# A Demand-Side Account of Market Macrostructure and Shock Transmission *

Greg Buchak† Erica Xuewei Jiang‡

**Abstract**

The allocation of saving and borrowing between banks and markets and the transmission of shocks through the financial system vary widely across countries and over time. While existing work emphasizes supply-side determinants such as institutions, regulation, and intermediary technology, we study a demand-side determinant: household and firm composition and their demand for imperfectly substitutable financial claims. We build and estimate an equilibrium model of financial intermediation that uses granular household and firm data to recover how financial demand varies with individual characteristics and aggregates across households and firms. Reaggregating over alternative populations changes equilibrium financial structure and shock transmission. Differences in household and firm composition explain nearly all the 1980–2019 decline in banks' share of U.S. private-sector saving and 69 percent of the cross-country variation, but less variation in banks' share of financing. Composition also alters the impact of an increase in Treasury supply by changing which sector absorbs the new debt: under the 1980 distribution of household and firm characteristics, banks absorb twice as much, raising their cost of lending and generating greater crowding out of private credit.

*We thank Nicolas Crouzet, Andrea Eisfeldt, Valentin Haddad, Zhiguo He, Hanno Lustig, Tyler Muir, Amit Seru, Amir Sufi, David Sraer, the conference participants at the SF Fed Macrofinance Workshop, SITE-Financial Regulation, and ESSFM in Banking and Corporate Finance, and the seminar participants at ITAM, UCLA Anderson, and Stanford GSB for helpful comments. We thank Chuhan Zhu for her excellent research assistance. This paper was previously circulated under the title "Real Origins of Financial Structure: The Role of Household and Firm Heterogeneity."

†Stanford GSB and NBER. Email: buchak@stanford.edu.

‡UCLA Anderson and NBER. Email: erica.jiang@anderson.ucla.edu.

Financial systems differ in how much saving and borrowing passes through banks rather than markets and nonbank intermediaries—what is sometimes referred to as market macrostructure[1]—and this mix varies widely across countries and over time (Figure 1). If financial claims issued by different types of intermediaries were perfect substitutes, this mix would be indeterminate and irrelevant for aggregate allocations—a financial-sector analogue of Modigliani–Miller (Fama, 1980). In practice, saving instruments offer distinct combinations of risk, return, and money-like features, while financing sources differ in their rates and other contractual terms. These differences make claims imperfect substitutes, and financial structure becomes determined and consequential: how savers and borrowers substitute across claims helps determine where intermediation occurs and how shocks propagate into financing costs, credit quantities, and real activity (Gurley and Shaw, 1956; Tobin and Brainard, 1963).

Existing work has largely explained financial structure and shock transmission through supply-side forces that shape the availability, costs, and characteristics of financial claims, including legal institutions, regulation, and intermediary technology.[2] We study a complementary demand-side force: the composition of households and firms. Households and firms with different characteristics have different saving and borrowing needs and consequently demand different financial claims. Aggregating individual demands over the population determines both the level and elasticity of aggregate demand for financial claims. The level helps determine how intermediation is allocated between banks and markets; the elasticity governs how prices and quantities respond to shocks. Changes in household and firm composition can therefore change both financial structure and shock transmission even when institutions, regulation, and intermediary technology are held fixed.

Figure 2 shows systematic cross-country relationships between household and firm characteristics and financial structure. Deposit shares are lower in wealthier countries and higher in countries with older populations. Banks' share of private credit is lower where services or large firms account for more economic activity. These relationships are descriptive, since household and firm composition may covary with the supply-side forces above. However, they motivate our central question: holding supply-side forces fixed, how does household

[1]The term is from Haddad and Muir (2025), who use it for the broad structure of financial markets—their key players and institutional features. The division of intermediation between banks and markets that we study is one example of this structure.

[2]See, for example, Beck et al. (2003) on legal institutions; Buchak et al. (2018) on regulation and intermediary technology; Crouzet (2018) on differences in the costs and contractual technologies of bank and market finance; and Brunnermeier and Sannikov (2014) on intermediary balance sheets and shock transmission.

and firm composition shape the equilibrium allocation of intermediation between banks and markets and the transmission of shocks?

To quantify this demand channel, we build and estimate a static structural equilibrium model of financial intermediation. The model traces funds through the gross balance sheets of households and firms that both save and borrow, the intermediaries that supply their financial instruments, and the government and foreign sectors that supply and absorb securities. Households and firms choose both the scale and composition of assets and liabilities, and these demands vary systematically with their characteristics: net worth and age for households, industry and production technology for firms. We estimate these characteristic-dependent demands directly from individual balance-sheet data, while aggregate time-series variation identifies substitution across financial claims. Summing the estimated individual demand curves over the observed distributions of households and firms yields aggregate demand for each claim. Changing the population over which these individual demand curves are aggregated changes the level of aggregate demand. These changes also alter the elasticity of aggregate demand by shifting the relative scale, and hence absorptive capacity, of more- or less-elastic sectors.

Three features of the data motivate our modeling choices. First, households and firms both save and borrow, and choices on one side of their balance sheets affect choices on the other. We therefore model the gross balance sheets of individual households and firms rather than impose an abstract segmentation between borrowers and savers. Second, portfolio and financing choices vary systematically with observable characteristics. We therefore allow preferences to depend on such characteristics, focusing on the characteristics that explain significant variation in behavior: net worth and age for households and size and industry for firms. Third, the funding and lending sides of bank intermediation move separately. That is, deposit funding is not mechanically deployed as bank loans. We therefore model bank funding and credit extension on distinct margins linked through banks' balance sheets. We describe each sector in turn.

A household is endowed with net worth and age. It derives utility from consumption and effective savings, which is a composite of bank deposits, money market fund shares, fixed-income claims, and equities. It finances consumption and savings with net worth and effective borrowing, a composite of bank and nonbank loans. Financial instruments are imperfect substitutes because they differ in non-rate attributes, such as transaction services and risk on the saving side and monitoring or other contractual features on the borrowing side. Claims are perfect substitutes within each class, except that deposits and bank

loans are differentiated across banks. Total borrowing is limited by debt-service capacity, so consumption, gross saving, and borrowing are jointly determined.

Net worth and age shape both the scale and composition of household balance sheets, affecting available resources, the relative demand for consumption and saving, debt-service capacity, and the preference weights on individual saving and borrowing instruments. At a given set of prices, households with different characteristics therefore choose different asset and liability mixes. As prices vary, these preferences and constraints trace out a household-level demand curve for each financial product. Aggregating these curves over the population yields the corresponding market demand curves.

A firm is characterized by its industry and production technology. It allocates assets between productive capital and effective financial assets, a composite of bank deposits and money market fund shares, and finances them with equity and effective debt, a composite of bank and nonbank loans. As on the household side, firms treat financial assets and funding sources as imperfect substitutes due to their different attributes and contractual features. A Tobin's q condition maps financing costs into the required return on productive capital. Finally, a downward-sloping schedule of returns to physical capital, determined by the production technology, pins down equilibrium scale for each firm type.

Industry and production technology shape both the scale and composition of firm balance sheets. They govern the split between productive capital and financial assets, the composition of financial assets, the preferred equity share, and the division of debt between bank and nonbank lenders. At a given set of prices, firms with different characteristics therefore operate at different scales and choose different asset and financing mixes. As with households, these choices generate firm-level demand curves for each financial product, which we aggregate over the firm population to obtain market demand.

Intermediaries supply the saving and borrowing technologies used by households and firms. Banks make household and firm loans and hold a liquid portfolio of reserves, Treasuries, MBS, corporate bonds, and claims on nonbank lenders. These assets are financed by deposits and fixed outside equity. Two features distinguish banks. First, deposits and loans are differentiated across banks, so banks set rates under monopolistic competition. Second, deviations of liquidity and capital ratios from target levels are costly, capturing regulatory and agency costs as well as the liquidity risk associated with funding illiquid lending with deposits. Other intermediaries are competitive: money market funds issue shares against repo and other marketable securities, while nonbank household and firm lenders finance loans by issuing MBS and corporate bonds, respectively. Because banks also hold the securities

that finance nonbank loans, bank- and market-based intermediation are linked rather than parallel: shocks to the banking system can propagate to the nonbank market system, and vice versa.

Finally, a consolidated government sector fixes marketable Treasury supply and the Federal Reserve's holdings of Treasuries and MBS, while supplying reserves and repo elastically at exogenous policy rates. A homogeneous foreign sector allocates fixed financial wealth across major domestic asset classes. Together with households, firms, and intermediaries, these sectors close the model, with endogenous asset and borrowing rates adjusting to clear financial markets.

We take the model to the data using a largely bottom-up estimation strategy. We estimate household and firm demand heterogeneity directly from disaggregated data. Repeated cross sections of the Survey of Consumer Finances (SCF) identify how household demand weights and debt-service capacity vary with net worth and age, while industry-by-size data from the Quarterly Financial Report (QFR) identify how firms' asset and financing weights vary with industry and size. Aggregate time-series variation in quantities and instrumented rates identifies substitution elasticities. For intermediaries, aggregate quantities and rates identify portfolio substitution and pricing, while pass-through from banks' instrumented shadow cost of funds identifies the within-class elasticities that govern bank market power. Bank pricing and nonbank zero-profit conditions recover regulatory wedges and operating costs. Foreign holdings and instrumented relative returns identify foreign investors' substitution elasticity, with portfolio weights and wealth calibrated to observed holdings. Together, these estimates deliver the characteristic-dependent demand curves that form the basis of our counterfactual analysis.

Although aggregate financial structure is not directly targeted in estimation, the model reproduces the main features of the 2019 equilibrium. It matches the ordering of financial returns and key relative spreads, and closely approximates banks' shares of private-sector saving and financing and the composition of firm financing. These aggregate outcomes are the result of demand heterogeneity that is largely estimated from individual household and firm data. This provides a structural grounding for our counterfactuals, which vary household and firm composition while holding the underlying individual demand system fixed.

Household and firm characteristics systematically shift demand for both intermediary liabilities and intermediary assets. Wealthier households place less weight on deposits relative to market instruments, consistent with transaction services becoming less important as wealth rises, but have greater debt-service capacity, borrow more, and rely more on banks

conditional on borrowing. Older households shift from equity toward deposits, borrow less, and rely more on banks conditional on borrowing. Consistent with a working-capital role at firms, real and financial assets are gross complements, and smaller firms place more weight on financial assets and, within them, on deposits. Larger firms rely more on nonbank debt relative to bank loans, consistent with greater monitoring needs among smaller firms. These patterns rationalize the observed cross-sectional variation in household and firm balance sheets and imply that changes in composition can alter both where saving is held and how borrowing is financed.

We use the estimated model to construct aggregate demand curves for deposits and bank credit. Changes in composition alter both the level and slope of aggregate demand even when the underlying type-specific curves are unchanged. Each curve's level helps determine where the market clears and consequently the equilibrium financial structure. The slope at the equilibrium helps determine how a shock's impact falls on prices and quantities. At the 2019 equilibrium the deposit and loan markets differ sharply. Deposit demand is inelastic, while bank loan demand is approximately unit-elastic. Composition-induced shifts in deposit demand therefore pass largely into quantities and bank shares, while shifts in bank-loan demand induce larger rate adjustments.

We vary one feature of the household or firm distribution at a time and recompute equilibria. Household characteristics matter most on the saving side because households account for most private-sector saving. Among the household changes, greater wealth concentration produces the largest decline in banks' share of saving. Firm characteristics matter most on the financing side because firms account for most private-sector financing. Among the firm changes, reallocation toward large firms produces the largest decline in banks' share of private-sector financing: because it changes borrower composition without a comparable change in total financing, little of the displacement is offset by the loan rate. These compositional shifts also propagate through the system through equilibrium repricing: changes in the household distribution alter financing costs, while changes in firm composition alter securities returns and household portfolios.

Our first counterfactual application asks how much household and firm composition can explain observed variation in how intermediation is allocated between banks and markets over time and across countries. We hold technological and institutional parameters fixed at their 2019 U.S. values and replace the household and firm distributions with their historical U.S. or cross-country counterparts. Additionally, we scale exogenous positions such as foreign wealth, bank equity, and government holdings with household wealth, and recompute equi-

libria. Because the resulting financial structure outcomes are not used in estimation, these exercises provide untargeted tests of the aggregate implications of the estimated demand system.

We find that composition explains substantial variation in financial structure. Between 1980 and 2019, the model generates a 9.1 percentage-point decline in the bank deposit share, nearly all of the observed 9.6 percentage-point decline. Across countries, composition explains 69 percent of the variation in the bank deposit share, with predicted and observed shares close to a one-for-one relationship. On the financing side, the model predicts the direction of observed changes but, for the 1980–2019 decline, only about a fifth of its magnitude. The model also misses the observed rise in banks' securities-to-deposit ratio. These gaps point to an important role for changes in bank technology, regulation, and other institutional forces held fixed in the counterfactuals.

Our second counterfactual application studies the response to a shock: an increase in marketable Treasury supply equal to 10 percent of GDP. We trace how the increased supply is absorbed by the financial system and how it spills over into private-sector borrowing and saving. Aggregate saver demand for Treasuries relative to intermediated deposits determines whether the new debt is absorbed directly by households or indirectly through bank balance sheets. These routes generate different equilibrium adjustments. Household demand for securities is relatively inelastic, so direct absorption requires larger movements in market returns. Banks have more elastic securities portfolios, so they can absorb Treasuries with smaller price movements, but do so by reallocating their balance sheets away from private claims. Greater direct absorption therefore produces more market-wide repricing, while greater bank absorption leads to more balance-sheet displacement. Both channels raise the marginal cost of bank lending: higher market returns increase the opportunity cost of loans, while greater Treasury holdings crowd out other bank assets.

Banks pass these cost increases through to borrowers. Because they set loan rates at a markup over marginal cost, bank borrowing rates rise substantially more than competitively priced nonbank credit. Given approximately unit-elastic demand for bank credit, a rate increase produces a large contraction in bank lending and, in turn, firm investment. The incidence depends on which borrowers rely on bank credit. Smaller, bank-dependent firms contract more than firms with market access, while leveraged, younger, and less-wealthy households lose from tighter borrowing conditions. Older and wealthier savers gain from higher returns.

Composition determines which of these channels is more important and who is exposed to

it. In the 2019 economy, households have greater capacity to absorb additional Treasuries, so most of the new debt is held directly and adjustment falls relatively more on market returns than on bank balance sheets. Bank loan rates rise by roughly 0.5 percentage points, and banks reduce lending by $1.22 for every dollar of securities they add. In the 1980 economy, younger and poorer households have less capacity to absorb Treasuries directly, while banks absorb roughly twice their 2019 share. More of the shock therefore runs through bank balance sheets, generating greater displacement of private lending and raising bank loan rates by roughly 0.8 percentage points. The 1980 economy is also more exposed to a bank lending shock: substantially more capital is held by bank-dependent firms, and leveraged young households account for a larger share of consumption. Firm investment consequently falls more, while aggregate household consumption shifts from a small gain to a small decline.

Taken together, our results show that the composition of households and firms shapes the aggregate financial demand system and thereby both equilibrium financial structure and shock transmission. Composition explains substantial variation in banks' role in saving and financing across countries and over time, while leaving an important role for institutions, regulation, and intermediary technology, especially on the financing side. How intermediation is allocated between banks and markets and the transmission of shocks are therefore joint equilibrium outcomes of the same financial demand system.

A large literature studies how imperfect substitution across financial claims shapes the organization and consequences of financial intermediation. Early empirical work developed a sectoral flow-of-funds view of the financial system (Copeland, 1952) and documented substantial variation in financial structure across countries and over time (Goldsmith, 1955, 1958). Classic theory then placed substitution across intermediary assets and liabilities at the center of both intermediary scale and monetary transmission (Gurley and Shaw, 1956; Tobin and Brainard, 1963). The services that make financial claims imperfect substitutes have classic microfoundations: deposits provide liquidity insurance (Diamond and Dybvig, 1983), money-like assets provide transaction services (Lucas, 1984), and bank loans bundle financing with delegated monitoring (Diamond, 1984). Frictionless markets would let investors unwind this insurance (Jacklin, 1987); banks retain their roles alongside markets when participation in markets is limited (Diamond, 1997), and financial systems differ durably in how they combine bank and market finance (Allen and Gale, 2000). Modern work emphasizes supply-side forces that shape substitution across banks, markets, and nonbank intermediaries, including legal institutions, regulation, and intermediation technologies (Beck et al., 2003; Plantin, 2015; Buchak et al., 2018; Begenau, 2020; Begenau and Landvoigt, 2022). For

example, Crouzet (2018) shows how differences in the costs and contractual features of bank loans and bonds determine firms' debt choices and the transmission of bank credit-supply shocks. Buchak et al. (2024) studies the secular decline of bank balance-sheet intermediation through saver and borrower demand alongside regulation and securitization technology. We add a complementary demand-side determinant: holding these supply-side forces fixed, the composition of households and firms reshapes aggregate financial demand on both sides of intermediary balance sheets, and with it both financial structure and shock transmission.

A related literature studies the consequences of intermediary structure for asset prices, credit, and the transmission of shocks. Macro-finance and intermediary asset-pricing work shows how intermediary balance sheets shape asset prices, credit, and aggregate activity (Gertler and Kiyotaki, 2010; He and Krishnamurthy, 2013; Brunnermeier and Sannikov, 2014; Moreira and Savov, 2017; Haddad and Muir, 2021; Elenev et al., 2021). In monetary economics, the bank lending channel ties policy transmission to bank balance sheets and bank-dependent borrowers (Kashyap and Stein, 2000), deposit market power shapes the pass-through of policy rates (Drechsler et al., 2017), monetary tightening shifts deposit funding toward shadow banks (Xiao, 2020), unconventional policy operates through intermediary balance sheets (Gertler and Karadi, 2011), and the composition of bond investors governs the yield impact of supply shocks (Vayanos and Vila, 2021). Haddad and Muir (2025) label this field market macrostructure—the organization of financial markets into key players and institutions, and its consequences for asset prices—and emphasize that such structure matters when end investors do not arbitrage it away. We ask what determines the structure in the first place: with heterogeneous end investors and imperfect substitution, the composition of savers and borrowers is itself a determinant of market macrostructure, and of how shocks transmit through it.

Our emphasis on composition connects to work on the aggregate consequences of household and firm heterogeneity. Population aging changes saving, portfolio demand, wealth, and—though estimates of this margin vary—equilibrium returns (Poterba, 2001; Carvalho et al., 2016; Auclert et al., 2021), while rising inequality shifts saving toward wealthier households and changes the allocation of credit (Mian et al., 2020). On the firm side, changes in the distribution of activity across firms affect factor shares, investment, debt capacity, and corporate saving (Autor et al., 2020; Crouzet and Eberly, 2019; Falato et al., 2022). We show that these distributional changes also reshape aggregate demand for financial claims. Because households and firms with different characteristics make systematically different asset and financing choices, changes in their composition shift both the level and elasticity

of aggregate financial demand. Financial structure and shock transmission therefore change even when the underlying characteristic-dependent demands and supply-side environment remain fixed.

The shock-transmission implication also connects to work on government debt and crowding out. Classic arguments emphasize substitution between public and private claims (Friedman, 1978; Elmendorf and Mankiw, 1999), while subsequent work studies the safety and liquidity value of Treasuries (Krishnamurthy and Vissing-Jorgensen, 2012, 2015; Caballero et al., 2017) and recent work documents the pass-through of Treasury supply to bank deposit funding and lending (Li et al., 2026). We add a real-sector composition channel. Composition changes whether new government debt is absorbed directly by ultimate investors or through intermediary balance sheets and therefore how much lending to the private sector is crowded out. It also changes how strongly the resulting financing adjustment translates into aggregate investment and consumption.

Methodologically, we build on demand-based asset-pricing and structural banking approaches that recover financial demand from observed quantities and prices (Koijen and Yogo, 2019; Haddad et al., 2025; Egan et al., 2017; Drechsler et al., 2017; Wang et al., 2022). Our bottom-up approach estimates characteristic-dependent saving and financing demands from granular household and firm balance-sheet choices. Aggregating these demands allows composition to change both the level and elasticity of market demand without changing the underlying type-specific demand schedules.

## 1 Stylized Facts

The cross-country evidence in Figure 2 shows that household and firm characteristics vary systematically with banks' role in saving and financing. These aggregate relationships, however, do not reveal the underlying household and firm choices that generate them. We therefore turn to U.S. microdata, which allow us to observe these balance-sheet choices directly within a common institutional setting.

For households, we use the Survey of Consumer Finances (SCF), a repeated cross section conducted roughly every three years that reports detailed household assets, liabilities, and characteristics. For firms, we use the Census Quarterly Financial Report (QFR), which reports balance-sheet aggregates for nonfinancial firms by industry and size. These are the same data we later use to estimate the household and firm demand systems. Three key facts emerge.

### 1.1 Fact 1: Saving and Borrowing Are Not Segmented

Households and firms commonly save and borrow at the same time. Figure 3 shows that substantial household debt is common throughout the financial-wealth distribution, including among households at the very top. Debt in excess of $100,000 becomes more common as wealth rises. Firms exhibit the same coexistence: panels 3b and 3c show positive financial assets and interest-bearing debt throughout the firm-size distribution. Firms do not exhaust their liquid assets before borrowing or retire debt before accumulating financial claims. Both sides of the balance sheet are active simultaneously.

Thus, while many macroeconomic models assign saving and borrowing to separate sectors,[3] this segmentation is at odds with the data. This coexistence matters for our exercise because a change in household or firm composition can affect saving and borrowing simultaneously, and potentially in different directions. Choices on one side of the balance sheet also affect choices on the other. We therefore model households and firms through their gross balance sheets rather than segmenting them ex ante as savers or borrowers, allowing banks and markets to play different roles on the two sides.

### 1.2 Fact 2: Household Characteristics Shape Both Asset and Liability Choices

Household net worth and age shape both sides of the balance sheet. On the asset side, higher-net-worth households hold more financial wealth, while financial wealth also rises strongly over the life cycle. Portfolio composition changes at the same time: wealthier households hold a smaller share of their financial wealth in deposits and more in equity and private business claims, while deposit shares are U-shaped and equity shares hump-shaped in age.

On the liability side, higher-net-worth households also borrow more. Over the life cycle, borrowing rises into middle age and then declines. Conditional on borrowing, wealthier households rely more heavily on banks, while the bank share of household borrowing rises with age before flattening. Figure 4 reports the composition patterns, while Appendix B reports the corresponding balance-sheet levels and shows that the main composition relationships survive controls for financial risk-taking, sophistication, and saving motives.

[3] See, for example, Kiyotaki and Moore (1997), Bernanke et al. (1999), and Iacoviello (2005).

### 1.3 Fact 3: Firm Characteristics Shape Both Asset and Liability Choices

Firm size and industry likewise shape both sides of the balance sheet. On the asset side, financial assets fall as a share of total assets as firms become larger. Their composition changes as well: larger firms hold a smaller share of their financial assets in deposits.

On the liability side, leverage is broadly stable across much of the size distribution and lower among the largest firms. Conditional on debt, larger firms finance a smaller share with bank loans and rely more heavily on nonbank finance. Figure 3 reports the financial-asset and leverage patterns, while Figure 5 reports deposit and bank-loan shares. Industry generates additional variation in these margins at a given size.

Taken together, these microeconomic facts identify the household and firm choices underlying the aggregate relationships documented above. Characteristics predict both the scale of household and firm positions and how assets and liabilities are allocated across financial claims. Our quantitative exercise uses these characteristic-dependent choices to construct aggregate financial demand. Capturing them requires gross household and firm balance sheets, type-specific demand on both sides, and an intermediary sector in which bank funding and lending are distinct margins. The imperfect correlation between banks' funding and lending shares in Figure 1 provides complementary aggregate evidence for the last feature. With these ingredients, changes in household and firm composition can change aggregate financial structure even when the financial environment is held fixed.

## 2 Model

The model traces financial claims across households, firms, intermediaries, the consolidated government, and the rest of the world. Households and firms are heterogeneous, with their characteristics governing both the scale and composition of their balance sheets. Intermediation is supplied by banks, money market funds, and nonbank lenders, which differ in their pricing and balance-sheet structure. The government consolidates the fiscal and monetary authorities, while a homogeneous rest-of-world sector represents foreign investors.

Figure 6 maps the claims in the economy to the balance sheets on which they reside. Each claim is an asset to one sector and a liability to another, so the figure also enumerates the markets that must clear. Households and firms hold positions on both sides of their balance sheets. Intermediaries can hold claims issued by other intermediaries: banks hold securities alongside direct loans, including securities that finance nonbank lending. Bank and market intermediation are therefore connected through intermediary balance sheets rather

than operating as separate, parallel channels.

Returns are the model's prices. Households and firms take them as given and choose quantities. Banks face downward-sloping demand for their own products and set four rates: deposit and loan rates for households and firms. Returns on Treasuries, agency MBS, corporate bonds, equity, and nonbank-lender securities adjust to clear markets, while competitive nonbank intermediaries satisfy zero-profit conditions. Aggregating household and firm choices produces market demand schedules. Their level helps determine how intermediation is allocated across banks and markets, while their local slopes govern how equilibrium adjustment is divided between rates and quantities. We describe each block in turn and then define equilibrium.

### 2.1 Households

The model contains a population of households indexed by $i$. Endowed with net worth $w^i$, household $i$ chooses consumption $c^i$, dollar holdings $q^i_{s,j}$ of each saving class $j \in J^h_S$, and dollar borrowing $q^i_{b,j}$ from each lender class $j \in J^h_B \equiv \{b, n\}$ to solve

$$\begin{aligned} \max_{c^i,\,\{q^i_{s,j}\},\,\{q^i_{b,j}\}} \quad & u^i\big(c^i, \mathcal{S}^i\big) \\ \text{subject to} \quad & w^i + \mathcal{B}^i \;\geq\; \sum_{j \in J^h_S} q^i_{s,j} + c^i, \\ & \bar{D}^i \;\geq\; \sum_{j \in J^h_B} q^i_{b,j} r^h_j. \end{aligned} \tag{1}$$

The first constraint is the budget constraint: net worth and effective borrowing $\mathcal{B}^i$ finance consumption and saving.[4] The second is a debt-service constraint: interest payments cannot exceed the household's debt-service capacity $\bar{D}^i$. The objective aggregates consumption with saving services $\mathcal{S}^i$. We define $u^i$, $\mathcal{S}^i$, and $\mathcal{B}^i$ in turn.

Utility is a constant-elasticity aggregate of consumption and saving services,

$$u^i\left(c^i, \mathcal{S}^i\right) \equiv \left(\gamma^i_c (c^i)^{\frac{\sigma^h - 1}{\sigma^h}} + \gamma^i_s (\mathcal{S}^i)^{\frac{\sigma^h - 1}{\sigma^h}}\right)^{\frac{\sigma^h}{\sigma^h - 1}}, \tag{2}$$

which captures a reduced-form consumption–saving problem in an otherwise static environment. Here $\sigma^h$ is the common elasticity of substitution between consumption and saving

[4] Both are measured in effective dollars rather than payoff units.

services, and $(\gamma_c^i, \gamma_s^i)$ are the type's weights on consumption and saving.

Saving services aggregate differentiated asset classes:

$$\mathcal{S}^i \equiv \left( \sum_{j \in J_S^h} \alpha_j^i (r_j^h q_{s,j}^i)^{\frac{\sigma_S^h - 1}{\sigma_S^h}} \right)^{\frac{\sigma_S^h}{\sigma_S^h - 1}}, \tag{3}$$

where $\alpha_j^i$ are type-specific weights, $r_j^h$ the class return, and $\sigma_S^h$ the across-class elasticity. Within each nondeposit class—Treasuries, agency MBS, corporate bonds, equity, and MMF shares—securities are homogeneous and perfectly substitutable. In contrast, deposits are differentiated across the banks that supply them, so $r_{\text{dep}}^h$ and $q_{s,\text{dep}}^i$ are themselves indices over individual banks. Section 2.3 defines this within-class nest, which is common to households and firms and generates downward-sloping bank-level demand. Households therefore substitute both across saving classes and, within deposits, across banks, capturing differences in risk, liquidity, and convenience across these choices.

Effective borrowing has the same two-layer structure over bank and nonbank credit:

$$\mathcal{B}^i \equiv \left( \sum_{j \in J_B^h} \beta_j^i (q_{b,j}^i)^{\frac{\sigma_B^h - 1}{\sigma_B^h}} \right)^{\frac{\sigma_B^h}{\sigma_B^h - 1}}. \tag{4}$$

Nonbank loans are homogeneous, while bank borrowing is again an index over individual banks, given by the same within-class nest. Here $\beta_j^i$ is the type's weight on borrowing technology $j$ and $\sigma_B^h$ the elasticity across borrowing classes. The effective-borrowing aggregator captures, in reduced form, that a dollar borrowed through different lending technologies can provide different amounts of financing services because those technologies finance different uses. For example, mortgages can finance housing but not other purchases.

Household heterogeneity enters through four objects: the consumption–saving weights $(\gamma_c^i, \gamma_s^i)$, the saving-class weights $\alpha_j^i$, the borrowing-class weights $\beta_j^i$, and debt-service capacity $\bar{D}^i$. Apart from these objects and net worth $w^i$, households are identical.

For notational convenience, let $D^i \equiv \sum_{j \in J_B^h} q_{b,j}^i r_j^h$ denote total debt service and $S^i \equiv \sum_{j \in J_S^h} q_{s,j}^i$ total dollar saving. Solving the program yields demand for each saving and borrowing instrument together with the corresponding return and borrowing-cost indices; Appendix C.1 provides the derivation. Aggregating across households gives class-level demand

and, for deposits and bank loans, demand at the level of the individual bank:

$$\begin{aligned} Q^h_{s,j} &= \sum_i q^i_{s,j}, & Q^h_{b,j} &= \sum_i q^i_{b,j}, \\ Q^h_{s,\text{dep},k} &= \sum_i q^i_{s,\text{dep},k}, & Q^h_{b,b,k} &= \sum_i q^i_{b,b,k}. \end{aligned} \tag{5}$$

### 2.2 Firms

The model contains a population of firm types indexed by $i$. Firm type $i$ chooses real capital $K^i$, dollar holdings $q^i_{a,j}$ of each financial-asset class $j \in J^f_A \equiv \{\text{dep}, \text{mmf}\}$, outside equity $E^i$, and dollar borrowing $q^i_{b,j}$ from each lender class $j \in J^f_B \equiv \{b, n\}$ to maximize cash flow to insiders,

$$\begin{aligned} \max_{K^i,\, \{q^i_{a,j}\},\, E^i,\, \{q^i_{b,j}\}} \quad & \Pi^i_I \;\equiv\; \underbrace{R^i_A A^i - R^i_D \mathcal{D}^i - \Phi^i(E^i; A^i)}_{\Pi^i_E\text{: cash flow to equityholders}} - r_E E^i, \\ \text{subject to} \quad & A^i \;=\; \mathcal{D}^i + E^i. \end{aligned} \tag{6}$$

Total assets $A^i = K^i + F^i$ consist of real capital and financial assets, $F^i = \sum_{j \in J^f_A} q^i_{a,j}$. The balance-sheet constraint states that assets are funded by effective debt $\mathcal{D}^i$ and outside equity, measured in effective-funding units. Here $R^i_A$ is the effective return on assets, $R^i_D$ the effective cost of debt, and $\Phi^i$ a financing friction. Outside equity is supplied competitively at required return $r_E$. Thus $\Pi^i_E$ is cash flow available to equityholders before compensating outside investors, while $\Pi^i_I$ is the residual accruing to insiders. We define $\Phi^i$, the asset-return aggregator underlying $R^i_A$, and the debt-cost aggregator underlying $R^i_D$ in turn.

The financing friction is

$$\Phi^i(E^i; A^i) = \frac{\eta_E}{2} \left( \frac{E^i}{A^i} - \bar{s}^i \right)^2 A^i, \tag{7}$$

where $\bar{s}^i$ is the type's reference equity share and $\eta_E$ is common curvature. The optimal equity share rises when the debt-cost index $R^i_D$ increases relative to the economy-wide cost of equity $r_E$. Appendix C.2 derives this condition and the conditional asset and debt demands.

On the asset side, return services have two layers: an inner nest across financial-asset classes and an outer nest between real capital and the financial composite. Financial return

services are

$$\mathcal{F}^i = \left( \sum_{j \in J_A^f} \gamma_j^i (r_j^f q_{a,j}^i)^{\frac{\sigma_F^f - 1}{\sigma_F^f}} \right)^{\frac{\sigma_F^f}{\sigma_F^f - 1}}, \tag{8}$$

where $\gamma_j^i$ is a type-specific weight and $\sigma_F^f$ is the elasticity across financial asset classes. As on the household side, deposits are differentiated across banks, so $r_{\text{dep}}^f$ and $q_{a,\text{dep}}^i$ are themselves indices over individual banks, given by the within-class nest in Section 2.3.

The outer nest combines real- and financial-asset return services:

$$\mathcal{A}^i = \left[ \alpha_{\text{real}}^i (r_{\text{real}}^i K^i)^{\frac{\sigma_A^f - 1}{\sigma_A^f}} + \alpha_{\text{fin}}^i (R_{\text{fin}}^i F^i)^{\frac{\sigma_A^f - 1}{\sigma_A^f}} \right]^{\frac{\sigma_A^f}{\sigma_A^f - 1}}. \tag{9}$$

Here $r_{\text{real}}^i$ is the type-specific return on real capital, $R_{\text{fin}}^i$ is the financial return index dual to $\mathcal{F}^i$, and $\sigma_A^f$ is the elasticity between real and financial assets. At the optimum, $\mathcal{A}^i = R_A^i A^i$, so $R_A^i$ is the effective asset return entering the firm's objective. Appendix C.2 provides the associated price indices, demand functions, and the normalization that maps relative asset weights into the level of this return index.

On the liability side, effective debt funding has the same two-layer structure over bank and nonbank credit as household borrowing:

$$\mathcal{D}^i = \left( \sum_{j \in J_B^f} \beta_j^i (q_{b,j}^i)^{\frac{\sigma_D^f - 1}{\sigma_D^f}} \right)^{\frac{\sigma_D^f}{\sigma_D^f - 1}}, \tag{10}$$

where $\beta_j^i$ is the type's weight on lender class $j$ and $\sigma_D^f$ is the elasticity across debt classes. Accounting debt $B^i \equiv \sum_{j \in J_B^f} q_{b,j}^i$ generally differs from effective debt $\mathcal{D}^i$, which is why the balance-sheet constraint in (6) is stated in effective-funding units. Bank borrowing is again an index over individual banks, given by the same within-class nest.

Two objects remain: the scale at which each type operates and aggregation from types to markets. Each type contains a continuum of atomistic firms, and all $i$-level quantities denote type-level aggregates. An individual firm takes type-level returns as given and therefore does not internalize the effect of its own investment on the type's real-return schedule. Because its objective is linear in scale, free entry drives insider cash flow to zero. Equivalently, enterprise

value equals assets and Tobin's $q$ is one,

$$\mathcal{Q}^i \equiv \frac{V^i}{A^i} = 1. \tag{11}$$

Substituting the optimal equity share into this zero-profit condition expresses the required asset return in financing costs alone,

$$R_A^{\text{req},i} = R_D^i(1 - \bar{s}^i) + r_E \bar{s}^i - \frac{(R_D^i - r_E)^2}{2\eta_E}. \tag{12}$$

Financing costs therefore determine firm scale through a sequence of equilibrium conditions. Bank and nonbank loan rates determine the debt-cost index $R_D^i$, which together with the cost of equity determines the required asset return $R_A^{\text{req},i}$. The condition $R_A^i = R_A^{\text{req},i}$ then determines the required return on real capital $r_{\text{real}}^i$ through the asset nest (9). Finally, $r_{\text{real}}^i$ determines capital along the type's decreasing-returns schedule,

$$r_{\text{real}}^i = \bar{r}_{\text{real}}^i \left( \frac{K^i}{\bar{K}^i} \right)^{-\eta_K}, \tag{13}$$

where $\bar{K}^i$ is a reference capital level, $\bar{r}_{\text{real}}^i$ the return at that level, and $\eta_K > 0$ governs how quickly the return declines with scale. Equivalently,

$$\log r_{\text{real}}^i = \zeta_t^i - \eta_K \log K^i, \qquad \zeta_t^i \equiv \log \bar{r}_{\text{real}}^i + \eta_K \log \bar{K}^i, \tag{14}$$

where $\zeta_t^i$ is the type's productivity (or scale) intercept. A higher $\zeta_t^i$ shifts the schedule upward and increases the capital operated by that type at any given required return. The cross-type profile of $\zeta_t^i$ therefore governs the firm-size distribution and is the object perturbed by the firm-size comparative static in Section 4. Because an increase in bank credit costs raises $R_A^{\text{req},i}$ more for bank-dependent types, their real capital contracts more. Appendix C.2 derives the zero-profit, valuation, and required-return conditions.

Firm heterogeneity enters through five objects: the outer asset weights $(\alpha_{\text{real}}^i, \alpha_{\text{fin}}^i)$, the financial-class weights $\gamma_j^i$, the debt-class weights $\beta_j^i$, the reference equity share $\bar{s}^i$, and the productivity intercept $\zeta_t^i$. Apart from these objects, firms are identical.

Aggregating across types gives class-level firm demand and, for deposits and bank loans,

demand at the individual-bank level:

$$\begin{aligned} Q^f_{a,j} &= \sum_i q^i_{a,j}, & Q^f_{b,j} &= \sum_i q^i_{b,j}, \\ Q^f_{a,\mathrm{dep},k} &= \sum_i q^i_{a,\mathrm{dep},k}, & Q^f_{b,b,k} &= \sum_i q^i_{b,b,k}. \end{aligned} \tag{15}$$

### 2.3 Intermediaries

The model contains three types of intermediaries: banks, money market funds (MMFs), and nonbank lenders (NBLs). Banks have market power in their deposit and loan products and choose the corresponding rates. MMFs and NBLs are competitive and satisfy zero-profit conditions. We describe the bank problem first and then the two competitive intermediary types.

**Banks.** For each sector $j \in \{h, f\}$—households and firms—the model contains $N_j$ differentiated banks. Banks choose deposit and loan rates and face the demand schedules implied by the within-class nests introduced above. Let $D^j_B$ and $L^j_B$ denote the schedules $D^j_B(r^j_{\mathrm{dep},B})$ and $L^j_B(r^j_{b,B})$, with the arguments suppressed below. A bank chooses deposit rates $(r^h_{\mathrm{dep},B}, r^f_{\mathrm{dep},B})$ and loan rates $(r^h_{b,B}, r^f_{b,B})$ to maximize net cash flow to inside equity,

$$\begin{aligned} \max_{\{r^j_{\mathrm{dep},B}\},\{r^j_{b,B}\}} \quad \Pi_B = &\sum_{j\in\{h,f\}} \Big[(r^S_B - r^j_{\mathrm{dep},B} - c^j_{\mathrm{dep},B})D^j_B + (r^j_{b,B} - r^S_B - c^j_{b,B})L^j_B\Big] \\ &- \mathcal{L}(S_B, D^h_B, D^f_B) - \mathcal{K}(E_B, L^h_B, L^f_B) + r^S_B E_B, \\ \text{subject to} \quad & L^h_B + L^f_B + S_B = D^h_B + D^f_B + E_B. \end{aligned} \tag{16}$$

The constraint is the bank balance-sheet constraint. Assets consist of household and firm loans $(L^h_B, L^f_B)$ and a liquid-security composite $S_B$ of reserves, Treasuries, agency MBS, corporate bonds, and NBL securities, with net payoff $r^S_B$ per dollar invested. Deposits $(D^h_B, D^f_B)$ and an exogenous quantity of inside equity $E_B$ finance these assets. The terms $c^j_{\mathrm{dep},B}$ and $c^j_{b,B}$ are per-unit operating costs, while $\mathcal{L}$ and $\mathcal{K}$ are shadow costs of deviating from target liquidity and capital ratios.

For each product, the bank internalizes how its posted rate changes its own deposit or loan demand, while taking the corresponding class index and aggregate class quantity as given. Its perceived demand elasticity is therefore the within-class elasticity, rather than the across-class elasticity governing substitution between deposits and MMF shares or between bank

and nonbank credit. Given deposits and loans, securities $S_B$ adjust through the balance-sheet constraint.

The liquid-security composite is itself a CES portfolio over reserves, Treasuries, agency MBS, corporate bonds, and NBL securities, $j \in J_B \equiv \{r, g, h, c, n\}$, held in quantities $S_j^B$ at beginning-of-period prices $p_j = 1/(1 + r_j)$:

$$\mathcal{S}_B = \left( \sum_{j \in J_B} (\gamma_B^j)^{1/\eta_B} (S_j^B)^{\frac{\eta_B - 1}{\eta_B}} \right)^{\frac{\eta_B}{\eta_B - 1}}, \qquad P_B = \left( \sum_{j \in J_B} \gamma_B^j (1 + r_j)^{1 - \eta_B} \right)^{\frac{1}{1 - \eta_B}}, \tag{17}$$

where $\gamma_B^j$ is the weight on asset $j$ and $\eta_B$ the elasticity across liquid assets. The dual index $P_B$ is the price of a unit of end-of-period payoff, so the net return on the composite is $r_B^S \equiv 1/P_B - 1$. This return is the bank's opportunity cost of lending and is the market return that enters its loan-pricing decision.

Banks are symmetric and each is small relative to its product market. All therefore post the same rates, each serves $1/N_j$ of each class, and none internalizes the effect of its own rate on the class index. We use the subscript $B$ for consolidated banking-sector quantities, while the pricing conditions below are the individual-bank conditions implied by within-class competition. Appendix C.3 derives the asset-level demands $S_j^B$ implied by this composite.

The shadow costs penalize deviations from target liquidity and capital ratios. Defining $D_B \equiv D_B^h + D_B^f$, $L_B \equiv L_B^h + L_B^f$, $\psi \equiv S_B/D_B$, and $\phi \equiv E_B/L_B$,

$$\mathcal{L}(S_B, D_B^h, D_B^f) = \frac{\beta_L}{2}(\lambda - \psi)^2, \qquad \mathcal{K}(E_B, L_B^h, L_B^f) = \frac{\beta_K}{2}(\kappa - \phi)^2, \tag{18}$$

where $\lambda$ and $\kappa$ are the target liquidity and capital ratios and $\beta_L$ and $\beta_K$ govern the curvature of the corresponding shadow costs.

The household and firm sections left open the within-class substitution across individual banks. For a sector-$j$ agent, let $q_{\text{dep}}^i$ denote total deposits in the deposit class ($q_{s,\text{dep}}^i$ for households and $q_{a,\text{dep}}^i$ for firms) and let $q_{b,b}^i$ denote total bank borrowing. The common within-class nests are

$$r_{\text{dep}}^j q_{\text{dep}}^i \equiv \left( \sum_{k \in \mathcal{N}_j} N_j^{-1/\sigma_{D,j}} (r_{\text{dep},k}^j q_{\text{dep},k}^i)^{\frac{\sigma_{D,j} - 1}{\sigma_{D,j}}} \right)^{\frac{\sigma_{D,j}}{\sigma_{D,j} - 1}}, \quad q_{b,b}^i \equiv \left( \sum_{k \in \mathcal{N}_j} N_j^{-1/\sigma_{L,j}} (q_{b,b,k}^i)^{\frac{\sigma_{L,j} - 1}{\sigma_{L,j}}} \right)^{\frac{\sigma_{L,j}}{\sigma_{L,j} - 1}}, \tag{19}$$

where $\mathcal{N}_j$ is the set of $N_j$ banks serving sector $j$, $q^i_{\text{dep},k}$ and $q^i_{b,b,k}$ are the agent's deposits at and borrowing from bank $k$, and $r^j_{\text{dep},k}$ and $r^j_{b,k}$ are that bank's rates. The $N_j^{-1/\sigma}$ terms normalize the aggregators so that, in a symmetric equilibrium, each class index equals the common bank rate and individual-bank demands sum to the class total.

Because each bank takes the within-class price index and aggregate class quantity as given, the first-order conditions of (16) imply a markdown on deposits and a markup on loans relative to the marginal value of funds,

$$r^j_{\text{dep},B} = \left(\frac{\sigma_{D,j}-1}{\sigma_{D,j}}\right)\left[r^S_B + \beta_L(\lambda-\psi)\frac{1-\psi}{D_B} - c^j_{\text{dep},B}\right], \tag{20}$$

$$r^j_{b,B} = \left(\frac{\sigma_{L,j}}{\sigma_{L,j}-1}\right)\left[r^S_B + \beta_L\frac{\lambda-\psi}{D_B} + \beta_K\frac{\phi}{L_B}(\kappa-\phi) + c^j_{b,B}\right]. \tag{21}$$

These conditions expose the two margins through which bank balance sheets affect pricing. Changes in the return $r^S_B$ pass into loan rates with the markup $\sigma_{L,j}/(\sigma_{L,j}-1)$, while changes in the bank's liquidity and capital positions alter the regulatory wedges.

The bank block is governed by the within-class elasticities $\sigma_{D,j}$ and $\sigma_{L,j}$, product operating costs $c^j_{\text{dep},B}$ and $c^j_{b,B}$, target ratios $\lambda$ and $\kappa$, and shadow-cost curvatures $\beta_L$ and $\beta_K$. Banks are otherwise symmetric, so intermediary heterogeneity does not generate cross-sectional variation in the model; that variation comes from the household and firm types.

**Money market funds and nonbank lenders.** MMFs hold a CES portfolio of repo and other short-term instruments, agency MBS, and Treasuries and finance it entirely by issuing MMF shares. They are competitive and incur per-unit operating cost $c_M$. If $r_M$ is the net payoff on the optimal MMF portfolio and $r^{ud}_M$ the return paid to shareholders, zero profit implies $r^{ud}_M = r_M - c_M$.

NBLs make loans to households and firms and finance them with CES composites of broadly held securities and NBL securities held by banks. Household and firm NBLs specialize in their respective borrower sectors but are otherwise symmetric and competitive. If $\tilde{r}^k_n$ denotes the funding cost of NBL type $k \in \{h, f\}$ and $c^k_n$ its operating cost, zero profit implies $r^k_n = \tilde{r}^k_n + c^k_n$.

Aggregate household and firm demand for nonbank credit determines the scale of the two NBL sectors, just as aggregate demand for MMF shares determines the scale of the MMF sector. Appendix C.3 provides the complete MMF and NBL portfolio, funding, and aggregation systems.

### 2.4 Government and the Rest of the World

Two sectors complete the financial system: the consolidated fiscal and monetary authority, which determines the net supply of government safe assets, and the rest of the world, which, in the data, absorbs a large share of U.S. marketable claims.

**Government.** We represent the Treasury and Federal Reserve as a consolidated fiscal and monetary authority. Gross marketable Treasury supply and Federal Reserve holdings of Treasuries and agency MBS are exogenous. After consolidation, Treasury supply to the remaining sectors is gross supply net of the Federal Reserve's holdings. Reserves supplied to banks and repo supplied to MMFs are perfectly elastic at exogenous policy rates, so their quantities accommodate intermediary demand. We do not impose a government budget constraint; counterfactuals change the relevant quantities or policy rates directly.

**Rest of the world.** Foreign investors demand U.S. Treasuries, agency MBS, corporate bonds, and equity, indexed by $j \in J^W \equiv \{g, h, c, e\}$. Their demand follows the CES system

$$P^W = \left( \sum_{j \in J^W} \alpha_j^W p_j^{1-\sigma^W} \right)^{\frac{1}{1-\sigma^W}}, \qquad q_j^W = M^W \alpha_j^W \left( \frac{p_j}{P^W} \right)^{1-\sigma^W}, \tag{22}$$

where $P^W$ is the foreign price index, $p_j = 1/(1 + r_j)$, $\alpha_j^W$ is the asset weight, $\sigma^W$ is the substitution elasticity, and $M^W$ is exogenous foreign financial wealth. The quantity $q_j^W$ is the beginning-of-period dollar value of foreign holdings rather than the number of payoff units. The rest of the world also supplies exogenous quantities of foreign-issued corporate bonds and equity to U.S. investors; these liabilities enter the corresponding market-clearing conditions separately from foreign demand for U.S. claims.

### 2.5 Equilibrium

An equilibrium is a vector of returns and quantities such that households, firms, banks, MMFs, NBLs, the consolidated fiscal and monetary authority, and foreign investors satisfy their optimality or zero-profit conditions and all markets clear. Four bank pricing conditions and five clearing conditions—for agency MBS, Treasuries, corporate bonds, NBL securities, and equity—determine the endogenous financial returns. Deposit, direct-loan, nonbank-loan, and MMF-share markets clear through intermediary balance sheets; reserves and repo

accommodate demand at their policy rates; and real-asset demand satisfies the type-level return schedule. Together, these conditions determine asset prices, intermediary balance sheets, household saving and borrowing, and firm scale and financing. Appendix C.4 states the five market-clearing conditions explicitly.

# 3 Estimation

We estimate the model largely from the bottom up. The basic identification approach is the inversion of a demand curve: exogenous movements in relative prices identify its slope. Then, conditional on the slope, observed prices and quantities determine the level of the curve. In our setting, the slopes are substitution elasticities, which we estimate from time-series variation, while the levels of household and firm demand curves are governed by characteristic-dependent weights and constraints, which we recover from cross-sectional microdata. The remaining intermediary wedges, costs, and equilibrium levels are estimated from pricing conditions or recovered by calibration and inversion of intermediary first-order conditions.

## 3.1 Data

The household SCF and firm QFR data are described in Section 1. We use twelve SCF waves from 1989 to 2022 and aggregate households into fine net-worth–age cells. The regressions use each cell's mean net worth and age as continuous characteristics so that we can perturb these characteristics when running counterfactuals. The QFR provides industry-by-size balance sheets from 1980 onward. Corporate industry–size cells, together with an aggregated noncorporate sector, yield twenty-two firm types.

Two additional sources connect these microdata to aggregate financial markets. The Financial Accounts from the Federal Reserve provide sector-level quantities, asset-class holdings, and Federal Reserve balance-sheet positions. Bank balance-sheet data and product rates map to intermediary balance-sheet and pricing decisions.

Because the SCF and QFR do not reproduce aggregate financial positions exactly, we reconcile their quantities to the Financial Accounts before estimation. For each asset and liability class, we apply a time-invariant multiplicative scalar to household or firm observations so that their population-weighted aggregates match the corresponding aggregate positions on average. These adjustments change levels but preserve the cross-sectional variation that identifies demand heterogeneity. For household holdings of Treasuries, agency MBS, corpo-

rate bonds, and equity, the aggregate targets are constructed residually from market clearing rather than taken directly from reported household holdings.

We use the full available sample for each estimating equation and anchor the general-equilibrium model in 2019, when the relevant aggregate quantities, household and firm cross sections, and financial rates are jointly observed. Historical and cross-country counterfactuals then change the distributions of household and firm characteristics while holding the estimated demand system fixed.

### 3.2 Empirical Strategy

Each individual-level demand curve contains two conceptually distinct parameters: a substitution elasticity that determines the slope, and shifters that determine the level. We identify them in that order. Given our functional form, we write relative demand as a log quantity ratio equal to a demand-weight term plus a coefficient on the log relative return. Exogenous variation in relative returns identifies the elasticity. Once the elasticity is known, observed relative prices and quantities can be inverted to exactly recover the demand weights.

**Demand elasticities.** We estimate the common substitution elasticities primarily from aggregate time-series variation in prices and quantities. As prices and quantities are jointly determined, we instrument relative returns with policy-driven shifts in asset supplies and short rates, including Federal Reserve holdings of Treasuries and agency MBS, the federal funds rate, and monetary-policy surprises. In some cases, the relevant return index varies by type, and so we additionally interact our instruments with household or firm characteristics to generate cross-sectional variation in the effective return induced by the same aggregate shock. Appendices D.1 through D.3 give the exact estimating equations and instrument sets for each nest.

The household- and firm-level elasticities of substitution across individual banks are estimated by a different approach. We do not observe bank-specific quantities and rates for household and firm deposits and loans, so we cannot identify these elasticities from customer reallocation across banks. Instead, we use instrumented changes in banks' cost of funds to measure pass-through to deposit and loan rates. Banks' first-order conditions map this pass-through into the corresponding within-class elasticities.

**Characteristic-dependent demand.** Given the estimated slopes, household and firm microdata determine the level of each type's demand curve. Within an SCF wave, households

face common national asset-class and lender rates. Conditional on those elasticities, their observed portfolio and borrowing quantities exactly pin down the relative demand weights needed to rationalize those choices. We parameterize these implied weights as functions of net worth and age. Household borrowing levels similarly identify the relationship between characteristics and debt-service capacity. The firm estimation follows the same logic. Firm types face common class-level financial rates. Conditional on their estimated elasticities, observed asset and financing choices determine the demand weights associated with each industry and size. Leverage additionally identifies the reference equity-share surface.

Our counterfactuals impose an important stability assumption. They require the estimated mapping from observable characteristics to financial demand to remain fixed across populations, but do not require those characteristics themselves to causally determine demand. For example, suppose that wealth predicts higher equity shares because wealthier households are less risk averse. When we increase wealth in a counterfactual, we assign households the demand associated with that higher wealth, implicitly carrying along whatever underlying traits generate the observed wealth–portfolio relationship. The counterfactuals therefore require the conditional mapping from characteristics to demand to be stable, not a particular causal mechanism behind it.

**Intermediary wedges, costs, and levels.** The remaining model blocks are disciplined by equilibrium conditions. Bank liquidity and capital targets and their shadow-cost curvatures are estimated by GMM. For firms, $\eta_K$ and the asset-service normalizations are calibrated. Firm productivity and intermediary operating costs are pinned down by observed scale and zero-profit conditions, respectively. For foreign investors, instrumented relative returns identify the substitution elasticity, and their 2019 holdings pin down portfolio weights and foreign financial wealth.

### 3.3 Estimates

**Households.** Household heterogeneity enters through the consumption–saving weights $(\gamma_c^i, \gamma_s^i)$, saving-class weights $\alpha_j^i$, borrowing-class weights $\beta_j^i$, and debt-service capacity $\bar{D}^i$. Let $\widetilde{w}^i$ denote centered log net worth and $\widetilde{a}^i = (\text{Age}^i - \overline{\text{Age}})/10$. For each relative demand

weight $\chi_k^i/\chi_l^i$, with $\chi \in \{\gamma, \alpha, \beta\}$, we estimate

$$\log\left(\frac{\chi_k^i}{\chi_l^i}\right) = \chi_{k,l}^0 + \chi_{k,l}^w \widetilde{w}^i + \chi_{k,l}^a \widetilde{a}^i + \chi_{k,l}^{a2}(\widetilde{a}^i)^2 + \epsilon_{k,l}^{\chi,i},$$
$$\log \bar{D}^i = \delta^0 + \delta^w \widetilde{w}^i + \delta^{w2}(\widetilde{w}^i)^2 + \delta^a \widetilde{a}^i + \delta^{a2}(\widetilde{a}^i)^2 + \epsilon^{\delta,i}. \tag{23}$$

Age enters quadratically to accommodate the nonlinear life-cycle patterns documented in Section 1. Net worth enters quadratically in debt-service capacity to allow borrowing capacity to rise at a diminishing rate.

Table 1 reports the estimates. The across-class saving and borrowing elasticities are $\widehat{\sigma}_S^h = 1.49$ and $\widehat{\sigma}_B^h = 1.55$, implying incomplete substitution across saving instruments and between bank and nonbank credit. Conditional on these slopes, the cross-sectional quantities imply that higher-net-worth households place less weight on deposits relative to other financial assets, while placing more weight on bank borrowing relative to nonbank credit. As households age, they shift their portfolios away from equity and toward deposits, and rely more on banks conditional on borrowing. The outer consumption–saving elasticity is $\widehat{\sigma}^h = 0.91$, while debt-service capacity rises with net worth at a diminishing rate and declines after middle age. Appendix D.1 reports the underlying regressions.

**Firms.** Firm heterogeneity enters through the financial-asset weights $\gamma_j^i$, debt weights $\beta_j^i$, outer asset weights $\alpha_j^i$, reference equity share $\bar{s}^i$, and productivity intercept $\zeta_t^i$. Let $x^i$ denote centered log firm size. For $\chi \in \{\gamma, \beta, \alpha\}$, we estimate

$$\log\left(\frac{\chi_k^i}{\chi_l^i}\right) = \chi_{k,l}^0 + \chi_{k,l}^{\text{size}} x^i + \chi_{k,l}^{\text{size}^2}(x^i)^2 + \chi_{k,l}^{\text{ind}}\text{Industry}^i + \epsilon_{k,l}^{\chi,i},$$
$$\bar{s}^i = s^0 + s^{\text{size}} x^i + s^{\text{size}^2}(x^i)^2 + s^{\text{ind}}\text{Industry}^i. \tag{24}$$

Table 2 reports the estimates. The financial-asset and debt elasticities are $\widehat{\sigma}_F^f = 1.75$ and $\widehat{\sigma}_D^f = 1.81$. Given these slopes, observed asset and financing shares imply that larger firms place relatively more weight on MMF shares than deposits and less weight on bank loans than nonbank debt. The outer asset elasticity, $\widehat{\sigma}_A^f = 0.85$, implies that real and financial assets are gross complements. The leverage regression implies $\widehat{\eta}_E = 2.56$. Quantitatively, a one-percentage-point increase in the debt-cost spread over equity raises the optimal equity share by roughly 0.4 percentage points. We set $\eta_K = 0.33$, implying a long-run capital elasticity of about three, and recover each type's productivity intercept by inverting the

real-capital schedule. Appendix D.2 reports the estimation details, and Appendix Figure A4 reports the 2019 productivity distribution.

**Intermediaries and foreign investors.** Table 3 reports the intermediary estimates. The bank securities elasticity is $\widehat{\eta}_B = 22.77$, implying high substitution across liquid assets.[5] Within-class loan elasticities are 2.49 for households and 2.57 for firms, corresponding to pass-through of 1.67 and 1.64 from the shadow cost of funds into loan rates. Deposit elasticities are 1.41 and 6.55, implying much lower pass-through of 0.29 and 0.85. Banks therefore pass changes in funding costs more than one-for-one into loan rates while attenuating them in deposit rates.

The MMF and household-NBL funding elasticities are also high, at 14.6 and 15.2, while the firm-NBL elasticity is 4.9. The 2019 cost inversion implies a material operating spread for household nonbank credit and approximately zero for firm nonbank credit under the AAA corporate bond yield proxy. The rest-of-world substitution elasticity is 18.1, implying strong reallocation across U.S. marketable claims. Appendix D.3 reports the intermediary specifications and coefficient mappings; Appendix D.4 and Appendix Table A11 report the remaining portfolio calibration and foreign-investor estimates.

**Equilibrium fit.** Our estimation targets the household and firm demand system—their cross-sectional asset and financing choices and their responses to relative returns—as well as intermediary substitution and pricing behavior. It does not target the aggregate division of saving and financing between banks and markets. Figure 7 therefore provides an equilibrium validation of the estimated system. The model reproduces the broad ordering of returns and the main relative spreads: the bank-loan spread over Treasuries is 2.78 percentage points versus 3.14 in the data, and the equity premium is 5.56 percent versus 6.61 percent. It also comes close to the aggregate financial structure, generating a bank deposit share of 17.3 percent versus 20.5 percent in the data and a bank share of private-sector financing of 15.7 percent versus 19.2 percent. Thus, demand heterogeneity estimated largely from household and firm microdata produces aggregate bank shares that were not directly targeted in estimation.

Three features of the estimates drive the results that follow. First, substitution is imperfect and differs sharply across sectors. Household and firm demand across broad financial

[5]The estimation values reserves at the federal funds rate because interest on reserves is unavailable before 2008. The general-equilibrium closure uses interest on reserves. In 2019 the two rates differ by about two basis points, implying less than a one-basis-point difference in the bank shadow return.

classes is relatively inelastic, while intermediary portfolio and funding demands are much more elastic. Changing the relative scale of these sectors therefore changes both the economy's absorptive capacity and the elasticity of aggregate demand. Second, household and firm characteristics shift assets and liabilities differently, so changes in composition can move bank funding and credit in different directions. Third, bank product rates exhibit non-unit pass-through: changes in banks' marginal cost of funds are amplified for loan rates but attenuated for deposit rates. The next section explores the aggregate consequences of these results.

# 4 How Composition Shapes Aggregate Financial Demand

We now use the estimated demand system to study how household and firm composition shapes aggregate financial demand. Holding the underlying demand functions and financial environment fixed, changing composition changes the relative scale of different types and sectors and therefore the level and elasticity of aggregate demand. We first construct aggregate demand curves for deposits and bank credit, then vary household and firm characteristics and trace the resulting equilibrium adjustments.

## 4.1 Aggregate Demand Curves

Aggregate demand for each bank product sums household and firm demand over the population. Its local elasticity therefore depends on the relative scale of constituent sectors with different responses. Reweighting the population can thus change aggregate absorptive capacity even though primitive elasticities within each demand block remain fixed.

We construct these schedules in conditional general equilibrium. For deposits, we fix household and firm deposit rates at a common multiple of their 2019 equilibrium values and allow every other market to clear. A multiplier of one reproduces the 2019 equilibrium. We construct the bank-loan schedule analogously. Appendix E describes the procedure and accuracy checks.

Figure 8 shows that the two sides of bank intermediation have sharply different aggregate elasticities. At the 2019 equilibrium, the own-rate elasticity of deposit demand is 0.32, compared with $-1.02$ for bank-loan demand. Deposit demand is therefore relatively insensitive to rates, consistent with households and firms valuing the non-rate attributes of deposits (e.g., transaction services). In contrast, borrowers respond more strongly to bank-loan rates by substituting toward nonbank finance or equity, or by borrowing less overall.

These elasticity differences determine how composition-driven demand shifts are absorbed. Because deposit demand is inelastic, changes in deposit rates offset relatively little of a demand shift, leaving larger movements in deposit quantities and banks' share of saving. Bank-credit demand is approximately unit-elastic, so loan-rate adjustment offsets more of an initial shift. Whether the remaining adjustment appears in banks' share of financing also depends on changes in borrower composition and total financing.

### 4.2 Differential Responses of Deposits and Loans

We alter real-sector composition along three dimensions: household net worth, household age, and firm productivity. For each, we consider both a level shift and a mean-preserving distributional shift. Specifically, we raise mean household net worth or wealth concentration; mean household age or age dispersion; and mean firm productivity or the productivity of large firms relative to small firms. Throughout, the estimated mapping from characteristics to demand is held fixed; only the distribution of characteristics changes. Appendix E details the transformations.

We separate three stages of adjustment. First, changing composition shifts demand at baseline prices. Second, prices in other financial markets adjust, further shifting the relevant bank-product demand schedule. Finally, the deposit or loan rate adjusts along that schedule to the new equilibrium. Figure 9 reports the resulting bank shares and rates, while Appendix Figures A5, A6, and A7 trace the underlying demand shifts and general-equilibrium repricing.

**Households.** At baseline prices, household characteristics shift both saving and borrowing. Wealthier households allocate a smaller share of financial wealth to deposits, so greater wealth concentration shifts portfolios toward market claims. Older households place relatively more weight on deposits, so aging shifts saving toward banks. Higher mean net worth combines a portfolio shift away from deposits with a large increase in total saving. On the liability side, debt-service capacity rises with net worth and declines after middle age, so these same characteristics also change household credit demand.

As other markets clear, cross-market repricing can materially alter the direct shift in deposit demand. For higher mean net worth, the baseline-price increase in deposit demand is about 20 percent. The additional saving then lowers Treasury and equity returns, making deposits relatively more attractive and raising it further, to about 40 percent. Aging works similarly: the direct increase in deposit demand is about 6 percent, while the accompanying fall in Treasury yields and rise in equity returns increase it to about 11 percent. Wealth

concentration, by contrast, redistributes a fixed amount of wealth and moves security returns much less, so cross-market repricing adds relatively little to the initial shift.

Finally, the deposit rate adjusts, but offsets only a small part of the demand shift because aggregate deposit demand is inelastic. Household composition affects the financing side mainly through market rates and banks' cost of funds. Higher mean net worth, for example, lowers market returns and therefore banks' opportunity cost of lending; bank-loan pricing passes this decline through more than one-for-one into lower loan rates, expanding bank credit. This channel also illustrates why bank quantities and bank shares can move differently: higher mean net worth increases deposits in dollars even as deposits fall as a share of saving because total financial assets rise faster.

**Firms.** At baseline prices, larger firms rely less on bank loans and more on market finance, so concentrating productive activity among large firms shifts financing away from banks. Higher mean productivity instead expands financing demand across firms without materially changing borrower composition, producing the largest initial increase in bank-credit demand among the six exercises.

As other markets clear, cross-market repricing substantially offsets the productivity effect. Higher productivity raises security returns and financing costs, reducing the increase in bank-credit demand from about 32 percent at baseline prices to about 9 percent before the bank-loan rate itself adjusts. The same increase in security returns induces households to shift away from deposits. Although firms demand more deposits at baseline prices, the household response is large enough to reverse the aggregate deposit effect. Firm characteristics therefore reach the saving side mainly through the prices generated by their financing demand.

Finally, the loan rate adjusts. Because aggregate bank-credit demand is approximately unit-elastic, this adjustment absorbs much of the remaining productivity-driven increase in demand, leaving equilibrium lending little changed. Concentrating activity among large firms works differently. Because total financing changes relatively little, security returns and bank-loan rates move little, so the direct reallocation away from bank credit survives largely into banks' share of financing. This reweighting also makes aggregate bank-credit demand more elastic by shifting the composition of bank-credit demand toward firms with different bank–nonbank financing shares.

Figure 9 summarizes the resulting equilibria. The upper panels reveal a strong asymmetry between the two sides of intermediation: household characteristics primarily affect banks' share of private-sector saving, while firm characteristics primarily affect banks' share of

private-sector financing. This asymmetry reflects the aggregate balance sheet. Households hold nearly all private-sector financial assets but account for only about one-quarter of private financing, so household composition acts directly on saving and reaches financing mainly through equilibrium funding costs. Firms occupy the opposite position, so firm composition acts directly on financing and reaches saving mainly through equilibrium security returns. Appendix Table A12 reports these aggregate positions.

The lower panels show the corresponding rate adjustments. Deposit rates move relatively little, while loan rates absorb more of the financing-demand shifts, consistent with the elasticities in Figure 8. Changes in borrower composition operate differently: reallocating activity toward large firms can reduce banks' share of financing with little change in total financing or equilibrium rates.

These exercises show how changes in real-sector composition propagate through direct demand shifts and equilibrium repricing to alter financial structure. The next sections ask how much this mechanism explains the observed variation in that structure and how it changes the transmission of a common shock.

# 5 Financial Structure Over Time and Across Countries

The preceding exercises show how household and firm characteristics shape both the level and slope of aggregate financial demand and how equilibrium repricing translates these changes into quantities and bank shares. We now quantify one implication of this demand system: how much changes in composition can explain observed variation in equilibrium financial structure. We hold the financial environment fixed at its 2019 U.S. values and reaggregate the same estimated demand system over historical U.S. and cross-country distributions of household and firm characteristics. Because the corresponding financial outcomes are not used in estimation, these exercises serve as untargeted tests of the model's aggregate implications.

## 5.1 U.S. Financial Structure, 1980–2019

We first ask how much changes in U.S. household and firm composition can account for the shift toward market-based finance between 1980 and 2019. We compare the 2019 baseline with counterfactual equilibria that replace the household distribution, the firm distribution, or both with their 1980 counterparts, while holding policy, technology, and institutional

parameters fixed at 2019 values.[6]

The decline in banks' share of private-sector saving is overwhelmingly household-driven. From the constructed 1980 economy to 2019, the deposit share falls by 9.1 percentage points, against an observed decline of 9.6 points, with household change accounting for 8.1 points (Figure 10). Rising household wealth expands saving and shifts portfolios toward market securities; because deposit demand is inelastic, equilibrium repricing offsets little of this displacement.

Firm composition matters more on the financing side. Banks' share of private-sector financing falls by 2.3 percentage points in the model, with changes in the firm distribution accounting for 2.1 points. The observed decline is much larger, 12.4 points, so composition captures the direction but only about one-fifth of the magnitude. The gap points to financing- or institutional-side forces held fixed in the exercise. The model also predicts a 14.7-point decline in the ratio of bank securities to deposits, whereas the observed ratio rises by 18.1 points, highlighting the importance of omitted changes in regulation and the monetary environment.

Equilibrium rates reflect the same forces. Greater household wealth raises aggregate demand for financial assets and lowers market returns; the Treasury yield falls by 4.02 percentage points, of which household change accounts for 3.54 points (Figure A8 in Appendix F). This channel echoes mechanisms through which demographics and wealth concentration raise aggregate saving and lower equilibrium rates (Carvalho et al., 2016; Mian et al., 2020). Bank loan rates fall substantially with market rates, while deposit rates adjust much less, compressing the spread between bank lending and funding rates.

Overall, household composition accounts for most of the decline in banks' share of saving, while firm composition accounts for most of the model-implied decline in banks' share of private-sector financing. We next ask whether the same asymmetry appears across countries.

### 5.2 Financial Structure Across Countries

We construct counterfactual U.S. economies for the 15 countries with complete household and firm inputs.[7] For each country, we reweight the household distribution to match mean

[6]The SCF begins in 1989. We construct the 1980 household distribution by retaining the 1989 population weights and relative wealth distribution and backcasting wealth levels with the estimated SCF wealth-growth rate. The household counterfactual also proportionally scales bank equity, Treasury supply, Federal Reserve holdings, rest-of-world issuance, and foreign wealth with aggregate household wealth. The firm counterfactual uses the 1980 industry and size composition.

[7]The starting panel contains twenty countries with household-side coverage. Requiring firm-concentration data removes Hungary, Japan, the Netherlands, and Portugal, leaving sixteen; Austria is then dropped

wealth per capita, old-age dependency, and the country–U.S. ratios of the top-1% and top-10% wealth shares, and the firm distribution to match the services value-added share and large-firm concentration. Exogenous dollar supplies scale with mean household wealth, while preference elasticities, intermediary parameters, policy settings, and institutions remain fixed at their 2019 U.S. values. These are therefore characteristic counterfactuals rather than country-specific calibrations.

The cross-country results mirror the historical pattern. Differences in household and firm characteristics explain 69% of the cross-country variation in banks' share of private-sector saving and 34% of the variation in banks' share of private-sector financing (Figure 11). The saving-side fit is driven primarily by household heterogeneity: greater wealth and wealth concentration shift portfolios away from deposits, while older populations place greater weight on deposits. Because deposit demand is inelastic, these shifts survive equilibrium rate adjustment and appear in banks' share of saving.

On the financing side, firm composition plays the larger role. In economies where large firms account for more activity, financing demand tilts toward firms that rely less on bank loans and more on market debt and equity. This channel allows differences in real-sector composition to account for a meaningful share of the cross-country variation in banks' role in private-sector financing.

Taken together, the historical and cross-country exercises deliver a common result. Real-sector composition has substantial explanatory power for both banks' share of private-sector saving and their share of private-sector financing, but through different characteristics on the two sides: household composition primarily shapes saving, while firm composition primarily shapes financing. The remaining variation leaves room for the financial-sector forces held fixed in these exercises—including market depth, creditor protection, regulation, the nonbank investor base, and intermediary technology.

## 6 Financial Transmission of Government Borrowing

We now study how a common shock is transmitted across economies with different real-sector compositions. We increase marketable Treasury supply by an amount equal to 10% of GDP while holding Federal Reserve holdings fixed, and compare the response in the 2019 economy with that in the constructed 1980 economy. The new Treasuries must ultimately be absorbed either directly by households and foreign investors or indirectly through banks

because its target wealth distribution is not attainable under the survey-weight reweighting.

and money market funds (MMFs).

The two absorption routes generate different adjustments. Under direct absorption, households and foreign investors increase their Treasury holdings, which requires market returns to adjust enough to induce them to substitute toward the additional government debt. Under intermediated absorption, banks and MMFs instead take Treasuries onto their balance sheets against the deposits and fund shares they issue. This absorption places government securities in direct competition with other intermediary assets: in particular, bank absorption reallocates balance-sheet capacity away from private claims and raises the return on banks' securities portfolio, and hence their opportunity cost of lending. Intermediaries have relatively elastic portfolio demand, so greater intermediated absorption can require less market-wide repricing, but it produces more balance-sheet displacement and routes the shock through intermediary pricing wedges. Household composition determines the balance between these two absorption routes, while household and firm composition determine exposure to the resulting changes in asset returns and financing costs.

### 6.1 Absorption and Transmission in the 2019 Economy

In the 2019 economy, households and foreign investors directly absorb 69% of the new Treasury issuance, while banks and MMFs intermediate the remaining 31%; banks alone absorb 14% (Figure 13). Although banks absorb a modest share of the issuance, their balance sheets respond substantially. Bank lending contracts by \$1.22 for each additional dollar of securities banks hold, as higher Treasury supply both reallocates bank portfolios toward securities and raises returns on the broader securities portfolio.

These changes raise banks' opportunity cost of lending. Their securities-portfolio return rises by about 33 basis points, while bank market power amplifies the pass-through: household and firm bank-loan rates rise by about 52 and 51 basis points, respectively (Table 4). Regulatory constraints relax slightly as securities replace loans on bank balance sheets.[8] Given approximately unit-elastic bank-credit demand, the higher rates produce a substantial contraction in bank lending.

Higher financing costs reduce firm investment by 4.7% (Table 5). Higher returns on firms' liquid assets provide some offset, but the increases in the costs of bank credit, nonbank credit, and equity dominate. The effect is larger for firms more exposed to bank credit: investment falls by 6.0% among smaller and noncorporate firms, compared with 3.8% among large corporations.

[8] Appendix G provides the bank-pricing decomposition.

Aggregate household consumption changes little, rising by 0.13%. Higher borrowing costs reduce the resources available to borrowers, while higher asset returns benefit savers, and the two effects nearly offset each other in the aggregate. The incidence is nevertheless heterogeneous: consumption falls for leveraged, less-wealthy young households, while older and wealthier households benefit from higher saving returns. These results hold the value of outstanding securities fixed. Appendix G.3 incorporates the capital losses generated by equilibrium repricing; rates and investment change little, but the wealth loss reverses the sign of the small aggregate consumption gain.

### 6.2 How Real-Sector Composition Changes the Transmission

We next apply the same Treasury-supply shock to the 1980 economy while holding the financial environment and other institutional features fixed. The younger and poorer 1980 household sector absorbs only 12% of the new Treasuries directly, about half the 2019 household share. More of the issuance therefore reaches intermediary balance sheets: bank absorption doubles to 28%, and the combined bank and MMF share rises to 41% (Figure 13).

More of the shock consequently runs through bank balance sheets. Banks' securities return rises by 53 basis points, compared with 33 basis points in 2019, and bank-loan rates rise by about 0.8 percentage points rather than 0.5 percentage points (Figure 14). Thus the change in saver composition alters not only who holds the additional government debt but also the financing conditions faced by private borrowers.

Borrower composition then changes the real consequences of those financing conditions. Firm investment falls by 5.4%, 0.7 percentage points more than in 2019. The 1980 economy is substantially more exposed to bank credit: smaller, bank-dependent firms account for 79% of capital, compared with 37% in 2019. Household consumption likewise turns from the small 2019 gain to a decline of 0.05%. Leveraged young households account for a larger share of consumption (59% versus 48%) and experience a larger decline ($-0.34\%$ versus $-0.19\%$; Table 5).

The same Treasury-supply shock therefore follows a different path through the financial system and has different real incidence when household and firm composition changes. Saver composition determines where the new government debt is absorbed; borrower composition determines who is most exposed to the resulting change in financing conditions.

# 7 Conclusion

Real-sector composition shapes both financial structure and shock transmission. Household characteristics affect saving and borrowing choices, while firm characteristics affect liquidity demand, leverage, and the choice between bank and market finance. Aggregating these heterogeneous choices yields aggregate demand for each financial claim. Because composition affects both demand level and slope, it determines the equilibrium allocation of intermediation across banks and nonbanks. The same demand system, together with the equilibrium financial structure, governs how a common shock is transmitted through financial rates and quantities.

Quantitatively, changes in household and firm composition account for substantial observed variation in financial structure over time and across countries, with greater explanatory power for banks' share of saving than for their share of financing. The government-borrowing experiment shows that the same shock can have different financial and real effects across economies with different compositions. Greater absorption through intermediary balance sheets exposes the shock to more intermediation wedges and crowds out more private lending, while greater concentration of activity among bank-dependent borrowers amplifies the resulting effects on investment and consumption. Financial structure and shock transmission are therefore joint equilibrium implications of the aggregate financial demand system and vary with the composition of the real economy even when the supply-side environment is unchanged.

## References


Franklin Allen and Douglas Gale. *Comparing Financial Systems*. MIT Press, Cambridge, MA, 2000.

Adrien Auclert, Hannes Malmberg, Frédéric Martenet, and Matthew Rognlie. Demographics, wealth, and global imbalances in the twenty-first century. Working Paper 29161, National Bureau of Economic Research, 2021.

David Autor, David Dorn, Lawrence F. Katz, Christina Patterson, and John Van Reenen. The fall of the labor share and the rise of superstar firms. *The Quarterly Journal of Economics*, 135(2):645–709, 2020. doi: 10.1093/qje/qjaa004.

Thorsten Beck, Asli Demirgüç-Kunt, and Ross Levine. Law, endowments, and finance. *Journal of Financial Economics*, 70(2):137–181, 2003.

Juliane Begenau. Capital requirements, risk choice, and liquidity provision in a business-cycle model. *Journal of Financial Economics*, 136(2):355–378, 2020. doi: 10.1016/j.jfineco.2019.10.004.

Juliane Begenau and Tim Landvoigt. Financial regulation in a quantitative model of the modern banking system. *The Review of Economic Studies*, 89(4):1748–1784, 2022. doi: 10.1093/restud/rdab088.

Ben S. Bernanke, Mark Gertler, and Simon Gilchrist. The financial accelerator in a quantitative business cycle framework. In John B. Taylor and Michael Woodford, editors, *Handbook of Macroeconomics*, volume 1, pages 1341–1393. Elsevier, 1999. doi: 10.1016/S1574-0048(99)10034-X.

Markus K. Brunnermeier and Yuliy Sannikov. A macroeconomic model with a financial sector. *American Economic Review*, 104(2):379–421, 2014. doi: 10.1257/aer.104.2.379.

Greg Buchak, Gregor Matvos, Tomasz Piskorski, and Amit Seru. Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of Financial Economics*, 130(3):453–483, 2018.

Greg Buchak, Gregor Matvos, Tomasz Piskorski, and Amit Seru. The secular decline of bank balance sheet lending. Working Paper 32176, National Bureau of Economic Research, 2024.

Ricardo J. Caballero, Emmanuel Farhi, and Pierre-Olivier Gourinchas. The safe assets shortage conundrum. *Journal of Economic Perspectives*, 31(3):29–46, 2017. doi: 10.1257/jep.31.3.29.

Carlos Carvalho, Andrea Ferrero, and Fernanda Nechio. Demographics and real interest rates: Inspecting the mechanism. *European Economic Review*, 88:208–226, 2016. doi: 10.1016/j.euroecorev.2016.04.002.

Morris A. Copeland. *A Study of Moneyflows in the United States*. National Bureau of Economic Research, New York, 1952.

Nicolas Crouzet. Aggregate implications of corporate debt choices. *The Review of Economic Studies*, 85(3):1635–1682, 2018.

Nicolas Crouzet and Janice C. Eberly. Understanding weak capital investment: The role of market concentration and intangibles. Working Paper 25869, National Bureau of Economic Research, 2019.

Douglas W. Diamond. Financial intermediation and delegated monitoring. *Review of Economic Studies*, 51(3):393–414, 1984. doi: 10.2307/2297430.

Douglas W. Diamond. Liquidity, banks, and markets. *Journal of Political Economy*, 105(5): 928–956, 1997.

Douglas W. Diamond and Philip H. Dybvig. Bank runs, deposit insurance, and liquidity. *Journal of Political Economy*, 91(3):401–419, 1983. doi: 10.1086/261155.

Itamar Drechsler, Alexi Savov, and Philipp Schnabl. The deposits channel of monetary policy. *Quarterly Journal of Economics*, 132(4):1819–1876, 2017.

Mark Egan, Ali Hortacşu, and Gregor Matvos. Deposit competition and financial fragility: Evidence from the US banking sector. *American Economic Review*, 107(1):169–216, 2017. doi: 10.1257/aer.20150342.

Vadim Elenev, Tim Landvoigt, and Stijn Van Nieuwerburgh. A macroeconomic model with financially constrained producers and intermediaries. *Econometrica*, 89(3):1361–1418, 2021. doi: 10.3982/ECTA16438.

Douglas W. Elmendorf and N. Gregory Mankiw. Government debt. In John B. Taylor and Michael Woodford, editors, *Handbook of Macroeconomics*, volume 1, chapter 25, pages 1615–1669. Elsevier, 1999. doi: 10.1016/S1574-0048(99)10038-7.

Antonio Falato, Dalida Kadyrzhanova, Jae W. Sim, and Roberto Steri. Rising intangible capital, shrinking debt capacity, and the U.S. corporate savings glut. *The Journal of Finance*, 77(5):2799–2852, 2022. doi: 10.1111/jofi.13174.

Eugene F. Fama. Banking in the theory of finance. *Journal of Monetary Economics*, 6(1): 39–57, 1980. doi: 10.1016/0304-3932(80)90017-3.

Benjamin M. Friedman. Crowding out or crowding in? Economic consequences of financing government deficits. *Brookings Papers on Economic Activity*, 1978(3):593–641, 1978. doi: 10.2307/3217952.

Mark Gertler and Peter Karadi. A model of unconventional monetary policy. *Journal of Monetary Economics*, 58(1):17–34, 2011.

Mark Gertler and Nobuhiro Kiyotaki. Financial intermediation and credit policy in business cycle analysis. In Benjamin M. Friedman and Michael Woodford, editors, *Handbook of Monetary Economics*, volume 3, pages 547–599. Elsevier, 2010.

Raymond W. Goldsmith. Financial structure and economic growth in advanced countries: An experiment in comparative financial morphology. In *Capital Formation and Economic Growth*, pages 112–167. Princeton University Press, Princeton, NJ, 1955.

Raymond W. Goldsmith. *Financial Intermediaries in the American Economy Since 1900*. Princeton University Press, Princeton, NJ, 1958.

John G. Gurley and Edward S. Shaw. Financial intermediaries and the saving-investment process. *Journal of Finance*, 11(2):257–276, 1956.

Valentin Haddad and Tyler Muir. Do intermediaries matter for aggregate asset prices? *Journal of Finance*, 76(6):2719–2761, 2021. doi: 10.1111/jofi.13086.

Valentin Haddad and Tyler Muir. Market macrostructure: Institutions and asset prices. *Annual Review of Financial Economics*, 17:133–150, 2025. doi: 10.1146/annurev-financial-090524-120754.

Valentin Haddad, Paul Huebner, and Erik Loualiche. How competitive is the stock market? theory, evidence from portfolios, and implications for the rise of passive investing. *American Economic Review*, 115, 2025.

Zhiguo He and Arvind Krishnamurthy. Intermediary asset pricing. *American Economic Review*, 103(2):732–770, 2013. doi: 10.1257/aer.103.2.732.

Matteo Iacoviello. House prices, borrowing constraints, and monetary policy in the business cycle. *American Economic Review*, 95(3):739–764, 2005. doi: 10.1257/0002828054201477.

Charles J. Jacklin. Demand deposits, trading restrictions, and risk sharing. In Edward C. Prescott and Neil Wallace, editors, *Contractual Arrangements for Intertemporal Trade*, pages 26–47. University of Minnesota Press, Minneapolis, MN, 1987.

Anil K. Kashyap and Jeremy C. Stein. What do a million observations on banks say about the transmission of monetary policy? *American Economic Review*, 90(3):407–428, 2000. doi: 10.1257/aer.90.3.407.

Nobuhiro Kiyotaki and John Moore. Credit cycles. *Journal of Political Economy*, 105(2): 211–248, 1997. doi: 10.1086/262072.

Ralph S. J. Koijen and Motohiro Yogo. A demand system approach to asset pricing. *Journal of Political Economy*, 127(4):1475–1515, 2019. doi: 10.1086/701683.

Arvind Krishnamurthy and Annette Vissing-Jorgensen. The aggregate demand for treasury debt. *Journal of Political Economy*, 120(2):233–267, 2012. doi: 10.1086/666526.

Arvind Krishnamurthy and Annette Vissing-Jorgensen. The impact of treasury supply on financial sector lending and stability. *Journal of Financial Economics*, 118(3):571–600, 2015. doi: 10.1016/j.jfineco.2015.08.012.

Wenhao Li, Yiming Ma, and Yang Zhao. The passthrough of treasury supply to bank deposit funding. *Journal of Financial Economics*, 184:104334, 2026. doi: 10.1016/j.jfineco.2026.104334.

Robert E. Lucas, Jr. Money in a theory of finance. *Carnegie-Rochester Conference Series on Public Policy*, 21:9–46, 1984.

Atif R. Mian, Ludwig Straub, and Amir Sufi. The saving glut of the rich. Working Paper 26941, National Bureau of Economic Research, 2020.

Alan Moreira and Alexi Savov. The macroeconomics of shadow banking. *The Journal of Finance*, 72(6):2381–2432, 2017. doi: 10.1111/jofi.12540.

Guillaume Plantin. Shadow banking and bank capital regulation. *Review of Financial Studies*, 28(1):146–175, 2015. doi: 10.1093/rfs/hhu055.

James M. Poterba. Demographic structure and asset returns. *Review of Economics and Statistics*, 83(4):565–584, 2001. doi: 10.1162/003465301753237650.

James Tobin and William C. Brainard. Financial intermediaries and the effectiveness of monetary controls. *The American Economic Review*, 53(2):383–400, 1963.

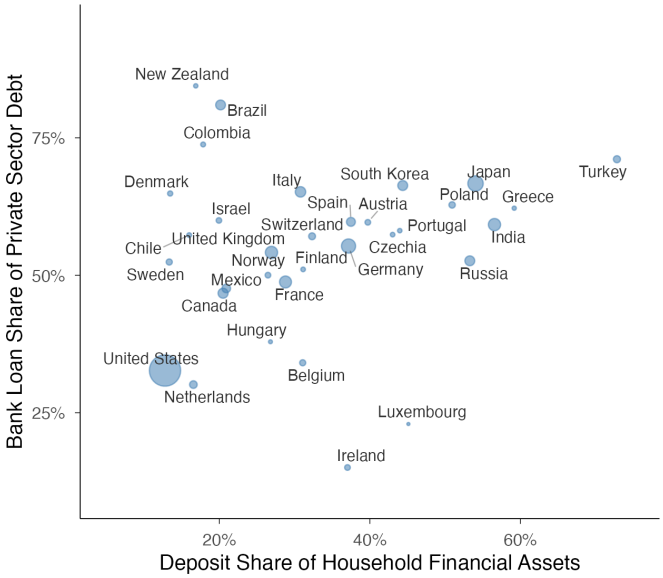
Dimitri Vayanos and Jean-Luc Vila. A preferred-habitat model of the term structure of interest rates. *Econometrica*, 89(1):77–112, 2021. doi: 10.3982/ECTA17440.

Yifei Wang, Toni M. Whited, Yufeng Wu, and Kairong Xiao. Bank market power and monetary policy transmission: Evidence from a structural estimation. *The Journal of Finance*, 77(4):2093–2141, 2022. doi: 10.1111/jofi.13159.

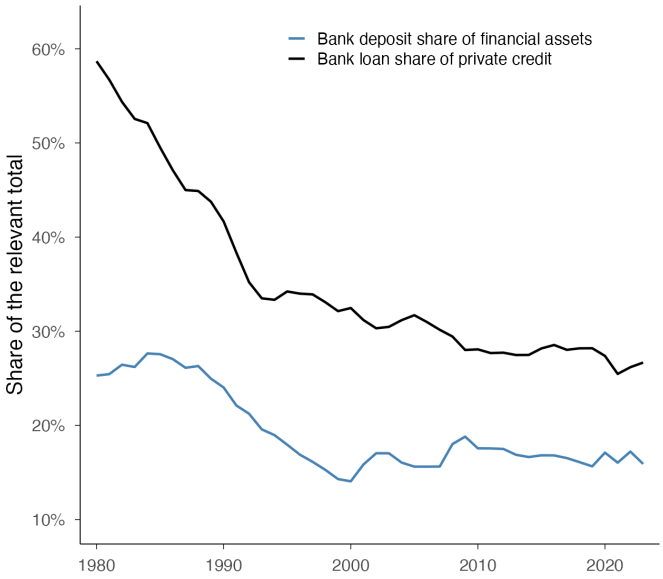
Kairong Xiao. Monetary transmission through shadow banks. *Review of Financial Studies*, 33(6):2379–2420, 2020. doi: 10.1093/rfs/hhz112.

**Figure 1:** Variation in the bank share of financial intermediation

Panel (a) plots banks' share of credit to the private nonfinancial sector against the deposit share of household financial assets; observations are country means over 2018–2022 and bubble area is proportional to nominal GDP. Panel (b) plots the corresponding annual U.S. shares, with both series on a common axis. The two panels use different deposit measures: panel (a) scales deposits by household financial assets only, for comparability with Figure 2, whereas panel (b) pools households and nonfinancial firms on both sides of the ratio, the measure used in Sections 4 and 5. Sources: BIS, Eurostat, OECD, and the Financial Accounts of the United States.



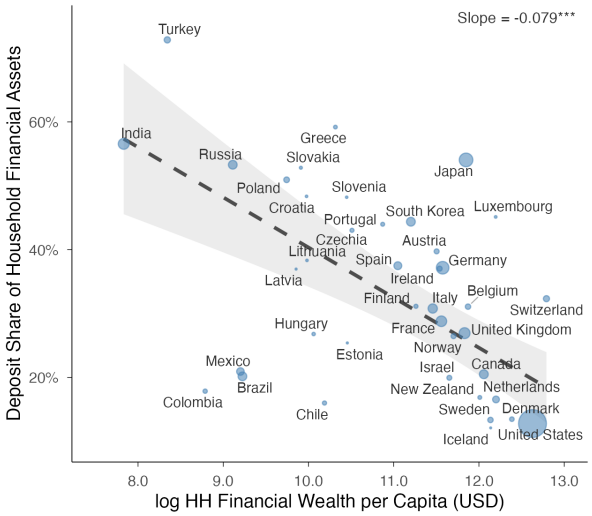

(a) Bank reliance across countries



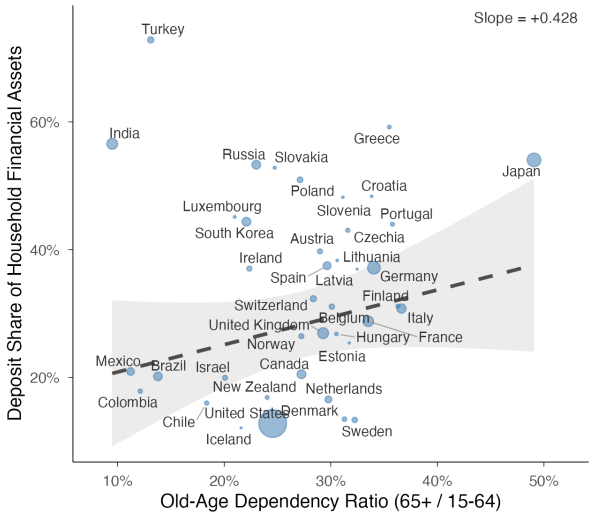

(b) Bank reliance in the United States over time

**Figure 2:** Real-sector characteristics and bank reliance across countries

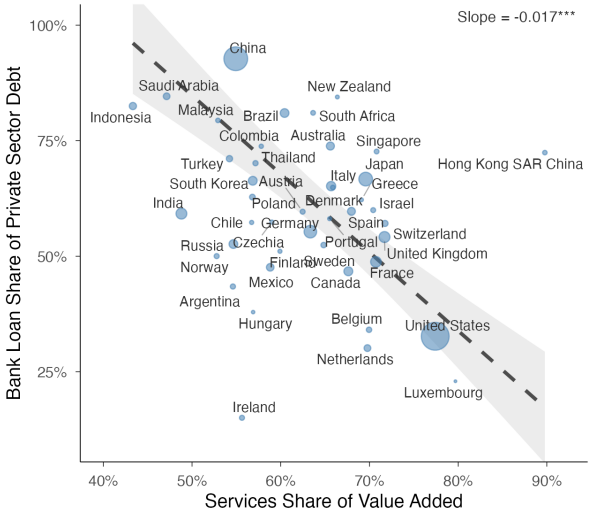
Panels (a) and (b) plot the deposit share of household financial assets against household financial wealth and the old-age dependency ratio. Panels (c) and (d) plot banks' share of credit to the private nonfinancial sector against the services share of value added and the value-added share of firms with at least 250 employees. Outcomes and the characteristics in panels (a)–(c) are country means over 2018–2022; the large-firm share is averaged over 2015–2019. Deposits are scaled by household financial assets only, as in panel (a) of Figure 1. Bubble area is proportional to nominal GDP. Dashed lines are GDP-weighted OLS fits with 95% confidence intervals, and each panel reports the fitted slope with significance stars; sample sizes are in Appendix A, which also describes the data.



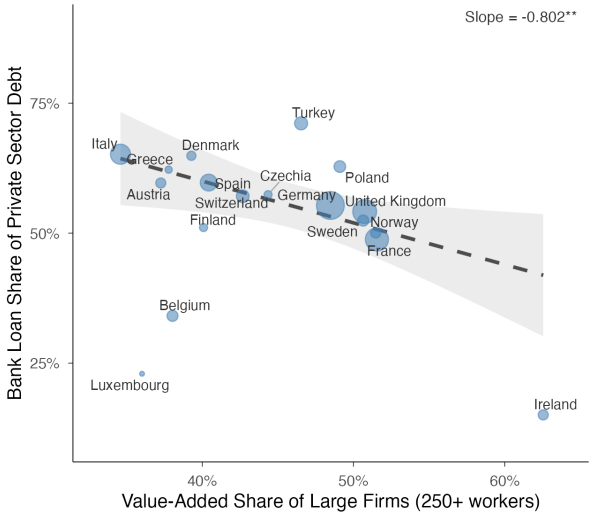

(a) Household financial wealth per capita




(b) Old-age dependency ratio



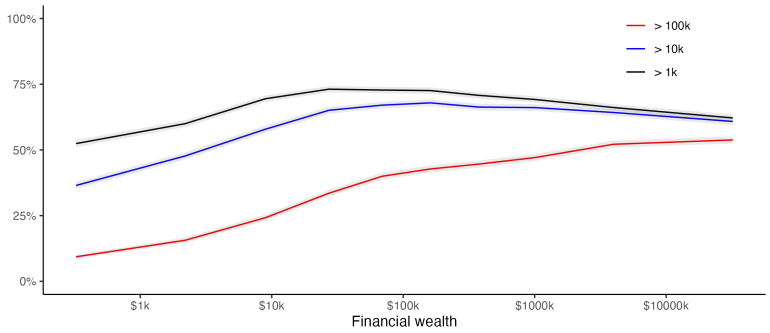

(c) Services share of value added



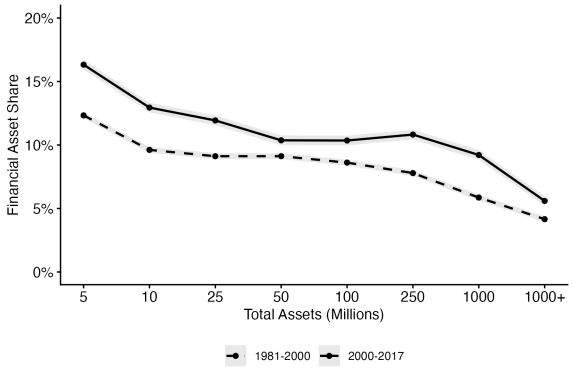

(d) Large-firm share of value added

**Figure 3:** Households and firms hold assets and debt simultaneously

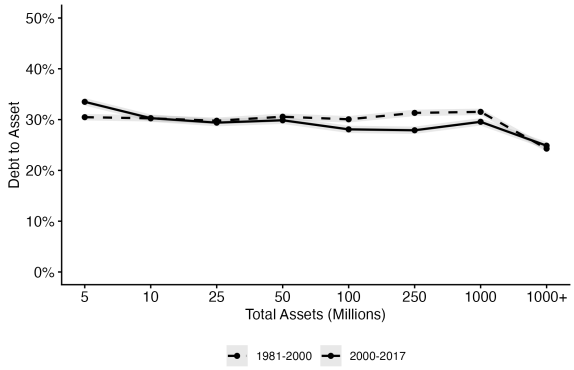
Panel (a): share of households with total borrowing above $1,000, $10,000, and $100,000, by decile of financial wealth (Survey of Consumer Finances, pooled waves). Borrowing is bank plus nonbank borrowing, excluding government, credit card, and pension debt. Financial wealth is financial assets plus private business equity. Shaded bands are ±2 standard errors and the horizontal axis is on a log scale. Panels (b) and (c): firm financial assets and firm debt—bank loans, nonbank loans, and debt securities—each as a share of total assets, with firms split by size (Census Quarterly Financial Report).




(a) Households with debt, by financial wealth



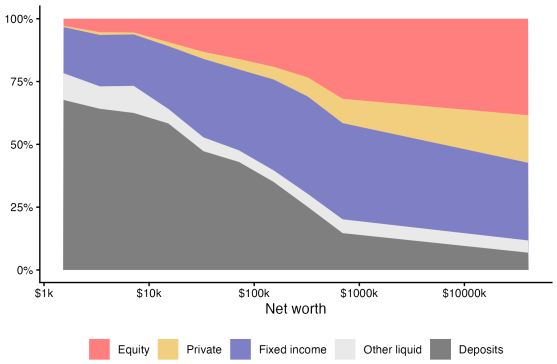

(b) Firm financial-asset share, by size



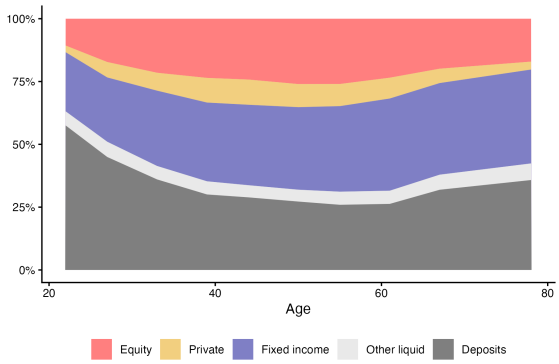

(c) Firm leverage, by size

**Figure 4:** Household portfolio and borrowing composition, by net worth and age

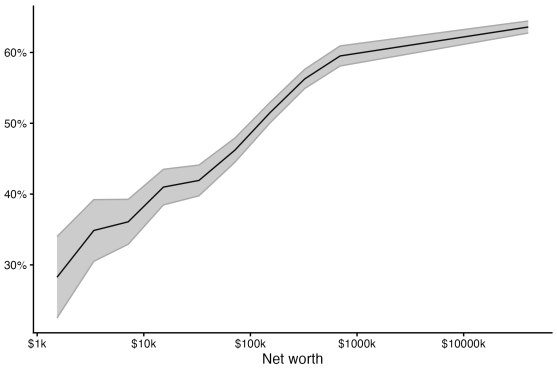
Panels (a) and (b) plot portfolio shares of augmented financial wealth, defined as financial assets plus private business interests. Panels (c) and (d) plot bank loans as a share of total household borrowing, among households with total borrowing above $1,000. Source: Survey of Consumer Finances.



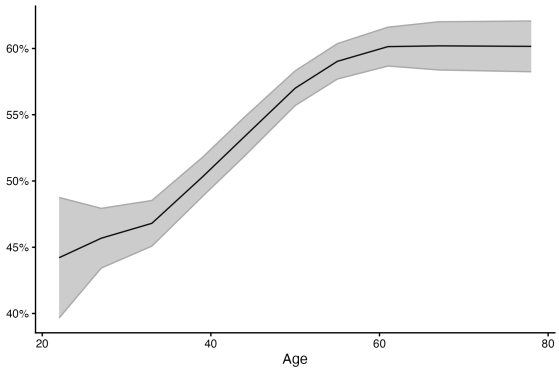

(a) Portfolio shares by net worth




(b) Portfolio shares by age



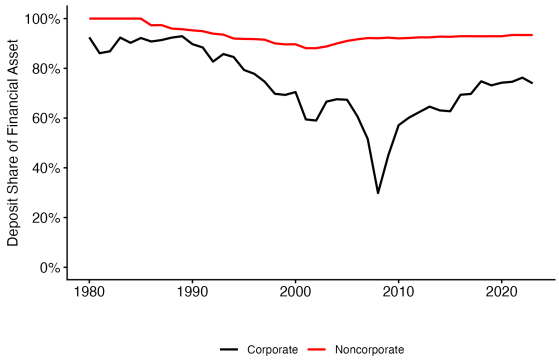

(c) Bank share of borrowing by net worth



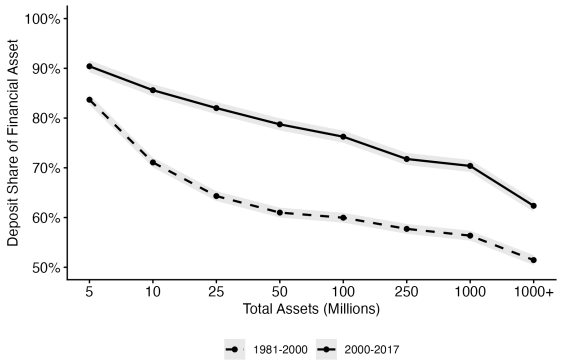

(d) Bank share of borrowing by age

**Figure 5:** Firm deposit and bank-loan shares

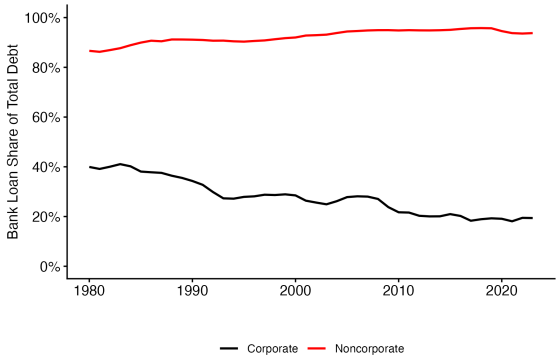
Panels (a) and (b) plot deposits as a share of financial assets. Panels (c) and (d) plot bank loans as a share of total debt. The left panels report aggregates over time; the right panels split firms by size. Source: Census Quarterly Financial Report.



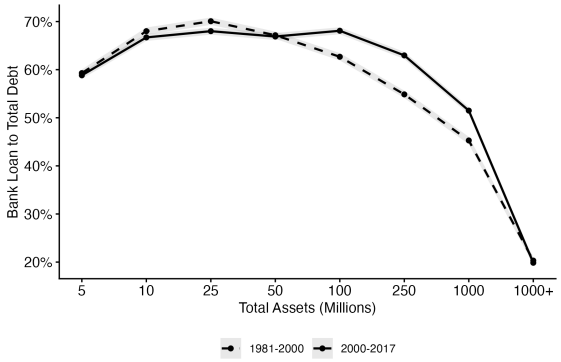

(a) Deposit share: time series




(b) Deposit share: by firm size




(c) Bank-loan share: time series




(d) Bank-loan share: by firm size

**Figure 6:** Sector balance sheets in the model

Assets appear on the left and liabilities on the right. Equal-sized blocks depict composition rather than magnitudes; colors identify claim types. The olive block denotes NBL securities held by banks. White central-bank blocks are outside the model.

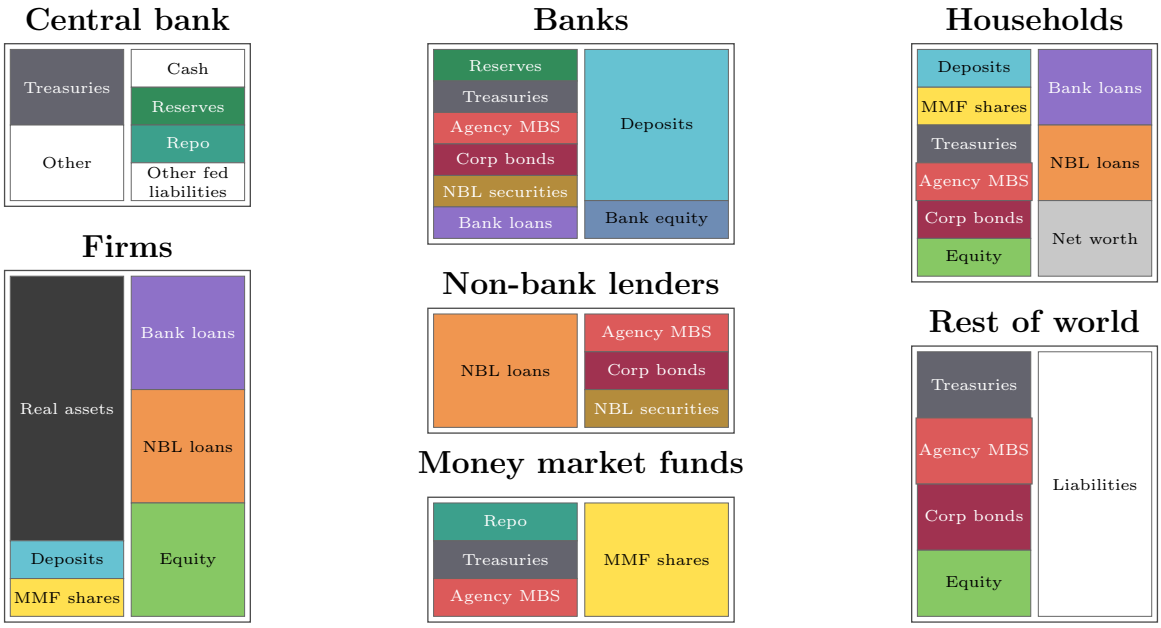
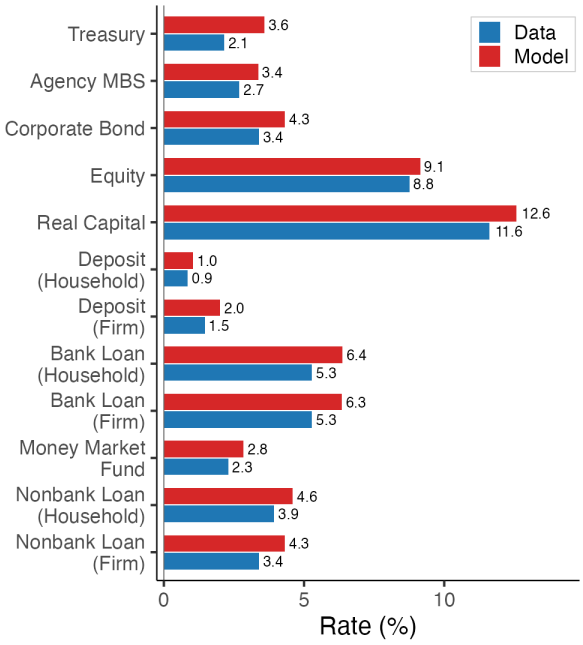
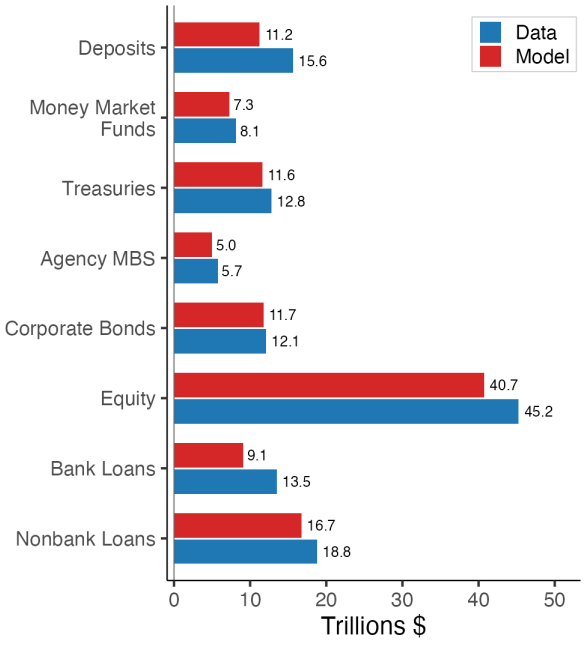


**Figure 7:** Equilibrium and observed prices and quantities, 2019

Each pair compares the solved equilibrium with the observed data. In panel (a), the Treasury, agency MBS, corporate bond, equity, and real capital returns are determined solely by market clearing and the Tobin's-$q$ condition; the deposit, bank loan, money market fund, and nonbank loan rates are those at which the corresponding pricing conditions were inverted for operating costs. In panel (b), each market is summed across every sector holding the claim. No quantity is targeted in estimation.



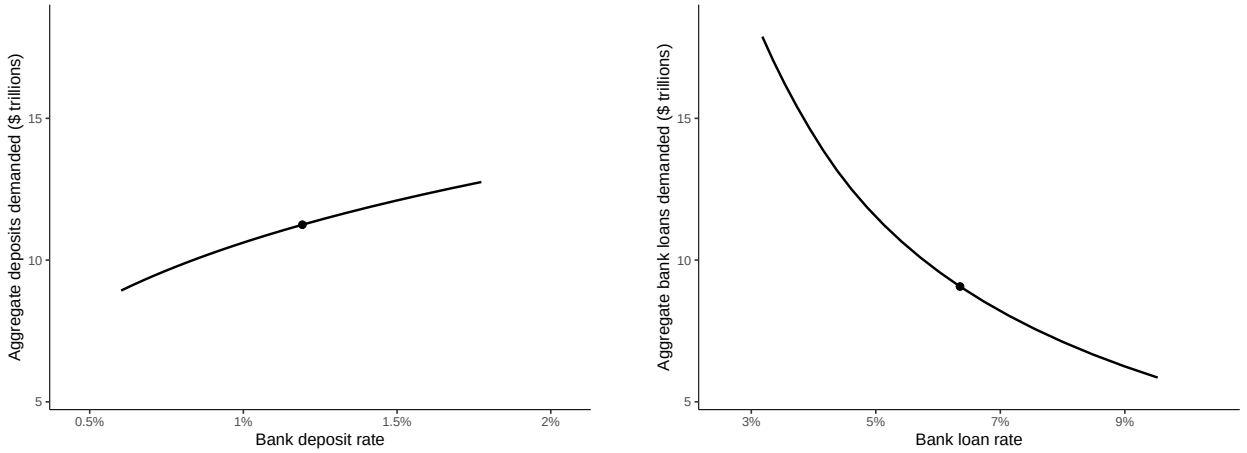

(a) Rates




(b) Market quantities

**Figure 8:** Aggregate demand for deposits and bank loans

Each point fixes household and firm own rates at a common multiple of their 2019 equilibrium values and clears every other market. The horizontal axis reports the quantity-weighted average own rate; the vertical axis aggregates household and firm demand. Dots mark the 2019 equilibrium, where own-rate elasticities are $+0.32$ for deposits and $-1.02$ for bank loans.




(a) Deposits

(b) Bank loans

**Figure 9:** Characteristic shifts: share and price responses

Each row is one change to the household or firm distribution. The hollow marker is the 2019 equilibrium and the filled marker the shifted equilibrium, so the distance between them is the change; every axis is a level in percent, and panels are on separate scales. The upper panels report banks' share of each market, measuring bank loans against private-sector financing, which includes firm equity. The lower panels report the corresponding equilibrium rates, averaged across households and firms using baseline quantities as weights.

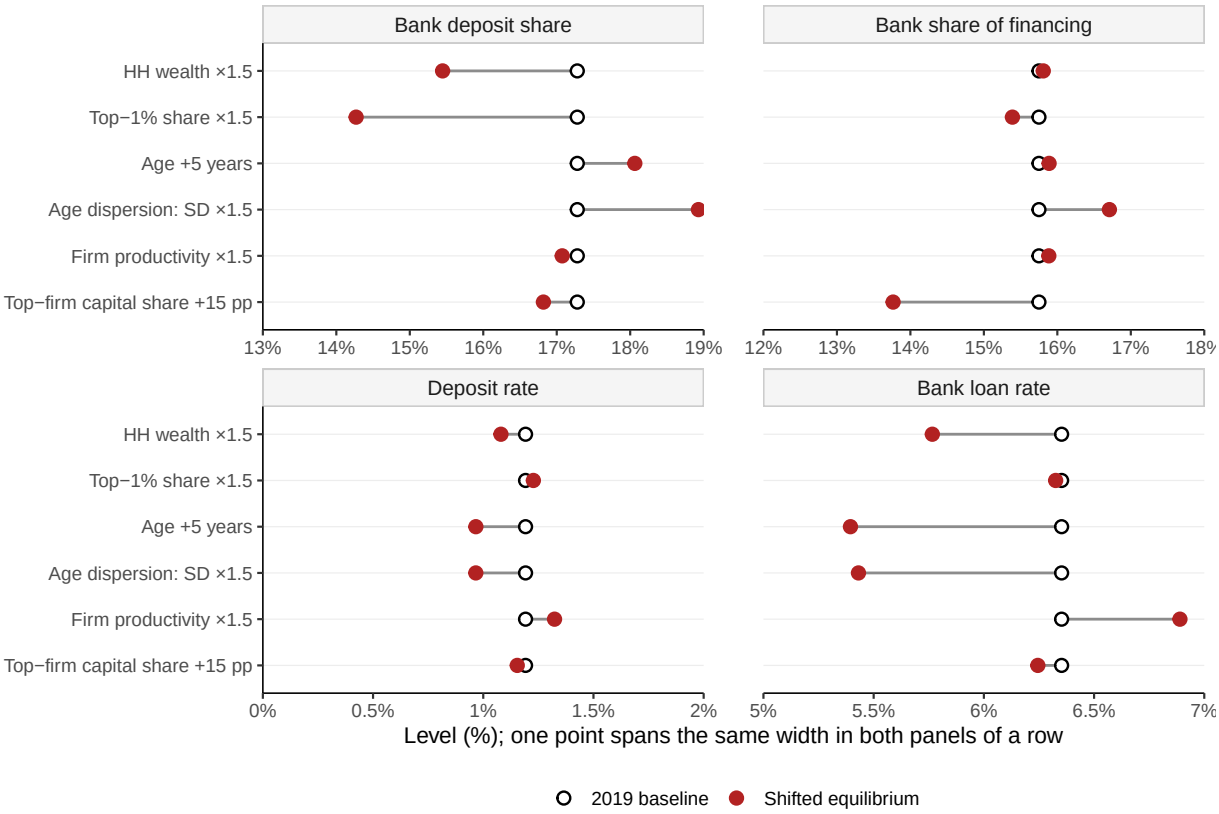
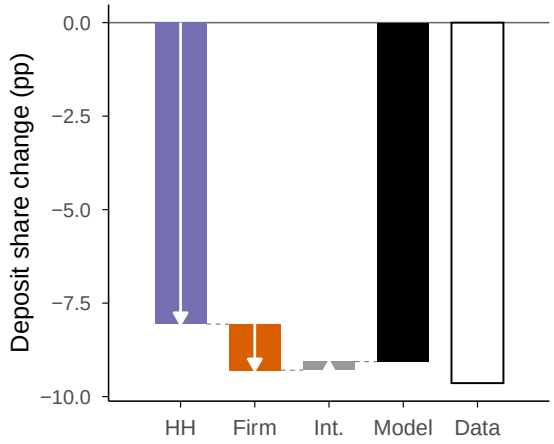
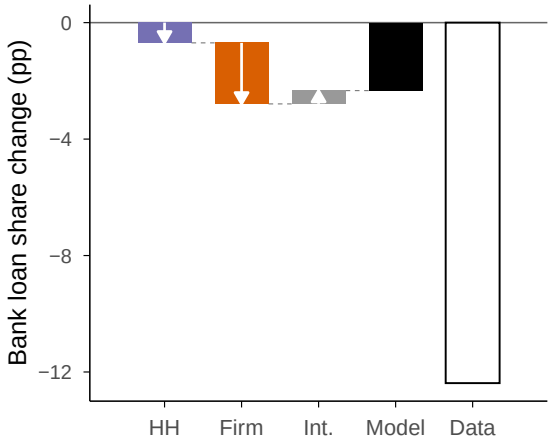


**Figure 10:** 1980-to-2019 real-sector channels

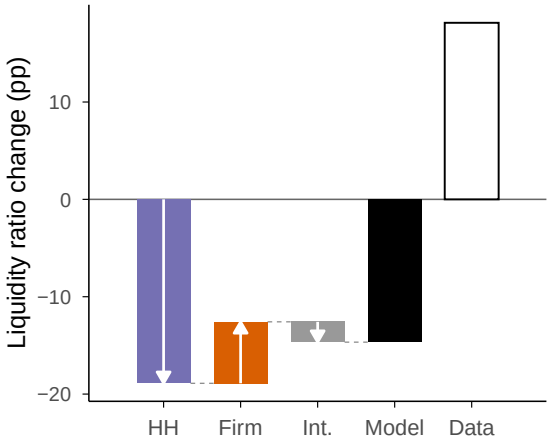
Household, firm, and interaction contributions to each outcome, computed as the 2019 value minus the 1980 value, so a negative bar is a decline over the period. The first three bars decompose the model's change into the household distribution, the firm distribution, and their interaction; the solid black bar is the model's total; the hollow bar is the observed change in the data, built from the same Flow-of-Funds aggregates the model is calibrated to. Bank loans are measured against total financing including firm equity, deposits against household and firm financial assets, and the liquidity ratio is bank securities over bank deposits. Net interest margin and return on equity are reported in the accompanying table rather than plotted.




(a) Deposit share



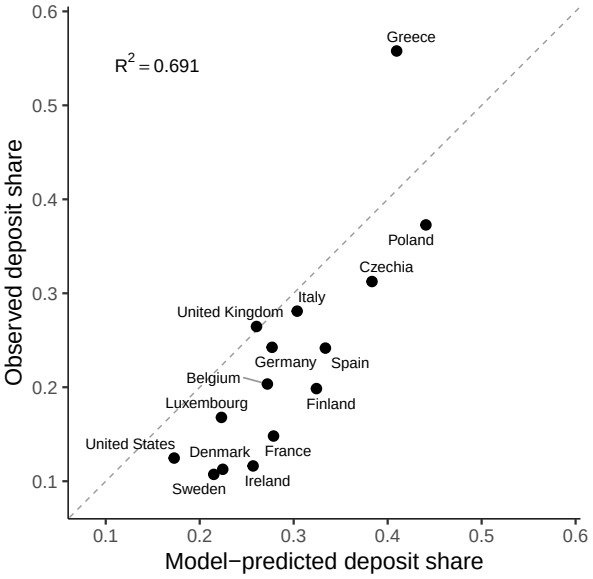

(b) Bank share of private-sector financing



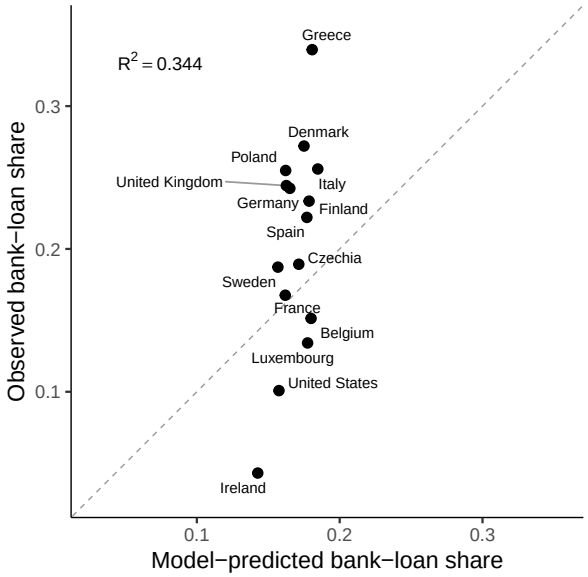

(c) Liquidity ratio

**Figure 11:** Cross-country real-sector counterfactuals

Observed and model-implied shares across 15 countries. The financing measure is bank loans as a share of total financing including firm equity; the funding measure is bank deposits as a share of pooled household and firm financial assets. The line is the OLS fit and each panel reports its $R^2$.




(a) Bank funding share.




(b) Bank share of private-sector financing, including equity.

**Figure 12:** The aggregate demand schedule for government debt, 1980 and 2019

The schedule pins the Treasury yield and lets every other market clear, the same conditional general-equilibrium construction used for the deposit and bank-loan curves. Treasury debt demanded is plotted as a share of GDP; GDP in the constructed 1980 economy is scaled by the same household-wealth ratio applied to Treasury supply, bank capital, and the Federal Reserve and foreign positions. Filled markers are the baseline equilibria. The dotted line is the debt level after the supply increase studied in this section, which raises debt by ten percentage points of GDP in both economies; hollow markers show where each schedule crosses it, with dashed lines dropping to the yields those crossings imply. The horizontal distance between an economy's two markers, labelled in basis points, is therefore the yield increase it requires in order to hold the additional debt.

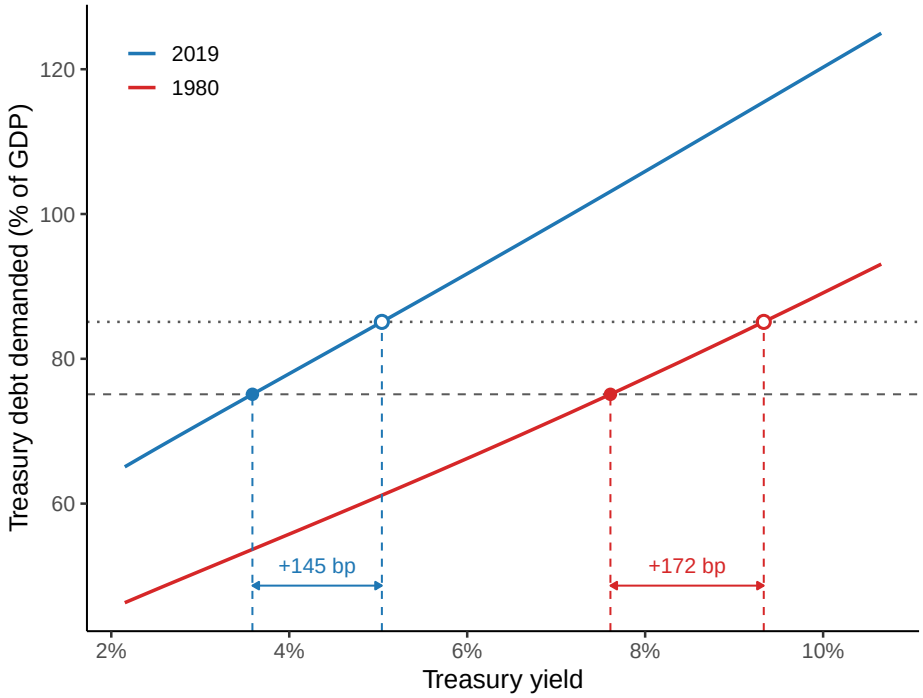


**Figure 13:** Government borrowing: absorption of the new Treasury supply

Each bar is the change in a sector's Treasury holdings as a share of the increase in marketable Treasury supply, so the four sectors sum to one hundred percent within each economy. The shock raises marketable Treasury supply by an amount equal to ten percent of GDP, holding Federal Reserve holdings fixed, and the same proportional shock is applied to the 2019 economy (blue) and to the constructed 1980 economy (red). Households and foreign investors absorb the debt directly, by holding Treasuries themselves; banks and money market funds absorb it indirectly, taking the securities onto their own balance sheets against the deposits and shares they issue.

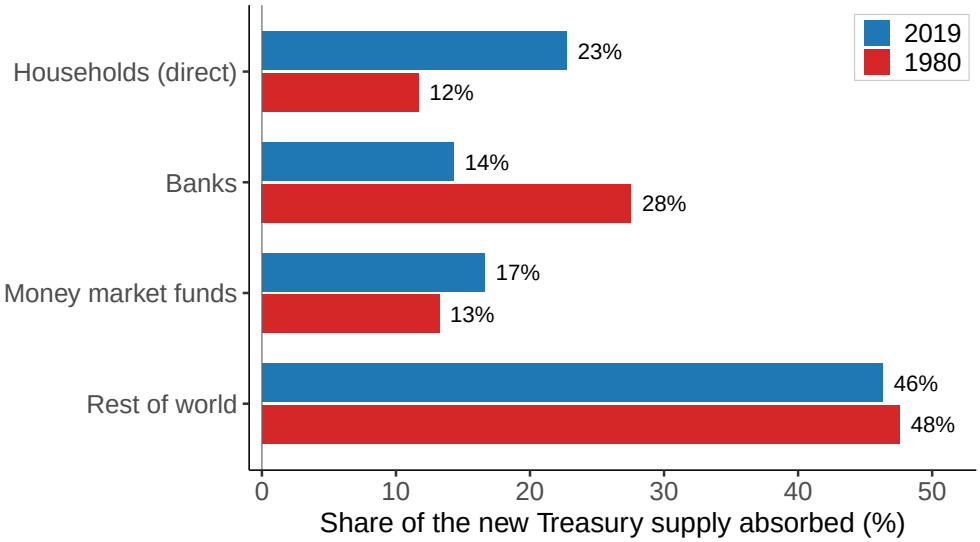
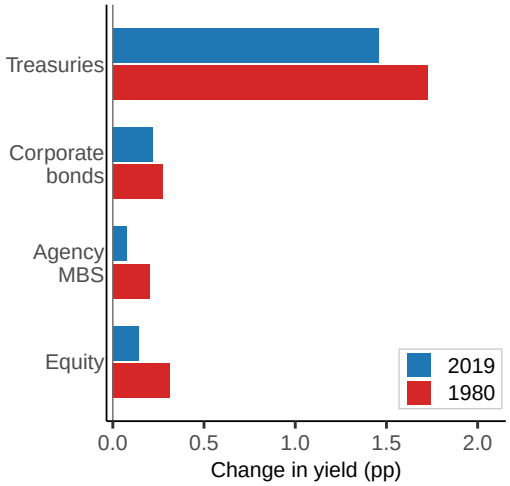
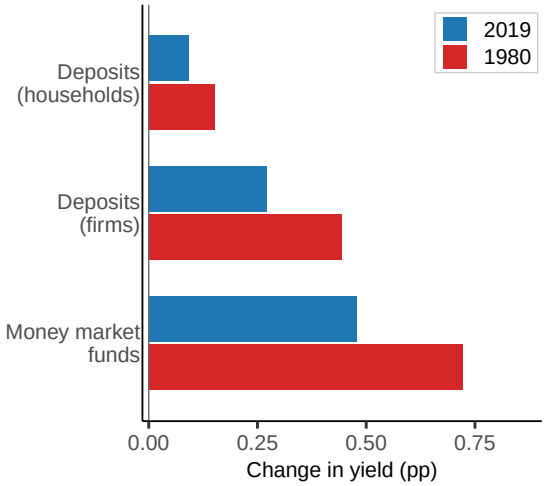


**Figure 14:** Government borrowing: price responses

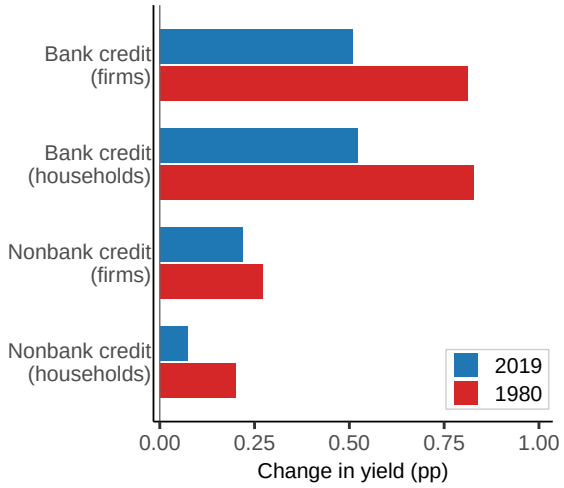
Each bar is the change in an equilibrium yield, in percentage points, under the same Treasury-supply shock used in Figure 13: marketable supply rises by ten percent of GDP with Federal Reserve holdings fixed. Blue bars are the 2019 economy and red bars the constructed 1980 economy. Panel (a) reports the yields on securities that savers and intermediaries hold directly, panel (b) the rates on the liabilities intermediaries issue to savers, and panel (c) the rates borrowers pay, separated by lender type and by household versus firm borrowers. Appendix Figure A9 reports the same changes in proportional terms.




(a) Market and asset yields




(b) Deposit and MMF yields




(c) Cost of credit

**Table 1:** Household parameter estimates

CES elasticities and characteristic-dependent demand and debt-capacity parameters. Net worth is centered log net worth; age is centered and measured in ten-year units, $\widetilde{a} = (\text{Age} - \overline{\text{Age}})/10$. Elasticities use the IV estimates. Bond and equity coefficients combine the common nondeposit loading with the corresponding interaction. Full regression output appears in Appendix Tables A4 and A5.

| Parameter | Description | Estimate |
|---|---|---|
| **Consumption–Savings Nest** | | |
| $\sigma^h$ | Consumption–savings elasticity | 0.908 |
| $\gamma_s^w$ | Loading on log net worth | 0.186 |
| $\gamma_s^a$ | Loading on age | −0.071 |
| $\gamma_s^{a2}$ | Loading on age squared | 0.037 |
| **Savings Nest (Relative to Deposits)** | | |
| $\sigma_S^h$ | Across-class elasticity | 1.492 |
| $\alpha_{\text{MMF}}^w$ | MMF on log net worth | 0.485 |
| $\alpha_{\text{bond}}^w$ | Bond on log net worth | 0.237 |
| $\alpha_{\text{equity}}^w$ | Equity on log net worth | 0.469 |
| $\alpha_{\text{MMF}}^a$ | MMF on age | −0.041 |
| $\alpha_{\text{bond}}^a$ | Bond on age | 0.024 |
| $\alpha_{\text{equity}}^a$ | Equity on age | −0.167 |
| $\alpha_{\text{MMF}}^{a2}$ | MMF on age squared | 0.047 |
| $\alpha_{\text{bond}}^{a2}$ | Bond on age squared | −0.048 |
| $\alpha_{\text{equity}}^{a2}$ | Equity on age squared | −0.069 |
| **Borrowing Nest (Bank Relative to Nonbank)** | | |
| $\sigma_B^h$ | Across-class elasticity | 1.547 |
| $\beta_b^w$ | Loading on log net worth | 0.125 |
| $\beta_b^a$ | Loading on age | 0.019 |
| $\beta_b^{a2}$ | Loading on age squared | 0.014 |
| **Borrowing Constraint** | | |
| $\delta^0$ | Debt-service intercept | 10.474 |
| $\delta^w$ | Loading on log net worth | 0.470 |
| $\delta^{w2}$ | Squared log net worth | −0.038 |
| $\delta^a$ | Loading on age | −0.396 |
| $\delta^{a2}$ | Loading on age squared | −0.116 |

**Table 2:** Firm parameter estimates

CES elasticities, size-dependent demand weights, equity-share parameters, and decreasing-returns curvature. Elasticities and $\eta_E$ use the IV estimates, while $\eta_K$ is calibrated. Industry rows report the unweighted mean and cross-industry standard deviation, in brackets, of residual-free normalized weights evaluated at centered log size $x = 0$. Individual industry values and full regression output appear in Appendix Figure A3 and Tables A6–A7.

| Parameter | Description | Estimate |
|---|---|---|
| **Financial-Asset Nest (MMF Relative to Deposits)** | | |
| $\sigma_F^f$ | Across-class financial-asset elasticity | 1.750 |
| $\gamma_{\text{MMF}}^{\text{size}}$ | MMF-weight loading on log size | 0.146 |
| $\gamma_{\text{MMF}}^{\text{size}^2}$ | MMF-weight loading on squared log size | 0.012 |
| $\gamma_{\text{MMF}}^{\text{industry}}$ | Industry-specific MMF weight: mean [SD] | 0.394 [0.084] |
| **Debt Nest (Bank Relative to Nonbank)** | | |
| $\sigma_D^f$ | Across-class debt elasticity | 1.806 |
| $\beta_b^{\text{size}}$ | Bank-loan-weight loading on log size | −0.226 |
| $\beta_b^{\text{size}^2}$ | Bank-loan-weight loading on squared log size | −0.103 |
| $\beta_b^{\text{industry}}$ | Industry-specific bank-loan weight: mean [SD] | 0.679 [0.095] |
| **Outer Asset Nest (Real Relative to Financial)** | | |
| $\sigma_A^f$ | Real–financial asset elasticity | 0.852 |
| $\alpha_{\text{real}}^{\text{size}}$ | Real-asset-weight loading on log size | 0.184 |
| $\alpha_{\text{real}}^{\text{size}^2}$ | Real-asset-weight loading on squared log size | 0.039 |
| $\alpha_{\text{real}}^{\text{industry}}$ | Industry-specific real-asset weight: mean [SD] | 0.929 [0.038] |
| **Equity-Share and Real-Capital Margins** | | |
| $\eta_E$ | Equity-share adjustment-cost curvature | 2.564 |
| $\bar{s}^{\text{size}}$ | Reference-equity-share loading on log size | −0.003 |
| $\bar{s}^{\text{size}^2}$ | Reference-equity-share loading on squared log size | −0.002 |
| $\bar{s}^{\text{industry}}$ | Industry-specific reference equity share: mean [SD] | 0.818 [0.035] |
| $\eta_K$ | Real-capital decreasing-returns curvature (calibrated) | 0.330 |
| $\zeta_t^i$ | Productivity intercept (calibrated per cell): mean [SD] | 2.230 [0.559] |

**Table 3:** Intermediary parameter estimates

CES elasticities, portfolio weights, and regulatory parameters for banks, MMFs, and NBLs. Bank within-class elasticities come from the first-differenced IV regressions and are held fixed in the GMM. Full estimation results appear in Appendix Tables A8–A10.

| Parameter | Description | Estimate |
|---|---|---|
| **Banks — Securities Portfolio** | | |
| $\eta_B$ | Securities CES elasticity | 22.774 |
| $a_{\text{res}}$ | Reserve weight | 0.480 |
| $a_{\text{tre}}$ | Treasury weight | 0.121 |
| $a_{\text{age}}$ | Agency weight | 0.280 |
| $a_{\text{cor}}$ | Corporate bond weight | 0.097 |
| $a_{\text{nbl}}$ | NBL securities weight | 0.023 |
| **Banks — Within-class elasticities** | | |
| $\sigma_{L,h}$ | HH loans | 2.489 |
| $\sigma_{L,f}$ | Firm loans | 2.571 |
| $\sigma_{D,h}$ | HH deposits | 1.407 |
| $\sigma_{D,f}$ | Firm deposits | 6.551 |
| **Banks — Regulation** | | |
| $\lambda$ | Liquidity ratio target | 0.398 |
| $\kappa$ | Capital ratio target | 0.173 |
| $\beta_L$ | Liquidity cost parameter | 0.022 |
| $\beta_K$ | Capital cost parameter | 0.078 |
| **Nonbanks** | | |
| $\eta_M$ | MMF CES elasticity | 14.637 |
| $\eta_{L,h}$ | HH nonbank lender elasticity | 15.164 |
| $\eta_{L,f}$ | Firm nonbank lender elasticity | 4.886 |

**Table 4:** Absorption of new government debt and transmission to private credit
Panel A reports, for each holder of government debt, the elasticity of its Treasury demand with respect to the Treasury yield, $\varepsilon_s = \partial \ln Q_s / \partial \ln r^{\text{tre}}$, evaluated at each economy's own equilibrium, and the share of the new issuance that holder absorbs. Federal Reserve holdings are fixed and are excluded, so the aggregate covers private holders. Panel B reports loan-rate changes and the credit response. Cost of funds is the change in a lender's marginal funding cost: the securities-portfolio return for banks, and the agency mortgage-backed security yield (household lending) or corporate bond yield (firm lending) for nonbank lenders. Bank market power is $(m-1)$ times the change in the bank cost of funds, where $m$ is the volume-weighted loan markup; the regulatory wedge is $m$ times the change in the combined liquidity and capital wedge. Weighted averages use baseline loan volumes. Securities added is the change in banks' total securities holdings. Entries are basis points except where noted.

Panel A. Absorption of the new debt issuance

| | 2019 | | 1980 | |
|---|---|---|---|---|
| | $\varepsilon_s$ | Absorbed (%) | $\varepsilon_s$ | Absorbed (%) |
| Households | 0.40 | 23 | 0.35 | 12 |
| Banks | 0.95 | 14 | 1.42 | 28 |
| Money market funds | 0.39 | 17 | 0.65 | 13 |
| Foreign investors | 0.33 | 46 | 0.66 | 48 |
| Private aggregate | 0.39 | 100 | 0.66 | 100 |

Panel B. Transmission to private credit

| | 2019 | | 1980 | |
|---|---|---|---|---|
| | Bank | Nonbank | Bank | Nonbank |
| Loan-rate change (bps) | | | | |
| Households | +52.1 | +7.3 | +82.9 | +19.9 |
| Firms | +51.0 | +21.8 | +81.2 | +27.1 |
| Weighted average | +51.4 | +14.8 | +81.9 | +22.7 |
| Decomposition of the weighted average (bps) | | | | |
| Cost of funds | +32.8 | +14.8 | +53.2 | +22.7 |
| Bank market power | +21.3 | 0.0 | +34.6 | 0.0 |
| Regulatory wedge | −2.7 | 0.0 | −6.0 | 0.0 |
| Balance-sheet reallocation | | | | |
| Securities added ($B) | +611 | – | +200 | – |
| Loans displaced per $1 of securities | 1.22 | – | 1.26 | – |
| Total credit change (%) | −8.3 | −2.1 | −8.5 | −2.4 |

**Table 5:** Government borrowing: real effects by segment

First-order channel contributions to firm investment and household consumption in the 2019 and constructed 1980 economies. Large corporates combine the large manufacturing groups and nonmanufacturing corporate industries; wealthy households are the top 1% by net worth. Entries are percent log changes, and weights are baseline outcome shares. Derivations and definitions appear in Appendix G.

*Panel A: Firm investment ($d\log K$, %)*

| | 2019 | | | | 1980 | | | |
|---|---|---|---|---|---|---|---|---|
| | Cost of capital | Fin. income | Total | Weight (%) | Cost of capital | Fin. income | Total | Weight (%) |
| Large Corporate | −7.45 | +3.63 | −3.82 | 63.1 | −8.14 | +3.16 | −4.98 | 21.3 |
| Rest | −9.59 | +3.59 | −6.00 | 36.9 | −9.49 | +4.05 | −5.44 | 78.7 |
| Aggregate GE | −8.24 | +3.62 | −4.68 | 100.0 | −9.20 | +3.86 | −5.36 | 100.0 |

*Panel B: Household consumption ($d\log C$, %)*

| | 2019 | | | | 1980 | | | |
|---|---|---|---|---|---|---|---|---|
| | Borrowing capacity | Saving return | Total | Weight (%) | Borrowing capacity | Saving return | Total | Weight (%) |
| Wealthy, old | −0.01 | +0.50 | +0.49 | 9.6 | −0.02 | +0.45 | +0.43 | 7.4 |
| Wealthy, young | −0.05 | +0.34 | +0.29 | 14.3 | −0.07 | +0.32 | +0.25 | 11.8 |
| Non-wealthy, old | −0.16 | +0.58 | +0.42 | 28.0 | −0.17 | +0.50 | +0.32 | 22.3 |
| Non-wealthy, young | −0.64 | +0.44 | −0.19 | 48.1 | −0.74 | +0.40 | −0.34 | 58.5 |
| Aggregate GE | −0.36 | +0.47 | +0.13 | 100.0 | −0.48 | +0.42 | −0.05 | 100.0 |

# Internet Appendix

# A Cross-Country Macro Evidence: Supplemental Material

This appendix documents the cross-country evidence presented in the introduction. It describes the source and construction of each variable, the harmonization of annual observations across providers, and the samples and methods used in Figure 1, panel (a), Figure 2, Appendix Figure A1, and Appendix Table A2.

## A.1 Sample Construction and Harmonization

The starting universe contains 55 economies and covers 1995–2022. It includes advanced and emerging economies in the Americas, Europe, Asia, the Middle East, Africa, and Australasia. All source observations are harmonized to three-letter ISO country codes and calendar years. We do not interpolate missing observations. Consequently, each figure and regression uses the natural intersection of countries or country-years with finite values for its outcome, covariates, and GDP weight.

The cross-sectional figures use country means over 2018–2022. For a variable $x_{ct}$, the plotted value is

$$\bar{x}_c = \frac{1}{T_c^x} \sum_{t \in \{2018,\ldots,2022\}: x_{ct} \text{ observed}} x_{ct}, \tag{25}$$

where $T_c^x$ is the number of available annual observations for country $c$. Thus, an available country-year contributes to the mean and a missing country-year does not. Nominal GDP is averaged in the same way for bubble size and regression weight. The only exception is the large-firm value-added share. Because value added by firm-size class is reported less frequently and changes slowly, we first calculate the annual share for each available year from 2015 through 2019 and then average those annual shares within country. This pre-period country measure is used in Figure 2, panel (d), and as a time-invariant firm-concentration proxy in columns (3) and (6) of Table A2.

The annual timing follows the underlying source. The BIS credit measures are fourth-quarter end-of-period stocks; they are not averages of the four quarterly observations. Eurostat and OECD financial-account measures are annual balance-sheet stocks. Demographic, national-accounts, wealth-distribution, governance, and firm-composition measures are annual observations. Ratios are formed within a source and country-year before any cross-year averaging, which avoids mixing levels measured in different currencies.

## A.2 Data Sources

Table A1 summarizes the source series and statistical concepts. The definitions and economic construction of each measure follow in the order used in the main text.

**Table A1: Sources for the cross-country macro evidence.** Series and concepts used in Figure 1, panel (a), Figure 2, Appendix Figure A1, and Appendix Table A2.

| Measure | Provider and dataset | Series or statistical concept |
|---|---|---|
| Bank-loan share | Bank for International Settlements, Total Credit Statistics | Private nonfinancial borrowers; bank and all-lender series (WS_TC) |
| Deposit share | Eurostat annual financial accounts; OECD annual financial balance sheets | Currency and deposits (F2) and total financial assets (F); sectors S14–S15/S1M |
| Household wealth per capita | OECD annual financial balance sheets; World Bank, World Development Indicators | Household financial assets (F); total population (SP.POP.TOTL) |
| Top-1% wealth share | World Inequality Database | Share of net personal wealth, percentile p99p100 |
| Old-age dependency ratio | United Nations, World Population Prospects 2024 | Single-year-of-age population, medium variant |
| Services value-added share | World Bank, World Development Indicators | Services value added as a share of GDP (NV.SRV.TOTL.ZS) |
| Intangible-investment intensity | Global INTAN-Invest, sponsored by WIPO | Corrado–Hulten–Sichel intangible investment and adjusted GVA |
| Large-firm value-added share | OECD, Structural Business Statistics by size class, ISIC Rev. 4 | Value added at factor cost; nonfinancial business economy; 250+ employees |
| Legal origin | La Porta et al. legal-origin classification | English, French, German, Scandinavian, and Socialist origins |
| Governance | World Bank, Worldwide Governance Indicators, 2023 update | Rule of law, regulatory quality, and government effectiveness |
| GDP | World Bank, World Development Indicators | Nominal GDP in current U.S. dollars (NY.GDP.MKTP.CD) |

## A.3 Outcome Variables

**Bank-loan share of private nonfinancial-sector credit.** The borrower-side outcome comes from the BIS Total Credit Statistics. Let $C_{ct}^{B}$ denote bank loans to the private nonfinancial sector and $C_{ct}^{A}$ total credit to that sector from all lenders. The reported share is

$$B_{ct} = \frac{C_{ct}^{B}}{C_{ct}^{A}}. \tag{26}$$

The private nonfinancial sector is the BIS "P" borrower category and combines households and nonfinancial corporations. The bank-lender breakdown is available only for this combined borrower category, so $B_{ct}$ cannot be constructed separately for firms and households. We use fourth-quarter stocks at market value, expressed as percentages of GDP and adjusted by the BIS for series breaks. Because numerator and denominator have the same GDP normalization, that normalization cancels in equation (26). Values outside the unit interval, which can arise when the bank and all-lender series have inconsistent cross-border coverage, are treated as missing.

**Deposit share of household financial assets.** Let $F2_{ct}^{HH}$ denote household holdings of currency and deposits and $F_{ct}^{HH}$ total household financial assets, both on the asset side of the financial balance sheet. The deposit share is

$$D_{ct} = \frac{F2_{ct}^{HH}}{F_{ct}^{HH}}. \tag{27}$$

For European countries, the preferred source is Eurostat's annual non-consolidated financial accounts for households and nonprofit institutions serving households (sectors S14–S15, asset position, instruments F2 and F). Because the numerator and denominator are both reported in millions of euros, the currency unit cancels. Where a finite Eurostat ratio is unavailable, we use the corresponding OECD annual financial-balance-sheet ratio. In the OECD data, we prefer the combined household and nonprofit-institution sector (S1M) and use households alone (S14) when the combined sector is unavailable. The OECD series are reported in U.S. dollars, but their currency unit likewise cancels in the ratio. The source priority is applied separately by country-year.

### A.4 Household Characteristics

**Household financial wealth per capita.** Household wealth is total household financial assets from the OECD annual financial balance sheets, using the same S1M-then-S14 sector priority described above. Dividing the current-U.S.-dollar stock by World Development Indicators population gives financial wealth per capita. The analysis uses its natural logarithm,

$$W_{ct} = \log\left(\frac{\text{household financial assets}_{ct}}{\text{population}_{ct}}\right), \tag{28}$$

and requires both the financial-asset stock and population to be positive. This is a measure of financial, rather than total, household wealth: housing, consumer durables, and other nonfinancial assets are not included.

**Wealth concentration.** The top-1% wealth share is the World Inequality Database share of net personal wealth held by the p99p100 group. It is expressed as a fraction between zero and one. The database sometimes reports more than one admissible series variant for a country-year; when more than one is present, their mean is used, while in most country-years only one is available.

**Population aging.** The old-age dependency ratio is constructed from the United Nations World Population Prospects 2024 single-year-of-age population counts:

$$A_{ct} = \frac{\sum_{a \geq 65} \mathrm{Pop}_{cta}}{\sum_{15 \leq a \leq 64} \mathrm{Pop}_{cta}}. \tag{29}$$

It is therefore the number of people aged 65 or older per working-age person aged 15–64 and is reported as a fraction (for example, 0.30 corresponds to 30 older people per 100 working-age people).

### A.5 Firm-Sector Characteristics

**Services value-added share.** The services share is the World Development Indicators measure of services value added as a percentage of GDP. We use the provider's published aggregate, which covers wholesale and retail trade, transport, accommodation and food services, information and communications, finance, real estate, professional services, public administration, and other services under the applicable ISIC classification. The variable is reported on a 0–100 percentage-point scale.

**Intangible-investment intensity.** Global INTAN-Invest applies the Corrado–Hulten–Sichel framework and includes software and databases, research and development, design and other innovative property, branding, firm-specific training, and organizational capital. Let $I_{ct}^{\mathrm{intan}}$ be total intangible investment and $VA_{ct}^{\mathrm{adj}}$ intangible-adjusted gross value added. We measure intensity as

$$I_{ct} = 100 \times \frac{I_{ct}^{\mathrm{intan}}}{VA_{ct}^{\mathrm{adj}}}. \tag{30}$$

Adjusted gross value added adds back intangible expenditures that are treated as current expenses in conventional national accounts, making the denominator consistent with the capitalized numerator. When the adjusted measure is unavailable or non-positive, current-price gross value added is used. The resulting variable is on a 0–100 percentage-point scale, despite being a ratio.

**Large-firm value-added share.** Firm concentration is measured using the OECD Structural Business Statistics by enterprise size class. For each country-year, the numerator is value added at factor cost in enterprises with at least 250 employees and the denominator is value added at factor cost across all enterprise sizes, both for the nonfinancial business economy aggregate:

$$L_{ct} = \frac{\text{value added of enterprises with 250+ employees}_{ct}}{\text{value added of enterprises of all sizes}_{ct}}. \tag{31}$$

The country-level measure $L_c$ is the mean of the available annual ratios over 2015–2019. It is a value-added concentration measure, not a capital-stock share: the OECD size-class data do not provide a comparable capital-stock measure. The United States and Japan do not report the required value-added breakdown by size class and are therefore absent from analyses using $L_c$.

### A.6 Institutional Controls and GDP Weights

Legal origin is represented by four indicators for French, German, Scandinavian, and Socialist legal origin; English legal origin is the omitted category. These indicators are time invariant. The governance controls are the point estimates of the Worldwide Governance Indicators for rule of law, regulatory quality, and government effectiveness. Each is measured on the World Bank's approximately $-2.5$ to 2.5 scale and varies by country and year. Nominal GDP in current U.S. dollars supplies both the bubble areas and the weights in the fitted relationships. Using GDP weights gives larger economies more influence; multiplying all weights by a common constant would leave the estimates unchanged.

### A.7 Empirical Methods and Exhibit-Specific Samples

**Cross-sectional figures.** Each point in Figure 1, panel (a), Figure 2, and Appendix Figure A1 is a country mean constructed according to equation (25). Bubble area is proportional

to the country's mean nominal GDP. In Figure 2 and Appendix Figure A1, the dashed line is the GDP-weighted bivariate least-squares fit

$$\bar{y}_c = a + b\bar{x}_c + u_c, \qquad \min_{a,b} \sum_c G\bar{D}P_c u_c^2, \tag{32}$$

and the shaded region is the conventional pointwise 95% confidence interval for the fitted conditional mean. Figure 2 contains 40 countries in each household panel, 43 countries in the services panel, and 18 countries in the large-firm panel. Appendix Figure A1 contains 20 countries. The different counts reflect source coverage, not discretionary deletion of countries.

**Panel regressions.** Table A2 uses the annual country-year observations from 1995–2022. For outcome $y_{ct} \in \{D_{ct}, B_{ct}\}$, the most complete specification is

$$y_{ct} = \alpha_t + H_{ct}'\beta_H + F_{ct}'\beta_F + Z_c'\delta + G_{ct}'\theta + \rho L_c + \varepsilon_{ct}, \tag{33}$$

where $\alpha_t$ are year fixed effects; $H_{ct}$ contains log household financial wealth per capita, the top-1% wealth share, and the old-age dependency ratio; $F_{ct}$ contains the services value-added share and intangible-investment intensity; $Z_c$ contains the legal-origin indicators; $G_{ct}$ contains the three governance measures; and $L_c$ is the 2015–2019 large-firm value-added share.

Columns (1) and (4) include $H_{ct}$, $F_{ct}$, and year fixed effects. Columns (2) and (5) add $Z_c$ and $G_{ct}$. Columns (3) and (6) additionally add $L_c$. The regressions do not include country fixed effects: legal origin and $L_c$ are time invariant, and the exercise is intended to describe both cross-country and time-series covariance rather than isolate within-country changes. Every specification is estimated by weighted least squares using contemporaneous nominal GDP as the weight. Standard errors are clustered by country, allowing arbitrary serial correlation and heteroskedasticity within a country. Complete-case selection is applied separately to each specification, so the concentration columns have fewer observations. The table reports the resulting observation count and overall $R^2$.

Coefficient units follow the underlying data. The deposit share, bank-loan share, top-1% wealth share, old-age dependency ratio, and large-firm value-added share are fractions on a 0–1 scale. Services value added and intangible-investment intensity are measured in percentage points on a 0–100 scale. Household wealth per capita is in natural logs. All results are descriptive associations; neither the weighting scheme nor the included controls

gives the coefficients a causal interpretation.

### A.8 Additional Firm Characteristic and Panel Regressions

This subsection presents an additional firm-composition comparison, followed by the panel regressions supporting Figure 2. The sample, variable construction, weighting, and estimating equation are described above.

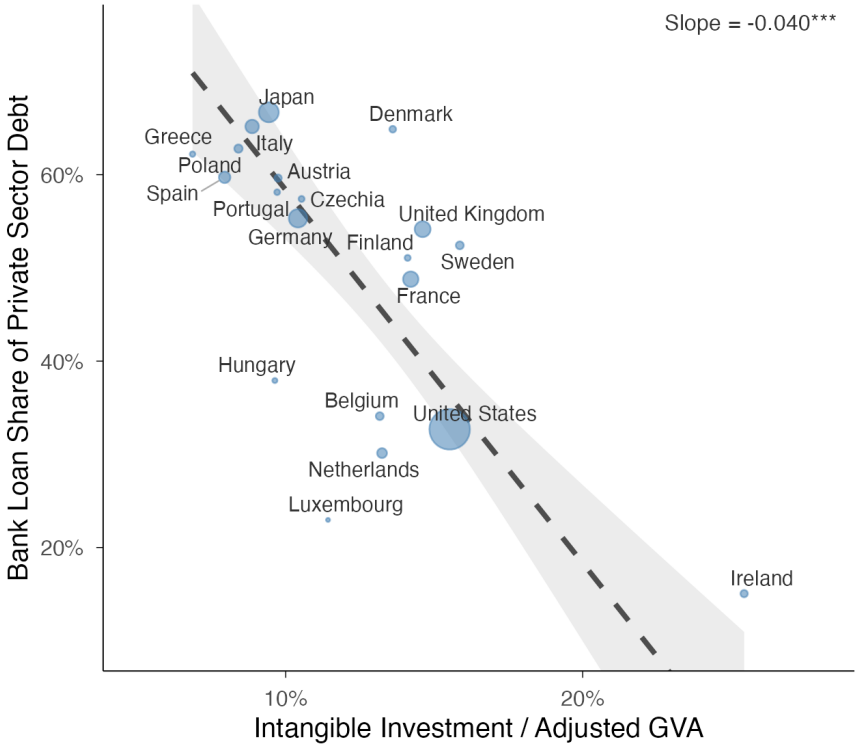



**Figure A1: Bank-loan share and intangible-investment intensity.** The bank-loan share and intangible-investment intensity use country means over 2018–2022. Bubble area is proportional to nominal GDP; the dashed line is a GDP-weighted OLS fit and the shaded region is its 95% confidence interval. The panel reports the fitted slope with significance stars. Appendix A describes the data, measurement, and sample.

Table A2 uses annual observations from 1995–2022, GDP weights, year fixed effects, and standard errors clustered by country. Columns (1)–(2) use the household deposit share as the outcome and columns (3)–(4) use the bank-loan share. Every column includes La Porta et al. legal-origin indicators and the World Governance Indicators for rule of law, regulatory quality, and government effectiveness. Columns (2) and (4) additionally include the 2015–2019 country average of the large-firm value-added share. Because that measure is available for fewer countries, these two columns use smaller samples.

**Table A2: Real-sector characteristics and bank reliance, with institutional controls.** GDP-weighted country-year regressions with year fixed effects. Standard errors in parentheses are clustered by country. All columns include legal-origin and governance controls; columns (2) and (4) add the large-firm value-added share. Appendix A provides the data definitions, sample construction, and estimating specification. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

| | Deposit share | | Bank loan share | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| log HH wealth / capita | −0.170*** | −0.180*** | −0.125** | −0.094 |
| | (0.027) | (0.038) | (0.044) | (0.056) |
| Top-1% wealth share | −0.587*** | −0.502 | −0.551 | +0.949 |
| | (0.195) | (0.293) | (0.390) | (0.660) |
| Old-age dep. ratio | +0.530** | −0.643* | +0.872** | +1.045* |
| | (0.190) | (0.343) | (0.343) | (0.562) |
| Services VA share | +0.007 | +0.002 | +0.008 | +0.014*** |
| | (0.006) | (0.004) | (0.005) | (0.004) |
| Intangible inv./GVA | −0.000 | +0.000 | −0.013** | −0.007 |
| | (0.003) | (0.002) | (0.005) | (0.005) |
| Large-firm VA share | — | −0.074 | — | −0.571* |
| | | (0.151) | | (0.318) |
| Legal origin (LLSV) | Yes | Yes | Yes | Yes |
| WGI (RL, RQ, GE) | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Observations | 333 | 272 | 255 | 194 |
| $R^2$ | 0.942 | 0.864 | 0.919 | 0.821 |

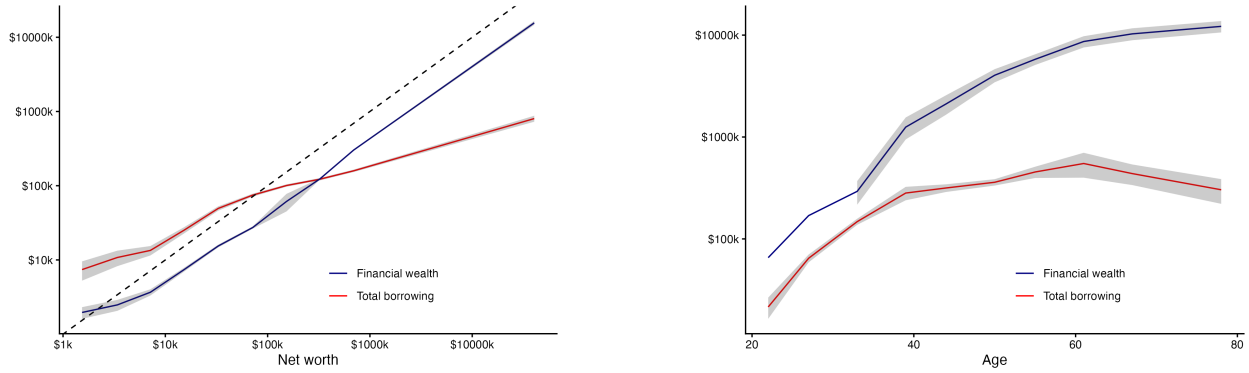
The $R^2$ values in columns (2) and (4) should not be compared mechanically with those in columns (1) and (3) because adding firm concentration changes the estimation sample. The legal-origin and firm-concentration variables are time invariant, so the specifications include year fixed effects but not country fixed effects. The estimates therefore summarize both cross-country and within-country covariance and are interpreted as descriptive rather than causal.

## B Stylized Facts: Supplemental Material

This section supports the household facts in Section 1 with two exhibits: the balance-sheet levels behind the main-text composition patterns, and multivariate regressions showing that the net-worth and age gradients survive household-level controls.

Figure A2 reports the household balance-sheet levels omitted from main-text Figure 4. Households hold financial assets and debt across the net-worth and age distributions, while

the scale of both sides varies systematically across types.




(a) Balance-sheet levels by net worth

(b) Balance-sheet levels by age

**Figure A2: Household borrowing and financial wealth vary with net worth and age.** Panels (a) and (b) compare total borrowing with augmented financial wealth across net-worth and age groups, respectively. Augmented financial wealth is financial assets plus private business interests. Shaded bands are ±2 standard errors. Source: Survey of Consumer Finances.

Table A3 examines the composition relationships in Figure 4 in a multivariate setting. The deposit share is measured relative to augmented financial wealth, as in the main-text figure and the estimation below. After controlling for financial risk-taking, financial sophistication, saving motives, and year fixed effects, a one-log-point increase in net worth is associated with a 7.5-percentage-point lower deposit share. Conditional on borrower characteristics and year fixed effects, the same increase in net worth is associated with a 4.5-percentage-point higher bank share of borrowing. Age is especially important on the borrowing side: elderly borrowers are substantially more likely to obtain credit from banks.

**Table A3: Household Deposit Shares and Borrowing Regressions.** Columns (1)–(2) report regressions of the deposit share of augmented household financial wealth (financial assets plus private business equity, as in Figure 4); columns (3)–(4) report regressions of the bank share of household borrowing. $^{*}$p<0.1, $^{**}$p<0.05; $^{***}$p<0.01. Source: Survey of Consumer Finances.

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Deposit share | | Bank loan share | |
| | (1) | (2) | (3) | (4) |
| log(Net worth) | −0.098*** | −0.075*** | 0.044*** | 0.045*** |
| | (0.001) | (0.002) | (0.002) | (0.003) |
| Middle-aged | −0.004 | −0.038*** | 0.014** | 0.004 |
| | (0.004) | (0.009) | (0.007) | (0.013) |
| Elderly | 0.092*** | 0.023** | 0.076*** | 0.090*** |
| | (0.005) | (0.010) | (0.009) | (0.017) |
| Takes financial risk | | −0.085*** | | −0.025** |
| | | (0.006) | | (0.010) |
| Financially sophisticated | | −0.042*** | | −0.005 |
| | | (0.006) | | (0.010) |
| Saving for consumption | | 0.016* | | |
| | | (0.009) | | |
| Saving for other | | 0.042*** | | |
| | | (0.009) | | |
| Borrowing for housing | | | | −0.012 |
| | | | | (0.011) |
| Year FE | Yes | Yes | Yes | Yes |
| Observations | 46,045 | 13,289 | 30,438 | 8,565 |
| $R^2$ | 0.227 | 0.216 | 0.042 | 0.040 |
| *Note:* | | | | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |

# C Model: Supplemental Material

This section supports the model in Section 2. It derives the household, firm, and intermediary solutions used in the text, details the consolidated government closure, and states the explicit market-clearing system that defines equilibrium.

## C.1 Households

**Solution to household $i$'s problem.** The household chooses consumption, saving classes, and borrowing classes subject to the budget and debt-service constraints in (1). The problem nests allocations across saving and borrowing classes and, within deposits and bank loans, across individual banks. Conditional on effective saving $\mathcal{S}^i$ and borrowing $\mathcal{B}^i$, the class-level demands are:

$$q^i_{s,j} r^h_j = \mathcal{S}^i (\alpha^i_j)^{\sigma^h_S} \left( \frac{r^h_j}{R^i_s} \right)^{\sigma^h_S}, \qquad R^i_s = \left( \sum_{j \in J^h_S} (\alpha^i_j)^{\sigma^h_S} (r^h_j)^{\sigma^h_S - 1} \right)^{\frac{1}{\sigma^h_S - 1}}, \qquad \mathcal{S}^i = S^i R^i_s \tag{34}$$

$$q^i_{b,j} = \mathcal{B}^i (\beta^i_j)^{\sigma^h_B} \left( \frac{r^h_j}{R^i_b} \right)^{-\sigma^h_B}, \qquad R^i_b = \left( \sum_{j \in J^h_B} (\beta^i_j)^{\sigma^h_B} (r^h_j)^{1 - \sigma^h_B} \right)^{\frac{1}{1 - \sigma^h_B}}, \qquad \mathcal{B}^i = D^i / R^i_b. \tag{35}$$

For the deposit and bank-loan classes, the class-level returns $r^h_{\text{dep}}$ and $r^h_b$ entering (34)–(35) are themselves CES aggregates of individual bank rates, and class-level quantities allocate across banks according to within-class CES demand:

$$r^h_{\text{dep}} = \left( \frac{1}{N_h} \sum_{k \in \mathcal{N}_h} (r^h_{\text{dep},k})^{\sigma_{D,h} - 1} \right)^{\frac{1}{\sigma_{D,h} - 1}}, \qquad q^i_{s,\text{dep},k} r^h_{\text{dep},k} = \frac{q^i_{s,\text{dep}} r^h_{\text{dep}}}{N_h} \left( \frac{r^h_{\text{dep},k}}{r^h_{\text{dep}}} \right)^{\sigma_{D,h}}, \tag{36}$$

$$r^h_b = \left( \frac{1}{N_h} \sum_{k \in \mathcal{N}_h} (r^h_{b,k})^{1 - \sigma_{L,h}} \right)^{\frac{1}{1 - \sigma_{L,h}}}, \qquad q^i_{b,b,k} = \frac{q^i_{b,b}}{N_h} \left( \frac{r^h_{b,k}}{r^h_b} \right)^{-\sigma_{L,h}}. \tag{37}$$

These expressions follow from the normalized within-class nest in equation (19), evaluated at $j = h$. When all banks offer the same class-specific rate, $r^h_{\text{dep},k} = r^h_{\text{dep}}$ and $r^h_{b,k} = r^h_b$, the class indices equal the common individual-bank rates and each bank receives $1/N_h$ of the class quantity. Hence the within-class elasticities do not enter the estimated across-class demand system; they are identified from bank rate pass-through.

Finally, using the budget constraint $c^i + \mathcal{S}^i/R^i_s = w^i + \mathcal{B}^i$, one obtains

$$\mathcal{S}^i = (\gamma^i_s)^{\sigma^h}(w^i + \mathcal{B}^i)R^i \left(\frac{R^i_s}{R^i}\right)^{\sigma^h}, \qquad R^i = \left((\gamma^i_c)^{\sigma^h} + (\gamma^i_s)^{\sigma^h}(R^i_s)^{\sigma^h - 1}\right)^{\frac{1}{\sigma^h - 1}}. \tag{38}$$

The borrowing composite $\mathcal{B}^i$ is pinned down by the debt-service constraint, $\mathcal{B}^i R^i_b = \bar{D}^i$.

### C.2 Firms

**Optimal equity ratio.** Write $s^i_E \equiv E^i/A^i$. Substituting $\mathcal{D}^i = A^i - E^i$ into equation (6) gives insider cash flow per dollar of assets:

$$\frac{\Pi^i_I}{A^i} = R^i_A - R^i_D(1 - s^i_E) - r_E s^i_E - \frac{\eta_E}{2}(s^i_E - \bar{s}^i)^2. \tag{39}$$

For an interior solution, the first- and second-order conditions are

$$R^i_D - r_E - \eta_E(s^i_E - \bar{s}^i) = 0, \qquad \frac{\partial^2(\Pi^i_I/A^i)}{\partial(s^i_E)^2} = -\eta_E < 0. \tag{40}$$

Solving the first-order condition gives

$$s^i_E \equiv \frac{E^i}{A^i} = \bar{s}^i + \frac{R^i_D - r_E}{\eta_E}, \qquad 0 < s^i_E < 1. \tag{41}$$

If the unconstrained solution lies outside $[0, 1]$, the equity share is clamped at the corresponding boundary; the analysis focuses on interior equilibria.

**Asset-side solution.** Maximizing unit-normalized return services for a given scale $A^i$ yields the following firm-level demand functions and price indices. At the level of the overall nest, the unit-normalized price index is

$$P^i = \left((\alpha^i_{\text{real}})^{\sigma^f_A}(r^i_{\text{real}})^{\sigma^f_A - 1} + (\alpha^i_{\text{fin}})^{\sigma^f_A}(R^i_{\text{fin}})^{\sigma^f_A - 1}\right)^{\frac{1}{\sigma^f_A - 1}}, \tag{42}$$

and the optimal choice of real and financial investment is

$$K^i = A^i(\alpha^i_{\text{real}})^{\sigma^f_A}\left(\frac{r^i_{\text{real}}}{P^i}\right)^{\sigma^f_A - 1}, \qquad F^i = A^i(\alpha^i_{\text{fin}})^{\sigma^f_A}\left(\frac{R^i_{\text{fin}}}{P^i}\right)^{\sigma^f_A - 1}. \tag{43}$$

Within the financial nest,

$$R^i_{\text{fin}} = \left( \sum_{j \in J^f_A} (\gamma^i_j)^{\sigma^f_F} (r^f_j)^{\sigma^f_F - 1} \right)^{\frac{1}{\sigma^f_F - 1}}, \qquad q^i_{a,j} = F^i (\gamma^i_j)^{\sigma^f_F} \left( \frac{r^f_j}{R^i_{\text{fin}}} \right)^{\sigma^f_F - 1}. \tag{44}$$

For the deposit class ($j = \text{dep}$), the class-level return $r^f_{\text{dep}}$ entering the within-financial demand above is itself a CES aggregate of individual bank deposit rates, and class-level quantity allocates across banks according to within-class CES demand:

$$r^f_{\text{dep}} = \left( \frac{1}{N_f} \sum_{k \in \mathcal{N}_f} (r^f_{\text{dep},k})^{\sigma_{D,f} - 1} \right)^{\frac{1}{\sigma_{D,f} - 1}}, \qquad q^i_{a,\text{dep},k} = \frac{q^i_{a,\text{dep}}}{N_f} \left( \frac{r^f_{\text{dep},k}}{r^f_{\text{dep}}} \right)^{\sigma_{D,f} - 1}. \tag{45}$$

These expressions follow from the normalized within-class nest in equation (19), evaluated at $j = f$. Under the optimal allocation, $\mathcal{A}^i = P^i A^i$. The effective asset return entering the firm objective is $R^i_A = z_s P^i$, as discussed below.

**Debt-side solution.** Optimally choosing borrowing quantities to minimize the cost of borrowing $\sum_j q^i_{b,j} r^f_j$ yields

$$R^i_D = \left( \sum_{j \in J^f_B} (\beta^i_j)^{\sigma^f_D} (r^f_j)^{1 - \sigma^f_D} \right)^{\frac{1}{1 - \sigma^f_D}}, \qquad q^i_{b,j} = \mathcal{D}^i (\beta^i_j)^{\sigma^f_D} \left( \frac{r^f_j}{R^i_D} \right)^{-\sigma^f_D}. \tag{46}$$

For the bank-loan class ($j = b$), the class-level rate $r^f_b$ entering the across-class debt demand above is itself a CES aggregate of individual bank loan rates, and class-level quantity allocates across banks according to within-class CES demand:

$$r^f_b = \left( \frac{1}{N_f} \sum_{k \in \mathcal{N}_f} (r^f_{b,k})^{1 - \sigma_{L,f}} \right)^{\frac{1}{1 - \sigma_{L,f}}}, \qquad q^i_{b,b,k} = \frac{q^i_{b,b}}{N_f} \left( \frac{r^f_{b,k}}{r^f_b} \right)^{-\sigma_{L,f}}. \tag{47}$$

These expressions follow from the same within-class nest, equation (19) at $j = f$. Effective funding and debt cost satisfy $\sum_{j \in J^f_B} r^f_j q^i_{b,j} = R^i_D \mathcal{D}^i$. When all banks offer the same class-specific rate, $r^f_{\text{dep},k} = r^f_{\text{dep}}$ and $r^f_{b,k} = r^f_b$, the class indices equal the common individual-bank rates and each bank receives $1/N_f$ of the class quantity. Hence the within-class elasticities

do not enter the estimated across-class demand system; they are identified from bank rate pass-through.

**Zero profit, Tobin's $q$, and type-level scale.** Because the individual firm takes all returns as given, its objective is homogeneous of degree one in scale. Competitive entry therefore requires $\Pi_I^i/A^i = 0$. Before substituting the equity first-order condition, this condition is

$$R_A^{\text{req},i} = R_D^i(1 - s_E^i) + r_E s_E^i + \frac{\eta_E}{2}(s_E^i - \bar{s}^i)^2. \tag{48}$$

Using equation (41) yields the required-return condition (12) in the main text, $R_A^{\text{req},i} = R_D^i(1 - \bar{s}^i) + r_E\bar{s}^i - (R_D^i - r_E)^2/(2\eta_E)$. With $\Pi_E^i$ the cash flow to all equityholders, defined in (6), $V_E^i = \Pi_E^i/r_E$. Zero insider value means $V_E^i - E^i = 0$. Defining enterprise value in the same effective-funding units as $V^i = V_E^i + \mathcal{D}^i$ then gives $V^i = A^i$, which is the Tobin's-$q$ condition (11). Thus competitive entry, rather than an additional wedge, delivers both average and marginal $\mathcal{Q}^i$ equal to one.

At the type level, invert equation (13) to obtain aggregate real capital:

$$K^i = \bar{K}^i \left( \frac{r_{\text{real}}^i}{\bar{r}_{\text{real}}^i} \right)^{-1/\eta_K}. \tag{49}$$

The type-specific return $r_{\text{real}}^i$ adjusts until $z_s P^i$, with $P^i$ given by (42), satisfies the zero-profit condition (12). Individual firms take this return as given and do not internalize the type-level schedule.

**Asset-service normalization.** The conditional asset shares identify the ratio $\alpha_{\text{real}}^i/\alpha_{\text{fin}}^i$ but not the common level of the two weights. In particular, rescaling both weights by a common factor $\varphi$ multiplies the unit-normalized index $P^i$ in equation (42) by $\varphi^{\sigma_A^f/(\sigma_A^f-1)}$ while leaving the conditional asset shares (43) unchanged. The unit-sum normalization $\alpha_{\text{real}}^i + \alpha_{\text{fin}}^i = 1$ therefore fixes the level of $P^i$ arbitrarily. This is innocuous for portfolio shares but consequential once the zero-profit condition (12) equates the effective asset return to the required return. We separate the identified share index from this level by writing

$$R_A^i = z_s\, P^i, \tag{50}$$

where $z_s$, common within sector $s \in \{\text{corp}, \text{noncorp}\}$, is a Hicks-neutral asset-service normalization. It is neither a Tobin's-$q$ wedge—equation (12) continues to hold exactly—nor an additive return wedge, which would enter the leverage response through a different channel. We calibrate $z_{\text{corp}}$ so that the observed-real-capital-weighted corporate real return, $\sum_i K_i^{\text{obs}} r_{\text{real}}^i / \sum_i K_i^{\text{obs}}$ over corporate cells, equals its national-accounts value, and $z_{\text{noncorp}}$ so the noncorporate real return matches its national-accounts value. Each calibration is a one-dimensional root-find in which every cell's $r_{\text{real}}^i$ solves $z_s P^i = R_A^{\text{req},i}$. Because $z_s$ is common within a sector, $R_A^{\text{req},i}$, $R_D^i$, $R_{\text{fin}}^i$, and the weight ratios remain type-specific, preserving cross-type cost-of-capital heterogeneity.

In the calibration, $z_{\text{noncorp}} < 1$. Consequently, using the raw unit-sum index $P^i$ directly at the calibrated allocation—equivalently, setting $z_{\text{noncorp}} = 1$ without recalibrating the other primitives—would give $P^i = R_A^{\text{req},i} / z_{\text{noncorp}} > R_A^{\text{req},i}$ and hence $\mathcal{Q}_{\text{noncorp}}^i > 1$. This comparison is relative to the arbitrary unit-sum normalization of the CES weights and therefore should not be interpreted as evidence of structural underinvestment by noncorporate firms.

### C.3 Intermediaries

**Bank liquid-asset portfolio.** The bank's liquid-asset composite $\mathcal{S}_B$ and its price index $P_B$ are given in the main text, equation (17), over $j \in J_B \equiv \{r, g, h, c, n\}$ with beginning-of-period prices $p_j$. Cost minimization for a given end-of-period payoff yields the individual asset demand,

$$P_B = \left( \sum_{j \in J_B} \gamma_B^j (1 + r_j)^{1-\eta_B} \right)^{\frac{1}{1-\eta_B}}, \qquad S_j^B = \gamma_B^j \left( \frac{p_j}{P_B} \right)^{-\eta_B} \frac{S_B}{P_B}. \tag{51}$$

The gross payoff per dollar of liquid assets is $1/P_B$, with net payoff $r_B^S \equiv 1/P_B - 1$.

**Bank-level product demand and pricing.** Demand for the bank's products follows from the within-class CES systems in the household and firm blocks. Holding the within-class deposit return index $R_{D,j}$ and aggregate sectoral deposits $D^j$ fixed, the bank's deposit

demand from sector $j \in \{h, f\}$ is

$$D_B^j = \delta_{D,j} D^j \left( \frac{r^j_{\text{dep},B}}{R_{D,j}} \right)^{\sigma_{D,j}-1}, \tag{52}$$

$$L_B^j = \delta_{L,j} L^j \left( \frac{r^j_{b,B}}{R_{L,j}} \right)^{-\sigma_{L,j}}. \tag{53}$$

The constants $\delta_{D,j}$ and $\delta_{L,j}$ reflect the normalization of the corresponding within-class CES nest. Both the household and firm nests carry the $N_j^{-1/\sigma}$ normalization, so $\delta_{D,j} = \delta_{L,j} = 1/N_j$, where $N_j$ is the number of banks serving sector $j$. Together with the corresponding class indices, this convention allocates $1/N_j$ of the class quantity to each bank in a symmetric equilibrium. The household-side bank-level quantities $(D_B^h, L_B^h)$ correspond to the positions from the household problem aggregated across households; the firm-side quantities are defined analogously.

Each bank is small relative to its product market and therefore does not internalize the effect of its own price on the within-class CES price indices $R_{D,j}$ and $R_{L,j}$. A change in $r^j_{\text{dep},B}$ moves only the bank's own quantity $D_B^j$, holding $R_{D,j}$ and $D^j$ fixed. Without this assumption, the perceived elasticity would be $\sigma_{D,j} - \omega_B(\sigma_{D,j} - \sigma^j_{\text{across}})$, where $\omega_B$ is the bank's market share within deposits and $\sigma^j_{\text{across}}$ is the sector's across-class elasticity, equal to $\sigma_S^h$ for households and $\sigma_F^f$ for firms. The no-internalization assumption is the standard Dixit–Stiglitz monopolistic-competition convention and is also standard in the deposit-channel literature. Substituting the balance-sheet constraint in (16) into the bank objective and differentiating with respect to the four product rates yields the pricing conditions (20)–(21) in the main text.

**Money market funds.** Money market funds own a composite of liquid securities, with beginning-of-period value $S_M$, which they finance entirely by issuing MMF shares. They incur a per-unit operating cost $c_M$, and competition drives individual-fund profits to zero.

The MMF portfolio contains repo and other short-term instruments ($o$), agency MBS ($h$), and Treasuries ($g$), with quantities $S_j^M$, $j \in J_M \equiv \{o, h, g\}$. Each asset has beginning-of-period price $p_j$. The portfolio delivers $\mathcal{S}_M$ units of end-of-period payoff according to

$$\mathcal{S}_M(\{S_j^M\}_j) = \left( \sum_{j \in J_M} (\gamma_M^j)^{1/\eta_M} (S_j^M)^{\frac{\eta_M - 1}{\eta_M}} \right)^{\frac{\eta_M}{\eta_M - 1}}, \qquad S_M = \sum_{j \in J_M} p_j S_j^M. \tag{54}$$

Cost minimization for a given end-of-period payoff yields

$$P_M = \left( \sum_{j \in J_M} \gamma_M^j (1 + r_j)^{1-\eta_M} \right)^{\frac{1}{1-\eta_M}}, \qquad S_j^M = \gamma_M^j \left( \frac{p_j}{P_M} \right)^{-\eta_M} \frac{S_M}{P_M}. \tag{55}$$

The gross payoff from the optimal portfolio per dollar invested is $1/P_M$, with net payoff $r_M \equiv 1/P_M - 1$. MMFs issue shares one-to-one with their assets, with promised return $r_M^{ud}$. MMF profit per unit of assets is

$$\Pi_M = \underbrace{(1 + r_M)}_{\text{portfolio payoff}} - \underbrace{(1 + r_M^{ud})}_{\text{investor payoff}} - \underbrace{c_M}_{\text{operating cost}}. \tag{56}$$

The zero-profit condition implies $r_M^{ud} = r_M - c_M$. Aggregate demand for MMF shares pins down the sector's scale:

$$S_M = D_M^{ud} \equiv Q_{s,\text{mmf}}^h + Q_{a,\text{mmf}}^f, \tag{57}$$

where $Q_{s,\text{mmf}}^h$ and $Q_{a,\text{mmf}}^f$ are the aggregate MMF holdings from the household and firm problems. The MMF class is treated as a single market claim, so it has no within-class structure across funds.

**Nonbank lenders.** There are two NBL types, a household lender indexed by $h$ and a firm lender indexed by $f$. They specialize in the sector to which they lend but are otherwise symmetric, competitive, and subject to zero profit. Each type $k \in \{h, f\}$ lends $L_{L,k}$ and receives end-of-period payoff $(1 + r_n^k)L_{L,k}$.

The household lender's financing composite contains $j \in J_h \equiv \{\text{sec}, \text{nbl}\}$, where sec denotes broadly held securities financed by household loans, such as agency MBS, and nbl denotes NBL securities held by banks. The firm lender's composite contains $j \in J_f \equiv \{\text{sec}, \text{nbl}\}$, where sec denotes broadly held securities financed by corporate loans, such as corporate bonds. We abstract from repo funding for NBLs because repo is treated primarily as a short-term money-market instrument intermediated by MMFs and the central bank. NBLs incur per-unit operating cost $c_n^k$.

Each NBL type issues $S_{L,k}^j$ units of financing instruments, with required repayment $1 + r_j$

at the end of the period. Issuing $\{S^j_{L,k}\}$ raises $\mathcal{S}_{L,k}$ effective units of funding through

$$\mathcal{S}_{L,k} = \left( \sum_{j \in J_k} (\gamma^j_{L,k})^{1/\eta_{L,k}} (S^j_{L,k})^{\frac{\eta_{L,k}-1}{\eta_{L,k}}} \right)^{\frac{\eta_{L,k}}{\eta_{L,k}-1}}. \tag{58}$$

Cost minimization for a given amount of effective funding yields

$$P_{L,k} = \left( \sum_{j \in J_k} \gamma^j_{L,k} (1+r_j)^{1-\eta_{L,k}} \right)^{\frac{1}{1-\eta_{L,k}}}, \qquad S^j_{L,k} = \gamma^j_{L,k} \left( \frac{1+r_j}{P_{L,k}} \right)^{-\eta_{L,k}} \mathcal{S}_{L,k}. \tag{59}$$

To raise one dollar of effective funding, the NBL must repay $P_{L,k} \equiv 1 + \tilde{r}^k_n$ at the end of the period. NBL profit per unit of investment is

$$\Pi_{L,k} = (1 + r^k_n) - (1 + \tilde{r}^k_n) - c^k_n. \tag{60}$$

Zero profit implies $r^k_n = \tilde{r}^k_n + c^k_n$. Given the funding rate, aggregate borrowing demand pins down the scale of each NBL sector:

$$\mathcal{S}_{L,h} = Q^h_{b,n}, \qquad \mathcal{S}_{L,f} = Q^f_{b,n}, \tag{61}$$

where $Q^h_{b,n}$ and $Q^f_{b,n}$ are aggregate household and firm nonbank borrowing from the corresponding demand problems.

### C.4 Other Sectors and Equilibrium

**Government closure.** The government represents the consolidated balance sheet of the fiscal and monetary authorities. Let $\bar{T}$ denote gross marketable Treasury supply, $T_f$ Federal Reserve Treasury holdings, and $A_f$ Federal Reserve agency-MBS holdings. All three quantities are exogenous. Although the implementation records $\bar{T}$ and $T_f$ separately, consolidation leaves $\bar{T} - T_f$ as the Treasury supply that must be absorbed by the remaining sectors. The government supplies reserves to banks elastically at the interest rate on reserve balances (IORB) and repo to MMFs elastically at the federal funds rate; these policy rates are exogenous, while reserve and repo quantities accommodate demand. We do not impose a government budget constraint in the model.

**Equilibrium and market clearing.** An equilibrium is a vector of returns and quantities such that households, firms, intermediaries, the government, and the rest of the world satisfy their optimality conditions and all asset markets clear. Household saving and borrowing choices are governed by the consumption–saving condition (38), the saving demand system (34), the borrowing demand system (35), and the debt-service constraint in (1). Firms satisfy the asset-side and debt-side demand systems (43)–(46), the equity-ratio condition (41), and the zero-profit required-return condition (12). Banks satisfy the balance-sheet constraint in (16), liquid-asset demand (51), and pricing conditions (20)–(21). MMFs and NBLs satisfy their zero-profit conditions and CES portfolio or funding choices. Real asset returns satisfy (13), and foreign demand satisfies (22).

To state the five explicit market-clearing conditions, let $V_j^s$ denote the beginning-of-period dollar value of claim $j$ held by sector $s$, where $s \in \{H, B, M, W\}$. Let $V_{L,k}^j$ denote the dollar value of claim $j$ issued by NBL type $k \in \{h, f\}$, and let $X_c^W$ and $X_e^W$ denote foreign-issued corporate bonds and equity held by U.S. investors. The traded-claim markets clear according to

$$\begin{aligned}
V_{L,h}^h &= A_f + V_h^H + V_h^W + V_h^M + V_h^B, && \text{(agency MBS)} \\
\bar{T} &= T_f + V_g^H + V_g^W + V_g^M + V_g^B, && \text{(Treasuries)} \\
V_{L,f}^c + X_c^W &= V_c^H + V_c^W + V_c^B, && \text{(corporate bonds)} \\
V_{L,h}^n + V_{L,f}^n &= V_n^B, && \text{(NBL securities)} \\
E^F + X_e^W &= V_e^H + V_e^W. && \text{(equity)}
\end{aligned} \tag{62}$$

Here $E^F$ is equity issued by the modeled firm sector. In particular, bank funding of NBLs is represented by banks' holdings $V_n^B$ of NBL securities and therefore belongs to the bank's liquid-security portfolio, not to direct bank loans.

The remaining markets clear by construction. Bank deposits equal household plus firm deposit demand, and direct bank loans equal household plus firm bank-loan demand. The scale of each NBL equals aggregate nonbank borrowing by its corresponding borrower sector, and MMF assets equal aggregate household and firm demand for MMF shares. Reserve and repo quantities accommodate bank and MMF demand at IORB and the federal funds rate, respectively. Finally, each firm type's demand for real capital satisfies its decreasing-returns supply schedule. Thus the numerical equilibrium consists of the four bank pricing conditions together with the five clearing conditions in (62).

# D Estimation: Supplemental Material

This section supports the estimation in Section 3. For each block—households, firms, intermediaries, and foreign investors—it states the estimating equations, instruments, and identification, and reports the full regressions behind the main-text parameter summaries.

## D.1 Households

**Stage 1.** For any two saving classes $k$ and $l$, equation (34) implies

$$\log\left(\frac{Q^h_{s,k,t}}{Q^h_{s,l,t}}\right) = \sigma^h_S \log\left(\frac{\bar{\alpha}_k}{\bar{\alpha}_l}\right) + (\sigma^h_S - 1)\log\left(\frac{r^h_{k,t}}{r^h_{l,t}}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{63}$$

where $Q^h_{s,k,t}$ is household-sector holdings of class $k$ in year $t$ in the Financial Accounts and $\bar{\alpha}_k$ denotes the effective aggregation-weighted preference term. We estimate (63) on annual holdings of MMF shares, Treasuries, agencies, corporate bonds, and equity, each relative to deposits. Asset-class fixed effects absorb $\log(\bar{\alpha}_k/\bar{\alpha}_l)$. This specification maintains that the effective relative preference term is time invariant; changes in household composition enter the regression error. The relative return is instrumented with Federal Reserve Treasury holdings interacted with the asset class; the interactions let the balance-sheet shifter move each class's relative return differently. The borrowing-side analog follows from (35):

$$\log\left(\frac{Q^h_{b,k,t}}{Q^h_{b,l,t}}\right) = \sigma^h_B \log\left(\frac{\bar{\beta}_k}{\bar{\beta}_l}\right) - \sigma^h_B \log\left(\frac{r^h_{k,t}}{r^h_{l,t}}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{64}$$

estimated on nonbank relative to bank household credit. The instruments are Federal Reserve Treasury holdings and (one plus) Federal Reserve agency MBS holdings; a post-2000 dummy enters as an exogenous control for the structural shift in mortgage funding. In both regressions the IV slope on the relative return identifies the elasticity: $\sigma^h_S - 1$ on the saving side and $-\sigma^h_B$ on the borrowing side.

**Stage 2.** Given $\sigma^h_S$, equation (34) rearranges so that the preference weights are the regressand:

$$\frac{1}{\sigma^h_S}\left[\log\left(\frac{q^i_{s,k,t}}{q^i_{s,l,t}}\right) - (\sigma^h_S - 1)\log\left(\frac{r^h_{k,t}}{r^h_{l,t}}\right)\right] = \log\left(\frac{\alpha^i_k}{\alpha^i_l}\right) + \tilde{\varepsilon}^i_{k,l,t}, \tag{65}$$

with relative weights parameterized by net worth and age. Let $\widetilde{w}^i = \log w^i - \overline{\log w}$ and $\widetilde{a}^i = (\text{Age}^i - \overline{\text{Age}})/10$:

$$\log\left(\frac{\alpha_k^i}{\alpha_l^i}\right) = \alpha_{k,l}^0 + \alpha_{k,l}^w \widetilde{w}^i + \alpha_{k,l}^a \widetilde{a}^i + \alpha_{k,l}^{a2} (\widetilde{a}^i)^2. \tag{66}$$

The unit of observation is an SCF group defined by survey year, a fine net-worth bin, and a fine age bin; the cell's population-weighted mean age enters equation (66) continuously. Deposits are the base class. One pooled regression recovers all class pairs: class indicators estimate the intercepts $\alpha_{k,l}^0$, while net-worth and age gradients may differ for bonds and equity. Regressions are weighted by group population. The borrowing-side analog applies the same rearrangement to (35),

$$\frac{1}{\sigma_B^h}\left[\log\left(\frac{q_{b,k,t}^i}{q_{b,l,t}^i}\right) + \sigma_B^h \log\left(\frac{r_{k,t}^h}{r_{l,t}^h}\right)\right] = \log\left(\frac{\beta_k^i}{\beta_l^i}\right) + \tilde{\varepsilon}_{k,l,t}^i, \tag{67}$$

with

$$\log\left(\frac{\beta_k^i}{\beta_l^i}\right) = \beta_{k,l}^0 + \beta_{k,l}^w \widetilde{w}^i + \beta_{k,l}^a \widetilde{a}^i + \beta_{k,l}^{a2} (\widetilde{a}^i)^2, \tag{68}$$

for bank relative to nonbank loans. The estimated relative weights are converted to unit-sum CES weights within each nest. The implementation stores cell-level residuals as fit diagnostics but does not add them to the predicted weights used in the baseline or counterfactuals.

**Stage 3.** With the Stage-2 weights in hand, the household-specific saving return index $R_s^i$ from (34) is observed. The outer nest (38) gives the estimating equation

$$\log\left(\frac{\mathcal{S}^i}{c^i}\right) = \sigma^h \log\left(\frac{\gamma_s^i}{\gamma_c^i}\right) + \sigma^h \log R_s^i + \tilde{\varepsilon}^i, \tag{69}$$

where the weight term is parameterized by $\widetilde{w}^i$, $\widetilde{a}^i$, and $(\widetilde{a}^i)^2$. Consumption is not observed in the SCF; we construct it from the budget identity, $c^i = w_{\text{FOF}}^i + \mathcal{B}^i - \mathcal{S}^i/R_s^i$, spending net worth plus borrowing net of dollar saving. Here $w_{\text{FOF}}^i$ is the FOF-consistent net worth $w_{\text{FOF}}^i = \text{networth}_{\text{SCF}}^i + (\widetilde{S}^i - S_{\text{raw}}^i) - (\mathcal{B}^i - \mathcal{B}^{i,\text{raw}})$, where $\widetilde{S}^i$ ($S_{\text{raw}}^i$) is the FOF-scaled (raw) sum of financial assets and $\mathcal{B}^i$ ($\mathcal{B}^{i,\text{raw}}$) is the borrowing composite at FOF-scaled (raw) debt. The correction keeps the budget consistent with the FOF-scaled quantities; raw SCF net worth remains the regressor throughout. We instrument $\log R_s^i$ with the federal funds rate and its interactions with $\widetilde{w}^i$, $\widetilde{a}^i$, and $(\widetilde{a}^i)^2$. The interactions deliver cross-sectional variation

in the local return that a time-series instrument alone cannot: the same policy rate moves $R_s^i$ differently across cells because the Stage-2 weights differ.

**Borrowing constraint.** The Stage-1 elasticity $\sigma_B^h$ and the Stage-2 weights $\beta^i$ govern only how a household *splits* its borrowing between bank and nonbank loans. The *scale* of borrowing comes from the debt-service constraint in (1), $\mathcal{B}^i R_b^i = \bar{D}^i$. We estimate its empirical counterpart by projecting log debt service $\log(\mathcal{B}^i R_b^i)$ on $\widetilde{w}^i$, $(\widetilde{w}^i)^2$, $\widetilde{a}^i$, and $(\widetilde{a}^i)^2$, weighted by cell population. The baseline and counterfactuals use the predicted capacity surface without cell residuals. This regression determines how borrowing scale responds when the comparative statics perturb net worth or age.

**Identification.** $\sigma_S^h$ and $\sigma_B^h$ are identified from time-series variation in relative returns under Federal Reserve balance-sheet instruments—Treasury holdings interacted with asset class on the saving side, Treasury and agency MBS holdings on the borrowing side. The preference-heterogeneity coefficients are identified from cross-sectional SCF variation given those elasticities. $\sigma^h$ is identified from shifts in $R_s^i$ induced by interactions of the federal funds rate with net worth and the continuous age polynomial.

**From estimates to main-text parameters.** The household rows of Table 1 are direct transformations of the regressions below. The saving elasticity is one plus the IV slope in column (2) of Table A4 ($0.49 \to \widehat{\sigma}_S^h = 1.49$), and the borrowing elasticity is the negative of the IV slope in column (4) ($-1.55 \to \widehat{\sigma}_B^h = 1.55$). The net-worth and age gradients are the coefficients of the weight regressions in columns (1)–(2) of Table A5, with the bond and equity rows combining the common nondeposit loading and the corresponding interaction. The consumption–saving elasticity is the IV slope on the log saving return in column (4) ($\widehat{\sigma}^h = 0.91$), and the debt-service-capacity row reports the coefficients of column (5) without further transformation.

**Table A4: Household across-class substitution.** Columns (1)–(2) are OLS and IV for the savings nest; the IV slope identifies $\sigma_S^h - 1$. Columns (3)–(4) are OLS and IV for the borrowing nest; the IV slope identifies $-\sigma_B^h$. Instruments: Federal Reserve Treasury holdings interacted with asset class on the saving side; Federal Reserve Treasury holdings and (1 + agency MBS holdings) on the borrowing side. Standard errors in parentheses.

| | Savings OLS | Savings IV | Borrowing OLS | Borrowing IV |
|---|---|---|---|---|
| log relative return | 0.268*** | 0.492*** | -0.384* | -1.547*** |
| | (0.055) | (0.076) | (0.210) | (0.462) |
| Treasury | 0.486*** | 0.253 | | |
| | (0.149) | (0.163) | | |
| Agency | 0.400*** | 0.128 | | |
| | (0.153) | (0.170) | | |
| Corporate | 1.410*** | 1.107*** | | |
| | (0.156) | (0.176) | | |
| Equity | 2.384*** | 1.970*** | | |
| | (0.171) | (0.201) | | |
| Constant | -1.834*** | -1.820*** | 0.420*** | 0.483*** |
| | (0.097) | (0.101) | (0.062) | (0.086) |
| Num.Obs. | 200 | 200 | 40 | 40 |
| R2 | 0.742 | 0.720 | 0.623 | 0.309 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

**Table A5: Household CES demand estimation.** Column (1) is the savings-nest preference regression (65), with the LHS the SCF log share relative to deposits adjusted by the Stage-1 rate term. Column (2) is the borrowing-nest preference regression (67). Columns (3)–(4) are OLS and IV for the outer nest (69); the IV slope identifies $\sigma^h$. Column (5) is the household borrowing-constraint regression. Age is centered and measured in ten-year units; every specification includes age and age squared. All regressions are at the SCF cell level and weighted by population. Standard errors are in parentheses.

| | Savings nest | Debt nest | Outer OLS | Outer IV | Borrowing constraint |
|---|---|---|---|---|---|
| logW | 0.485*** | 0.125*** | 0.166*** | 0.169*** | 0.470*** |
| | (0.013) | (0.010) | (0.007) | (0.007) | (0.009) |
| age (10 years, centered) | -0.041*** | 0.019* | -0.061*** | -0.065*** | -0.396*** |
| | (0.013) | (0.010) | (0.007) | (0.007) | (0.009) |
| age squared | 0.047*** | 0.014** | 0.034*** | 0.033*** | -0.116*** |
| | (0.008) | (0.006) | (0.004) | (0.004) | (0.006) |
| MMF | -2.260*** | | | | |
| | (0.030) | | | | |
| Treasury | -1.538*** | | | | |
| | (0.023) | | | | |
| Agency | -1.885*** | | | | |
| | (0.023) | | | | |
| Corporate | -1.105*** | | | | |
| | (0.023) | | | | |
| Equity | -0.921*** | | | | |
| | (0.030) | | | | |
| age: Bond | 0.065*** | | | | |
| | (0.015) | | | | |
| age squared: Bond | -0.096*** | | | | |
| | (0.010) | | | | |
| age: Equity | -0.125*** | | | | |
| | (0.019) | | | | |
| age squared: Equity | -0.117*** | | | | |
| | (0.012) | | | | |
| logW: Bond | -0.249*** | | | | |
| | (0.015) | | | | |
| logW: Equity | -0.017 | | | | |
| | (0.018) | | | | |
| (Intercept) | | -0.428*** | 0.689*** | 0.516*** | 10.474*** |
| | | (0.022) | (0.074) | (0.088) | (0.022) |
| log saving return | | | 0.943*** | 0.908*** | |
| | | | (0.015) | (0.018) | |
| logW squared | | | | | -0.038*** |
| | | | | | (0.003) |
| Num.Obs. | 7990 | 1598 | 1598 | 1598 | 1598 |
| R2 | 0.480 | 0.137 | 0.773 | 0.772 | 0.747 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

### D.2 Firms

**Stage 1.** For any two financial-asset classes $k$ and $l$, equation (44) implies

$$\log\left(\frac{Q^f_{a,k,t}}{Q^f_{a,l,t}}\right) = \sigma^f_F \log\left(\frac{\bar{\gamma}_k}{\bar{\gamma}_l}\right) + (\sigma^f_F - 1)\log\left(\frac{r^f_{k,t}}{r^f_{l,t}}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{70}$$

estimated as a two-class IV (MMFs relative to deposits) on quarterly Financial Accounts data. The deposit rate is the three-month CD rate, the component of firm deposit yields relevant for substitution at the margin. Instruments are Federal Reserve Treasury holdings and Federal Reserve agency MBS holdings; a post-2000 dummy absorbs the structural break in firm liquidity composition. The borrowing-side analog from (46) is

$$\log\left(\frac{Q^f_{b,k,t}}{Q^f_{b,l,t}}\right) = \sigma^f_D \log\left(\frac{\bar{\beta}_k}{\bar{\beta}_l}\right) - \sigma^f_D \log\left(\frac{r^f_{k,t}}{r^f_{l,t}}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{71}$$

estimated on bank relative to nonbank firm debt with the same instrument set. As on the household side, the IV slope identifies $\sigma^f_F - 1$ in the financial nest and $-\sigma^f_D$ in the debt nest. The type-level ratio equations are exact. After aggregation across heterogeneous types, however, a ratio of sums is not a simple average of CES weights. Thus $\bar{\gamma}_k$ and $\bar{\beta}_k$ are effective aggregation-weighted preference terms, assumed stable over time in Stage 1.

**Stage 2.** Given the Stage-1 elasticities, the cell-level firm demands rearrange so that the preference weights are the regressand:

$$\frac{1}{\sigma^f_F}\left[\log\left(\frac{q^i_{a,k,t}}{q^i_{a,l,t}}\right) - (\sigma^f_F - 1)\log\left(\frac{r^f_{k,t}}{r^f_{l,t}}\right)\right] = \log\left(\frac{\gamma^i_k}{\gamma^i_l}\right) + \tilde{\varepsilon}^i_{k,l,t} \tag{72}$$

and

$$\frac{1}{\sigma^f_D}\left[\log\left(\frac{q^i_{b,k,t}}{q^i_{b,l,t}}\right) + \sigma^f_D \log\left(\frac{r^f_{k,t}}{r^f_{l,t}}\right)\right] = \log\left(\frac{\beta^i_k}{\beta^i_l}\right) + \tilde{\varepsilon}^i_{k,l,t}. \tag{73}$$

Let $x^i$ denote mean-centered log firm size. Relative weights are parameterized as

$$\log\left(\frac{\gamma^i_k}{\gamma^i_l}\right) = \gamma^0_{k,l} + \gamma^{\text{size}}_{k,l} x^i + \gamma^{\text{size}^2}_{k,l}(x^i)^2 + \gamma^{\text{ind}(i)}_{k,l} + \epsilon^{\gamma,i}_{k,l}, \tag{74}$$

$$\log\left(\frac{\beta^i_k}{\beta^i_l}\right) = \beta^0_{k,l} + \beta^{\text{size}}_{k,l} x^i + \beta^{\text{size}^2}_{k,l}(x^i)^2 + \beta^{\text{ind}(i)}_{k,l} + \epsilon^{\beta,i}_{k,l}. \tag{75}$$

The unit of observation is a QFR cell: industry × size class × year. Industry enters through fixed effects, and the regressions are weighted by total assets. Cell-level residuals are retained for fit diagnostics and for a separate exact-fit artifact; the baseline and counterfactuals use the predicted size–industry surfaces without those residuals.

**Stage 3.** With the Stage-2 weights in hand, the firm-specific financial return index $R^i_{\text{fin}}$ from (44) is observed. The outer asset nest (43) gives the estimating equation

$$\log\left(\frac{K^i_t}{F^i_t}\right) = \sigma^f_A \log\left(\frac{\alpha^i_{\text{real}}}{\alpha^i_{\text{fin}}}\right) + (\sigma^f_A - 1)\log\left(\frac{r_{\text{real},t}}{R^i_{\text{fin},t}}\right) + \tilde{\varepsilon}^i_t, \tag{76}$$

with heterogeneity in the real-vs-financial weight parameterized as

$$\log\left(\frac{\alpha^i_{\text{real}}}{\alpha^i_{\text{fin}}}\right) = \alpha^0 + \alpha^{\text{size}} x^i + \alpha^{\text{size}^2}(x^i)^2 + \alpha^{\text{ind}(i)} + \epsilon^{\alpha,i}. \tag{77}$$

The endogenous relative return is instrumented with the Bauer–Swanson monetary-policy surprise $\text{mps}_t$ and Federal Reserve Treasury holdings $\text{Tre}_t$, each interacted with $\log \text{Size}^i$ and $(\log \text{Size}^i)^2$:

$$\text{IVs}_{i,t} \;=\; \left\{\text{mps}_t,\ \text{mps}_t{\times}\log \text{Size}^i,\ \text{mps}_t{\times}(\log \text{Size}^i)^2,\ \text{Tre}_t,\ \text{Tre}_t{\times}\log \text{Size}^i,\ \text{Tre}_t{\times}(\log \text{Size}^i)^2\right\}.$$

The size interactions deliver cross-sectional variation in the local return that monetary-policy time series alone cannot: the same shock moves $R^i_{\text{fin}}$ differently across cells because the Stage-2 weights differ. The regression is at the cell-by-year level, weighted by total assets, with industry fixed effects and $\log \text{Size}^i$ and its square as controls.

The estimating equation uses the common observed real-return series $r_{\text{real},t}$ as an empirical proxy. In the structural model and calibration, the relevant object is instead the type-specific, model-implied return $r^i_{\text{real},t}$ that satisfies the asset nest and zero-profit condition. This distinction affects the mapping from the estimated demand system into the structural baseline, not the algebra of the Stage-3 share equation.

**Stage 4.** The leverage margin is disciplined by (41). Writing $s^i_{E,t} \equiv E^i_t / A^i_t$,

$$s^i_{E,t} = \bar{s}^i + \frac{R^i_{D,t} - r_{E,t}}{\eta_E} + \tilde{\varepsilon}^i_t. \tag{78}$$

The reference equity share is parameterized as

$$\bar{s}^i = s^0 + s^{\text{size}} x^i + s^{\text{size}^2} (x^i)^2 + s^{\text{ind}(i)}. \tag{79}$$

Define the endogenous spread $X_t^i \equiv R_{D,t}^i - r_{E,t}$. Because $r_{E,t}$ is endogenous in general equilibrium, the first stage instruments the entire spread, $X_t^i = \pi Z_t^i + \text{controls} + u_t^i$, using the size-interacted monetary-policy and balance-sheet instruments from Stage 3. The common slope identifies $1/\eta_E$, while the controls and industry fixed effects identify the reference-equity-share parameters. Since $r_{E,t}$ varies over time, it is not absorbed by industry fixed effects. The reported leverage estimates use this spread-based specification.

**Calibration of $\eta_K$.** The decreasing-returns parameter in the real-asset supply schedule (13) is calibrated to $\eta_K = 0.33$, consistent with structural estimates of returns to scale in U.S. production; an internal time-series estimate from sectoral first differences is weakly identified and is not used. Given $\eta_K$, the firm-type productivity shifter is recovered by inverting the supply schedule at observed quantities,

$$\zeta_t^i = \log r_{\text{real},t}^i + \eta_K \log K_t^i, \tag{80}$$

where $r_{\text{real},t}^i$ is recovered from the type's required asset return (12) and the asset-service condition (50). The recovered shifter makes observed quantities consistent with the model-implied type-specific required returns. The value of $\eta_K$ therefore governs counterfactual quantity responses.

**Identification.** $\sigma_F^f$ and $\sigma_D^f$ are identified from time-series variation in aggregate relative returns under Federal Reserve balance-sheet instruments and a post-2000 dummy. Stage-2 heterogeneity coefficients are identified cross-sectionally from QFR variation by industry and size given the Stage-1 elasticities. $\sigma_A^f$ and the common curvature $\eta_E$ are identified from the cross-section of firm types under size-interacted monetary-policy and balance-sheet instruments. As on the household side, within-class elasticities $\sigma_{D,f}$ and $\sigma_{L,f}$ do not enter here.

**From estimates to main-text parameters.** The firm rows of Table 2 follow the same pattern. The financial-asset elasticity is one plus the IV slope in column (2) of Table A6 ($0.75 \to \widehat{\sigma}_F^f = 1.75$), and the debt elasticity is the negative of the IV slope in column (4)

($-1.81 \to \widehat{\sigma}_D^f = 1.81$). The size gradients are the coefficients of the weight regressions in columns (1)–(3) of Table A7; the industry rows report the unweighted mean and cross-industry standard deviation of the residual-free weights evaluated at $x = 0$, as described above. The outer asset elasticity is one plus the IV slope in column (5) ($-0.15 \to \widehat{\sigma}_A^f = 0.85$), and the leverage curvature is the reciprocal of the IV slope on the debt–equity spread in column (7) ($0.39 \to \widehat{\eta}_E = 2.56$). $\eta_K = 0.33$ is calibrated, and the productivity intercepts are recovered by the inversion (80) rather than estimated.

**Industry heterogeneity.** Figure A3 reports the industry and sector components summarized in Table 2. For each CES nest, we evaluate the estimated industry-specific log weight ratio at mean-centered log size $x = 0$, exclude the industry–size–year residual, and map the result into a unit-sum weight. We evaluate the reference equity share analogously. The bars therefore isolate fitted industry heterogeneity rather than differences in size distributions or residual-inclusive calibration targets; dashed lines show the unweighted means across the eight industries and sectors.

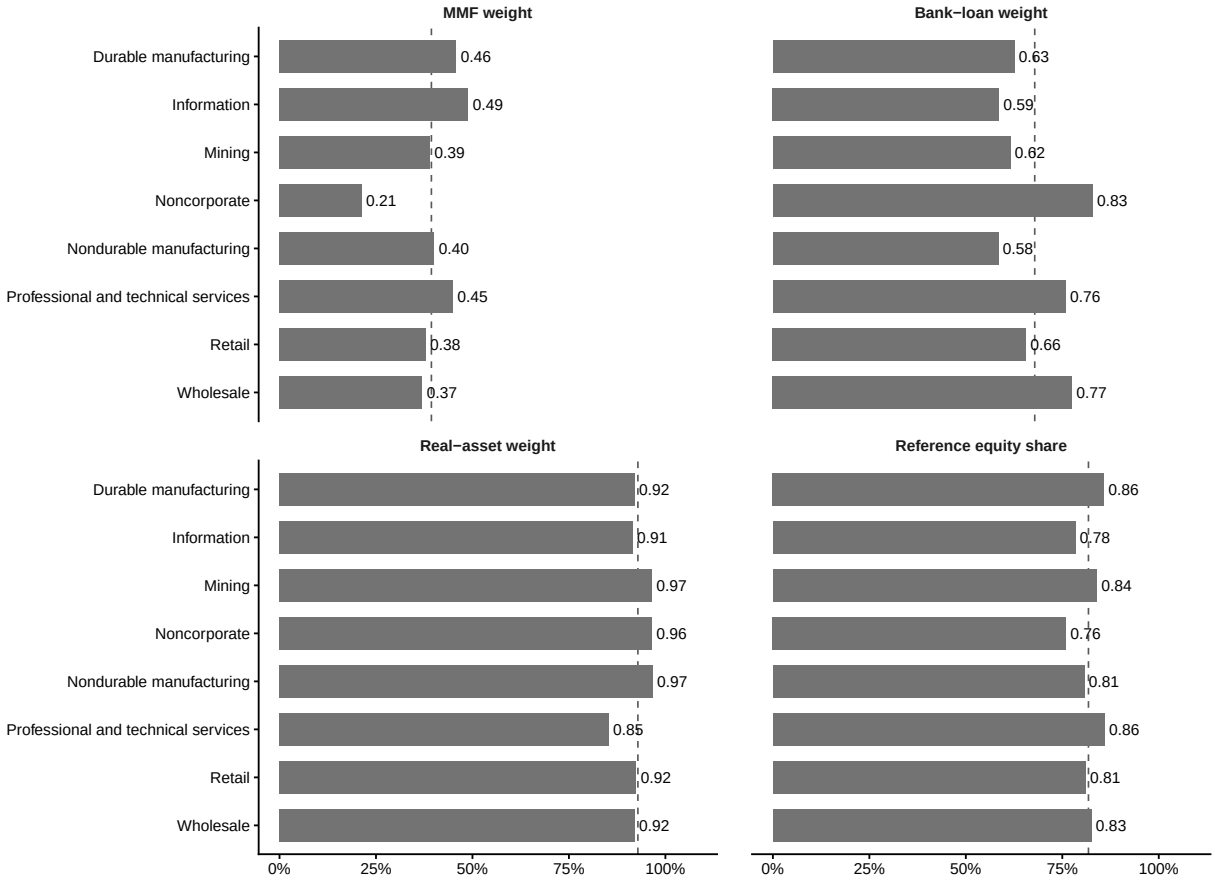



**Figure A3: Firm preference weights by industry and sector.** The panels report residual-free fitted MMF, bank-loan, and real-asset weights and the reference equity share at mean-centered log size $x = 0$. CES weights are normalized to sum to one within their respective nests. Dashed vertical lines show unweighted cross-industry means; the main-text parameter table reports these means and the corresponding cross-industry standard deviations.

**Productivity intercepts.** Figure A4 plots the recovered 2019 productivity intercepts $\zeta_t^i$ across the industry–size cells. They rise with firm size within manufacturing and are highest for the noncorporate and services groups, reflecting the capital each type operates at its required return. The firm-size comparative static in Section 4 raises $\zeta_t^i$ for the large-firm cells and lowers it for the rest, holding aggregate productivity-implied capital fixed.

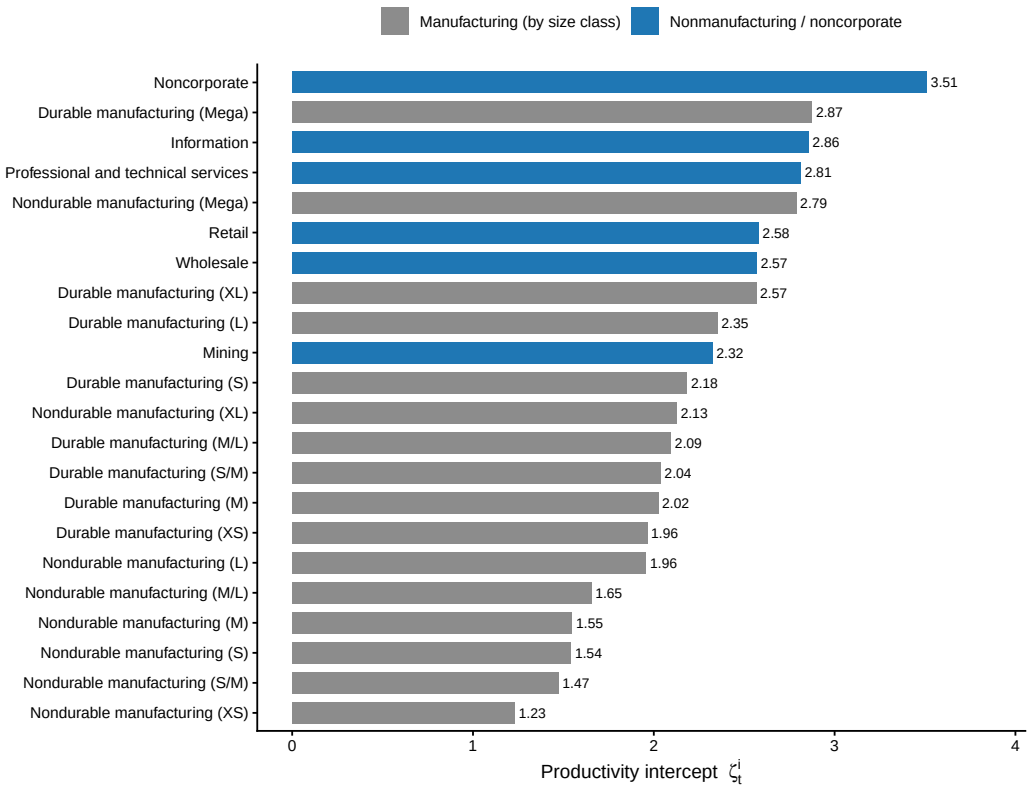



**Figure A4: Firm productivity intercepts by industry and size (2019).** Each bar is the calibrated intercept $\zeta_t^i$ of the type-level real-return supply schedule (13), recovered by inverting the schedule at observed capital, $\zeta_t^i = \log r_{\text{real},t}^i + \eta_K \log K_t^i$ (equation (80)). Manufacturing cells are shown by size class; the remaining industries enter at the sector level.

**Table A6: Firm across-class substitution.** Columns (1)–(2) are OLS and IV for the financial-asset nest (70); the IV slope on the relative return identifies $\sigma_F^f - 1$. Columns (3)–(4) are OLS and IV for the debt nest (71); the IV slope identifies $-\sigma_D^f$. All specifications include a post-2000 dummy. The instruments are Federal Reserve Treasury holdings and Federal Reserve agency MBS holdings. Standard errors are in parentheses.

| | Financial OLS | Financial IV | Debt OLS | Debt IV |
|---|---|---|---|---|
| log relative return | -0.024 | 0.750*** | -0.062 | -1.806*** |
| | (0.064) | (0.212) | (0.046) | (0.538) |
| Post-2000 | 0.960*** | 1.380*** | -0.243*** | -0.322*** |
| | (0.082) | (0.155) | (0.021) | (0.061) |
| Constant | -2.111*** | -2.062*** | 0.286*** | 0.310*** |
| | (0.056) | (0.079) | (0.013) | (0.034) |
| Num.Obs. | 157 | 157 | 245 | 245 |
| R2 | 0.528 | 0.080 | 0.351 | -3.504 |

* p < 0.1, ** p < 0.05, *** p < 0.01

**Table A7: Firm demand and financing estimation.** Columns (1)–(3) report the financial-asset-, debt-, and outer-asset-weight regressions. Columns (4)–(5) are OLS and IV for the outer asset nest (76); the IV slope identifies $\sigma_A^f - 1$. Columns (6)–(7) are OLS and IV for the equity-share equation (78); the regressor is the debt–equity spread $R_D^i - r_E$, and the IV slope identifies $1/\eta_E$. Size is mean-centered log size and its square. All cell-level regressions include industry fixed effects and are weighted by total assets; the IV columns use the size-interacted monetary-policy and Federal Reserve balance-sheet instruments described above. Standard errors are in parentheses.

| | Financial nest | Debt nest | Asset nest | Outer OLS | Outer IV | Leverage OLS | Leverage IV |
|---|---|---|---|---|---|---|---|
| log(Size) | 0.146*** | -0.226*** | 0.184*** | 0.143*** | 0.157*** | -0.003** | -0.003*** |
| | (0.018) | (0.014) | (0.015) | (0.011) | (0.013) | (0.001) | (0.001) |
| log(Size) squared | 0.012 | -0.103*** | 0.039*** | 0.030*** | 0.033*** | -0.002** | -0.002** |
| | (0.011) | (0.009) | (0.009) | (0.007) | (0.008) | (0.001) | (0.001) |
| log relative return | | | | -0.052*** | -0.148*** | | |
| | | | | (0.006) | (0.016) | | |
| Debt–equity spread | | | | | | 0.490*** | 0.390*** |
| | | | | | | (0.070) | (0.088) |
| Num.Obs. | 828 | 907 | 828 | 828 | 828 | 830 | 830 |
| R2 | 0.823 | 0.932 | 0.603 | 0.667 | 0.576 | 0.570 | 0.569 |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

* p < 0.1, ** p < 0.05, *** p < 0.01

### D.3 Intermediaries

**Estimating the bank securities CES.** Let $V_j^B \equiv p_j S_j^B$ denote the beginning-of-period dollar value of asset $j$. The bank's CES portfolio of liquid securities with common elasticity $\eta_B$ then satisfies, from (51),

$$\log\left(\frac{V_j^B}{V_{\text{res}}^B}\right) = \log\left(\frac{\gamma_B^j}{\gamma_B^{\text{res}}}\right) + (1-\eta_B)\log\left(\frac{p_j}{p_{\text{res}}}\right). \tag{81}$$

We estimate this equation on quarterly Financial Accounts holdings of Treasuries, agencies, corporate bonds, and NBL claims relative to reserves, with prices $p_j = 1/(1+r_j)$ and the reserve return set to the federal-funds-implied rate. A pre-2008 dummy absorbs the trend break introduced by interest on reserves. The relative price is instrumented with Federal Reserve Treasury holdings and the federal funds rate, each interacted with asset-class indicators. The IV slope identifies $1-\eta_B$.

**Estimating bank pass-through and regulatory wedges.** The bank's first-order conditions (20)–(21) yield rate pass-through equations of the form

$$r_{b,B}^j = \frac{\sigma_{L,j}}{\sigma_{L,j}-1}\big(c_{b,B}^j + \tilde{r} + \text{wedge}\big), \qquad j \in \{h, f\}, \tag{82}$$

where $\tilde{r}$ is the bank's shadow cost of funds and the wedge captures liquidity and capital regulation costs. We estimate the four within-class elasticities from first-differenced IV regressions of product rates on $\tilde{r}$, each with a single constant pass-through coefficient: loan rates are instrumented with the federal funds rate and deposit rates with monetary-policy surprises. The pass-through slope $b$ maps to elasticities through $\sigma_{L,j} = b/(b-1)$ for loans and $\sigma_{D,j} = 1/(1-b)$ for deposits. The four regulatory parameters $(\beta_L, \beta_K, \lambda, \kappa)$ and constant operating-cost margins are jointly estimated by two-step GMM, using orthogonality conditions between the four rate residuals, the constraint deviations, and the instruments in both levels and first differences. Standard errors for the GMM parameters use a Newey–West HAC covariance matrix with Bartlett weights; standard errors for reported transformations of IV coefficients use the delta method.

**Recovering bank operating costs.** Given the regulatory parameters and year-specific pass-through elasticities, we recover year-specific operating costs by inverting the four bank first-order conditions at observed rates. When the inversion and the GE use the same

annual CES weights, intermediary-residual convention, and reserve-rate measure, this makes the model reproduce observed bank deposit and loan rates exactly at each date.

**Estimating the MMF portfolio.** Let $V_j^M \equiv p_j S_j^M$ denote beginning-of-period dollar holdings. MMF demand then satisfies, from (55),

$$\log\left(\frac{V_j^M}{V_o^M}\right) = \log\left(\frac{\gamma_j^M}{\gamma_o^M}\right) + (1-\eta_M)\log\left(\frac{p_j}{p_o}\right). \tag{83}$$

This equation is estimated on Treasuries and agencies relative to repo and other short-term paper, with the return on the residual short-term category proxied by the federal funds rate, instrumented with Federal Reserve Treasury holdings and the federal funds rate. The MMF is competitive, so its operating cost $c_{M,t}$ is recovered year by year as the residual that reconciles the CES price index with the observed MMF rate.

**Estimating nonbank lender funding.** The household-NBL funding system is

$$\log\left(\frac{S_{\text{sec}}^{L,h}}{S_{\text{nbl}}^{L,h}}\right) = \log\left(\frac{\gamma_{\text{sec}}^{L,h}}{\gamma_{\text{nbl}}^{L,h}}\right) - \eta_{L,h}\log\left(\frac{\bar{p}_{\text{age}}}{\bar{p}_{\text{nbl}}}\right), \tag{84}$$

where $\bar{p}_j = 1 + r_j$ is the issuer price and the instruments are the same as in the MMF system. Because the dependent variable is a ratio of funding principal rather than end-of-period repayment values, the IV slope identifies $-\eta_{L,h}$, so $\widehat{\eta}_{L,h} = -\widehat{b}_h$. The firm-NBL equation is analogous and implies $\widehat{\eta}_{L,f} = -\widehat{b}_f$. In the annual cost recovery, the firm-NBL lending rate is proxied by the AAA corporate bond yield. Operating costs are recovered year by year from

$$c_{M,t} = r_{M,t} - r_{M,t}^{ud}, \tag{85}$$

$$c_{L,k,t} = r_{n,t}^k - \tilde{r}_{n,t}^k. \tag{86}$$

**Identification.** The portfolio elasticities $\eta_B$, $\eta_M$, $\eta_{L,h}$, and $\eta_{L,f}$ are identified from time-series variation in relative returns under Federal Reserve balance-sheet and federal-funds-rate instruments. The bank pass-through elasticities and regulatory wedges are identified from the response of product rates to the shadow cost of funds under monetary-policy and federal-funds instruments. Operating costs are exactly identified as first-order-condition residuals given the structural parameters.

**From estimates to main-text parameters.** The rows of Table 3 are obtained as follows. The bank securities elasticity is one minus the IV slope in column (2) of Table A8 ($-21.77 \to \widehat{\eta}_B = 22.77$). The within-class elasticities apply the pass-through mappings to the IV slopes of Table A9: for loans, $\sigma_{L,j} = b/(b-1)$ ($1.67 \to 2.49$ for households, $1.64 \to 2.57$ for firms); for deposits, $\sigma_{D,j} = 1/(1-b)$ ($0.29 \to 1.41$ and $0.85 \to 6.55$); the pass-through columns of the main-text table report the slopes $b$ themselves. The regulatory parameters $(\beta_L, \beta_K, \lambda, \kappa)$ and constant margins are the GMM estimates with no transformation. The MMF elasticity is one minus the IV slope in column (2) of Table A10 ($-13.6 \to \widehat{\eta}_M = 14.6$), and the NBL funding elasticities are the negatives of the IV slopes in columns (4) and (6) ($\widehat{\eta}_{L,h} = 15.2$, $\widehat{\eta}_{L,f} = 4.9$). Operating costs are the 2019 values of the year-specific inversions.

**Table A8: Bank securities portfolio (CES demand).** OLS and IV estimates of (81) on quarterly Financial Accounts data, reserves as numeraire. The IV slope on the relative price identifies $1 - \eta_B$. Instruments: Federal Reserve Treasury holdings and the federal funds rate, interacted with asset-class indicators. Standard errors in parentheses.

| | OLS | IV |
|---|---|---|
| log relative price | -17.154*** | -21.774*** |
| | (2.217) | (2.734) |
| Treasury | -1.297*** | -1.378*** |
| | (0.080) | (0.085) |
| Agency | -0.422*** | -0.540*** |
| | (0.090) | (0.099) |
| Corporate | -1.471*** | -1.603*** |
| | (0.095) | (0.105) |
| NBL claims | -2.892*** | -3.031*** |
| | (0.097) | (0.108) |
| Pre-2008 | 2.984*** | 3.019*** |
| | (0.063) | (0.064) |
| Num.Obs. | 756 | 756 |
| R2 | 0.810 | 0.809 |

* p < 0.1, ** p < 0.05, *** p < 0.01

**Table A9: Bank within-class pass-through (Stage 0 IV).** First-differenced OLS and IV regressions of product rates on the bank shadow cost of funds, for household loans, firm loans, household deposits, and firm deposits. The IV slope $b$ on $\Delta\tilde{r}$ maps to within-class elasticities through $\hat{\sigma}_{L,j} = b/(b-1)$ for loans and $\hat{\sigma}_{D,j} = 1/(1-b)$ for deposits. All four specifications use a single constant pass-through coefficient. Standard errors in parentheses.

| | HH loans OLS | HH loans IV | Firm loans OLS | Firm loans IV | HH dep. OLS | HH dep. IV | Firm dep. OLS | Firm dep. IV |
|---|---|---|---|---|---|---|---|---|
| Δ shadow rate | 1.390*** | 1.671*** | 1.364*** | 1.637*** | 0.573*** | 0.289 | 0.970*** | 0.847*** |
| | (0.113) | (0.135) | (0.110) | (0.132) | (0.068) | (0.228) | (0.075) | (0.210) |
| Constant | 0.001 | 0.001 | 0.001 | 0.001 | -0.001 | -0.001 | 0.000 | -0.000 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Num.Obs. | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| R2 | 0.821 | 0.787 | 0.823 | 0.790 | 0.681 | 0.514 | 0.836 | 0.823 |

* p < 0.1, ** p < 0.05, *** p < 0.01

**Table A10: Nonbank intermediary CES demand.** OLS and IV estimates of the MMF portfolio (83) (columns 1–2), the household-NBL funding system (84) (columns 3–4), and the firm-NBL funding system (columns 5–6). The MMF IV slope identifies $1-\eta_M$, whereas the household- and firm-NBL IV slopes identify $-\eta_{L,h}$ and $-\eta_{L,f}$, respectively. Instruments: Federal Reserve Treasury holdings and the federal funds rate. Standard errors in parentheses.

| | MMF OLS | MMF IV | NBL-HH OLS | NBL-HH IV | NBL-Firm OLS | NBL-Firm IV |
|---|---|---|---|---|---|---|
| MMF rel. price | -11.069*** | -13.637*** | | | | |
| | (3.661) | (4.472) | | | | |
| MMF Treasury | -2.089*** | -2.126*** | | | | |
| | (0.078) | (0.087) | | | | |
| MMF Agency | -2.137*** | -2.194*** | | | | |
| | (0.100) | (0.115) | | | | |
| HH-NBL rel. price | | | -15.238*** | -15.164*** | | |
| | | | (2.928) | (3.536) | | |
| HH-NBL ABS | | | 4.718*** | 4.718*** | | |
| | | | (0.036) | (0.037) | | |
| Firm-NBL rel. price | | | | | -5.602** | -4.886* |
| | | | | | (2.385) | (2.675) |
| Firm-NBL corp. | | | | | 5.028*** | 5.028*** |
| | | | | | (0.030) | (0.030) |
| Num.Obs. | 322 | 322 | 161 | 161 | 161 | 161 |
| R2 | 0.029 | 0.027 | 0.146 | 0.146 | 0.034 | 0.033 |

* p < 0.1, ** p < 0.05, *** p < 0.01

## D.4 Foreign Investors

With Treasuries as the numeraire, the demand system (22) implies

$$\log\left(\frac{q_j^W}{q_{\text{tre}}^W}\right) = \log\left(\frac{\alpha_j^W}{\alpha_{\text{tre}}^W}\right) + (1-\sigma^W)\log\left(\frac{p_j}{p_{\text{tre}}}\right), \tag{87}$$

estimated on annual foreign holdings of agency MBS, corporate bonds, and equity relative to Treasuries. Because $q_j^W$ is a dollar holding, the exponent in (87) is $1-\sigma^W$. The relative price is instrumented with Federal Reserve Treasury holdings and the federal funds rate,

each interacted with asset-class indicators. Corporate-bond and equity indicators control for their average relative holdings compared with the agency-MBS base. Because foreign wealth cancels from the holding ratios, the year fixed effects do not absorb variation in $M^W$; instead, they absorb a common time-varying shift in non-Treasury holdings relative to Treasuries, including common denominator measurement. The IV slope identifies $1 - \sigma^W$. Conditional on that elasticity, the four CES weights and $M^W$ are jointly calibrated to reproduce the gross 2019 foreign holdings exactly and are then held fixed in counterfactuals, apart from exercises that proportionally scale the economy.

Table A11 reports the estimates. The IV yields $\hat{\sigma}^W = 18.1$: foreign investors treat U.S. Treasuries, agency MBS, corporate bonds, and equity as close substitutes. The OLS slope is attenuated toward zero ($-9.3$ versus the IV's $-17.1$), consistent with relative prices co-moving with demand shifts. The asset-class dummies are positive, indicating that, conditional on returns, foreign investors tilt toward corporate bonds and equity relative to the agency-MBS base.

**From estimates to main-text parameters.** The foreign elasticity reported in Table 3 is one minus the IV slope in column (2) of Table A11 ($-17.1 \to \widehat{\sigma}^W = 18.1$). The portfolio weights $\alpha_j^W$ and foreign wealth $M^W$ do not come from this regression; they are calibrated to reproduce gross 2019 foreign holdings exactly, as described above.

**Table A11: Rest-of-World CES demand.** OLS and IV estimates of (87), using foreign holdings of agency MBS, corporate bonds, and equity relative to Treasuries. The IV slope on relative price identifies $1 - \sigma^W$. Instruments are Federal Reserve Treasury holdings and the federal funds rate, interacted with asset-class indicators. Year fixed effects are included. Standard errors are in parentheses.

| | OLS | IV |
|---|---|---|
| log relative price | -9.269* | -17.083*** |
| | (4.691) | (5.539) |
| Corporate | 1.073*** | 1.037*** |
| | (0.067) | (0.069) |
| Equity | 1.151*** | 0.846*** |
| | (0.194) | (0.226) |
| Num.Obs. | 120 | 120 |
| R2 | 0.913 | 0.910 |

* p < 0.1, ** p < 0.05, *** p < 0.01

# E Demand-Curve Construction and Shift Details

This section supports Section 4. It details the construction of the aggregate demand curves and their accuracy checks, reports the aggregate balance sheet behind the direct and indirect channels of Section 4.2, states each characteristic transformation and the restrictions it is verified against, and plots the shifted schedules for every exercise.

## E.1 Demand-Curve Construction

Each schedule in Section 4 varies one own rate and reports the resulting aggregate demand. Both sectors' own rates move together, and they move *proportionally*: the household and firm deposit rates are set to $m\, r^{h}_{\text{dep}}$ and $m\, r^{f}_{\text{dep}}$ for a common multiplier $m$, and the bank-loan schedule scales the two loan rates the same way. Proportional scaling rather than a common additive shift is what makes the two sectors comparable. Demands in the model are constant-elasticity in log rates, so an equal $d \log r$ is an equally sized shock to each sector even though the levels differ—the firm deposit rate is roughly twice the household deposit rate at the 2019 equilibrium. At $m = 1$ the construction returns the observed equilibrium rates and therefore reproduces the equilibrium exactly. The curves in the paper use $m \in [1/2,\, 3/2]$.

The elasticities reported in Section 4 are centered log-log slopes of a schedule at $m = 1$, formed from the grid points on either side of it. The baseline elasticity uses the 2019 schedule; the shifted elasticity uses the reweighted population's general-equilibrium schedule, each evaluated at its own equilibrium. Both are aggregate objects. Because aggregate demand adds the individual schedules, the aggregate elasticity is a demand-weighted average of individual elasticities, so reweighting the population changes it even when no individual elasticity changes.

Two constructions appear in Section 4. The general-equilibrium schedule pins the two own rates at $m$ times their equilibrium values through the solver's rate-fixing hook, which replaces the corresponding bank pricing conditions, and re-solves the remaining system: every other rate and every other market clears. Each point is therefore a conditional general-equilibrium fixed point, and it costs one full solve. The partial-equilibrium schedule instead evaluates household and firm demand directly at the scaled own rates with every other rate held at its 2019 equilibrium value. Its firm block replicates the general-equilibrium firm problem outside the solver: CES demands give the required return on assets, the Tobin's-$q$ condition $\mathcal{Q}^{i} = 1$ is inverted for the type-specific return on real capital, and that return determines the scale of capital along the type's schedule. The inversion uses the same routine

as the solver, so the two blocks cannot drift apart.

The programs check this at every stage. At $m = 1$ the partial-equilibrium evaluation reproduces the cached 2019 household and firm quantities to machine precision, and so does the pinned general-equilibrium solve. In each comparative static, the path from individual household rows to predicted preferences reproduces the baseline exactly before any characteristic is changed, the partial-equilibrium replica reproduces the shifted equilibrium at its own rates, and the $m = 1$ point of the shifted general-equilibrium schedule reproduces the unconstrained shifted equilibrium to within $10^{-5}$ in relative terms. Grid points at which the firm block reaches a CES corner are dropped rather than extrapolated; none occurred in the exercises reported here.

### E.2 The Aggregate Balance Sheet in 2019

Table A12 reports the gross financial balance sheets behind the discussion in Section 4.2: each nonfinancial sector's financial claims held and issued in 2019, in trillions of dollars, using the same Flow-of-Funds definitions as the model's calibration. Household holdings of each security are the residual of market clearing—total supply less the Fed, foreign, money-fund, and bank positions—exactly as in the calibration. Foreign positions in corporate bonds and equity are net of foreign issuance held domestically, the convention those residuals use; government borrowing is gross marketable Treasury debt. Firm savings are deposits and money-fund shares, the financial-asset aggregate the firm demand system prices; real capital is what the claims finance, not itself a claim held. The two sides' totals differ by the net position of the intermediary sectors, whose balance sheets the table consolidates away: deposits and money-fund shares held by savers, net of the securities and loans those intermediaries hold.

### E.3 Household Shifts

Household characteristics are changed at the level of individual survey households, not of cells. Scaling net worth multiplies each household's raw and Financial-Accounts-scaled wealth by a common factor. The wealth-concentration exercise applies a rank-preserving monotone transform of log wealth that raises the top-one-percent share to its target while holding aggregate wealth, survey weights, and ages fixed. The age-level exercise adds a constant to every household's age, holding weights and both wealth measures fixed. The age-dispersion exercise tilts survey weights in the upper tail to raise the weighted standard

**Table A12: Aggregate gross financial balance sheets, 2019 ($ trillions).** Financial claims held (savings) and issued (borrowing) by nonfinancial sector, from the Financial Accounts of the United States, using the model-consistent definitions described above. Household security holdings are market-clearing residuals; ROW corporate-bond and equity positions are net of foreign issuance; government borrowing is gross marketable Treasuries.

| Savings (claims held) | | Borrowing (claims issued) | |
|---|---|---|---|
| **Households** | **67.2** | **Households** | **14.3** |
| Deposits | 12.9 | Bank loans | 5.3 |
| Money funds | 2.1 | Nonbank loans | 9.0 |
| Treasuries | 5.2 | | |
| Agency MBS | 2.0 | | |
| Corporate bonds | 7.5 | | |
| Equity | 37.5 | | |
| **Firms** | **2.1** | **Firms** | **47.2** |
| Deposits | 1.5 | Bank loans | 2.1 |
| Money funds | 0.6 | Nonbank credit | 8.8 |
| | | Equity | 36.3 |
| **ROW** | **7.4** | **Government** | **16.2** |
| Treasuries | 6.7 | Treasuries | 16.2 |
| Agency MBS | 1.2 | | |
| Corporate bonds (net) | 0.7 | | |
| Equity (net) | -1.2 | | |
| **Total** | **76.7** | **Total** | **77.6** |

deviation of age by half while holding the weighted mean age, total population, and aggregate wealth fixed. Figures A5 and A6 show the wealth and age exercises on the deposit and financing margins.

### E.4 Firm Shifts

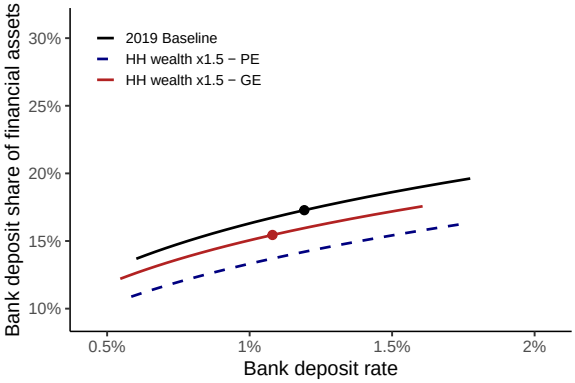
Firm characteristics enter through the cell-level productivity intercepts $\zeta_t^i$ of the capital schedule; Figure A7 reports both exercises. Because $\zeta_t^i$ is a log intercept, adding $\eta_K \log \mu$ to every cell multiplies every cell's capital schedule by $\mu$ at fixed prices without changing the industry or size composition of capital; this is the productivity exercise. The concentration exercise instead adds $\eta_K \log \mu_{\text{top}}$ to the large-firm cells and $\eta_K \log \mu_{\text{rest}}$ to the others, with

$$\mu_{\text{top}} = \frac{\tau^*}{\tau_0}, \qquad \mu_{\text{rest}} = \frac{1-\tau^*}{1-\tau_0},$$

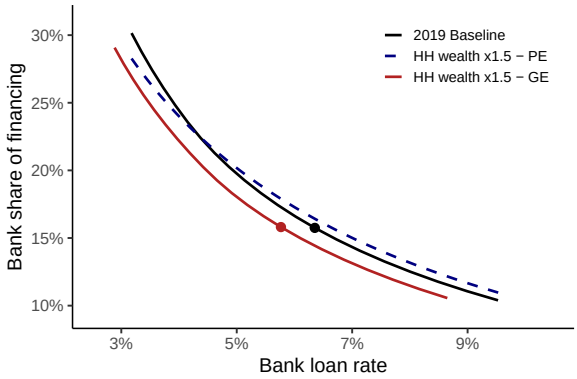
where $\tau_0$ is the baseline large-firm share of capital and $\tau^*$ its target. These capital multipliers raise the large-firm share to $\tau^*$ while leaving aggregate capital at baseline cell prices unchanged and preserving relative capital shares within each group, so the exercise moves

**Figure A5:** Household wealth and the bank share of each market

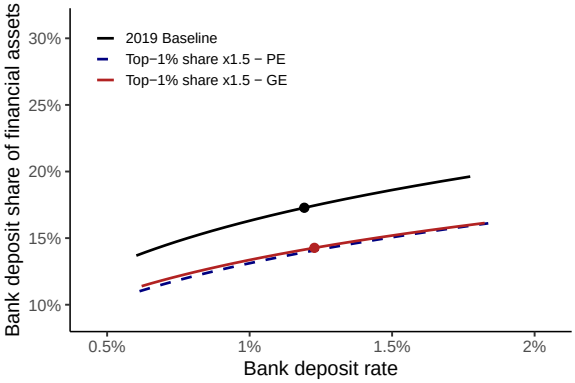
The vertical axis is banks' share of the market named in each panel, and the two columns share one scale, so their slopes are comparable. Each panel shows the 2019 baseline schedule (black), the shifted schedule at baseline cross-prices (navy dashed, PE), and the shifted schedule with all other markets re-cleared (red, GE); dots mark the two equilibria. Bank loans are measured against private-sector financing, which includes firm equity. The first row scales every household's net worth by 1.5; the second scales the top-one-percent wealth share by 1.5 at fixed aggregate wealth.



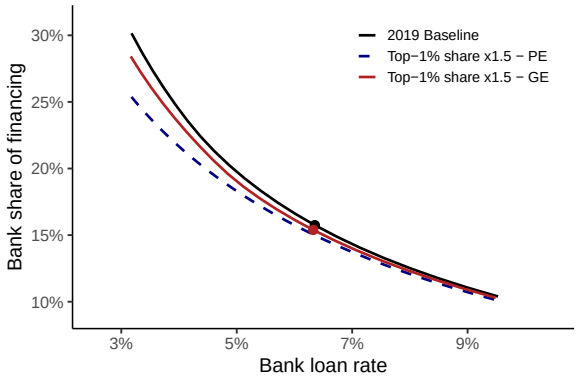

(a) Net worth: deposit




(b) Net worth: loan



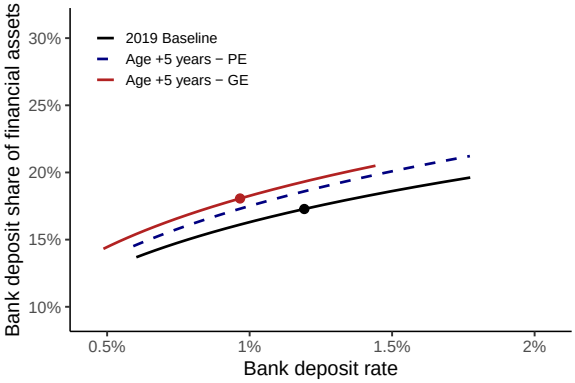

(c) Top-1% share: deposit



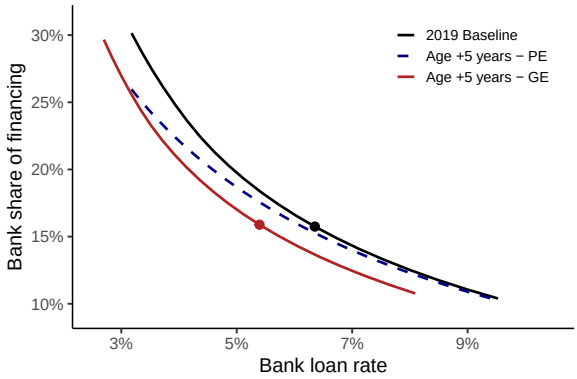

(d) Top-1% share: loan

**Figure A6:** Household age and the bank share of each market

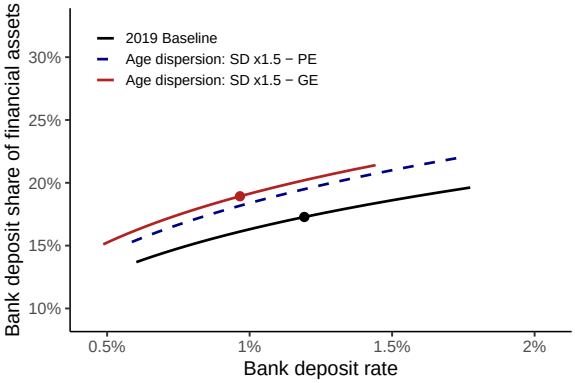
The vertical axis is banks' share of the market named in each panel, and the two columns share one scale, so their slopes are comparable. Each panel shows the 2019 baseline schedule (black), the shifted schedule at baseline cross-prices (navy dashed, PE), and the shifted schedule with all other markets re-cleared (red, GE); dots mark the two equilibria. Bank loans are measured against private-sector financing, which includes firm equity. The first row raises every household's age by five years; the second scales the standard deviation of age by 1.5 at a fixed mean.



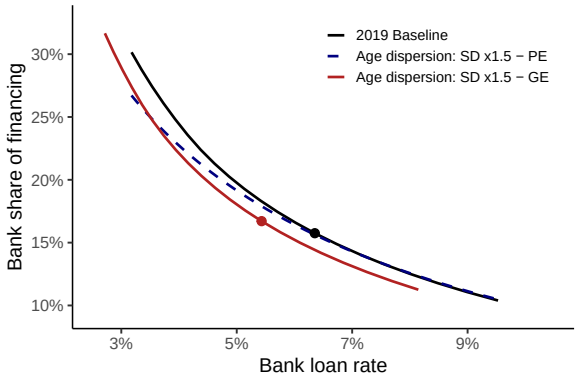

(a) Age level: deposit




(b) Age level: loan




(c) Age dispersion: deposit

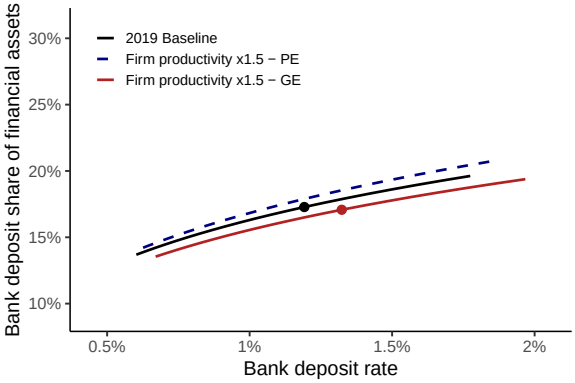



(d) Age dispersion: loan

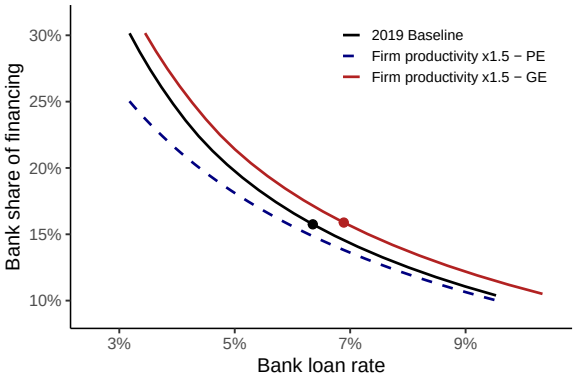
composition and nothing else. Large firms are the three largest corporate size brackets together with the non-manufacturing universe cells. Both transforms are verified against these restrictions before they are used.

**Figure A7:** Firm productivity, concentration, and the bank share of each market

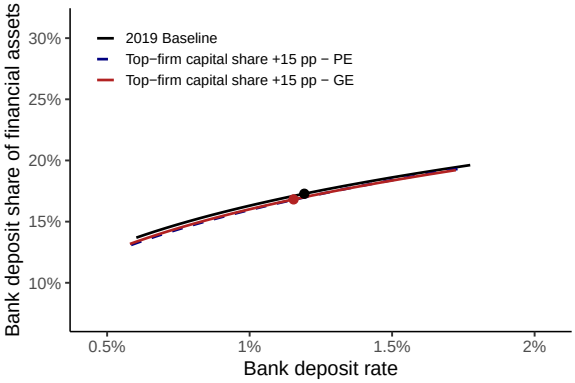
The vertical axis is banks' share of the market named in each panel, and the two columns share one scale, so their slopes are comparable. Each panel shows the 2019 baseline schedule (black), the shifted schedule at baseline cross-prices (navy dashed, PE), and the shifted schedule with all other markets re-cleared (red, GE); dots mark the two equilibria. Bank loans are measured against private-sector financing, which includes firm equity. The first row multiplies every firm cell's productivity by 1.5; the second raises the capital share of large firms by 15 percentage points at fixed aggregate capital.



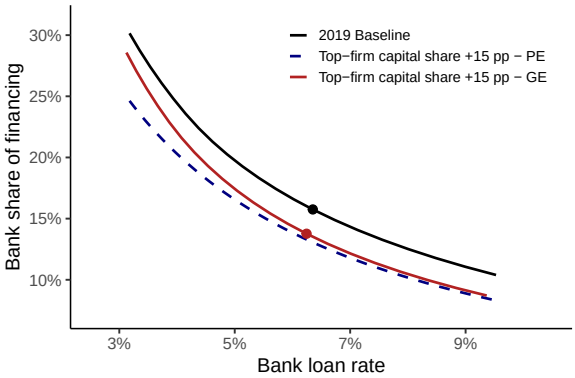

(a) Productivity: deposit




(b) Productivity: loan




(c) Top-firm share: deposit




(d) Top-firm share: loan

# F Additional Results for the Historical Application

This section supports the historical exercise in Section 5.1. Figure A8 reports the price counterpart to the quantity and balance-sheet outcomes in Figure 10 and underlies the rate discussion there. The decomposition uses the same four equilibria and reports each rate or spread as its 2019 value minus its constructed 1980 value.

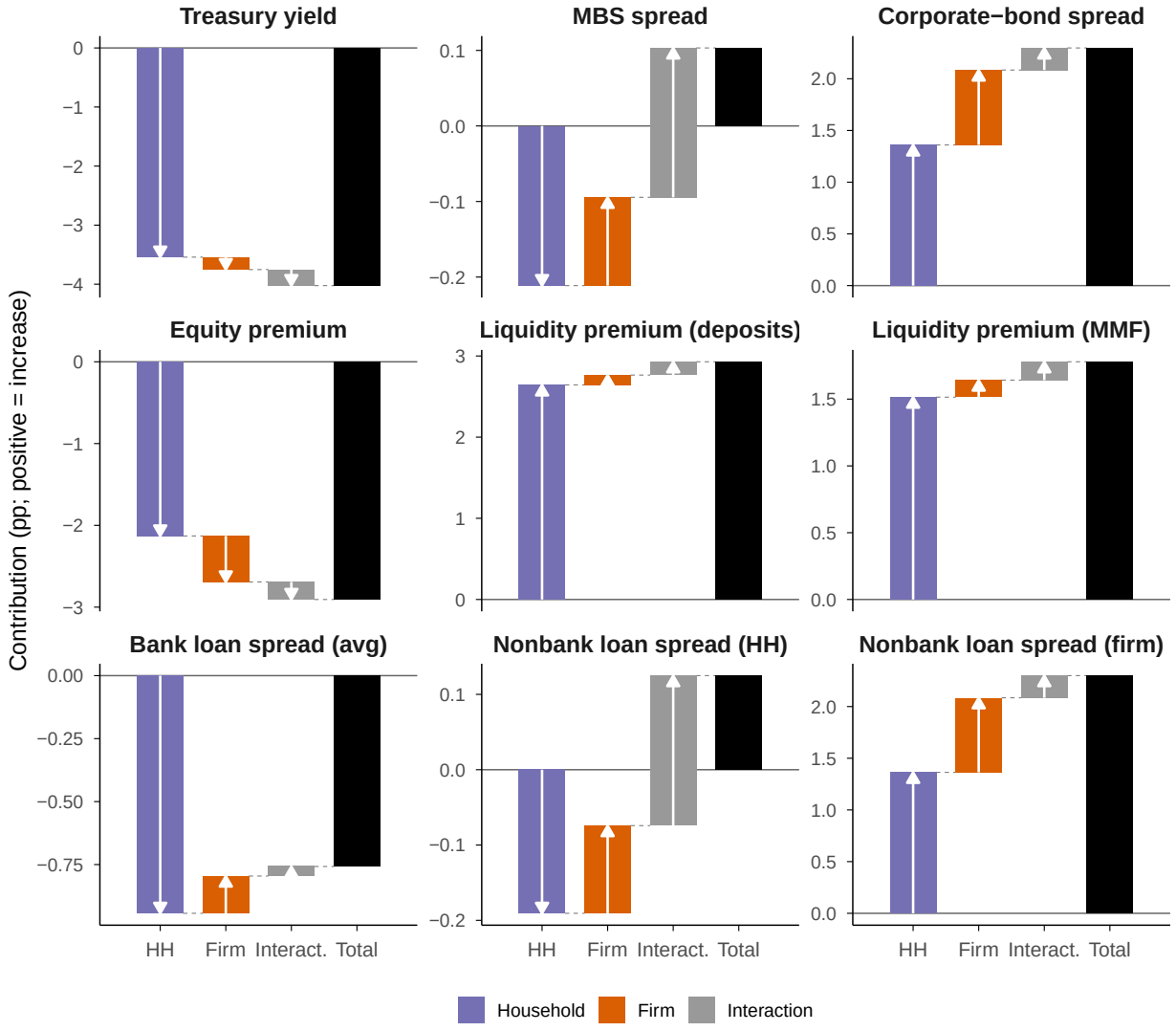



**Figure A8: 1980-to-2019 equilibrium rates and spreads.** Household, firm, and interaction contributions to each rate or spread, computed as the 2019 value minus the 1980 value (positive = higher in 2019). The first panel reports the Treasury yield; the others report spreads over it. Deposit and bank-loan rates are quantity-weighted household–firm averages.

# G Government Borrowing: Supplemental Material

This section supports the government-borrowing exercise in Section 6. The first subsection derives the first-order decomposition behind Table 5 and the bank loan-rate decomposition behind Table 4; the second reports the yield responses in proportional terms; the third quantifies the revaluation of existing holdings that the baseline experiment holds fixed. Throughout, exposures are evaluated at the baseline equilibrium and $d\log r$ denotes the equilibrium change in a rate between the baseline and counterfactual solves.

## G.1 First-Order Decomposition of Real Effects

**Firm investment.** Type-level capital satisfies $\log K^i = (\zeta_t^i - \log r^i_{\text{real}})/\eta_K$ from (13), so $d\log K^i = -(1/\eta_K)\, d\log r^i_{\text{real}}$. Differentiating the asset-service condition $z_s P^i = R_A^{\text{req},i}$ from (50) at fixed $z_s$, and using the CES share expressions (43),

$$d\log r^i_{\text{real}} = \frac{1}{s^i_{\text{real}}}\Big[d\log R_A^{\text{req},i} - s^i_{\text{fin}}\, d\log R^i_{\text{fin}}\Big]. \tag{88}$$

By the envelope theorem on the leverage first-order condition (41), the required return (12) responds to rates only through the direct terms, $dR_A^{\text{req},i} = (1-s_E^i)\, dR_D^i + s_E^i\, dr_E$, and the debt cost index satisfies $d\log R_D^i = \omega_b^i\, d\log r_b^f + \omega_n^i\, d\log r_n^f$ with $\omega_j^i$ the type's debt cost shares. Collecting terms,

$$d\log K^i = -\frac{1}{\eta_K\, s^i_{\text{real}}}\Bigg[\underbrace{\frac{(1-s_E^i)R_D^i}{R_A^{\text{req},i}}\big(\omega_b^i\, d\log r_b^f + \omega_n^i\, d\log r_n^f\big)}_{\text{credit cost}} + \underbrace{\frac{s_E^i\, r_E}{R_A^{\text{req},i}}\, d\log r_E}_{\text{equity cost}} - \underbrace{s^i_{\text{fin}}\, d\log R^i_{\text{fin}}}_{\text{financial income}}\Bigg]. \tag{89}$$

**Household consumption.** The debt-service constraint fixes $\mathcal{B}^i R_b^i$ given demographics, so borrowing responds one-for-one to the borrowing cost index: $d\log \mathcal{B}^i = -\big(s_b^i\, d\log r_b^h + s_n^i\, d\log r_n^h\big)$, with $s_j^i$ the borrowing cost shares. From the consumption–saving nest (38), consumption is $c^i = (\gamma_c^i)^{\sigma^h}(w^i + \mathcal{B}^i)(R^i)^{1-\sigma^h}$, and the outer index responds to the saving return with elasticity equal to the effective saving share, $d\log R^i = s^i_{\text{save}}\, d\log R_s^i$ with $s^i_{\text{save}} = S^i/(w^i + \mathcal{B}^i)$, while $d\log R_s^i = \sum_k s_k^i\, d\log r_k^h$ over the household's portfolio value shares.

Hence

$$d\log c^i = \underbrace{\frac{\mathcal{B}^i}{w^i + \mathcal{B}^i}\, d\log \mathcal{B}^i}_{\text{borrowing capacity}} + \underbrace{(1-\sigma^h)\, s^i_{\text{save}} \sum_k s^i_k\, d\log r^h_k}_{\text{saving return}}. \tag{90}$$

**Aggregation by segment.** For an outcome $X \in \{K, c\}$, partition types into segments $g$ (firm size groups; household wealth–age groups) with baseline weights $w_g = X_g/X$. To first order,

$$d\log X = \sum_g w_g\, d\log X_g, \qquad d\log X_g = \sum_c \Lambda^g_c, \tag{91}$$

where $\Lambda^g_c$ is the $X$-weighted mean of the channel-$c$ contributions (89)–(90) within segment $g$. Heterogeneity matters for the aggregate through the cross-segment dispersion of the $\Lambda^g_c$ and the reallocation of weights across segments under the shock. Table 5 reports, for each segment and for both the 2019 and 1980 economies, the combined channel contributions, the segment total $d\log X_g$, and its baseline weight $w_g$; the "Aggregate GE" row is the actual equilibrium change, which differs from $\sum_g w_g \sum_c \Lambda^g_c$ only by higher-order terms and within-type share adjustments.

**Comparing economies.** The same segment decomposition (89)–(91) is evaluated for the 1980 economy and reported alongside the 2019 economy in Table 5, so the cross-economy difference in any channel or total is read directly off the two blocks of columns. A channel's aggregate contribution differs across economies both because the equilibrium rate responses differ (the 1980 shock is larger and reprices instruments in different proportions) and because the baseline exposures and the composition of the outcome across segments differ (large corporates are 63% of the 2019 capital stock but only 21% of the 1980 stock); Section 6.2 reads both margins off the table.

**Bank loan-rate decomposition.** Section 6.1 attributes the loan-rate response to an interest-rate channel and a bank channel. With operating costs fixed, the bank pricing

conditions give

$$\Delta r^j_{b,B} = \underbrace{\Delta r^S_B}_{\text{interest-rate channel}} + \underbrace{\underbrace{\frac{1}{\sigma_{L,j}-1}\Delta r^S_B}_{\text{market power}} + \underbrace{\frac{\sigma_{L,j}}{\sigma_{L,j}-1}\Delta W_B}_{\text{regulatory wedge}}}_{\text{bank channel}}, \tag{92}$$

$$W_B = \frac{\beta_L(\lambda-\psi)}{D_B} + \frac{\beta_K\phi(\kappa-\phi)}{L_B}.$$

Here $r^S_B$ is the return on the bank's liquid-securities portfolio and therefore the opportunity cost of lending; its one-for-one pass-through is the interest-rate channel. Loan-market power scales the same change by $1/(\sigma_{L,j}-1)$, so amplification is larger the less substitutable banks are and vanishes as $\sigma_{L,j}$ grows, and changes in the liquidity and capital wedges pass through at the markup $\sigma_{L,j}/(\sigma_{L,j}-1)$. Table 4 reports each component for both economies.

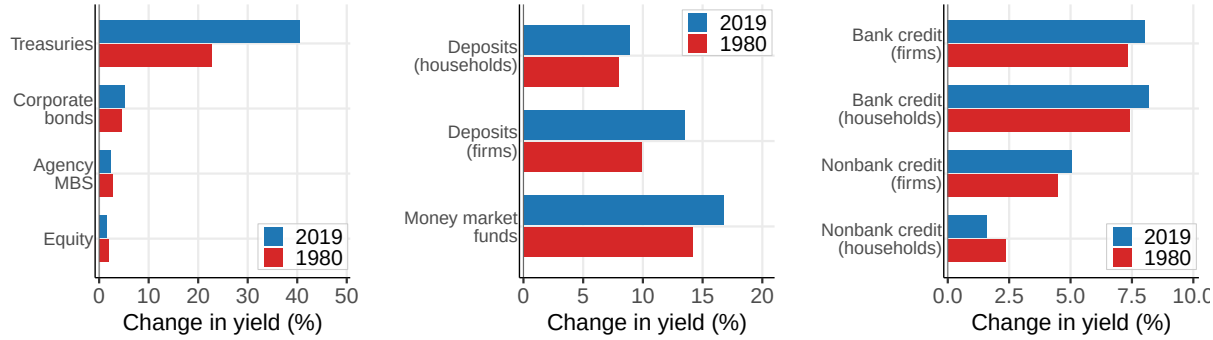
### G.2 Proportional Yield Changes

Figure 14 reports the change in each yield in percentage points, which is the object the loan-rate decomposition (92) and the incidence calculations of Section 6 operate on. Firms' and households' demands, however, are constant-elasticity in log rates, so the proportional change matters for quantities. The two readings differ because baseline rates differ—between instruments within an economy, and between the 2019 and 1980 economies, where rates start between 1.4 and 2.2 times as high.

Figure A9 repeats the three panels with the proportional change on the horizontal axis. Two comparisons reverse. The Treasury yield rises more in 1980 in percentage points but far less in proportional terms, because its 1980 base is more than twice as high; bank loan rates likewise rise more in level and slightly less in proportion. Both reversals come from the same source: where the elastic bank sector absorbs more of the new supply, the Treasury market clears with a smaller proportional move, and more of the adjustment surfaces in the securities banks hold. Three instruments have larger proportional responses in 1980: agency MBS—the security banks hold most—equity, and nonbank household credit, which is funded by agency securitization and so inherits the MBS repricing.

### G.3 Revaluation of Existing Holdings

The baseline exercise holds the value of outstanding securities fixed. Higher equilibrium yields, however, reduce the value of existing holdings. Because claims are one period, with




(a) Market and asset yields (b) Deposit and MMF yields (c) Cost of credit

**Figure A9: Government borrowing: proportional yield responses.** Percent change in each equilibrium yield under the same proportional Treasury-supply shock in the 2019 and constructed 1980 economies. Figure 14 reports the same responses in percentage points. Produced by `code/gov_borrowing_price_diagnostics.r`.

$P = 1/(1+r)$, the internally consistent capital loss is the model's equilibrium price change. That price change is determined by the supply shock and demand elasticity, not by an assumed duration.[9] Revaluation is modest: outstanding Treasuries lose 1.4% of value in 2019 and 1.6% in the constructed 1980 economy; losses on agency, corporate, and equity claims are smaller.

Table A13 assigns these losses according to security holdings, looking through MMFs to their household and firm shareholders. Outstanding loans and deposits remain at par, so the calculation has no liability or issuer side. Households bear the largest loss in 2019, $138 billion including their MMF exposure. The loss is concentrated at the top of the wealth distribution: the top 1% bear $46 billion, about one-third of the household total, and the top decile bears $104 billion, about three-quarters. Foreign investors lose $122 billion on gross holdings, the Federal Reserve $35 billion, banks $12 billion, and firms $6 billion through MMFs. Across holders, the market value of outstanding Treasuries falls $227 billion. The government's outstanding debt falls in value by the same amount, which is the fiscal counterpart of the losses borne by security holders.

Stock and flow incidence fall on different households. Through the flow channel, consumption falls only for leveraged, less-wealthy young households ($-0.19\%$), while older and wealthier households gain 0.3–0.5% from higher saving returns. Revaluation instead falls on

[9] A longer assumed duration would rescale the *yield* change required to clear the same quantity, not the equilibrium price change. Applying a duration adjustment to that price change would therefore double count. Large realized bond losses, as in 2022, instead reflect *exogenous* yield shocks—a different experiment from a supply increase that the market absorbs endogenously.

security holders, with three-quarters of the household loss borne by the top wealth decile. Feeding these losses back into net worth reverses the aggregate consumption response from $+0.13\%$ to $-0.05\%$. Government borrowing therefore affects young borrowers through rates and wealthy savers through asset prices.

Re-solving after subtracting the losses from household net worth and bank equity leaves the main transmission nearly unchanged (Table A14). In 2019, investment falls an additional 0.24 percentage points, and yields move by only one or two basis points. Consumption is the exception: the wealth loss reduces it by 0.18 percentage points, reversing the sign of the aggregate response. Feedback is somewhat larger in the constructed 1980 economy. Thinner bank capital converts a similar securities loss into a 2.0% decline in bank equity, compared with 0.7% in 2019, and deepens the investment decline by 0.4 points. Even there, valuation feedback remains second order for investment and rates. Abstracting from revaluation is therefore innocuous for aggregate crowding out, but not for the distribution of losses or the sign of the consumption response.

**Table A13:** Government borrowing: incidence of revaluation

Capital losses, in $ billions, on pre-shock security holdings valued at the equilibrium price change $\Delta P = \Delta[1/(1+r)]$. MMF positions are attributed pro rata to household and firm shareholders; deposits, loans, and repo remain at par. Indented rows report losses for the top 1% and top 10% of households by net worth. The bottom row gives the decline in each security's aggregate market value; rest-of-world holdings are gross.

| | Treasury | Agency | Corporate | Equity | Total |
|---|---|---|---|---|---|
| **A. 2019 economy** | | | | | |
| *Price change ($\Delta P/P$): Treasury -1.4%, agency -0.1%, corporate -0.2%, equity -0.1%* | | | | | |
| Households | −74.0 | −2.6 | −15.9 | −45.7 | −138.2 |
| Top 1% | | | | | −45.6 |
| Top 10% | | | | | −103.7 |
| Firms | −6.0 | −0.2 | 0.0 | 0.0 | −6.2 |
| Banks | −9.5 | −1.5 | −1.1 | 0.0 | −12.0 |
| Rest of world | −103.6 | −0.9 | −8.4 | −9.6 | −122.5 |
| Federal Reserve | −33.4 | −1.2 | 0.0 | 0.0 | −34.7 |
| Decline in market value of the stock | −226.5 | −6.4 | −25.4 | −55.3 | −313.5 |
| **B. Constructed 1980 economy** | | | | | |
| *Price change ($\Delta P/P$): Treasury -1.6%, agency -0.2%, corporate -0.3%, equity -0.3%* | | | | | |
| Households | −26.1 | −2.1 | −5.4 | −22.9 | −56.5 |
| Top 1% | | | | | −17.4 |
| Top 10% | | | | | −38.6 |
| Firms | −2.1 | −0.2 | 0.0 | 0.0 | −2.3 |
| Banks | −8.1 | −2.8 | −0.6 | 0.0 | −11.5 |
| Rest of world | −33.6 | −0.7 | −2.1 | −8.6 | −44.9 |
| Federal Reserve | −12.1 | −1.0 | 0.0 | 0.0 | −13.1 |
| Decline in market value of the stock | −82.0 | −6.8 | −8.1 | −31.4 | −128.3 |

**Table A14:** Government borrowing: feedback from revaluation

Outcomes with and without capital losses fed back into household net worth and bank equity. Household losses include look-through MMF exposure. Rates are percentage-point changes; quantities are percent changes.

| | Reval. off (cached) | Reval. on (fixed point) | Feedback (on − off) |
|---|---|---|---|
| **A. 2019 economy** | | | |
| $\Delta r_{\text{tre}}$ (pp) | +1.45 | +1.47 | +0.02 |
| $\Delta r_b^h$ (pp) | +0.52 | +0.53 | +0.01 |
| $\Delta r_n^h$ (pp) | +0.07 | +0.08 | +0.01 |
| Firm capital $K$ (%) | −4.57 | −4.81 | −0.24 |
| HH borrowing (%) | −2.99 | −3.15 | −0.15 |
| HH consumption (%) | +0.13 | −0.05 | −0.18 |
| **B. Constructed 1980 economy** | | | |
| $\Delta r_{\text{tre}}$ (pp) | +1.72 | +1.76 | +0.04 |
| $\Delta r_b^h$ (pp) | +0.83 | +0.87 | +0.05 |
| $\Delta r_n^h$ (pp) | +0.20 | +0.22 | +0.02 |
| Firm capital $K$ (%) | −5.22 | −5.62 | −0.40 |
| HH borrowing (%) | −3.40 | −3.70 | −0.30 |
| HH consumption (%) | −0.05 | −0.32 | −0.27 |