibrated parameters for the baseline model. A time period in the model is one year.

the habit stock process, χ and m, are set jointly with the relative volatility of the technology and distribution shocks to achieve a standard deviation for annual aggregate consumption growth around 1.76%.[17] Moreover, $\chi = 1$ and $m = 0.8$, similar to Jaccard (2014) for the case of inelastic labor supply. Finally, the degree of capital adjustment costs, governed by χ_k, is set to a standard value of 0.6. This achieves a volatility of investment growth close to the data and a high relative volatility between capitalists' and workers' consumption growth.[18] Regarding financial moments, I report those related to the *levered* equity return. As the model abstracts from leverage, I exploit the relationship $R^{lev} = R^s + (\chi_l - 1)(R^s - R^b)$, where χ_l is the leverage factor. The levered equity return R^{lev} has the same Sharpe Ratio as the stock return R^s, but higher mean and volatility. The parameter χ_l is set to 1.551, to exactly match the standard deviation of realized stock returns.

[17] The ratio $\frac{\sigma_\nu}{\sigma_a} = 2.357$ is slightly higher than the 1.855 employed in Lansing (2015). This is because the author considers permanent labor-augmenting technology shocks in a model with long-run growth. Differently, I consider transitory TFP technology shocks in a model abstracting from long-run growth.

[18] Following Jermann (1998), the other parameters a_1 and a_2 in the adjustment cost function in Equation (18) are constructed so that $\Phi\left(\frac{I}{K}\right) = \delta$, $\left(\frac{I}{K}\right) = \delta$ and $\Phi'\left(\frac{I}{K}\right) = 1$ in steady state. Thus, $a_1 = \delta^{1/\chi_k}$ and $a_2 = \delta - \frac{\delta}{1-1/\chi_k}$.

3.5 Moment matching and model dynamics

As the novelty of the analysis lies in the study of the macro-financial effects of participation rather than the moment-matching performance and dynamics of the model, these aspects are briefly discussed here and reported in detail in Appendix B. Table B.1 reports the theoretical unconditional moments computed by second-order perturbation methods.[19] It demonstrates that the framework replicates targeted and non-targeted moments. The model achieves a high equity premium—4.27 versus the empirical 4.63—and a low and stable risk-free rate—$E(R^B) = 1.69$ and $\mathrm{std}(R^B) = 2.17$. Furthermore, capitalists' consumption growth is realistically more volatile than workers', as the relative volatility of 1.63 lies well in the ballpark of estimates discussed in Guvenen (2009). Figure B.1 reports the impulse response functions of key macroeconomic and asset-pricing variables to TFP, IST and distribution (KS) shocks, expressed in percentage deviations from the non-stochastic steady state. According to the figure, the high volatility of capitalists' consumption is due to distribution shocks. An exogenous increase in the capital share of income strongly raises the dividends accruing to capital owners, while having a negative initial impact on labor income—the only source of revenues for workers. This negative comovement, and the fact that capitalists constitute a small fraction of the total population, entails a mild conditional response in aggregate consumption. From an asset-pricing perspective, the distribution shock makes stock prices and realized stock returns strongly procyclical and volatile, while the response of the risk-free rate is more muted but persistent. These model dynamics are similar to those discussed by Lansing (2015).

4 Macro-financial effects of higher participation

In this section, I show how an increase in financial participation affects asset prices and aggregate volatility. Then, I perform a counterfactual analysis that mimics the Great Moderation period to compare the main model implications with recently observed U.S. macro-financial trends.

[19] Malkhozov (2014) shows that the macroeconomic and asset-pricing moments computed with second-order perturbation methods are essentially identical to those obtained with global solution algorithms for a wide set of models, including RBC models with habit utility and capital adjustments costs.

4.1 Risk-exposure and surplus-consumption channels

To build intuition about the main model mechanism, it is instructive to collect the following equilibrium expressions:

$$C_t^c = W_t N_t^c + \frac{D_t}{1-\gamma}, \tag{34}$$

$$C_t = W_t + D_t, \tag{35}$$

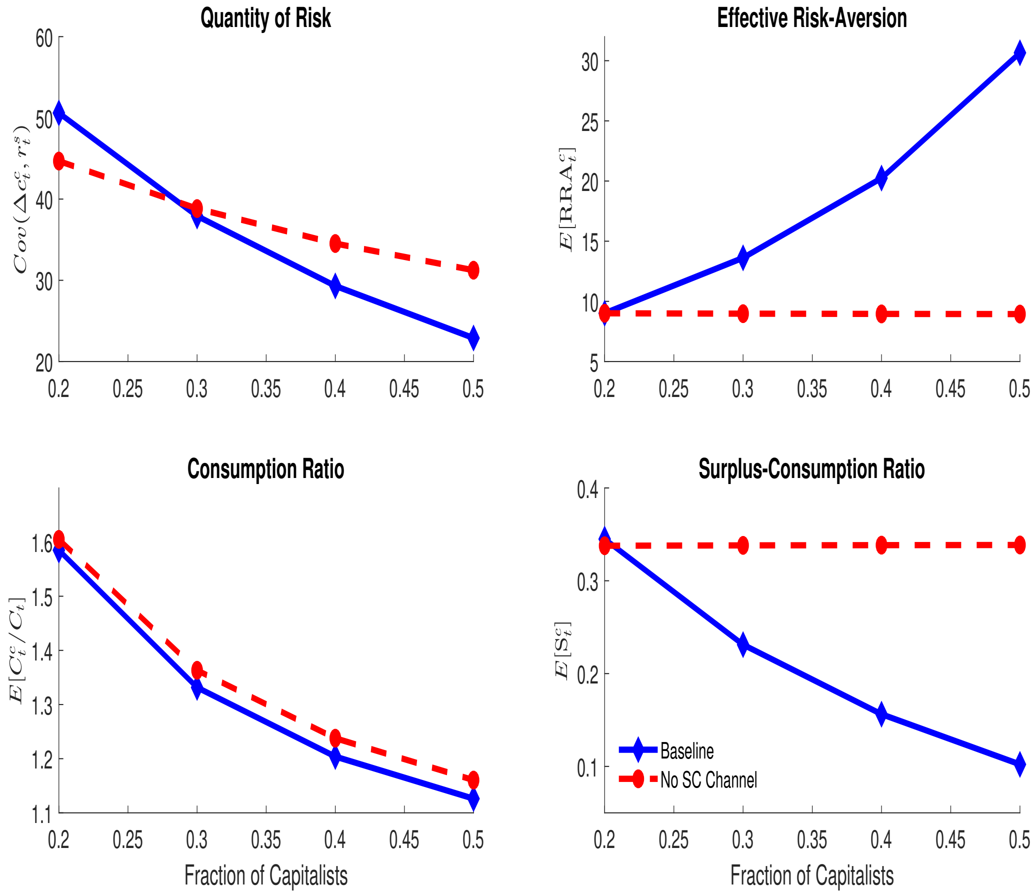
$$\text{RRA}^c = \frac{\sigma}{S^c} = \frac{\sigma}{1-\chi(C^c/C)^{-1}}, \tag{36}$$

i.e., the equilibrium capitalist's consumption, aggregate consumption, and the capitalist's (average) effective risk aversion, respectively. Furthermore, Figure 2 illustrates the key channels through which participation affects macro-financial moments in this economy.

As participation rises, the total supply of stocks is diluted over a wider public of market participants, implying that the risk stemming from stockholdings is shared among a larger number of investors. This is reflected in the representative capitalist's equilibrium budget constraint (34), where the weight of dividends declines as the fraction $1-\gamma$ increases. Therefore, investors' consumption becomes less exposed to volatile dividend income, and, in turn, to volatile stock returns. Accordingly, the top-left panel of Figure 2 displays a falling covariance between capitalists' consumption growth and stock returns as participation rises (blue-diamonds solid line). This *risk-exposure channel* is the one usually explored in the extant literature and predicts a decline (rise) in the equity premium (risk-free rate) as a consequence of more widespread participation.

The second and novel channel pertains to the relationship between participation, consumption, and the surplus-consumption ratio of the representative stock market participant. As capitalists constitute a higher fraction of the population, the average capitalist's consumption converges to aggregate (per-capita) consumption, which can be seen by comparing Equations (34) and (35). This, in turn, shrinks her *relative* consumption (bottom-left panel of Figure 2). As exemplified in Equation (36)—and the right panels of the Figure—this maps in a lower surplus consumption. Hence, higher participation is associated with a rise in the effective risk aversion of the average participant. Economically, this mechanism captures the idea that the financial and regulatory developments started in the 1980s triggered a decline in participation costs that induced middle-income, *relatively* more risk-averse households to enter the stock market. As shown in the next section, this mechanism generates opposite predictions on the macro-financial effects of higher participation compared to existing literature featuring the exposure channel alone.

Figure 2: Channels of participation



Notes: This figure depicts the unconditional model-implied: covariance between capitalist's consumption growth and stock returns (top-left panel); capitalist's average effective risk aversion (top-right panel); average capitalist-aggregate consumption ratio (bottom-left panel); and capitalist's average surplus-consumption ratio (bottom-right panel), as a function of the fraction of capitalists. These variables are reported for the baseline model (blue-diamonds solid line) and the alternative model where the *surplus-consumption channel* is shut down ("No SC Channel", red-dots dashed line).

In the case of group-specific habit, conversely, the average surplus consumption (and effective risk aversion) is exogenous (recall Equation (12)). The mechanisms at work in this alternative "No SC channel" scenario are also depicted in Figure 2 (red-dots dashed lines). This setup is calibrated to have essentially identical predictions as the baseline economy at the intercept (i.e., for $1-\gamma = 20\%$).[20] Again, both risk exposure and relative consumption decline. However, the average surplus consumption (and effective risk aversion) of the average stock market participant is independent of the participation rate.

[20]Details about this version of the model, including the calibration and the predictions for the pre-Great Moderation period, can be found in Appendix C.

It must be stressed that external habit models typically require a low surplus consumption (high risk aversion) to match asset pricing moments, and my model is no exception in this respect. However, to contextualize the magnitudes, note that in Campbell and Cochrane (1999) the representative agent has an average surplus consumption ratio of 5%, and its ergodic distribution is truncated at a maximum of 10%.[21] Here, the participant's surplus consumption is *on average* 35% (10%) when a fifth (half) of the population participates. Within this framework, therefore, the size of the surplus consumption—and the implied risk aversion—in my model seems reasonable and consistent with previous literature (see also Chen, 2017, for instance).

4.2 Macroeconomic effects

Figure 3 shows heterogeneous effects of higher participation on macroeconomic variables. The effects on output growth and workers' consumption growth volatility are negligible, as these moments are almost exclusively determined by the size of the technology and distribution shocks given the assumption of an inelastic labor supply. Increasing participation from 20% to 50% raises output (wage) volatility by about 5 basis point(s). Conversely, the impact on the standard deviation of aggregate consumption and investment growth is remarkable. From a quantitative perspective, increasing market participation from 20% to 50% reduces the volatility of aggregate consumption from 1.69% to about 1.32%, i.e., by about 22%. Qualitatively, the sign of the effect is quite intuitive. It seems reasonable to expect that higher degrees of access to financial instruments should improve the economy's ability to smooth consumption intertemporally.[22] In contrast, higher fractions of capitalists are associated with more volatile investment growth.

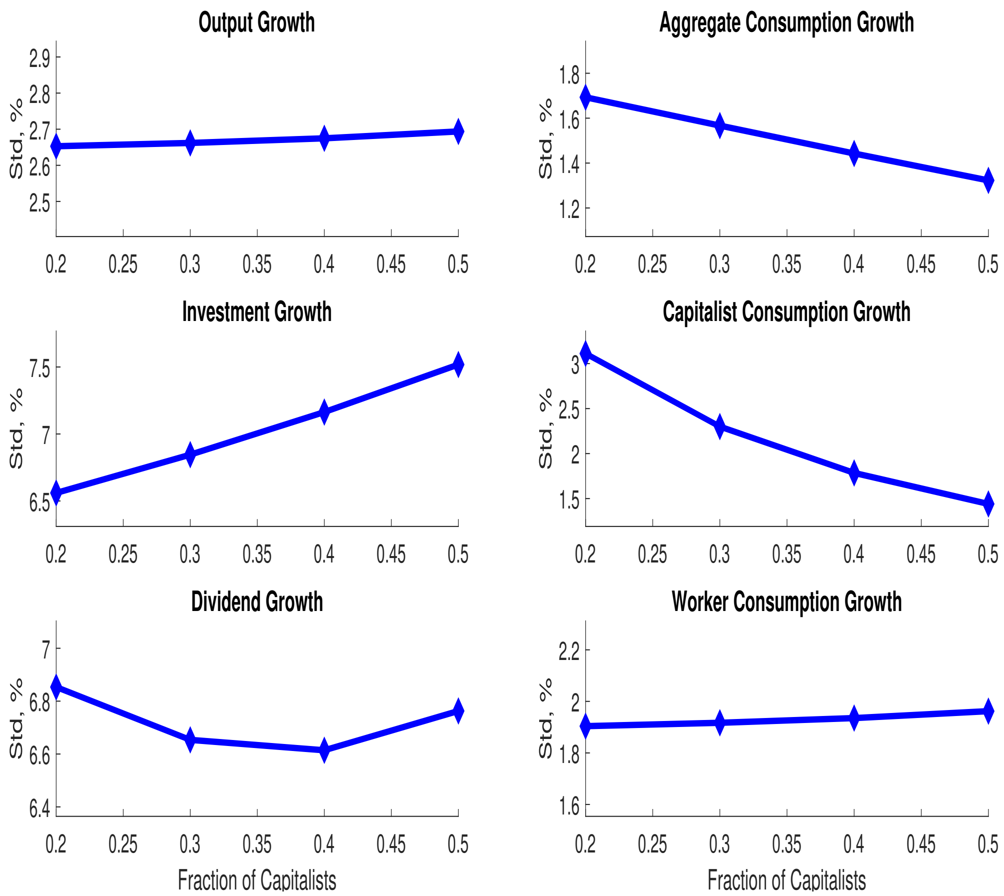
These results stem from the intertemporal non-homotheticity introduced by external habit preferences. As noted earlier, an increase in participation determines a decline in the average investor's EIS that translates into a stronger consumption smoothing motive. As a consequence, the standard deviation of capitalists' consumption growth drops, and this pattern is inherited by aggregate consumption. On the other hand, investment is used more aggressively to smooth consumption over time, which explains the increase in its standard deviation.[23]

[21] I focus on the surplus consumption ratio because effective risk aversion is simply a multiple σ of its inverse.

[22] A similar interpretation has been provided by earlier works on the topic (Blanchard and Simon, 2001; Stock and Watson, 2003; Campbell and Hercowitz, 2006, among the others). For a critical view of the relevance of the financial liberalization process as a driver of the Great Moderation, see Den Haan and Sterk (2011).

[23] The stronger consumption smoothing motive is also reflected in the persistence of aggregate and

Figure 3: Macroeconomic effects - Standard deviations



Notes: This figure displays the effects of higher participation on macroeconomic volatility. All standard deviations are reported in percent. The degree of asset market participation, captured by the fraction of capitalists, is discretely varied between 20 and 50 percent.

Finally, according to Figure 3, the standard deviation of dividend growth (bottom-left panel) is overall only mildly affected. This result is strictly linked to the different impacts of technology and distribution shocks on dividends. Figure B.2 in Appendix B shows that KS and IST shocks always increase dividends at impact, whereas the sign of the response to a TFP shock depends on the level of participation. For higher levels of participation, investment is used more aggressively in response to TFP shocks to smooth consumption, eventually reverting the sign of the immediate dividends' response. The opposite conditional responses rationalize the flat profile of dividend growth volatility.

agent-specific consumption. In unreported results, I find that the autocorrelation of capitalists' consumption growth rises from 0.05 to 0.27, as well as workers' (from 0.13 to 0.20). Both forces affect the autocorrelation of aggregate consumption, which increases from 0.21 to 0.4.

4.3 Asset-pricing effects

The *surplus-consumption channel* drives the asset-pricing effects of higher participation too. The decline (increase) in the surplus-consumption ratio (average effective risk aversion) lowers the risk-free rate and produces an increase in the mean equity premium. Similarly, the associated decline in the EIS tends to raise the volatility of both risk-free rate and stock returns (Chen, 2017). The changes are quantitatively non-negligible. According to Figure 4, an increase in the fraction of capitalists from 20% to 50% raises the equity premium from 4.27% to about 5.83%, while increasing the volatility of stock returns from 17.52% to above 20.1%. Conversely, the risk-free rate drops from 1.69% to 0.23%, i.e., by about 86%. Furthermore, an interesting result pertains to the price-dividend ratio. As depicted in the bottom-left panel of Figure 4, an increase in participation raises it from 26 to 32, i.e., by about 23%.

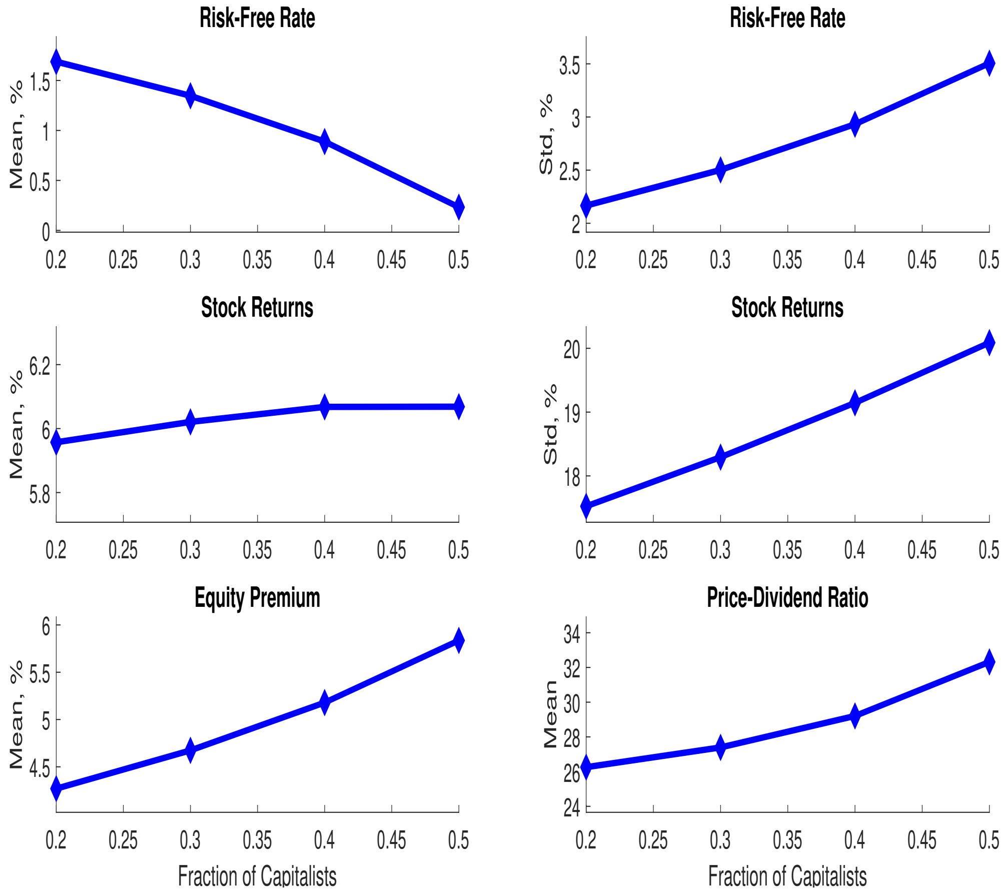
These findings suggest that easier access to financial markets was one of the factors that contributed significantly to the run-up in stock prices relative to fundamentals observed since the 1990s. Higher participation can also account for a strong fall in the average risk-free rate, while the variation in average stock returns is an order of magnitude smaller, in line with the motivating evidence in Figure 1. Therefore, the increase in the average equity premium is almost entirely due to falling safe (rather than rising risky) asset returns (as also documented in Caballero et al., 2017b; Farhi and Gourio, 2018; Delle Monache et al., 2020).

4.4 Application to the Great Moderation

The results so far clarify the effects of higher participation on macro-financial moments. Since the mid-1980s, the U.S. also experienced a structural break in the volatility of main macroeconomic indicators—a phenomenon known as Great Moderation. I now perform a counterfactual exercise combining both dimensions to offer a quantitative intuition of the historical relevance of the observed structural change in financial participation.

Specifically, I perform a regime-shift analysis that compares the pre-GM sample—interpreted as a period with low participation and high macroeconomic volatility—and the post-2000—characterized by higher participation and lower aggregate volatility. A few remarks are in order. First, the choice of the second sample alleviates concerns about the transition in equity ownership rates observed during the 1990s and seems more consistent with a steady-state analysis, as the equity ownership rate plateaued after 2000. Second, I consider a shift in the participation rate from 20 to 40%, in line with the estimates for a dollar threshold of $10000\$$ (Figure 1), and the top-

Figure 4: Asset-pricing effects



Notes: This figure displays the effects of higher participation on key asset pricing moments. All moments are reported in percent, except for the price-dividend ratio. The degree of asset market participation, captured by the fraction of capitalists, is discretely varied between 20 and 50 percent.

1% wealth-weighted rate (Figure A.1). This represents a reasonable range accounting for the intensive margin of participation, i.e., that some participants still invest relatively little in the stock market.[24] Finally, in this stylized setup, the Great Moderation is modeled as a reduction in the volatility of exogenous shocks—as in the "good luck hypothesis" by Stock and Watson (2003). This is calibrated to match the relative variation in the standard deviation of TFP and relative price of investment growth (-34% and -56%, respectively) from the first to the second sub-sample.[25]

Table 3 summarizes the results of this quantitative exercise. The first column re-

[24]This is also the same range considered in Melcangi and Sterk (2024), and very similar to Favilukis (2013).

[25]To do so, I reduce σ_a from 1.7% to 1.12% and σ_{p^I} from 2.58% to 1.14%. In contrast, the standard deviation of capital share growth did not change significantly over the two samples and is left at its baseline value.

Table 3: Relative variation from pre-GM to post-2000 period

	Empirical	Simulated		
		Partic. = 20% (Baseline)	Partic. = 40% (No SC channel)	Partic. = 40% (Baseline)
Volatility				
std(Δy)	−49% [3.07→1.57]	−13% [2.65→2.31]	−13% [2.69→2.34]	−12% [2.65→2.33]
std(Δc)	−40% [1.76→1.06]	−24% [1.69→1.28]	−22% [1.72→1.34]	−34% [1.69→1.13]
std(Δi)	−20% [6.02→4.80]	−10% [6.56→5.93]	−17% [6.79→5.65]	−3% [6.56→6.37]
std(Δd)	17% [6.79→7.93]	0% [6.85→6.82]	26% [6.15→7.75]	−7% [6.85→6.39]
std(R^s)	1% [17.52→17.77]	−5% [17.52→16.59]	−14% [17.52→15.09]	1% [17.52→17.72]
std(R^b)	−34% [2.14→1.4]	−10% [2.17→1.94]	−30% [2.89→2.03]	17% [2.17→2.53]
Mean				
$E(R^b)$	−135% [1.58→−0.56]	10% [1.69→1.85]	84% [1.45→2.68]	−31% [1.69→1.16]
$E(R^{e,s} - R^b)$	16% [4.63→5.38]	−7% [4.27→3.96]	−33% [4.19→2.80]	9% [4.27→4.66]

Notes: The empirical variation from the 1955-1983 (pre-GM) to the 2001-2017 period is compared to the variation obtained by simulating the baseline model with unchanged (third column) or increased (last column) participation, or the alternative "No SC channel" economy with increased participation (fourth column). In brackets is reported the shift (indicated by the arrow) in the moments from the first to the second sub-sample. The participation rate is increased from 20% to 40%, in line with the empirical fraction of households holding at least 10000$ in stocks. The empirical relative variation in the volatility of TFP (−34%) and relative price of investment (−56%) growth is exactly matched in all simulated models by construction.

ports the empirical (percent) variation in the moment of interest from the first to the second sub-sample. The second column reports the results obtained in a counterfactual regime characterized by low volatility but no increase in financial participation, i.e., keeping the fraction of capitalists at 20%. Hence, these results isolate the effects of only lower shocks' volatility. In this scenario, the standard deviation of all variables declines by construction. Moreover, less aggregate risk raises the average risk-free rate and compresses the average equity premium. The fourth column highlights the effects of the *risk-exposure* channel, combining an increase in the participation rate with lower aggregate risk in the alternative model with group-specific habits. The rise in financial participation reinforces the effects of reduced aggregate risk on asset prices. The volatility of stock returns decreases remarkably more than in the data, and the equity premium (risk-free rate) declines (rises) by a noticeable 33% (84%).

The last column clarifies the contribution of the novel *surplus-consumption channel* to generate model predictions more aligned with the data. The baseline model with high participation generates a 12% decrease in output growth volatility and an empirically plausible 34% decrease in consumption growth standard deviation, while investment fluctuations are only mildly affected.[26] Importantly, these results are accompanied by a slight increase in the average equity premium (9%) and a substantial fall in the average risk-free rate (-31%). Further, stock return volatility remains overall unchanged, although the variation safe rate volatility is the opposite of the data. Most importantly, however, the differences between the last two columns highlight a large net impact of the novel channel, especially from an asset-pricing perspective.

It is worth stressing that this analysis is not designed to explain empirical trends fully. Several other relevant factors, such as shifts in the monetary policy conduct (Bilbiie, 2008; Justiniano and Primiceri, 2008), easier credit access (Jensen et al., 2018, 2020), population aging or increasing market power (Caballero et al., 2017a; Farhi and Gourio, 2018; Corhay et al., 2020), and the global savings glut (Caballero et al., 2017b) do not feature in this study. Rather, the exercise stresses how accounting for endogenous and decreasing relative risk aversion overturns the macro-financial implications of more widespread access to financial markets, and points to this structural change as a novel and quantitatively relevant factor behind recent macro-financial trends.

5 Model extensions

I now present some model extensions that relax key simplifying assumptions imposed in the baseline model. For each, I replicate the exercise conducted in Table 3. Each version of the model is re-calibrated so that simulated moments for the pre-GM period are essentially unchanged. Here, I summarize the main results of these robustness checks, while all details are reported in Appendix D.

Bondholders vs stockholders The first robustness exercise (Appendix D.1) allows workers to participate in the bond market. Indeed, the baseline calibration implies that 80% of the population behaves in a hand-to-mouth fashion, which contradicts established evidence on households' financial portfolios (e.g., Kaplan et al., 2014). The bondholders vs stockholders setup is similar to Guvenen (2009). However, through external habits, non-stockholders are *endogenously* more risk averse (and have lower EIS) than stockholders. According to the third column of Table D.1, results hold quite

[26]The decline in output and investment volatility falls short of the empirical counterpart. This is strictly linked to the effects of increasing participation studied in Figure 3. Higher participation weakens the effect of lower aggregate risk on investment growth volatility. The result for output growth is instead independent of the level of participation.

closely. As bond trade improves aggregate risk sharing between workers and capitalists, the *surplus-consumption channel* of participation is slightly weaker than in the baseline. Nonetheless, it still overturns the impact of lower aggregate volatility and reduced risk exposure on asset-pricing moments.

Endogenous participation The second model extension (Appendix D.2) relaxes the assumption of exogeneity of the participation decision. Following Morelli (2021), I employ a dynamic discrete-choice model setup that keeps the model tractable and comparable to the baseline, while allowing households to optimally choose whether to enter or exit financial markets. As shown in the fourth column of Table D.1, endogenizing the participation decision does not alter the main findings. A decline in the fixed cost of participation induces more households to (optimally) enter financial markets, which in turn generates an increase (drop) in the equity premium (risk-free rate) of similar magnitudes as in the benchmark economy.

Endogenous labor supply I also consider a case where both workers and capitalists supply labor endogenously (Appendix D.3), thus relaxing the restrictive assumption of inelastic labor supply. In particular, I assume that both agents feature GHH preferences (Greenwood et al., 1988), while retaining external habit formation in the consumption good.[27] As shown in the fifth column of Table D.1, again the key model mechanisms and quantitative results remain intact. If anything, the *surplus-consumption channel* of participation is amplified, as the decline (increase) in the average risk-free rate (equity premium) is now even larger.

Indirect stockholders Finally, I study an economy where the higher participation rate is driven entirely by the entry of passive investors. As discussed in Appendix D.4, the fraction of households investing in the stock market exclusively through retirement accounts (specifically, defined contribution plans) increased from 10% to 30% between 1989 and 2016, suggesting that the development of the retirement asset market facilitated access to financial markets. Thus, I introduce a third type of household called "indirect stockholder". The calibration accounts for a skewed distribution of stock wealth between active and passive investors—with the former holding 60% of

[27]As noticed by Guvenen (2009), GHH preferences provide flexibility in that the Frisch elasticity depends on a distinct parameter that does not impose unintended restrictions on the EIS, as in the case of the commonly used Cobb-Douglas preferences, for instance. Moreover, GHH preferences help generate procyclical hours worked (as in the data) by eliminating wealth effects on labor supply, which limits the negative impact of endogenous labor choice on the ability to reproduce asset-pricing facts in a production economy.

the stock market, as in the data—and distinguishes between average and marginal investor (the representative stockholder and the *direct* stockholder, respectively). Although slightly dampened, the *surplus-consumption channel* still produces a mildly positive variation in the equity premium in tandem with a decline in the risk-free rate. From a macroeconomic perspective, the results are almost identical to the baseline.

6 Inspecting the mechanism analytically

In this section, I show analytically how the two channels of participation exert opposite forces on risky and safe asset returns. I consider the simple case where capitalists have constant relative risk aversion (CRRA) preferences, to obtain closed-form solutions while preserving the key model intuition.

6.1 Participation and average asset returns

I first study the impact of participation on the (unconditional) average equity premium and the risk-free rate. In a representative-agent economy, where all households participate in financial markets, the stochastic discount factor that prices financial assets is a function of *aggregate* consumption growth. In contrast, in a limited-participation economy, the relevant stochastic discount factor depends only on *capitalists'* consumption growth. The unconditional equity risk premium can thus be written as:

$$E(r^{ex}) = \sigma \times Cov(\Delta c^c, r^s). \tag{37}$$

where $r^{ex} \equiv E(r^s - r^b)$ denotes (log) stock excess returns.

This decomposition shows that the average equity premium depends on both relative risk aversion, σ, and the quantity of risk, $Cov(\Delta c^c, r^s)$. In the baseline model, participation affects both components. As shown in Figure 2, the *risk-exposure channel* implies that higher participation rates are associated with a lower covariance between capitalist consumption growth and stock returns. Quantitatively, this covariance is halved when participation increases from 20% to 50%. This channel is also present in the version of the model where the *surplus-consumption channel* is shut down. Therefore, for a given and constant σ parameter, standard models with limited participation predict a negative relationship between participation rates and the average equity premium. However, this effect is overturned in the presence of the *surplus-consumption channel*, as effective risk aversion (captured only by σ in this analytical framework) rises with participation. Quantitatively, the latter force dominates and produces an overall strong increase in the equity premium.

The average risk-free rate in the limited-participation economy can similarly be obtained as:

$$E(r^b) = -\log(\beta) + \sigma \times E(\Delta c^c) - \frac{1}{2}\sigma^2 \times Var(\Delta c^c). \tag{38}$$

As the model economy does not feature trend growth, $E(\Delta c^c) = 0$. Thus, the participation rate only affects the average risk-free rate through the variance term, i.e., the precautionary savings motive, which enters Equation (38) with the negative sign. An increase in participation exerts two opposite forces on the safe asset return. On the one hand, the *risk-exposure channel* tends to increase the risk-free rate. As the fraction of capitalists rises, volatile dividend income weighs less on the representative investor's budget constraint (recall Equation (34)). As a consequence, $Var(\Delta c^c)$ declines (as shown in Figure 3). On the other hand, higher participation pushes the average relative risk aversion σ upward, thus strengthening the precautionary savings motive. As before, the *surplus-consumption channel* dominates over the *risk-exposure channel* and reduces the safe asset average return.

6.2 Participation and asset returns volatility

How does higher participation affect the volatility of stock returns? To show this, I follow Campbell and Shiller (1988). Notice that unexpected log-returns on stocks can be written in terms of revisions in expected future dividends and returns:

$$r^s_{t+1} - E_t r^s_{t+1} = (E_{t+1} - E_t)\sum_{j=0}^{\infty}\rho^j \Delta d_{t+1+j} - (E_{t+1} - E_t)\sum_{j=1}^{\infty}\rho^j r^s_{t+1+j}, \tag{39}$$

where ρ is a linearization constant smaller but close to 1.

For simplicity, assume that capitalists finance their consumption only with dividend income, i.e.:

$$C^c_t = \frac{D_t}{1-\gamma}.$$

The decomposition provides a natural framework to analyze asset returns volatility as a function of the stockholder's consumption growth process. As for stock returns, it can be shown that from Equation (39) one obtains:[28]

$$Var(r^s_{t+1} - E_t r^s_{t+1}) = \\ Var(R^{t,t+1}_{\Delta c^c}) + (1-\sigma)^2 Var(R^{t+1,\infty}_{\Delta c^c}) + 2(1-\sigma)Cov(R^{t,t+1}_{\Delta c^c}, R^{t+1,\infty}_{\Delta c^c}), \tag{40}$$

where $R^{t,t+1}_{\Delta c^c}$ captures the revision in the capitalist's consumption growth rate between

[28] The proof is provided in Appendix E.

t and $t+1$ while $R_{\Delta c^c}^{t+1,\infty}$ captures the revisions between $t+1$ and the infinite future.

Similarly, acknowledging that real bonds pay no dividends, the variance of the risk-free rate can be expressed as:[29]

$$Var(r_{t+1}^b - E_t r_{t+1}^b) = \sigma^2 Var(R_{\Delta c^c}^{t+1,\infty}). \tag{41}$$

Equation (40) shows that the volatility of stock returns depends on the volatility of realized capitalists' consumption growth, $Var(R_{\Delta c^c}^{t,t+1})$, the volatility of the discounted sum of revisions in expected future capitalists' consumption growth, $Var(R_{\Delta c^c}^{t+1,\infty})$, and the covariance between the two. Note that, for a parameter of risk aversion greater than 1, the coefficient $(1-\sigma)$ is negative and larger than 1 in modulus. Moreover, the covariance term is negative if shocks are transitory. Indeed, a positive shock to realized consumption growth is necessarily followed by negative expected growth rates in the long run, as consumption reverts to the steady state. Therefore, all three addends of Equation (40) contribute positively to the variance of stock returns. In contrast, according to Equation (41), the variance of the risk-free rate exclusively depends on fluctuations in future expected consumption growth rates.

The above expressions highlight the opposite effects of the *risk-exposure* and *surplus-consumption channels*. An increase in participation reduces the volatility of asset returns through tighter fluctuations in both realized and expected consumption growth, as captured by the declining variance of capitalists' consumption growth (recall Figure 3). As shown in Appendix C, standard models featuring the *risk-exposure channel* alone indeed predict a negative relationship between the participation rate and the standard deviation of the risk-free rate and stock returns. On the other hand, the *surplus-consumption channel* amplifies the sensitivity of returns to shocks to the consumption growth process, by raising the effective relative risk aversion. Therefore, even smaller fluctuations in expected consumption produce larger swings in asset prices.

7 Participation and surplus consumption in the data

I document that the key novel mechanism is consistent with evidence from the U.S. Consumption Expenditure Survey for the sample 1984-2017. The results presented next show that the relationship between participation and stockholders' surplus consumption (and implied effective risk aversion) in the data is consistent with the model, both in the time series and the cross-section of U.S. states. Further, I show that the

[29]This expression is obtained by setting dividends equal to zero in Equation (39) and using the Euler equation for bonds. For more details, see Campbell (2003) and Appendix E.

stochastic discount factor employed in the quantitative analysis is empirically highly volatile and correlated with excess stock returns, providing external validation for the relevance of the main model implications.

I calculate quarterly consumption expenditures for the representative stockholder following the consumption and stockholding status definitions in Malloy et al. (2009).[30] Consumption consists of non-durable goods and some services aggregated from the disaggregated expenditure categories reported in the survey. I combine the financial information reported in the CEX and the Survey of Consumer Finances to sort the population into stockholders and non-stockholders. In the main analysis, stockholders are defined as households holding positive amounts of stocks, either directly or indirectly. At the end of this section, I briefly present robustness tests accounting for a more comprehensive consumption measure, restricting the focus on rich stockholders, or dealing with potential misclassification due to the sorting procedure. The construction of the dataset is extensively discussed in Appendix F, while robustness exercises are presented in detail in Appendix G.

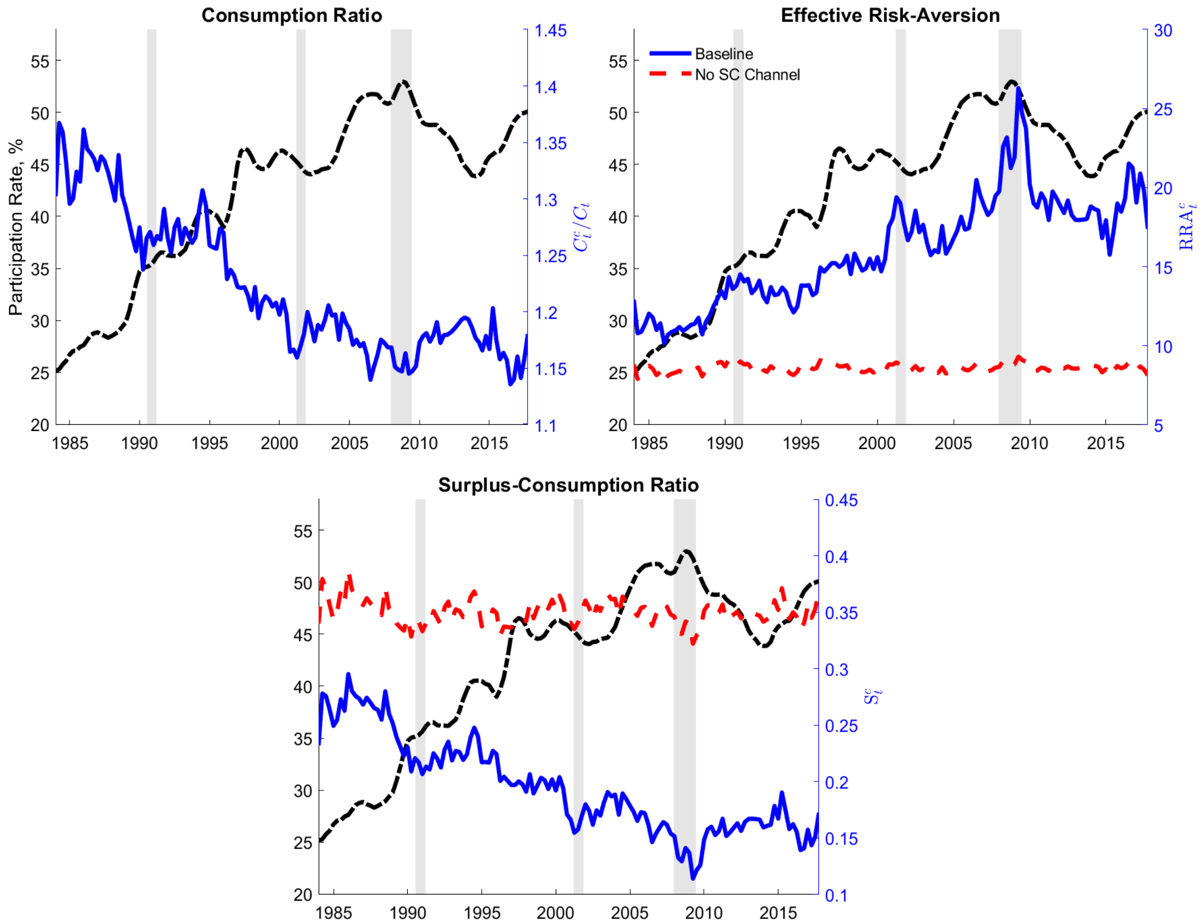
7.1 Time-series evidence

The three panels of Figure 5 contrast the degree of stock market participation estimated from the CEX (black dash-dotted line) with the empirical counterparts of the consumption ratio, effective risk aversion, and surplus-consumption ratio in Figure 2. The top-left panel reports the estimated stockholder-to-aggregate per-capita consumption ratio (C_t^c/C_t in the model notation). The indicator trends downward and mirrors the evolution of the participation rate, implying convergence of the representative investor consumption towards the aggregate level. The ratio systematically drops around recessions, suggesting that the consumption of stockholders tends to be more cyclical than the aggregate. Quantitatively, it ranges between 1.35 and 1.15, which is in the ballpark of the model values in Figure 2 and supports the baseline calibration.

Measures of effective risk aversion and surplus-consumption ratio are depicted in the top-right and bottom panels, both for the baseline (blue solid lines) and the alternative "No SC Channel" economy (red dashed lines). The two setups differ in the definition of the habit stock. In the baseline economy, habits are computed as

[30]The setup assumes perfect risk-sharing within groups, thus ignoring uninsurable idiosyncratic consumption shocks. Malloy et al. (2009) show that the comovement between asset returns and within-group cross-household inequality plays a minor role in explaining risk-premia. Moreover, as argued by Mankiw and Zeldes (1991), considering the growth rate in the group-average consumption, rather than the average of the growth rates, gives greater weight to the growth rate of high-consumption families, who are more likely to be the marginal investors.

Figure 5: Surplus-consumption channel - Time-series evidence



Notes: This figure shows the empirical: stockholder-aggregate consumption ratio (top-left panel); stockholder implied effective risk aversion (top-right panel); and stockholder surplus-consumption ratio (bottom panel), plotted against the participation rate. Blue solid lines are computed as the counterparts of the baseline model. Red dashed lines are computed as the counterparts of the alternative "No SC Channel" economy. All quantities are estimated from the CEX. Shaded bands indicate NBER recessions.

an exponentially-weighted moving average of past *aggregate* consumption (Equation (3)). In the alternative economy, habits are computed as an exponentially-weighted moving average of past *stockholders'* consumption (Equation (11)). In both cases, the deep parameters are set to their calibrated model values. Notice that the local utility curvature parameter, σ, does not affect the correlation between the degree of participation and the estimated average effective risk aversion, but only the level of the latter. Its *dynamics* exclusively depend on the surplus-consumption ratio, S_t^c, which is fully data-driven except for the persistence parameter for the habit stock, m.[31] The baseline

[31] However, the results are very robust to changes in this parameter. Moreover, while the initial value for H_t is set to aggregate or stockholders' consumption in 1984Q1, results are identical if the recursion is initialized to the average over 1982Q1-1984Q1.

measures display clear trends in tandem with the degree of stock market participation, in the same direction of the model. Conversely, the alternative measures are stationary and less volatile over the business cycle. In either specification, however, effective risk aversion (surplus-consumption ratio) is strongly countercyclical (procyclical), systematically rising (dropping) during recessions. This result aligns with the standard habit mechanism (Campbell and Cochrane, 1999). In quantitative terms, effective risk aversion ranges between 11 and 25 for the baseline case while being constantly around 9 in the alternative scenario, which is fully compatible with the theoretical economy.

Table 4 reports evidence on the long-run comovement between the participation rate and the variables considered in Figure 5 for the baseline economy. Specifically, I compute the measures proposed by Müller and Watson (2018) for periods longer than 12 years. As noted by the authors, such a length abstracts from business cycle fluctuations. The table displays the point estimate (denoted by the hat) of the long-run correlation coefficient ρ_{LR} and of the slope coefficient β_{LR} of a long-run regression of the variable of interest (first column) on the participation rate. Focusing on the second and third columns, the estimated long-run correlations are strongly significant. The negative relationship between relative consumption (C_t^c/C_t) and participation is sizeable, with a correlation of -92%. In turn, this drives the strong long-run comovement between the (model-implied) surplus consumption and effective risk aversion measures with the participation rate. The results are confirmed when looking at the estimated long-run betas (last two columns), which are also significantly different from zero based on the 90% confidence intervals. In particular, an increase of one percentage point in the participation rate is associated with a decline of 0.007 (0.005) points in the consumption (surplus-consumption) ratio, and a rise of 0.33 points in the measure of effective risk aversion.

7.2 State-level evidence

The CEX also allows me to exploit the cross-sectional variation at the state level to study the relationship between participation and effective risk aversion or consumption inequality, measured again as stockholders' relative consumption. I estimate the participation rate and consumption series for the aggregate and the representative stockholder for each of the U.S. states considered in the survey.

Figure 6 displays the results. The left panels depict the relationship between median consumption inequality (top) or effective risk aversion (bottom) and median participation rate at the state level over the full sample.[32] The right panels report the same

[32]As thoroughly discussed in Appendix F, the state-level data is available only from 1993 and not

Table 4: Long-run covariation with participation rate

Variable	ρ_{LR}		β_{LR}	
	$\hat{\rho_{LR}}$	90% CI	$\hat{\beta_{LR}}$	90% CI
C_t^c/C_t	-0.92	$[-0.99, -0.25]$	-0.007	$[-0.009, -0.003]$
RRA_t	0.82	$[0.15, 0.98]$	0.33	$[0.08, 0.55]$
S_t	-0.95	$[-0.99, -0.45]$	-0.005	$[-0.006, -0.003]$

Notes: This table reports the long-run covariation measures proposed by Müller and Watson (2018) between the variables in the first column (for the baseline model) and the participation rate estimated from the CEX. The covariation is computed for periods longer than 12 years, to capture frequencies lower than business cycles. ρ_{LR} denotes the long-run correlation coefficient, while β_{LR} is the long-run slope coefficient of the regression of the variable of interest on the participation rate. Hats denote the point estimate, reported along with the 90% confidence interval.

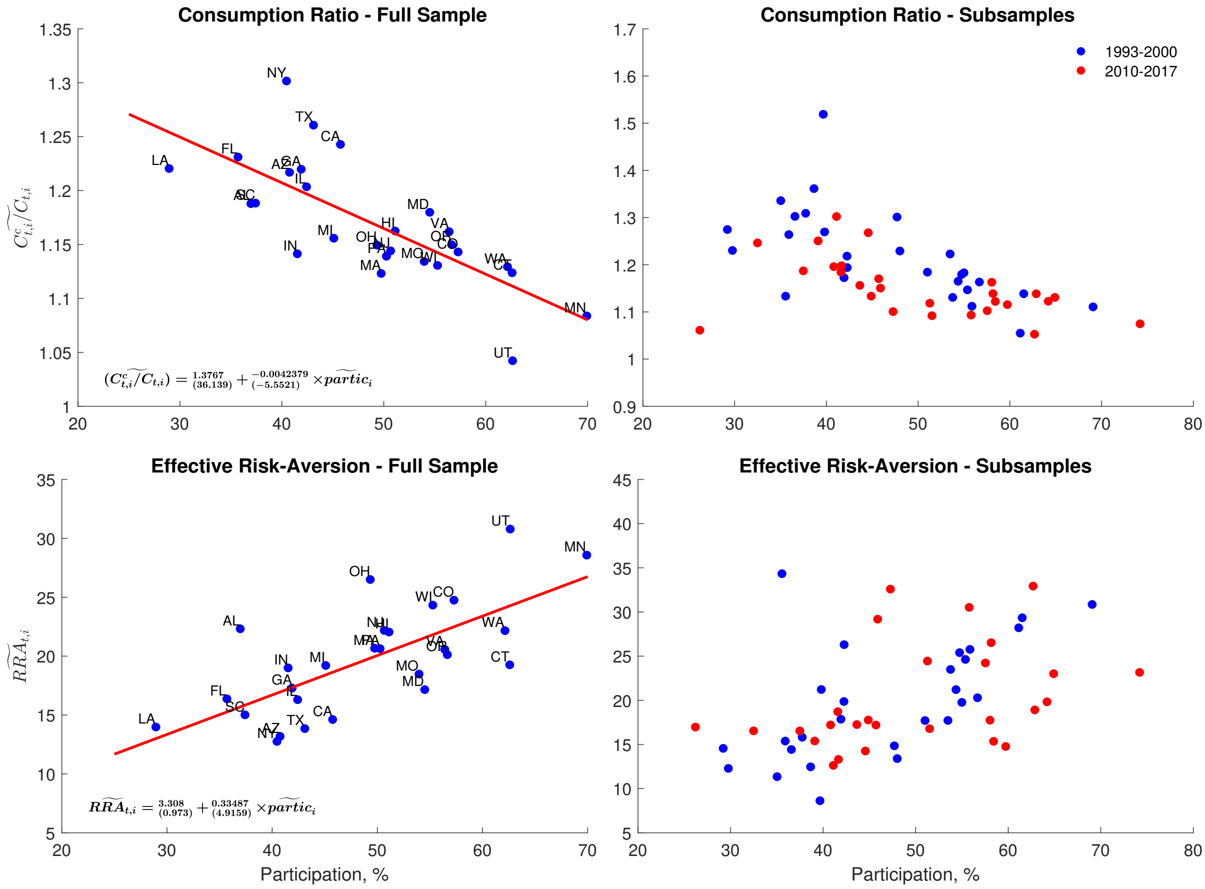
information but for the two sub-samples 1993-2000 and 2010-2017. In the top-left scatterplot, the data cloud indicates a negative correlation with the participation rate, with a slope coefficient of about -0.004. In line with the model mechanism, the evidence suggests that states registering higher degrees of participation exhibit lower degrees of consumption inequality between the average investor and the average household. Regarding the sub-sample analysis, the red cloud appears to be shifted down-right compared to the blue one. Thus, in most states, the participation rate rose over time while the average consumption ratio declined. Opposite results hold for the effective risk aversion measure. The cloud follows an upward-sloping regression line, with a strongly significant and positive slope coefficient of about 0.33. Therefore, the evidence suggests that states with higher participation exhibit a higher effective risk aversion. In the bottom-right panel, for both clouds again a positive relationship emerges. Moreover, the red cloud appears to be slightly shifted to the right compared to the blue one. This indicates that most states experienced an upward trend in the participation rate, coupled with an increase in the median effective risk aversion measure.

7.3 Surplus-consumption channel and the equity premium puzzle

The time-series and cross-sectional results suggest that the main model mechanism is consistent with the evolution of participation and stockholders' consumption found in the data. In this last exercise, I show that the external habit preferences em-

for all 50 U.S. states. Given the sample restrictions adopted, the analysis employs data from 27 states. Moreover, as the sample size at the state level is much smaller, I report the median rather than the mean of each variable, since the former moment is more robust to outliers. For the same reason, in this exercise I aggregate the consumption and participation series at the annual, rather than the quarterly, frequency.

Figure 6: Surplus-consumption channel - Cross-sectional evidence



Notes: This figure displays the median (denoted by the tilde) stockholder-aggregate consumption ratio (top panels) and effective risk aversion (bottom panels) against the median participation rate at the state level. Given the smaller sample size, the consumption and participation series are aggregated at the annual frequency. Left panels: medians computed on the full sample 1993-2017. Right panels: medians computed on the 1993-2000 (blue dots) and 2010-2017 (red dots) sub-samples.

ployed in the model, which introduce the novel *surplus-consumption channel* of participation, have desirable properties for the well-known equity premium puzzle (Mehra and Prescott, 1985). In this respect, I conduct an analysis similar to Mankiw and Zeldes (1991) to show that the baseline stochastic discount factor (SDF) is significantly more volatile and correlated with stock returns than the alternative "No SC Channel" case.

As seen in Equation (37), with power utility, the equity premium can be rewritten as:

$$E(r^{ex}) = \sigma \times Cov(g, r^s). \tag{42}$$

The definition of g depends on the assumed SDF. In the case of CRRA preferences and limited participation, $g = \Delta c^c$ denotes *stockholders'* consumption growth. In the full-participation, representative-agent case instead $g = \Delta c$, i.e. aggregate consumption growth. Finally, with habit preferences and limited participation: i) marginal utility depends on stockholders' surplus consumption, implying $g = \Delta \log(C^c - \chi H)$; and ii) σ is related (but not equal) to *effective* risk aversion, which also depends on the surplus-consumption ratio (recall Equation (8)).

Table 5 reports key statistics related to the equity premium puzzle, computed with the empirical quarterly realized excess stock returns (denoted by r^{ex}) and different measures for g. All moments are reported in annualized terms. For reference, Panel A reports the CRRA case for both the full and limited participation scenarios. The first row summarizes the equity premium puzzle by exactly replicating the statistics discussed in Campbell (2003). Historically, $E(r^{ex}) = 8.14\%$.[33] As $Cov(g, r^{ex}) = 3.09/100$ for aggregate consumption, an implausibly high $\sigma \approx 262$ is required to rationalize the empirical equity premium. Even when imposing a perfect correlation between consumption growth and excess returns (i.e., by setting $Cov(g, r^{ex}) = \text{std}(g) \times \text{std}(r^{ex})$), the implied σ_2 is still very high and above 50, meaning that aggregate consumption is not volatile enough.[34] In line with Mankiw and Zeldes (1991), I find that stockholders' consumption growth (second row) displays a higher covariance with stock returns, which is also reassuring regarding the appropriateness of the procedure to sort households between stockholders and non.[35] Therefore, the σ required to match the historical excess return is half when accounting for limited participation. Similarly, as stockholders' consumption volatility is almost three times that of aggregate consumption, a much more acceptable $\sigma_2 \approx 18$ is obtained for the perfect correlation counterfactual.

Panel B restricts the focus on the novel limited participation economy with habit utility. In the baseline (third row), surplus consumption growth is almost twice as volatile as the alternative "No SC Channel" case (last row), and nearly 15 times as volatile as aggregate consumption growth. Most interestingly, it also implies the highest covariance ($36.98/100$) with excess stock returns, which provides reassuring external evidence on the empirical relevance of the SDF employed in the theoretical analysis. These findings directly map into the lowest implied σ and σ_2. To test the

[33] Notice that the average of *historical* excess returns likely overestimates the equity premium, especially in the post-WWII sample (Fama and French, 2002), and is indeed much larger than the one estimated using *expected* stock returns in Section 2. Therefore, the results reported here can be seen as conservative, since employing a lower estimate of the equity premium would shift downward the implied σ and σ_2, without however affecting the ranking among SDFs.

[34] As discussed in Campbell (2003), the perfect correlation case is a valuable diagnostic showing how the equity premium puzzle arises from the smoothness of consumption rather than the low correlation between consumption and stock returns. A correlation of one is also implicitly assumed in many calibration exercises such as Mehra and Prescott (1985) and Campbell and Cochrane (1999).

[35] Relatedly, in unreported results I find that the covariance of non-stockholders consumption growth with excess returns is $2.77/100$, i.e. even less than the aggregate.

Table 5: Calibration of the equity premium

	std(g)	$100 \times$ Cov(g, r^{ex})	σ	σ_2
		Panel A: CRRA Utility		
Aggregate	1.02	3.09	261.97	50.45
Stockholders	2.92	6.01	134.82	17.67
		Panel B: Habit Utility		
Baseline	15.11	36.98	21.9	3.41
No SC Channel	8.70	17.12	47.3	5.93

Notes: This table reports key equity premium statistics, computed by using the empirical quarterly excess stock returns r^{ex} and different measures for the stochastic discount factor captured by g, which varies across rows. σ denotes the implied risk aversion parameter, retrieved from Equation (42), while σ_2 denotes the implied risk aversion parameter for the perfect correlation case, retrieved from Equation (42) but imposing $Cov(g,r^{ex}) = \text{std}(g) \times \text{std}(r^{ex})$.

significance of the positive difference in the covariances for the habit cases, I estimate the following regression:

$$g^{Base.}_{t,t+1} - g^{NoSC}_{t,t+1} = \alpha + \beta r^{ex}_{t+1} + \epsilon_{t+1}, \tag{43}$$

where the β measures the difference in the covariance of $g^{Base.}$ and g^{NoSC} with excess stock returns, divided by the variance of the latter. I find $\beta = 0.08$ with a one-sided p-value equal to 0.02 (based on Newey-West standard errors with 4 lags), implying that the baseline SDF covaries with stock returns significantly more. Quantitatively, $\beta = 0.08$ means that when excess returns are 20% (about one standard deviation away from the historical mean, in annualized terms), the baseline SDF increases by 1.6% relative to the alternative. These results have a straightforward explanation. As aggregate consumption is smoother than stockholders', the common habit is smoother than stockholders' specific habit. Therefore, stockholders' consumption fluctuates more relative to the common (rather than the agent-specific) habit, i.e. the baseline surplus consumption is more volatile. As the latter is strongly procyclical, higher volatility naturally translates into a larger covariance with realized excess returns.

To sum up, this evidence suggests that the *surplus consumption channel* does not only have novel implications for the long-run relationship between participation and asset prices, but also stems from a stochastic discount factor with desirable properties in relation to the equity premium puzzle.

7.4 Robustness

Appendix G demonstrates that these results are robust to a more comprehensive consumption definition and to alternative sorting strategies between stockholders and non-stockholders. Figures G.1-G.2 and Panel A of Table G.1 show that both time-series and cross-sectional results are essentially unchanged when extending the consumption measure to include durable goods and services with substantial durable components. The omission of such items (such as tv and audio equipment, education, or health expenses), which are in principle more relevant for richer households, could bias the consumption ratio downward. In line with this intuition, I find that the total (rather than non-durables and services) consumption ratio is slightly higher than the baseline, in turn shifting up (down) the surplus-consumption ratio (effective risk aversion) estimates. As the additional expense categories are highly cyclical, their inclusion raises the covariance of the SDF with excess returns (Panel A of Table G.2), which remains significantly higher than the alternative (first column of Table G.3).

Similar results hold when focusing only on households owning at least $10000\$$ in stocks, to capture richer stockholders with relevant exposure to the stock market as in Mankiw and Zeldes (1991). Recall that this threshold was also benchmarked in the counterfactual exercise in Section 4.4. As expected, the consumption ratio is significantly higher now, starting at about 1.6 rather than 1.4 (Figure G.3). Furthermore, the (annualized) standard deviation of stockholders' consumption growth is now 4.05, i.e. about 1.37 times that of the baseline definition. However, the cross-sectional and time-series relationship between participation and consumption are not substantially affected (Figure G.4 and Table G.1, Panel B), as well as the properties of the corresponding SDF (Table G.2, Panel B and second column of Table G.3). Finally, I verify that results do not critically hinge on the stockholding-status imputation procedure. In the main analysis, a household is classified as a stockholder if it reports stockholdings in the CEX data or if its SCF-based probability exceeds a given threshold. Now, I construct a 'continuous' measure of stock-market participation that weighs household-level variables by estimated probabilities of holding stocks, rather than univocally assigning a household to a group. This robustness therefore deals with the potential imprecision of the classification. Results hold quite closely in this case too (see Figures G.5-G.6 and last panel or column of Tables G.1-G.2).

8 Conclusion

Recent literature points to the heterogeneity between workers and stockholders as a first-order determinant of asset prices. I employ a limited participation production-based asset-pricing model to study the macroeconomic and asset-pricing implications of the upward trend in stock market participation observed in the U.S. since the late 1980s. With external habit preferences that intimately link consumption inequality to the investors' surplus-consumption ratio, the combination of high participation and low aggregate volatility moves the average equity premium and risk-free rate in the direction observed during the Great Moderation, while leaving stock returns volatility unchanged. This work identifies the upward trend in stock market participation and the developments in the representative investor's surplus consumption as novel relevant drivers of the macro-financial trends observed in the U.S. over the last decades.

References

Atkeson, A. and Ogaki, M. (1996). Wealth-varying intertemporal elasticities of substitution: Evidence from panel and aggregate data. *Journal of monetary Economics*, 38(3):507–534.

Basak, S. and Cuoco, D. (1998). An equilibrium model with restricted stock market participation. *Review of Financial Studies*, 11(2):309–341.

Bhamra, H. S. and Uppal, R. (2013). Asset prices with heterogeneity in preferences and beliefs. *Review of Financial Studies*, 27(2):519–580.

Bilbiie, F. O. (2008). Limited asset markets participation, monetary policy and (inverted) aggregate demand logic. *Journal of Economic Theory*, 140(1):162–196.

Bilbiie, F. O. (2020). The New Keynesian cross. *Journal of Monetary Economics*, 114:90–108.

Blanchard, O. and Simon, J. (2001). The long and large decline in us output volatility. *Brookings Papers on Economic Activity*, 2001(1):135–174.

Briggs, J. S., Cesarini, D., Lee, S. C., Lindqvist, E., and Östling, R. (2023). Financial windfalls, portfolio allocations, and risk preferences. *NBER Working Paper Series*, 31864.

Broer, T., Hansen, N.-J. H., Krussel, P., and Oberg, E. (2019). The New Keynesian transmission mechanism: A heterogeneous-agent perspective. *Review of Economic Studies*, 0:1–25.

Brunnermeier, M., Farhi, E., Koijen, R. S. J., Krishnamurthy, A., Ludvigson, S. C., Lustig, H., Nagel, S., and Piazzesi, M. (2021). Perspectives on the future of asset pricing. *Review of Financial Studies*, 34(4):2126–2160.

Caballero, R. J., Farhi, E., and Gourinchas, P.-O. (2017a). Rents, technical change, and risk premia Accounting for secular trends in interest rates, returns on capital, earning yields, and factor shares. *American Economic Review*, 107(5):614–20.

Caballero, R. J., Farhi, E., and Gourinchas, P.-O. (2017b). The safe assets shortage conundrum. *Journal of Economic Perspectives*, 31(3):29–46.

Calvet, L. E., Campbell, J. Y., and Sodini, P. (2009). Fight or flight? portfolio rebalancing by individual investors. *The Quarterly Journal of Economics*, 124(1):301–348.

Calvet, L. E. and Sodini, P. (2014). Twin picks: Disentangling the determinants of risk-taking in household portfolios. *Journal of Finance*, 69(2):867–906.

Campbell, J. R. and Hercowitz, Z. (2006). The role of collateralized household debt in macroeconomic stabilization. *Foerder Institute for Economic Research Working Papers*, 275707.

Campbell, J. Y. (2003). Consumption-based asset pricing. *Handbook of the Economics of Finance*, 1:803–887.

Campbell, J. Y. and Cochrane, J. H. (1999). By force of habit: A consumption-based explanation of aggregate stock market behavior. *Journal of Political Economy*, 107(2):205–251.

Campbell, J. Y., Pflueger, C., and Viceira, L. M. (2020). Macroeconomic drivers of bond and equity risks. *Journal of Political Economy*, 128(8):3148–3185.

Campbell, J. Y. and Shiller, R. J. (1988). The dividend-price ratio and expectations of future dividends and discount factors. *Review of Financial Studies*, 1(3):195–228.

Cantore, C. and Freund, L. B. (2021). Workers, capitalists, and the government: Fiscal policy and income (re) distribution. *Journal of Monetary Economics*, 119:58–74.

Chan, Y. L. and Kogan, L. (2002). Catching up with the Joneses: Heterogeneous preferences and the dynamics of asset prices. *Journal of Political Economy*, 110(6):1255–1285.

Chen, A. Y. (2017). External habit in a production economy: A model of asset prices and consumption volatility risk. *Review of Financial Studies*, 30(8):2890–2932.

Corhay, A., Kung, H., and Schmid, L. (2020). Competition, markups, and predictable returns. *The Review of Financial Studies*, 33(12):5906–5939.

Danthine, J.-P. and Donaldson, J. B. (2002). Labour relations and asset returns. *Review of Economic Studies*, 69(1):41–64.

De Graeve, F., Dossche, M., Emiris, M., Sneessens, H., and Wouters, R. (2010). Risk premiums and macroeconomic dynamics in a heterogeneous agent model. *Journal of Economic Dynamics and Control*, 34(9):1680–1699.

Debortoli, D. and Galí, J. (2017). Monetary policy with heterogeneous agents: Insights from TANK models. mimeo.

Del Negro, M., Giannone, D., Giannoni, M. P., and Tambalotti, A. (2017). Safety, liquidity, and the natural rate of interest. *Brookings Papers on Economic Activity*, 2017(1):235–316.

Del Negro, M., Giannone, D., Giannoni, M. P., and Tambalotti, A. (2019). Global trends in interest rates. *Journal of International Economics*, 118:248–262.

Delle Monache, D., Petrella, I., and Venditti, F. (2020). Price dividend ratio and long-run stock returns: A score driven state space model. *Journal of Business & Economic Statistics*, Forthcoming.

Den Haan, W. J. and Sterk, V. (2011). The myth of financial innovation and the Great Moderation. *Economic Journal*, 121(553):707–739.

Duarte, F. and Rosa, C. (2015). The equity risk premium: A review of models. *Economic Policy Review*, (2):39–57.

Duca, J. V. (2001). The democratization of America's capital markets. *Economic and Financial Policy Review*, (Q II):10–19.

Eggertsson, G. B., Robbins, J. A., and Wold, E. G. (2021). Kaldor and Piketty's facts: The rise of monopoly power in the United States. *Journal of Monetary Economics*, 124:S19–S38.

Fama, E. F. and French, K. R. (2002). The equity premium. *Journal of Finance*, 57(2):637–659.

Farhi, E. and Gourio, F. (2018). Accounting for macro-finance trends: Market power, intangibles, and risk premia. *Brookings Papers on Economic Activity*, Fall 2018:147–223.

Favilukis, J. (2013). Inequality, stock market participation, and the equity premium. *Journal of Financial Economics*, 107(3):740–759.

Galí, J., López-Salido, J. D., and Vallés, J. (2007). Understanding the effects of government spending on consumption. *Journal of the European Economic Association*, 5(1):227–270.

Gaudio, F. S., Petrella, I., and Santoro, E. (2023). Asset market participation, redistribution, and asset pricing. *CEPR Discussion Paper*, 17984.

Gomes, F. and Michaelides, A. (2005). Optimal life-cycle asset allocation: Understanding the empirical evidence. *Journal of Finance*, 60(2):869–904.

Gomes, F. and Michaelides, A. (2007). Asset pricing with limited risk sharing and heterogeneous agents. *Review of Financial Studies*, 21(1):415–448.

Greenwald, D. L., Lettau, M., and Ludvigson, S. C. (2019). How the wealth was won: Factors shares as market fundamentals. *NBER Working Paper Series*, 25769.

Greenwood, J., Hercowitz, Z., and Huffman, G. W. (1988). Investment, capacity utilization, and the real business cycle. *American Economic Review*, pages 402–417.

Greenwood, J., Hercowitz, Z., and Krusell, P. (1997). Long-run implications of investment-specific technological change. *American Economic Review*, pages 342–362.

Guiso, L., Haliassos, M., and Jappelli, T. (2003). Household stockholding in Europe: Where do we stand and where do we go? *Economic Policy*, 18(36):123–170.

Guiso, L. and Sodini, P. (2013). Household finance: An emerging field. In *Handbook of the Economics of Finance*, volume 2, pages 1397–1532. Elsevier.

Guvenen, F. (2006). Reconciling conflicting evidence on the elasticity of intertemporal substitution: A macroeconomic perspective. *Journal of Monetary Economics*, 53(7):1451–1472.

Guvenen, F. (2009). A parsimonious macroeconomic model for asset pricing. *Econometrica*, 77(6):1711–1750.

Holston, K., Laubach, T., and Williams, J. C. (2017). Measuring the natural rate of interest: International trends and determinants. *Journal of International Economics*, 108:S59–S75.

Iachan, F. S., Nenov, P. T., and Simsek, A. (2021). The choice channel of financial innovation. *American Economic Journal: Macroeconomics*, 13(2):333–372.

Ilut, C., Krivenko, P., and Schneider, M. (2024). Uncertainty or frictions? a quantitative model of scarce safe assets. *NBER Working Paper Series*, 32198.

Jaccard, I. (2014). Asset returns and labor supply in a production economy. *Journal of Money, Credit and Banking*, 46(5):889–919.

Jensen, H., Petrella, I., Ravn, S. H., and Santoro, E. (2020). Leverage and deepening business-cycle skewness. *American Economic Journal: Macroeconomics*, 12(1):245–81.

Jensen, H., Ravn, S. H., and Santoro, E. (2018). Changing credit limits, changing business cycles. *European Economic Review*, 102:211–239.

Jermann, U. J. (1998). Asset pricing in production economies. *Journal of Monetary Economics*, 41(2):257–275.

Justiniano, A. and Primiceri, G. E. (2008). The time-varying volatility of macroeconomic fluctuations. *American Economic Review*, 98(3):604–41.

Kaplan, G. and Violante, G. L. (2018). Microeconomic heterogeneity and macroeconomic shocks. *Journal of Economic Perspectives*, 32(3):167–94.

Kaplan, G., Violante, G. L., and Weidner, J. (2014). The wealthy hand-to-mouth. *Brookings Papers on Economic Activity*, 45(1 (Spring):77–153.

Kuvshinov, D. and Zimmermann, K. (2022). The big bang: Stock market capitalization in the long run. *Journal of Financial Economics*, 145(2):527–552.

Lansing, K. J. (2015). Asset pricing with concentrated ownership of capital and distribution shocks. *American Economic Journal: Macroeconomics*, 7(4):67–103.

Lettau, M., Ludvigson, S. C., and Ma, S. (2019). Capital share risk in U.S. asset pricing. *Journal of Finance*, 74(4):1753–1792.

Liu, Z., Wang, P., and Zha, T. (2013). Land-price dynamics and macroeconomic fluctuations. *Econometrica*, 81(3):1147–1184.

Malkhozov, A. (2014). Asset prices in affine real business cycle models. *Journal of Economic Dynamics and Control*, 45:180–193.

Malloy, C. J., Moskowitz, T. J., and Vissing-Jørgensen, A. (2009). Long-run stockholder consumption risk and asset returns. *Journal of Finance*, 64(6):2427–2479.

Mankiw, N. G. (2000). The savers-spenders theory of fiscal policy. *American Economic Review*, 90(2):120–125.

Mankiw, N. G. and Zeldes, S. P. (1991). The consumption of stockholders and non-stockholders. *Journal of Financial Economics*, 29(1):97–112.

Marx, M., Mojon, B., and Velde, F. R. (2021). Why have interest rates fallen far below the return on capital? *Journal of Monetary Economics*, 124:S57–S76.

Meeuwis, M. (2022). Wealth fluctuations and risk preferences: Evidence from US investor portfolios. Available at SSRN: http://dx.doi.org/10.2139/ssrn.3653324.

Mehra, R. and Prescott, E. C. (1985). The equity premium: A puzzle. *Journal of Monetary Economics*, 15(2):145–161.

Melcangi, D. and Sterk, V. (2024). Stock market participation, inequality, and monetary policy. *CEPR Discussion Papers*, 18853.

Morelli, J. M. (2021). Limited participation in equity markets and business cycles. Finance and Economics Discussion Series 2021-026, Board of Governors of the Federal Reserve System U.S.

Müller, U. K. and Watson, M. W. (2018). Long-run covariability. *Econometrica*, 86(3):775–804.

Pflueger, C. (2024). Back to the 1980s or not? the drivers of inflation and real risks in treasury bonds. *NBER Working Paper Series*, 30921.

Poterba, J. M., Samwick, A. A., Shleifer, A., and Shiller, R. J. (1995). Stock ownership patterns, stock market fluctuations, and consumption. *Brookings Papers on Economic Activity*, 1995(2):295–372.

Rios-Rull, J.-V. and Santaeulalia-Llopis, R. (2010). Redistributive shocks and productivity shocks. *Journal of Monetary Economics*, 57(8):931–948.

Santos, T. and Veronesi, P. (2022). Leverage. *Journal of Financial Economics*, 145(2, Part B):362–386.

Stock, J. H. and Watson, M. W. (2003). Has the business cycle changed? Evidence and explanations. In *Monetary policy and uncertainty: Adapting to a changing economy*, pages 9–56. Citeseer.

Vissing-Jørgensen, A. (2002). Limited asset market participation and the elasticity of intertemporal substitution. *Journal of Political Economy*, 110(4):825–853.

Vissing-Jorgensen, A. (2002). Towards an explanation of household portfolio choice heterogeneity: Nonfinancial income and participation cost structures. *NBER Working Paper Series*, 8884.

Vissing-Jorgensen, A. (2003). Perspectives on behavioral finance: Does" irrationality" disappear with wealth? Evidence from expectations and actions. *NBER Macroeconomics Annual*, 18:139–194.

Xiouros, C. and Zapatero, F. (2010). The representative agent of an economy with external habit formation and heterogeneous risk aversion. *Review of Financial Studies*, 23(8):3017–3047.

Internet Appendix to Stock Market Participation and Macro-Financial Trends

Francesco Saverio Gaudio[†]

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[†]Sapienza University of Rome. Email: francescosaverio.gaudio@uniroma1.it.

Appendices

A Dataset for motivating evidence

Stock market participation data The direct and indirect stock-ownership rates are taken from the 2016 Survey of Consumer Finances.[1] In the main text, and for the calibration of the model, I consider the raw participation rate. Indeed, it seems the least arbitrary measure of participation. According to this measure, a household is defined as a stockowner if holding any positive amount of stocks. However, such a measure could hide substantial heterogeneity in stockholdings, since many of the new entrants in the stock market might hold very low amounts of stocks. For this reason, Figure 1 reports also more refined measures of participation, based on a $10000\$$ threshold or top-5% wealth-weighted rate.

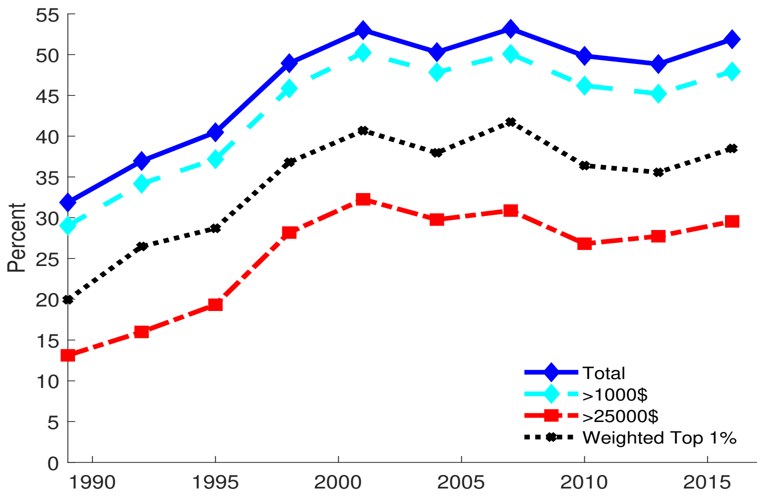
Figure A.1 depicts additional measures of stock market participation. Even when considering dollar-amount thresholds of 1000 or $25000\$$ (cyan-diamonds dashed line and red-dots dashed-dotted line, respectively) the participation rate increased substantially, although the estimated rate is lower than the baseline. The same holds when measuring the top-1% wealth-weighted rate (black-crosses dotted line).

Macroeconomic data The data commented in the main text is all at the annual frequency and spans until 2017, unless otherwise noted. All macroeconomic data are expressed in real per-capita terms, where appropriate. Real variables are obtained by deflating the nominal variables by the annual Consumer Price Index (CPI) obtained from the Bureau of Labor Statistics.[2] Per-capita measures are obtained by dividing the real variables by the U.S. population, obtained from the National Income and Products Accounts (NIPA, Table 2.1, line 39). Growth rates are constructed as the first difference in the logarithm of the variables.

GDP is constructed as Nominal GDP (NIPA, Table 1.1.5, Line 1). Consumption is defined as the sum of Nominal Expenditures on Nondurable Goods (NIPA, Table 2.3.5, Col. 8) plus Nominal Expenditures on Services (NIPA, Table 2.3.5, Col. 13). Investment is defined as the sum of Nominal Private Nonresidential Fixed Investment (PNFIA series from the FRED website) plus Nominal Expenditures on Durable Goods (Table 2.3.5, Col. 3). The capital share of income and the macroeconomic dividends are constructed following Lansing (2015). The former is defined as one minus the ratio between the compensation of employees (NIPA, Table 1.14, Line 4) and the

[1] Available at: https://www.federalreserve.gov/econres/scfindex.htm
[2] Available at: https://data.bls.gov/PDQWeb/cu

Figure A.1: Stock market participation - Additional measures



Notes: The figure documents the upward trend in several measures of stock market participation, based on different dollar-amount thresholds or a different weighting scheme.

gross value added of corporate business (NIPA, Table 1.14, Line 1). Dividends are constructed by subtracting real per-capita investment to the product between the capital share of income and real per-capita GDP. Consistent with the definition of the capital share of income, wages are constructed as the compensation of employees. The (not utilization adjusted) total factor productivity (TFP) growth series is from Fernald (2014).[3] Finally, the relative price of investment to consumption goods is defined as the Quality-Adjusted Price of New Equipment and Software from Israelsen (2010), which is available up to 2016.

Financial data Regarding financial variables, real asset returns are obtained by subtracting the annual CPI inflation from nominal ones. The annual risk-free rate is defined as the annual gross return on the 90-day T-Bill return, downloaded from the WRDS (Wharton Research Data Services) website. As an alternative measure, I employ the estimated U.S. short-term natural rate of interest *r-star* from Del Negro et al. (2019), which is available for the sample 1870-2016.[4] As discussed in the main text, this variable measures the real interest rate that would prevail in a flexible-price economy and is therefore unaffected by monetary policy. Annual historical S&P500 stock returns are taken from the version of Damodaran (2013) updated through 2019.[5]

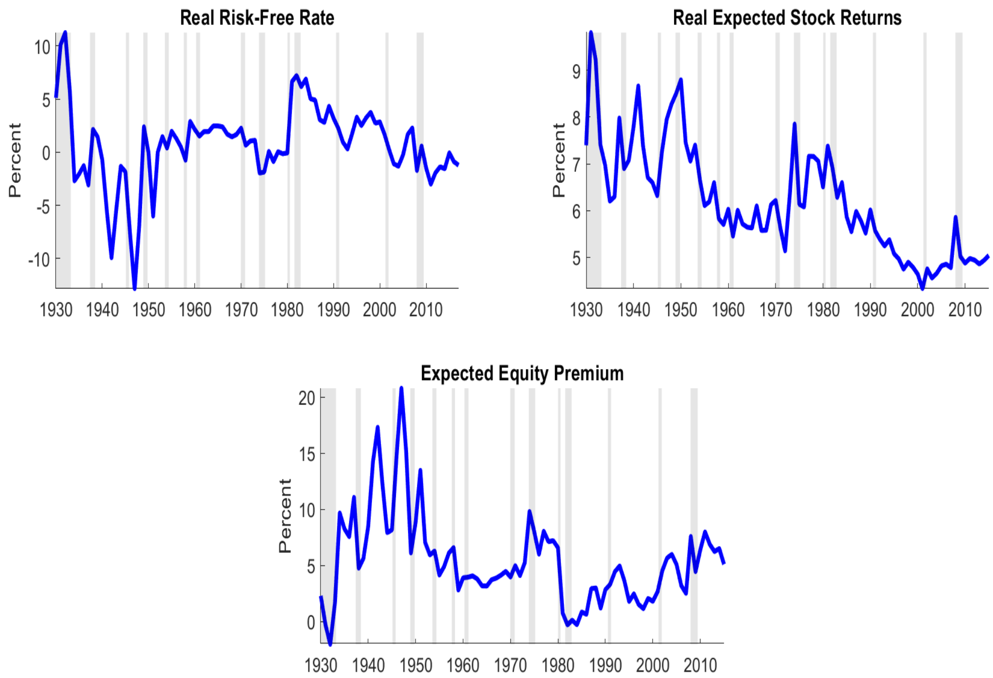
Estimates of expected stock returns are retrieved from several sources. In the base-

[3] Available at: https://www.frbsf.org/economic-research/indicators-data/total-factor-productivity-tfp/

[4] Available at: https://github.com/FRBNY-TimeSeriesAnalysis/rstarGlobal.

[5] Available at: http://pages.stern.nyu.edu/~adamodar/

Figure A.2: Asset-pricing trends - Long sample



Notes: The figure reports the trend since 1930 in the real risk-free rate (top-left panel), expected equity return (top-right panel) and the expected equity premium (bottom panel). Expected stock returns are taken from Kuvshinov and Zimmermann (2022). Shaded bands indicate NBER recessions.

line analysis, I employ the series computed by Kuvshinov and Zimmermann (2022), which can be downloaded from the authors' websites for the period 1872-2015. The estimate is based on expected cash flow growth by constructing long-run forecasts of future dividends. This forecast is the average of two proxies, one of which forecasts future dividends using current asset valuations within a time-varying VAR specification, whereas the other equates the long-run dividend growth rate to a long-run GDP growth forecast. A second measure, available from 1931 through 2011, is obtained from Iachan et al. (2021), who adopt the Blanchard (1993) methodology. As a third measure, I employ the series from Damodaran (2013), updated through 2016. Expected returns are computed by a Dividend Discount Model (DDM) that accounts for the free cash flow to equity (FCFE) as a measure of potential dividends. This measure adds stock buybacks to the dividends actually paid to gauge a more accurate estimate of the total cash flow. As a last measure, I rely on Duarte and Rosa (2015), who calculate the one-year ahead equity premium since 1964 as the first principal component of 20 models. Finally, the annual S&P500 real dividends and price-to-dividend ratio are taken from Lansing (2015)[6], who constructs both series from Robert Shiller's database

[6]Available at: http://dx.doi.org/10.1257/mac.20110130

Table A.1: Asset-pricing moments - Robustness

	1955-1983	1989-2017	2001-2017
Panel A: *r-star* from Del Negro et al. (2019)			
$\text{std}(R^b)$	0.70	0.70 [0%]	0.37 [−47%**]
$E(R^b)$	2.05	1.13 [−45%***]	0.61 [−70%***]
$E(R^{e,s} - R^b)$	4.16	3.85 [−8%]	4.24 [2%]
Panel B: Expected stock returns from Iachan et al. (2021)			
$E(R^{e,s})$	4.12	3.33 [−19%***]	3.05 [−26%**]
$E(R^{e,s} - R^b)$	2.54	2.08 [−18%]	3.28 [28%]
Panel C: Expected stock returns from Damodaran (2013)			
$E(R^{e,s})$	6.17	6.22 [1%]	6.09 [−1%]
$E(R^{e,s} - R^b)$	4.52	5.48 [21%**]	6.65 [47%***]
Panel D: Expected stock returns from Duarte and Rosa (2015)			
$E(R^{e,s})$	8.21	7.52 [−8.4%]	8.21 [0%]
$E(R^{e,s} - R^b)$	6.64	6.75 [1.7%]	8.69 [31%***]

Notes: Sub-sample analysis for additional asset-pricing series.

for the period 1871-2012. In all cases, the expected equity premium is defined as the average difference between expected stock returns and the risk-free rate. Notice that, as in Farhi and Gourio (2018), the equity premium is not estimated using historical excess returns as they are extremely noisy, and detecting changes in the realized excess returns over sub-samples would be impossible.

B Moment matching and model dynamics

I present the moment-matching performance and dynamic properties of the baseline model, which is solved with second-order perturbation methods. I show that the model can replicate key macro-financial moments for the U.S. in the pre-Great Moderation period for typical parameter values. Moreover, its dynamic properties, as exemplified by the impulse response functions of key variables to the exogenous shocks, are demonstrated to be very close to Lansing (2015).

B.1 Model predictions

The macroeconomic and asset-pricing moments of the baseline model are reported in Table B.1 and are directly compared to the pre-Great Moderation data.

The standard deviation of aggregate consumption growth is 1.69%, while investment growth is about 2.48 times more volatile than output growth. The volatility of investment growth is 6.56%, which compares well with the empirical 6.02%. On the other hand, the output growth volatility (2.65%) falls short of the empirical point estimate but lies well within the 95% confidence interval. The model also yields a relative volatility of capitalists' and workers' aggregate consumption growth of 1.63, in line with the empirical evidence reported in Guvenen (2009) suggesting that stockholders' consumption is about $1.5-2$ times as volatile as non-stockholders'.

While the standard deviation of the growth in the relative price of investment is matched exactly, the volatility of TFP growth in the model is lower than in the data. On the contrary, the model requires a high volatility of the growth in the capital share of income, which is 4.01% compared to the empirical 2.46%. However, the 6.85% volatility of dividends provides a good match with the data. Notice that the volatility of dividend growth is strictly related to wage growth and hence the relative volatility of capitalists' and workers' consumption growth. As depicted in Figure 3, the model delivers a volatility of workers' consumption growth of about 1.9%. Since workers consume only labor income and supply labor inelastically, this volatility corresponds to the volatility of wage growth. Therefore, wage growth is sufficiently smoother than output growth, with a relative volatility of 0.71.[7] The relative smoothness of wages clearly positively impacts dividends growth volatility, thus helping also to match the ratio $\mathrm{std}(\Delta c^c)/\mathrm{std}(\Delta c^w)$.

Regarding asset-pricing moments, the calibration perfectly matches the standard deviation of stock returns despite a relatively low leverage factor. The combination of habit utility and high capital adjustments costs helps match this moment (Chen, 2016, 2017). At the same time, as it is well known in the literature (Jermann, 1998; Jaccard, 2014; Chen, 2017, among the others) these features usually entail excessive fluctuations in the risk-free rate. Nevertheless, the highly persistent distribution shock process counteracts such an effect and helps achieve a very plausible value for the volatility of the risk-free rate. The model also produces a sufficiently low average interest rate (1.69% in the model compared to the empirical 1.58%) and generates a mean equity premium of 4.27%, very close to the estimated value of 4.63%.

Finally, the model produces first-order autocorrelation coefficients, AC(1), with the

[7] The relative smoothness of wages is a well-established business cycle fact, see also De Graeve et al. (2010), among the others.

Table B.1: Pre-Great Moderation - Model versus data

Moment	Empirical		Simulated
Volatility			
$\text{std}(\Delta y)$	3.07	$[2.17, 3.22]$	2.65
$\text{std}(\Delta c)$	1.76	$[1.23, 1.89]$	1.69
$\text{std}(\Delta i)$	6.02	$[4.73, 6.39]$	6.56
$\text{std}(\Delta d)$	6.79	$[4.15, 7.51]$	6.85
$\text{std}(\Delta \log(A))$	2.00	$[1.32, 2.22]$	1.71
$\text{std}(\Delta \log(P^I))$	2.63	$[1.31, 3.64]$	2.63
$\text{std}(\Delta \log(\alpha))$	2.46	$[1.80, 2.64]$	4.01
$\text{std}(\Delta c^c), \text{std}(\Delta c^w)$	$> 1.5 - 2^*$	$-$	1.63
$\text{std}(R^b)$	2.14	$[0.63, 2.33]$	2.17
$\text{std}(R^s)$	17.52	$[13.92, 19.55]$	17.52
Persistence: AC(1)			
$\text{AC}(\Delta y)$	0.12	$[-0.11, 0.29]$	0.13
$\text{AC}(\Delta c)$	0.30	$[-0.04, 0.46]$	0.20
$\text{AC}(\Delta i)$	0.08	$[-0.08, 0.25]$	0.06
$\text{AC}(\Delta d)$	-0.08	$[-0.25, 0.13]$	-0.01
$\text{AC}(\Delta \log(A))$	0.08	$[-0.16, 0.23]$	-0.015
$\text{AC}(\Delta \log(P^I))$	-0.07	$[-0.25, 0.25]$	-0.04
$\text{AC}(\Delta \log(\alpha))$	-0.15	$[-0.28, 0.12]$	-0.005
$\text{AC}(R^b)$	0.61	$[0.06, 0.68]$	0.97
$\text{AC}(R^s)$	-0.17	$[-0.48, 0.03]$	-0.001
Mean			
$E(R^b)$	1.58	$[0.34, 1.93]$	1.69
$E(R^{e,s} - R^b)$	4.63	$[3.86, 6.11]$	4.27

Notes: Matching performance of the baseline model for the 1955-1983 period. Lowercase letters denote the logarithm of the variable. Moments are all annual. The third column reports, in brackets, the lower and upper bounds of the (block-bootstrapped) 95% confidence interval around the point estimate (second column). Volatility and mean values are in percent. *The range is taken from Guvenen (2009).

correct sign and of the same order of magnitude as in the data. It is worth noting that for all the variables these coefficients are small and not statistically significant, with the only exception of the risk-free rate.

B.2 Impulse response functions

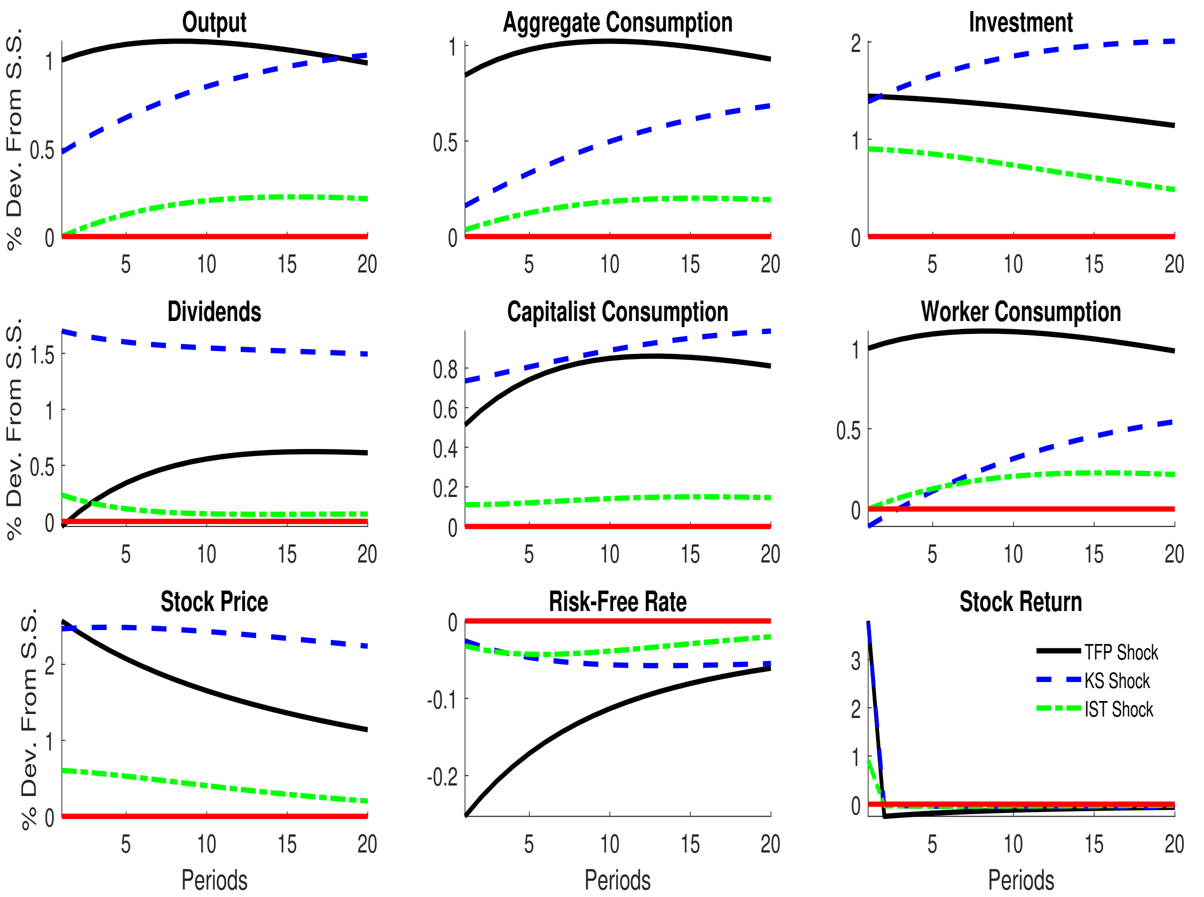
To help intuition about the model dynamics, Figure B.1 displays the impulse response function of the main variables to a one-percent neutral technology shock (TFP, black-squares line), distribution shock (KS, blue-circles line), and investment-specific technology shock (IST, green-diamonds line). The IRFs are computed on the logarithm of the variable of interest and the numbers on the y-axis represent relative variations from the non-stochastic steady state (in percent).

A positive neutral and investment-specific technology shock raises all macroeconomic variables, with investment and aggregate consumption being more and less volatile than output, respectively. Also, dividends positively comove with output, although they weakly respond to the shocks. The mild response of dividends, together with capitalists' ability to smooth consumption intertemporally, implies that capitalists' consumption increases less than workers' consumption in response to a neutral technology shock. On the other hand, the immediate response of dividends to an IST shock implies that capitalist consumption reacts more promptly compared to worker consumption. The two agents' consumption however comoves positively after a neutral or investment-specific technology shock. The positive response of dividends raises the price of stocks and their realized return. In contrast, the risk-free rate is only mildly countercyclical.

Compared to technology shocks, a distribution shock more strongly affects investment. A distribution shock increases the capital share of income thus making physical capital more productive. Hence, capitalists invest more resources to raise the capital stock which in turn boosts output. Although a strong investment response tends to shrink dividends, the joint increase in the capital share of income and output still allows a strong procyclical response in the dividends accruing to capital owners (recall Equation (23)). This helps match the high volatility of capitalists' consumption relative to workers' since the latter only rely on labor income. Moreover, unlike technology shocks, a distribution shock redistributes resources away from workers in favor of capitalists making their consumption comove negatively at impact. This negative comovement, together with the fact that capitalists constitute a small fraction of the total population, entails a mild response in aggregate consumption. However, in the medium term, the positive effect on output positively influences workers' consumption as well, although only slightly.

From an asset-pricing perspective, the distribution shock makes stock prices and realized stock returns strongly procyclical and volatile, while the response of the risk-free rate is more muted but persistent. Taken together, these results are well in line with those obtained by Lansing (2015) and clarify how distribution shocks help match high and volatile stock returns while generating a sufficiently smooth aggregate consumption process.

Figure B.1: Impulse response functions

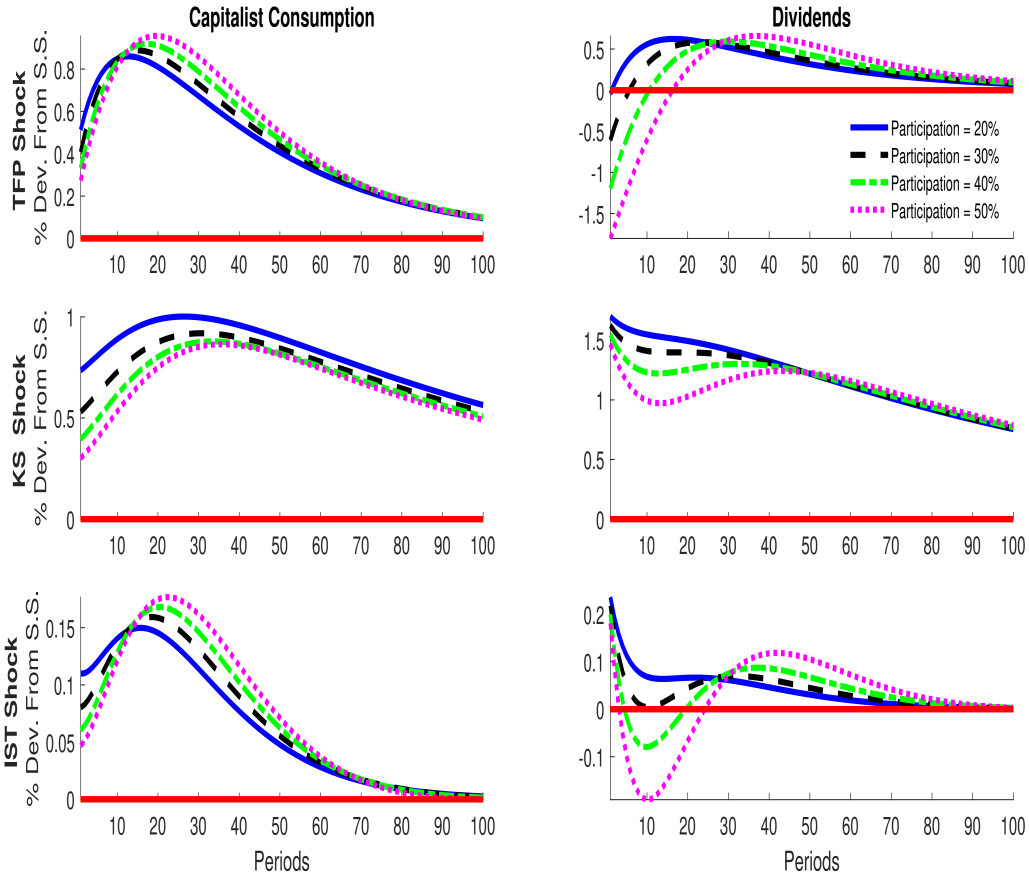


Notes: IRFs to a one-percent neutral technology shock (TFP, black-squares line), distribution shock (KS, blue-circles line), and investment-specific technology shock (IST, green-diamond line). The IRFs are computed on the logarithm of the variables and are generated with a first-order approximation of the model. Numbers on the y-axis, therefore, represent relative deviations from the non-stochastic steady state (in percent).

B.3 Participation and macroeconomic volatility: IRF analysis

The macroeconomic effects of higher participation can be alternatively gauged by inspecting Figure B.2, which reports the IRFs of capitalist's consumption and dividends to both neutral and investment-specific technology shocks (TFP and IST, respectively) and distribution (KS) shocks for different levels of market participation. Darker lines denote higher degrees of participation. Regarding capitalist consumption (left column), as financial participation increases two opposite effects are at work. First, the impact response becomes less sizeable, implying lower volatility of their realized consumption growth. Second, reductions in the immediate response generate higher volatility of future expected consumption, because the response becomes

Figure B.2: Capitalist's consumption and dividends - IRFs



Notes: IRFs of capitalist's consumption and dividends to a one-standard deviation neutral technology shock (TFP, top panels), distribution shock (KS, middle panels), and investment-specific technology shock (IST, bottom panels) for different levels of participation. Darker lines denote higher levels of participation.

more hump-shaped. Therefore, the future expected marginal utility of consumption becomes more volatile relative to the current realization, which translates into higher volatility of the stochastic discount factor. As highlighted by Equations (24) and (26), investment volatility is thus affected as well.

C Comparison to earlier models

This Appendix shows that, in existing models with concentrated ownership of capital, an increase in financial participation lowers the equity premium and stock market volatility while raising the standard deviation of aggregate consumption growth and the mean level of the risk-free rate. The level of participation only affects the quantity of risk faced by investors. As a result, these models predict that the trend in participation did not contribute to the behavior of U.S. macroeconomic and financial variables over the last few decades. I consider the case where capitalists exhibit group-specific habits as in Lansing (2015) (i.e., the alternative "No SC Channel" case in the main text) or a different specification for distribution shocks, as proposed by Danthine and Donaldson (2002) and De Graeve et al. (2010).

C.1 Group-specific habits as in Lansing (2015)

I start with the case where both agents supply labor inelastically but capitalists feature external group-specific habits in utility similar to Lansing (2015). In particular, the instantaneous utility function of capitalists now depends on the past value of the representative capitalist's consumption, rather than past aggregate per-capita consumption:

$$u^c\left(C_t^c\right) = \frac{\left(C_t^c - \chi H_t\right)^{1-\sigma}}{1-\sigma},$$

where χ_c denotes the weight of the external habit in the capitalists' utility function and the habit stock H_t is

$$H_t = mH_{t-1} + (1-m)\, C_{t-1}^c.$$

For comparability with the baseline results, this specification of the habit stock includes the parameter m, controlling the degree of persistence in the habit stock and hence allowing for a slow-moving process. The marginal utility of consumption is again given by $\Lambda_t = \left(C_t^c - \chi H_t\right)^{-\sigma}$ and the consequent stochastic discount factor reads $M_{t,t+1} = \beta \frac{E_t[\Lambda_{t+1}]}{\Lambda_t}$.

In the steady state, the level of effective risk aversion is equal to

$$\text{RRA}^c = \frac{\sigma}{1-\chi},$$

which depends only on the deep preference parameters and is therefore independent of the gap between capitalists' and aggregate per-capita consumption. In other words, in this version of the model, the *surplus-consumption channel* is shut down.

The calibration adopted (reported in Table C.1) is kept as close as possible to the baseline model to generate comparable macro-financial moments for the pre-Great Moderation period, as can be seen in the first panel of Table C.2. Nevertheless, the implications of higher participation are now the opposite of the baseline case. In particular, an increase in participation entails higher (lower) consumption (investment) growth volatility and an increase in the average risk-free rate. Conversely, the standard deviation of asset returns declines as well as the average equity premium, which

Table C.1: Group-specific habits as in Lansing (2015) - Calibration

Description	Parameter	Value
Fraction of workers	γ	0.8
Discount rate	β	0.957
Capital share of income	α	0.37
Depreciation rate	δ	0.115
Technology persistence	ρ_a	0.97
Distribution shock persistence	ρ_ν	0.99
IST persistence	ρ_{p^I}	0.92
IST shock volatility	σ_{p^I}	0.0258
Distribution shock volatility	σ_ν	0.04
Technology shock volatility	σ_a	0.017
Local utility curvature	σ	3
Habit weight in utility	χ	0.66
Habit stock persistence	m	0.8
Capital adjustment cost	χ_k	0.45
Leverage factor	χ_l	1.124

Notes: Calibration of the model with group-specific habits as in Lansing (2015).

drops by more than 1 percentage point. This result stems from the fact that the capitalist's average effective risk aversion is determined only by exogenous parameters. Hence, the degree of participation does not affect the average surplus-consumption ratio but only the quantity of risk borne by investors, i.e., the model features only the standard *risk-exposure channel*.

C.2 Operating leverage

Danthine and Donaldson (2002) and De Graeve et al. (2010) focus on the asset-pricing implications of the "operating leverage", i.e., the riskiness of dividends deriving from the priority status of wage claims. If the wage share is not constant over the cycle, then wages represent an insurance device between workers and firms (hence, shareholders). A countercyclical wage share exacerbates the procyclicality of dividends by simultaneously smoothing the income of workers. The mechanism analyzed by these authors is similar in spirit to the distribution shock featured in the baseline model.

I study the implications of increasing participation in the two-agent version of the model proposed by De Graeve et al. (2010) featuring workers and shareholders.[8] In

[8]This is the "T1-T3 with correlated shocks" specification in De Graeve et al. (2010), see Tables 3 and 4 in the paper.

Table C.2: Comparison to earlier models

$(1-\gamma)$	std(Δy)	std(Δc)	std(Δi)	std(Δd)	std(R^s)	std(R^b)	$E(R^b)$	$E(R^{e,s}-R^b)$
External Habit Utility (Lansing, 2015)								
20%	2.69	1.72	6.79	6.15	17.52	2.89	1.45	4.19
50%	2.67	1.75	6.03	8.52	15.54	2.30	2.60	2.92
Operating Leverage (De Graeve et al., 2010)*								
20%	1.72	1.36	3.19	23.86	21.28	1.87	1.69	4.58
50%	1.72	1.46	2.73	20.77	16.70	1.57	2.85	2.56

Notes: This table reports the results of two variants of the baseline model, for two different degrees of participation (1-γ). *This case is based on the workers-shareholders version of the model proposed by De Graeve et al. (2010). The calibration is kept at the frequency (quarterly) and values employed by the authors. Moments are reported in percent. Macroeconomic variables are detrended with the HP filter. The moments are therefore referred to detrended variables (not growth rates). Asset-pricing moments are reported in annualized terms.

this model, both agents exhibit GHH preferences and supply labor elastically, but workers have lower EIS than shareholders. As a consequence, workers have a stronger consumption-smoothing motive than capitalists. This stronger consumption smoothing motive is satisfied through a long-term labor contract that "*guarantees an optimal risk-sharing between workers and shareholders on a period-by-period basis for a given realization of the exogenous bargaining weight*" (De Graeve et al., 2010, p. 1683). The contract, therefore, makes workers' consumption smooth at the expense of higher volatility in capitalists' consumption.

The second panel of Table C.2 shows that higher participation produces the same results highlighted earlier. For comparability of the results, the calibration is kept at the frequency[9] and the values employed by the authors.[10] In this case, the standard deviation of dividends drops as the fraction of capitalists rises. Higher participation implies a less broad application of the wage contract since shareholders supply labor at the spot (perfectly competitive) wage. Wages become less rigid which in turn stabilizes dividends. This mechanism further enhances the *risk-exposure channel* through which higher participation reduces the equity premium while raising the risk-free rate.

[9] In particular, the model is calibrated at the quarterly frequency. Macroeconomic variables are detrended with the Hodrick-Prescott filter, while asset-pricing moments are reported in annualized terms.

[10] The only difference lies in the volatility of the redistribution shocks, which is lowered from 3.1675% to 2.2%. This generates essentially the same macroeconomic moments (compare with Table 4 in the article) but asset-pricing results that are more directly comparable to my baseline model. The effect of higher participation does not depend on the size of the standard deviation of the shocks.

D Model extensions and robustness

This Appendix reports all the details regarding the model extensions and robustness exercises discussed in Section 5 in the main text.

D.1 Bondholders and stockholders

As a first robustness check, I allow workers (also referred to as "bondholders") to trade the risk-free asset with capitalists (also referred to as "stockholders"). In this sense, the setup is very similar to Guvenen (2009) and, more recently, Cantore and Freund (2021).

Capitalists' and firms' blocks are unchanged. In contrast, workers' utility function now must be specified and their budget constraint must account for bond trade. I assume that workers have the same instantaneous utility function as capitalists:

$$u_t^w = \frac{(C_t^w - \chi_w H_t)^{1-\sigma} - 1}{1-\sigma}, \tag{D.1}$$

where the weight of the habit stock in the utility function χ_w is allowed to differ from capitalists' (χ), and the habit stock follows the law of motion (3). Regarding the budget constraint, now Equation (7) becomes:

$$C_t^w + P_t^b Q_{w,t+1}^b + P_t^b \left[\frac{\psi_w^b}{2} (Q_{w,t+1}^b - Q_w^b)^2 \right] = Q_{w,t}^b + W_t N_t^w + f_t. \tag{D.2}$$

Workers participate in the bond market subject to convex bond portfolio adjustment costs as in Schmitt-Grohé and Uribe (2003). Workers are penalized when their holdings deviate from some benchmark level—specifically, their steady-state bondholdings. The strength of this financial friction is governed by the parameter ψ_w^b, and adjustment cost takes a simple quadratic form. Notice that portfolio adjustment costs are rebated to the household in lump-sum through the term f_t. As a consequence, the financial friction does not affect the *level* of consumption, but only workers' Euler equation for bonds, which reads:

$$P_t^b = \frac{E_t M_{t,t+1}^w}{1 + \psi_w^b (Q_{w,t+1}^b - Q_w^b)}, \tag{D.3}$$

where $M_{t,t+1}^w$ is the representative workers' stochastic discount factor. Finally, the bond market equilibrium condition becomes:

$$0 = \gamma Q_{w,t+1}^b + (1-\gamma) Q_{t+1}^b. \tag{D.4}$$

Calibration The model extension involves four new parameters relative to the baseline: the weight of the habit stock in the workers' utility function, χ_w; the steady-state bondholdings for stockholders and bondholders, Q^b and Q^b_w; and the portfolio adjustment cost parameter, ψ^b_w.

The calibration strategy is as follows. First, I set $\chi_w = 0.75$. As workers consume less than average, the parameter χ_w is bounded above (in particular, at 0.85 in steady state) to ensure that the utility function is well-defined. The calibrated value is therefore sufficiently high so that workers are substantially more risk-averse than capitalists—with an average effective risk aversion of 27 compared to capitalists' 9 for the pre-Great Moderation period—while satisfying the condition that consumption does not fall below habit. Moreover, workers feature not only a higher effective risk aversion but also a lower EIS compared to stockholders (around 0.04 vs 0.12 in steady state), in line with Vissing-Jørgensen (2002) and Guvenen (2006).[11] Second, I assume for simplicity that both agents' bondholdings in the non-stochastic steady state are equal to zero. However, stockholders' simulated average bondholdings are negative, implying positive bondholdings for workers. In other words, in the presence of aggregate risk workers are net savers and capitalists are net borrowers, as in Guvenen (2009).

Finally, for the calibration of the portfolio adjustment cost parameter, not much guidance is available in the existing literature. In this sense, Cantore and Freund (2021) show that this parameter helps match the average contemporaneous and intertemporal marginal propensities to consume (MPCs) out of exogenous income variations in two-agent models as the one considered here. The average, partial equilibrium (contemporaneous) MPC can be computed as:

$$MPC_0 = \gamma MPC_{w,0} + (1-\gamma)(1-\beta), \tag{D.5}$$

i.e., as the weighted average of workers' and unconstrained households' MPCs. Assuming log-utility and up to a first-order approximation:

$$MPC_{w,0} = 1 - \mu_2^{-1}, \tag{D.6}$$

where $\mu_2 \equiv 1 + \beta^{-1} + \psi^b_w - \mu_1$ and $\mu_1 \equiv \frac{1}{2}\left(1 + \beta^{-1} + \psi^b_w + \sqrt{(1 + \beta^{-1} + \psi^b_w)^2 - \beta^{-1}}\right)$ (see Proposition 1 in Cantore and Freund, 2021). I set $\psi^b_w = 1.11$, which would yield, in the simple model with log-utility (for which the approximation holds), $MPC_0 = 0.55$ consistent with the evidence from Fagereng et al. (2021). Finally, the leverage factor χ_l

[11] I verified that results go through for other values of χ_w, as long as workers remain more risk averse than capitalists.

is slightly adjusted to 1.5735, to keep $\text{std}(R^s) = 17.52$ for the pre-GM period.[12]

Results The third column of Table D.1 displays the results of the counterfactual exercise performed in Section 4.4 for the bondholders vs stockholders setup. The reported variations are similar to the baseline (second column), although some differences arise. First, the model generates too volatile dividends for the pre-GM period (with a standard deviation of 8.05 instead of the empirical 6.69). Second, as in Guvenen (2009), I find that workers' consumption smoothing desire comes at the expense of a more volatile stockholders' consumption process. Indeed, $\text{std}(\Delta c^c)/\text{std}(\Delta c^w) = 2$ here instead of 1.63. Third, this model keeps the volatility of stock returns unchanged, while limiting the counterfactual increase in the risk-free rate standard deviation. Finally, the risk-free rate drop and equity premium rise are somewhat smaller than the baseline. Consistent with the key model mechanisms, the quantity of risk and consumption inequality measure decline (from 49 to 25 and from 1.58 to 1.21, respectively) while the capitalist's average effective risk aversion increases from about 9 to 20. Taken together, these results suggest that the *surplus-consumption channel* of participation remains quantitatively relevant even in the presence of bond trade between workers and stockholders.

D.2 Endogenous participation

In this robustness exercise, I extend the baseline model to endogenize the participation decision. Following Morelli (2021), I employ a dynamic discrete-choice model setup that keeps the model tractable and comparable with the baseline analysis. The economy is populated by two groups of households, workers, and capitalists, each composed of a large number of households. Within each group, there is perfect insurance so that all households consume (and save, in the case of capitalists) the same amounts. Workers represent a fraction γ_t of the unit mass population.

Each period, in addition to the aggregate shocks, each household i in the workers' group is subject to a preference shock $\nu_{iw,t} \sim N(0, \sigma^2_{\nu_w})$. Given these shocks, the worker household i decides whether to remain in the workers' group or to switch to the capitalists' group, i.e., whether to enter financial markets. In case of switching, the household has to pay a fixed entry cost, F_1. In other words, the worker household i solves $\max\{V^w_t - \nu_{iw,t}; V^c_t - F_1\}$, where V^w_t and V^c_t indicate the value function as a worker and as a capitalist, respectively. Therefore, household i remains in the work-

[12]Recall that the model is calibrated at the annual frequency. I also verified that the simulated variations from the pre-GM to the GM period are quantitatively very similar even for $\psi^b_w = 0.07$, which is the calibrated value in Cantore and Freund (2021).

Table D.1: Relative variation from pre-GM to post-2000 period - Extensions

	Baseline	Bondholders/ Stockholders	Endogenous Participation	Endogenous Labor	Indirect Stockholders
			Volatility		
std(Δy)	-12% [2.65→2.33]	-12% [2.65→2.33]	-12% [2.66→2.34]	-13% [2.65→2.31]	-12% [2.65→2.32]
std(Δc)	-34% [1.69→1.13]	-28% [1.58→1.14]	-33% [1.65→1.11]	-27% [1.94→1.41]	-30% [1.69→1.18]
std(Δi)	-3% [6.56→6.37]	-6% [6.45→6.08]	-5% [6.82→6.49]	-3% [6.17→5.98]	-5% [6.56→6.21]
std(Δd)	-7% [6.85→6.39]	-7% [8.05→7.48]	-2% [6.24→6.12]	-9% [7.02→6.36]	-5% [6.85→6.50]
std(R^s)	1% [17.52→17.72]	-2% [17.53→17.17]	-1% [18.23→18.04]	2% [17.53→17.80]	1% [17.52→17.32]
std(R^b)	17% [2.17→2.53]	7% [2.46→2.63]	15% [2.24→2.58]	19% [1.99→2.38]	6% [2.17→2.29]
			Mean		
$E(R^b)$	-31% [1.69→1.16]	-27% [1.77→1.30]	-28% [2.18→1.58]	-68% [1.67→0.53]	-15% [1.69→1.44]
$E(R^{e,s} - R^b)$	9% [4.27→4.66]	6% [4.17→4.40]	11% [3.91→4.36]	16% [4.51→5.24]	3% [4.27→4.49]

Notes: Simulated variations from the 1955-1983 (pre-GM) to the 2001-2017 period from several extensions to the baseline model.

ers' group if and only if $\nu_{iw,t} \leq V_t^w - (V_t^c - F_1) \equiv \nu_{w,t}^*$, meaning that every period a fraction $\kappa_{w,t} = \Phi(\nu_{w,t}^*)$ of worker households remains in the workers' group, where $\Phi(\cdot)$ denotes the CDF of the Normal distribution.

A symmetric argument is applied to capitalist households. Each period, each household i in the capitalists' group is subject to a preference shock $\nu_{ic,t} \sim N(0, \sigma_{\nu_c}^2)$. In case of switching, the household has to pay a fixed exit cost, F_2. Thus, the capitalist household i solves $\max\{V_t^c - \nu_{ic,t}; V_t^w - F_2\}$. Household i remains in the capitalists' group if and only if $\nu_{ic,t} \leq V_t^c - (V_t^w - F_2) \equiv \nu_{c,t}^*$, meaning that every period a fraction $\kappa_{c,t} = \Phi(\nu_{c,t}^*)$ of capitalist households does not exit financial markets.

Combining the optimal switching decisions, it is possible to obtain the endogenous law of motion for the fraction of workers γ_t (hence, for the participation rate $1 - \gamma_t$):

$$\gamma_t = \kappa_{w,t}\gamma_{t-1} + (1 - \kappa_{c,t})(1 - \gamma_{t-1}), \tag{D.7}$$

i.e., the fraction of workers today is the sum of yesterday's workers who do not enter and yesterday's capitalists who exit financial markets.

In this setup, only a minimal set of adjustments needs to be implemented on the baseline model. First, I assume that switchers' resources are not brought along to the new family, but remain in the group of households they leave and are equally distributed among the new number of households. On the one hand, this means that workers' budget constraint (7) remains unaltered. On the other hand, the representative capitalist's budget constraint becomes, in equilibrium:

$$C_t^c = W_t + \frac{1-\gamma_{t-1}}{1-\gamma_t}(D_t + P_t^s)Q_t^s - P_t^s Q_{t+1}^s, \tag{D.8}$$

given the stock market equilibrium $1 = (1-\gamma_t)Q_{t+1}^s$. In other words, the proceedings from yesterday's stock-ownership $(D_t + P_t^s)Q_t^s$, deriving from yesterday's fraction of capitalists $1-\gamma_{t-1}$, are equally distributed among the new number of capitalist households, who represent a fraction $1-\gamma_t$ of the population. Therefore, substituting the stock market equilibrium condition, the budget constraint (D.8) simplifies to:

$$C_t^c = W_t + \frac{1}{1-\gamma_t} D_t. \tag{D.9}$$

Second, given that now the participation decision is endogenous, workers' utility needs to be specified. I again impose the instantaneous utility function in Equation (D.1). Third, capitalists' stochastic discount factor is adapted to account for the probability of exiting financial markets. Therefore, in the model with endogenous switching, the stochastic discount factor used to price assets and the firm's cash flows is given by:

$$M_{t.t+1} = \beta E_t\left[\kappa_{c,t+1}\Lambda_{t+1}/\Lambda_t\right] + \beta E_t\left[(1-\kappa_{c,t+1})\Lambda_{t+1}^w/\Lambda_t^w\right], \tag{D.10}$$

where Λ_t^w is the representative worker's marginal utility of consumption.

Finally, the households' value function, which is necessary to determine the optimal entry/exit choice, is computed as:

$$V_t^j = \left[(1-\beta)(C_t^j - \chi_j H_t)^{(1-\sigma)} + \beta E_t (V_{t+1}^j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \quad j \in \{w, c\}, \tag{D.11}$$

which represents an ordinally equivalent transformation of the utility function.[13]

Calibration The model extension involves five new parameters relative to the baseline: the volatility of the preference shocks, σ_{ν_w} and σ_{ν_c}; the fixed entry and exit costs, F_1 and F_2; and the weight of the habit stock in the workers' utility function, χ_w. For simplicity, I assume that the preference shocks hitting capitalist and worker households have the same volatility, $\sigma_{\nu_w} = \sigma_{\nu_c}$. The calibration of this parameter, and of the

[13]To see this, notice that Equation (D.11) can be rewritten as $(V_t^j)^{1-\sigma} = (1-\beta)(C_t^j - \chi_j H_t)^{(1-\sigma)} + \beta E_t (V_{t+1}^j)^{1-\sigma}$. Setting $U \equiv \frac{1}{1-\sigma}V^{1-\sigma} - \frac{1}{1-\sigma}$, one obtains $V^{1-\sigma} = (1-\sigma)U_{t+1}$. Substituting into Equation (D.11), it is easy to verify that $U_t^j = (1-\beta)\left[\frac{(C_t^j - \chi_j H_t)^{1-\sigma} - 1}{1-\sigma}\right] + \beta E_t[U_{t+1}^j]$.

switching fixed costs F_1 and F_2, targets an average participation rate of 20% (40%) for the pre-Great Moderation (post-2000s) period, and a standard deviation of the participation rate of 2.80%, as measured for the yearly series imputed from the CEX over the period 1997-2017.[14] For comparability with the baseline model, all other parameters are left unchanged.

The calibration strategy proceeds as follows. First, I set $\chi_w = 0.75$ as in Appendix D.1, which is needed to compute workers' value function, V_t^w. Otherwise, this parameter has a limited impact on simulated moments, as workers' marginal utility affects aggregate quantities and asset prices only through the stochastic discount factor of the representative capitalist—in particular, through the probability of exiting financial markets $(1 - \kappa_{c,t+1})$.

Second, instead of looking for all the possible combinations of F_1 and F_2 that deliver the targeted average participation rate, I look for the *implicit* F_1 and F_2 given the targeted participation rate. To do so, I exploit the steady state relationship for the workers' population share deriving from the law of motion (D.7):

$$\gamma = \frac{1 - \kappa_c}{2 - \kappa_c - \kappa_w}. \tag{D.12}$$

Specifically, for given targeted γ and probability of remaining capitalist κ_c, which is set to 0.98 as in Bilbiie et al. (2022), the above expression is solved for κ_w. Thus, the conditions $\kappa_w = \Phi(\nu_w^*)$ and $\kappa_c = \Phi(\nu_c^*)$ can be exploited to recover the implicit F_1 and F_2. Having obtained the targeted average participation rate, the parameter $\sigma_{\nu_w} = \sigma_{\nu_c}$ can be tuned to match its standard deviation. Interestingly, and in line with previous literature (Guiso and Sodini, 2013), I find that the entry cost F_1 needs to decline substantially (by 47%) to increase the participation rate from 20% to 40%.

Results The fourth column of Table D.1 reports the results for the model extension with endogenous participation. Model implications are essentially identical to the baseline case. Even in this version of the model, the quantity of risk and consumption inequality measure decline from the first to the second sub-sample (from 47 to 25 and from 1.56 to 1.21, respectively), while the capitalist's average effective risk aversion increases from 9 to 19. Therefore, the key model mechanism and quantitative implications remain intact even when relaxing the assumption of exogenous participation decisions.

[14]Since no participation data is available for the pre-Great Moderation period, I keep the same target value for the volatility of the participation rate over both simulated sub-samples.

D.3 Endogenous labor supply

I now relax the assumption that both workers and capitalists supply labor inelastically. To this end, I assume that both agents feature GHH preferences (Greenwood et al., 1988) while retaining habit formation over the consumption good. As noticed by Guvenen (2009), GHH preferences provide flexibility in that the Frisch elasticity depends on a distinct parameter that does not impose unintended restrictions on the EIS, as in the case of the commonly used Cobb-Douglas preferences, for instance. Moreover, GHH preferences help generate procyclical hours worked (as in the data) by eliminating wealth effects on labor supply, which limits the negative impact of endogenous labor choice on the model's ability to reproduce asset-pricing facts in a production economy.

The instantaneous utility function reads:

$$u_t^i = \frac{\left[(C_t^i - \chi_i H_t) - \frac{\psi^i}{1+\phi}(N_t^i)^{1+\phi}\right]^{1-\sigma}}{1-\sigma}, \quad i \in \{w, c\}, \tag{D.13}$$

where N_t^i denotes the time devoted to labor by agent i, ϕ is the inverse Frisch labor supply elasticity, and ψ^i weighs the disutility of work in the utility function. For $\psi^i = 0$, agents do not value leisure and the model coincides with the baseline setup.

Given the non-separability between consumption and leisure, the marginal utility of consumption now becomes:

$$\lambda_t^i = \left[(C_t^i - \chi_i H_t) - \frac{\psi^i}{1+\phi}(N_t^i)^{1+\phi}\right]^{-\sigma}, \quad i \in \{w, c\}, \tag{D.14}$$

while the intratemporal optimality condition that governs the labor supply is:

$$W_t = \psi^i (N_t^i)^{\phi}, \quad i \in \{w, c\}, \tag{D.15}$$

which clarifies how, by eliminating wealth effects on labor supply choice, GHH preferences imply that: *i*) labor supply dynamics are identical between workers and capitalists since hours worked are simply a function of the real wage; *ii*) aggregate labor hours, given by the labor market clearing condition (27), are procyclical.

Furthermore, the average capitalist's effective risk aversion becomes (evaluating at the steady state):

$$\text{RRA}^c = \frac{\sigma}{\left(1 - \chi \frac{C}{C^c}\right) - \frac{\psi^c}{1+\phi}\frac{(N^c)^{1+\phi}}{C^c}}, \tag{D.16}$$

which reduces to the baseline expression (10) for $\psi^c = 0$, i.e., if capitalists do not value leisure.

Calibration The introduction of time-varying labor supply imposes changes on several model parameters to match the same moments as in the baseline analysis. First, the discount factor β is slightly lowered to 0.95 to match an average price-dividend ratio of 26. Second, the volatility of the TFP shock, σ_a, is set to 1.3% instead of 1.7%. Indeed, procyclical labor supply by both capitalists and workers reinforces the positive comovement, conditional on TFP shocks, between the two agents' consumption, which in turn raises the volatility of aggregate consumption. Thus, a lower TFP shock standard deviation is required to get closer to the empirical value for this variable. Third, the capital adjustment cost parameter χ_k is raised to 0.7 to match investment volatility. As this parameter strongly affects the stock returns' second moment, the leverage factor χ needs to be raised to 1.927 to obtain $\text{std}(R^s) = 17.52$, as in the data. Finally, regarding households' preferences parameters, I impose $\chi_c = \chi_w = 0.65$, which achieves an average capitalists' effective risk-aversion equal to 9 as in the baseline. In this regard, two remarks are in order. First, the workers' utility function parameters do not affect equilibrium outcomes, since labor supply is independent of wealth effects and assets are priced only by capitalists. Second, according to Equation (D.16), the presence of labor disutility raises capitalists' effective risk-aversion for any value of χ_c. Thus, a lower χ_c is needed to keep the value of RRA as in the baseline model.

Turning to the new parameters governing the dynamics of labor supply, I set $\phi = 1.3$, implying a Frisch elasticity of 0.77, which lies well within the ballpark of standard values considered in the macroeconomics literature (see Guvenen, 2009, for a discussion). With this parameter value, the model exactly matches the empirical standard deviation (0.95%) of the growth rate in aggregate per-capita hours worked for the pre-GM period.[15] Moreover, the parameter ψ^i is set so that $N^c = N^w = 0.33$ in steady state, as customary in the literature.

Results The fifth column of Table D.1 shows how the simulation results are qualitatively and quantitatively in line with the baseline economy featuring inelastic labor supply. From a macroeconomic perspective, no major differences can be noticed.[16] From an asset-pricing perspective, however, the variations in the average risk-free rate and equity premium are remarkably larger. This finding can be explained by noticing that, as highlighted in Equation (D.16), the *surplus-consumption channel* of participa-

[15]In the data, this moment is computed using the series "Average Annual Hours Worked by Persons Engaged for United States" (AVHWPEUSA065NRUG) from the FRED website.

[16]In addition, I find that the volatility of hours worked declines to 0.77% in the second regime, which is consistent with the empirical 0.70% for the post-2000s period.

tion is amplified in the presence of a labor disutility term affecting the endogenous capitalists' risk aversion. Indeed, in this version of the model, the capitalist's average effective risk aversion increases to 24 for a 40% participation rate, which is larger than the 19 found in the baseline and previous model extensions.[17] Introducing an elastic labor supply strengthens, if anything, the quantitative relevance of the novel channel proposed in the main analysis.

D.4 Indirect stockholders

Finally, I extend the model to capture the fact that the increase in the stock market participation rate was mostly driven by passive investors who hold stocks indirectly, i.e., exclusively through illiquid retirement accounts (Duca, 2001; Guiso and Sodini, 2013). As shown in the left panel of Figure D.1, the upward trend in the total participation (black line) hides different patterns in direct (blue line) and indirect (red line) participation rates. While direct stockownership peaked at the beginning of the 2000s, to then go back to the 1989 value, the indirect participation rate steadily increased over the sample from 10% to 30%.[18] Moreover, as shown in the right panel, since the early 2000s around 40% (30%) of total (direct stockholders') equity wealth was held in retirement accounts (blue and red lines, respectively), hinting to a gradual shift from direct to indirect stockownership not only along the extensive, but also along the intensive margin. The baseline model does not account for these heterogeneous trends in direct and indirect stockownership, and implicitly assumes that the totality of the participation increase occurred in direct forms.

To account for this evidence, I extend the baseline model to include a third type of agent, referred to as "indirect capitalist" (or "indirect stockholder"). Relative to the baseline model, the (direct) capitalists', workers', and firms' blocks remain unchanged. As before, workers represent a fraction γ of the total population. However, now a fraction $\phi(1-\gamma)$ is composed of direct capitalists, while indirect capitalists make up the residual fraction $(1-\phi)(1-\gamma)$. Therefore, the model collapses to the baseline case for $\phi = 1$.

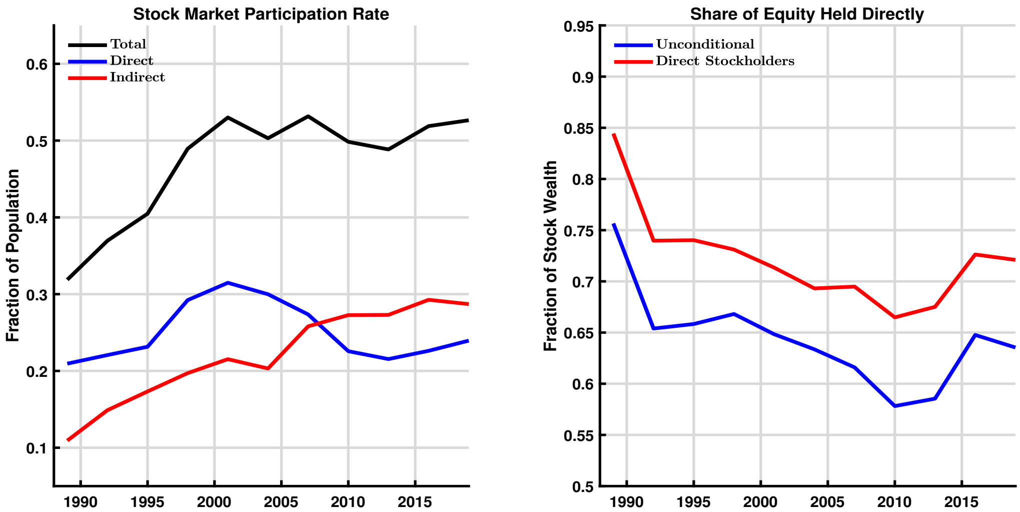
Indirect stockholders maximize:

$$\max_{C_t^{ic}, Q_{ic,t+1}^s, Q_{ic,t+1}^b} E_0 \sum_{t=0}^{\infty} \beta^t \frac{(C_t^{ic} - \chi_{ic} H_t)^{1-\sigma} - 1}{1-\sigma}, \tag{D.17}$$

[17] In contrast, the quantity of risk and relative consumption measures decline by similar magnitudes, i.e., from 54 to 28 and from 1.60 to 1.20, respectively.

[18] The definition of direct and indirect holdings follows Gomes et al. (2009).

Figure D.1: Direct and indirect stockownership



Notes: Trends in stock market participation (left panel) and share of equity held directly in household portfolios (right panel). The definition of direct and indirect holdings follows Gomes et al. (2009).

subject to the constraint

$$C_t^{ic} + P_t^b Q_{ic,t+1}^b + P_t^b \left[\frac{\psi_{ic}^b}{2} (Q_{ic,t+1}^b - Q_{ic}^b)^2 \right] + P_t^s Q_{ic,t+1}^s + P_t^s \left[\frac{\psi_{ic}^s}{2} (Q_{ic,t+1}^s - Q_{ic}^s)^2 \right]$$
$$= Q_{ic,t}^b + (P_t^s + D_t) Q_{ic,t}^s + W_t N_t^{ic} + f_t. \tag{D.18}$$

In words, indirect stockholders have full access to financial markets but face portfolio adjustment costs for both stocks and bonds. In the same spirit as Appendix D.1, indirect capitalists are penalized when their stock and bondholdings deviate from some benchmark level—specifically, their steady-state holdings. Again, the strength of this financial friction is governed by the parameters ψ_{ic}^b and ψ_{ic}^s, for bonds and stocks respectively. Portfolio adjustment costs are rebated to the household in lump-sum through the term f_t. As a consequence, the financial friction only affects indirect capitalists' Euler equation for bonds and stocks, which read, respectively:

$$P_t^b = \frac{E_t M_{t,t+1}^{ic}}{1 + \psi_{ic}^b (Q_{ic,t+1}^b - Q_{ic}^b)}, \tag{D.19}$$

$$P_t^s = \frac{E_t M_{t,t+1}^{ic} (P_{t+1}^s + D_{t+1})}{1 + \psi_{ic}^s (Q_{ic,t+1}^s - Q_{ic}^s)}, \tag{D.20}$$

where $M_{t,t+1}^{ic}$ denotes the stochastic discount factor of the representative indirect capitalist. Given the portfolio adjustment costs for indirect holders, direct capitalists remain the marginal investors in both the bond and the stock market. Moreover, to capture the idea that indirect holders represent passive investors, I assume that the firm uses the stochastic discount factor of *direct* capitalists to discount the flow of dividends, as in the baseline model.

Finally, the stock and bond market equilibrium conditions become:

$$(1-\gamma)[\phi Q^s_{t+1} + (1-\phi)Q^s_{ic,t+1}] = 1, \tag{D.21}$$
$$(1-\gamma)[\phi Q^b_{t+1} + (1-\phi)Q^b_{ic,t+1}] = 0, \tag{D.22}$$

while aggregate consumption is defined as:

$$C_t = \gamma C^w_t + (1-\gamma)[\phi C^c_t + (1-\phi)C^{ic}_t]. \tag{D.23}$$

Calibration This version of the model adds the parameters χ_{ic}, ψ^s_{ic} and ψ^b_{ic}. In addition, it requires pinning down the steady-state bond and stockholdings of both direct and indirect capitalists, and their respective population weights (governed by the parameter ϕ). Regarding the weight of habit in the utility function, I assume $\chi_{ic} = 1$, as for direct capitalists.[19] Regarding the portfolio adjustment cost parameters, I assume $\psi^s_{ic} = \psi^b_{ic} \to \infty$. This assumption, which entails that indirect stockholders never deviate from their steady-state financial holdings, has two key advantages: *i*) it captures, in a stylized way, the illiquidity feature of retirement accounts and the idea that indirect holders are long-term investors; *ii*) it allows to abstract from potential trade in stocks and bonds between the two types of investors, a mechanism that was analyzed in isolation in Appendix D.1.

Finally, I calibrate the parameters $\phi = \{1, 0.4\}$, $Q^b_{ic} = \{0, 0\}$ and $Q^s_{ic} = \left\{0, \frac{0.4}{(1-\gamma)(1-\phi)}\right\}$ for the pre-GM and post-2000 period, respectively. Given these parameters, from the stock (bond) market equilibrium condition (D.21) (condition (D.22)) one can retrieve direct capitalists' steady-state stock (bond) holdings as $Q^s = \frac{\frac{1}{1-\gamma} - (1-\phi)Q^s_{ic}}{\phi}$ ($Q^b = \{0, 0\}$).[20] First, this calibration implies that in the pre-GM 100% of the capitalist population is composed of direct capitalists, who hold the entire stock market. This is in line with the evidence reported in Figure D.1, where in 1989 only about 10% of U.S. households held stocks through retirement accounts, suggesting that this type of investor was likely not common before the 1980s.[21] As a result, the pre-GM period economy is

[19] Again, as direct and indirect capitalists will be calibrated to hold different shares of the stock market, heterogeneity in consumption will endogenously generate heterogeneity in the EIS and effective risk aversion.

[20] Recall that bonds are in zero net supply.

[21] This is also consistent with the fact that defined contribution plans grew in popularity since the 1980s (Duca, 2001).

identical to the baseline.

Second, the calibration for the post-2000 period implies that the entry of indirect stockholders entirely drives the increase in the (total) participation rate to 50%. Indeed, the calibrated $\phi = 0.4$ translates into a fraction of direct stockholders remaining constant at 20%, while the share of indirect stockholders increases from 0 to 30%. Both values are approximations for the end of the sample reported in the left panel of Figure D.1. Moreover, $Q^s_{ic} = \frac{0.4}{(1-\gamma)(1-\phi)}$ means that indirect investors hold 40% of the market, consistent with the share of equity held directly ($\approx 60\%$) reported in the right panel of the figure (blue line). Thus, this model extension reproduces the idea that new stock market participants, being relatively poorer, hold a relatively smaller fraction of the market (Lettau et al., 2019) and do not likely play a relevant role in pricing assets.

Results The last column of Table D.1 reports the results. The macroeconomic implications of higher participation remain quantitatively very similar to the baseline model, whereas some differences arise on the asset-pricing side. The volatility of stock returns (risk-free rate) remains unaffected (increases slightly less), while the variations in average asset returns are somewhat more contained. These findings can be explained by noticing that the increase in the risk-aversion of the average *direct* stockholder, who is the marginal investor, is less pronounced (from 9 to 15) because stock market wealth is not equally distributed among all stockholders (recall direct stockholders are calibrated to hold three-fifths of the stock market). Therefore, direct stockholders' relative consumption declines less than in the baseline. Despite the dampening, the *surplus-consumption channel* effects are still remarkable and drive asset returns in the same direction as in the data.

E Inspecting the mechanism analytically: Proofs

Proof for Equations (40) and (41) For simplicity, assume that capitalists only consume dividend income:

$$C^c_t = \frac{D_t}{1-\gamma}$$

which in logs, and ignoring constants, becomes

$$c^c_t = d_t. \tag{E.1}$$

Now, consider the pricing equation

$$1 = E_t\left\{M_{t,t+1}R^s_{t+1}\right\},$$

that in case of simple CRRA preferences becomes

$$1 = E_t \left\{ \beta \left(\frac{C^c_{t+1}}{C^c_t} \right)^{-\sigma} R^s_{t+1} \right\},$$

which note depends on capitalists', not aggregate, consumption growth. Using joint log-normality and homoskedasticity, with the latter implying constant variance and covariance, I can rewrite

$$0 = \log\left[E_t\left\{\cdot\right\}\right] = E_t\left\{\log\beta - \sigma \times \left(\Delta c^c_{t+1}\right) + r^s_{t+1}\right\}.$$

Thus, in the case of CRRA preferences, the Euler equation is log-linearized as:

$$\sigma \times E_t(\Delta c^c_{t+1}) = E_t(r^s_{t+1}), \tag{E.2}$$

where σ is the parameter of relative risk aversion.

Substituting (E.1) and (E.2) into (39), I obtain

$$r^s_{t+1} - E_t r^s_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta c^c_{t+1+j} - \sigma(E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \Delta c^c_{t+1+j}, \tag{E.3}$$

where notice the first summation starts from $j = 0$ while the second one from $j = 1$. Hence

$$r^s_{t+1} - E_t r^s_{t+1} = \underbrace{(\Delta c^c_{t+1} - E_t \Delta c^c_{t+1})}_{\equiv R^{t,t+1}_{\Delta c^c}} + (1-\sigma) \underbrace{(E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \Delta c^c_{t+1+j}}_{\equiv R^{t+1,\infty}_{\Delta c^c}}, \tag{E.4}$$

where $R^{t,t+1}_{\Delta c^c}$ captures the revision in the capitalist's consumption growth rate between t and $t+1$ while $R^{t+1,\infty}_{\Delta c^c}$ captures the revisions between $t+1$ and the infinite future.[22] Equations (40) and (41) simply follow.

F Construction of consumption series from CEX

In this Appendix, I describe the dataset and steps to construct a quarterly time series of real aggregate per-capita consumption (representative agent) and real average consumption for households who own stocks (representative stockholder) and who do not own stocks (representative non-stockholder) over the period 1984-2017 from the

[22]The derivation of Equation (E.4) is standard, see Campbell (2003).

U.S. Consumer Expenditure Survey. Quarterly financial data—specifically, realized stock returns and the risk-free rate—employed in Section 7.3 are sourced from Amit Goyal's website (as discussed in Welch and Goyal, 2008).

F.1 Description of the household-level dataset

The CEX is a national survey collecting household-level data on detailed consumption expenditures together with income, financial and demographic information on a sample that is designed to represent the non-institutionalized civilian population of the U.S. The survey is divided into two parts: Interview Survey and Diary Survey. The analysis developed here focuses on the Interview Survey. Data from CEX are available from the start of 1980 to the end of 2017. The survey is a rotating panel containing interviews of about 4,500 households per quarter before 1999, increasing to about 7,500 thereafter. About 20% of the sample is replaced each quarter. In each interview, households report detailed expenditures made in the previous three months. Households are interviewed every three months for a maximum of 5 interviews. The first interview is for practice and is not publicly available, while financial information is collected only in the last interview.

F.2 Sample choice, consumption definition, and stockholder status

Consumption definition

The analysis relies on data available for the whole sample 1980Q1-2018Q1. The consumption measure in the baseline analysis consists of nondurable goods and some services aggregated from the disaggregated expenditure categories reported in the monthly expenditure files (MTAB and MTBI files) of the CEX. Following Malloy et al. (2009), in the main analysis I exclude services categories with substantial durable components, such as housing expenses (except for household operations and utilities), medical care costs, and education costs. More specifically, the categories included are food, alcoholic beverages, household operations, utilities, apparel and services, gasoline and motor oil, public transportation, fees and admissions, reading, tobacco, and personal care products.

Stock-holding status from the CEX

Regarding the distinction between stockholders and non-stockholders, similarly to Malloy et al. (2009) I define the stock-holding status based on holdings at the beginning of period t, since the standard Euler equation links the consumption growth rate between t and $t+1$ with stock returns at time $t+1$. The FMLY/FMLI files report household-level financial information on holdings of ”stocks, bonds, mutual funds, and other such securities”. For the period 1980-2012, I use the same variables as the authors to define the stock-holding status. Recall that financial information is collected only in the fifth (last) interview. The first variable, SECESTX, reports whether the household holds (on the last day of the month preceding the interview) positive amounts of the aforementioned asset categories; the second variable, COMPSEC, asks whether the household holds the same amount, more or less of those assets compared to the same day of the previous year; the third variable, COMPSECX, quantifies, in dollar values, the change reported in the variable COMPSEC. Therefore, a household is defined as a stockholder at the beginning of period t if: 1) holds a positive amount of the assets at the time of the interview and reports having the same amount as last year; 2) reports having lower holdings compared to last year; 3) reports an increase compared to last year, but by a dollar amount lower than the current holdings.[23]

Since 2013 the variables SECESTX, COMPSEC, and COMPSECX have been removed from the survey. However, at the same time two new variables, STOCKYRX and STOCKYRB, were added. The latter variable reports the ”range which best reflects the total value of all directly-held stocks, bonds, and mutual funds one year ago today”, while the former indicates the ”median value of bracket range for STOCKYRB”. Therefore, these two variables can be directly used to determine stock-holding status at the beginning of period t. In particular, for the period 2013 through 2017, I define as stockholders those households who report: 1) a positive value for STOCKYRX; 2) a positive range for STOCKYRB when the response for STOCKYRX is flagged as nonvalid (type ”B” or ”C” responses).

Exclusions and replication of Malloy et al. (2009)

In a first step, I replicate the quarterly stockholders’ and non-stockholders’ consumption growth series constructed by Malloy et al. (2009) for the sample March 1982 to November 2004 and available on Tobias Moskowitz’s personal webpage.[24] This ensures that the consumption and stock-holding status definitions, together with the exclusions applied, are in line with previous literature.

I calculate average quarterly consumption growth rates for both groups of house-

[23]Similarly to the authors, I also define as stockholders those households who report an increase in their asset holdings but do not specify either the current amount or the dollar difference from last year. Indeed, these few households are likely to have held these assets the previous year.

[24]Available at: https://faculty.som.yale.edu/tobymoskowitz/research/data/

holds, namely stockholders and non-stockholders, as

$$\frac{1}{H_t^g}\sum_{h=1}^{H_t^g}(c_{t+1}^{h,g}-c_t^{h,g}),$$

where $c_t^{h,g}$ is quarterly log-real consumption of household h in group g (stockholders or non-stockholders) for quarter t and H_t^g is the number of households in group g at quarter t. Notice that this quantity is conceptually different from the growth rate in the average consumption of a certain group, which would be more in line with the concept of a representative agent. As discussed by the authors, the representative agent specification, which is the one employed in the analysis in the main text, assumes perfect risk-sharing within each group of households and thus ignores uninsurable idiosyncratic consumption shocks. On the contrary, the above definition sums the household-specific growth rates cross-sectionally, thus being able to capture comovements of asset returns with the within-group cross-household inequality. Nevertheless, the authors show that such comovements play a minor role in explaining risk-premia.

Quarterly consumption is constructed as the sum of real monthly expenditures reported in each of the four interviews, with nominal values being deflated by the monthly BLS Consumer Price Index for All Urban Consumers: Nondurables, Index 1982=100, Not Seasonally Adjusted (CUUR0000SAN from FRED). Hence, for each household at most four (three) quarterly consumption (consumption growth) observations are available. However, while the same household is interviewed every three months, interviews across households are made every month. Hence, household-level quarterly growth rates can be constructed at the monthly frequency. Changes in log-consumption are regressed over changes in log-family size and 12 monthly seasonal dummies at the household level and separately for each group of households. The residuals from this regression constitute the consumption growth measure.

I apply the same exclusions as the authors. To construct household-specific consumption growth rates it is necessary to match households across quarters. Only households who completed the survey, i.e., for which four interviews are available in the FMLY/FMLI files, are kept in the sample. Indeed, financial information is collected only in the fifth (i.e., the last) interview. Matching households across quarters is not possible around changes in sample design, which happened at the beginning of 1986, 1996, 2005, and 2015.[25] Such changes imply new household identification

[25]The year-specific documentation files report this type of information. These files can be found at: http://www.nber.org/ces

numbers. Therefore, all the households who did not finish their interviews before the ID changes are dropped. This boils down to treating the full sample 1980-2017 as five independent samples 1980-1986Q1, 1986-1996Q1, 1996-2005Q1, 2005-2015Q1, and 2015-2018Q1.[26]

Observations for which the consumption growth ratio C^h_{t+1}/C^h_t is less than 0.2 or more than 5 are dropped, as these could reflect reporting or coding errors. Negative or missing consumption observations are also dropped. Non-urban households, households residing in student housing, and households with incomplete income responses are excluded from the sample. Regarding the latter exclusion, for the period 1980-2013 the variable RESPSTAT is used, which indicates whether the household is a complete or incomplete income reporter. Since 2014 such a variable is no longer available. Hence the variable ERANKH, which measures the weighted cumulative percent expenditure outlay ranking of the household to the total population and is left blank for incomplete income reporters, is used. Moreover, all consumption observations for households interviewed in the years 1980 and 1981 are dropped as the food question was changed in 1982 leading to a drop in reported food expenditures.[27] Finally, all households who report a change in the household head's age different from 0 or 1 between any two interviews are excluded.

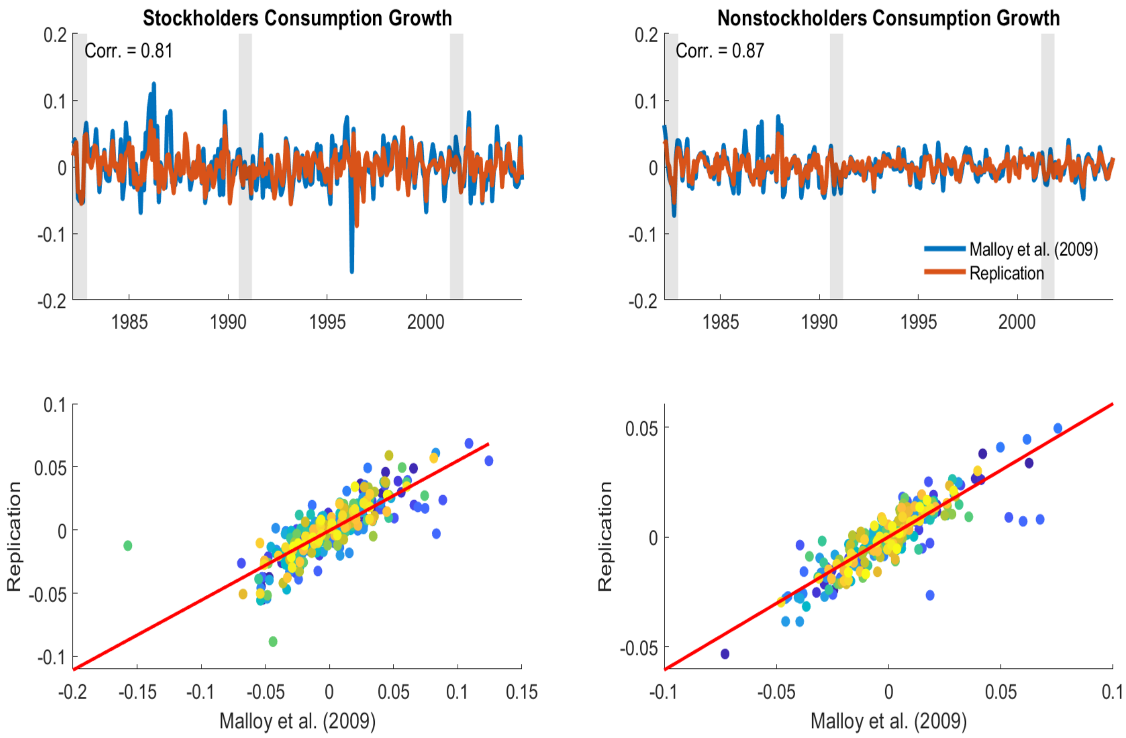
The final sample for the period March 1982 (the month for which the first quarterly consumption growth observation is available) to November 2004 consists of $196,813$ quarterly consumption growth observations across $75,346$ households, 21.91% of which are classified as stockholders (implying 78.09% as non-stockholders). These numbers are very close, respectively, to $206,067$, $76,568$, and 22.7 as reported by Malloy et al. (2009), who consider the same sample period. As shown in Figure F.1, the consumption growth rate series obtained for stockholders and non-stockholders track quite closely the authors', with correlation coefficients of 81% and 87%, respectively, over the whole sample.

The left panel of Figure F.2 shows the population-weighted stock market participation rate obtained from the CEX (in red) in comparison to the one obtained from the SCF (in blue). Clearly, the two measures of participation substantially differ. Indeed,

[26] It is important to note that each year of the survey includes five quarters, as the first quarter of the following year is necessary to calculate average expenditures for the year of interest. Regarding the sample design changes, and taking 1986 as an example, the data for 1986Q1 reported in the 1985 survey will be different from the 1986Q1 data for the 1986 survey, as the two surveys will employ different sample designs. Therefore, in my analysis, the sample 1980-1986Q1 includes 1986Q1 as reported in the 1985 survey, while the sample 1986-1996Q1 will include the 1986Q1 as reported in the 1986 survey. Same reasoning for all the other breaks in the sample design.

[27] As noted by the authors, the food question was changed back to the initial one in 1988 but there is no sensible way to solve this issue without losing a substantial number of observations.

Figure F.1: Replication of Malloy et al. (2009)



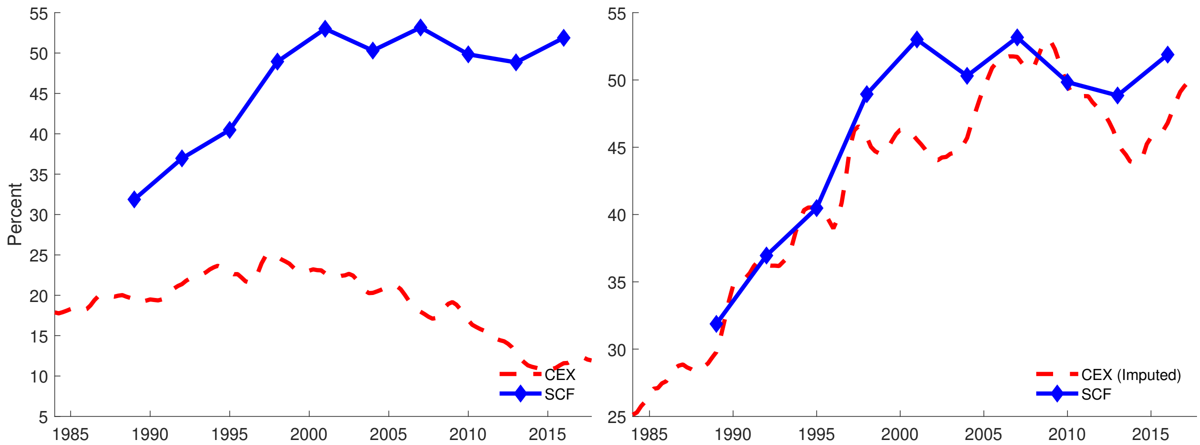
Notes: The figure reports the average quarterly growth rates for stockholders (top-left panel) and non-stockholders (top-right panel) at the monthly frequency for the period March 1982 to November 2004. The series obtained here (in orange) closely tracks the authors' (in blue), with correlation coefficients of 81 and 87 percent for stockholders and non-stockholders, respectively. The bottom panels depict the corresponding scatterplots.

while the SCF includes both direct and indirect stockownership, the latter cannot be retrieved from the CEX, as also noted by Malloy et al. (2009). Consistent with the authors, I find that the participation rate in the CEX is somewhat upward trending until the early 2000s, from around 18% to 25%. Nevertheless, the same rate substantially drops from those years until 2017, when only about 11% of the sample is classified as stockholders. This result could seems consistent with the evidence from the SCF if interpreted as a decrease in the rate of direct stock-ownership (recall Figure D.1 in Appendix D). Indeed, in 2013 the financial assets question was changed to consider only direct holdings. Also, Lettau et al. (2019) argue that the CEX provides inferior measures for financial holdings compared to other surveys, including the SCF.

Imputation procedure from the Survey of Consumer Finances

The replication of the consumption growth series constructed by Malloy et al. (2009) ensures that the exclusions applied on the dataset and the consumption and

Figure F.2: Stock-ownership rate - CEX vs SCF



Notes: Comparison between the stock market participation rate from the CEX (red lines) and from the SCF (blue lines). The left panel reports the raw participation rate from the CEX. The right panel reports the one estimated from the CEX by imputation.

stockholder status definitions are in line with previous literature. However, the participation rate estimated from the CEX variables does not include indirect stock-ownership, which significantly contributed to the upward trend observed in the SCF dataset. To refine the stock-holding status definition, I perform an imputation procedure similar to Attanasio et al. (2002) and Malloy et al. (2009).

Specifically, I employ a probit analysis from the SCF, since this dataset contains wealth information on both direct and indirect stockholdings (the variable "equity"), to predict the probability that a household holds stocks directly or indirectly in the CEX. I use the SCF from 1989 through 2016 (the last year available). I generate a dummy variable equal to 1 if such holdings are positive. Following Malloy et al. (2009), I then estimate a probit model where the dependent variable is the stock-holding dummy and the regressors are observable characteristics that are available also in the CEX: age, age squared, an indicator for the head of household having education of > 12 but < 16 years ("highschool"), and one for > 16 years ("college"), an indicator for race not being white/Caucasion, year dummies, log real total household income before taxes, log of real dollar amount in checking and saving accounts (put to 0 if the sum of checking and savings equals zero), an indicator for checking+savings accounts equal to zero, an indicator for positive interest+dividend income, and a constant. SCF weights are employed in the probit model to have population estimates. The estimated coefficients (with t-statistics in parentheses) from the probit regression are:

$$x'_{SCF}b = \underset{(-126.74)}{-8.68} + \underset{(20.24)}{0.0269}age \underset{(-22.88)}{-0.0003}age^2 + \underset{(24.35)}{0.319}highschool + \underset{(45.28)}{0.583}college$$
$$\underset{(-37.53)}{-0.323}nonwhite + \underset{(10.78)}{0.225}Y_{1992} + \underset{(19.25)}{0.393}Y_{1995} + \underset{(30.5)}{0.619}Y_{1998} + \underset{(35.43)}{0.713}Y_{2001}$$
$$+ \underset{(32.38)}{0.649}Y_{2004} + \underset{(37.35)}{0.758}Y_{2007} + \underset{(38.11)}{0.717}Y_{2010} + \underset{(36.64)}{0.698}Y_{2013} + \underset{(40.35)}{0.767}Y_{2016}$$
$$+ \underset{(90.06)}{0.587}log(income) + \underset{(34.83)}{0.082}log(chk + sav) + \underset{(12.17)}{0.264}(chk + sav = 0)$$
$$+ \underset{(63.80)}{0.599}log(int + div > 0).$$

The estimated coefficients are very similar to those estimated by Malloy et al. (2009). I then use these coefficients to predict the probability that a household in the CEX holds stocks as $\Phi(x'_{CEX}b)$, where Φ is the CDF of the standard normal distribution and x_{CEX} is the vector of the same regressors as in the SCF. When predicting the stock-holding probability for a household in the CEX, I use the dummy 1992 coefficient for the years 1990-1993, the dummy coefficient 1995 for the years 1994-1996, the dummy 1998 coefficient for the years 1997-1999, and so on. Similar to the SCF, dollar amounts for the variables in the regression in year t are multiplied by the absolute variation between year $t-1$ and year t in the (yearly average of the monthly) current-methods version of the CPI for all urban consumers (CPI-U-RS).[28]

In the baseline measure used in the main text, a household in the CEX is classified as a stockowner if the predicted probability is greater than 41%, which represents a mid-value in the trend observed in the SCF. Specifically, I use the probability predicted for the last month of observation for the households, since financial information is reported only in the last interview. Notice that this imputation procedure is applied only to those households who 1) are classified as non-stockholders according to the baseline CEX definition and 2) have non-missing responses to the checking and savings account questions. Therefore, households who are classified as stockholders based on the CEX definition remain classified as such with probability 1; and households who are non-stockholders in the CEX but have no valid responses to the checking and savings accounts receive probability 0 of being stockholders.

The result of the procedure is depicted in the right panel of Figure F.2, which compares the rate of direct and indirect stock-ownership from the SCF (in blue) and the one imputed in the CEX (in red) for the sample 1984-2017. The imputed series closely tracks the SCF one, especially in the first part of the sample, where the rates are essentially identical. However, since the end of the 1990s, the two series slightly diverge,

[28]Available at: https://www.bls.gov/cpi/research-series/home.htm

although from the late 2000s the two series follow very similar dynamics. The difference in the levels, rather than dynamics, of the two participation rates could be due to differences in the design of the two surveys. As discussed in Lettau et al. (2019), the SCF is designed to measure the wealthiest households and has high-quality financial information. On the other hand, the CEX has notorious limitations when measuring the top-end of the wealth distribution due to under-reporting, with very wealthy households being more likely to hold stocks. Moreover, Bee et al. (2012) document that such under-reporting increased since the 2000s, suggesting that the imputation based on income and financial observables can be expected to underestimate the true participation rate.

Nevertheless, the result of the imputation is quite satisfactory. For example, it is worth noting that the participation rate estimated for 1984 is about 25%, which justifies the 20% adopted in the calibration of the model for the pre-Great Moderation period.[29] Also, the maximum participation rate estimated in the CEX is around 53% as in the SCF, with both values occurring right before the financial crisis (2007 in the SCF, 2008 in the CEX). Moreover, both series capture a U-shaped pattern in the stock-ownership rate following the crisis and display a strong upward trend until the early 2000s, when they reach a new plateau. Overall, the imputed series captures the key properties of the stock-ownership rate in the U.S.

F.3 Quarterly consumption estimates

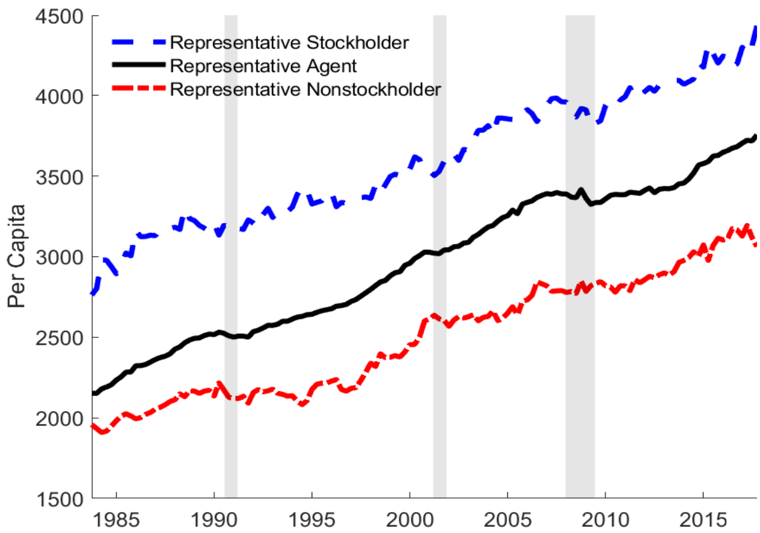
The building of the dataset aims to obtain a time series of real consumption for a representative stockholder and a representative non-stockholder over the sample 1984-2017, by employing the stock-holding status definition from the imputation procedure described above. To do so, I compute population (weighted) quarterly mean expenditure estimates aggregated from monthly expenditures across 120,934 households, following the formulae provided in the CEX documentation.[30,31] Nominal expenditure values are deflated by the CPI for all items, and divided by family size to obtain per-capita expenditures. Mean estimates are calculated for a representative agent, i.e., over the whole sample of households; for a representative stockholder, i.e., when considering only the group of households owning stocks; and for a represen-

[29]Recall that Poterba et al. (1995) estimate a participation rate of 20% for 1962. Hence, this rate was clearly quite stable until the mid-1980s.

[30]In particular, I focus on calendar months. Calendar periods are the periods (months, quarters, or years) when expenditures were actually made, while collection periods correspond to the periods when expenditures were reported in the interview. See the CEX documentation for a detailed discussion.

[31]In particular, I employ the example codes provided at the link: https://www.bls.gov/cex/pumd-getting-started-guide.htm#section5

Figure F.3: Quarterly consumption series



Notes: This figure plots the real consumption for the representative agent (black solid line), representative stockholder (blue dashed line), and representative non-stockholder (red dash-dotted line) as estimated from the CEX with stock-holding status imputed from the SCF.

tative non-stockholder, i.e., when considering only the group of households who do not own stocks, according to the imputed participation rate. Similar to Cloyne et al. (2019), the group-specific consumption expenditure series are first seasonally adjusted (by taking the residuals from a regression of the growth rates on quarterly dummies) and then adjusted every quarter by the ratio between the corresponding aggregate NIPA series and the estimated CEX aggregate.

Figure F.3 shows the results. The quarterly consumption series for the representative agent, representative stockholder, and representative non-stockholder are compared. As we can see, the representative stockholder (non-stockholder) consumes more (less) than the average. This is consistent with the evidence that only richer households tend to invest in the stock market. Moreover, stockholders' consumption process appears less smooth than non-stockholders'.

F.4 Cross-sectional evidence at the state-level

The CEX reports the variable "STATE", which identifies the state in which a particular household resides at the time of the interview. This variable, therefore, allows me to conduct the empirical validation also in the cross-section of the different U.S. states. As explained in the survey manual, the state identifier is not reported for all states for top-coding reasons. Moreover, the population weights in the survey are designed to be representative of the entire U.S. population and not of the state-level population. Therefore, in the cross-sectional evidence section, all estimates are unweighted. Finally, the STATE variable is available only since 1993.

The state-level sample is restricted to states with data available over 1993-2017 and at least 100 (household-level) observations on average over the sample. These restrictions are imposed to ensure that the state-level sample size is not too small. Since not all states are available in the survey, the final sample comprises 27 states. The consumption series and stockholding status dummy are constructed exactly as in the time-series analysis, with only the following differences: 1) to increase the sample size for the computation of the group averages, the participation and consumption series are aggregated at the annual frequency; 2) as a consequence, no seasonal adjustment is required in this case; 3) given the different units of observation, the state-level variables are not adjusted by the NIPA aggregate.

G Evidence from the CEX: Robustness

In this Appendix, I provide details on the different consumption and stockholding status definitions employed in the robustness exercises discussed in Section 7.

Extended consumption measure The consumption measure in the main text closely follows Malloy et al. (2009) and excludes goods and services with substantial durable components. However, a concern is that the omitted consumption categories could disproportionately affect stockholders' consumption and, as a consequence, bias the consumption ratio downward. To address this concern, I construct an extended measure that adds other vehicle expenses, other entertainment supplies, equipment, and services, house furnishings, tv and audio equipment, and health and education expenditures. Moreover, group-specific consumption expenditure series are now adjusted every quarter by the ratio between the sum of non-durables and services and durables aggregate (i.e., total consumption) NIPA series and the estimated CEX aggregate.

Rich stockholders In the main text, households are defined as stockholders if they report holding positive amounts of financial assets in the CEX or if the imputed probability of holding stocks directly or indirectly is above 0.41. A concern is that this classification also includes households with small amounts invested and are therefore unlikely to be relevantly exposed to stock market risk. In this respect, I repeat the empirical analysis by restricting the focus on stock holdings above $10000\$$ (as also done in Mankiw and Zeldes, 1991), thus re-estimating the coefficients of the probit regression accordingly. Furthermore, as the estimated participation rate is lower than the baseline (recall Figure 1), the probability threshold is lowered from 0.41 to 0.32, as a mid-point of the participation rate estimated in the SCF for a 10000$ threshold. Except for these adjustments, the sorting procedure remains identical to the main analysis, yielding an estimated participation rate very close to the SCF (reported in Figure G.3).

Probability-weighted participation and consumption Finally, to attenuate concerns about potential misclassification due to the baseline sorting procedure, I employ a probability-weighted measure of participation. According to this, every household contributes to the population weight and consumption of the representative stockholder based on the predicted probability, rather than being univocally classified as a stockholder (or non-stockholder). Specifically, I use the probability predicted for the last month each household is observed, since financial information is reported only in the last interview. Notice that this imputation procedure is applied only to those households who have non-missing responses to all the questions involved in the imputation procedure. Otherwise, the household receives a probability 0 of being a stockholder.

Table G.1: Long-run covariation with participation rate - Robustness

Variable	ρ_{LR}		β_{LR}	
	$\hat{\rho_{LR}}$	90% CI	$\hat{\beta_{LR}}$	90% CI
Panel A: Extended Consumption				
C_t^c/C_t	-0.92	$[-0.99, -0.30]$	-0.007	$[-0.01, -0.003]$
RRA_t	0.79	$[0.15, 0.97]$	0.28	$[0.06, 0.51]$
S_t	-0.92	$[-0.99, -0.35]$	-0.005	$[-0.007, -0.003]$
Panel B: Rich Stockholders				
C_t^c/C_t	-0.94	$[-0.99, -0.30]$	-0.01	$[-0.01, -0.006]$
RRA_t	0.92	$[0.25, 0.99]$	0.26	$[0.13, 0.37]$
S_t	-0.95	$[-0.99, -0.40]$	-0.006	$[-0.008, -0.004]$
Panel C: Probability Weighted				
C_t^c/C_t	-0.71	$[-0.97, -0.42]$	-0.006	$[-0.01, -0.000]$
RRA_t	0.67	$[0.13, 0.94]$	0.37	$[-0.01, 0.74]$
S_t	-0.83	$[-0.97, -0.15]$	-0.004	$[-0.007, -0.001]$

Notes: This table reports the long-run covariation measures proposed by Müller and Watson (2018) between the variables in the first column (for the baseline model) and the participation rate estimated from the CEX, for different robustness checks.

Table G.2: Calibration of the equity premium - Robustness

	$\text{std}(g_{t,t+1})$	$\text{Cov}(g_{t,t+1}, r^{ex}_{t+1})$	σ	σ_2
Panel A: Extended Consumption				
Baseline	15.99	40.29	20.20	3.24
No SC Channel	10.50	24.49	33.24	4.93
Panel B: Rich Stockholders				
Baseline	15.96	32.40	25.12	3.24
No SC Channel	12.12	19.46	41.83	4.27
Panel C: Probability Weighted				
Baseline	14.98	46.36	17.55	3.46
No SC Channel	7.43	19.01	42.80	6.97

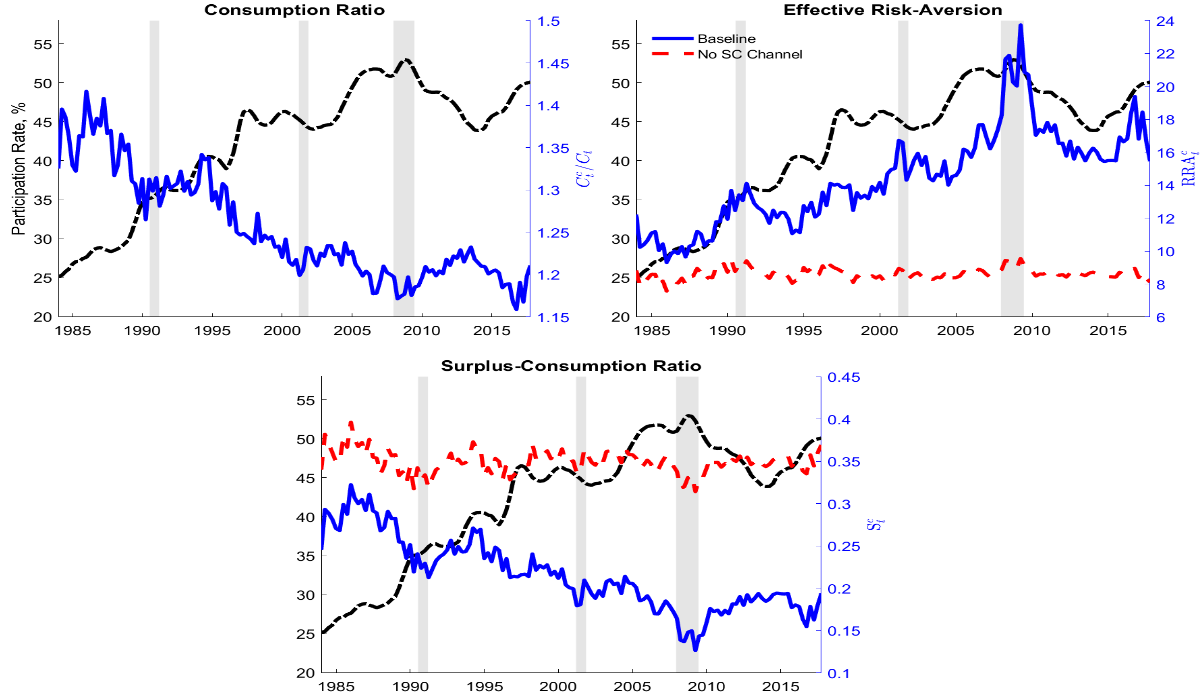
Notes: This table reports key equity premium statistics for different robustness checks.

Table G.3: Test for equality of covariances - Habit utility

	Total Consumption	Rich Stockholders˙	Probability Weighted
	$g^{Base.}_{t,t+1} - g^{NoSC}_{t,t+1} = \alpha + \beta r^{ex}_{t+1} + \epsilon_{t+1}$		
β	0.08	0.05	0.11
p-value (one-sided)	0.04	0.03	0.00

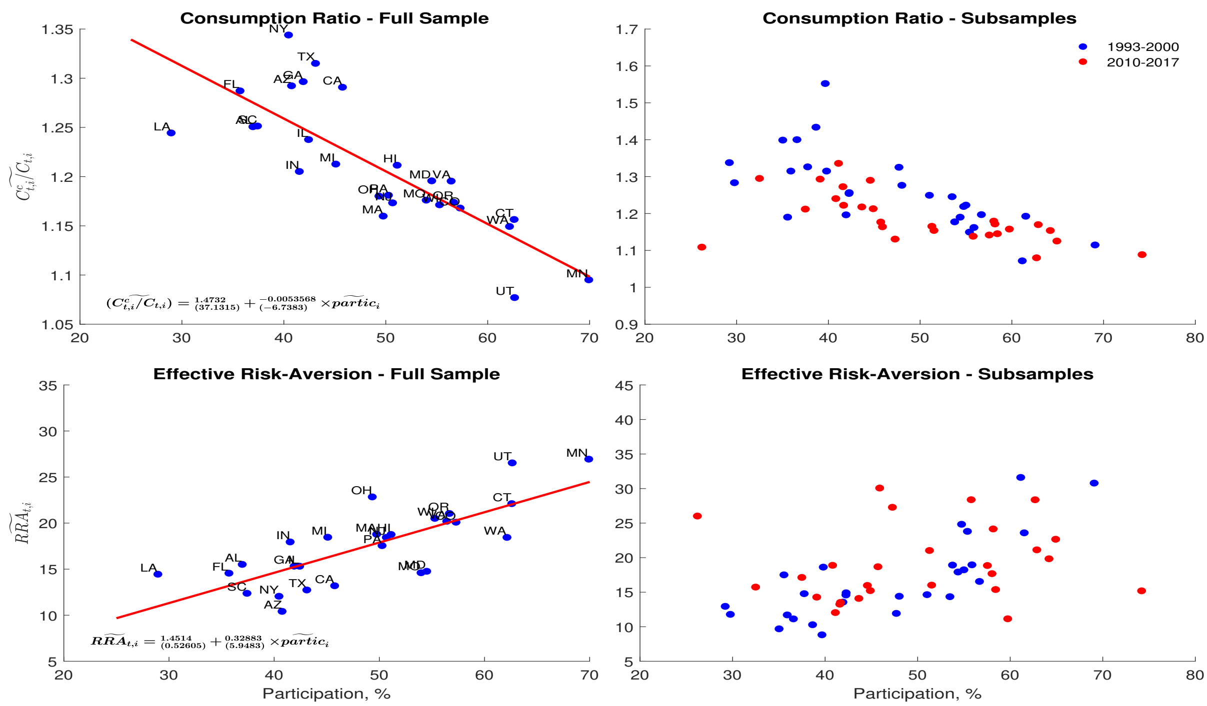
Notes: This table reports the estimated β, along with the one-sided p-value (based on Newey-West standard errors with 4 lags), from regression (43) in the main text for different robustness checks. β measures the difference in the covariance of $g^{Base.}$ and g^{NoSC} with excess stock returns r^{ex}, divided by the variance of the latter.

Figure G.1: Time-series evidence - Extended Consumption



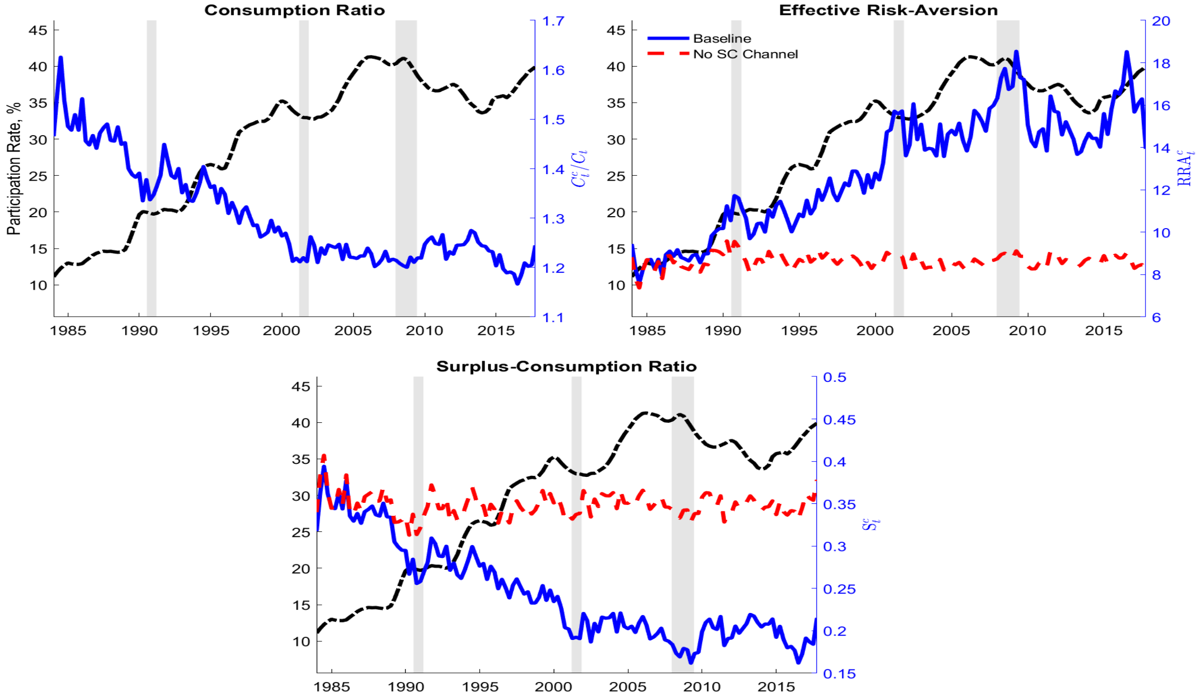
Notes: This figure displays the stockholder-aggregate consumption ratio, effective risk aversion, and surplus-consumption ratio against the participation rate, using the extended consumption measure.

Figure G.2: Cross-sectional evidence - Extended Consumption



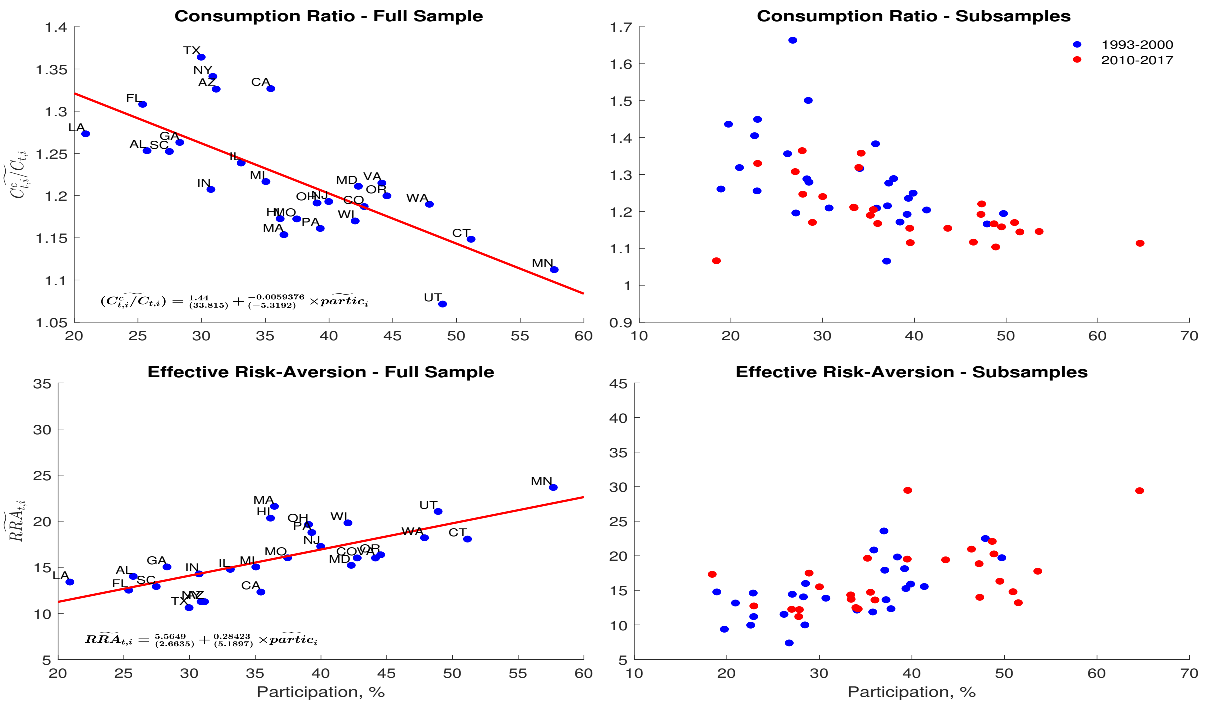
Notes: This figure displays the median stockholder-aggregate consumption ratio and effective risk aversion against the median participation rate at the state level, using the extended consumption measure.

Figure G.3: Time-series evidence - Rich stockholders



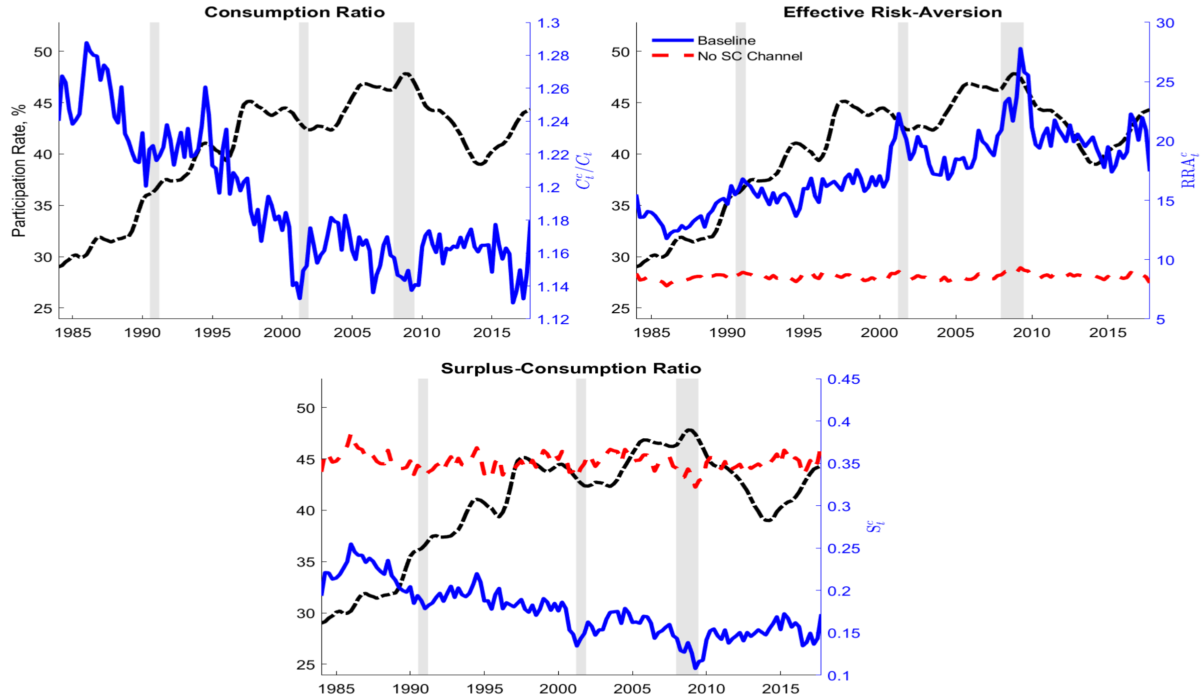
Notes: This figure displays the stockholder-aggregate consumption ratio, effective risk aversion, and surplus-consumption ratio against the participation rate, for rich stockholders.

Figure G.4: Cross-sectional evidence - Rich stockholders



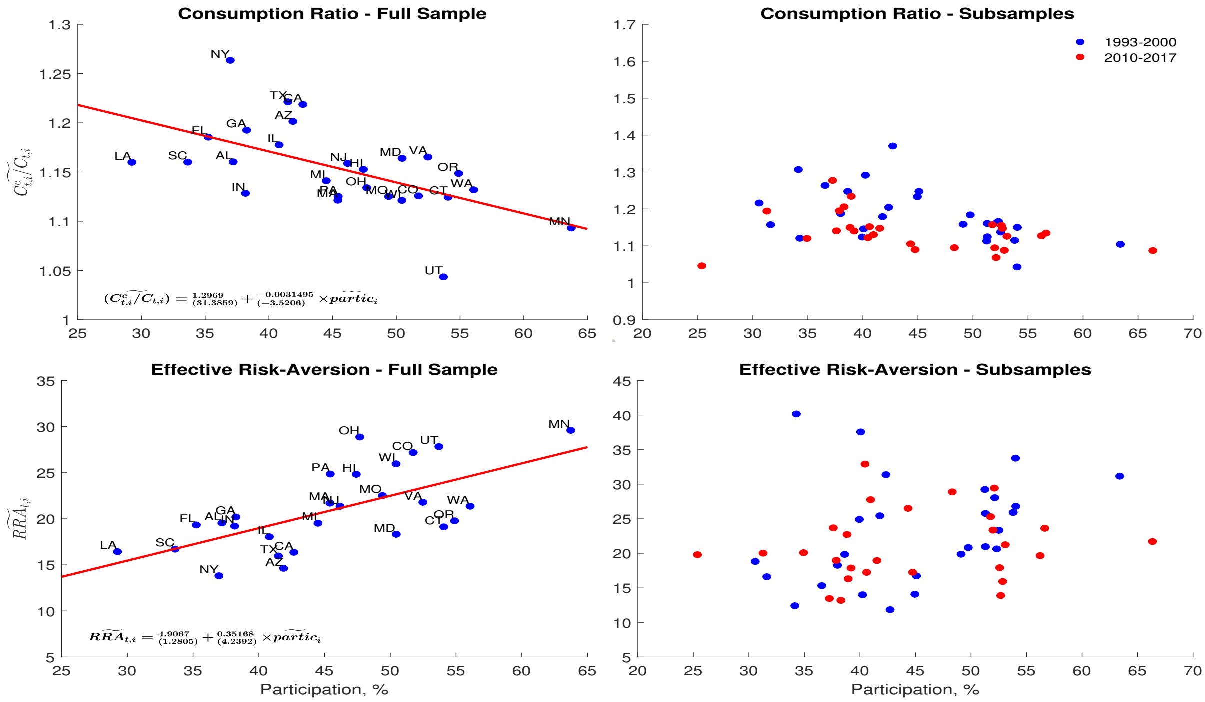
Notes: This figure displays the median stockholder-aggregate consumption ratio and effective risk aversion against the median participation rate at the state level, for rich stockholders.

Figure G.5: Time-series evidence - Probability weighted



Notes: This figure displays the stockholder-aggregate consumption ratio, effective risk aversion, and surplus-consumption ratio against the participation rate, for probability-weighted stockholders.

Figure G.6: Cross-sectional evidence - Probability weighted



Notes: This figure displays the median stockholder-aggregate consumption ratio and effective risk aversion against the median participation rate at the state level, for probability-weighted stockholders.

References

Attanasio, O. P., Banks, J., and Tanner, S. (2002). Asset holding and consumption volatility. *Journal of Political Economy*, 110(4):771–792.

Bee, A., Meyer, B. D., and Sullivan, J. X. (2012). The validity of consumption data: are the consumer expenditure interview and diary surveys informative? *NBER Working Paper Series*, 18308.

Bilbiie, F. O., Känzig, D. R., and Surico, P. (2022). Capital and income inequality: An aggregate-demand complementarity. *Journal of Monetary Economics*, 126:154–169.

Blanchard, O. J. (1993). Movements in the equity premium. *Brookings Papers on Economic Activity*, 1993(2):75–138.

Campbell, J. Y. (2003). Consumption-based asset pricing. *Handbook of the Economics of Finance*, 1:803–887.

Cantore, C. and Freund, L. B. (2021). Workers, capitalists, and the government: Fiscal policy and income (re) distribution. *Journal of Monetary Economics*, 119:58–74.

Chen, A. (2016). Semi-parametric restrictions on production-based asset pricing models. Available at SSRN: http://dx.doi.org/10.2139/ssrn.2742323.

Chen, A. Y. (2017). External habit in a production economy: A model of asset prices and consumption volatility risk. *Review of Financial Studies*, 30(8):2890–2932.

Cloyne, J., Ferreira, C., and Surico, P. (2019). Monetary policy when households have debt: New evidence on the transmission mechanism. *Review of Economic Studies*, 0:1–28.

Damodaran, A. (2013). Equity risk premiums (ERP): Determinants, estimation and implications–The 2013 edition. *Managing and measuring risk: Emerging global standards and regulations after the financial crisis*, pages 343–455.

Danthine, J.-P. and Donaldson, J. B. (2002). Labour relations and asset returns. *Review of Economic Studies*, 69(1):41–64.

De Graeve, F., Dossche, M., Emiris, M., Sneessens, H., and Wouters, R. (2010). Risk premiums and macroeconomic dynamics in a heterogeneous agent model. *Journal of Economic Dynamics and Control*, 34(9):1680–1699.

Del Negro, M., Giannone, D., Giannoni, M. P., and Tambalotti, A. (2019). Global trends in interest rates. *Journal of International Economics*, 118:248–262.

Duarte, F. and Rosa, C. (2015). The equity risk premium: A review of models. *Economic Policy Review*, (2):39–57.

Duca, J. V. (2001). The democratization of America's capital markets. *Economic and Financial Policy Review*, (Q II):10–19.

Fagereng, A., Holm, M. B., and Natvik, G. J. (2021). MPC heterogeneity and household balance sheets. *American Economic Journal: Macroeconomics*, 13(4):1–54.

Farhi, E. and Gourio, F. (2018). Accounting for macro-finance trends: Market power, intangibles, and risk premia. *Brookings Papers on Economic Activity*, Fall 2018:147–223.

Fernald, J. (2014). A quarterly, utilization-adjusted series on Total Factor Productivity. *Federal Reserve Bank of San Francisco Working Paper Series*, 2012-19.

Gomes, F., Michaelides, A., and Polkovnichenko, V. (2009). Optimal savings with taxable and tax-deferred accounts. *Review of Economic Dynamics*, 12(4):718–735.

Greenwood, J., Hercowitz, Z., and Huffman, G. W. (1988). Investment, capacity utilization, and the real business cycle. *American Economic Review*, pages 402–417.

Guiso, L. and Sodini, P. (2013). Household finance: An emerging field. In *Handbook of the Economics of Finance*, volume 2, pages 1397–1532. Elsevier.

Guvenen, F. (2006). Reconciling conflicting evidence on the elasticity of intertemporal substitution: A macroeconomic perspective. *Journal of Monetary Economics*, 53(7):1451–1472.

Guvenen, F. (2009). A parsimonious macroeconomic model for asset pricing. *Econometrica*, 77(6):1711–1750.

Iachan, F. S., Nenov, P. T., and Simsek, A. (2021). The choice channel of financial innovation. *American Economic Journal: Macroeconomics*, 13(2):333–372.

Israelsen, R. D. (2010). Investment based valuation and managerial expectations. Available at SSRN: http://dx.doi.org/10.2139/ssrn.1563502.

Jaccard, I. (2014). Asset returns and labor supply in a production economy. *Journal of Money, Credit and Banking*, 46(5):889–919.

Jermann, U. J. (1998). Asset pricing in production economies. *Journal of Monetary Economics*, 41(2):257–275.

Kuvshinov, D. and Zimmermann, K. (2022). The big bang: Stock market capitalization in the long run. *Journal of Financial Economics*, 145(2):527–552.

Lansing, K. J. (2015). Asset pricing with concentrated ownership of capital and distribution shocks. *American Economic Journal: Macroeconomics*, 7(4):67–103.

Lettau, M., Ludvigson, S. C., and Ma, S. (2019). Capital share risk in U.S. asset pricing. *Journal of Finance*, 74(4):1753–1792.

Malloy, C. J., Moskowitz, T. J., and Vissing-Jørgensen, A. (2009). Long-run stockholder consumption risk and asset returns. *Journal of Finance*, 64(6):2427–2479.

Mankiw, N. G. and Zeldes, S. P. (1991). The consumption of stockholders and nonstockholders. *Journal of Financial Economics*, 29(1):97–112.

Morelli, J. M. (2021). Limited participation in equity markets and business cycles. Finance and Economics Discussion Series 2021-026, Board of Governors of the Federal Reserve System U.S.

Müller, U. K. and Watson, M. W. (2018). Long-run covariability. *Econometrica*, 86(3):775–804.

Poterba, J. M., Samwick, A. A., Shleifer, A., and Shiller, R. J. (1995). Stock ownership patterns, stock market fluctuations, and consumption. *Brookings Papers on Economic Activity*, 1995(2):295–372.

Schmitt-Grohé, S. and Uribe, M. (2003). Closing small open economy models. *Journal of International Economics*, 61(1):163–185.

Vissing-Jørgensen, A. (2002). Limited asset market participation and the elasticity of intertemporal substitution. *Journal of Political Economy*, 110(4):825–853.

Welch, I. and Goyal, A. (2008). A comprehensive look at the empirical performance of equity premium prediction. *Review of Financial Studies*, 21(4):1455–1508.