Income Inequality and the Rise of Risky Capital*

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Abstract

I study how income inequality shapes the composition of firms through the composition of aggregate household asset demand. Because higher-income households hold riskier asset portfolios, the degree of income inequality affects the allocation of resources across households with different risk-bearing capacities. Using a quantitative heterogeneous agent model, I show that the sharp rise in income inequality in the United States since the 1980s tilted household portfolios towards riskier assets and shifted the firm distribution towards riskier but more productive firms. This reallocation of capital raised overall productivity and benefitted low-income households through higher wage rates. The model can account for several macro-finance trends, including the secular decrease in the risk-free rate and the stable return to capital. Empirical tests support the model's predictions, showing that higher income inequality is associated with a larger aggregate share of risky assets and lower risk premia.

Keywords: Income inequality, Portfolio allocation, Firm heterogeneity

JEL Codes: D31, E21, E22, G11

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1 Introduction

The stark rise in income inequality since the 1980s in the United States has been proposed as a central explanation for the secular decline in safe real interest rates.[1] The basic idea builds on the empirical observation that high-income households have higher saving rates than low-income households. A higher income share earned by high-income households therefore lifts the aggregate demand for savings, which, for a given supply of savings, lowers the interest rate. This phenomenon has occasionally been referred to as the "savings glut of the rich" (Mian et al., 2020).

In this paper, I propose that higher income inequality not only raises the *level* of savings demand, but also changes its *composition*. It is well known that at the *individual* level, the asset portfolios of high-income households are tilted towards risky assets such as equities, whereas low-income households predominantly hold safe assets such as bank deposits.[2] I argue that a higher income share earned by high-income households shifts the composition of *aggregate* asset demand away from safe towards risky assets.

Changes in asset demand composition matter because they directly affect which firms receive funding and which firms do not due to segmented funding markets. Large, established firms such as Walmart can issue effectively risk-free debt to finance their operations, whereas start-ups, for example, rely mostly on risky venture capital. By changing the relative prices and quantities of risky and safe capital, the composition of asset demand therefore shapes the distribution of firms in terms of characteristics that are correlated with the type of funding that firms rely on.

I analyze the implications of changes in asset demand composition using a quantitative general equilibrum model with endogenous portfolio choice and household and firm heterogeneity. The central prediction of the model is that higher income inequality raises aggregate productivity when the firms supplying the risky asset are on average more productive than firms supplying the safe asset. When income inequality increases, households demand relatively more risky assets which induces a reallocation of capital from less productive to more productive firms, yielding higher aggregate productivity. The assumption that riskier firms are more productive is fairly natural. Investors in the risky asset need to be compensated for taking on risk with returns that are on average higher than those on the safe asset. The higher expected returns are generated through higher productivity.

[1] See, for example, Rachel and Smith (2015); Auclert and Rognlie (2018); Rachel and Summers (2019); Straub (2019); Mian et al. (2021a,b); Platzer and Peruffo (2022)

[2] See, for example, Carroll (2000); Bach et al. (2020); Fagereng et al. (2020); Smith et al. (2021).

The model also delivers a novel explanation for several salient macro-finance trend of the last decades, most prominently the secular decrease in safe interest rates against the backdrop of stable returns to capital. While existing explanations center on changes in market power (Farhi and Gourio, 2018; Eggertsson et al., 2021), demographics (Kopecky and Taylor, 2022), or risk (Farhi and Gourio, 2018), I show that higher income inequality can match the empirical trends through a combination of two forces, an overall increase in the level of savings and a reallocation of savings towards riskier assets. While jointly, these channels reduce both safe and risky returns, the reallocation from safe to risky assets yields a stable overall return to capital through changing the composition of capital.

I begin by revisiting several stylized facts about the rise in income inequality and household portfolio allocation. Income inequality, as measured by the share of disposable income held by the Top 10%, has increased from 29 percent in 1980 to 39 percent in 2019. This increase has been particularly concentrated in the right tail of the income distribution – the income share of the Top 0.01% more than tripled over this period. A large part of the overall increase in income inequality has been due to higher labour income inequality, as evidenced for example in Piketty et al. (2018).

At the same time, household asset portfolios differ substantially across the distribution of income. The share of risky assets, defined as the sum of equity and business wealth, varied from less than 5 percent for the lowest decile to almost 50 percent for the top decile of the income distribution in 2019. Recent evidence suggests that these differences in portfolio composition also persist among ultra-high net worth individuals, roughly corresponding to the Top 1 percent who hold a large fraction of overall wealth in the economy (Balloch and Richers, 2021; Gabaix et al., 2024).

Turning to aggregate household portfolios, Figure 1 depicts the two key trends that this paper is motivated by. It shows that both aggregate savings and the share of risky assets among these savings increased substantially since 1989.[3] The wealth-to-income ratio increased from 4.6 to 6.7 between 1989 and 2019, whereas the share of risky assets rose from 27 to 42 percent.

To quantify the role of income inequality for the evolution of household portfolios, I develop a dynamic general equilibrium model in the spirit of Angeletos (2007). The model features heterogeneity on the household and the firm side. Households differ in their permanent and transitory productivity types, which influence their consumption-savings and portfolio allocation decisions between a safe and a risky investment. Firms are heterogeneous in their productivity process, which determines the type of capital they supply between safe and risky capital.

[3]The Survey of Consumer Finances only provides detailed household portfolios starting in 1989.

Figure 1: Rising wealth and risky assets in the United States

Notes: US Survey of Consumer Finances. The figure reports the evolution of the aggregate wealth-to-income ratio and the fraction of risky assets in total assets between 1989 and 2019. Risky assets are defined as the sum of public and private equity.

A main contribution of the model is to integrate a household block that matches cross-sectional patterns of savings behaviour and portfolio allocation into a production economy with productivity risk on the firm side. The central feature of the household block are non-homothetic preferences over bequests, a common assumption in the literature on income inequality (Straub, 2019; Mian et al., 2021a). Several papers have argued that such non-homothetic preferences are critical to match the empirically observed high savings level of the right tail of the wealth distribution (Benhabib et al., 2019; Gaillard et al., 2023; Halvorsen et al., 2024).

I show that the standard formulation of the non-homothetic bequest motive not only alters the level, but also the composition of savings once portfolio choice is endogenized. With CRRA utility over consumption and bequests, the curvature of utility over bequests needs to be lower than the curvature of utility over consumption for bequests to be a luxury good.[4] When household income increases, a larger share of utility is derived from bequests relative to consumption. This effectively lowers the household's risk aversion, which is a weighted average of the curvature over consumption and bequest utility. All else equal, this yields a higher share of risky assets for wealthier households.[5] I formalize this insight by proposing a new approximation for optimal risky asset shares under non-

[4]An alternative way to introduce non-homothetic preferences over bequests is to assume the same curvature over consumption and bequest utility, but introduce a Stone-Geary shifter in the bequest component (De Nardi, 2004).

[5]This mechanism was proposed in Carroll (2000) as one potential explanation for the cross-sectional differences in portfolio allocation.

homothetic bequest preferences based on numerical simulations that extends the canonical results in Merton (1969) and Samuelson (1969).

In the aggregate, the model therefore generates an explicit link between the distribution of labour income and the aggregate level and composition of savings demand. By affecting the allocation of resources across households with different risk-bearing capacities, the degree of labour income inequality effectively determines the aggregate level of risk aversion in the economy.

The supply of safe and risky saving opportunities in the economy is given by firms with different productivity processes. As in Angeletos (2007), there are two types of firms, a representative safe firm with deterministic productivity and a continuum of risky firms which are more productive but subject to idiosyncratic and non-diversifiable productivity risk. These productivity differences map directly into the trade-off that households as the providers of capital in this economy face: lend capital to the safe firm at the risk-free rate or lend to a risky firm at a higher expected return as compensation for bearing additional risk. Because this risk is not diversifiable, its existence is sufficient to generate a risk premium, even in the absence of aggregate risk. This way of modelling risk is convenient because its tractability allows me to enrich the model across other dimensions that are important to accurately capture household savings behaviour.

The model nests the economy in Angeletos (2007) as a special case in which preferences are homothetic and idiosyncratic income risk, borrowing constraints and asset market participation costs are absent. In this case, the non-linear individual decision rules collapse to linear rules and the model allows for exact aggregation. I use such a stylized version of the model to study analytically the role of shifts in the income distribution for the allocation of capital across safe and risky firms and the returns to capital. Despite the absence of non-homothetic preferences, I can broadly capture the effects of income inequality by performing comparative statics on two structural parameters that mimic the role of non-homotheticities, the discount factor and risk aversion. Variation in the discount factor captures changes in the level of savings demand, whereas variation in risk aversion captures changes in the composition of savings demand. I illustrate how higher patience and lower risk aversion as proxies for higher income inequality raise the overall capital stock, increase the share of risky capital and reduce returns on both safe and risky capital.

To perform quantitative experiments, I calibrate the model to the US economy in 1980. The calibration strategy consists of targeting cross-sectional moments on household saving levels and portfolio composition and using aggregate moments of the income and wealth distribution for validation. The model performs well across several dimensions.

First, it correctly captures the increasing saving levels and risky asset shares across the distribution of income and wealth. Second, it predicts that average returns to wealth are increasing in wealth, as evidenced for example in Xavier (2021). Third, it jointly accounts for the observed concentration of consumption, labour income, wealth and capital income, a puzzle for heterogenous agent models raised in Gaillard et al. (2023). The fact that the combination of non-homothetic preferences and endogenous portfolio choice endogenously generates scale-dependent returns presents a separate contribution of this paper.

The main experiment consists of tracing out the effects of the stark rise in labour income inequality between 1980 and 2019. I make two assumptions in conducting this exercise. First, labour income inequality increased exogenously and I remain agnostic on its source, i.e. whether it was driven by technological change or by changes in taxation, for example. Second, I assume that dispersion increased in the permanent component of income as opposed to the transitory one, based on empirical evidence for the US (DeBacker et al., 2013; Guvenen et al., 2022). Specifically, I adjust the distribution of the permanent component of labour income to match the empirical top income shares in 2019, leaving all other parameters unchanged. As such, the exercise isolates the effects of changes in the distribution of permanent income without affecting its overall level.

The model predicts an increase in the aggregate share of risky assets by five percentage points, or 40 percent of the observed increase in the data. This reallocation of capital towards risky firms is accompanied by an overall increase in capital of 20 percent, again accounting for around 40 percent of the increase in the data. With respect to prices, both safe real interest rates and risk premia are lower, but the overall return to capital remains relatively stable due to a reallocation of capital from the low-return towards the high-return sector.

A direct consequence of inequality-induced capital reallocation is a rise in total factor productivity. Because more productive firms make up a higher share of the overall capital stock, aggregate productivity increases through a compositional effect. This increase in productivity benefits all households in the economy through higher wages. The latter partly compensates low-income households for their income losses caused by the changes in the distribution of permanent income.

The final part of the paper performs empirical tests of the core predictions of the model. Exploiting variation across countries and over time, I document three stylized facts that lend credence to the model. First, the quantity of risky capital, measured by either the stock market capitalisation of publicly listed firms or the amount of venture capital investment, increases in response to higher labour income inequality. Second, the price of risky capital, as measured by the equity risk premium, declines with higher labour income inequality. Third, I find that higher labour income inequality is also associated with higher productivity. These results highlight that the model predictions are not necessarily at odds with the empirical trends of increasing risk premia and stagnating productivity growth once other confounding factors are accounted for.

Related literature. This paper contributes to a large literature that documents portfolio heterogeneity across the distribution of income and wealth by developing a theoretical framework that matches the empirical evidence and studying its macroeconomic implications. Using data from the Survey of Consumer Finances, Carroll (2000) shows that the portfolios of the rich are heavily skewed towards risky assets, while Xavier (2021) also shows that wealthier households generate higher returns. Similar evidence has been found using administrative tax data both in the US and in other countries (Bach et al., 2020; Fagereng et al., 2020; Smith et al., 2021). Balloch and Richers (2021) and Gabaix et al. (2024) use a proprietary database of investment portfolios to document substantial heterogeneity in portfolio composition and returns among ultra-high net worth individuals who are typically not well captured in survey data.

The idea that portfolio heterogeneity can be explained by non-homothetic preferences dates back to at least Carroll (2000) who argues that if wealth is a luxury good, wealthier households hold riskier assets. Several papers build on variations of this argument and show that the existence of luxury bequest motives (Ding et al., 2014), luxury goods (Wachter and Yogo, 2010) or a subsistence level of consumption (Achury et al., 2012) yield similar predictions. A different set of papers shows how ex-ante heterogeneity in risk preferences (Azzalini et al., 2023; Fernández-Villaverde and Levintal, 2024) can be used to match the empirically observed portfolio heterogeneity. This paper introduces a non-homothetic bequest motive into a general equilibrium model with endogenous portfolio choice and endogenously determined asset returns and quantifies its relevance for the determination of household portfolios.

The paper firmly relates to the literature that studies the long-term macroeconomic implications of rising income inequality. Several papers focus on the effect of income inequality on the overall level of savings and through that on the equilibrium interest rate (Straub, 2019), the efficacy of monetary and fiscal policy (Mian et al., 2021a) or the occurence of financial crises (Kumhof et al., 2015). Fewer papers study the effects on the composition of household asset portfolios. Doerr et al. (2022) documents that rising income inequality reduces job creation in a model in which households have a preference for holding deposits. Elina and Huleux (2023) analyzes the portfolio choice over liquid and illiquid assets and shows that income inequality affects the valuation of capital. I show, instead, that income inequality affects the portfolio choice over safe and risky investments, and how that, in turn, affects the composition of firms issuing different types of capital. Favilukis (2013) and Laudati (2024) also study the role of increased income inequality, but focus on changes in income risk and the labour share, whereas I study an increase in permanent labour income inequality.

Motivated by rich micro-data on household savings behaviour, several papers argue that non-homothetic preferences, wealth-dependent returns, or a combination of the two are needed to explain the large concentration of wealth in the economy (Benhabib et al., 2019; Hubmer et al., 2021; Gaillard et al., 2023; Halvorsen et al., 2024). I show that introducing endogenous portfolio choice in a model with non-homothetic preferences endogenously generates wealth-dependent returns that are in line with the data. Another literature studies the asset pricing implications of household heterogeneity and inequality. As in my framework, these models typically build on the observation that wealthier households hold riskier assets, be it through preference heterogeneity, participation frictions or other exogenous forces (Gollier, 2001; Guvenen, 2009; Gomez et al., 2016; Toda and Walsh, 2020; Cioffi, 2021). In contrast to these papers, I also consider how changes in asset prices affect firm's funding conditions and through that the overall economy.

Finally, this paper also contributes to the literature on financial frictions and venture capital by highlighting the link between income inequality and the supply of risky capital. A large body of literature has shown that access to finance spurs growth (King and Levine, 1993a,b; Brown et al., 2009). Samila and Sorenson (2011) shows that increases in the supply of venture capital positively affect firm starts, employment, and aggregate income. Even though only around 0.2% of all firms in the economy raised venture capital financing, venture capital-backed firms contributed 15.8% of aggregate growth in terms of payroll between 1990 and 2019 (Ando, 2024).

2 Stylized facts

This section presents a set of stylized facts that motivate the ensuing quantitative analysis. The first part revisits the evidence on the rise in income inequality in the United States since the 1980s. The second part describes the cross-sectional heterogeneity in household portfolio composition across the distribution of income.

2.1 The rise in income inequality

Several papers have documented a substantial rise in income inequality over the last decades in the United States (see, for example, the reviews in Alvaredo et al. (2013) or Hoffmann et al. (2020)). I review some of these findings using data from the World Inequality Database (WID) based on Piketty et al. (2018), the dataset compiled in Piketty and Saez (2003) and the Global Repository of Income Dynamics (GRID) (Guvenen et al., 2022). Combining these datasets allows me to decompose the rise in income inequality along two dimensions, the split between labour and capital income, and between permanent and transitory labour income.[6]

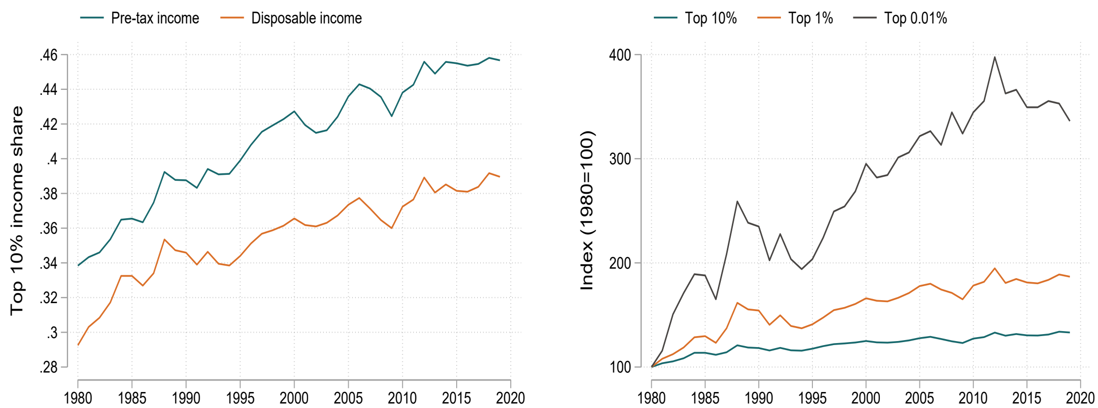
Distinguishing between different sources of income inequality is important for understanding their implications for household portfolio choice because different types of income are associated with distinct risk profiles. Capital income is typically more volatile than labour income. Within labour income itself, the permanent component – reflecting long-term human capital for instance – exhibits lower risk compared to its transitory counterpart. These differences in income volatility fundamentally shape household decisions regarding portfolio allocation, as households exposed to higher income risk may exhibit a greater desire for safer assets to buffer against income uncertainty.

The left panel in Figure 2 plots the evolution of overall income inequality in the United States since 1980. The share of disposable income, i.e. income net of taxes and transfers, earned by the Top 10% of the distribution increased by 10 percentage points from 29 to 39 percent. The evolution of pre-tax, or market-based income inequality paints a similar picture, suggesting that the role of taxation has been relatively stable over that period. The right panel illustrates that the increase in income inequality was concentrated in the very right tail of the income distribution. The share of disposable income earned by the Top 1% roughly doubled, while the share of the Top 0.01% more than tripled. These changes are sizeable from a macroeconomic perspective, in particular once the degree of wealth inequality is accounted for. Appendix A.1 reports additional statistics and shows that the rise in income inequality was accompanied by a comparable rise in wealth inequality.

The income concept analyzed so far included the sum of labour and capital income. The empirical evidence suggests that a large part of income inequality growth was driven

[6] The WID combines national accounts and survey data with fiscal data sources, but does not consistently distinguish between labour and capital income. Piketty and Saez (2003) and GRID provide estimates of labour earnings inequality using administrative data. GRID additionally includes moments of the earnings distribution which can be used to estimate income processes. Earnings are defined as individual labor earnings (i.e., market income from employment services) comprehensive, whenever possible, of bonuses, overtime pay, tips, commissions, and so on, earned from all jobs held during the calendar year but excluding self-employment income.

Figure 2: Evolution of income inequality in the US



(a) Top 10% income share (b) Concentration of disposable income

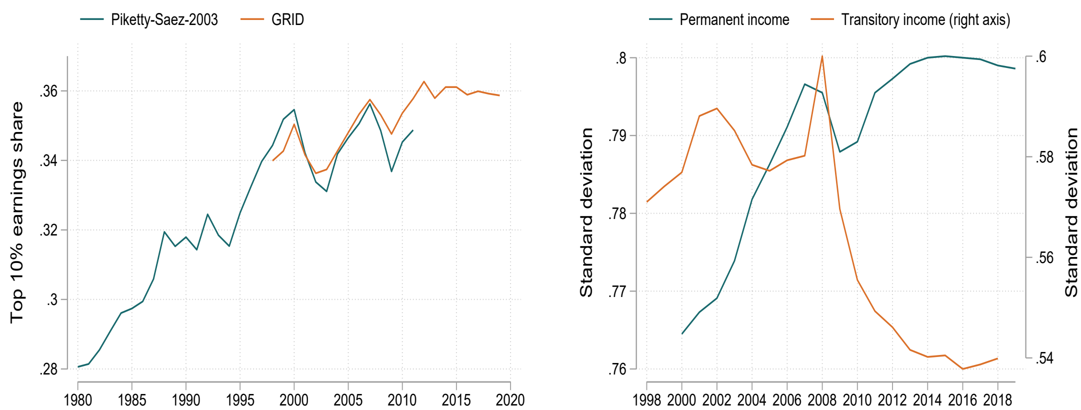
Notes: Data from the WID. The right panel reports figures for disposable income inequality. Disposable income includes labour and capital income, net of taxes and transfers.

by the labour component, especially during the period 1980-2000 (Piketty et al., 2018; Hoffmann et al., 2020). The left panel of Figure 3 confirms this notion by reporting the evolution of labour earnings inequality, measured again by the Top 10% share. Between 1980 and 2000 alone, the earnings share of the Top 10% increased by 8 percentage points, or almost 30 percent.

A different way to think about the sources of rising labour income inequality is to consider separately changes in the distribution of permanent income versus changes in income risk. This distinction is important from a theoretical perspective because transitory income risk is typically insurable while permanent income differences are not. Variation in the different income components can be measured by assuming that income follows specific statistical processes whose underlying parameters can be estimated from the data, as for example in Blundell et al. (2008). Previous decomposition exercises of this kind have shown that the increase in labour income inequality was mostly due to a higher dispersion of the permanent component of income (DeBacker et al., 2013; Guvenen et al., 2022). The right panel in Figure 3 considers a simple approach to capturing the level of inequality in permanent income. Motivated by Guvenen et al. (2022), I proxy permanent income with 3-year averages of log-earnings. To proxy for the transitory component of earnings, I use year-to-year changes in log-earnings.[7] Due to data limitations, I can only perform this decomposition starting in 1998. The rise in permanent income inequality,

[7]This approximation follows, for example, from an income process with a time-invariant permanent and a fully transitory iid component that is normally distributed.

Figure 3: Labour income inequality



(a) Top 10% earnings share

(b) Permanent vs transitory income

Notes: Earnings inequality from Piketty and Saez (2003) and GRID. The right panel decomposes earnings using 3-year averages of log earnings as a proxy for permanent income and year-to-year log earnings changes as a proxy for transitory income.

measured by the standard deviation, is nevertheless visible. At the same time, the standard deviation of the transitory component has decreased notably. Figure 12 in the Appendix shows that similar patterns are observed for alternative measures of dipsersion, for example the p90-p50 ratio, but also for alternative ways of decomposing permanent from transitory income, such as in Blundell et al. (2008).

The main takeways from this section are threefold. First, income inequality has risen substantially since 1980. Second, a large part of that increase stems from the labour component of income. Third, labour income inequality has primarily risen due to a larger dispersion of the permanent component of income. These three facts will guide the quantitative analysis in the following sections.

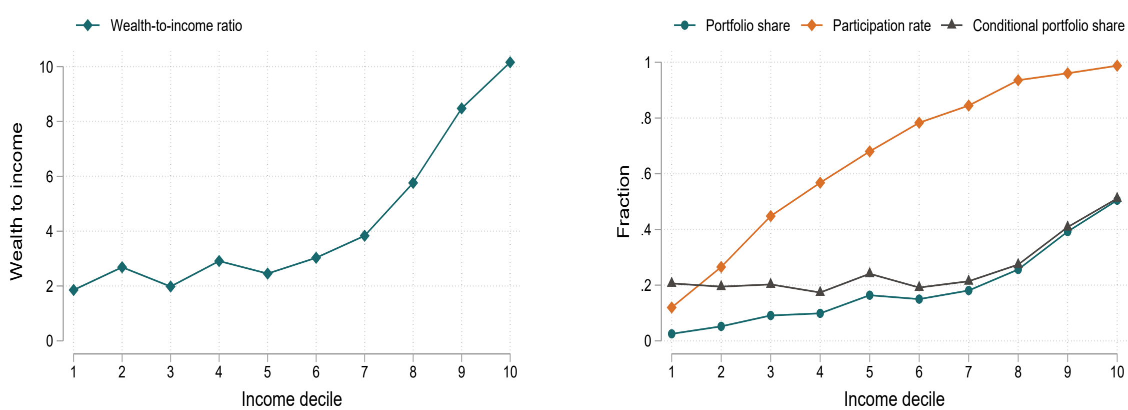
2.2 Portfolio allocation across the income distribution

It is a well established fact from the household finance literature that higher income households hold more wealth relative to income (Dynan et al., 2004; Brendler et al., 2024) and a higher share of risky assets, both in the United States (Carroll, 2000; Smith et al., 2021) and in other countries (Bach et al., 2020; Fagereng et al., 2020). In this section, I revisit this evidence using data from the Survey of Consumer Finances (SCF). I define risky assets as the sum of public and private equity. The former includes all financial assets that are invested in stocks, both directly and indirectly. The latter includes all business wealth in which the household has an active or nonactive interest. Appendix A.2.1 provides details on the sample selection and variable definitions.

The left panel of Figure 4 divides households into deciles based on total income and shows their wealth holdings relative to income, using data from 2019. Wealth holdings remain relatively stable as a proportion of income for the bottom half of the income distribution but start increasing thereafter. While the median household holds wealth around twice its annual income, the average household in the top decile holds wealth exceeding 10 times its income.

The right panel shows risky asset holdings as a fraction of total assets across the distribution of income. Higher-income households invest a substantially larger part of their portfolios in risky assets. The risky asset share increases from close to zero percent for the bottom decile to more than 50 percent for the top decile. The rise in the risky asset share is particularly steep for higher income deciles and doubles, for example, between the eight and the tenth decile.

Figure 4: Wealth and risky portfolio shares across the income distribution



(a) Wealth-to-income ratio

(b) Risky asset shares

Notes: Survey of Consumer Finances 2019. Risky assets are defined as the sum of public equity and private equity. Conditional portfolio shares condition on households that participate in risky asset markets.

It is well known that not all households participate in risky asset markets.[8] The right panel shows that not only overall risky asset shares, but also participation in risky asset markets is more common across high-income households. Whereas only 15 percent of households in the lowest income decile hold any type of risky asset, essentially all households in the top decile do. This raises the question to what extent overall risky portfolio

[8]See, for example, Mankiw and Zeldes (1991); Haliassos and Bertaut (1995); Vissing-Jorgensen (2003).

shares are a result of differences in participation. Conditional on participation, the risky asset share is still increasing steeply in income, albeit somewhat less than unconditionally, in particular for low-income households. This suggests that both the extensive and intensive margin play a role, but that the intensive margin is more relevant for the right tail of the income distribution. Appendix A.2.2 provides a more detailed discussion of portfolio heterogeneity based on a finer split of individual asset categories into equity, business wealth, housing and liquid assets.

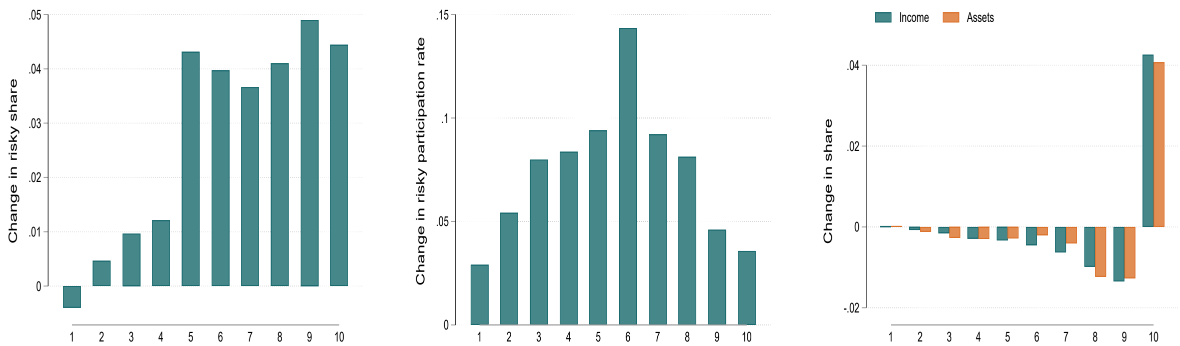
One potential concern is a mechanical relationship between total income and risky asset shares due to risky assets typically generating higher returns and income including capital income. Appendix A.2.3 shows that risky asset shares behave similarly across the distribution of wage income only which is not affected by capital income. Risky asset shares are also increasing in overall wealth and the wealth-to-income ratio.

Moving from the cross-sectional evidence in 2019 to the time-series of aggregate portfolio shares, Figure 1 shows that both the aggregate level of wealth relative to income and the share of risky assets as a percentage of total assets has increased notably over time. Starting from below 30 percent in 1989, the risky asset share reached 42 percent in 2019. This rise occured primarily at the expense of a decrease in relatively safe asset holdings such as housing and liquid financial assets.

The time-series evidence raises the question if the rise in the aggregate risky asset share was driven by compositional effects, i.e. overall asset holdings shifting from low- to high-income households, or by changes in cross-sectional portfolio allocation patterns over time, i.e. households at different income deciles exhibiting changes in their portfolio shares. To answer this question, I inspect changes in cross-sectional portfolio allocation between the early sample period from 1989-1995 and the late sample period from 2013-2019. Each period averages over three waves of the SCF to obtain smoother asset shares. Figure 5 shows that that there has been an increase in risky asset shares for higher-income households, in particular starting from the fifth decile. At the same time, there was a broad-based increase in participation rates, which was particularly pronounced for middle-income households. Among high-income households, almost all households were already participants in the early sample period, and so the smaller increase is not surprising. The right panel shows how income and overall asset shares changed over time. The largest changes are observable for the top income decile, for which both the total income and asset share increased substantially. Taken together, both changing overall asset shares across income deciles and changing risky asset shares conditional on income deciles appear to have contributed to the aggregate rise in the risky asset share.

To quantify more formally which components contributed to the rise in aggregate

Figure 5: Cross-sectional portfolio allocation: Change between 2013-2019 and 1989-1995



(a) Risky asset shares (b) Risky participation rates (c) Income and asset shares

Notes: Survey of Consumer Finances. The panels show the changes in risky shares, participation rates and overall income and asset shares between the period 1989-1995 and 2013-2019.

risky assets, I decompose the aggregagate change into changes in income shares, asset shares and risky asset shares using the following decomposition:

$$\Delta S^{risky} = \sum_i \underbrace{\mathrm{s}^{risky}_{i,89-95} \cdot \mathrm{s}^{asset}_{i,89-95} \cdot \Delta \mathrm{s}^{inc}_i}_{\text{Change in income shares}} + \underbrace{\mathrm{s}^{risky}_{i,89-95} \cdot \mathrm{s}^{inc}_{i,89-95} \cdot \Delta \mathrm{s}^{asset}_i}_{\text{Change in asset shares}} + \underbrace{\mathrm{s}^{inc}_{i,89-95} \cdot \mathrm{s}^{asset}_{i,89-95} \cdot \Delta \mathrm{s}^{risky}_i}_{\text{Change in risky shares}}$$
$$+ \text{higher-order terms} \tag{1}$$

where $\Delta s^j_i = s^j_{i,13-19} - s^j_{i,89-95}$ and higher-order terms refer to the interaction between changes in the respective shares. The first term captures the effect of changes in the total income share held by each income decile. The second term captures the effect of the total asset share held by each decile. The third term captures the change in risky asset shares conditional on the income decile. The decomposition yields that approximately half of the change in aggregate risky asset shares is driven by changes in risky asset shares within income deciles, and the other half by higher asset and income shares held by high-income households.

Due to well-known top-coding issues, the SCF does not capture well the portfolios of the Top 1 percent.[9] There is ample evidence, however, that also within the very wealthy, there are substantial differences in portfolio holdings. Using a proprietary database of investment portfolios, Balloch and Richers (2021) and Gabaix et al. (2024) show that the

[9] Appendix Figure 15 splits households into income ventiles and shows that the Top 5 percent invest a substantially larger fraction of assets in risky assets compared to the Top 5-10 percent.

risk-profile of the Top 0.01%, i.e. the ultra-wealthy, is vastly different from those of the remaining Top 1%. At higher wealth levels, investors increasingly hold assets in alternative asset classes such as hedge funds and venture capital. But also within asset classes, portfolios differ. Within the category of equities, for example, wealthier investors tend to be more exposed to individual stocks than to the aggregate stock market via mutual funds or ETFs, for example.

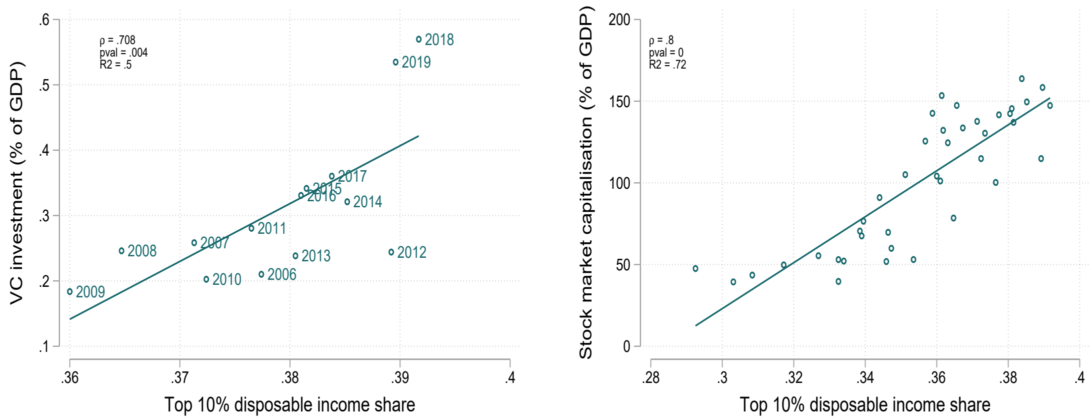
Using aggregate time-series data on specific investment classes, one can trace out to what extent cross-sectional differences in portfolios translate into changing aggregate asset volumes outside of the Survey of Consumer Finance. One issue is that historical data on the volume of alternative investments are not readily available. One exception is the investment of venture capital firms that is provided by the OECD. The left panel plots the amount of venture capital investment against the level of income inequality in the US, measured by the share of disposable income held by the Top 10 percent. The figure shows that venture capital investment is higher in years when income inequality is large. The right panel, instead, analyses the overall stock market capitalisation of publicly listed firms in the US, but for a much longer time period starting in 1980. Again, there is a tight positive correlation between stock market investment and income inequality. Appendix A.2.5 shows that this correlation is also present across measures of labour income inequality specifically.

The next section presents a model that aims to capture the cross-sectional heterogeneity in wealth levels and asset portfolios. With respect to the latter, the goal is to incorporate both differences in the external margin, i.e. participation in risky asset markets, and the internal margin, i.e. risky asset shares conditional on participation.

3 Model

This section develops a dynamic general equilibrium model of heterogenous households and firms with two purposes. The first is to match jointly the cross-sectional evidence on household savings levels and portfolio allocation. The second is to study the role that the distribution of labour income plays for the allocation of capital and the determination of return rates, and consequently the wider macroeconomic implications. The model is fundamentally an overlapping-generations variant of the economy developed in Angeletos (2007) with a rich household sector.

Figure 6: Income inequality, VC investment and stock market capitalisation



VC investment: 2006-2019 Stock market capitalisation: 1980-2019

Notes: WID, World Bank and OECD.

3.1 Households

Overview. Time is discrete and indexed by t. The economy is populated by a continuum of households who die at a constant rate ε. Households are indexed by i and are ex-ante heterogeneous in their permanent productivity type s_i, which I interchangeably refer to as permanent income type, and ex-post heterogeneous in their stochastic productivity level z_{it}. Each household supplies one unit of labour inelastically in a competitive labour market.

Each period, households choose how much to consume and how much to save. They also face a portfolio choice between saving in a safe and a risky asset. Investing in the safe asset yields a deterministic return, whereas investing in the risky asset yields an idiosyncratic stochastic return.

Preferences. Households discount the future at rate β and derive utility from consumption and leaving bequests. The utility functions over consumption c and bequests a are both CRRA and given by:

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma}, \quad v(a) = \psi \frac{a^{1-\eta}}{1-\eta} \tag{2}$$

where I assume that $\eta < \gamma$, and ψ parametrizes the relative weight of leaving bequests in total utility. This formulation yields preferences that are non-homothetic because the marginal utility of leaving bequests declines more slowly than the marginal utility of consumption. Bequests are effectively a luxury good.

By choosing this preference structure, I build on a large body of literature that aims to capture the empirically documented differences in saving rates across households (Carroll, 1998; Dynan et al., 2004; Fagereng et al., 2019; Straub, 2019).[10] Based on rich microdata, several papers have argued that non-homothetic preferences are needed, at least in an accounting sense, to match the savings behaviour of the right tail of the wealth distribution (Benhabib et al., 2019; Gaillard et al., 2023; Halvorsen et al., 2024).[11]

Labour income. Household labour income is given by the product of the aggregate wage rate ω_t, the permanent income type s_i and the transitory income state z_{it}. The permanent component s_i is assigned at birth and is drawn from a three-point distribution which represents the *Bottom*, *Middle*, and *Top* of the income distribution, with cutoffs at the 50th and 90th percentiles. The permanent component can be interpreted as the innate ability, skill or education of the household and is the main object through which changes in income inequality will be introduced. The transitory income component is stochastic and its logarithm follows an AR-1 process with mean zero, persistence ρ_z and a normally distributed mean-zero innovation with variance σ_z^2:

$$\log z_{it} = \rho_z \log z_{it-1} + \epsilon_{it}, \qquad \epsilon_{it} \sim N(0, \sigma_z^2) \tag{3}$$

Dynamic optimization problem. Formally, the recursive household problem is given by:

$$V(s,z,w) = \max_{c,a^{s\prime},a^{r\prime}} \frac{c^{1-\gamma}}{1-\gamma} + \epsilon\psi \frac{(a^{s\prime}+a^{r\prime})^{1-\eta}}{1-\eta} + \beta(1-\epsilon)\mathbb{E}_{z'|z,r^{r\prime}} V(s,z',w') \tag{4}$$

$$\text{s.t.} \quad c + a^{s\prime} + a^{r\prime} + I_{a^{r\prime}>0}\kappa = \omega s z + (1+r^s)a^s + (1+r^r) \tag{5}$$

$$a^{s\prime}, a^{r\prime} \geq 0 \tag{6}$$

The permanent income type s, idiosyncratic productivity state z and wealth w fully describe the household state. Wealth is given by the sum of the safe asset a^s which pays a deterministic return r^s and the risky asset a^r which pays a stochastic return r^r. In case of death, the household derives utility from leaving a bequest, given by total savings, i.e. the sum of the safe asset and the risky asset. The household forms expectations about two variables, the idiosyncratic productivity state z' and the idiosyncratic return to the risky

[10]See, for example, Straub (2019); Mian et al. (2021a); Platzer and Peruffo (2022) for the role of rising income inequality. Lockwood (2018) and De Nardi et al. (2021) argue for including luxury bequest motives to match the savings behaviour of retirees.

[11]An alternative interpretation of the bequest motive is a warm-glow motive of holding wealth, often referred to as 'capitalist spirit' (Kumhof et al., 2015).

investment $r^{r\prime}$. The distribution that underlies risky returns will be described once firms are introduced. I impose a zero borrowing constraint on both types of assets. Households that want to invest in the risky asset need to pay a fixed participation cost κ each period. This cost captures the well documented information and search frictions in risky asset markets.

Demographic structure. Each newly born household inherits the permanent income state of its predecessor. The stochastic income state is drawn from the unconditional distribution of z. I assume that bequests are fully expropriated and households start their life with zero assets. This assumption helps ensure the stationarity of the cross-sectional wealth distribution.

3.2 Firms

The economy consists of two types of firms, a representative safe firm and a continuum of risky firms. The labels "safe" and "risky" are assigned based on the nature of the stochastic productivity technology that the firm uses.[12] The safe firm is owned by all households in the economy while each risky firm i can only be owned by one household, and index i of the firm therefore corresponds to index i of the household. The safe firm corresponds to the supplier of the safe asset, while risky firms supply the risky asset.

Safe firm. A representative safe firm produces output by hiring capital and labour and faces constant returns to scale. The firm's production technology is given by:

$$F(Z^s, K^s, L^s) = Y_t^s = Z^s K_t^{s,\alpha} L_t^{s,1-\alpha} \tag{7}$$

where superscript s is used to refer to the safe firm. Z^s denotes the time-invariant productivity of the safe firm. The parameter $\alpha \in (0,1)$ denotes the output elasticity of capital. The firm's optimization problem is given by:

$$\max_{K^s, L^s} \Pi_t^s = Y_t^s - (r_t^s + \delta) K_t^s - \omega_t L_t^s \tag{8}$$

where r_t^s denotes the rental rate of capital, ω_t the wage rate and δ the depreciation rate of capital. Note that r_t^s corresponds to the safe return that households earn on their savings.

[12] In the language of Angeletos (2007), the safe firm corresponds to a "public" firm and the risky firm to a "private" firm. This paper does not make a distinction between the public and private sector, and is purely about the diversifiability of risk associated with each firm.

The capital and labour demand of the firm are given by:

$$K_t^s = \left(\frac{\alpha Z^s}{r_t^s + \delta}\right)^{\frac{1}{1-\alpha}} L_t^s, \qquad L_t^s = \left(\frac{(1-\alpha)Z^s}{\omega_t}\right)^{\frac{1}{\alpha}} K_t^s \tag{9}$$

It follows directly that the labour-capital ratio depends only on prices and technology parameters. Combining the two conditions, the wage can be expressed as a function of the interest rate:

$$\omega_t = (Z^s)^{\frac{1}{1-\alpha}}(1-\alpha)\left(\frac{\alpha}{r_t^s + \delta}\right)^{\frac{\alpha}{1-\alpha}} \tag{10}$$

These expressions will be helpful for characterizing differences between the safe and risky firms. For the rest of the analysis, I normalize, without loss of generality, Z^s to 1.

Risky firms. There is a continuum of risky firms of mass one operated by households. Each household i can operate one firm i. Risky firms use the same production technology as the safe firm, but differ in two important aspects. First, the capital of risky firms is subject to idiosyncratic productivity risk through a shock ζ_{it}. Second, risky firms are more productive than the safe firm by a factor $\mu > 1$, such that $Z^r = \mu Z^s = \mu > Z^s$. The assumption of higher productivity is needed for households to be willing to supply capital to the risky firm as a compensation for risk. The production technology of risky firms is thus described by:

$$f(Z^r, k^r, l^r, \zeta) = y_{it}^r = \mu(\zeta_{it} k_{it}^r)^\alpha l_{it}^{r,1-\alpha}, \quad \ln \zeta_{it} \sim N(-\frac{\sigma_\zeta^2}{2}, \sigma_\zeta^2) \tag{11}$$

The idiosyncratic productivity shock is assumed to be iid log-normally distributed with mean one and variance σ_ζ^2. The timing of the shock is such that uncertainty over the idiosyncratic shock resolves after the firm makes the capital input choice, but before it makes the labour input choice. This, together with the constant returns to scale assumption, yields the same labour-capital ratio across risky firms, irrespective of the realization of the idiosyncratic shock. The firm's problem is:

$$\max_{k^r, l^r} E[\pi_{it}^r] = \mu(\zeta_{it} k_{it}^r)^\alpha l_{it}^{r,1-\alpha} - \omega_t l_{it}^r \tag{12}$$

where risky and safe firms face the same wage rate due to a competitive, frictonless labour market. Modelling the productivity shock as capital-augmenting is useful because it yields that a mean preserving spread in ζ is equivalent to a mean preserving spread in individual returns and parsimoniously parametrizes the amount of uninsured idiosyncratic return risk faced by the household with the variance of the idiosyncratic productivity shock σ_ζ^2. Note that the mapping from expected profits to the expected return rate is simply given by $E[r_{it}^r] = E[\frac{\pi_{it}^r}{k_{it}^r}] - \delta$.

Discussion. Based on this firm block, one could narrowly interpret the choice of the household to invest in the risky asset as the choice to become an entrepreneur for one period. This is not the interpretation that I pursue in this paper. The investment in the risky asset should be interpreted in a broader sense in which the risky asset could constitute any type of investment that is associated with an uncertain return that cannot be diversified away. Starting a business is one such interpretation but the risky asset could equivalently capture investment into a venture capital fund that supplies capital to entrepreneurs or alternatively the investment in a public stock.

3.3 General equilibrium

Risk premium and wages. We can use the firm optimality conditions to determine the relation between the expected risky and safe interest rate. Using the first order conditions with respect to labour, we can show that the productivity differential μ pins down the difference in the optimal labour-capital ratio across sectors:

$$\frac{L_t^r}{K_t^r} = \mu^{\frac{1}{\alpha}} \frac{l_t^s}{k_t^s} \tag{13}$$

This follows directly from the fact that $f(Z^r, k^r, l^r, \zeta) = f(\mu, \zeta k^r, l^r)$ and $\mu f(\zeta k^r, l^r) = F(K^s, L^s)$. Because factor markets are competitive, $\frac{L^i}{K^i} = \frac{(1-\alpha)(r^i+\delta)}{\alpha\omega}$, and we can thus express return to capital before depreciation of the risky firm as $\mathbb{E}[r^r] + \delta = \mu^{\frac{1}{\alpha}}(r^s + \delta)$. We can then define the risk premium as:

$$\mathbb{E}[r^r] - r^s = (\mu^{\frac{1}{\alpha}} - 1)(r^s + \delta) \tag{14}$$

The risk premium is a function of the productivity differential μ, the capital intensity α, the depreciation rate δ and the level of the safe return r^s. This model therefore generates an endogenous risk premium without the inclusion of aggregate risk. It is purely based on the presence of idiosyncratic productivity risk that that cannot be diversified away.

We can also express the wage as a function of the safe interest rate by combining the firm's first order conditions:

$$\omega = (1-\alpha)\left(\frac{\alpha}{r^s + \delta}\right)^{\frac{\alpha}{1-\alpha}} \tag{15}$$

Market clearing. This economy features three markets that need to clear, the market for safe capital, labour and goods.

$$K^s = A^s \equiv \int a^s(s,z,w)dF(s,z,w) \tag{16}$$

$$1 = L^s + L^r \tag{17}$$

where $a^s(s,z,w)$ denotes the household policy function for safe assets and $F(s,z,w)$ the invariant household distribution over states. The market for goods clears by Walras' law. Together with the optimality conditions of households and firms, the market clearing conditions determine the three equilibrium prices, the safe interest rate r^s, the risky interest rate r^r and the wage rate ω, together with the quantities of safe capital K^s, risky capital K^r, and the split of labour across private and public firms, $L^s = 1 - L^r$. We can now define a stationary equilibrium of this economy.

Equilibrium definition. A stationary recursive equilibrium consists of prices (r^r, r^s, ω), quantities $(C, K^s, K^r, L^s, L^r, Y^s, Y^r)$, policy functions $a^s(s,z,w), a^r(s,z,w)$, a value function $V(s,z,w)$ and an invariant distribution of households $F(s,z,w)$ such that for given prices, the value and policy functions solve the household maximization problem, firms maximize profits, i.e. factor prices are consistent with their marginal products, the goods, safe capital and labour markets clear and the distribution of households is stationary.

Special case. The model nests the two-sector economy of Angeletos (2007) for the special case in which households face an infinite horizon and households have no preference for leaving bequests, i.e. $\varepsilon = \psi = 0$, idiosyncratic income uncertainty is absent, i.e. $\sigma_z = 0$, the borrowing limit corresponds to the natural borrowing limit and there is no asset market participation cost, i.e. $\kappa = 0$. In that case, household optimal decision rules are linear in wealth and the model can be solved analytically.

4 Understanding the model mechanisms

This section develops intuition for the workings of the model using two distinct approaches. The first part discusses how household portfolio allocation is affected by non-homothetic preferences. The second part sets up a stylized version of the model that allows for closed-form expressions of equilibrium interest rates and capital allocation. Its purpose is to illustrate the role of changes in patience and risk aversion, two structural preference parameters that serve as proxies for the effects of non-homothetic preferences, for equilibrium outcomes.

4.1 Portfolio allocation with non-homothetic preferences

This section illustrates the role of non-homothetic preferences for households' portfolio decisions by inspecting the policy functions for risky assets and contrasting them with the policy functions derived from homothetic preferences.

A standard result in the household finance literature is that with CRRA utility, no borrowing constraints and no income risk, the share of risky assets is constant in wealth and can be approximated by the canonical Merton-Samuelson formula $\varphi^*_H \approx \frac{\mathbb{E}[r^r]-r^s}{\sigma^2\gamma}$, i.e. the excess return over the return variance and the degree of risk aversion.[13] With non-homothetic preferences, the relevant risk aversion parameter for the optimal risky portfolio share changes. Besides γ, the curvature of the utility over consumption, also η, the curvature of the utility over bequests influences the optimal risky share. In particular, as a larger fraction of utility is derived from bequests, the magnitude of η becomes increasingly important in the determination of the portfolio composition. In fact, one can approximate the optimal risky portfolio share with the rule:

$$\varphi^*_{NH} \approx \frac{\mathbb{E}[r^r]-r^s}{\sigma^2}\frac{1}{\lambda(w)\gamma+(1-\lambda(w))\,\eta} \tag{18}$$

where $\lambda(w) \in [0,1]$ is an increasing function in wealth and captures the share of utility that is derived from bequeathing. In the limit in which all utility is derived from bequeathing, the optimal risky portfolio share is given by $\frac{\mathbb{E}[r^r]-r^s}{\sigma^2\eta}$.

I use a parsimonious parametrization of the baseline economy to numerically illustrate the relevance of non-homothetic preferences for portfolio choice.[14] The upper panel of Figure 7 shows the share of risky assets for different levels of financial wealth and permanent income across the homothetic and non-homothetic economy. In the homothetic economy, the risky share is decreasing in the amount of financial wealth held. This is a well known result. The underlying reason is that the net present value of labour income, often referred to as human wealth, is a substitute for the riskless asset. High labour income relative to financial wealth means that a large share of resources is risk-free, inducing riskier behaviour. Following the same logic, for a given level of financial wealth, higher permanent income predicts a higher risky share because relatively more wealth is held in safe human capital. Therefore, the split of total wealth across financial and human wealth is of first-order for portfolio allocation.

Turning to portfolios with non-homothetic pereferences, there are two differences.

[13] This approximation is exact in continuous time.

[14] I consider the case without idiosyncratic income risk and asset market participation costs.

First, the risky share is non-monotonic in financial wealth. While higher financial wealth still lowers the risky asset share through changing the composition of total wealth, decreasing relative risk aversion partly offsets this effects and raises the risky asset share. Second, the risky asset share converges to a higher level. The relevant risk aversion parameter for the portfolio approximation formula, given a high enough level of wealth, is not γ, the curvature of the utility over consumption, but η, the curvature of the utility over wealth. As a larger fraction of utility is derived from holding wealth, the magnitude of η becomes increasingly important in the determination of the portfolio shares.

Another way to illusrate the role of non-homothetic preferences is to look at risky asset shares across financial wealth relative to income. The bottom panel shows that in the homothetic economy, the portfolio allocation is affected by the ratio of financial wealth to income, but not by the level of income itself. That is, the portfolio share is scale-invariant. Non-homothetic preferences, instead, break this prediction. Risky asset shares are higher for higher levels of permanent income, holding the financial wealth to income ratio fixed.

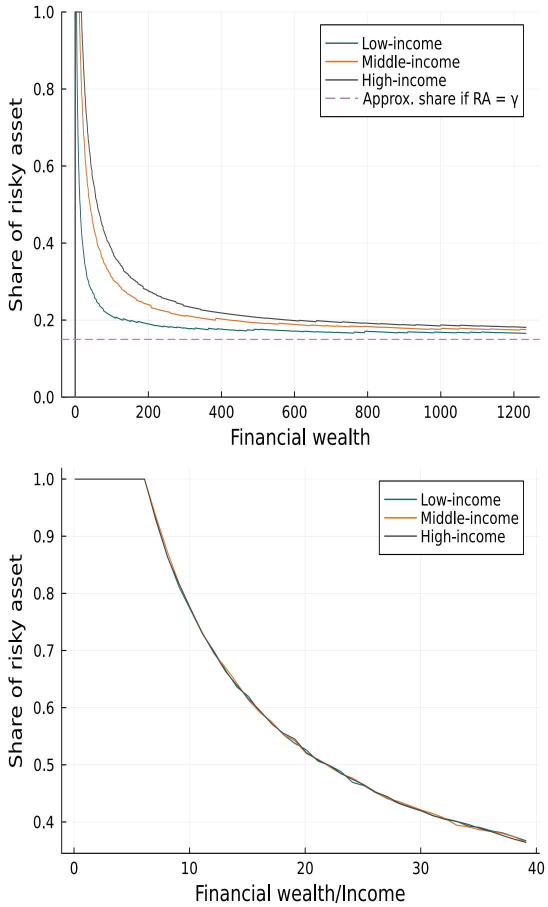
Discussion and related empirical evidence. The non-homothetic preference structure effectively induces decreasing relative risk aversion. This channel has been suggested by Carroll (2000), without explicitly formalizing it. Relatedly, Browning and Crossley (2000) shows that similar effects can be generated in a two-good economy in which one good represents a luxury.[15]

There is ample empirical evidence that supports the existence of decreasing relative risk aversion. Several papers find that the portfolio share invested in risky assets, including participation rates, is increasing in financial wealth using different research designs such as exploiting panel data (Calvet et al., 2009), data on inheritances (Andersen and Nielsen, 2011), lotteries (Briggs et al., 2021) or hypothetical survey questions (Christelis et al., 2022). Brunnermeier and Nagel (2008) and Chiappori and Paiella (2011), on the other hand, exploit time variation using panel data and argue for CRRA based on the observation that the risky share does not respond to changes in wealth. However, as evident from the policy functions, this is not necessarily evidence against DRRA as the offsetting effect of higher financial relative to human wealth might be too strong.

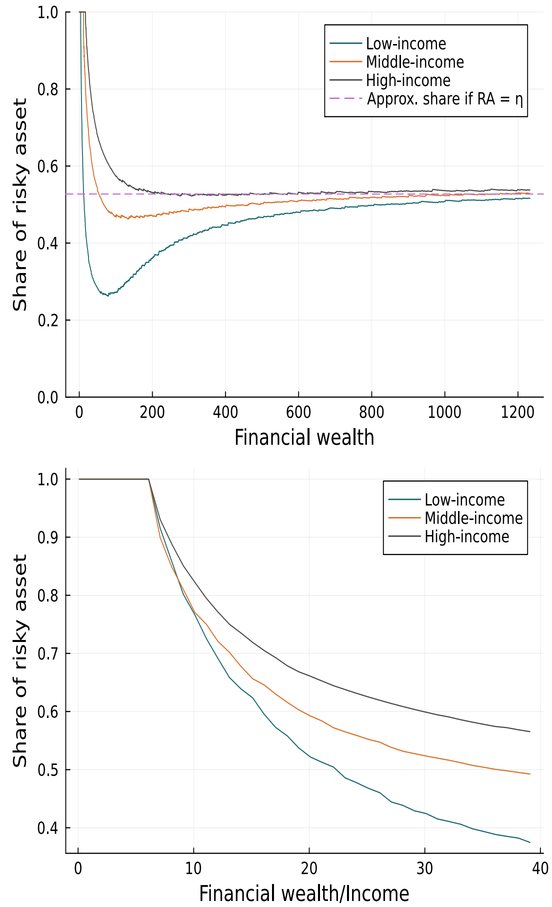
Arguably better tests of DRRA are provided in studies which identify the effects of both increases in wealth *and* permanent income. Calvet and Sodini (2014), for example, finds that both wealth and human capital affect risk-taking positively. Meeuwis (2020) using panel data on investors finds that positive and persistent shocks to income increase

[15] An even earlier contribution is given by the analysis of savings, portfolio choices and asset prices in an economy with status preferences that are not separable from consumption preferences in Bakshi and Chen (1996).

Figure 7: Risky portfolio shares with homothetic and non-homothetic preferences



(a) Homothetic



(b) Non-homothetic

Notes: This figure reports the policy functions for risky asset shares in the homothetic and the non-homothetic economy. In the homothetic economy, there is no bequest motive, i.e. $\psi = 0$.

the equity share, while increases in financial wealth lead to a a small decline. On balance, the two effects combined are positive in net terms, suggesting DRRA.

4.2 A stylized general equilibrium model

The current setup does not allow for an analytical characterization of the economy due to the non-linearity of households' decision rules in wealth. To obtain closed-form expressions for equilibrium prices and quantities, I make several simplifications and one extension to the household problem. Households are infinitely lived and have no preference over bequests, i.e. $\varepsilon = \psi = 0$, there is no income uncertainty, i.e. $\sigma_z = 0$, the borrowing limit is given by the natural borrowing limit and the depreciation rate δ is set to zero.

Compared to the time-separable utility in the baseline model, I introduce Epstein-Zin preferences to distinguish risk aversion from the intertemporal elasticity of substitution (IES). Under these assumptions, the economy collapses to the two-sector economy in Angeletos (2007). The contribution of the analysis is to perform comparative statics on key parameters of the economy analytically, which complements the numerical simulations in Angeletos (2007).

The derivations of the policy functions and equilibrium outcomes are summarized in Appendix B.1 and described in more detail in the original paper. What follows is a brief review of the main objects of interest.

In this simplified economy, the policy functions for consumption and capital are linear in wealth. This yields aggregate quantities and prices that are independent of the wealth distribution. In particular, the gross returns on safe and risky capital are given by:

$$R^s = \beta^{-1} \varrho^{\frac{1}{\theta}-1} \left(\varphi \left(\mu - 1\right) + 1\right)^{-\frac{1}{\theta}}, \quad \mathbb{E}[R^r] = \mu^{\frac{1}{\alpha}} R^s \tag{19}$$

where θ denotes the intertemporal elasticity of substitution, ϱ the certainty equivalent of the portfolio return and φ the share of risky assets. The latter two objects are functions of exogenous parameters only. This yields R^s and $\mathbb{E}[R^r]$, the expected return on the risky investment. From there, one can compute the wage and labour-capital ratio using Equation 15 and 13 as functions of the risk-free rate.

The allocation of capital across the risky and safe sector is given by:

$$K^r = \frac{\frac{1}{l^s(\omega)} + \frac{\omega}{r^s}}{\mu + \frac{1}{\varphi} - 1}, \quad K^s = \frac{1}{l^s(\omega)} - \mu K^r \tag{20}$$

where $l^s(\omega) \equiv \frac{L^s}{K^s}(\omega) = \left(\frac{\omega}{Z^s(1-\alpha)}\right)^{-\frac{1}{\alpha}}$. For the rest of the analysis, I make two further simplifying assumptions. First, I make use of the Epstein-Zin preference structure and assume a unit intertemporal elasticity of substitution, i.e. $\theta = 1$. This yields a simpler expression for the equilibrium interest rate, while preserving the possibility to study the role of varying degrees of risk aversion. Intuitively, by setting $\theta = 1$ the saving rate depends only on the discount factor and not the risk-adjusted return ϱ because income and substitution effects cancel out. Second, I approximate the optimal portfolio allocation using a second-order Taylor expansion to obtain a closed-form solution for the optimal portfolio share φ:

$$\varphi \approx \frac{\mu^{\frac{1}{\alpha}} - 1}{\gamma \sigma_\zeta^2} \tag{21}$$

Taken together, this yields the following expression for the safe interest rate:

$$R^s \approx \beta^{-1} \left(\frac{\left(\mu^{\frac{1}{\alpha}} - 1\right)^2}{\gamma \sigma_\zeta^2} + 1 \right)^{-1} \tag{22}$$

Comparative statics. Given the expressions for equilibrium quantities and prices, I now turn to analyzing how varying patience β and risk aversion γ affects returns and capital allocation. Changes in these parameters mimic the effects of non-homothetic preferences across the income distribution. Starting with returns, we can establish the following relationships:

Proposition 1. *With $\theta = 1$, the return on risky and safe capital is decreasing in the discount factor β and increasing in the degree of risk aversion γ. The risk premium is also decreasing and increasing, respectively.*

$$\frac{\partial R^s}{\partial \beta} < 0, \quad \frac{\partial R^r}{\partial \beta} < 0, \quad \frac{\partial R^s - R^r}{\partial \beta} < 0; \qquad \frac{\partial R^s}{\partial \gamma} > 0, \quad \frac{\partial R^r}{\partial \gamma} > 0, \quad \frac{\partial R^r - R^s}{\partial \gamma} > 0$$

Proof. For the discount factor, this follows trivially from the expression for R^s and R^r. For risk aversion, note that:

$$\frac{\partial R^s}{\partial \gamma} = \beta^{-1} \left(\frac{\left(\mu^{\frac{1}{\alpha}} - 1\right)^2}{\gamma \sigma_\zeta^2} + 1 \right)^{-2} \frac{\left(\mu^{\frac{1}{\alpha}} - 1\right)^2}{\gamma^2 \sigma_\zeta^2} > 0 \quad \Rightarrow \frac{\partial R^r}{\partial \gamma} > 0$$

□

The fact that the interest rate is increasing in risk aversion might be surprising, but is consistent with Proposition 5 of Angeletos (2007). Under a low enough intertemporal elasticity of substitution, which is the case if $\theta = 1$, the reallocation of capital towards safe firms reduces productivity and therefore wages, which increases the interest rate according to the firm FOCs.

With respect to the allocation of capital, we first establish auxiliary results for wages and labour demand:

Lemma 1. *With $\theta = 1$, the wage ω is increasing in β and decreasing in γ. Labour demand $l^s(\omega)$,* *in contrast, is decreasing in β and increasing in γ.*

$$\frac{\partial \omega}{\partial \beta} = \underbrace{\frac{\partial \omega}{\partial R^s}}_{<0} \underbrace{\frac{\partial R^s}{\partial \beta}}_{<0} > 0, \qquad \frac{\partial l^s(\omega)}{\partial \beta} = \underbrace{\frac{\partial l^s(\omega)}{\partial \omega}}_{<0} \underbrace{\frac{\partial \omega}{\partial \beta}}_{>0} < 0$$

$$\frac{\partial \omega}{\partial \gamma} = \underbrace{\frac{\partial \omega}{\partial R^s}}_{<0} \underbrace{\frac{\partial R^s}{\partial \gamma}}_{>0} < 0, \qquad \frac{\partial l^s(\omega)}{\partial \gamma} = \underbrace{\frac{\partial l^s(\omega)}{\partial \omega}}_{<0} \underbrace{\frac{\partial \omega}{\partial \gamma}}_{<0} > 0$$

The next proposition describes how changes in patience and risk aversion affect the allocation of capital towards safe and risky firms.

Proposition 2. *With $\theta = 1$, risky capital is increasing in the discount factor β and decreasing in the degree of risk aversion γ. Safe capital is increasing both in the discount factor and the degree of risk aversion. The share of risky capital is independent of the discount factor and decreasing in risk aversion.*

$$\frac{\partial K^r}{\partial \beta} > 0, \qquad \frac{\partial K^s}{\partial \beta} > 0, \qquad \frac{\partial \frac{K^s}{K^r}}{\partial \beta} = 0$$

$$\frac{\partial K^r}{\partial \gamma} < 0, \qquad \frac{\partial K^s}{\partial \gamma} > 0, \qquad \frac{\partial \frac{K^s}{K^r}}{\partial \gamma} > 0$$

Proof. See Appendix B.2 □

Higher patience increases the overall capital stock, but does not affect the allocation between safe and risky capital. Higher risk aversion, instead, increases the share of risky capital by raising the level of safe capital and lowering the level of risky capital. An increase in income inequality therefore unambiguously increases the share of risky capital through higher effective patience and lower risk aversion.

Appendix C.1 extends the analytical results of the stylized model with numerical simulations. I use the simulations to illustrate the quantitative relevance of changes in the discount factor and risk aversion and to validate the analytical results which were based on approximations of the optimal portfolio shares. I also use the simulations to investigate the role of the size of the IES which I assumed to be 1.

5 Calibration

The calibration strategy is guided by the aim of understanding how changes in the income distribution between 1980 and 2019 in the United States affected macroeconomic outcomes. For this purpose, I calibrate the baseline model to the US economy in 1980.

The calibration exercise consists of two parts. I first calibrate a set of parameters outside the model and then calibrate the remaining parameters internally. Table 1 reports the calibration results.

Table 1: Calibration

Parameter	Description	Value	Target/Source
Panel A: Externally calibrated			
Households			
γ	Curvature u(c)	4	Standard
$\underline{a}$	Borrowing constraint	0.	Standard
ε	Death Probability	0.02	Standard
Income			
s^1	Permanent income pct 0-50 %	0.45	Income share of 21.6%
s^2	Permanent income pct 50-90%	1.45	Income share of 50.4%
s^3	Permanent income of top 10%	2.5	Income share of 28.1%
ρ_z	Persistence of stochastic income	0.8	PSID
σ_z^2	Standard deviation of income innovation	0.02	PSID
Production			
Z^s	Productivity of safe firms	1	Normalized
σ_ζ	Standard deviation of idiosyncratic firm shock	0.4	Standard deviation of equity premium
α	Output elasticity of capital	0.36	Standard
δ	Depreciation	0.08	Standard
Panel B: Internally calibrated			
β	Discount factor	0.9	Aggregate wealth-income ratio
η	Curvature v(a)	3.6	Wealth-income ratios across income
ψ	Utility weight of v(a)	1.4	Wealth-income ratios across income
μ	Productivity of risky firms	1.15	Aggregate risky share
κ	Participation cost	0.25	Risky share of bottom decile

Notes: The table reports the calibrated parameters of the baseline economy.

5.1 External parameters

A model period is one year. I choose a standard value for the elasticity of intertemporal substitution of consumption and set γ = 4. The household death probability is set to $\varepsilon = 0.02$, yielding an average productive life span of 50 years. On the production side, I choose an output elasticity of capital of $\alpha = 0.36$ and a depreciation rate δ of 8 percent a year. I normalize the productivity parameter of the safe firm Z^s to 1.

I set the standard deviation of idioysncratic returns to $\sigma_\zeta = 0.4$, based on the estimates in Herskovic et al. (2016) for 1980. This estimate is based on the residuals of a regression of firm-level returns on the market-return and is therefore purged of aggregate risk. In a robustness exercise, I also consider $\sigma_\zeta = 0.16$ to match the standard deviation of the equity premium over the period 1980-2019.

The calibration of the income process involves choosing parameters for the permanent and the transitory component of income. With regards to the former, I select permanent income levels for the Bottom, Middle, and Top of the distribution in order to match the share of aggregate labour income held by each group in the respective percentile range using data from Piketty and Saez (2003) on wage income inequality. Because I only observe the distribution of the bottom 90 percent between the bottom 50 and mid 40 percent starting in 1998, I assume that the relative shares have not changed over time. This yields labour income shares of 28.1% for the Top 10%, 50.4% for percentiles 50-90 and 21.6% for the Bottom 50%. The persistence and variance of the transitory income component are calibrated based on household-level income data in the PSID. I directly take the estimates provided in Kaplan and Violante (2022) for the annual model with permanent heterogeneity and persistent-transitory shocks, but abstract from the fully transitory shock to keep the model tractable. An implicit assumption behind this choice is that the stochastic income process remained stable over time.

5.2 Internal parameters

The remaining parameters $(\beta, \eta, \psi, \mu, \kappa)$ are calibrated internally by targeting selected moments of the data. In particular, I use a set of aggregate and cross-sectional moments regarding wealth-to-income levels and risky asset shares to discipline these parameters. While all parameters jointly affect the targeted moments, some parameters are more informative about individual moments than others. The discount factor is set to match the aggregate wealth-to-income ratio. The preference parameters over bequests are calibrated to generate the savings level heterogeneity across the distribution of income. The productivity differential between safe and risky firms is set to match the aggregate share of risky assets in the economy. The fixed cost of asset market participation is calibrated to match the risky asset share of the bottom decile of the income distribution. Due to the absence of detailed household portfolios in the Survey of Consumer Finances before 1989, I use the 1989 wave for calibration.

An alternative strategy to calibrate these parameters would be to choose moments that are unrelated to households' savings and portfolio decisions and see to what extent the model can match these moments endogenously. However, for the purpose of the main exercise of comparing two steady-states across different periods in time, it is important to match the cross-sectional heterogeneity in savings behaviour precisely to be able to quantify the effects of changes in income inequality. In the next section, I discuss the validity of the calibration by showing that the model matches untargeted moments of the data fairly well.

5.3 Validation

Solution method. The model is solved globally over a discretized grid of wealth, transitory productivity and return states. I use 100 grid points for wealth, 3 grid points for productivity and 11 grid points for returns. For a given guess of the safe interest rate r^s, I obtain the risky rate r^r and wage ω using Equations 14 and 15. Given prices, I can solve the firm problem yielding capital demand and the household problem using value function iteration yielding capital supply. The equilibrium safe interest rate is obtained through iteration on guesses of the safe interest rate until the capital market clears.

Targeted moments. Panel A of Table 2 compares the data moments targeted in the calibration exercise with the model-generated moments. The model matches the targeted moments well overall. Both aggregate wealth-to-income ratios and risky asset shares, and their cross-sectional moments are reproduced closely. The model also generates the distribution of labour income observed in the data.

Untargeted moments. How well does the model match other moments of the data? I first investigate to what extent differences in labour income inequality translate into differences in wealth inequality. The model predicts a wealth Gini index that is substantially larger than the Gini index for income. The model, however, slightly underestimates the degree of wealth inequality in the data. It also somewhat understates the concentration of wealth, with a top 10% share of 50% compared to 65% in the data. In terms of total income inequality which includes both labour and capital income, the model matches the data quite well. The model Gini index is 37.9 compared to 37.2 in the data, and the top 10% share is close to the 29.3 observed empirically.

The model also generates a sizeable risk-premium of 6.1 percentage points. For comparison, the average equity risk premium has been around 4.5 since 1980, with an extra 3% premium on private capital (Harris et al., 2014). The size of the risk premium can be explained by the productivity differential between safe and risky firms μ, which is calibrated to 1.15.

Cross-sectional wealth levels and portfolio shares. Figure 8 illustrates graphically differences in savings levels and portfolio allocation by plotting the average wealth-to-income ratio and share of risky assets for the Bottom 50, Middle 40 and Top 10% of the income distribution. The model closely captures the heterogeneity observed in the data across both saving levels and portfolio allocation.

Return rate heterogeneity. A large literature has documented not only differences in

Table 2: Model versus data moments

Moment	Data	Model	Source
Panel A: Targeted moments			
Household portfolios			
Aggregate wealth-to-income ratio	4.6	4.4	SCF 1989
Aggregate risky asset share	0.28	0.29	SCF 1989
Wealth-to-income ratio of top 10%	10.1	9.8	SCF 1989
Wealth-to-income ratio of mid 40%	4.7	4.3	SCF 1989
Risky asset share of bottom 10%	0.01	0.00	SCF 1989
Labour income distribution			
Top 10% share	28.1	28.1	Piketty and Saez (2003)
Mid 40% share	50.4	50.4	Piketty and Saez (2003)
Bottom 50% share	21.6	21.6	Piketty and Saez (2003)
Panel B: Untargeted moments			
Wealth distribution			
Gini	80.8	78.8	WID
Top 10% share	65.0	50.0	WID
Income distribution			
Gini	37.2	37.9	WID
Top 10% share	29.3	23.8	WID
Other			
Risk premium	7.5	6.1	Harris et al. (2014)

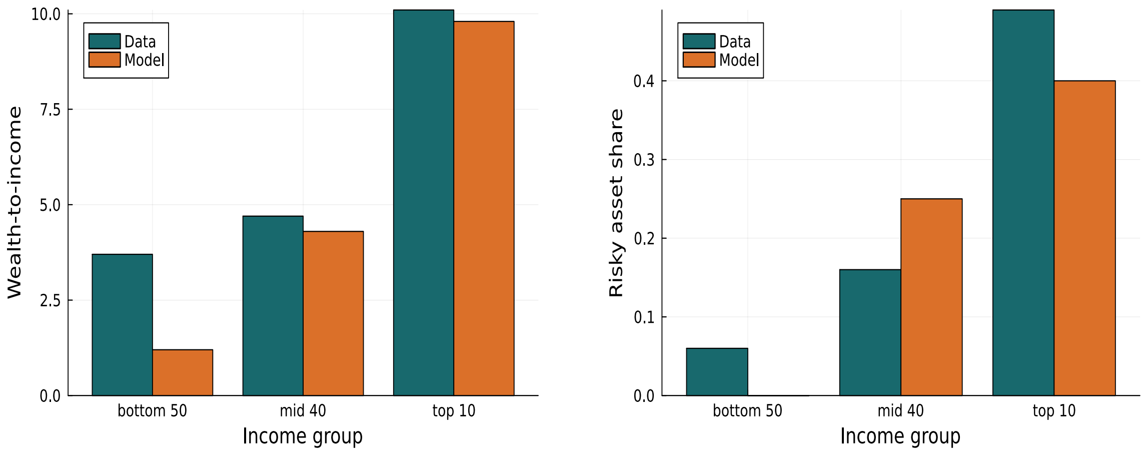
Notes: This table reports targeted and untargeted moments of the calibration exercise and compares the model to the data.

risky asset shares, but also in returns across the distribution of wealth. Figure 9 shows that the model captures both dimensions of the data. First, risky asset shares are not only increasing in income, but also in wealth. Second, also average returns are increasing in the level of wealth. The latter is a direct consequence of the portfolio composition.

Pareto tail coefficients. Gaillard et al. (2023) raises a puzzle for heterogeneous agent models. Canonical models cannot jointly account for the observed concentration of consumption, labor income, wealth, and capital income. The underlying reason is that consumption and capital income are asymptotically linear in wealth, and therefore equally concentrated. Models that are able to match the concentration of wealth therefore often overstate the concentration of consumption. The authors develop a model with non-homothetic preferences and exogenously imposed scale-dependent returns to account for these patterns.

I show that the combination of non-homothetic preferences is sufficient to generate the

Figure 8: Risky portfolio shares across income in the model



(a) Wealth-to-income

(b) Risky asset share

Notes: The figure reports wealth-to-income ratios and risky asset portfolio shares across different income groups for the baseline model calibration and the data. Data moments are computed using the SCF 1989.

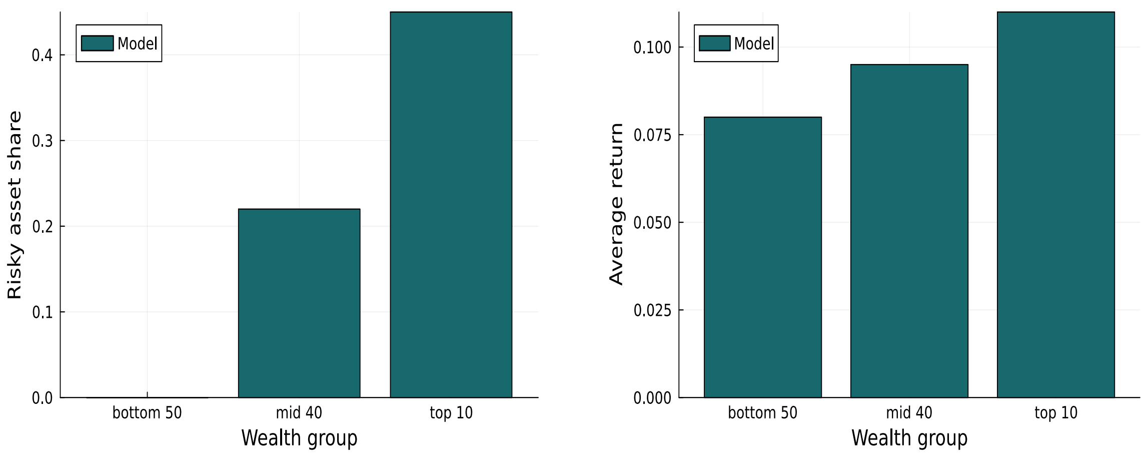
observed concentration patterns once endogenous portfolio choice is introduced. Figure 10 plots the Pareto coefficients of consumption, labour income, wealth and capital income generated by the model. The x-axis denotes different cut-off values of the distribution that are used to estimate the Pareto tail, and higher values of the Pareto coefficient indicate a lower concentration. Across all cut-offs, the model predicts that capital income is the most concentrated, followed by wealth, labour income and consumption. This is precisely the ordering that Gaillard et al. (2023) uncover in US data.

6 Quantitative analysis

This section quantifies the effects of the rise in income inequality in the US over the period 1980 and 2019. The analysis consists of comparing steady-states between 1980 and 2019, in which the steady-state in 2019 is characterized by a different labour income distribution. The main questions that this section answers is what happens to the allocation of capital across sectors, the returns to capital across sectors and consequently the more general macroeconomic implications, in particular with regards to productivity.

Description of experiment. The experiment consists of changing the distribution of permanent income s such that the labour income distribution matches the empirical distribution in 2019. The implicit assumption is that the rise in income inequality was driven by the permanent component of income, which is supported by empirical evidence (De-

Figure 9: Portfolio share and return rate heterogeneity across wealth



(a) Risky asset share (b) Returns

Notes: The figure reports risky asset portfolio shares and average return rates across different wealth deciles for the baseline model calibration.

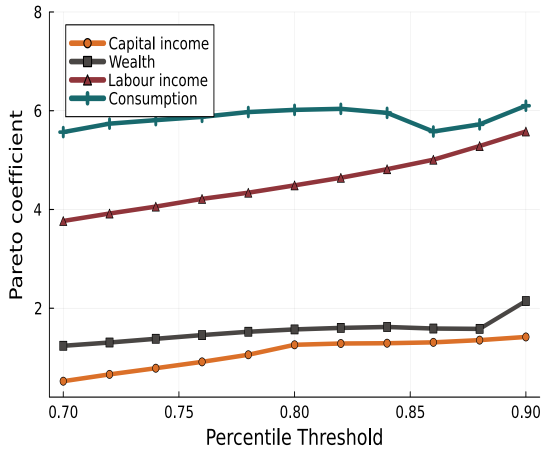
Backer et al., 2013; Guvenen et al., 2022). Notably, this is an assumption about the change in the statistical process underlying the income distribution. I do not take a stance on what was driving these changes, i.e. if it was due to technological changes, such as a rise in the college-skill premium, or, for example, by changes in taxation.[16] Specifically, I increase the labour income share of the Top 10% from 28.1 to 35.9%, and decrease the share of the Middle 40% from 50.3 to 45.1% and the Bottom 50% from 21.6 to 19.0%.

Results. Table 3 compares the main macroeconomic variables across the two models. The first observation is that the aggregate share of risky assets increased by 5 percentage points. This increase accounts for around 40 percent of the increase observed in the data over that period. The second observation is that both the return on safe and risky capital decreased as a consequence of increased inequality. At the same time, the overall return to capital decreased less due to the reallocation of capital towards the risky sector.

Output in the economy increased by five percent. This is a result of the combined level and composition effect on asset demand that is induced by the change in income inequality. While the overall capital stock increased as a result of higher overall asset demand, the reallocation of capital through the composition effect raised total factor productivity in the economy. This is a central prediction of the model. Higher income inequality is associated with higher productivity because it tilts asset demand towards riskier, but more productive firms.

[16]There is evidence for rising returns to education, see for example Hoffmann et al. (2020).

Figure 10: Pareto tail coefficients in the model



Notes: The figure reports Pareto tail coefficients of the distribution of consumption, labour income, wealth and capital income. The x-axis indicates the percentile of the distribution above which the Pareto distribution is fit.

The increase in productivity benefits all households in the economy through higher wages. Wages increase by 5 percent overall. This implies that bottom earners are partly compensated for their permanent productivity loss through an increase in wages. Based on a simple calculation, the increase in wages offsets around a third of the overall decrease in income if wages were held fixed.

Discussion. Risk-free rates have declined gradually over the last decades. At the same time, the return to capital has remained relatively stable (Gomme et al., 2011). Several explanations for this trend have been put forward, such as changes in market power (Farhi and Gourio, 2018; Eggertsson et al., 2021), demographics (Kopecky and Taylor, 2022), financial frictions (Ilut et al., 2023), or risk (Caballero et al., 2017; Farhi and Gourio, 2018; Marx et al., 2021).

I show that the rise in income inequality presents an alternative explanation. Whereas income inequality has been shown to contribute to the decline in the risk-free rate (Mian et al., 2021b), I demonstrate that it can also account for the stability of the return to capital by changing the composition of asset demand. The stability of the return to capital is a result of capital reallocation from safe, less productive to risky, more productive firm. In that sense, the channel is similar to the one proposed by Irie (2024) but the underlying cause of reallocation is different. In Irie (2024), the reallocation is a result of improved entrepreneurial equity financing, while I argue that the changes in capital allocation are caused by shifts in the distribution of income.

The model also makes stark predictions about the link between income inequality and

Table 3: Effects of the rise in labour income inequality

Variable	1980	2019	Δ
Risky assets and returns			
Risky capital share	29.0%	33.8%	+4.8pp
Risk-free rate	8.1%	6.9%	-1.2pp
Risk premium	6.1%	5.8%	-0.3pp
Avg. return to capital	9.9	8.9	-0.9pp
Other variables			
Output	-	-	+5.0%
Capital	-	-	+15.1%
Avg. TFP	-	-	+0.8 %
Wage	-	-	+5.0 %

Notes: The table reports differences in macroeconomic variables between the baseline model calibrated to 1980 and the model calibrated to the 2019 labour income distribution. The difference between the models is given by the labour income shares of the different income groups, which for the Top 10% increases from 28.1 to 35.9%, and for the Middle 40% and Bottom 50% decreases from 50.3 to 45.1% and from 21.6 to 19.0%, respectively.

total factor productivity. The degree of income inequality effectively determines which firms receive financing, with higher income households disproportionally investing in more productive firms. Higher income inequality therefore raises productivity through a capital allocation effect.

How does this square with the observation that productivity growth has been slowing in the US, despite increasing income inequality? This prediction is not necessarily at odds with the data, once one acknowledges the existence of parallel developments in the economy that are not captured in the model. For example, productivity growth has been stagnating across most advanced economies. The relevant thought experiment is therefore to what extent productivity growth has been stronger in the US than in other comparable economies that experienced a smaller rise in income inequality. To make that point, Appendix Figure 22 reports TFP growth between 1980-1989 and 2019-2019 and the change in the share of disposable income held by the Top 10% for the same period for a set of advanced economies. The figure suggests that countries with higher income inequality growth experienced more TFP growth. The next section tests several other hypotheses that are implied by the model using regression analysis with cross-country data.

7 Empirical tests of the model predictions

This section performs empirical tests of the core predictions of the model. I examine the relation between income inequality, asset portfolios and asset returns using cross-country data. Across all tests, I distinguish between different types of income inequality measures, as from a theoretical perspective, changes of different components of income inequality can have very different implications for the response of asset quantities and prices. In doing so, I document two novel stylized facts. First, labour income inequality and risky capital measured by (i) venture capital investment and (ii) stock market capitalization are positively correlated. Second, higher labour income inequality is associated with lower equity premia.

7.1 Risky capital

The first test consists of analyzing the relation between income inequality and quantities of risky capital.

Data. I analyze the relation between income inequality and the volume of risky capital using two asset classes for which data is widely available in a cross-country setting. First, I study venture capital investment using data from the OECD for the period 2006-2019. Second, I study the stock market capitalization of publicly listed firms. I restrict the sample to countries for which both measures of total and labour income inequality, including permanent income inequality, are available. This yields a sample of seven countries comprising Canada, Germany, Spain, France, Italy, Norway and the United States. The panel is unbalanced and spans the years 2006-2019.

Empirical strategy. I estimate the following regression to estimate the relation between income inequality and the volume of risky capital:

$$Asset^{j}_{it} = \alpha_i + \delta_t + \boldsymbol{\beta}\mathbf{X_{it}} + \gamma Inequality_{it} + u_{it} \tag{23}$$

where index i denotes the country, t the year, $asset^{j}$ is either venture capital investment or stock market capitalisation as a percentage of GDP, X_{it} denotes a set of control variables including GDP per capital, GDP growth, inflation, population growth, the old-age dependency ratio and the labour share. $Inequality_{it}$ denotes the measure of income inequality and α_i and δ_t denote country and time fixed effects.

Results. Table 4 reports the results of this regression. Column 1-4 show that higher income inequality is associated with higher stock marekt capitalisation across all measures of income inequality. The coefficient is only statistically different from zero at the 10 percent level for the standard deviation of permanent labour income inequality. Measures of overall income inequality comprising capital and labour income (Column 1) and total labour income inequality (Column 2 and 3) are not statistically significant instead. The fact that both labour income inequality measured by the share of income held by the top 10 percent and by the standard deviation are not significant suggests that the significant coefficient in Column 4 is not purely a result of moving from top shares to standard deviations. The average standard deviation of the standard deviation of permanent labour income inequality is around 0.1, implying that a one standard deviation increase in permanent labour income inequality increases stock market capitalisation by 20.6 percent of GDP. This is relatively large given that the average stock market capitalisation in the sample is 78% of GDP.

Turning to venture capital investment, we observe similar results. A one standard deviation increase in income inequality as measured by the standard deviation of permanent income raises venture capital investment by 0.14 percent of GDP. This is substantial, given that the average level of VC investment in the sample amounts to 0.09 percent of GDP. As for stock market capitalisation, other measures of income inequality are not statistically significant.

Appendix Table 6 reports results for other measures of income inequality which yield broadly consistent results. One potential concern is the small number of years available per country, and thus relatively little within-variation that is used to estimate the coefficients. Table 7 reports results without country fixed effects and shows that the inclusion of variation between countries in the estimation procedure yields much more precisely estimated coefficients. More unequal countries tend to have larger quantities of risky capital. Taken together, these results suggest that from a cross-country perspective, higher income inequality is associated with a larger volume of risky assets.

7.2 Asset prices

This section documents several facts regarding income inequality and asset prices using cross-country panel regressions.

Data. I use data on asset prices from the Macrohistory dataset compiled in Jordà et al. (2019). The dataset provides time-series for returns on safe assets (bills and bonds) and risky assets (equity and housing). All return series are deflated using the national CPI. I again restrict the sample to countries for which both measures of total and labour income inequality, including permanent income inequality, are available. This yields a sample of eight countries comprising Canada, Denmark, Germany, Spain, France, Italy, Norway,

Table 4: Income inequality, venture capital investment and stock market capitalisation

	Stock market capitalisation (% of GDP)				VC investment (% of GDP)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 10% income share	3.77				0.01			
	(2.81)				(0.01)			
Top 10% labour income share		11.80***				0.03		
		(3.04)				(0.03)		
Std. dev. of labour income			173.55				0.79	
			(114.32)				(0.42)	
Std. dev. of perm. labour income				206.42*				1.39**
				(101.33)				(0.55)
R2	0.77	0.78	0.76	0.76	0.78	0.78	0.80	0.81
Observations	74	74	74	74	74	74	74	74
Countries	7	7	7	7	7	7	7	7

Notes: This table reports the coefficient of different measures of income inequality on venture capital investment and stock market capitalisation estimated in equation 23. Coefficients of other covariates are omitted from the regression table. Standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Sweden and the United States. The panel is unbalanced and spans the years 1987-2019.

Empirical strategy. I estimate a variant of Equation 23 in which I replace the risky asset quantity as the dependent variable by the equity risk premium.

$$RiskPremium_{it} = \alpha_i + \delta_t + \boldsymbol{\beta}\mathbf{X_{it}} + \gamma Inequality_{it} + u_{it} \tag{24}$$

where i denotes the country, t the year, $RiskPremium$ the difference between the return on equity and the return on safe assets, X_{it} a set of country-specific macroeconomic controls, $Inequality$ a measure of income inequality and α_i and δ_t country and time-fixed effects. The country-time specific controls include debt to GDP ratios, the growth rate of per-capita real consumption and investment, and the demographic controls population growth and the old-age depedendency ratio. The latter captures differences in portfolio allocation across age groups (as explored in Kopecky and Taylor (2022)). I also include a control for the labour share.

Results. Table 5 reports the results of this regression using the same measures of income inequality as in the quantity regressions. Across all measures, higher income inequality is assocaited with lower equity risk premia. However, the coefficient is only statistically significant for the standard deviation of overall and permanent labour income. Top income shares comprising capital and labour income (Column 1) and labour income only (Column 2) are not statistically significant instead. The average standard deviation of the standard deviation of permanent labour income inequality is around 0.01, implying that a one standard deviation increase in permanent labour income inequality lowers the equity risk premium by rouughly 1.2 percentage points.

Table 5: Income inequality and asset returns across countries

	(1)	(2)	(3)	(4)
Top 10% income share	0.25			
	(0.81)			
Top 10% labour income share		0.24		
		(1.93)		
Std. dev. of labour income			-0.97***	
			(0.18)	
Std. dev. of perm. labour income				-1.19**
				(0.44)
R2	0.83	0.83	0.83	0.83
Observations	179	179	179	179
Countries	8	8	8	8

Notes: This table reports the coefficient of several measures of income inequality on asset returns estimated in equation. Coefficients of other covariates are omitted from the regression table. Standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix Table 8 decomposes the change in the equity risk premium into safe and equity returns separately. Higher income inequality is primarily associated with lower equity returns, and less so with lower safe returns. Appendix Table 9 shows additional results for alternative income inequality measures.

The empirical strategy is similar to the one pursued in Kopecky and Taylor (2022) who study the effects of demographics. I show that shifts in income inequality affect asset returns beyond the effects of demographics. My findings extend the results in Toda and Walsh (2020) across several dimensions who provide causal evidence of income inequality lowering equity risk premia exploiting tax changes in the US. I show that equity risk premia and income inequality are negatively correlated also in a cross-country setting, which goes beyond the cross-country results established for equity returns in that paper. I also show that it is primarily labour income inequality that matters, in line with the findings in Markiewicz and Raciborski (2022). In contrast to these papers, I also control for time-fixed effects which pick up common trends across countries.

8 Conclusion

This paper provides a novel perspective on how rising income inequality influences macro-financial outcomes by altering the composition of household savings demand. While previous literature has emphasized the role of increased income inequality in elevating savings levels, I demonstrate that a higher concentration of income shifts demand away from safe towards risky assets. This shift can have profound effects on the economy by affecting firms' financing conditions.

By integrating realistic household saving behavior and endogenous portfolio choice into a general equilibrium model, I provide a framework through which long-term trends in asset returns, capital allocation, and productivity can be analyzed. The central result is that higher income inequality induces a reallocation of capital from less productive, safer firms to more productive, riskier firms, leading to higher aggregate productivity. This reallocation helps explain the stability of the return to capital against the backdrop of the secular decline in safe real interest rates.

From a policy perspective, these findings underscore the importance of understanding the broader implications of income inequality on financial markets and the macroeconomy. Policymakers have a direct role in shaping the distribution of income through fiscal and monetary policies, and this paper suggests that doing so has important cross-sectional ramifications. Under certain conditions, rising inequality might generate broader economic gains, mitigating some of the adverse effects on lower-income households.

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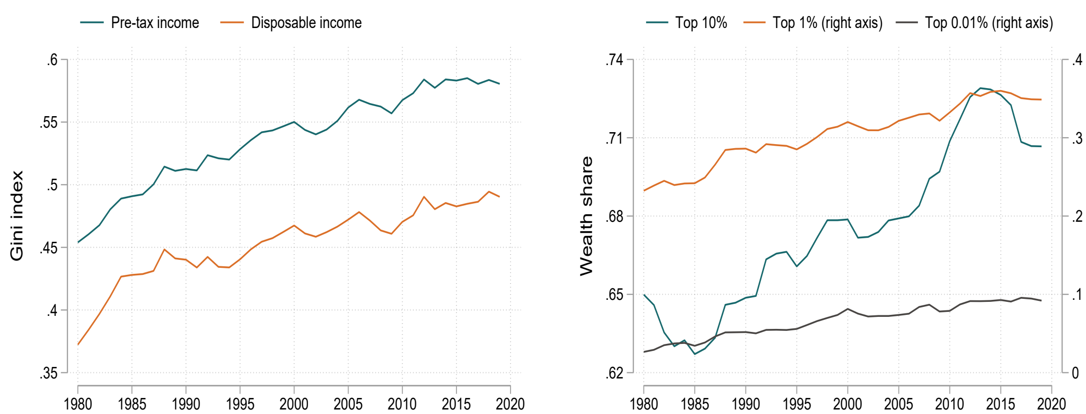
A Empirical appendix

This section provides details on the empirical analysis and presents additional evidence that support the main analysis.

A.1 Income inequality

This section documents additional evidence on the evolution of income inequality. The left panel of Figure 11 reports the evolution of the income Gini index and illustrates that the rise in income inequality is visible across the entire distribution of income and not just the right tail. The right panel shows that the rise in income inequality was accompanied by a substantial rise in wealth inequality.

Figure 11: Evolution of income and wealth inequality in the US



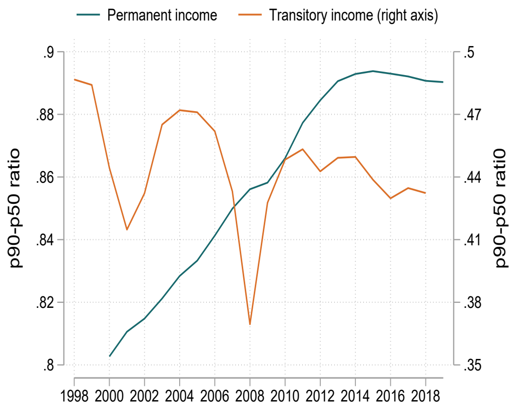
(a) Income Gini

(b) Wealth top shares

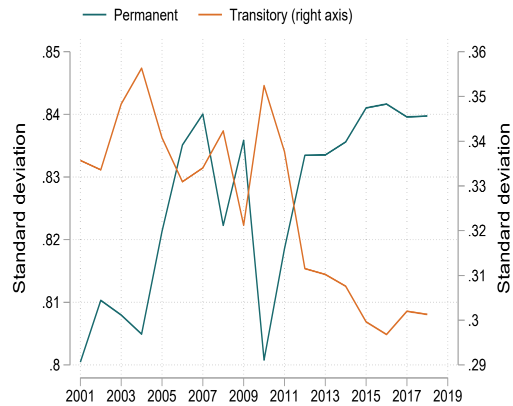
Notes: Data from the WID. The right panel reports figures for disposable income inequality. Disposable income includes labour and capital income, net of taxes and transfers.

Figure 12 considers alternative approaches to capturing the level of inequality in permanent income. The left panel considers the ratio of the 90th percentile of income to the 50th percentile of income. Permanent income is proxied with 3-year averages of log-earnings, the transitory component with year-to-year changes in log-earnings. The right panel performs the BPP decomposition assuming that income follows a random walk plus an MA(1) component (Blundell et al., 2008).

Figure 12: Permanent versus transitory labour income inequality



(a) p90-p50 ratio



(b) BPP decomposition

Notes: Data from GRID. The left panel decomposes earnings using 3-year averages of log earnings as a proxy for permanent income and year-to-year log earnings changes as a proxy for transitory income. The right panel decomposes earnings using the BPP procedure assuming a permanent-transitory income process composed of a random walk and an MA(1) component.

A.2 Portfolio allocation

A.2.1 Sample selection and variable definitions

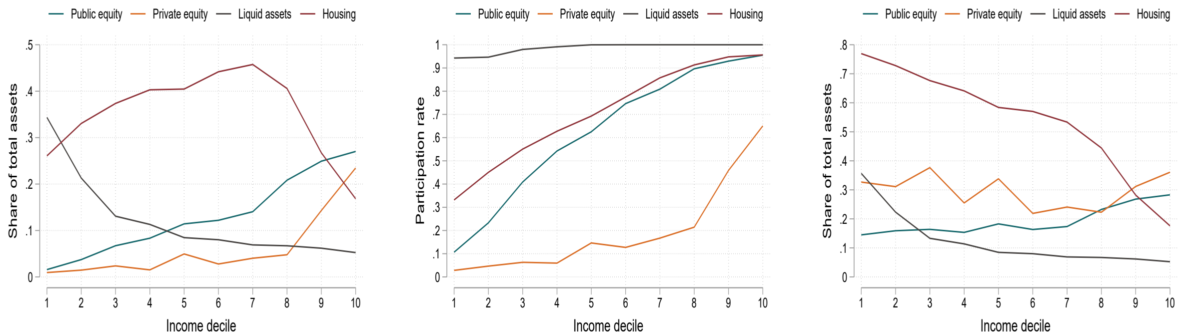
Sample. All figures are based on the Survey of Consumer Finances extract files for the years 1989-2019. I keep households who report to be employed and self employed of age 25-65. I drop all households with total household income of less than 20,000 USD. I also drop households who report having negative assets or negative business wealth.

Variable definitions. Income includes wages, self-employment and business income, taxable and tax-exempt interest,dividends, realized capital gains, food stamps and other support programs provided by the government, pension income and withdrawals from retirement accounts, Social Security income, alimony and other support payments, and miscellaneous sources of income. Public equity denotes the total value of financial assets held by household that are invested in stock. Private equity denotes the total value of business(es) in which the household has either an active or nonactive interest. Liquid assets denotes the total value of all types of transactions accounts.

A.2.2 Detailed portfolio shares

Figures 13 and 14 show portfolio shares and participation rates for a more detailed split of asset categories. I split risky assets into public and private equity, and show the housing and liquid asset component of safe assets. The figures illustrate that most of the rise in risky asset shares, both across income and time, comes from the equity component.

Figure 13: Portfolio shares and participation rates across the income distribution



(a) Portfolio shares

(b) Participation rates

(c) Portfolio shares conditional on participation

Notes: Survey of Consumer Finances 2019.

Figure 15 shows cross-sectional heterogeneity across income ventiles instead of deciles. The results look similar.

A.2.3 Portfolio allocation across wage income, wealth and wealth-to-income

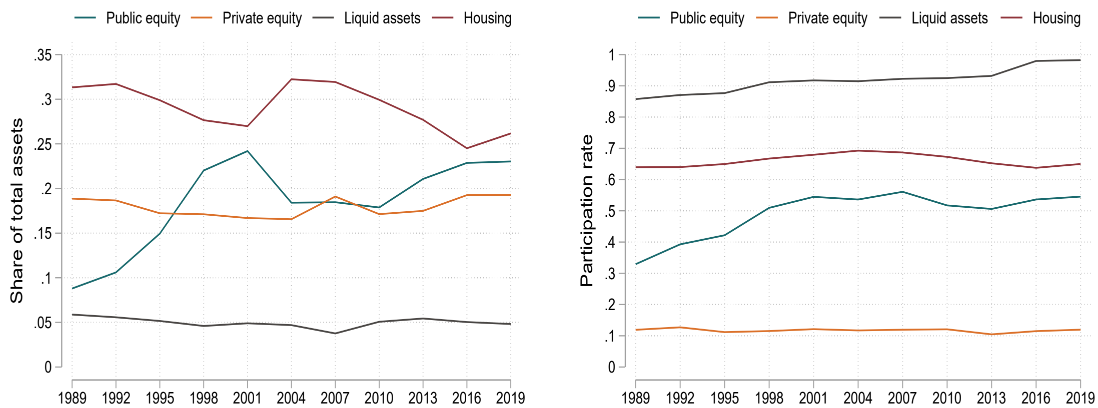
This section inspects portfolio heterogeneity across the distributions of wage income, wealth and wealth-to-income. Wage income is defined as income from salaries. Wealth denotes total asset holdings. Risky shares are increasing across all distributions.

A.2.4 Decomposing the rise in the equity share

Could the rise in equity shares be driven by rising equity participation of pension funds, i.e. not active decisions by households? And is the rise driven by more investment into individual stocks or mutual funds? The left panel in Figure 18 shows that both the share of directly and indirectly held stocks went up. The right panel shows that the increase in directly held equity is due to both larger holdings of stocks and mutual funds.

Figure 19 zooms into different income deciles. The left panel plots the previous decomposition of equity holdings across income deciles for SCF wave 2022. It shows that all types of equity are held disproportionately more by high-income households. The top decile stands out. While the bottom 90 percent predominantly hold equity indirectly, the top decile holds mostly direct equity, both in the form of individual stocks and mutual

Figure 14: Portfolio shares and participation rates over time

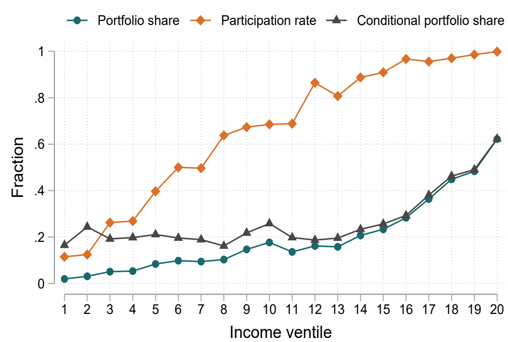


(a) Portfolio shares

(b) Participation rates

Notes: Survey of Consumer Finances.

Figure 15: Portfolio shares and participation rates across income ventiles

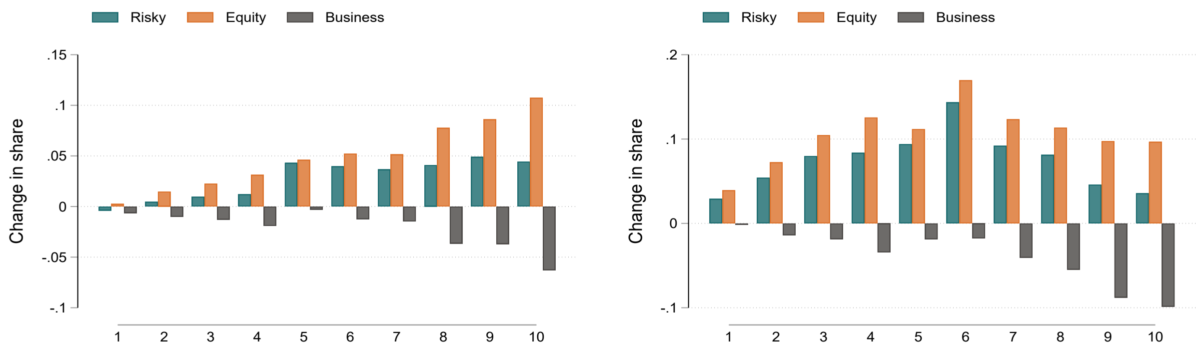


Notes: Survey of Consumer Finances 2019.

funds. The right panel plots the change in asset shares between 1989 and 2022 across income deciles. Indirect equity holdings increased across all deciles. The top decile is again different in the sense that it experienced the largest increase in direct mutual fund holdings. Direct stock holdings, instead, have not changed much over that period and a large part of the overall increase in stock holdings comes therefore from a reallocation of assets from lower to higher income households.

Figure 20 illustrates differences in participation rates and equity shares conditional on participation across directly and indirectly held equity.

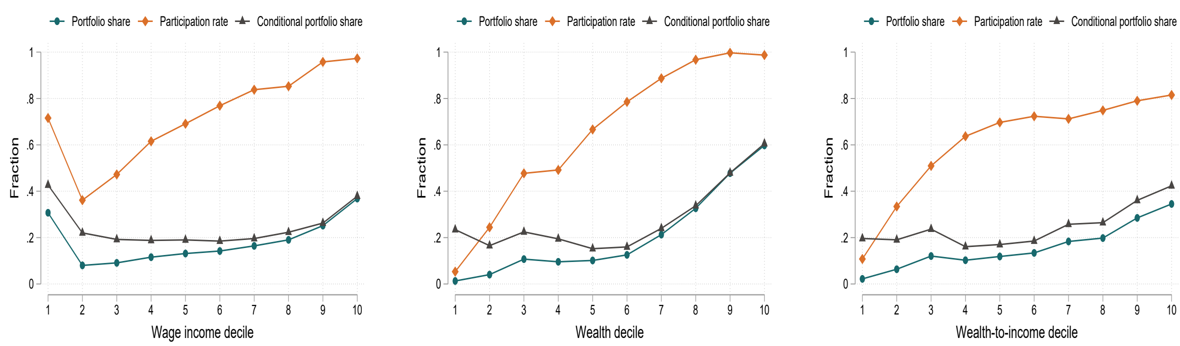
Figure 16: Cross-sectional portfolio allocation: Change between 2013-2019 and 1989-1995



(a) Portfolio shares (b) Participation rates

Notes: Survey of Consumer Finances.

Figure 17: Portfolio shares and participation rates across the wage income distribution



(a) Wage income (b) Wealth (c) Wealth-to-Income

Notes: Survey of Consumer Finances 2019.

A.2.5 Income inequality and risky capital

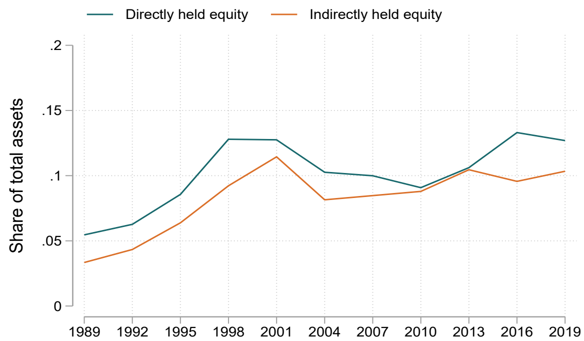
This section presents additional scatterplots that illustrate the correlation between incoem inequality and risky capital quantities.

A.3 Income inequality and productivity

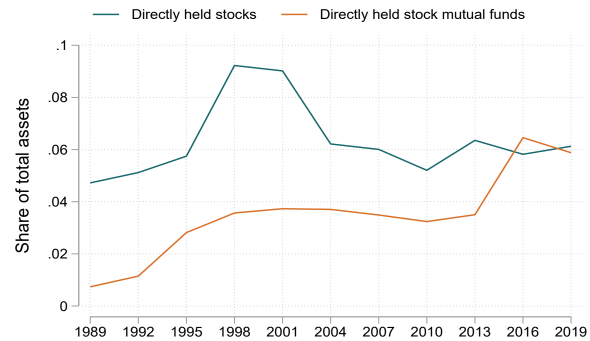
A.4 Income inequality and risky capital

This section reports additional regression results. Table 6 shows results with other income inequality measures. Table 7 reports results without country fixed effects instead.

Figure 18: Decomposition of the rise in the equity share



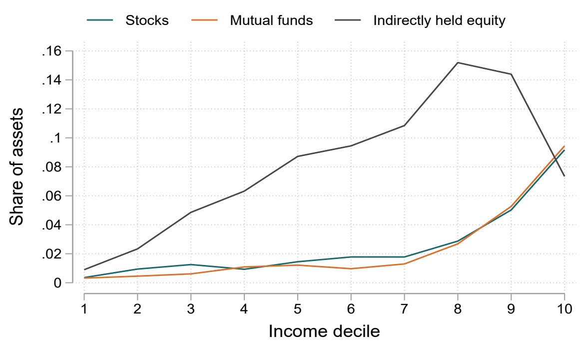
(a) Direct vs indirect holdings



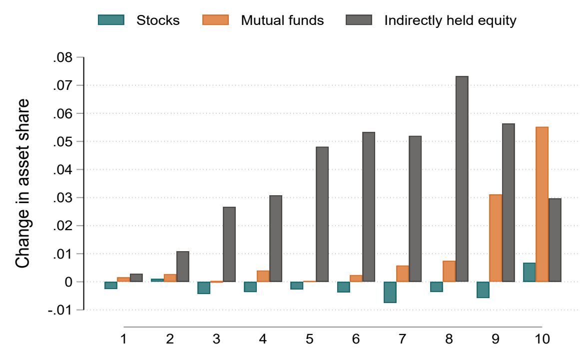
(b) Stocks vs mutual funds

Notes: Survey of Consumer Finances. Directly held equity includes stocks and stock mutual funds, where the latter also includes half of the value of combination mutual funds. Indirect equity includes IRAs, thrift type retirement accounts invested in stock and other managed assets with equity interest.

Figure 19: Decomposition of equity holdings across the income distribution



(a) 2019



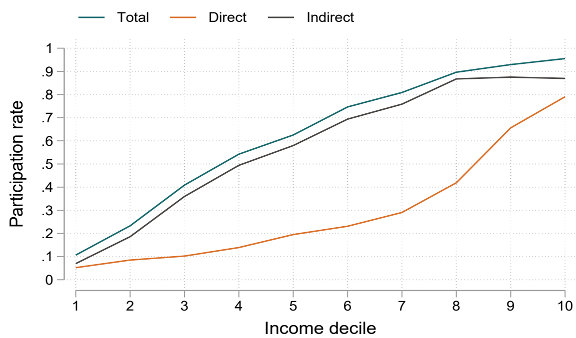
(b) Change between 1989 and 2019

Notes: Survey of Consumer Finances. Directly held equity includes stocks and stock mutual funds, where the latter also includes half of the value of combination mutual funds. Indirect equity includes IRAs, thrift type retirement accounts invested in stock and other managed assets with equity interest.

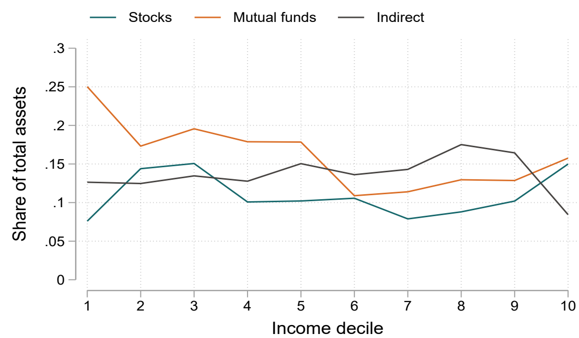
A.5 Income inequality and asset returns

This section reports additional regression results. Table 8 shows results for safe and equity returns separately. Table 9 reports results for other inequality measures.

Figure 20: Participation and conditional equity shares across the income distribution



(a) Participation rate



(b) Shares conditional on participation rate

Notes: Survey of Consumer Finances. Directly held equity includes stocks and stock mutual funds, where the latter also includes half of the value of combination mutual funds. Indirect equity includes IRAs, thrift type retirement accounts invested in stock and other managed assets with equity interest.

B Theoretical appendix

B.1 Derivations

This section reports the derivations to obtain optimal portfolio shares, equilibrium interest rates and quantities of capital in the analytical model. It follows closely the derivations in Angeletos (2007) and is primarily included for completeness.

Decision rules. Starting with individual decision rules, Lemma 2 in that paper shows that for given prices, optimal consumption, public and private investment are linear in wealth, i.e.:

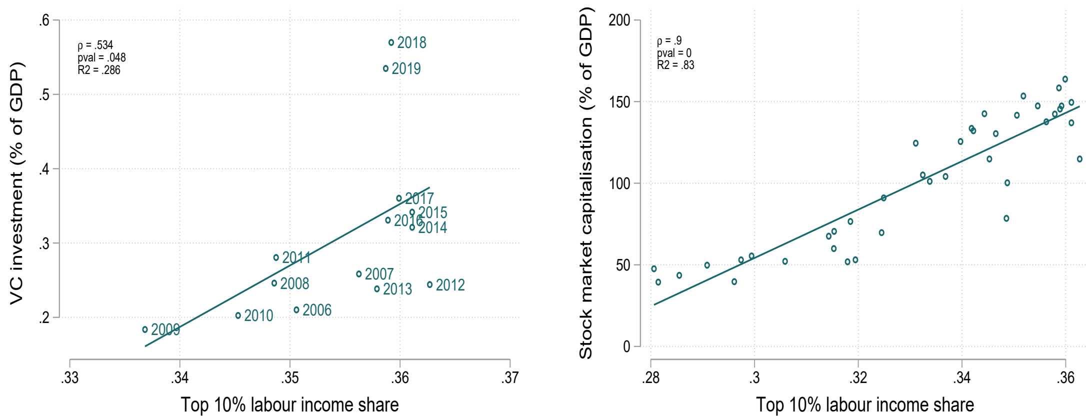
$$c_{it} = (1 - \varsigma_t)(w_{it} + h_t), \quad k_{it+1} = \varsigma_t \phi_t (w_{it} + h_t), \quad x_{it+1} = \varsigma_t (1 - \phi_t)(w_{it} + h_t)$$

where ς_t denotes the share of total wealth saved and ϕ_t denotes the share of savings allocated to the private firm. The linearity of decision rules is obtained by guess-and-verify. The optimal portfolio is described by:

$$\varphi \equiv \arg\max_{\phi \in [0,1]} CE_t \left(\phi \mu z_{t+1} + 1 - \phi \right), \qquad \varrho \equiv \max_{\phi \in [0,1]} CE_t \left(\phi \mu z_{t+1} + 1 - \phi \right)$$

To derive this formula, we use the fact that $E_t r_{t+1} = E_t \mu R_{t+1}$ which is established later. The interest R_{t+1} functions as a deterministic parameter and can therefore be taken out of the equation. $CE_t u^i_{t+1} \equiv \Gamma^{-1}[E_t \Gamma(u^i_{t+1})]$ represents the certainty equivalent of u_{t+1} condi-

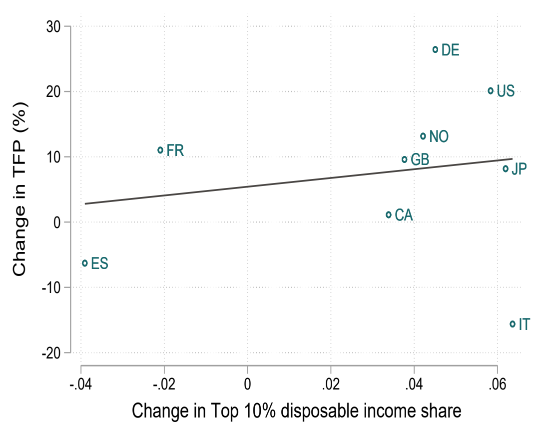
Figure 21: Labour income inequality, VC investment and stock market capitalisation



VC investment: 2006-2019 Stock market capitalisation: 1980-2019

Notes: GRID, Piketty and Saez (2003), World Bank and OECD.

Figure 22: Income inequality and productivity growth



Notes: This figure reports the change in TFP between 1980-1989 and 2019-2019 on the y-axis against the change in the share of disposable income held by the Top 1% for the same period. TFP data is taken from the Penn World Tables.

Table 6: Income inequality, VC investment and stock market capitalisation across countries. Other inequality measures

	Stock market capitalisation (% of GDP)					VC investment (% of GDP)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Top 1% income share	3.44					0.02				
	(3.64)					(0.01)				
Income Gini		2.95					0.01			
		(2.60)					(0.01)			
Top 1% labour income share			4.17					0.01		
			(4.13)					(0.02)		
Labour Income Gini				11.15***					0.03	
				(1.67)					(0.02)	
p90/50 of perm. labour income					384.65*					0.55
					(171.31)					(0.69)
R2	0.76	0.76	0.75	0.79	0.77	0.79	0.78	0.77	0.80	0.77
Observations	74	74	74	74	74	74	74	74	74	74
Countries	7	7	7	7	7	7	7	7	7	7

Notes: This table reports the coefficient of different measures of income inequality on venture capital investment and stock market capitalisation estimated in equation 23. Coefficients of other covariates are omitted from the regression table. Standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

tional on period t information, where Γ aggregates consumption across states: $\Gamma(c) = \frac{c^{1-\gamma}}{1-\gamma}$. Note that $\phi = \frac{k}{k+K+h}$ denotes the share of risky assets in total wealth, i.e. financial + human wealth, where $h_t \equiv \sum_{j=1}^{\infty} \frac{\omega_{t+j}}{R_{t+1}\ldots R_{t+j}}$. Given the CRRA specification, we can rewrite the optimal portfolio allocation as solving $\varphi \equiv \arg\max_{\phi\in[0,1]}(1-\gamma)\left[E_t\frac{(\phi\mu z_{t+1}+1-\phi)^{1-\gamma}}{1-\gamma}\right]^{\frac{1}{1-\gamma}}$ and similarly for ϱ.

Aggregate dynamics. Proposition 4 describes the aggregate dynamics of the economy which are shown below.

$$
\begin{aligned}
C_t + K_{t+1} + X_{t+1} &= Y_t = F(K_t, N_t, 1) + G(X_t, L_t) \\
C_t &= (1-\varsigma_t)(Y_t + H_t) \\
(1-\varsigma_t)^{-1} &= 1 + \beta^{\theta}\rho(\omega_{t+1}, R_{t+1})^{\theta-1}(1-\varsigma_{t+1})^{-1} \\
R_t &= G_X(X_t, L_t), \quad \omega_t = G_L(X_t, L_t) \\
K_{t+1} &= \phi(\omega_{t+1}, R_{t+1})\varsigma_t(Y_t + H_t), \quad N_t = \bar{n}(\omega_t)K_t \\
N_t + L_t &= 1 \\
H_t &= \frac{\omega_{t+1} + H_{t+1}}{R_{t+1}}
\end{aligned}
$$

Equilibrium prices. To obtain equilibrium prices, we use the additional Assumption

Table 7: Income inequality, VC investment and stock market capitalisation across countries. No country fixed effects

	Stock market capitalisation (% of GDP)				VC investment (% of GDP)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 1% income share	2.73***				0.03***			
	(0.89)				(0.00)			
Top 1% labour income share		5.64***				0.05***		
		(1.42)				(0.00)		
Std. dev. of labour income			56.23**				0.67***	
			(25.93)				(0.12)	
Std. dev. of perm. labour income				51.36*				0.69***
				(27.10)				(0.12)
R2	0.90	0.91	0.89	0.89	0.88	0.92	0.80	0.80
Observations	74	74	74	74	74	74	74	74

Notes: This table reports the coefficient of different measures of income inequality on venture capital investment and stock market capitalisation estimated in equation 23, but without country fixed effects. Coefficients of other covariates are omitted from the regression table. Standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A2 that $G(X, L) = F(X, L, 1/\mu)$. Combined with Assumption A1, i.e. $F(K, L, A) = F(AK, L, 1), \ln A \sim N(-\frac{\sigma^2}{2}, \sigma^2)$, yields that μ pins down the risk premium, i.e. $E_t r_{t+1} = E_t \mu R_{t+1}$. We get the level of R from the stationarity condition of aggregate savings: $\beta^\theta \rho^{\theta-1}[\varphi \bar{r}(\omega) + (1-\varphi)R] = 1$. This condition is derived from the Euler condition and the resource constraint. Using the fact that $R = R(\omega)$, $\bar{r}(\omega) = \mu R(\omega)$, we have that $\rho = \varrho R$ and $\varphi \bar{r}(\omega) + (1-\varphi)R = (\varphi\mu + 1 - \varphi)R$ which yields the expression for R:

$$
\begin{aligned}
R &= \beta^{-1} \varrho^{\frac{1}{\theta}-1} (\varphi\mu + 1 - \varphi)^{-\frac{1}{\theta}} \\
\bar{r} &= \mu R
\end{aligned}
$$

This derivation works under the assumption that we have shown that $\rho(\omega, R) = \varrho R$ and $\phi(\omega, R) = \varphi$. To derive the stationarity condition, note from the Euler equation that $\varsigma = \beta^\theta \rho(\omega, R)^{\theta-1}$.

Equilibrium quantities. In steady-state, $K = \phi\varsigma(Y + H)$ and $X = \varsigma(1-\phi)(Y + H) - H$. Combining this with the labour market condition $\bar{n}(\omega)K + l(\omega)X = 1$ and $\bar{n}(\omega) = \mu l(\omega)$ yields the allocation of capital across the private and public sector:

$$
K = \frac{\frac{1}{l(\omega)} + \frac{\omega}{R-1}}{\mu + \frac{1}{\varphi} - 1}, \quad X = \frac{1}{l(\omega)} - \mu K, \quad \frac{K}{X} = \frac{\frac{1}{l(\omega)} + \frac{\omega}{R-1}}{\left(\mu + \frac{1}{\varphi} - 1\right)\left(\frac{1}{l(\omega)} - \mu \frac{\frac{1}{l(\omega)} + \frac{\omega}{R-1}}{\mu + \frac{1}{\varphi} - 1}\right)}
$$

Approximate portfolio shares. We can approximate the optimal portfolio composition in

Table 8: Income inequality, safe and equity returns

	Safe return				Equity return			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 1% income share	0.04				-0.98			
	(0.26)				(0.92)			
Top 1% labour income share		1.92				0.42		
		(1.34)				(2.43)		
Std. dev. of labour income			0.08				-0.90***	
			(0.08)				(0.14)	
Std. dev. of perm. labour income				0.14				-1.05**
				(0.09)				(0.42)
R2	0.74	0.75	0.74	0.74	0.81	0.81	0.82	0.82
Observations	179	179	179	179	179	179	179	179
Countries	8	8	8	8	8	8	8	8

Notes: This table reports the coefficient of several measures of income inequality on asset returns estimated in Equation. Coefficients of other covariates are omitted from the regression table. Standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the following way. Note that because z_t is log-normally distributed, $E_t[z_{t+1}] = e^{\ln z + \frac{1}{2}\sigma_z}$ and $\log E[z] = E[\log z] + \frac{1}{2}Var(\log(z))$.[17] We next take logs because maximizing logs is the same as levels:

$$\begin{aligned}
\log \varrho &= \log E_t\left[(\phi\mu z_{t+1} + 1 - \phi)^{1-\gamma}\right] \\
&= (1-\gamma)E_t\left[\log\left(\phi\mu z_{t+1} + 1 - \phi\right)\right] + \frac{1}{2}(1-\gamma)^2\phi^2\mu^2(e^{\sigma_z^2} - 1) \\
&\approx E_t\left[\log\left(\phi\mu z_{t+1} + 1 - \phi\right)\right] + \frac{1}{2}(1-\gamma)\phi^2\sigma_z^2
\end{aligned}$$

where the last step uses approximation for small σ and μ. Next, we want to take a second-order Taylor expansion around the mean and then take expectations.

$$\begin{aligned}
\log\left(\phi\mu z_{t+1} + 1 - \phi\right) = \log(x) &\approx \log(\bar{x}) + \frac{1}{\bar{x}}(x - \bar{x}) - \frac{1}{2}\frac{1}{\bar{x}^2}(x - \bar{x})^2 \\
&\approx \log(\phi\mu + 1 - \phi) - \frac{1}{2(\phi\mu + 1 - \phi)^2}\phi^2\mu^2\sigma_z^2 \\
&\approx \phi(\mu - 1) - \frac{1}{2}\phi^2\sigma_z^2
\end{aligned}$$

[17] If $\ln z \sim N(-\frac{\sigma_z^2}{2}, \sigma_z^2)$, then $E(z) = 1$ and $Var(z) = (e^{\sigma^2} - 1)(e^{2E(\ln z) + \sigma^2})$. $e^{\sigma} \approx 1 + \sigma$ for small σ.

Table 9: Income inequality, equity risk premia. Other inequality measures

	(1)	(2)	(3)	(4)	(5)
Top 10% income share	0.25				
	(0.81)				
Income Gini		-0.13			
		(0.66)			
Top 10% labour income share			0.24		
			(1.93)		
Labour Income Gini				-1.43^{***}	
				(0.34)	
p90/50 of perm. labour income					0.25
					(0.50)
R2	0.83	0.83	0.83	0.83	0.83
Observations	179	179	179	179	179
Countries	8	8	8	8	8

Notes: This table reports the coefficient of several measures of income inequality on asset returns estimated in Equation. Coefficients of other covariates are omitted from the regression table. Standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Now we plug this approximation back into the maximization problem and solve for ϕ:

$$\max_{\phi} \phi(\mu - 1) - \frac{1}{2}\phi^2\sigma_z^2 + \frac{1}{2}(1-\gamma)\phi^2\sigma_z^2 = \max_{\phi} \phi(\mu - 1) - \frac{1}{2}\gamma\phi^2\sigma_z^2$$
$$\Rightarrow \varphi = \frac{\mu - 1}{\gamma\sigma_z^2}, \quad \varrho = \exp\left(\frac{(\mu-1)^2}{2\gamma\sigma_z^2}\right)$$

This yields the optimal portfolio shares which resemble the solution from the standard Merton-Samuelson portolio choice problem.[18]

B.2 Proofs

Across all proofs, we make the simplifying assumption that $\theta = 1$ and we use the approximate portfolio shares derived in the previous section.

Proof of Proposition 2. Starting with the discount factor, we can show the following for

[18] This is identical to the solution in Angeletos (2007): $\phi_t \approx \frac{\ln \bar{r}_{t+1} - \ln R_{t+1}}{\gamma\sigma_{t+1}^2}$ and $\rho_t \approx R_{t+1}\exp\left(\frac{(\ln \bar{r}_{t+1} - \ln R_{t+1})^2}{2\gamma\sigma_{t+1}^2}\right)$ where $\bar{r}_{t+1} \equiv E_t[r(A_{t+1}, \omega_{t+1})]$ and $\sigma_{t+1}^2 \equiv Var_t(\ln(r(A_{t+1}, \omega_{t+1})))$.

the quantity of risky capital:

$$\frac{\partial K^r}{\partial \beta} = \frac{1}{\mu + \frac{1}{\varphi} - 1} \left(\underbrace{\frac{\partial (l^s)^{-1}}{\partial \beta}}_{>0} + \underbrace{\frac{\partial \frac{\omega}{r^s}}{\partial \beta}}_{>0} \right) > 0$$

To obtain results for safe capital and the safe capital share, rewrite the safe to risky capital share as:

$$\frac{K^s}{K^r} = \left(\frac{1}{l^s} - \mu \frac{\frac{1}{l^s} + \frac{\omega}{r^s}}{\mu + \frac{1}{\varphi} - 1} \right) \frac{\mu + \frac{1}{\varphi} - 1}{\frac{1}{l^s} + \frac{\omega}{r^s}} = \frac{\mu + \frac{1}{\varphi} - 1}{1 + \frac{\omega l^s}{r^s}} - \mu = \frac{\mu + \frac{1}{\varphi} - 1}{1 + \frac{1-\alpha}{\alpha}} - \mu$$

where the last equality follows from $l = \frac{1-\alpha}{\alpha} \frac{r^s}{\omega}$. The safe capital share is independent of the discount factor. Because the risky capital quantity is increasing in the discount factor and the risky share is constant, the safe capital quantity must also be increasing in patience.

For risk aversion, we start again with the risky capital quantity:

$$\frac{\partial K^r}{\partial \gamma} = \underbrace{\frac{\partial \frac{1}{\mu + \frac{1}{\varphi} - 1}}{\partial \gamma}}_{<0} \left(l^{-1} + \frac{\omega}{r^s} \right) + \frac{1}{\mu + \frac{1}{\varphi} - 1} \left(\underbrace{\frac{\partial l^{-1}}{\partial \gamma}}_{<0} + \underbrace{\frac{\partial \frac{\omega}{r^s}}{\partial \gamma}}_{<0} \right) < 0$$

From the expression for the safe capital share, it is also evident that $\frac{\partial \frac{K^s}{K^r}}{\partial \gamma} > 0$ because $\frac{\partial \varphi}{\partial \gamma} < 0$.

C Model appendix

C.1 Simulations of the stylized model

This sections complements the analytical results of the stylized model with numerical simulations. The simulations are useful in three ways. First, they illustrate quantitatively the relevance of changes in the discount factor and risk aversion for the price and allocation of capital. Second, they validate the analytical results which were based on approximations of the optimal portfolio shares. Third, they allow me to study the relevance of the magnitude of the IES which was previously assumed to be 1.

I set the following baseline parameters for the simulation: $\sigma_\zeta = 0.2, \gamma = 3, \theta = 1, \beta = 0.96, \alpha = 0.36, \mu = 1.005$. Across all simulations, I vary one parameter at a time and hold all other parameters fixed at their baseline values.

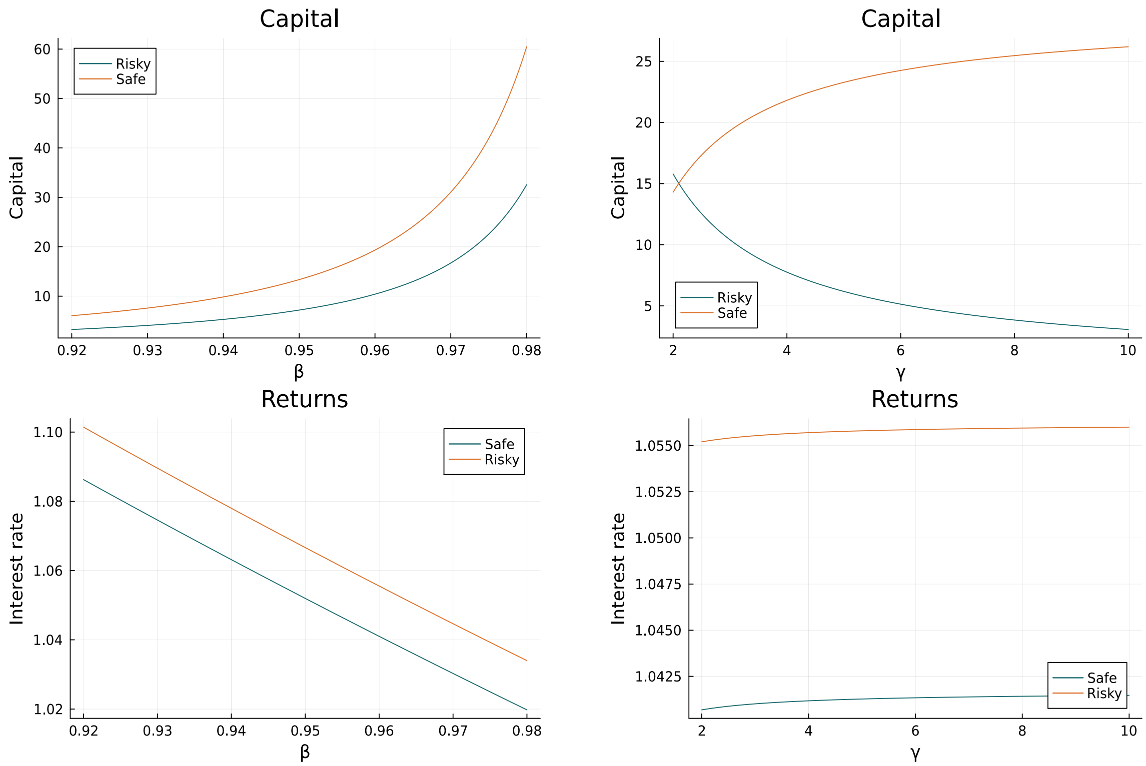
Figure 23 shows how risky and safe capital and their respective returns vary across different levels of patience and risk aversion. Overall, the simulations validate the analytical results. The amount of risky capital is increasing with higher discount factors and lower risk aversion which is precisely what higher income inequality should induce with non-homothetic preferences. Safe capital is also increasing in patience and in the degree of risk aversion. Turning to prices, returns to capital are decreasing in the discount factor approximately linearly. With respect to risk aversion, returns are slightly increasing, but are relatively inelastic.

I now turn to the role of the intertemporal elasticity of substitution, which I assumed to be 1 until now. I will use the simulations to answer two questions. First, to what extent are the comparative statics for the discount factor and risk aversion dependent on the size of the IES? And second, how do returns and quantities vary with the size of the IES? Figure 24 plots again the sensitivity of quantities and prices to changes in patience and risk aversion, but this time for low and high values of the IES, namely $\theta^L = 0.2$ and $\theta^H = 2$. These values capture the commonly used range of IES values used in the literature. The figure shows that irrespectively of the level of the IES, the sensitivity of the two capital types behaves similarly. The behaviour of returns, on the other hand, flips signs. For low levels of θ, interest rates decrease with the degree of risk aversion. This suggests that the result derived in Proposition 1 that interest rates are increasing in risk aversion holds only above a certain threshold level of the IES, which is below $\theta = 1$.[19]

Figure 25 plots the response of capital and returns to changes in the IES itself. Investigating the sensitivity to different values of the IES is of interest because standard non-time

[19] This is consistent with the findings in Angeletos (2007).

Figure 23: The role of patience and risk aversion for risky and safe returns and capital



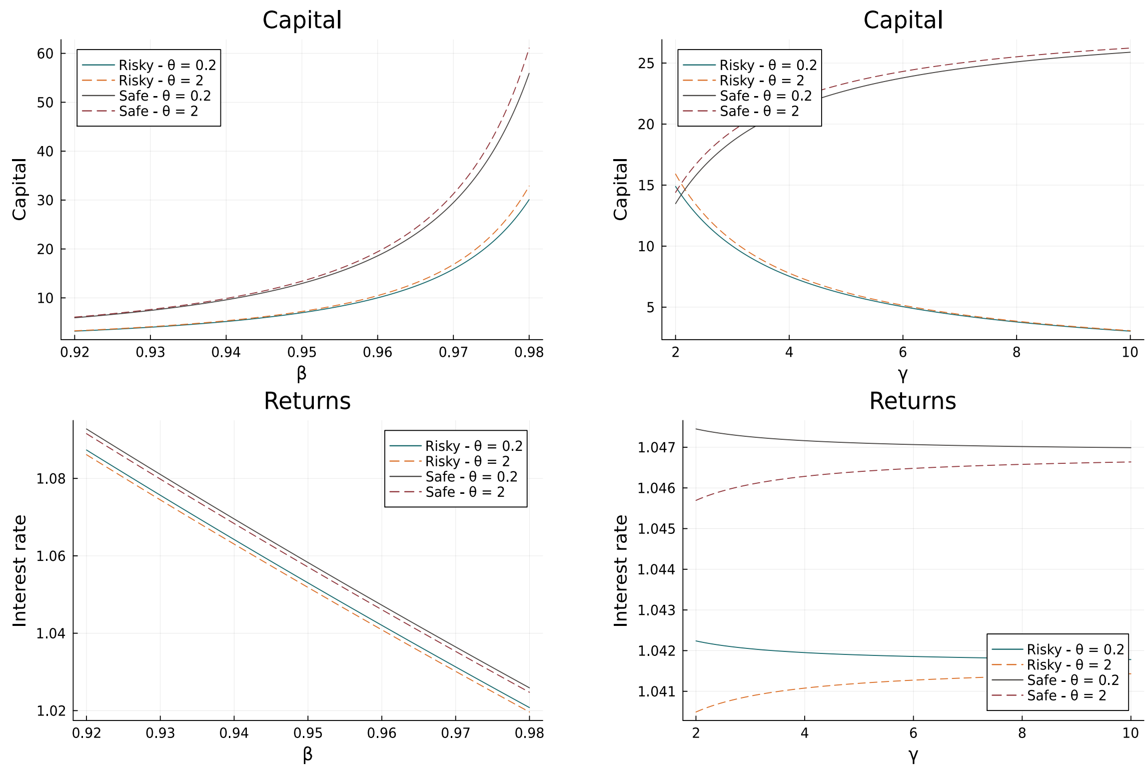
(a) Patience

(b) Risk aversion

Notes: This figure reports capital quantities and returns across different values of the discount factor β and risk aversion γ. The baseline parametrization is $\sigma_\zeta = 0.2, \gamma = 3, \theta = 1, \beta = 0.96, \alpha = 0.36, \mu = 1.005$.

separable CRRA preferences parametrize the magnitude of the IES and risk aversion with just one parameter. Understanding to what extent capital quantities and returns respond differently to variations in these two parameters is informative about the adequacy of the CRRA utility specification in that context. The left panel shows that both risky and safe capital are increasing in the IES. Because $\theta = \frac{1}{\gamma}$ under CRRA, this means that these two forces are working in the opposite direction for safe capital, but in the same direction for risky capital. The decrease in risky capital from an increase in risk aversion is not offset by an increase from a lower IES. Quantitatively, capital is much less elastic to changes in θ than γ. Note that the range of risk aversion values for which quantities are most elastic is not shown in the figure ($\gamma < 2$), while this corresponds to the range of values for θ for which capital is least elastic ($\theta > 0.5$). Similarly, both decreasing risk aversion and increasing IES lower the interest rate. Quantitatively, the elasticities or returns are broadly similar across IES and risk aversion.

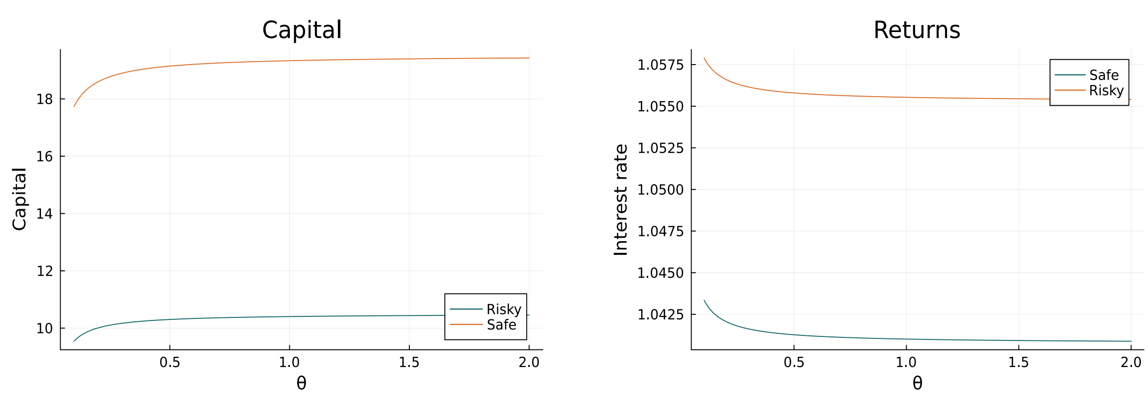
Figure 24: The interaction between patience, risk aversion, and the IES



(a) Patience (b) Risk aversion

Notes: This figure reports capital quantities and returns across different values of the discount factor β and risk aversion γ for two levels of the EIS, $\theta^L = 0.2$ and $\theta^H = 2$. The baseline parametrization is $\sigma_\zeta = 0.2, \gamma = 3, \beta = 0.96, \alpha = 0.36, \mu = 1.005$.

Figure 25: The role of the IES for risky and safe returns and capital



Notes: This figure reports capital quantities and returns across different values of the intertemporal elasticity of substitution θ. The baseline parametrization is $\sigma_\zeta = 0.2, \gamma = 3, \beta = 0.96, \alpha = 0.36, \mu = 1.005$.