The Retirement Gap: Entrepreneurs, Tax Policy, and the Cost of Liquidity*

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Abstract

Entrepreneurs allocate a smaller share of their wealth to retirement accounts compared to non-business owners, despite the substantial tax advantages associated with accounts such as IRAs and 401(k) plans. We document that, on average, they have 8.4 percentage points less of their total assets invested in retirement accounts, a gap that persists across both age and wealth distributions. To explain this retirement account gap, we develop a life-cycle general equilibrium model featuring entrepreneurs and workers, who face trade-offs between the tax benefits and liquidity constraints of retirement accounts. The central mechanism is that collateral constraints and liquidity needs compel entrepreneurs to prioritize liquid assets over tax-advantaged savings. Leveraging the model, we conduct counterfactual experiments to assess the macroeconomic implications of varying the illiquidity of retirement accounts and enabling their collateralization. Preliminary results suggest that making retirement accounts collateralizable could significantly increase aggregate wealth and economic output while preserving tax-advantaged savings, without exacerbating economy-wide leverage. We also explore how varying the size of early-withdrawal penalties impacts entrepreneurs' contributions to retirement accounts and business investment.

Keywords: Entrepreneurship, Retirement Accounts, Taxation, Risk, Liquidity

JEL Codes: E22, D31, G32, L26

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1 Introduction

Retirement accounts, such as individual retirement accounts (IRAs) and 401(k) plans, constitute a significant share of household financial assets in the United States, accounting for approximately 33 percent of the total, according to the Survey of Consumer Finances (SCF 2019). These accounts offer valuable tax advantages, including tax-deferred growth and the potential for deductible contributions. In this paper we document that despite these benefits, entrepreneurs consistently allocate a smaller proportion of their wealth to retirement accounts than non-business owners. We then investigate the reasons behind this disparity and its broader economic implications.

Specifically, we quantify the gap in asset allocation between entrepreneurs and non-business owners after controlling for age and wealth. We then develop a structural macroeconomic model that provides a theory explaining the asymmetric asset allocation to retirement accounts between entrepreneurs and non-business owners. We use the quantitative model to understand the causes of this differential and explore the implications it has for macroeconomic policy.

Differences between non-business owners and entrepreneurs matter for understanding inequality and because entrepreneurs' financial decisions can have macroeconomic consequences. While only 12 percent households in the United States own and actively manage a business, these households are disproportionally income-rich, accounting for 30 percent of market income, and are disproportionally wealthy, owning 40 percent of the wealth in the economy.[1] An overwhelming majority of businesses in the U.S. are private. Despite the average private business being 62 times smaller than the average publicly traded company (Dinlersoz, Kalemli-Ozcan, Hyatt, and Penciakova (2019)), they still produce 75 percent of U.S. value added (Schlingemann and Stulz (2022)). A private business's and its owner's finances are usually tightly related. Thus, factors affecting entrepreneurs' financial choices impact their businesses. Due to the significance of private firms for the overall economy, this paper studies how the allocation of assets into retirement account balances impact entrepreneurs' abilities to invest in their businesses.

Our first contribution is to document the existence of a retirement account gap: entrepreneurs allocate, on average, 8.4 percentage points less of their total assets to retirement accounts compared to non-business owners. This disparity is systematic across both age and wealth distributions. This gap grows as households age, ranging from 7.4 percent for individuals aged 25–30 to 15.7 percent for those aged 60–65. In terms of wealth, entrepreneurs are heavily concentrated at the

[1] Authors' calculations for the 2019 Survey of Consumer Finances

top of the distribution, accounting for 41 percent of the top wealth decile. The retirement gap is present in almost every decile of net-worth, but is widest among the wealthiest 10% of households. Importantly, the retirement gap is a robust feature of the data; it persists regardless of whether we measure assets broadly or focus specifically on financial assets and whether we include the value of the private businesses themselves.

Our second contribution is to explain the retirement gap with an explicit economic mechanism. To do so, we develop a life-cycle, general equilibrium model featuring heterogeneous entrepreneurs and non-business owners (workers). Both types of households can allocate their financial resources into liquid assets (regular saving accounts) and retirement accounts. Our retirement account modeling reflects key features of how individual retirement accounts (IRAs) and 401(k)s are structured in the U.S. legal system. They are tax advantaged in two ways; first, contributions to retirement accounts are deducted from individual's taxable income. Second, capital income within the retirement account is tax-free, allowing compounded returns to grow without incurring any tax liability. However, withdrawals do add to the individual's pre-tax income and are then subjected to individual income tax.

Preferential tax treatment of retirement accounts makes them an attractive financial vehicle to allocate resources over the lifetime while minimizing lifetime tax liabilities. Under a progressive tax code, they allow individuals to reduce tax liabilities in high-income years and shift them to low-income years in later stages of life,resulting in lower lifetime tax liabilities.

At the same time, retirement accounts are illiquid financial instruments. Early withdrawals incur direct financial penalties. Absent potential differentials in returns, the trade-off between tax benefits and liquidity needs determines the allocation of assets inside and outside of retirement accounts. We model workers along the lines of the standard incomplete markets (SIM) model. They face uninsurable idiosyncratic risk to their labor income and are subject to exogenous borrowing constraints for liquid assets, which gives rise to liquidity needs for insurance purposes.

Liquidity is the key feature of how retirement accounts interact with entrepreneurial decisions. Entrepreneurs, like workers, are subject to borrowing constraints for liquid assets and face risks to the profitability of their business. These risks are unique to the individual entrepreneur and cannot be diversified away. Like workers, they have an incentive to save outside of retirement accounts in order to self-insure against the income risk that they face. Empirically, entrepreneurs face a much higher degree of income risk than workers (DeBacker, Panousi, and Ramnath, 2023). We calibrate our model to match key features of entrepreneurial and worker income risk, and the

additional income risk that entrepreneurs face provides the first reason why entrepreneurs in our model choose to invest less in illiquid retirement accounts.

Entrepreneurs in our model have access to a decreasing-returns-to-scale production function, which converts capital and labor into a final good and determines their optimal size of operation. The amount of invested capital is restricted by a collateral constraint, modeled following a standard approach (e.g., Moll (2014)), where an entrepreneur can lever up to a certain percentage of their *liquid* wealth. This reflects another key aspect of retirement accounts, which, according to U.S. tax law, are not collateralizable. The need for liquidity to grow their business towards the optimal scale creates an additional incentive, absent for workers, to hold assets outside of the retirement accounts. This is the most important reason entrepreneurs invest less in retirement accounts in our model relative to the workers. As long as there is a positive mass of constrained entrepreneurs in the model, this force is operational and pushing towards a smaller proportion of assets invested into retirement accounts among the population of entrepreneurs relative to workers.

According to our preliminary results, these two sources of liquidity needs, self insurance and collateral constraints, explains *more than half* of the difference in retirement account holdings between workers and entrepreneurs. Importantly, these results are from an endogenous economic mechanism and have not been targeted in the calibration procedure.

Our third contribution is to quantify the economic implications of the misalignment in asset allocation and to derive its consequences for macroeconomic policy. Leveraging our macroeconomic framework, we conduct a series of counterfactual experiments to measure the cost of liquidity constraints. In one counterfactual scenario, we allow retirement assets to be used as collateral for entrepreneurs. This policy incentivizes entrepreneurs to rebalance their portfolios, shifting assets towards tax-advantaged retirement accounts without compromising the growth of their businesses. Preliminary results suggest that this change more than doubles retirement account balances and increases overall wealth in the economy (now fully collateralizable) by 6.2 percent. Due to larger stock of wealth and the fact that all of it is now collateralizable this translates into a 12.2 percent rise in the capital stock and, ultimately, an 8.1 percent increase in output. Given the preliminary stage of this analysis, these results should be viewed as a proof of concept.

It is important to emphasize that this experiment is fundamentally different from simply relaxing entrepreneurs' borrowing constraints. To illustrate this distinction, we conduct an additional counterfactual in which the tightness of the collateral constraint is eased to achieve the same

increase in the capital stock as in the collaterizable retirement accounts scenario. In this case, portfolio rebalancing is minimal, and the total wealth in the economy rises by 30 percent less than in the previous scenario. The effect on output is also slightly smaller, increasing by 7.7 percent. These counterfactuals highlight an important policy implication: allowing retirement account balances–essentially investments in public equity–to be used as collateral can support private business investment without increasing the leverage and associated risks in the private sector.

We also use the model to illustrate that entrepreneurs, conditional on lifetime incomes, face higher overall tax liabilities than workers. This result arises from the preferential tax treatment of retirement accounts combined with the fact that entrepreneurs make less use of them. While there are many other factors–unmodeled here–that allow entrepreneurs to reduce their tax liabilities, such as tax avoidance or income reclassification, the specific channel we highlight operates in the opposite direction, increasing their tax burden.

Finally, we conduct a policy exercise to examine how the degree of illiquidity in retirement accounts affects aggregate outcomes. In this counterfactual analysis, we vary the early withdrawal penalties, which determine the illiquidity of retirement accounts. The impacts follow a consistent pattern: higher early withdrawal penalties discourage entrepreneurs from investing in retirement accounts, leading them to allocate more assets to liquid investments. While this shift increases liquid wealth, overall wealth decreases as entrepreneurs' tax burdens rise. Higher collateralizable wealth supports greater investment in private businesses, which in turn increases the capital stock. As a result, output rises, but the composition of economic aggregates changes. Specifically, there is less wealth and consumption but more investment and capital.

Related Literature.

This paper contributes to three strands of the literature: entrepreneurship, macro public finance, and empirical studies of retirement account withdrawals.

First, our work builds on the extensive literature examining how entrepreneurs' decisions impact macroeconomic outcomes. Seminal contributions by Quadrini (2000) and Cagetti and De Nardi (2006) demonstrate the impact of entrepreneurship on aggregate outcomes and wealth inequality. A related line of research emphasizes the role of liquidity constraints in shaping aggregate efficiency and resource allocation. Studies such as Buera (2009), Buera and Kaboski (2012), Midrigan and Xu (2014), Moll (2014) and Kochen (2022) illustrate how financial frictions prevent productive

entrepreneurs from scaling their businesses or making productive investments, thereby reducing aggregate total factor productivity and increasing misallocation. More recently, Robinson (2021) and Boar, Gorea, and Midrigan (2023) highlight the role of risk and risk premia in entrepreneurial decision-making, demonstrating how risk and incomplete insurance markets distort the allocation of capital and reduce aggregate efficiency. Additionally, a complementary strand of literature examines firm ownership dynamics and secondary markets for businesses. Papers such as Guntin and Kochen (2024), Mahone (2023), and Peter (2021) analyze how financial frictions and equity constraints influence firm ownership changes and business transfers, with implications for aggregate productivity and allocative efficiency.

Our contribution to this line of research is to integrate financial frictions and retirement account decisions into a life-cycle model of entrepreneurship. We demonstrate how the illiquidity of tax-advantaged retirement accounts interacts with entrepreneurial borrowing constraints, shaping portfolio choices, investment decisions, and aggregate outcomes. By embedding these mechanisms into a quantitative general equilibrium model, we provide novel insights into the interaction between entrepreneurial savings behavior and retirement policies.

Our work also contributes to the macro public finance literature on taxation, social security design, and entrepreneurial income taxation. A rich line of research studies optimal tax and social security design in life-cycle economies, with foundational contributions by Conesa and Krueger (1999), Conesa, Kitao, and Krueger (2009), and McGrattan and Prescott (2017), which analyze how taxation and social insurance programs affect labor supply, savings, and welfare. A parallel line of research focuses on the taxation of entrepreneurial income in incomplete markets. Dyrda and Pugsley (2019) study taxation of pass-through businesses, Brüggemann (2021) explores the role of entrepreneurs in shaping top tax rates, Boar and Midrigan (2023) study optimal capital income and wealth taxation in an economy that reproduces the importance of private businesses for output and inequality.

We contribute to these lines of research by developing a unified, quantitative, general equilibrium, life-cycle model that jointly studies the taxation of entrepreneurs and the design of retirement savings policies. Our model explicitly captures the interaction between entrepreneurial borrowing constraints and the illiquidity of retirement accounts, highlighting how these two policy margins are tightly related. We show that policies that increase the liquidity of retirement savings or allow their use as collateral can simultaneously enhance retirement security and improve entrepreneurial investment and aggregate efficiency.

Finally, we engage with the empirical literature on early withdrawals from tax-deferred retirement accounts, which documents how liquidity needs influence savings behavior. Existing empirical work, including Amromin and Smith (2003), Argento, Bryant, and Sabelhaus (2015), Goodman, Mortenson, Mackie, and Schramm (2021), and Stuart and Bryant (2024), shows that early withdrawal penalties affect savings decisions and that liquidity needs,often arising from unexpected shocks such as divorce, job loss, or medical expenses, are a key driver of early withdrawals.

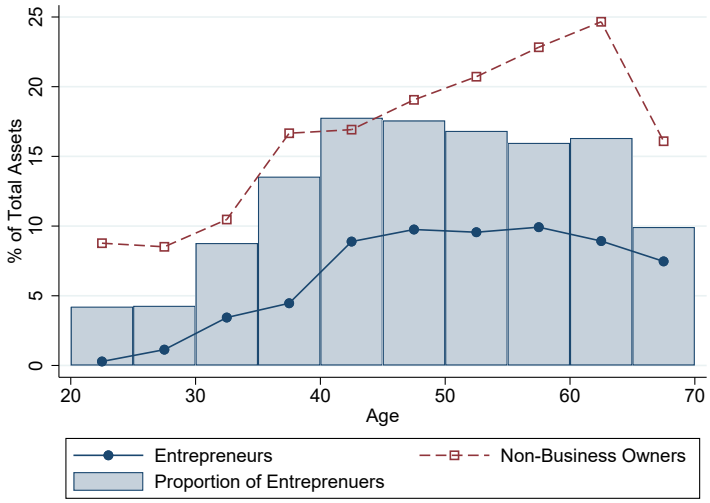
We complement this empirical literature by documenting the retirement gap between workers and entrepreneurs, demonstrating that entrepreneurs systematically invest less in tax-advantaged retirement accounts due to their heightened liquidity needs and borrowing constraints. We then embed early withdrawal decisions into a structural general equilibrium model, allowing us to quantify how varying withdrawal penalties and collateralization policies influence entrepreneurial savings, investment choices, and business dynamics. Our counterfactual policy experiments highlight the trade-offs between preserving retirement savings incentives and providing liquidity for entrepreneurial investment.

In summary, our key contribution is to integrate these three strands of the literature–entrepreneurship, public finance, and retirement savings behavior–into a unified macroeconomic framework. Our findings underscore the importance of considering entrepreneurial behavior and liquidity constraints when designing retirement savings policies and highlight the potential for policy reforms that jointly improve retirement security and aggregate economic efficiency.

2 Empirical Evidence

In this section, we document several facts about retirement account holdings in the 2019 wave of the Survey of Consumer Finances. We compare households that own no businesses to entrepreneurial households, who own and actively manage a business over both the life-cycle and over the distribution of wealth.

Figure 1: Retirement Account Balances over Age

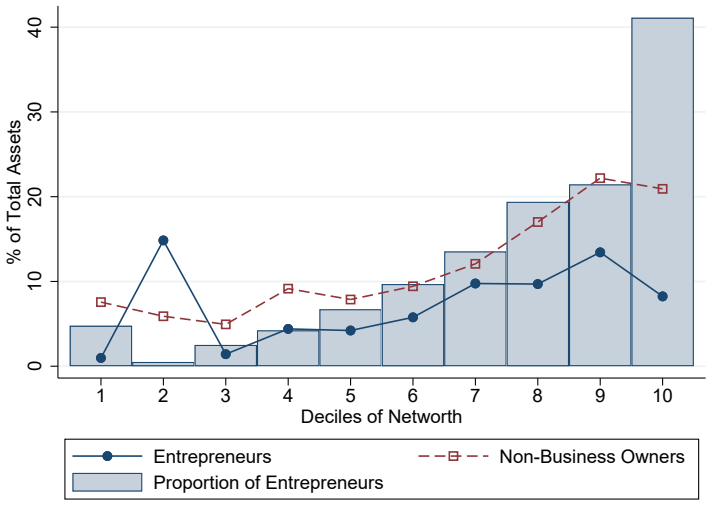


The share of total assets invested in retirement accounts over different age groups for households with no private business ownership compared to households that own and actively manage a business. The bars show the proportion of households that own and actively manage a business in each age group.

Figure 1 shows the share of total assets invested in retirement accounts over different ages[2]. On average, households invest more of their total assets in retirement accounts as they approach retirement age. Entrepreneurial households at every age tend to hold a smaller share of their retirement accounts in retirement accounts.

Figure 2 shows the share of total assets invested in retirement accounts over the distribution of wealth. On average, wealthier households hold more of their total assets in retirement accounts. Entrepreneurial households throughout the wealth distribution tend to hold a smaller share of their total assets in retirement accounts.

Figure 2: Retirement Account Balances over the Wealth Distribution



Figures 1 and 2 both show a gap between the proportion of total assets invested in retirement accounts by entrepreneurs and non-business owners. In order to quantify the average size of this gap, we run regression 1, where we regress the ratio of retirement account balances to total assets on an indicator variable for being an entrepreneurial household as well as some controls.

$$\frac{\text{Retirement Account Balance}_i}{\text{Total Assets}_i} = \beta_0 + \beta_1 \text{Entrepreneur}_i + \beta X_i + \epsilon_i \tag{1}$$

Table 1 shows the results of regression 1.[3] The first column shows that, without any controls, there is no average difference between the share of total assets invested in retirement accounts among entrepreneurial households and non-business owning households. However, this result is driven by the fact that entrepreneurial households are disproportionately older and wealthier than non-business owning households. Since older and wealthier people typically have higher shares of their total assets invested in retirement account balances, the correlation between entrepreneurship and both age and wealth falsely creates the impression that there is no average difference between entrepreneurial households and non-entrepreneurial households.

In columns two, three, and four, we show that after controlling for age, wealth, or both age

[2]Throughout this paper, age of the household is defined by the age of the respondent to the survey.

[3]Note that the standard errors in Table 1 are all computed using bootstrapped errors and take into account imputation uncertainty using the Stata package SCFCOMBO (Pence, 2015).

and wealth, there is a statistically significant gap between the share of total assets invested in retirement accounts by entrepreneurial households and non-business owning households. After controlling for both age and wealth, the average entrepreneurial household has a share of total assets invested in retirement accounts that is 8.4 percentage points lower than the average non-business owning household. This is a economically large difference given that the average household has only 12% of their total assets invested in retirement accounts.

Table 1: Retirement Account Gap

	(1) No Controls	(2) Wealth	(3) Age	(4) Both Wealth and Age
Entrepreneur	-0.00596	-0.0707***	-0.0197***	-0.0839***
	(0.00525)	(0.00574)	(0.00505)	(0.00581)
Constant	Yes	Yes	Yes	Yes
Net Worth Deciles	No	Yes	No	Yes
Age Groups	No	No	Yes	Yes
N	5,586	5,586	5,586	5,586

The fact that entrepreneurs hold a much lower share of their total assets in retirement accounts is not because they have a high share of their total assets held in their private businesses. In table 2, we report the results of regressing the share of non-business assets invested in retirement accounts on an indicator variable for being an entrepreneurial household as well as the same controls.

$$\frac{\text{Retirement Account Balance}_i}{\text{Total Assets}_i - \text{Business Assets}_i} = \beta_0 + \beta_1 \text{Entrepreneur}_i + \beta X_i + \epsilon_i \tag{2}$$

Table 2 shows that even excluding the value of privately held businesses, entrepreneurial households invest less of their assets in retirement accounts than non-business households. While the gap narrows to 5.8%, this is still an economically significant gap given that the average household invests 12% of their total assets in retirement accounts.

These results do not suggest that entrepreneurs save less for retirement than non-business owning households. As has been known since at least Quadrini (1999), entrepreneurial households on average have higher wealth-to-income ratios than non-entrepreneurial households. Instead, this means that entrepreneurs do not utilize the tax-deferral benefits of retirement savings accounts at the same rate as other households. In the following section, we present a theory of why

Table 2: Retirement Account Gap: Non-Business Assets

	(1) No Controls	(2) Wealth	(3) Age	(4) Both Wealth and Age
ActBusOwner	0.0223***	-0.0450***	0.00835	-0.0583***
	(0.00582)	(0.00627)	(0.00559)	(0.00631)
Constant	Yes	Yes	Yes	Yes
Net Worth Deciles	No	Yes	No	Yes
Age Groups	No	No	Yes	Yes
N	5,586	5,586	5,586	5,586

entreprenuers choose not to take advantage of these tax savings.

3 Quantitative Theory

This section presents a life-cycle, incomplete markets, general equilibrium model that integrates heterogeneous agents and endogenous portfolio decisions, including the allocation of assets to retirement accounts. The model captures key features of workers and entrepreneurs, who differ in their income risks, borrowing constraints, and investment opportunities. It incorporates realistic institutional details of U.S. retirement accounts, emphasizing the trade-offs between tax advantages and liquidity constraints. By modeling labor supply, savings, and production decisions jointly, the framework allows us to study the interplay between household behavior, market clearing conditions, and aggregate outcomes in a unified setting. The model captures the distribution of wealth, labor, and capital while accounting for the distinct roles of privately held businesses, publicly traded firms, and government policy.

Demographics. The model economy is structured around households as the primary unit of analysis. In each period a continuum of households is born born at age $j = 1$ and they face a finite lifespan, dying with certainty at age $j = J$. At each age j, households experience a probability of death equal to $1 - \phi_j$, where ϕ_j represents the probability of survival from age j to $j + 1$. The cumulative probability of survival to age j is denoted by $\Phi_j = \prod_{s=1}^{j} \phi_s$. At birth, households are assigned a type: a fraction μ become entrepreneurs, while the remaining fraction $1 - \mu$ become workers. These types are fixed until retirement and both types of agents retire exogenously at age $J_R < J$, conditional on survival. As a result, the economy consists of three distinct groups of households in any given period: workers (ω), entrepreneurs (e), and retirees (r).

Individual States. In the model, a household is characterized by a vector of individual state variables $s = \{j, o, a, b, z_o\}$. These variables include age $j \in \{1, \ldots, J\}$, occupation $o \in \{\omega, e, r\}$, liquid assets $a \in [\underline{a}, \infty)$, retirement account balance $b \in [0, \infty)$, and productivity z_o. For workers and entrepreneurs, productivity evolves stochastically. For retirees, productivity is fixed and determines their retirement benefits. The specific details of productivity evolution are described in the following paragraphs.

Preferences and Technology. Households derive utility from consumption and leisure over their lifetime. The lifetime utility is given by:

$$U(c,h) \equiv \mathbb{E}\left[\sum_{j=1}^{J} \beta^j \Phi_j \frac{\left(c_j^{\gamma}\left(1-1_{o\in\{w,e\}}h_j\right)^{1-\gamma}\right)^{1-\sigma}}{1-\sigma}\right] \tag{3}$$

where c_j stands for consumption and h_j for hours worked at age j, γ controls the consumption share relative to leisure; σ governs risk aversion and the intertemporal elasticity of substitution; β is the household's discount factor.

In this economy all households face the same exogenous age-efficiency profile, ε_{ij} for $i \in \{w,e\}$, during their working years $j \in \{1,...,J_R\}$. This profile is estimated from the data and recovers the fact that productive ability changes over the life cycle. On top of that both workers and entrepreneurs face stochastic shocks to their productivity level. These shocks are represented by a Markov process m_i, defined on $(M_i, \mathbb{B}(M_i))$ where $M \subset \mathbb{R}_{++}$ and $\mathbb{B}(M_i)$ is Borel $\sigma-$algebra on M_i. The process is characterized by a transition function $Q_i : M_i \to M_i$. The total productivity of a household of age $j < J_R$ is given by the product of the stochastic productivity in that period and the deterministic efficiency index at the same age: $z_{ij} = \varepsilon_{ij} m_i$.

Entrepreneurs in the model have access to a decreasing returns to scale technology, which converts labor l and capital k into final goods as follows

$$f(z_e,k,l) = z_{ej}^{1-\gamma}\left(k^{\alpha}l^{1-\alpha}\right)^{\gamma} \tag{4}$$

where γ determines span of control and α controls the capital share.

Retirement Accounts. The model incorporates retirement accounts designed to capture the primary features of Individual Retirement Accounts (IRAs) and 401(k)s, the most prevalent types of retirement savings vehicles in the United States. Let b denote the retirement account balance in a given period. Its evolution is described recursively as:

$$b' = b(1+r^b) + d, \tag{5}$$

where r^b represents the return on the retirement account, d denotes the agents contribution or withdrawal at age j and is restricted as follows

$$-b(1+r^b) \leq d \leq \theta_j \tag{6}$$

Contributions and withdrawals are constrained by the age-dependent contribution limit θ_j and the non-negativity condition on the retirement account balance, $b' \geq 0$.

Contributions to and withdrawals influence households' tax liabilities. Denoting market income by y, post-tax income by $\tilde{y}$, and the tax schedule by $\mathcal{T}(\cdot)$, we have:

$$\tilde{y} = y - \mathcal{T}(y-d) - \mathbf{1}_{d<0, j<J_b}\tau_b d. \tag{7}$$

Thus, contributions ($0 < d \leq \theta_j$) reduce taxable income, while withdrawals ($-b(1+r^b) < d < 0$) increase it. Consistent with IRS tax regulations, returns earned within retirement accounts are tax-exempt. However, early withdrawals made before age J_b incur a penalty, τ_b, which further reduces after-tax income.

Retirees. As the household achieves age $j \geq J_R$ it exogenously retires, which is an absorbing state. Household enters period J_R with liquid assets a, retirement account balance b and social security benefits x. It chooses how much to save in liquid assets form a', how much to consume and how much to contribute to the retirement account d. Thus, the household solves the following dynamic programming problem:

$$\begin{aligned} V_j^r(a,b,x) &= \max_{a',b',c,d} \frac{c_j^{1-\sigma}}{1-\sigma} + \phi_j \beta V_{j+1}^r(a',b',x) \\ \text{s.t.} & \quad (5), (6), (7) \text{ and} \\ c + a' + d &= \tilde{y} + a \\ y &= x + r^a a \\ a' &\geq \underline{a} \end{aligned} \tag{8}$$

where the first constraint is a budget constraint, the second one is pre-tax income

Workers. Households who are workers enter the period with liquid assets a, retirement balance b and labor productivity z_w. On top of choices that retirees make they also choose hours worked

h. Thus the recursive problem of a household who is a worker is thus given by

$$\begin{aligned} V_j^{\omega}(a,b,z_{\omega}) &= \max_{a',b',c,d,h} \frac{\left(c_j^{\gamma}(1-h)^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} + \phi_j\beta\left(\mathbb{E}\left[\mathbf{1}_{j<J_R}V_{j+1}^{\omega}(a',b',z'_{\omega})\right] + \mathbf{1}_{j\geq J_R}V_{j+1}^{r}(a',b',x')\right) \\ \text{s.t.} &\quad (5),(6),(7) \text{ and} \\ c+a'+d &= \tilde{y}+a \\ y &= whz_{\omega j} + r^a a \\ x' &= g(a,z_w,y) \\ a' &\geq \underline{a} \end{aligned} \tag{9}$$

A continuation value for the worker depends on the household's age. Pre-retirement age $j < J_R$ households continuation value is $V_{j+1}^{\omega}(a',b',z'_{\omega})$, while once the household hits the retirment age $j = J_R$, the continuation value becomes $V_{j+1}^{r}(a',b',x')$, where x' is a determined by function $g(a,z_{\omega},y)$. This function captures in a simplified way a conversion from current assets, productivity and income to a social security benefit that the household will enjoy once it retires. The other constraints workers face is similar to those of retirees with one difference: they collect labor income whz_{ω}.

Entrepreneurs. An entrepreneur at age j enters the period with liquid asserts a retirement account balance b and productivity z_e. She has access to production technology (4), which converts labor and capital inputs into a final good. She rents capital and labor on the spot market to maximize their profits and are subject to a standard collateral constraint, like in Moll (2014) or Buera and Kaboski (2012):

$$\begin{aligned} \pi(a,z) &= \max_{k,l} z_e^{1-\gamma}\left(k^{\alpha}l^{1-\alpha}\right)^{\gamma} - wl - (r^a+\delta)k \\ \text{s.t.} &\quad k \leq \lambda(j,z_e)a \end{aligned} \tag{10}$$

where the tightness of the constraint $\lambda(j, z_e)$ depends potentially on entrepreneur's age and productivity. Thus the recursive problem of the entrepreneur is

$$\begin{aligned} V_j^e(a,b,z_e) &= \max_{a',b',c,d} \frac{\left(c^\gamma \left(1-\bar{h}\right)^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} + \phi_j \beta \left(1_{j<J_R} \mathbb{E}\left[V_{j+1}^e(a',b',z_e')\right] + 1_{j\geq J_R} V_{j+1}^r(a',b',x')\right) \\ \text{s.t.} & \quad (5), (6), (7) \text{ and} \\ c + a' + d &= \tilde{y} + a \\ y &= \pi(a,z) + r^a a \\ x' &= g\left(a, z_e, y\right) \\ a' &\geq \underline{a} \end{aligned} \tag{11}$$

Similarly to workers, at age J_R household's continuation value switches from V_j^e to V_{j+1}^r. Unlike workers entrepreneurs supply fixed labor $\bar{h}$. Market income of entrepreneurs y consists of business profits defined in (10) and return on liquid assets. This income net of contributions to retirement account constitutes tax basis for entrepreneurs. Thus, from the taxation standpoint we model all entrepreneurs as pass-through businesses, which constutite the vast majority of businesses in the U.S. (Dyrda and Pugsley (2024)).

Public equity. We model publicly traded companies as a representative firm operating under constant returns to scale. The firm solves the following optimization problem:

$$\max_{k_p, l_p} A_p k_p^\zeta l_p^{1-\zeta} - w l_p - (r^b + \delta) k_p \tag{12}$$

where A_p represents the aggregate productivity of publicly traded firms, k_p denotes the capital stock, l_p is labor demand, and ζ controls the capital share in production. Given the constant returns to scale assumption, the specific ownership structure of public equity is immaterial in this model.

Aggregation and Market Clearings. Let $S = \{1, \ldots, J\} \times \{\omega, e, r\} \times [a, \infty) \times [0, \infty) \times Z_o$ denote the individual state space, where an individual state is represented as $s = \{j, o, a, b, z_o\}$. Here, Z_o is the domain of productivity, which depends on the occupation. Let λ represent the distribution over the state space S. For a given occupation o, let S_o denote the subset of the state space corresponding to that occupation, and λ_o denote the associated marginal distribution. The

labor market clearing condition is:

$$\int_{S_\omega} h \, d\lambda_\omega(j, a, b, z_\omega) = \int_{S_e} l \, d\lambda_e(j, a, b, z_e) + l_p, \tag{13}$$

where the left-hand side represents the labor supply from worker households, and the right-hand side represents labor demand from two sources: privately held businesses and the representative public equity firm. The liquid asset market clearing condition is:

$$\int_S a \, d\lambda(j, o, a, b, z_o) = \int_{S_e} k \, d\lambda_e(j, a, b, z_e), \tag{14}$$

where the left-hand side reflects the total supply of liquid assets in the economy, derived from the savings of all agents, and the right-hand side represents the capital demand from privately held businesses. This condition determines the equilibrium interest rate on liquid assets, r^a.

The public equity market clearing condition is:

$$\int_S b \, d\lambda(j, o, a, b, z_o) = k_p, \tag{15}$$

where the left-hand side aggregates the retirement account holdings across all agents, and the right-hand side reflects the capital demand of the public equity firm. This condition determines the equilibrium interest rate on public equity, r^b. Finally, the goods market clearing condition follows directly from Walras' Law.

Government. The government in the economy collect taxes from two sources of revenues: (i) individual income taxes, (ii) penalty withdrawals from retirement accounts. On the expenditure side the government finances an exogenous stream of expenditure G and social security retirement benefits. Thus the budget constraint of the government becomes

$$\int_S \tau_b d + \mathcal{T}(y - d) \, d\lambda(j, o, a, b, z_o) = \int_{S_r} x \, d\lambda_r(j, a, b, x) + G \tag{16}$$

Equilibrium. A recursive stationary equilibrium is defined in standard way. It is the set of value and policy functions, prices and distribution λ such that: (i) households solve problems (8), (9), (11); (ii) public equity firm solves (12); (iii) government budget constraint (16) holds; (iv) market clearing conditions (13), (14), (15) hold; (iv) a measure λ is stationary.

4 Taking the Model to the Data

A key step in our analysis is to discipline the model parameters using empirical data to ensure that it replicates observed economic behavior. This process involves calibrating the model to match a set of macro and microeconomic moments, covering demographics, preferences, technology, financial constraints, income processes, taxation, and retirement accounts. Our calibration strategy relies on a combination of direct estimation from data sources and indirect inference methods, ensuring consistency with observed aggregate and distributional statistics. We begin by setting demographic parameters, including survival probabilities and initial occupational choices, followed by preference parameters that govern intertemporal consumption and labor supply decisions. We then discipline the technology and financial constraints using empirical targets for wealth inequality, entrepreneurial returns, leverage dynamics, and capital shares. Next, we estimate life-cycle income profiles using indirect inference, ensuring that the earnings dynamics of workers and entrepreneurs match observed patterns. We further refine the productivity processes for both groups using empirical earnings volatility and persistence estimates. Finally, we calibrate the tax system and retirement accounts, ensuring alignment with U.S. tax progressivity, payroll contributions, and retirement savings behavior.

Demographics and Initial Distributions. Model age $j = 1$ corresponds to age 25 and retirement age $J_R = 41$ corresponds to age 65. The maximum age in the model, $J = 70$, corresponds to age 99. We set the survival probabilities ϕ_s using data from the Human Mortality Database (HMD) and U.S. Social Security Administration (SSA) Life Tables, ensuring that our model accurately captures observed U.S. survival patterns across different age groups. At birth of a cohort a fraction μ of households becomes entrepreneurs. We set this fraction to 12 percent in line with an average fraction of entrepreneurs in the SCF 2019 data. Naturally, initial holdings in the retirement accounts b_0 are set to zero. Workers and entrepreneurs draw their initial productivities $m_i(1)$ from stationary distributions ν_i of their respective transition probability matrices Q_i, for $i \in \{\omega, e\}$.

Preferences. We discipline preference parameters $\{\beta, \gamma, \sigma\}$ as follows. First, we match a capital-output ratio of 2.6 computed from NIPA for the period 2009-2019.[4] Second, to discipline the labor supply margin we target the average hours worked in the entire population 0.25 and we

[4]Capital is defined as nonresidential and residential private fixed assets and purchases of consumer durables. For more details, see Appendix B.1.

impose that the average Frisch elasticity equals 1.0.[5] Since household-level Frisch elasticities depend on the household's labor supply, we measure the intensive-margin average Frisch elasticity with the unweighted average of household-level Frisch elasticities for employed households, that is

$$\Psi \equiv \int_{h(s) \geq \underline{h}} \left(\gamma + (1-\gamma)\frac{1}{\sigma} \right) \frac{1-h(s)}{h(s)} \, d\lambda_{\omega}(s). \tag{17}$$

Note, that by pinning down these three preference parameters we indirectly pin down the intertemporal elasticity of subsitution (IES), which with non-separable preferences is given by $1/\left(1-\gamma(1-\sigma)\right)$.

Technology and Financial Constraints. We discipline the key parameters governing technology financial constraints by targeting key empirical moments related to wealth inequality, capital intensity, and financing constraints. First, the returns to scale parameter in private firm production, γ, is set to match the Gini coefficient of wealth of 0.82. Since lower returns to scale amplify wealth dispersion by increasing the incentives for entrepreneurs to accumulate wealth, we calibrate γ such that the model generates the observed wealth inequality. Another technology parameter α, the capital share parameter in private firms, is chosen to match the entrepreneurial rate of return on capital, estimated at 8-15% in the data. We set $\zeta = 0.34$ to match the observed capital share in the public corporate sector, ensuring consistency with U.S. national income accounts. Finally, for $\lambda(j, z_e)$, which represents the loan-to-value (LTV) ratio, which we use leverage dynamics over the life cycle estimated from the SCF 2019.

Life-cycle Income Profiles. To discipline parameters life-cycle income profiles $\{\varepsilon_{\omega j}, \varepsilon_{ej}\}_{j=25}^{65}$ we rely on indirect inference (Gourieroux, Monfort, and Renault, 1993) and exploit data and econometric framework from Bhandari, Kass, May, McGrattan, and Schulz (2024). They show that individuals categorized as self-employed have significantly higher average income and steeper income growth profiles than paid-employed peers with similar characteristics. We apply and adapt their econometric procedure on the model-simulated data. Our procedure can be summarized as follows.

Step 1: Simulate Model-Generated Income Data.

Simulate a large panel of agents. For each agent i in the simulation, compute income $y_{i,j}$ at

[5] To obtain the average hours worked we use the Current Population Survey (CPS) and compute average annual hours worked for the entire working-age population independent of their employment status, which is 1269. Assuming that the households can work at most 100 hours per capita per week for 52 weeks in a year, we get $1269/(52 \times 100) = 0.25$.

each age j using decision rules accordingly. Partition agents into groups $g \in G$ (e.g., workers, entrepreneurs, wealth quantiles) based on model-generated characteristics.

Step 2: Income Specification.
Specify the income process for estimation:

$$y_{i,a} = \alpha_i + \sum_{j=25}^{a} \gamma_{j,g(i)} + \epsilon_{i,a}, \tag{18}$$

where α_i: Individual fixed effect capturing time-invariant heterogeneity, $\gamma_{j,g}$ captures age effect for group g at age j and $\epsilon_{i,a}$: captures idiosyncratic transitory shock with $\mathbb{E}[\epsilon_{i,a}] = 0$.

Step 3: Removing Fixed Effects.
Transform the income process by subtracting lagged income:

$$\Delta y_{i,a} = y_{i,a} - y_{i,a-1} = \gamma_{a,g(i)} + \Delta\epsilon_{i,a}. \tag{19}$$

The key assumption here is that transitory shocks $\epsilon_{i,a}$ are serially uncorrelated.

Step 4: Estimate Age-Group Effects.
Compute the mean income growth for each group g at age a:

$$\hat{\gamma}_{a,g} = \frac{1}{N_g^a} \sum_{i \in g} \Delta y_{i,a}, \tag{20}$$

where N_g^a is the number of agents in group g at age a.

Step 5: Construct Life-Cycle Income Profiles.
Compute the mean income for each group g at the base age $a = 25$:

$$\bar{Y}_g(25) = \frac{1}{N_g^{25}} \sum_{i \in g} y_{i,25}. \tag{21}$$

For each group g, compute the life-cycle profile:

$$Y_g(a) = \bar{Y}_g(25) + \sum_{j=26}^{a} \hat{\gamma}_{j,g}. \tag{22}$$

Step 6: Parameterize Productivity Profiles

Approximate $\{\varepsilon_{\omega j}, \varepsilon_{ej}\}_{j=25}^{65}$ using Chebyshev polynomials:

$$\varepsilon_{\omega j} = \sum_{k=0}^{K} c_{\omega k} T_k(x_j), \tag{23}$$

$$\varepsilon_{ej} = \sum_{k=0}^{K} c_{ek} T_k(x_j), \tag{24}$$

where $T_k(x_j)$ is a Chebyshev polynomial of degree k evaluated at $x_j = 2\frac{j-25}{65-25} - 1$ (mapping ages 25–65 to $[-1, 1]$) and $c_{\omega k}, c_{ek}$ are coefficients to be estimated.

Step 7: Calibrate Polynomial Coefficients
Minimize the Euclidean distance between simulated and empirical age effects:

$$\min_{\{c_{\omega k}, c_{ek}\}_{k=0}^{K}} \sum_{j,g} \left(\hat{\gamma}_{j,g} - \gamma_{j,g}^{\text{empirical}}\right)^2, \tag{25}$$

where $\gamma_{j,g}^{\text{empirical}}$ are estimates from Bhandari et al. (2024). Resolve the model using updated productivity profiles until the desired tolerance is achieved.

Productivity Processes. To discipline the productivity processes for workers and entrepreneurs in the model, we rely on statistics provided by DeBacker et al. (2023) on the volatility of labor and business incomes. Among many other findings, they document that business income is less persistent and exhibits greater tail risk compared to labor income. To capture these properties, we model the productivity of entrepreneurs as the following AR(1) process:

$$m_e' = \rho_e m_e + u_e, \tag{26}$$

where the innovations to firm productivity u_e have standard deviation σ_e and are drawn from a ***Tukey g-h*** distribution, a flexible family of distributions that transforms a standard normal variable x according to

$$x \exp\left(\frac{h}{2}x^2\right)(1-2h)^{3/4}. \tag{27}$$

The parameter h governs the thickness of the tails, with larger values elongating the tails relative to the standard normal ($h = 0$). For workers, we adopt a ***mixture of normals*** process to capture

the heterogeneity in income shocks observed in the data:

$$m'_\omega = \rho_\omega m_\omega + u_\omega. \tag{28}$$

The innovation term u_ω follows a two-component mixture of normal distributions:

$$u_\omega \sim \begin{cases} \mathcal{N}(0, \sigma^2_{\omega,1}) & \text{with probability } p_1, \\ \mathcal{N}(0, \sigma^2_{\omega,2}) & \text{with probability } p_2 = 1 - p_1. \end{cases} \tag{29}$$

This specification allows for differential volatility regimes, capturing the fact that some workers experience more stable earnings trajectories while others face high-volatility shocks. To discipline these processes, we match six empirical moments from DeBacker et al. (2023), ensuring symmetry in calibration between workers and entrepreneurs. The moments are:

- Percentage of workers with 1-year earnings changes in $[-10\%, 10\%]$: 51.6%.
- Percentage of workers with 1-year earnings changes greater than 50%: 7.8%.
- Standard deviation of 1-year earnings changes: 22.5%.
- Percentage of entrepreneurs with 1-year income changes in $[-10\%, 10\%]$: 13.7%.
- Percentage of entrepreneurs with 1-year income changes greater than 50%: 29.2%.
- Standard deviation of 1-year business income changes: 72%.

These six moments allow us to identify six key parameters: (i) persistence parameters (ρ_e, ρ_ω) for both workers and entrepreneurs, (ii) standard deviations of innovations ($\sigma_e, \sigma_{\omega,1}, \sigma_{\omega,2}$), (iii) tail thickness parameter (h) for entrepreneurial productivity shocks.

By following this strategy, we aim to capture not only the ***absolute risk*** that workers and entrepreneurs face but also their ***relative risk exposure***. The significantly higher earnings volatility and fatter tails in the entrepreneurial income distribution indicate that entrepreneurs face substantially greater risk than workers, both in terms of magnitude and the frequency of extreme shocks. Our approach ensures that the productivity processes in the model replicate the empirical dispersion in income changes and the differential exposure to earnings fluctuations across occupational groups.

Tax System and Social Security. The tax function $\mathcal{T}$ has two components. One is a nonlinear component mimicking the U.S. income tax/transfer system. The other one is a social security payroll tax component consisting of a proportional tax that is subject to a maximum taxable

earnings cap. We model the nonlinear component in the fashion of and Heathcote, Storesletten, and Violante (2017). Specifically, the tax function is:

$$\mathcal{T}(y_b) = y_b - \lambda y_b^{1-\tau} + \tau_{ss} \min\{y_b, 2.47\bar{y}\} \tag{30}$$

where y_b is taxable income, τ controls the progressivity of the tax code, while λ controls the average tax rate in the economy. We set τ to match the degree of progressivity estimated by Guner, Kaygusuz, and Ventura (2014), and we calibrate λ such that total federal income tax receipts account for 8% of GDP, consistent with U.S. data. The social security payroll tax rate is set at $\tau_{ss} = 12.4\%$, which follows the current U.S. policy of funding Social Security through employer and employee contributions. The maximum taxable earnings cap is calibrated to $2.47\bar{y}$, where $\bar{y}$ denotes average taxable income, following the social security wage base limit.

Retirement Account Constraints. In our model, households have access to tax-advantaged retirement accounts that allow for pre-tax contributions but impose constraints on withdrawals. We discipline the two key parameters governing these accounts: the contribution cap θ_j and the early withdrawal penalty τ_b. The contribution cap θ_j aligns with the U.S. regulations for tax-deferred savings accounts, primarily 401(k)s and IRAs. Based on IRS limits for 2025, we set:

$$\theta_j = \begin{cases} 0.225 \cdot y_b, & \text{if } y_b < \bar{y} \\ 23,500, & \text{if } y_b \geq \bar{y} \end{cases} \tag{31}$$

where $\bar{y}$ represents the average household income. The cap reflects the 401(k) limit of $23,500$ for workers under 50 years old. For IRAs, the contribution limit remains at $7,000$ for 2025. For entrepreneurs, we consider the higher contribution ceilings available through SEP IRAs and Solo 401(k)s. According to IRS guidelines, the maximum contribution for SEP IRAs in 2025 is the lesser of 25% of compensation or $70,000$.Therefore, we set:

$$\theta_j^e = \min(0.25 \cdot y_b, 70,000) \tag{32}$$

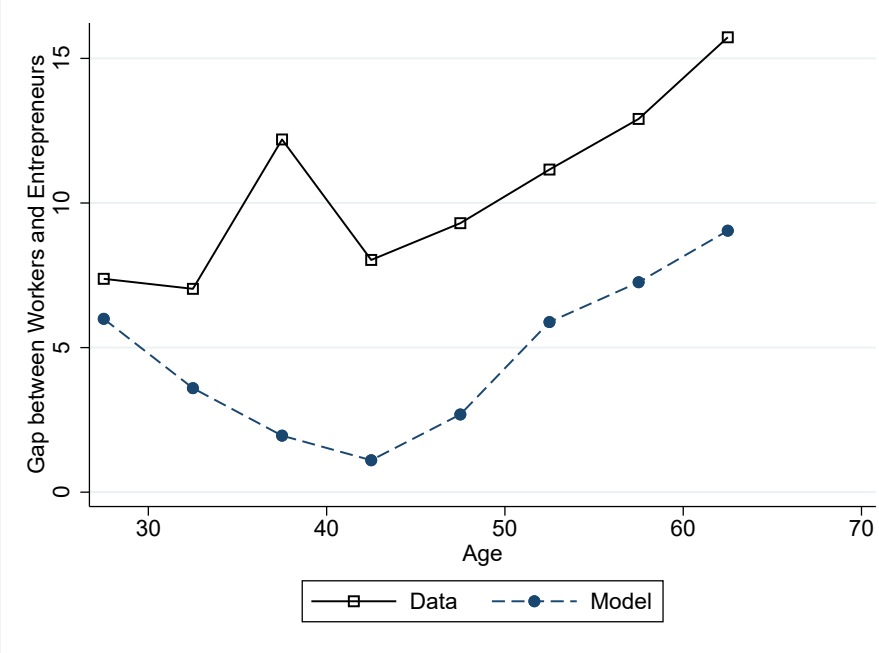
The early withdrawal penalty τ_b is set to 10%, in line with U.S. retirement account rules. This penalty applies to withdrawals made before age 59 and a half, unless specific exceptions are met (e.g., first-time home purchase, certain medical expenses).

5 Model Performance and Preliminary Results

5.1 Inspecting the Mechanism

Our model generates a substantial gap in retirement account usage between workers and entrepreneurs. Entrepreneurs hold a lower share of their total assets in retirement accounts. Figure 3 shows the difference between workers and entrepreneurs share of assets invested in the retirement account over the life-cycle in both the data and the model.

Figure 3: Retirement Account Gap over Age



Entrepreneurs invest less of their total assets in their retirement accounts in both the data and the model. In aggregate, our model explains about half of the gap in the data. Our model generates this result because entrepreneurs have higher needs for liquidity. The penalty on early-withdrawal from retirement accounts makes retirement accounts illiquid, and so entrepreneurs invest less in them.

Entrepreneurs have higher needs for liquidity for two reasons in our model. The first is borrowing constraints. Entrepreneurs need financial assets outside of their retirement accounts in order to

collateralize their capital stock. The more financial assets they have outside the business, the more they can invest in capital. Even if they are currently able to invest in a sufficient amount of capital, the possibility of receiving a positive productivity shock, which would make additional capital investment beneficial, means that entrepreneurs may want to avoid saving in retirement accounts.

The second reason why entrepreneurs have higher liquidity needs is risk. As disciplined in our calibration, entrepreneurs face much riskier income processes than workers. As a consequence, they require additional precautionary savings to provide self-insurance against this idiosyncratic risk. Our next two experiments are designed to investigate the relative liquidity needs that are generated by these two mechanisms.

These two needs for liquidity outweigh an opposing force in our model. On average, since entrepreneurs have higher incomes than workers, they tend to pay higher income taxes than workers according to the progressive tax schedule. Since these entrepreneurs pay higher marginal tax rates, the benefits of contributing to retirement accounts, and therefore reducing their tax liabilities are higher. However, this force is not enough to compensate for entrepreneur's higher liquidity needs, thus generating a positive gap, as we see in the data.

5.2 The Value of Liquidity: Collateral Constraints

In order to understand how the collateral constraint that entrepreneurs face discourages their investment in retirement accounts, we conduct an experiment where we allow entrepreneurs to collateralize their retirement account balances. The Internal Revenue Service's Code 401(a)-13 states that retirement account benefits "may not be anticipated, assigned (either at law or in equity), alienated or subject to attachment, garnishment, levy, execution or other legal or equitable process." This rule effectively prevents them from being pledged as collateral against loans that could be used to expand an entrepreneurs business. In this experiment, we propose repealing that rule and allowing entrepreneurs to borrow against their retirement accounts.

In our benchmark economy, the borrowing constraint is given by:

$$k \leq \lambda(j, z_e)a$$

In this counterfactual, we allow entrepreneurs to borrow against their retirement account bal-

ances, so that the borrowing constraint becomes:

$$k \leq \lambda(j, z_e)(a + b) \tag{33}$$

Table 3: Collateralizing Retirement Accounts

	Benchmark	Collaterized Retirement Accounts	Adjust λ to the same increase in K
Liquid Assets (A)	-	-16.4%	+2.5%
Retirement Account Balances (B)	-	+138.6%	+15.8%
Wealth (A+B)	-	+6.2%	+4.4%
Capital Stock (K)	-	+12.2%	+12.2%
Output (Y)	-	+8.1%	+7.7%
Constrained Entrepreneurs	63.4%	62.2%	60.4%

The policy allowing entrepreneurs to collateralize retirement account balances effectively increases overall wealth and boosts economic output without significantly levering up the economy. This approach leads to a significant reallocation of assets, with retirement account balances surging by 138.6% and liquid assets decreasing by 16.4%. Importantly, total wealth (the sum of liquid assets and retirement accounts) grows by 6.2%, demonstrating that this policy fosters genuine wealth creation. Additionally, aggregate capital stock and output rise by 12.2% and 8.1%, respectively, without substantially increasing financial leverage.

In contrast, adjusting the borrowing constraint parameter (λ) to achieve an equivalent capital stock increase introduces a higher degree of financial leverage into the economy, which could be risky. While this policy yields similar outcomes in capital stock, its impact on output is slightly lower, with an increase of 7.7%. Additionally, it has a different impact on asset composition: liquid assets increase slightly (by 2.5%), and retirement account balances grow by 15.8%, resulting in a smaller overall wealth increase of 4.4%. The reliance on leverage to achieve these economic gains introduces potential vulnerabilities, highlighting a critical trade-off between leveraging the economy and fostering stable wealth accumulation. This comparison underscores the relative merits of leveraging retirement account collateralization as a safer and more effective policy tool.

5.3 The Value of Liquidity: Differential Risk

In section 4, we discipline our model with statistics from DeBacker et al. (2023) that characterize how much riskier entrepreneurial incomes are compared to worker incomes. One key reason for

the need for liquidity is that entrepreneurs face higher income risk than workers.

We therefore study an economy where income risk is the same across workers and entrepreneurs. To evaluate this, we recalibrate the model so that workers and entrepreneurs face the same distribution of earnings changes that workers do in the data. This effectively reduces the degree of idiosyncratic risk that entrepreneurs face to the level of workers. We can then evaluate how much the declining risk reduces entrepreneurial needs for liquidity and how much that reduces the gap in investment in retirement accounts.

5.4 Policy Analysis

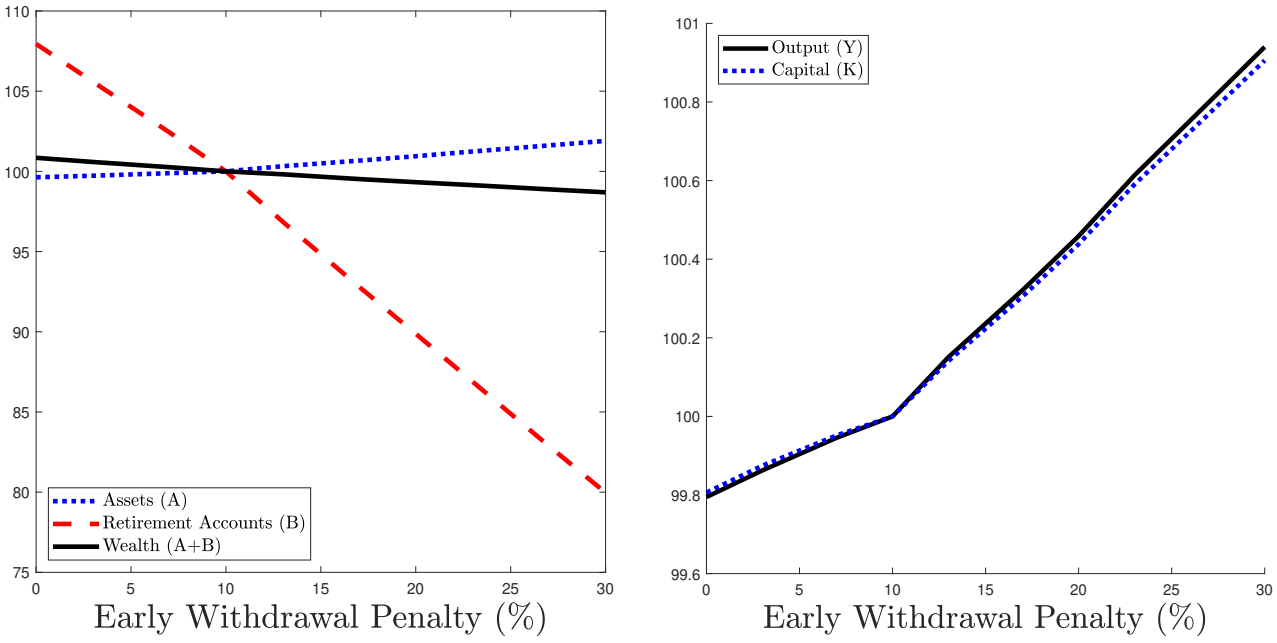


Figure 4: Impact of Early Withdrawal Penalties (τ_b) on Economic Aggregates. All variables are normalize to 100 for benchmark economy.

Finally, we conduct a policy exercise to examine how the degree of illiquidity in retirement accounts affects aggregate outcomes. In this counterfactual analysis, we vary the early withdrawal penalties, τ_b, which determine the illiquidity of retirement accounts. The results reveal several important trends, summarized in Figure 4.

The left panel of Figure 4 illustrates how varying τ_b affects the allocation of assets between liquid wealth (A) and retirement accounts (B), as well as total wealth ($A + B$). Higher early withdrawal penalties discourage entrepreneurs from contributing to retirement accounts due to reduced liq-

uidity, leading to a substantial decline in balances held in retirement accounts (B). At the same time, liquid assets (A) increase as entrepreneurs shift funds to more flexible forms of savings. Interestingly, total wealth ($A + B$) remains relatively stable across low and moderate values of τ_b, reflecting a compensatory reallocation of resources. However, at higher withdrawal penalties, total wealth declines due to the reduced tax efficiency of retirement savings and increased tax burdens on entrepreneurs.

The right panel of Figure 4 highlights the impact on aggregate capital (K) and output (Y). As τ_b increases, higher collateralizable liquid wealth enables greater investment in private businesses, resulting in a steady rise in the aggregate capital stock (K). This increase in productive investment leads to corresponding gains in output (Y), though the magnitude of these gains is relatively modest. The results demonstrate a trade-off in the composition of economic aggregates: while higher penalties reduce overall wealth and consumption, they stimulate investment, leading to greater capital accumulation and higher output. The shift in asset allocation and aggregate outcomes underscores the critical role of liquidity constraints in shaping entrepreneurial behavior and the broader economy.

6 Conclusions

This paper documents a systematic retirement gap in which entrepreneurs allocate 8.4 percentage points less of their wealth to tax-advantaged retirement accounts compared to non-business owners, after controlling for age and wealth. Our life-cycle model attributes this disparity to entrepreneurs greater need for liquidity driven by collateral constraints and elevated income risk. Liquidity serves a dual purpose for entrepreneurs: it allows them to self-insure against volatile business income and it provides collateral to finance capital investments. Counterfactual experiments reveal that allowing retirement accounts to be used as collateral could close much of this gap, increasing aggregate wealth by 6.2% and output by 8.1%, while avoiding the risks associated with broader leverage expansion. These results underscore the trade-off between the tax advantages of retirement accounts and their liquidity costs, which disproportionately penalize entrepreneurs.

The policy implications are twofold. First, reforming collateral rules for retirement accounts could unlock entrepreneurial investment without sacrificing tax efficiency, illustrating how institutional design shapes both individual financial decisions and macroeconomic outcomes. Second, while stricter withdrawal penalties discourage retirement savings, they paradoxically boost capital accumulation by redirecting funds to liquid, collateralizable assets. This highlights the nuanced role of liquidity constraints in balancing tax policy objectives with entrepreneurial dynamism. Future research could explore hybrid policiessuch as tiered withdrawal penalties or targeted collateral allowancesto optimize this trade-off. By bridging microeconomic behavior and macroeconomic aggregates, our findings contribute to a deeper understanding of how tax-advantaged savings instruments intersect with entrepreneurship, wealth inequality, and economic growth.

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Appendix

A Institutional Background

A.1 Summary of Tax Regimes for Saving and Investment Accounts

Table 4: Saving and Investment Accounts in the United States

	Tax on Principal	**No Tax on Principal**
Tax on Returns	Ordinary Savings Accounts Stocks Bonds	Traditional IRAs and 401(k)s Defined Benefit Pensions
No Tax on Returns	Roth IRAs Owner-Occupied Homes (below exempt gains thresholds) Tax-exempt Bonds and 529 Plans	Health Savings Accounts Labor component of DIY Home Improvements Employer-provided Health Insurance

The U.S. tax code provides households with multiple tax-advantaged saving vehicles, categorized by their treatment of principal contributions and investment returns. These regimes create distinct trade-offs between liquidity, tax deferral, and penalties for early accessfactors that disproportionately affect entrepreneurs, who often prioritize liquidity for business investments over long-term tax benefits.

Tax Regimes for Savings

The U.S. tax system distinguishes four primary savings regimes. First, **ordinary savings accounts**, **stocks**, **and bonds** fall under a regime where contributions are made with after-tax income, and returns (e.g., interest, dividends, or capital gains) are taxed annually. Second, **Traditional IRAs and 401(k) plans** allow pre-tax contributions that reduce taxable income in the contribution year, but withdrawals during retirement are taxed as ordinary income. Third, **Roth IRAs** invert this structure: contributions are made with after-tax income, but qualified withdrawals after age 59¡ are tax-free. Finally, **Health Savings Accounts (HSAs) and 529 education plans** combine tax-deductible contributions with tax-free withdrawals for qualified expenses (medical or educational), while tax-exempt bonds provide returns exempt from federal

taxes.

Retirement Accounts

401(k) plans are employer-sponsored retirement accounts that dominate U.S. household retirement savings. In 2024, individuals may contribute up to $22,500 annually ($30,000 for those aged 50+), with contributions reducing taxable income. Employers frequently match a portion of contributions, though investment options are restricted to funds selected by the employer. Early withdrawals before age 59¡ incur a 10% penalty in addition to ordinary income taxes, though hardship exceptions (e.g., medical emergencies) are permitted. Unlike IRAs, 401(k)s allow limited loansup to 50% of the vested balance or $50,000, whichever is lowerprovided they are repaid according to IRS guidelines.

Traditional IRAs offer similar tax deferral benefits but are individually managed, providing broader investment flexibility (e.g., stocks, bonds, or mutual funds). Annual contributions are capped at $6,500 in 2024 ($7,500 for ages 50+), with deductibility phased out at higher income levels. Critically, IRAs are prohibited from being used as collateral for loans under IRC Section 408(e)(4); violations trigger immediate taxation of the pledged amount and a 10% penalty for individuals under age 59¡. Early withdrawals are permitted penalty-free only for specific exceptions, such as first-time home purchases or educational expenses.

Education and Health Savings Vehicles

529 plans, state-sponsored education savings accounts, allow tax-free growth and withdrawals for qualified expenses, including tuition, books, and room/board. Lifetime contribution limits range from $350,000 to $500,000 per beneficiary depending on the state. Non-educational withdrawals incur income taxes on earnings plus a 10% penalty. **Health Savings Accounts (HSAs)**, available to individuals with high-deductible health plans, provide triple tax advantages: contributions are tax-deductible (up to $4,150 for individuals and $8,300 for families in 2024), growth is tax-free, and withdrawals for medical expenses are untaxed. After age 65, HSAs function as supplemental retirement accounts, allowing penalty-free non-medical withdrawals (though ordinary income taxes apply).

Collateral Restrictions and Liquidity Trade-offs

Retirement accounts face strict collateralization rules. Traditional IRAs cannot secure loans under IRC Section 408(e)(4), with violations treated as taxable distributions. Similarly, 401(k)s prohibit direct collateral use (IRC Section 401(a)(13)), though limited loans are permitted. These restrictions reduce liquidity, creating a significant hurdle for entrepreneurs who rely on accessible capital to finance business investments. For example, while 401(k) loans provide limited liquidity, entrepreneurs often require larger or more flexible financing than these accounts permit.

Table 5: Key Features of Traditional IRA and 401(k) Accounts

Feature	**Traditional IRA**	**401(k)**
Eligibility	Open to all earned income	Employer sponsorship required
Contribution Limit (2024)	\$6,500 (\$7,500 for 50+)	\$22,500 (\$30,000 for 50+)
Employer Match	Not available	Common
Investment Flexibility	Broad (stocks, bonds, funds)	Limited to employer options
Collateral Use	Prohibited	Loans permitted
Early Withdrawal Penalty	10% + taxes	10% + taxes

B Data

In what follows we describe our procedure to obtain macroeconomic data and cross-sectional moments at the household level. We use the Current Population Survey (CPS) to construct the cross-sectional moments for hours, the Survey of the Consumer Finances (SCF) to construct the cross-sectional moments for wealth, earnings and income.

B.1 National Income and Product Accounts (NIPA)

Following Aiyagari and McGrattan (1998) we define physical capital as the sum of nonresidential and residential private fixed assets and purchases of consumer durables. Therefore, our definition excludes government's fixed assets. We compute the average capital-output ratio, following the outlined definition, for period the 2009-2019 using two tables provided by the U.S. Bureau of Economic Analysis: Table 1.1. Current-Cost Net Stock of Fixed Assets and Consumer Durable Goods for the capital series and Table 1.1.5. Gross Domestic Product for the GDP series. We obtain the ration of 2.57.

We define the investment-output ratio in a way consistent with the capital-output ratio, that is,

we compute investment as the sum of nonresidential and residential private fixed assets and purchases of consumer durables and exclude the government's investment. We compute the average investment-output ratio, following the outlined definition, for 2009-2019 period using two tables provided by the U.S. Bureau of Economic Analysis: Table 1.5. Investment in Fixed Assets and Consumer Durable Goods for the capital series and Table 1.1.5. Gross Domestic Product for the GDP series.

The third statistic we discipline using data from the NIPA tables is the transfers-to-output ratio. We define transfers in the data as personal current transfer receipts, which include social security transfers, medicare, medicaid, unemployment benefits, and veteran benefits. We choose this for two reasons: First, we include retired and unemployed households in our inequality moments. Second, lump-sum transfers in the model can be interpreted as a basic income in the case of not working. We compute the transfers to output ratio, following the outlined definition, for 2009-2019 period using two tables provided by the U.S. Bureau of Economic Analysis: Table 2.1. Personal Income and Its Disposition for the construction of the transfers and Table 1.1.5. Gross Domestic Product for the GDP series. We obtain the average ratio of 0.147.

B.2 Equivalence Scale

We construct cross-sectional statistics at the household level. To account for the distribution of household sizes we use an equivalence scale. This way we take into the consideration the number of people living in the household and how these people share resources and take advantage of economies of scale. We use an equivalence adjustment based on a three-parameter scale that reflects and follows the procedure of the U.S. Census Bureau:[6]

1. On average, children consume less than adults.
2. As family size increases, expenses do not increase at the same rate.
3. The increase in expenses is larger for a first child of a single-parent family than the first child of a two-adult family.

The three-parameter scale is calculated in the following way:

[6]See the link here: https://www.census.gov/topics/income-poverty/income-inequality/about/metrics/equivalence.html

- One and two adults: scale = (number of adults)$^{0.5}$
- Single parents: scale = (number of adults + ($0.8 \times$ first child) + $0.5 \times$ other children)$^{0.7}$
- All other families: scale = (number of adults + $0.5 \times$ number of children)$^{0.7}$

We apply the same equivalence measures to the CPS and SCF.