Financial Literacy, Portfolio Choice, and Wealth Inequality: A General Equilibrium Approach*†

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Abstract

I develop a general equilibrium model in which households allocate their wealth to safe and risky assets ("bonds" and "stocks") and accumulate financial literacy to raise their risk-adjusted stock returns. Calibrated to match financial literacy and stock market participation rate of U.S. households, the model demonstrates that a policy subsidizing financial literacy acquisition increases short-run stock investments. In equilibrium, however, the resulting aggregate capital growth lowers the average equity premium, thereby moderating the subsidy's impact. The policy mitigates wealth inequality by inducing heterogeneous portfolio adjustments across the wealth distribution. With the subsidy, the middle wealth quartiles acquire more financial literacy and shift their portfolios toward stocks. The top quartile attains its maximum literacy level prior to the subsidy and shifts toward bonds to compensate for lower stock returns. The ratio of total wealth held by the top quartile versus the rest of the population decreases.

Keywords: Financial literacy, stock market participation, equity premium, return heterogeneity, wealth inequality

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1 Introduction

There is substantial dispersion in both financial literacy and returns to wealth across households in the United States (Lusardi and Mitchell, 2014; Hubmer et al., 2021). As defined in Lusardi and Mitchell (2014), financial literacy refers to people's "*ability to process economic information and make informed decisions about financial planning, wealth accumulation, debt, and pensions.*" Being capable of making informed decisions, more literate individuals tend to have higher portfolio shares in public equities than in interest-bearing assets, as well as higher Sharpe ratios on their stock investment, which together contribute to higher expected returns to net worth (Van Rooij et al., 2011; Clark et al., 2017; Von Gaudecker, 2015). In light of this positive correlation between financial literacy and investment outcomes, there has been growing research and policy interest in financial education interventions. These initiatives, commonly administered through workplace and school-based personal finance education programs, have demonstrated positive causal effects on the financial behaviors of individuals (Stolper and Walter, 2017; Kaiser et al., 2022).

Nevertheless, to date few studies have examined the effect of scaling these programs to the aggregate level. In this paper, I fill this gap by analyzing the macroeconomic interplay between financial literacy disparity and wealth inequality using a general equilibrium framework, which incorporates household portfolio choice and financial literacy investment into a heterogeneous-agent incomplete market model. This quantitative framework informs us about the aggregate and redistributive implications of policy interventions that subsidize households' financial literacy acquisition. Specifically, I use the model to quantify to what extent the policies can stimulate aggregate capital accumulation and mitigate wealth inequality. Understanding this relationship in a general equilibrium setup is crucial for accurately evaluating the counterfactual effects of financial education policies, since enhancing the economy's overall financial literacy may not fully translate into aggregate capital growth due to potential adjustments in asset returns.

In particular, I develop a life-cycle incomplete market model in which households smooth their consumption by investing in financial assets. Households also have the option to invest their resources to gain financial knowledge and sophistication that help them achieve higher asset returns. The household consumption-saving problem builds upon a standard household portfolio choice model with background labor income risks (Cocco et al., 2005; Gomes and Michaelides, 2005). In this overlapping generations framework, working-age households receive stochastic labor incomes while retired households receive deterministic pension benefits. Two types of assets are available in the economy: a risk-free asset ("bonds") and a risky asset with stochastic returns ("stocks"). Accordingly, households face uninsurable risks in both labor and capital incomes. In each period, households can save their wealth in either or both assets. Their portfolio choices are impacted by several market frictions, including borrowing and short-sale constraints, as well as a per-period stock market participation cost. The equity premium on stocks, therefore, compensates for idiosyncratic risk and participation cost.

The model incorporates households' endogenous accumulation of financial literacy, following Lusardi et al. (2017). Financial literacy represents various drivers of sophisticated wealth accumulation: financial knowledge, investment experience and expertise, educated use of financial advising and asset management services, and access to promising investment opportunities. Previous studies have demonstrated a positive association between measures of household financial literacy and their asset returns (Clark et al., 2017; Von Gaudecker, 2015; Bianchi, 2018). Motivated by this empirical evidence, the model assumes that households can raise their risk-adjusted stock returns by accumulating financial literacy. However, attaining such financial savvy and investment techniques comes at a cost, requiring households to allocate their resources between consumption, savings, and literacy acquisition. Furthermore, financial literacy depreciates over time. Considering these dynamic trade-offs between the expected increase in stock returns and the associated costs, households choose the level of financial literacy investment in each period. The resulting distribution of financial literacy gives rise to the endogenous heterogeneity in stock returns across households.

The household portfolio and financial literacy choices are embedded into a production economy where the government issues risk-free bonds, and a representative firm rents capital on a competitive market. The government debt is financed by capital income taxes on both financial assets. In equilibrium, productive capital is supplied by the total household savings in *stocks*. Moreover, the firm's aggregate capital rent payment constitutes the total stock investment income earned by all households. I formalize this additional consistency condition for capital income akin to Hubmer et al. (2021). My model extends their equilibrium definition by positing that financial literacy operates as a schedule to distribute aggregate capital income across households, such that a larger (smaller) share of capital income is allotted to more (less) literate households.[1] This equilibrium condition for aggregate capital income implies a zero-sum aspect of financial literacy accumulation: if a household improves its financial literacy and expected stock return, its increased return comes at the loss of other households. Accordingly, the household's financial literacy accumulation generates a *pecuniary externality* on the overall equity premium.

By accounting for the asset market clearing conditions, the general equilibrium model provides novel insight into the aggregate implications of financial literacy subsidies. In particular, the model permits a unique equilibrium mechanism through which financial literacy affects the equity premium. The equilibrium effects of financial literary subsidies are twofold. Firstly, the policies boost financial literacy and stock investments, but the increased capital supply leads to a drop in the market rental rate of capital. Secondly, as the economy becomes more financially literate, the total pecuniary externality from individual literacy acquisition also grows, further diminishing the relative share of the aggregate capital income distributed to households with below-average literacy. In order to capture the second channel, the model assumes that an increase in total pecuniary externality reduces the *base* expected stock return that households with minimum literacy can earn by investing in stocks.

1. In this model specification, financial literacy does not directly enter the firm's production function; that is, raising aggregate financial literacy has no impact on the economy's fundamental production capacity or total factor productivity (TFP).

The marginal product of capital and the base expected stock return are the key equilibrium objects governing the overall equity premium. In equilibrium, subsidizing financial literacy decreases both the market capital return and the base stock return, thereby decreasing the average equity premium of the economy. These equilibrium adjustments of asset returns, in turn, attenuate the subsidies' net effects on aggregate capital growth. Furthermore, the model implies that financial literacy subsidies have heterogeneous impacts on household-specific equity premia and portfolio choices across the wealth distribution, hence rendering non-trivial redistributive implications.

In quantifying the aggregate and distributional impacts of financial literacy subsidies, I calibrate the model to match the financial literacy and stock market participation of U.S. households in the Survey of Consumer Finances (SCF). The Survey provides a measure of financial literacy determined by survey respondents' understanding of fundamental economic concepts (namely, inflation, interest rates, and risk diversification).[2] The financial literacy *score* then ranges from 0 to 3, depending on how many questions the respondents answered correctly. According to the data from the 2016-2019 SCF, the average financial literacy score among U.S. households between ages 26 and 80 is 2.19. The data also indicates that only 44.2 percent of this population could answer all three financial literacy questions correctly, a number that is even lower than the population share of stock market participants, which is 54.1 percent. The model replicates well the hump-shaped life-cycle pattern of financial literacy, as well as the average stock market participation rates by wealth groups. To externally validate the model, I compare household-level stock market participation elasticities with respect to financial literacy in the data and in the model simulations.

In the primary counterfactual analysis of the paper, I assess the net effects of a policy intervention that subsidizes 75 percent of a household's financial literacy investment cost. The government funds this universal subsidy by levying a constant capital income tax on all financial assets, where the tax revenue is also utilized to pay for bond returns. With

2. These financial literacy questionnaires are based on the *Big Three Questions* developed by Lusardi and Mitchell (2014).

the subsidy, the model predicts that the average financial literacy score would rise by 10.1 percent, and the aggregate stock market participation rate would rise by 1.9 percentage points in partial equilibrium where only the labor market is cleared. By contrast, in general equilibrium, the net increase in the participation rate shrinks to 0.2 percentage points. This substantial attenuation is derived from the decrease in the aggregate equity premium from 5.38 to 5.28 percent, caused by (1) the decline in the rental rate of capital (from 7.70 to 7.68 percent), and (2) the increase in the capital income tax rate levied to finance the subsidy (from 9.8 to 10.8 percent). Calculating the policy effects accounting only for the rental rate adjustment leads to a predicted 0.8 percentage point increase in the stock market participation rate, indicating that the equilibrium capital return response itself makes a non-negligible impact on aggregate capital.

In any event, the financial literacy subsidy still mitigates wealth inequality by inducing heterogeneous portfolio rebalancing across the wealth distribution. The intervention increases financial literacy for the middle wealth quartiles the most, but it hardly impacts the top and bottom quartiles. The wealthiest households attain their maximum literacy level even without the subsidy, while the poorest households, who hold no stock due to participation costs, continue not to acquire financial literacy even when it is subsidized. Accordingly, households across the wealth distribution undergo heterogeneous changes in their own equity premia. The middle wealth quarterlies—with their improved literacy—experience an increase in their expected equity premium; while the top and bottom wealth quartiles experience a decrease. Consequently, the middle groups shift their portfolio toward stocks, *raising* their risky portfolio share by 1.8 percent, whereas the top wealth quartile shifts toward bonds to compensate for lower stock returns, *reducing* their risky share by 0.7 percent.

Wealth inequality, measured as a ratio of total wealth held by the top quartile versus the rest of the population, decreases by 1.9 percent. The model predicts that the poorest and least financially literate remain out of the stock market due to high participation costs, suggesting a possible benefit of market participation subsidies. I further explore the efficacy of alternative policy experiments targeted at different population subgroups such as young workers and middle-aged workers closer to retirement. In particular, I find that subsidizing both stock market participation and financial literacy investment for young workers can substantially increase the average stock market participation rate by 7.87 percent.

Related Literature This paper contributes to the literature at the intersection of macroeconomics and household finance. Wealth has been increasingly concentrated in the U.S. (Saez and Zucman, 2016; Gabaix et al., 2016). Underlying this severe wealth disparity, among other factors, is the heterogeneity in returns to wealth (Benhabib et al., 2019; Hubmer et al., 2021; Xavier, 2021). This observed wealth return heterogeneity can be potentially explained by differences in portfolio choice across households (Cocco et al., 2005; Gomes and Michaelides, 2005; Fagereng et al., 2017; Catherine, 2021). Still, the persistent correlation between household wealth and return suggests that permanent household characteristics can drive return heterogeneity even *within* asset classes (Fagereng et al., 2020; Bach et al., 2020). In particular, low-income and less-educated individuals tend to exhibit poorer financial literacy and make sub-optimal investment decisions (Calvet et al., 2007, 2009; Lusardi et al., 2017; Jappelli and Padula, 2017). This present paper's main contribution to the literature is to provide a novel equilibrium explanation for how raising financial literacy impacts capital accumulation and wealth inequality.

The remainder of the paper is structured as follows. Section 2 presents the model environment. Section 3 describes the data and quantification exercises. Section 4 discusses the quantitative and policy analyses. Section 5 investigates alternative model specifications and conducts sensitivity checks. Section 6 concludes.

2 Model

I develop a finite-horizon general equilibrium model with households making portfolio and financial literacy choices. The heterogeneity in capital income is shaped by the endogenous distribution of financial literacy. The first part of this section section outlines the decision problems for households, firms, and the government. The remaining part of the section elucidates the equilibrium concepts.

2.1 Household's Problem

2.1.1 Household Life Cycle and Preferences

Time is discrete with t representing a household's age. The economy consists of finitely-lived households born at $t = 0$ (age 25) and living for T more periods (age 80). Each cohort has an identical population size, and there is no population growth.[3] Households derive utility from consuming a single non-durable good c_t, and their preferences are defined à la Epstein and Zin (1989) and Weil (1990) as follows:

$$V_t = \left\{ \left(1 - \beta\right) c_t^{1-1/\psi} + \beta \mathbb{E}\left[V_{t+1}^{1-\gamma} \right]^{\frac{1-1/\psi}{1-\gamma}} \right\}^{\frac{1}{1-1/\psi}}, \tag{1}$$

where β is the discount factor, ψ is the elasticity of inter-temporal substitution (EIS), and γ is the coefficient of relative risk aversion (RRA).

2.1.2 Labor Incomes, Social Security, and Housing Costs

Labor supply is exogenous. Households work for the first $T_R < T$ periods of their life and then they receive retirement benefits afterwards. Working-age households' labor productivity is stochastic and their efficiency units of labor $\{l_t\}_{t=1}^{T_R}$ follow a log-AR(1) process:

$$\log(l_t) = m_t + \rho \log\left(l_{t-1}\right) + \varepsilon_t, \quad \text{for } t \leq T_R, \tag{2}$$

where the age-specific drift m_t is a deterministic life cycle component, $\rho \in [0, 1)$ is the AR(1) auto-correlation coefficient, and $\varepsilon_t \sim \mathcal{N}(0, \sigma_l^2)$ is an idiosyncratic shock to labor

3. Households face no mortality risk or health uncertainty.

productivity. After retirement, households receive deterministic social security benefits and pension payments which together substitute for their final working-age labor income at a replacement ratio $\lambda \in (0,1)$. The corresponding efficiency units of labor for retirees are:

$$l_t = \exp(m_t) \cdot \lambda l_{t_R} \quad \text{for } t > t_R, \tag{3}$$

Labor income is taxed at a constant rate τ^l while social security benefits are non-taxable. Households spend an exogenous fraction of their pre-tax labor incomes (or social security benefits) for housing, where the age-specific fraction is denoted by $h_t \in (0,1)$.[4]. The households' disposable labor and retirement benefit incomes, net of applicable taxes and housing costs, read as:

$$\tilde{l}_t = \begin{cases} \left(1-\tau^l\right)(1-h_t) \cdot w \cdot \exp(m_t + \varepsilon_t) \cdot l_{t-1}^{\rho} & \text{if } t \leq T^R, \\ \lambda\,(1-h_t) \cdot w \cdot \exp(m_t) \cdot l_{t_R} & \text{if } t > T^R, \end{cases} \tag{4}$$

where w is a wage per efficiency unit of labor, to be determined in equilibrium.

2.1.3 Financial Assets and Portfolio Choices

Markets are incomplete: households are not allowed to trade full state-contingent Arrow securities, yet they may engage in an inter-temporal exchange of resources and smooth consumption by investing in financial assets. There are two types of assets: a risk-free asset ("bonds") and a risky asset ("stocks"). Let b_t denote the amount of bonds a household has at the beginning of period t. Bonds yield a risk-free return r^b. Let a_t denote the household's stock holdings. The stock return schedules are characterized by a function of an

4. While the household problem in this paper does not directly incorporate the consumption choice of durable goods or a housing decision, it follows the literature's common practice of introducing housing costs as a faction of labor income to capture the life-cycle pattern of household consumption and saving behavior (Gomes and Michaelides, 2005; Love, 2010; Horneff et al., 2023). A set of previous studies incorporating the housing decision in the life-cycle model establishes the correlation between households' real estate holdings and financial asset positions Cocco (2005); Yao and Zhang (2005); Yogo (2016).

idiosyncratic shock as well as the individual household's financial literacy level at period t.[5] The functional form of household-specific stock returns is specified in Section 2.1.4, which describes a structural link between financial literacy and the idiosyncratic equity premia.

Markets are frictional in three aspects. First, borrowing bonds and short-selling stocks are not allowed: $b_t \geq 0$ and $a_t \geq 0$. These liquidity constraints ensure that households hold non-negative wealth throughout their life cycles. Moreover, the borrowing constraint prevents households from leveraging their future stream of incomes to invest in stocks. Second, households with positive stock holdings incur a constant *per-period* stock market participation cost θ (in consumption units) for each period t s.t. $a_t > 0$. Accordingly, these stock investors obtain an equity premium as compensation for both uninsurable shocks and participation costs associated with their risky portfolio choices. Third, capital incomes are taxed at a constant rate τ^r; for simplicity, I assume that bond and stock investments are subject to the same capital income tax rate.

It can be convenient to express household asset positions using portfolio shares. Define $\mathcal{S}_t = a_t + b_t$ as the amount of gross saving a household has in either or both financial assets at the beginning of period t. Also define $\kappa_t = a_t/\mathcal{S}_t$ as the household's risky portfolio share, or the fraction of its financial wealth invested in stocks, at time t. By construction, the wealth share in bonds is given by $(1 - \kappa_t) = b_t/\mathcal{S}_t$. The borrowing and short-selling constraints can be formulated as the bounds on portfolio shares: $\kappa_t \in [0, 1]$.

2.1.4 Financial Literacy Accumulation and Equity Premium

As in Lusardi et al. (2017), I augment the life-cycle portfolio choice model with household investment in financial literacy. A key assumption of the model is that a household can

5. As commonly assumed in the portfolio choice literature, I do not incorporate aggregate shocks in the model. As long as such systematic risks are uninsurable, household financial literacy would have a limited role in impacting the magnitude or volatility of those risks. Still, a more literate household may have better diversified portfolios with lower *non-systematic* risks, allowing them to tolerate a higher exposure to *systematic* risks of their portfolios. Potential studies in this direction can shed light on how financial literacy interventions can impact aggregate risk sharing among households with different levels of wealth and financial literacy. Also see a general equilibrium analysis by Zhang (2023), which shows that an economy-wide adoption of target date funds improves risk sharing.

raise its risk-adjusted stock returns by opting to accumulate financial literacy at the cost of forgoing instantaneous consumption and saving. Let $f_t \in [f_{\min}, f_{\max}]$ denote the household's level of financial literacy at the beginning of age t. Financial literacy depreciates at an annual rate of $\delta_f \in [0, 1)$, which captures the rate at which the capacity to process stock market information and utilize investment opportunities decays each period. Against such depreciation, a household can spend its resources to acquire additional $e_t > 0$ units of financial literacy. The law of motion of financial literacy then reads as:

$$f_{t+1} = (1 - \delta_f) f_t + e_t, \tag{5}$$

The resource cost of financial literacy acquisition is shaped by a convex function:

$$\Phi(e_t) = \phi e_t^{\iota}, \tag{6}$$

with $\phi > 0$ and $\iota > 1$.[6] As emphasized in Lusardi et al. (2017), this functional form implies an increasing marginal cost of investing in financial literacy, which ensures that households smooth such investments over their life spans.

The marginal benefit of financial literacy investment is manifested through an increase in household-specific expected stock returns. At the beginning of each period t, a stochastic stock return for a household with the financial literacy level f_t realizes as:

$$\tilde{r}(f_t) = \underline{r} + r^X(f_t) + \sigma^X \eta_t, \tag{7}$$

which consists of an equilibrium component, $\underline{r}$, as well as an idiosyncratic excess return

6. By modeling the financial literacy acquisition cost as a resource cost, I keep the household labor and literacy choices orthogonal to each other while still capturing the intertemporal trade-off between financial literacy and consumption (and saving). Alternatively, one may consider an environment in which households pay time costs, i.e., they allocate their endowed time units over labor, leisure, and financial literacy investment. In this specification, labor choice distorts financial literacy choice and vice versa. Moreover, the counterfactual analysis is likely to be fairly sensitive to (the calibration of) the household-level correlation between labor and capital incomes, which is beyond the scope of this paper.

schedule with a standard normal shock, $\eta_t \sim \mathcal{N}(0,1)$, whose mean and standard deviation are given by $r^X(\cdot)$ and σ^X, respectively. Importantly, financial literacy raises the mean excess return with bounds $[r^X(f_{\min}), r^X(f_{\max})] = [0, \bar{r}^X]$. Given the constant standard deviation σ^X, the positive literacy premium on the mean excess return ($r_f^X > 0$) implies that more literate households obtain a higher risk-adjusted return—hence a higher Sharpe ratio—on their stock investments. A potential interpretation of this reduced-form assumption is that more literate households can better identify a composite (or portfolio) of stocks that have a higher expected return, a lower idiosyncratic risk, or both, and such relationships between financial literacy and investment outcomes are empirically supported (e.g., Clark et al., 2017). As discussed in Section 3.3.3 in further detail, the excess return parameters, r_f^X and σ, are externally calibrated based on the empirical findings.

The remaining component of the realized stock return function, $\underline{r}$, is a key equilibrium object which has a symmetric impact on all stock market participants' returns. Assume that households with the minimum level of financial literacy obtain a zero mean excess return: $r^X(f_{\min}) = 0$. Then, the aggregate component represents the expected stock return for the least finacially literate houseoholds, $\underline{r} = \mathbb{E}[\tilde{r}(f_{\min})]$, which is determined in equilibrium according to the stock market clearing conditions specified in Section 2.4. In other words, individual households take this *base stock return* $\underline{r}$ as given when making portfolio and financial literacy decisions. On top of the base return, households can accrue an additional excess return $r^X(f)$ by accumulating financial literacy.

2.1.5 Recursive Household Problem

Households enter each period t with their own financial literacy level f_t, financial wealth $\mathcal{S}_t$, and the realized efficiency unit of labor l_t. The corresponding disposable labor income and social security benefit $\tilde{l}_t$ are defined in equation (4). The wealth stock $\mathcal{S}_t$ and disposable labor income flow $\tilde{l}_t$ constitute the amount of *cash on hand* that households can spend in period t: $\mathcal{X}_t = \mathcal{S}_t + \tilde{l}_t$. The cash on hand evolves according to the following law of motion:

$$\mathcal{X}_{t+1} = \underbrace{\Big[\kappa_{t+1}\tilde{R}(f_{t+1}) + (1-\kappa_{t+1})R^b\Big]}_{\text{weighted average return to wealth}} \underbrace{\Big(\mathcal{X}_t - c_t - \theta \cdot \mathbb{1}(\kappa_{t+1} > 0) - \Phi(e_t)\Big)}_{\equiv \mathcal{S}_{t+1},\text{ gross saving}} + \tilde{l}_{t+1}, \tag{8}$$

where R^b and $\tilde{R}(f_{t+1})$ denote the after-tax gross returns on bonds and stocks, respectively:

$$\tilde{R}(f_{t+1}) = 1 + (1-\tau^r)\tilde{r}(f_{t+1}), \tag{9}$$

$$R^b = 1 + (1-\tau^r)r^b, \tag{10}$$

and τ^r is a constant capital income tax rate. The household problem is to maximize the Epstein-Zin utility function (Eq. 1) subject to constraints (Eqs. 2-10). The recursive household problem in period $t \leq T$ is defined as below:

$$V_t\Big(\mathcal{X}_t, f_t; l_t, \eta_t\Big) = \max_{c_t, e_t, \kappa_{t+1}} \left\{ (1-\beta)c_t^{1-1/\psi} + \beta\mathbb{E}\Big[V_{t+1}^{1-\gamma}\Big(\mathcal{X}_{t+1}, f_{t+1}; l_{t+1}, \eta_{t+1}\Big)\Big]^{\frac{1-1/\psi}{1-\gamma}} \right\}^{\frac{1}{1-1/\psi}}$$

$$\begin{aligned}
\text{s.t.}\quad & \mathcal{X}_{t+1} = \Big[\kappa_{t+1}\tilde{R}(f_{t+1}) + (1-\kappa_{t+1})R^b\Big]\Big(\mathcal{X}_t - c_t - \theta \cdot \mathbb{1}(\kappa_t > 0) - \Phi(e_t)\Big) + \tilde{l}_{t+1} \\
& f_{t+1} = (1-\delta_f)f_t + e_t \\
& \tilde{R}(f_{t+1}) = 1 + (1-\tau^r)\left(\underline{r} + r^X(f_{t+1}) + \sigma\eta_{t+1}\right) \\
& R^b = 1 + (1-\tau^r)r^b \\
& \mathcal{X}_{t+1} \geq 0, \kappa_t \in [\underline{\kappa}, \overline{\kappa}] = [0, 1],
\end{aligned}$$

where $\tilde{l}_t$ is the disposable labor income defined in equation (4). The household's *endogenous* state variables include cash on hand and financial literacy $\big(\mathcal{X}_t, f_t\big)$, and the *exogenous* state variables include labor income productivity and stock return shock $\big(l_t, \eta_t\big)$. The choice variables include consumption, financial literacy acquisition, and risky portfolio share $\big(c_t, e_t, \kappa_{t+1}\big)$. Household decisions are subject to the borrowing and short-selling constraints $\kappa_{t+1} \in [0, 1]$, as well as the resource costs for financial literacy acquisition and stock market participation $\big(\Phi(\cdot), \theta\big)$.

Take note of the timing when the returns on financial literacy investment manifest: assume a household acquires $[e_t]$ units of financial literacy in period t. This literacy investment is immediately reflected in the quality of the portfolio choice $[k_{t+1}]$ made in the same period, consequently raising the mean excess return on stocks $[r^X_{t+1}(\cdot)]$ the household holds between period t to period $t+1$.

2.2 Production Economy

Consider a Bewley-Huggett-Aiyagari type economy, wherein a representative firm operates in perfectly competitive markets (Aiyagari, 1994). The firm rents capital K and employs labor L with a standard Cobb-Douglas production function:

$$g(K, L) = AK^{\alpha}L^{1-\alpha},$$

where A represents a constant total factor productivity (TFP). The capital K depreciates at a rate $\delta_K \in (0, 1)$. The firm's optimality condition determines the rental rate of capital $r^\star = g_K(F^\star, K^\star, L^\star) - \delta_K$ and the wage rate for an efficient unit of labor $w = g_L(F^\star, K^\star, L^\star)$. A crucial assumption of the model is that household financial literacy does not directly impact the firm's production process. It is not utilized as a direct input in the firm's production function and remains orthogonal to the economy's fundamental production capacity, or TFP.

2.3 Government's Budget Balance

The government has two main functions: it provides social security benefits and issues risk-free bonds. These functions have separate budgets with distinct funding sources. The social security system is exclusively funded by the labor income tax, while bond returns are covered by the capital income tax.

2.3.1 Retirement Benefits

The government administers a pay-as-you-go social security system, imposing a constant labor income tax τ^l on workers at age $t \leq t_R$ and redistributing the tax revenue to retirees at age $t > t_R$. The retirement benefit replaces the final working-age labor income at a ratio denoted by λ. The government's budget constraint for labor income tax revenue is:

$$\int \tau^l w l_t d\Gamma(\mathcal{X}, f; l, \eta, t \leq t_R) = \int \lambda w l_t d\Gamma(\mathcal{X}, f; l, \eta, t > t_R), \tag{11}$$

where w represents the wage rate, l_t is the realized labor productivity, t_R is the retirement age, and $\Gamma(\cdot)$ denotes the invariant distribution of households. Recall that the labor process $\{l_t\}_{t=0}^T$ is exogenous; hence, the labor income tax rate is computed independently of the remaining endogenous equilibrium components of the model. In essence, it is the ratio of retiree to worker labor productivity multiplied by the replacement rate λ:

$$\tau^l = \lambda \frac{\int l_t d\Gamma(\mathcal{X}, f; l, \eta, t > t_R)}{\int l_t d\Gamma(\mathcal{X}, f; l, \eta, t \leq t_R)}$$

2.3.2 Government bonds

The government issues a risk-free bond with a return denoted by r^b. Given aggregate output Y, the gross debt issuance level B is adjusted to sustain a constant government debt-to-GDP ratio, $\mathscr{B} = \frac{B}{Y}$. To fund debt payments and general expenditures, the government imposes a constant capital income tax on both bonds and stocks at rate τ^r. The budget constraint for capital income tax revenue is:

$$G + r^b B = \int \tau^r \left(r^b(1-\kappa) + \tilde{r}(f)\kappa \right) \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t), \tag{12}$$

where G denotes the government's general expenditure, and $\mathcal{S}$ denotes a household's gross savings in both financial assets. A straightforward algebraic solution yields the constant capital income tax rate:

$$\tau^r = \frac{G + r^b B}{r^b \int (1-\kappa)\mathcal{S} d\Gamma + \int \tilde{r}\kappa\mathcal{S} d\Gamma} = \frac{G + r^b B}{r^b \int b d\Gamma + \int \tilde{r} a d\Gamma},$$

where $b = (1-\kappa)\mathcal{S}$ and $a = \kappa\mathcal{S}$ represent a household's bond and stock holdings, respectively. In the baseline economy, the assumption is that the government incurs no general expenditures $G = 0$, allocating the entire revenue from capital income taxes to cover bond return payments. Section 4 explores alternative economies, where the government supports households in enhancing financial literacy and participating in the stock market. The magnitude of these policy interventions is quantified by positive expenditure $G > 0$.

2.4 General Equilibrium

The economy consists of T-overlapping generations with a stationary age distribution. In equilibrium, government bonds are in net positive supply and stocks serve as productive capital. Moreover, the aggregate capital income arising from the production process equals the combined stock investment incomes earned by all households.

2.4.1 Definition

Given the social security replacement rate λ, the government-debt-to-GDP ratio $\mathscr{B}$, and the excess stock return schedules $\left(r^X(\cdot), \sigma^X\right)$, a steady-state equilibrium of the economy is characterized by aggregate quantities $(F^\star, B^\star, K^\star, L^\star)$, asset returns $(r^{b\star}, r^\star, \underline{r}^\star)$, and wage rate w. Tax rates (τ^l, τ^r) are endogenously determined in the equilibrium.

[1] The representative firms' optimality conditions characterize the factor prices:

$$r^\star = g_K(K^\star, L^\star) - \delta_K, \tag{13}$$

$$w^\star = g_L(K^\star, L^\star). \tag{14}$$

[2] Given $(r^{b\star}, r^{\star}, \underline{r}^{\star}, \tau^{l\star}, \tau^{r\star})$, households solve the decision problems (defined in Section 2.1.5). The household policy functions include gross savings, risky portfolio share, and financial literacy, $(\mathcal{S}, \kappa, f)$, which give rise to an invariant distribution $\Gamma(\mathcal{X}, f; l, \eta, t)$.

[3] The labor market clears *exogenously*:

$$L^{\star} = \int l d\Gamma(\mathcal{X}, f; l, \eta, t).$$

[4] Aggregate financial literacy $F^{\star}$ evolves according to

$$F^{\star} = \int f d\Gamma(\mathcal{X}, f; l, \eta, t). \tag{15}$$

[5] The stock market clears:

$$K^{\star} = \int \kappa \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t), \tag{16}$$

$$r^{\star} K^{\star} = \int \left(\underline{r}^{\star} + r^{X}(f) + \sigma^{X}\eta\right) \kappa \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t). \tag{17}$$

[6] The bond market clears:

$$B^{\star} = \int (1-\kappa) \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t), \tag{18}$$

where the outstanding government debt $B^{\star} = \mathscr{B} Y^{\star} = \mathscr{B} g(K^{\star}, L^{\star})$.

[7] Given the labor income tax rate $\tau^{l\star}$, the government pension system budget is balanced:

$$\tau^{l\star} \int w^{\star} l d\Gamma(\mathcal{X}, f; l, \eta, t \leq T_R) = \lambda \int w^{\star} l d\Gamma(\mathcal{X}, f; l, \eta, t > T_R). \tag{11}$$

[8] Given the capital income tax rate $\tau^{r\star}$, the government budget for general expenditures

and debt payments

$$G^{\star} + r^{b\star} B^{\star} = \int \tau^{r\star} \left(r^{b\star}(1-\kappa) + \tilde{r}(f)\kappa \right) \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t). \tag{12}$$

2.4.2 Discussion

In this general equilibrium framework, asset returns not only adjust with the levels of aggregate savings in each asset, but also with the level of aggregate financial literacy.[7] Hence, the model allows us to quantify the equilibrium effects of financial literacy on aggregate asset positions as well as the resulting distribution of equity premia.

As in standard neoclassical growth models, the first stock market clearing condition (16) asserts that total household savings in stocks equals aggregate capital. In an economy where the endogenous distribution of financial literacy results in heterogeneous stock returns across households, an additional consistency condition (17) ensures that the sum of stock investment income for all households equals aggregate capital income.

The equilibrium mechanism through which financial literacy impacts asset returns operates in two ways: (1) through the elasticity of stock investment with respect to literacy, and (2) through the pecuniary externalities of literacy on expected stock returns. The assumption that financial literacy is not employed in the production process has important equilibrium implications in both channels. While a household's literacy acquisition raises its own mean excess return, improving overall financial knowledge and investment skills does not translate into productivity growth. Instead, it indirectly affects output by influencing household stock holdings, which constitute aggregate capital in equilibrium. Then, the firm's optimality condition (13) characterizes the marginal product of capital $r^{\star}$ solely as a function of aggregate capital. To the extent that an increase in aggregate financial literacy prompts greater capital accumulation, it leads to a decline in the rental rate of capital.

Meanwhile, equation (17) ensures that the total capital income of the economy is dis-

7. Recall that the labor process is exogenous; therefore, in equilibrium, aggregate labor $L^{\star}$ plays no active role in determining asset returns or the wage rate.

tributed across households according to their levels of financial literacy and corresponding mean excess return schedules $\{r^X(\cdot)\}$. As assumed in Section 2.1.4, if $r_f^X(\cdot) > 0$ and $r^X(f_{\min}) = 0$, then the equilibrium residual $\underline{r}^\star$ represents the *base* return that financially *illiterate* households expect to obtain when investing in stocks. Given that the level of total capital income $r^\star K^\star$ is not directly impacted by overall literacy, the *base expected stock return* $\underline{r}^\star$ adjusts to account for the change in aggregate mean excess return, $r^X(F^\star)$. The capital income consistency condition (17) precisely captures this zero-sum aspect of financial literacy: as a household boosts its mean excess return $r^X(\cdot)$ by accumulating literacy, this puts downward pressure on $\underline{r}^\star$. That is, the individual household's financial literacy choice generates a *pecuniary externality* on the base expected stock return.

In summary, the assumption that financial literacy is not employed in the production process implies that overall literacy impacts the rental rate of capital $r^\star$ only *indirectly* through aggregate capital, whereas it *directly* shapes the base expected stock return $\underline{r}^\star$. Additionally, the endogenous distribution of financial literacy gives rise to heterogeneous equity premia and portfolio choices across households. The household-specific expected equity premium is expressed as:

$$\mathbb{E}\left[\tilde{r}(f)\right] - r^b = \underline{r} + r^X(f_t) - r^b,$$

Here the *base equity premium* for the least financially literate households is defined as $\mathbb{E}\left[\tilde{r}(f_{\min})\right] - r^b = \underline{r} - r^b$. One can interpret this base equity premium as the *stock market participation premium* that households expect to obtain by participating in the stock market given the minimum level of literacy.

2.5 Subsidies for Financial Literacy and Participation

This proposed general equilibrium approach provides a framework to investigate how household portfolio and financial literacy choices interact systematically with asset returns. A vital policy question emerges: to what extent does enhancing financial literacy improve households' investment outcomes, particularly by promoting stock market participation, and thus alleviate wealth inequality? Evaluating the policy effects in an equilibrium framework is crucial because market asset returns adjust with households' decisions, in turn potentially attenuating the overall effectiveness of the subsidy. This section illustrates how I formulate the paper's main policy experiments: subsidizing financial literacy acquisition costs and stock market participation costs.

Consider an environment where the government subsidizes either $\varphi \in (0,1)$ fraction of financial literacy acquisition costs $\Phi(\cdot)$, $\vartheta \in (0,1)$ fraction of per-period fixed stock costs θ, or both. Under these policy regimes, the household budget constraint at age t reads as:

$$\mathcal{S}_{t+1} = \mathcal{X}_t - c_t - (1-\vartheta)\theta \cdot \mathbb{1}(\kappa_{t+1} > 0) - (1-\varphi)\Phi(e_t), \tag{19}$$

where $\mathcal{S}_{t+1}$ is gross saving in financial assets, $\mathcal{X}_t$ is the beginning-of-the-period cash on hand, c_t is consumption, κ_{t+1} is the risky portfolio share choice. Let G denote the amount of subsidy expenditures that the government incurs:

$$G \equiv \int \Big(\varphi_t \Phi(e_t) + \vartheta_t \theta \cdot \mathbb{1}(\kappa_{t+1} > 0)\Big) d\Gamma(\mathcal{X}, f; l, \eta, t),$$

where $\Gamma(\cdot)$ is the invariant distribution of households. The subsidy is financed by capital income tax revenues, which also serve to cover debt payments. Recall the associated government budget constraint (12):

$$G + r^b B = \int \tau^r \left(r^b(1-\kappa_{t+1}) + \tilde{r}(f)\kappa_{t+1}\right) \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t), \tag{12}$$

where B is outstanding government debt, and $(r^b, \tilde{r}(\cdot), \tau^r)$ are the risk-free return, household-specific realized stock returns, and the constant capital income tax rate, respectively.

This condition highlights two channels through which policy interventions may impact the overall equity premium: (1) as households adjust their portfolio and literacy choices in response to subsidized costs, aggregate asset positions change, influencing equilibrium asset returns; and (2) the resulting increase in the tax rate prompts households to demand higher returns for both assets. Then, characterizing the net policy effects on the equity premium is inherently a quantitative exercise. Section 3 discuss the quantification strategy and Section 4 presents the model predictions, decomposing the policy effects into the equilibrium return adjustment effect versus the tax effect.

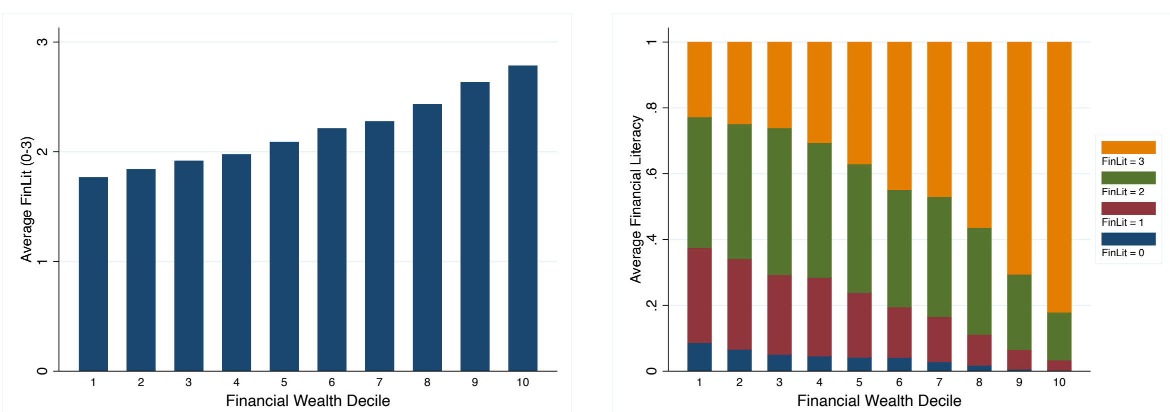
3 Model Quantification

The general equilibrium model is disciplined to match the average financial literacy level and stock market participation of U.S. households in the Survey of Consumer Finances (SCF). The calibrated model replicates two key empirical patterns: the life-cycle trajectory of financial literacy and wealth disparity in stock investment. This section describes the target data moments observed in the SCF, the quantification strategy, and the model fit.

3.1 Data: Financial Literacy in SCF

Figure 1: Dispersion in financial literacy across and within wealth groups

(a) Financial Literacy by Wealth Group (b) Within-Group Financial Literacy Variation



The Survey of Consumer Finances (SCF) is a triennial cross-sectional survey that provides extensive information on U.S. households' income flows and asset allocations. With its detailed records of household asset holdings and a careful sample design, the SCF provides a comprehensive snapshot of wealth inequality and portfolio choice dispersion among different demographic groups. Additionally, starting in 2016, the SCF has included financial literacy scores, facilitating empirical analysis of the link between financial literacy and investment decisions and outcomes based on a nationally representative sample. In particular, the Survey asks each respondent three questions on fundamental economic concepts, based on the *"Big Three Questions,"* (Lusardi and Mitchell, 2014):

① **Risk Diversification** Buying a single company's stock usually provides a safer return than a stock mutual fund. *True, <u>False</u>, Do not know, Prefer not to say*

② **Inflation** Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? *More than today, Exactly the same, <u>Less than today</u>, Do not know, Prefer not to say*

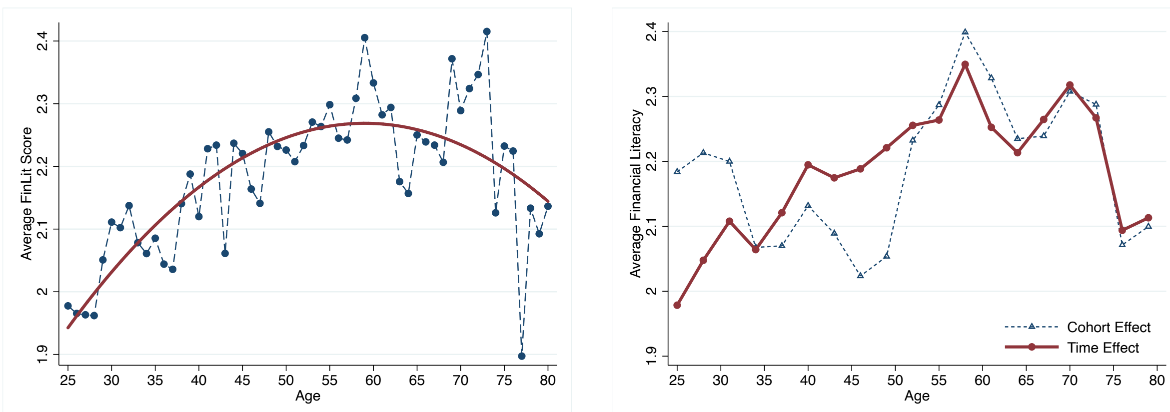
③ **Interest Rate** Suppose you had \$100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? *<u>More than \$102</u>, Exactly \$102, Less than \$102, Do not know, Prefer not to say*

The financial literacy score ranges from 0 to 3, based on the number of questions answered correctly. Consistent with previous findings, only 44.2 percent of U.S. households aged 26-80 can answer all three questions correctly, while the average level of financial literacy is 2.19. Financial literacy is also heterogeneous across and within wealth groups. The left panel of Figure 1 shows that financial literacy is positively correlated with financial wealth, and the right panel shows that financial literacy varies even *within* financial wealth deciles. The latter implies that there is a channel in which households' financial knowledge and investment skills can generate a further gap in investment outcomes in addition to the effect of wealth itself.

The SCF also illustrates that the average level of financial literacy increases with age until (a few years before) retirement, and then it depreciates. Figure 2 plots the humped-shape life cycle of financial literacy observed in the 2016-2019 SCF, where the left panel shows a simple-weighted average by age, while the right panel shows the average net of time and cohort effects. Assuming that there is no cohort effect and financial literacy has remained consistent across generations, the hump shape with age indicates that financial literacy evolves over the life cycle until households retire.

Figure 2: Lifecycle of Financial Literacy

(a) Average Financial Literacy Score (b) Composition of Financial Literacy score

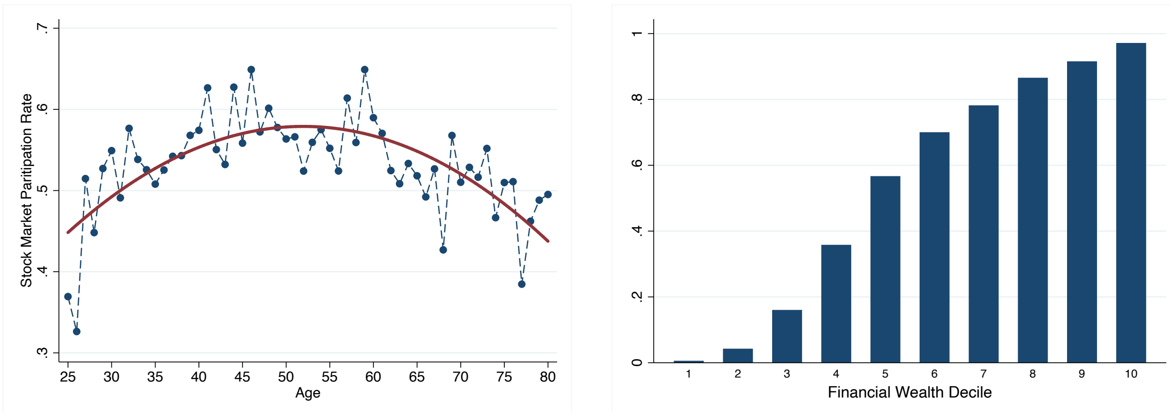


It is well known that U.S. households have a low tendency to participate in the stock market. The overall stock market participation rate of U.S. households between aged 26-80 is 54.1 percent in the 2016-2019 SCF. Figure 3 shows that stock market participation varies with both age and wealth, mirroring the patterns in financial literacy.

The key data moments I target to calibrate the model are (1) the average level of financial literacy level and (2) the overall stock market participation rate (see Section 3.4). I also use the granularity of the SCF data to externally validate the calibrated model by analyzing the household-level financial literacy effect on stock market participation in the data versus in the model (see Section 3.5).

Figure 3: Stock Market Participation Across Age and Wealth

(a) Life Cycle Participation (b) Wealth Disparity in Participation



3.2 Numerical Algorithm

Given a set of exogenous parameters, I simulate the labor income process for $N = 50,000$ households, each of them living for 56 periods (from age 25 to 80). The labor income tax rate τ^l is computed according to the government budget constraint (11). Since the labor process is exogenous; i.e., orthogonal to other aggregate components of the model, the labor income tax rate remains unaffected by the other general equilibrium objects. Given this simulated labor process and a set of initial guesses for asset returns and tax rates $(r^b, r, \underline{r}, \tau^l, \tau^r)$, I solve the life-cycle household problem backward using a grid search over future choices $(\mathcal{S}', \kappa', f') \in \mathscr{S} \times \mathscr{K} \times \mathscr{F}$ for each set of state variables $(\mathcal{X}, f; l, \eta, t)$.[8] With the acquired policy functions, I first simulate a partial equilibrium economy for a pre-defined population. The simulated life-cycles give rise to an invariant distribution $\Gamma(\mathcal{X}, f; l, \eta, t)$. With sufficiently large N, the simulated economy represents a steady-state economy with T overlapping generations, where each generation t consists of N individuals. Using a non-linear solver, I solve for a general equilibrium where the characterized prices $(r^{b\star}, r^\star, \underline{r}^\star, \tau^{l\star}, \tau^{r\star})$ and the corresponding

8. In solving their optimization problem, households do not necessarily need to be informed about the market average of stock returns $r^\star$ itself. This is because their realized stock returns depend on the base expected return $\underline{r}^\star$ and their individual financial literacy. In fact, households condition on the competitive wage rate $w^\star$ to calculate the value of their cash on hand. Here, I express that household condition on $(r^\star, \underline{r}^\star)$ because the firm's optimality conditions uniquely determine the set of capital and labor input prices; and also because the exogenous labor process and corresponding wage rate are not central pieces of the model.

distribution $\Gamma(\cdot)$ satisfy the government balance conditions (11)-(12) and the market clearing conditions (15)-(18). I use the method of simulated moments to calibrate the model.

3.3 External Parameterization

Table 1: Benchmark Parameter Values

Parameter		Value	Source
Household Preference			
Discount factor	β	0.96	
Elasticity of substitution	ψ	0.5	Gomes and Michaelides (2005)
Risk aversion	γ	5.0	
Labor process			
Persistency	ρ^l	0.91	Rupert and Zanella (2015)
Variance	σ^l	0.21	
Pension replacement rate	λ	0.36	Congressional Budget Office (2019)
Financial literacy			
Deprecation rate in literacy	δ_f	0.02	$\star$
Investment cost: coefficient	ϕ	0.22	$\star$
Investment cost: convexity	ι	1.75	Lusardi et al. (2017)
Stock market			
Mean excess return	$r^X(f_{\max})$	0.01	Clark et al. (2017)
Standard deviation	σ^X	0.157	Cocco et al. (2005)
Per-period fixed participation cost	θ	0.09	$\star$
Production			
Depreciation rate in capital	δ_K	0.08	
Capital Intensity	α	0.36	
Government debt to GDP ratio	B/Y	0.82	U.S. Data

$\star$ Internally calibrated parameters. See Section ??.

3.3.1 Household Preference and Life Cycle

Following Gomes and Michaelides (2005), I set the preference parameters as: the discount factor $\beta = 0.96$, the relative risk aversion $\gamma = 5$, and the intertemporal substitution coefficient $\psi = 0.5$. The model's initial period $t = 0$ corresponds to a real age of 25, while the terminal period $T = 55$ corresponds to age 80. While bequest motives and decisions are beyond the scope of this paper, it is assumed that all households begin their life cycles with exogenous levels of initial wealth. At time t=0, households are born with initial levels of financial literacy, labor productivity, and wealth. At $t = 0$, households are born with initial levels of financial literacy, labor productivity, and wealth, denoted as $(f_0, l_0, \mathcal{S}_0)$ respectively.

The model's initial literacy distribution is calibrated to the population shares of each financial literacy group among the SCF survey respondents aged 18-25. The initial wealth is drawn as a function of the realized initial literacy, capturing the observed correlation between financial literacy and wealth among young households. I posit that the initial wealth is realized in cash terms; hence, at the start of $t = 0$, households do not have any initial bond or stock holdings. Appendix II.1 discusses details on the initial distribution calibration.

3.3.2 Labor Income and Housing Cost

The stochastic labor productivity process for the working population (Eq. 2) is calibrated to the persistent component of a log wage process estimated in Floden and Lindé (2001), with an autocorrelation coefficient of $\rho = 0.9136$ and a standard deviation of $\sigma_l = 0.2064$. Retirement choice is exogenous, and households retire at the end of $t = 40$ (age 65).The retirement benefit replacement rate is set to $\lambda = 0.36$ as reported in a recent article by the Congressional Budget Office (2019).[9] The age-specific deterministic component $\{m_t\}$ is directly mapped to the estimated wage profile in Rupert and Zanella (2015).[10] Moreover, I estimate the age-specific housing cost share h_t as by regressing the ratio of annual housing expenditure to labor income on a cubic age polynomial and year dummies using the 2016-2019 SCF data (following a similar approach in Gomes and Michaelides, 2005).[11] Figure (A.1) shows the cross-sectional average of the simulated labor income process across age, before and net of housing costs.

9. The value corresponds to the social security replacement rates of the last 5 years of substantial earnings for individual long-career workers born in the 1960s. See www.cbo.gov/publication/55038 for details.
10. Rupert and Zanella (2015) provides the wage profile at a biennial frequency for ages 52 and above. Following Wu and Krueger (2021), I interpolate the profile for all ages between 25 and 80.
11. The total housing expenditure includes rent (`rent`) and mortgage (`mortpay`) payments. For households below age 65, labor income corresponds to wage income (`wageinc`), while for households aged 66 or above, it corresponds to retirement income (`ssretinc`).

3.3.3 Financial Literacy and Stock Returns

The grid for the financial literacy level is discretized into 5 equally spaced ranges spanning $f_{\min} = 0$ and $f_{\max} = 3$. Households cannot *decumulate* their financial literacy, or accumulate it beyond the maximum possible level. Hence, given its current financial literacy f, a household chooses the level of literacy acquisition in range, $e \in \mathscr{E}(f) = \big[0, e_{\max}(f)\big] = \big[0, f_{\max} - (1-\delta_f)\cdot f\big]$, which is also discretized into 5 values spread with equal spacing.

One of the key model ingredients to be parameterized is the mean excess stock return function, $r^X(f)$, whose slope schedules determine the extent to which literacy contributes to a higher stock return: $r^X_f > 0$. Ideally, one could estimate the slope using micro-level panel data containing both financial literacy and stock return measures of households, but the SCF dataset lacks sufficient information to compute annual realized stock returns.[12]

Alternatively, I calibrate the literacy-return slope using the findings from Clark et al. (2017), who utilize an administrative dataset on financial literacy and 401(k) investment performance of employees at the Federal Reserve System. This unique dataset reports investment history at the employee-product level, allowing Clark et al. (2017) to document that the most financially literate investors tend to (i) experience about 42 (3.5) basis points larger annual (monthly) asset returns, and (ii) hold portfolios with 1.71 percentage point less idiosyncratic risk, compared to their least literate counterparts. Although this data set lacks information on direct stock holdings and may not be nationally representative, I adopt their estimates as a reference point.

Specifically, the mean excess stock return is calibrated as an affine function of financial

12. The SCF includes information on U.S. households' overall dividend incomes (`x5710`) as well as *net realized capital gains* from the sale of mutual funds, stocks, bonds, or real estate (`kginc`) from the previous calendar year. However, these variables do not provide robust measures of dividend and realized capital gain from public equities per se; plus, the dataset has no information on *unrealized* capital gains from stock holdings, which is likely to be a major source of stock returns.

literacy: $r^X(f) = r_0 \cdot f$, with bounds from $r^X(f_{\min}) = 0$ to $r^X(f_{\max}) = 0.01$.[13][14] This parametrization implies that the stock return for the most literate households is 100 basis points higher than for the least literate, assuming constant idiosyncratic risk. This value falls within the range of results reported in similar empirical analyses using Dutch and French administrative data (Bianchi, 2018; Von Gaudecker, 2015).

Moreover, recall the functional form of the financial literacy acquisition cost: $\Phi(e) = \phi e^{\iota}$. While the coefficient ϕ is internally calibrated, the convexity component $\iota = 1.75$ is taken from Lusardi et al. (2017), who estimated the parameter from data on financial advisory fees. Their sensitivity analysis indicates that an increase in the cost convexity has a non-linear effect on wealth inequality. In this paper, I focus on the multiplicand component ϕ's direct effect on household financial literacy.

Lastly, I assume the standard deviation of innovations to stock return σ^X is constant across households with different financial literacy. The standard deviation is set to the historical value of 0.157 (Cocco et al., 2005).[15] Given this constant standard deviation, a positive literacy-return premium $r_f^X > 0$ implies that a more literate household obtain a higher risk-adjusted return. I assume there is no correlation between capital income risk and background labor income risk: $\text{corr}(\eta, \nu) = 0$.

3.3.4 Firm and Government

The production function parameters are calibrated to standard values in the literature. The productive capital share is set to $\alpha = 0.36$ and the annual depreciation rate $\delta_K = 0.08$. The TFP level is normalized to $A = 1$. The steady-state government debt-to-GDP ratio

13. With $(f_{\min}, f_{\max}) = (0, 3)$, the slope is simply given as $r_0 = \frac{1}{300}$. In the presented model specification, financial literacy is an ordinal concept in that the minimum and maximum levels of financial literacy, $(r^X_{\min}, r^X_{\max})$, can be rescaled without any loss of generality as long as the boundary literacy-return premia are fixed: $r^X \in [0, \overline{r}^X]$ for any parameterized values of $(f_{\min}, f_{\max})$. Note that the premium itself has a cardinal aspect: if a household becomes twice financially literate, its mean excess return doubles accordingly.
14. In their benchmark model, Lusardi et al. (2017) as well linearly scales the literacy-return premium. Their robustness analysis considers an exponential functional form and shows that when the literacy-return premium is more context, the income-to-wealth ratios across wealth groups become more dispersed.
15. The household finance literature estimates this value to be in a range between 0.15 and 0.18

$\mathscr{B} = \frac{B}{Y} = 0.823$ is set to the U.S. historical average from 2001:Q1 through 2019:Q4, assuming that the distribution of U.S. household financial literacy and stock market participation rate have been relatively stable during the specified periods.[16]

3.4 Internal Calibration

I jointly calibrate the per-period fixed stock market participation cost, the financial literacy acquisition cost coefficient, and the depreciation rate of financial literacy (θ, ϕ, δ_f) using the method of simulated moments. The participation and literacy costs are, respectively, disciplined to match the average stock market participation rate (0.541) and the average financial literacy score (2.19) of U.S. households aged 26-80. Note that I exclude the household at age 25 in the average calculation, because the model assumes that households are "*born*" with no bond holdings and no stock holdings, but only with initial wealth in cash terms (see Section 3.3.1 and Appendix II.1). The identifying assumption for the depreciation rate is that households do not accumulate financial literacy later in their retirement, which implies that financial literacy depreciates only after age 70.

3.5 Model Fit

3.5.1 Targeted Moments

The internal calibration results indicate that the financial literacy depreciation rate, financial literacy cost, and stock market participation cost parameters are estimated as: $\phi = 0.22$, $\theta = 0.09$, and $\delta_f = 0.02$, respectively. These numbers imply that, in the baseline economy, acquiring 0.03 additional units of financial literacy, which raises the mean excess return $r^X(\cdot)$ by 1 b.p., costs 1.8% of the equilibrium average pre-tax wage income. On average, households acquire 0.045 units of literacy each period. Similarly, the per-period stock market participa-

16. While there is very limited data on the historical records of financial literacy, Angrisani et al. (2020) finds that the overall distribution of financial literacy in the U.S. appears stable for a six-year period (2012-2018) using the RAND American Life Panel (ALP). I chose 2001 as the initial period, since the average stock market participation rate in the SCF has remained roughly around 50% from 2001.

Table 2: Baseline Model Fit

		Model	Data	
Distribution of financial literacy				
Avg. FinLit age 18-25	$\mathbb{E}[f\|t=0]$	1.98	1.98	$\star$
Avg. FinLit age 26-80	$\mathbb{E}[f]$	2.18	2.19	$\star$
S.D. FinLit age 26-80	$\mathbb{S}.\mathbb{D}(f)$	0.93	0.86	
(Avg. FinLit age 76-80)/(Avg. FinLit age 71-75)	$\frac{\mathbb{E}[f\|71 \leq \text{age} \leq 65]}{\mathbb{E}[f\|75 \leq \text{age} \leq 80]}$	0.93	0.91	$\star$
Stock market participation				
Avg. saving rate (%)	$\mathbb{E}[\mathbb{1}(\mathcal{S} > 0)]$	97.5	95.5	
Avg. participation rate (%)	$\mathbb{E}[\mathbb{1}(\kappa > 0)]$	54.6	54.1	$\star$
Conditional risky portfolio share (%)	$\mathbb{E}[\kappa\|\kappa > 0]$	84.4	46.4	
Baseline Equilibrium				
Risk-free return (%)	r^b	2.32		
Mkt. equity premium (%)	$r - r^b$	5.38		
Base equity premium (%)	$\underline{r} - r^b$	4.41		
Capital income tax rate (%)	τ^r	9.77		
Capital-output ratio	K/Y	2.29		

$\star$ Internally calibrated. Data source: SCF 2016-2019.

tion cost is equivalent to 5.8% of the average pre-tax wage income. This participation cost should not be interpreted as a direct monetary expense for households; instead, it symbolizes various potential hindrances that can impede stock market participation, reframed as a resource cost in the model.

Table 2 shows the baseline model fit and general equilibrium results. Note that the financial literacy at $t = 0$ is drawn from the population shares of financial literacy groups among households aged 18-25 in the SCF; hence the model and data average are matched by construction. The simulated standard deviation of financial literacy across households is slightly larger than in the data, which potentially implies that the (externally) calibrated exponent of the literacy acquisition cost $\iota = 1.75$ could be further adjusted.

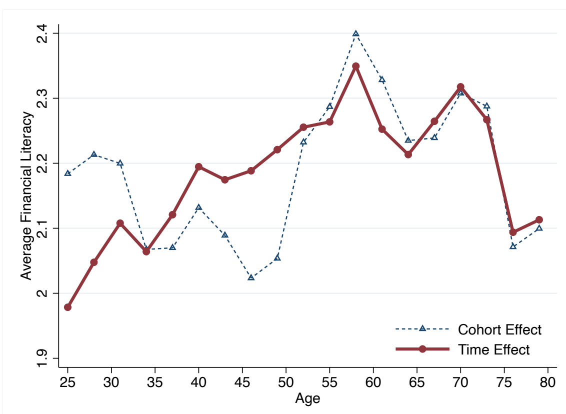
In the baseline economy, the simulated risk-free return is $r^{b\star} = 2.32$ percent and the cross-sectional market equity premium is $r^{\star} - r^{b\star} = 5.38$ percent, both of which align well with historical values. The base expected equity premium, $\underline{r}^{\star} - r^{b\star}$, is approximately one percentage point below the average, reflecting the endogenous return heterogeneity.

The model also replicates the saving rate (the share households with positive financial wealth) reasonably well; although, it exhibits a relatively high simulated average share of financial wealth invested in stocks, conditional on participation (84.4 percent in the model compared to 46.4 percent in the data). Conventional life-cycle portfolio choice models often predict such a high conditional risky share. Potential adjustments addressing this issue could involve introducing a positive correlation between capital and labor income shocks, as well as considering tail shocks in labor income.

3.5.2 Non-targeted Moments

Figure 4: Life Cycle Financial Literacy

(a) Data



(b) Model

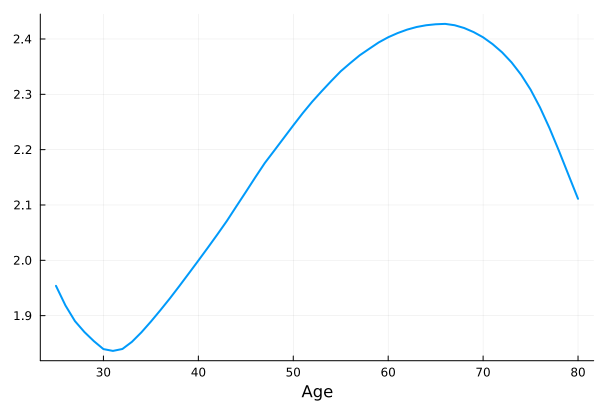


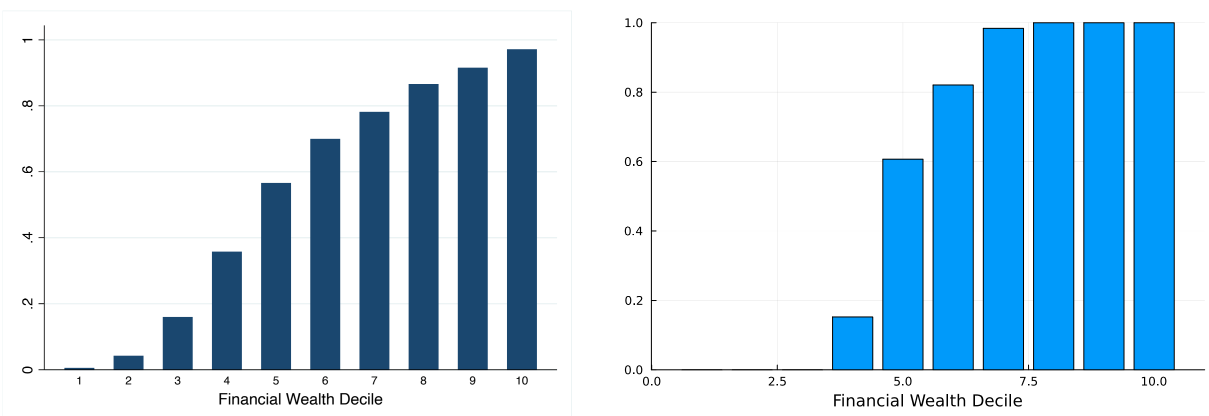
Figure 4 illustrates that the model does a decent job replicating the humped-shaped life cycle of financial literacy, even with its parsimonious set of target moments: average financial literacy and the literacy patterns past age 70. The model predicts that financial literacy is highest right around retirement and then depreciates thereafter. The observed decrease prior to age 30 indicates that young workers, who are relatively wealth-poor compared to their older counterparts, allow their initial literacy to depreciate for a while because maintaining or accumulating literacy is too costly. After accumulating sufficient wealth to afford both literacy and participation costs, households past age 30 begin to acquire literacy again and increase their risk-adjusted stock returns.

The model also reproduces the observed wealth disparity in stock market participation.

Figure 5 demonstrates that the predicted stock market participation rate increases with wealth, consistent with the patterns in the SCF. Still, the model does not fully capture the non-zero stock market participation rate at the lower end of the wealth distribution. This disparity could be partly due to the fact that the SCF participation data include *passive* investments made through retirement accounts, which may involve investments in stocks and public equities as default options. On the other hand, in the simulated model, participation occurs actively only when households choose the amount of wealth to allocate to stocks. Therefore, household wealth has a more significant effect on participation.

Figure 5: Average Participation by Wealth Deciles

(a) Data (b) Model



3.5.3 External Validation

To externally validate my overall calibration, I analyze the household-level correlation between financial literacy and investment outcomes in the simulated economy, compared with the SCF data. Following Cupák et al. (2022), I run an OLS regression:

$$(\text{Investment Outcome})_i = c + \beta \cdot \text{FinLit}_i + age_i + age_i^2 + \Gamma X_i + \epsilon_i,$$

where i denotes household and demographic controls X_i include financial wealth and labor income in both regressions with the SCF data and model simulations. Table 3 reports the

Table 3: Correlation Between Financial Literacy and Stock Investments

	Positive holdings of public equities?		**Conditional wealth share in stocks**	
	Data	Model	Data	Model
	(1)	(2)	(3)	(4)
Financial literacy score (0-3)	0.061***	0.089***	0.012*	0.101***
	(0.006)	(0.000)	(0.006)	(0.000)
ihs(net worth)	0.012***	0.310***	0.004***	-0.090***
	(0.001)	(0.000)	(0.001)	(0.000)
ihs(income)	0.096***	0.050***	0.007	0.141***
	(0.008)	(0.000)	(0.005)	(0.000)
Mean value	0.541	0.546	0.441	0.844
R-sq.	0.321	0.731	0.025	0.304
No. Obs	10997	2.75M	6858	1.5M

- Col (1), (3): Author's replication of Cupák et al. (2022) .

- Source: SCF 2016-2019. +p<0.10, *p<0.05, **p<0.01, ***<0.001.

regression results; in columns (1) and (3), I report regression results replicating Cupák et al. (2022), who additionally control for gender, race, education, employment status, business ownership, marital status, household size, the number of children, and a year fixed effect.[17] The SCF data indicates that a one-unit increase in financial literacy score is associated with a 6.1 percentage point increase in the probability of stock market participation. These estimates are statistically significant at 0.1 percent level, even controlling for demographic factors. As reported in columns (2) and (4), the model simulation delivers a slightly higher prediction, which may suggest potential omitted variables impacting both financial literacy and stock market participation.

4 Policy Analysis: Subsidy for Financial Literacy

I use the calibrated model to examine the counterfactual impact of enhancing household financial literacy on aggregate capital accumulation and wealth inequality. The model specifications for policy analyses are outlined in Section 2.5. In this section, I present the quan-

17. While Cupák et al. (2022) focuses only on the 2019 SCF data, my regression results pool both survey years 2016 and 2019.

titative results of the main policy experiment: a universal financial literacy subsidy.

4.1 Comparative Statics

I explore a hypothetical policy experiment where the government subsidizes 75 percent of the household financial literacy acquisition costs. The subsidy is financed through capital income tax revenues. Given the parameters calibrated in the baseline economy, I solve for a counterfactual steady state with the subsidy rate $\varphi = 0.75$, accounting for the government budget balance condition for the capital income tax (12) and the household budget constraint with the subsidy (19).

Table 4: Comparative Statics: Counterfactual Equilibrium Results

		Baseline	**ΔPE**	**ΔHE**	**ΔGE**
		(1)	(2)	(3)	(4)
Avg. FinLit (out of 3)	$\mathbb{E}[f]$	2.18	0.25	0.23	0.22
Risk-free return (%)	r^b	2.32		-0.01	0.08
Mkt. equity premium (%)	$r - r^b$	5.38		-0.06	-0.10
Base. equity premium (%)	$\underline{r} - r^b$	4.41		-0.09	-0.13
Capital income tax rate (%)	τ^r	9.77		-0.01	1.00
Aggregate capital (level)	K	4.40	0.15	0.03	0.008
Capital-output ratio	K/Y	2.29	0.05	0.01	0.003

* Column (1) reports the baseline asset returns and the tax rate in percentage terms (%).
* Columns (2)-(4) report the *difference* between the baseline results and the counterfactual results in percentage point term (%p).
* In partial equilibrium, the reported aggregate capital K in the partial equilibrium is essentially the short-run total household stock holdings $\mathbb{E}[\kappa \cdot \mathcal{S}]$, which has not been adjusted to match the productive capital level.

Table 4 presents the comparative statics before and after the policy intervention: column (1) shows the baseline results with no financial literacy subsidy (and no other government expenditure $G = 0$), and columns (2)-(4) show the *difference* between the baseline results and the counterfactual results. There are three sets of counterfactual steady states: first, in the **partial equilibrium [PE]** economy (column 2 in Table 4), households re-optimize with the subsidy holding the *original* asset returns and capital income rate in the baseline economy fixed. Changes in aggregate outcomes can be then interpreted as short-run results prior to market clearing, i.e. before returns and tax rates adjust to reflect the new steady-state aggregate levels. Moreover, in the ***hypothetical*** **equilibrium** **["HE"]** economy (column 3), markets clear; but the government budget has not yet been adjusted to account for the increase in subsidy expenditures. In other words, the equilibrium returns and tax rates are adjusted to the new steady-state levels of aggregate bond and stock holdings, but not to the increased level of government expenditure. Lastly, the full **general equilibrium** **[GE]** economy (column 4) represents a benchmark general equilibrium in which all markets clear and government budgets are fully balanced. As the subsidy is funded through the tax system, the intervention introduces additional distortions to the competitive equilibrium results. The asset returns and the capital income tax rate are fully adjusted.

The hypothetical equilibrium [HE] experiment is an intermediate step between partial and full general equilibrium experiments. The counterfactual results in this interim steady state are only *hypothetical* as the experiment posits that the government finances the subsidy *with no cost*. Still, this hypothetical experiment effectively serves to disentangle the equilibrium effects of asset return adjustments from the effects of capital income tax adjustments.

The predicted increases in average financial literacy are relatively constant across all counterfactual scenarios: the universal subsidy increases the average level of financial literacy from 2.18 to a range between 2.4 and 2.43, which corresponds to 10.16 to 11.26 percent growth. The unweighted average of the mean excess stock return, $\mathbb{E}[r^X(f)] = r^X(F^\star)$, rises by the same factor. In partial equilibrium [PE], where the base expected stock return $\underline{r}$ remains unchanged, this increase in the mean excess return fully translates into a higher risk-adjusted stock return. Consequently, aggregate stock holdings increased by 3.4 percent. Accordingly, the aggregate capital-output ratio also rises by 2.2 percent.

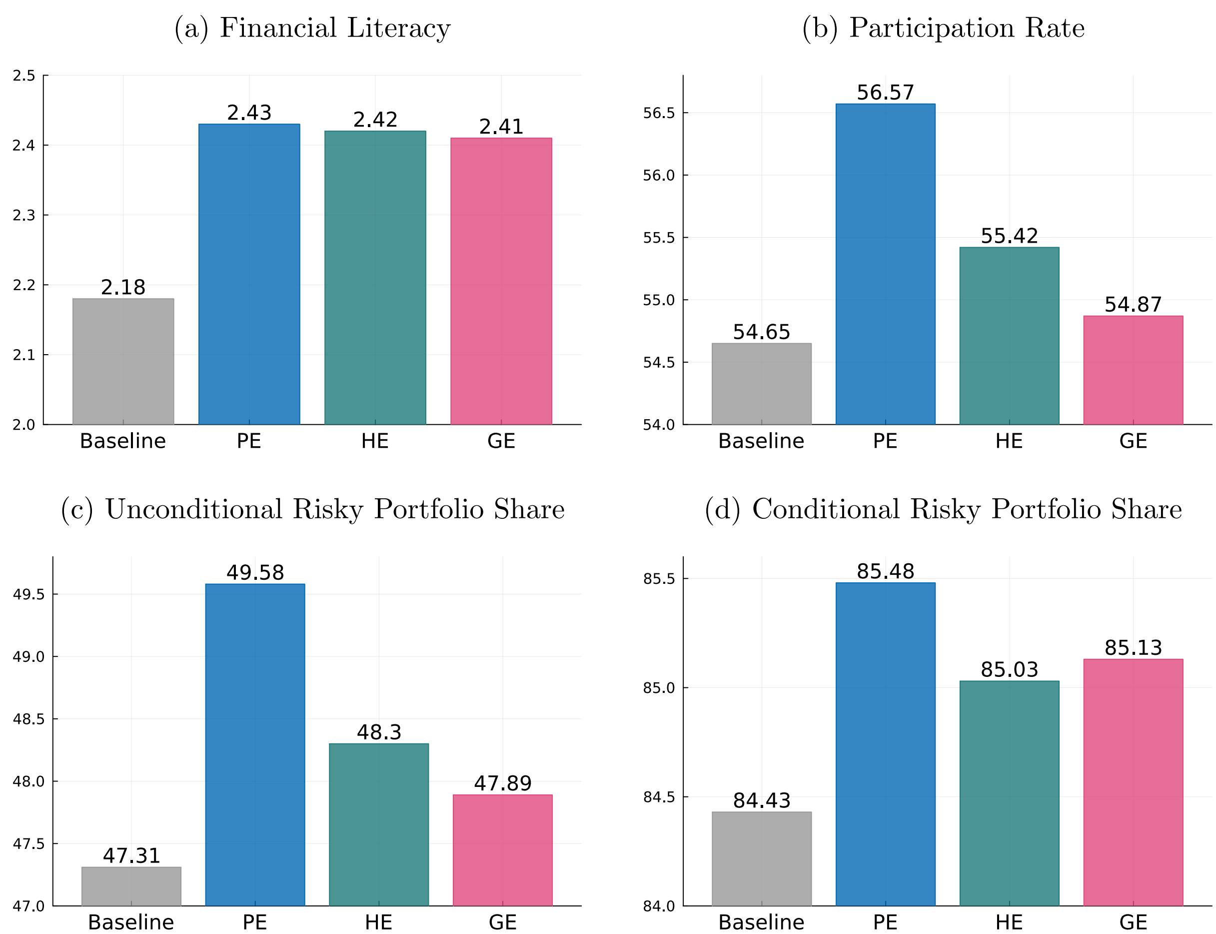
In the hypothetical equilibrium [HE], asset markets clear. Since the increase in financial literacy is assumed to have no impact on total factor productivity (TFP) and does not directly augment output, the growth in aggregate capital automatically leads to a decline in the marginal product of capital, thereby driving down overall stock returns in equilibrium. In this new steady state, the aggregate equity premium adjusts to the increased capital level and falls by $|\Delta(r - r^b)| = 0.06$ percentage point (p.p.) compared to the baseline case. In addition, the pecuniary externality from financial literacy contributes to a further decline in the base equity premium: $|\Delta(\underline{r} - r^b)| = 0.09$ p.p. Also note that the risk-free return r^b also decreases by 0.01 p.p. These quantitative results imply that the financial literacy subsidy has a repercussion on asset returns, which, in turn, diminishes households' incentives to hold stocks. As a result, the net increase in aggregate capital shrinks from $\Delta K = 0.15$ in the partial equilibrium case to $\Delta K = 0.03$ in the hypothetical equilibrium case. Similarly, the net effect on the capital-output ratio shrinks from a 2.2 percent increase to a 0.4 percent increase. That is, the equilibrium return adjustment channel attenuates the policy's net effect on aggregate capital accumulation.

The full general equilibrium [GE] experiment further accounts for the tax impact. In the associated steady state, the government is predicted to raise the capital income tax rate by 1 percentage point in order to finance the expenditures for the subsidy. Due to this tax rate increase, households demand a larger pre-tax risk-free return compared to the baseline economy: $\Delta r^b = 0.08$ p.p. Aggregate capital grows only by ΔK=0.008, or the capital-output ratio increases only by 0.1 percent, which is accompanied by a decrease in the rental rate of capital: $\Delta r = -0.02$ p.p. Consequently, the aggregate equity premium experiences the largest decline of all counterfactuals, with $\Delta(r - r^b) = -0.10$.

4.2 Policy Effects on Stock Market Participation

The low stock market participation of U.S. households has been a focal point of much policy and research interest. It has been demonstrated that financial education initiatives have meaningful causal effects on improving individuals' financial behaviors (Kaiser et al., 2022). In this section, I investigate to what extent such effects may scale up at the aggregate level. Specifically, I analyze the comparative statistics of the stock market participation rate and the average risky portfolio share (i.e, the share of wealth invested in stocks), before and after the universal literacy subsidy examined in the previous section. Figure 6 shows that aggregate stock investment patterns vary significantly across the counterfactual experiments: the partial equilibrium [PE], the hypothetical equilibrium considering return adjustments [HE], and the full general equilibrium which also takes into account the tax effect [GE].

Figure 6: Average Stock Market Investments



The same logic from Section 4.1 applies. In partial equilibrium, both overall stock market participation and the *conditional* risky portfolio shares among participants increase rather significantly as households anticipate a higher return from investing in stocks. Nonetheless, due to the decrease in the expected stock return and the increase in the capital tax rate, the overall equity premium falls, attenuating the subsidy's net effect on stock market expansion. The universal subsidy that improves average literacy by roughly 10.1 percent is predicted to raise the participation rate from 54.6 to 55.6 percent in the short run; i.e., the rate has increased by 1.9 percentage points (p.p.) in partial equilibrium. In the long run, however, the effect is reduced to a 0.77 p.p. increase as the model accounts for market clearing. Furthermore, when the tax rate hike is additionally considered, the long-run effect diminishes to a 0.21 p.p. increase.

The policy effects on conditional risky portfolio shares also weaken in general equilibrium. In the baseline economy, the average conditional share is 84.43 percent. This statistic increases to 85.48 in partial equilibrium but only to 85.03 in the *hypothetical* equilibrium, and to 85.13 in the full general equilibrium. Note that the net effect is slightly larger in the full model compared to the hypothetical case, which only considers the return adjustments but not the tax rate changes. It can be inferred from this result that the increase in the capital income tax rate makes the marginal participant exit from the stock market, thereby increasing the average risky portfolio share among the remaining participants.

The unconditional risky portfolio share is simply the weighted average of the participation rate and the conditional wealth share in stocks, which captures the extensive and intensive margin effects on household portfolio choices, respectively. The average unconditional share is 47.31 percent in the baseline economy. The partial equilibrium economy generates a substantial 2.26 p.p. increase, while the full general equilibrium predicts a more modest 0.57 p.p. increase. These predictions suggest that an economy-wide intervention is not necessarily as effective as smaller-scale programs in promoting stock investments, precisely due to the potential repercussions that the large-scale policy has on the equilibrium equity premium.

4.3 Heterogeneous Portfolio Adjustments

Thus far, I showed that the aggregate implications of financial literacy subsidies are partially offset in general equilibrium. However, it is not obvious how the policy would impact different households across the wealth distribution. In this section, I examine the various patterns in which households re-optimize their investment portfolios following the policy intervention. Investigating the heterogeneous effects that the subsidy may have provides further insights for wealth inequality.

Table 5: Policy Effects by Wealth Quartile: Equity Premium

Wealth Quartile	$\mathbb{E}[f]$ **Average financial literacy**			$\mathbb{E}[\tilde{r}(f)] - r^b$ ***Average* equity premium**		
	Baseline	Δ PE	Δ GE	Baseline	Δ PE	Δ GE
	(1)	(2)	(3)	(4)	(5)	(6)
Q1	1.56	0.07	0.07	4.93	0.02	-0.11
Q2	1.64	0.49	0.42	4.96	0.16	0.01
Q3	2.56	0.40	0.38	5.26	0.13	-0.01
Q4	2.98	0.02	0.02	5.40	0.01	-0.12
Total	2.18	0.25	0.22	5.14	0.08	-0.06

* The right panel of the table reports the *unconditional* average equity premium for each wealth quartile; i.e. the statistics average out the *expected* equity premium of all households (both stock market participants and non-participants) in each quartile.

Table 5 shows average financial literacy and the *unconditional* average equity premium by wealth quartile across the different counterfactual experiments: the baseline economy, the partial equilibrium economy, and the full general equilibrium economy. Columns (1)-(3) show a stark variation in the amount of financial literacy newly accumulated by each group when financial literacy acquisition is subsidized. The wealthiest quartile (Q4) almost tops out its literacy level in the baseline economy prior to the subsidy, while the poorest quartile (Q1) also does not benefit much from the subsidy. This most financially vulnerable population is also constrained by the other market friction, the stock market participation cost. Since financial literacy only raises the risk-adjusted *stock* return, not the bond return, the bottom wealth quartile does not have much of the incentive to invest in financial literacy, even at the subsidized cost. Accordingly, the average mean excess returns $r^X(f)$ of the top and bottom wealth quartiles do not increase much after the subsidy, even in partial equilibrium.

On the contrary, the households in the middle of the wealth distribution derive substantial benefits from the financial literacy subsidy. The second and third wealth quartiles (Q2 and Q3), who possess sufficient wealth to cover the per-period participation cost, actively leverage the subsidy to augment their literacy investment. For example, the average financial literacy of the second wealth quartile (Q2) increases from 1.64 to 2.13, which roughly corresponds to a 30 percent increase. This boost in financial literacy directly maps into a rise in the mean excess return $r^X(f)$. Accordingly, in the partial equilibrium economy where the asset returns remain constant, the expected equity premium for Q2 rises from 4.96 percent to 5.12 percent. However, in general equilibrium, aggregate stock returns $(r^\star, \underline{r}^\star)$ decrease while adjusting to the new aggregate capital size. The middle wealth groups offset the aggregate return depreciation with an increase in their own idiosyncratic returns. By contrast, the top and bottom wealth quartiles, who have not increased their financial literacy investment with the subsidy, experience a substantial decrease in their expected equity premium.

Table 6: Policy Effects by Wealth Quartile: Stock Investments

Wealth Quartile	$\mathbb{E}[\mathbb{1}(\kappa > 0)]$ **Participation rate**			$\mathbb{E}[\kappa \mid \kappa > 0]$ **Conditional portfolio share**		
	Baseline	Δ PE	Δ GE	Baseline	Δ PE	Δ GE
	(1)	(2)	(3)	(4)	(5)	(6)
Q1	0.00	0.00	0.00			
Q2	27.41	4.89	0.25	73.16	6.57	4.80
Q3	91.17	2.79	0.62	92.44	0.83	0.81
Q4	100.00	0.00	0.00	80.23	-0.21	-0.57
Total	54.65	1.92	0.22	84.43	1.05	0.70

Table 6 further shows the counterfactual changes in average stock market participation and the conditional risky portfolio share for each wealth quartile. The left panel of the table shows that the poorest wealth quartile (Q1) never participates in the stock market in any counterfactual, while the wealthiest quartile (Q4) always participates. With the literacy subsidy, the middle wealth quartiles increase their stock investment in both extensive and intensive margins. For example, in the baseline economy, 27.4 percent of households in the second quartile (Q2) participate in the stock market, and these participants have 73 percent of their wealth invested in stocks. The financial literacy subsidy increases this group's participation rate by 4.89 percentage points, and its average risky portfolio share by 6.57 percent points. Still, these predicted increases are attenuated in the general equilibrium.

Notably, the average risky portfolio share of the top wealth quartile falls in both partial and general equilibrium. This occurs because the subsidy allows the richest quartile to allocate fewer resources toward maintaining their financial literacy level and invest more resources in bonds instead. Additionally, in general equilibrium, these wealthiest households actively shift their wealth from stocks to bonds, in order to compensate for the loss in capital income caused by declining stock returns.

4.4 Implications for Wealth Inequality

Through the equilibrium return adjustments, the financial literacy subsidy generates heterogeneous portfolio rebalancing across the wealth distribution. In particular, the policy prompts the middle wealth groups to shift their portfolio toward stocks, while it prompts the top wealth group to reduce their risky portfolio share. The bottom wealth quartile continues to stay out of the stock market.

Table 7: Share of financial assets held by each wealth groups (%)

	Wealth		**Bond**		**Stocks**	
Wealth Quartile	Baseline (1)	Δ GE (2)	Baseline (3)	Δ GE (4)	Baseline (5)	Δ GE (6)
Q1	1.52	0.01	5.77	0.05	0.00	0.00
Q2	8.85	0.04	25.49	-0.99	2.87	0.44
Q3	23.82	0.35	13.25	-0.99	27.62	0.81
Q4	65.80	-0.40	55.49	1.93	69.51	-1.25
Total	100.00	0.00	100.00	0.00	100.00	0.00

Table 7 shows the resulting equilibrium changes in the share of financial assets held by each wealth quartile. In the baseline economy, the top quartile holds 65.8 percent of total financial wealth. Following the financial literacy subsidy, wealth holdings primarily shift between the middle and top quartiles. Specifically, the total wealth share held by the top quartile declines by 0.4 percentage point (p.p.), and this decrease is mostly absorbed by a 0.39 p.p. increase in the total wealth share held by the middle wealth quartiles. The total wealth share held by the bottom quartile experiences a slight increase of 0.01 percentage points, which is mainly attributable to the rise in the total bond share held by this group. Therefore, the financial literacy subsidy narrows the wealth gap of the economy primarily by redistributing wealth from the rich to the middle classes, despite that it has little impact on the poor. Specifically, the ratio of total wealth held by the top quartile versus the rest of the population decreases by 1.9 percent. Correspondingly, the Gini index for wealth decreases slightly from 56.3 percent to 55.9 percent.

In conclusion, the counterfactual analysis illustrates that the impact of a financial literacy subsidy on stock market investment is tempered by equilibrium channels: the decrease in the marginal product of capital and the increase in the capital income tax return. Nonetheless, these equilibrium adjustments have distinct effects on the equity premium, prompting households to engage in heterogeneous portfolio adjustments given their wealth levels. The resulting shift in wealth holdings contributes to the mitigation of wealth inequality.

5 Policy Alternatives

Table 8: Alternative Policy Experiments and Comparative Statics

	Baseline	FinLit Age 25-80 (1)	FinLit Age 61-65 (2)	FinLit Age 25-40 (3)	+ Participation Age 25-40 (4)
Risk-free return	**2.32**	**2.40**	**2.39**	2.31	2.31
Mkt. equity premium	5.38	5.28	5.34	5.35	5.35
Base equity premium	4.41	4.28	4.36	4.36	4.36
Capital income tax rate	**9.77**	**10.76**	**10.27**	10.06	**10.06**
Avg. FinLit	2.18	2.41	2.26	2.32	2.42
S.D. Finlit	0.93	0.84	0.89	0.89	0.84
Participation rate	**54.65**	**54.87**	54.57	**54.88**	**62.52**
Cond. risky portfolio share	84.43	85.13	84.68	84.79	86.04
Wealth Gini Index	56.34	55.97	56.18	56.24	55.38

* Average and standard deviation of financial literacy are reported in levels (the raw financial literacy score ranges between 0 and 3). All other results are in percentage (%) terms.

In the previous section, I presented quantitative predictions on how a policy subsidizing the cost of financial literacy acquisition can affect individual portfolio choices and aggregate capital accumulation. Specifically, the analysis so far demonstrates that a *universal* subsidy has little impact on promoting stock market participation among households in the bottom wealth quartile. This result is partly due to the stock market participation cost constraining the poorest households, and to the fact that financial literacy enhances only the stock return, and not the bond return. In Table 8, I present the results from alternative policy experiments that subsidize 75 percent of the financial literacy acquisition cost only for the near-retirement workers aged 61-65 (column 2), and only for the young workers below age 40 (column 3). I also explore a policy which subsidizes 75 percent of the literacy cost and 50 percent of the per-period stock market participation cost for young workers. The results show that a direct participation subsidy indeed increases the aggregate participation rate.

6 Conclusion

In this paper, I investigate to what extent policies subsidizing financial literacy can augment aggregate capital accumulation and mitigate wealth inequality. The paper incorporates household portfolio choice and financial literacy accumulation into a heterogeneous-agent incomplete market model. The model posits that households' accumulation of financial literacy raises their risk-adjusted returns. Disciplined to match financial literacy and stock market participation of U.S. households in the Survey of Consumer Finances (SCF), the model features the competing aggregate implications of financial literacy subsidies: on one hand, making financial literacy more affordable increases stock demand, while on the other hand, greater capital investment reduces the rental rate of capital, in turn lowering equity premium on average. Nevertheless, the policy interventions mitigate wealth inequality by generating heterogeneous portfolio rebalancing: the wealthiest group shifts toward bonds to compensate for lower stock returns, while the middle wealth group accumulates more financial literacy and increases stock holding.

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Appendix

I Model Details

I.1 Marginal product of capital and average stock return

Moreover, the capital income consistency condition (17) establishes that, in equilibrium, the rental rate of capital is equal to the unconditional mean stock return of all households: $r^\star = \underline{r} + r^X(F^\star)$.[18]

Given an exogenous excess return schedule $r^X(\cdot)f$ with $r^X(f\min) = 0$, the capital income consistency condition (17) asserts that, in equilibrium, the rental rate of capital $r^\star$ equals the unconditional mean stock return across all households:

$$
\begin{aligned}
r^\star K^\star &= \int \left(\underline{r}^\star + r^X(f) + \sigma^X\eta\right) \kappa\mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t) \qquad (17)\\
&\equiv \mathbb{E}\left[\left(\underline{r}^\star + r^X(f) + \sigma^X\eta\right) a\right]\\
&= \underline{r}^\star\mathbb{E}\big[a\big] + \mathbb{E}\big[r^X(f)a\big] + \mathbb{E}\big[\sigma^X\eta a\big]\\
&= \underline{r}^\star\mathbb{E}\big[a\big] + \mathbb{E}\big[\mathbb{E}[r^X(f)a|f]\big] + \mathbb{E}\big[\mathbb{E}[\sigma^X\eta a|a]\big]\\
&= \underline{r}^\star\mathbb{E}\big[a\big] + \mathbb{E}\big[r^X(f)\underbrace{\mathbb{E}[a|f]}_{\not\equiv K^\star}\big] + \mathbb{E}\big[\underbrace{\mathbb{E}[\sigma^X\eta|a]}_{=0}a\big]\\
&\neq \left(\underline{r}^\star + r^X(F^\star)\right)\cdot\underbrace{\mathbb{E}[a]}_{\equiv K^\star}\\
\Rightarrow\ r^\star &\neq \underline{r} + r^X(F^\star)
\end{aligned}
$$

18. See Section I.1 for proof.

$$
\begin{aligned}
r^\star K^\star &= \int \left(\underline{r}^\star + r^X(f) + \sigma^X \eta\right) \kappa \mathcal{S} d\Gamma(\mathcal{X}, f; l, \eta, t) && (17)\\
&\equiv \mathbb{E}\left[\left(\underline{r}^\star + r^X(f) + \sigma^X\eta\right) a\right] \\
&= \underline{r}^\star \underbrace{\mathbb{E}\big[a\big]}_{K^\star} + \mathbb{E}\big[r^X(f)a\big] + \mathbb{E}\big[\underbrace{\mathbb{E}[\sigma^X\eta|a]}_{=0}\, a\big] \\
&= \underline{r}^\star K^\star + \mathbb{E}\big[r^X(f)a\big] \\
\not\Rightarrow \qquad r^\star &= \underline{r} + r^X(F^\star) \ \text{ where } F^\star = \mathbb{E}[f] \\
r^\star - r^b &\neq \mathbb{E}[\tilde{r}(f)] - r^b = \underline{r}^\star + \mathbb{E}[r^X(f)] - r^b
\end{aligned}
$$

II Notes on the Quantification Exercises

II.1 Initial Distribution

The initial state is characterized by At $t = 0$, households are born with initial levels of financial literacy, labor productivity, and bequest denoted as $(f_0, l_0, \mathcal{S}_0)$, which denotes financial literacy, labor productivity, and bequest at $t = 0$. The initial literacy is drawn from the following *categories*, $f_0 \in \{0, 0.5, 1, 2, 3\}$, where the probability of drawing each category is based on the population shares of each financial literacy group among the total survey respondents in the 2016-2019 SCF aged between 18 and 25. While there are only 4 discrete values of financial literacy scores in the SCF ($\hat{f} \in \{0, 1, 2, 3\}$), I imputed the population share to have five distinct values, matching the number of grid points for financial literacy choices. Specifically, I randomly assigned the imputed level $f_0 = 0.5$ to households aged 18–25 with financial literacy scores $\hat{f} \in \{0, 1\}$ in the data, with a probability of one half.

To proxy for the observed correlation between financial literacy and wealth early in the life cycles, I draw the bequest $\mathcal{S}_0$ as a function of the initial literacy f_0. In particular, for each literacy group, I compute the median financial wealth scaled by the population median wage of all households aged 18-20 in SCF: $\omega_f = \frac{\text{median}(\texttt{fin}|f)}{\text{median}(\texttt{wageinc})}$. In the simulated model, a household's bequest $\mathcal{S}_0 = \omega_f \times \bar{l}_0$ is a multiple of the simulated median labor income for all households at $t = 0$, where the corresponding factor ω_f is subject to its realized initial literacy level f_0. This initial bequest is assumed to be delivered as *cash*, and households at $t = 0$ do not have initial bond and stock holdings. Instead, at the beginning of $t = 0$, their cash on hand realizes the sum of the labor income and the bequest in cash $\mathcal{X}_0 = \mathcal{S}_0(f_0) + \tilde{l}_0$.

II.2 Labor Income and Housing Cost

Figure A.1: Simulated Life Cycle of Labor Productivity Process