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

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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 aggregate 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."

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Financial systems differ in how much saving and borrowing passes through banks rather than markets and nonbank intermediaries, and this mix varies widely across countries and over time (Figure 1).[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 and firm composition shape equilibrium financial structure and shock transmission?

[1] Goldsmith (1955) measured how the size and composition of financial institutions and claims differ across advanced economies, and Goldsmith (1958) documented the shifting shares of U.S. intermediaries from 1900 to 1952.

[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.

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. Reaggregating individual demand curves over alternative populations changes aggregate demand level and slope.

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 impact 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 Fed-

eral 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 characteristic-dependent demand curves. Reaggregating them over alternative household and firm populations lets us quantify how composition shapes both equilibrium financial structure and the response to a common shock.

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 two counterfactual applications, which reaggregate the same demand system over alternative household and firm distributions to study the resulting financial structure and responses to a common shock.

Household and firm characteristics systematically shift demand on both sides of bank intermediation. 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. Smaller firms place more weight on financial assets and,

within them, on deposits, consistent with a working-capital role that declines with size. Real and financial assets are gross complements. 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. Each curve sums type-specific demand over the population. In consequence, changes in composition alter both the level and slope 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 financial structure 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 equilibria. 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 10 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 common shock: an increase in marketable Treasury supply equal to 10 percent of GDP. We trace its absorption by the financial system and its transmission to private investment. The new debt can be absorbed directly by households and foreign investors or indirectly through intermediaries. Saver composition determines demand for Treasuries relative to other claims and therefore which absorption route dominates. Direct absorption primarily reprices market claims. When intermediaries absorb the debt, Treasuries also displace private claims from their balance sheets. In 2019, most new Treasuries are absorbed directly, and the resulting repricing raises banks' opportunity cost of lending. Because banks set loan rates at a markup over marginal cost, this increase is amplified into bank borrowing rates, while competitively priced nonbank credit reprices substantially less. Given the approximately unit-elastic demand for bank credit, the larger increase in bank loan rates produces a substantial quantity response: banks reduce lending by \$1.22 for every dollar of securities they add. The contraction in bank credit reduces firm investment. Borrower composition determines the incidence of the shock: bank-dependent firms contract more than firms with market access, while leveraged, younger, and less-wealthy households lose from tighter borrowing conditions and older and wealthier savers gain from higher returns.

Real-sector composition changes both how the shock is absorbed and who is exposed to it. In the constructed 1980 economy, younger and poorer households absorb only about half as much of the new debt directly, while banks absorb twice their 2019 share. More government debt therefore passes through bank balance sheets, raising banks' marginal cost of lending and amplifying the loan-rate response: bank loan rates rise by roughly 0.8 percentage points rather than 0.5. Exposure also differs. Substantially more capital is held by bank-dependent firms, and leveraged young households account for a larger share of consumption. Firm in-

vestment consequently falls more, while aggregate household consumption shifts from a small gain to a small decline. The same real-sector composition that shapes financial structure therefore governs both the shock's path through bank balance sheets and its incidence across households and firms.

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. Financial structure and the transmission of common 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). 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; Haddad and Muir, 2021; Elenev et al., 2021), and models with both banks and shadow banks trace how shocks shift activity between them (Moreira and Savov, 2017; Xiao, 2020). 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 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 examines how Treasury supply affects deposits and bank lending (Phillot, 2025; 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 and aggregates them over alternative real-sector populations. This aggregation allows composition to change both the

level and elasticity of market demand without changing the underlying type-specific demand schedules.

1 Stylized Facts

We present stylized facts about U.S. household and firm balance sheets to motivate our modeling choices. The household facts come from the Survey of Consumer Finances and the firm facts from the Census Quarterly Financial Report, the same two microdata sources we later use to estimate demand. Two features stand out: the same households and firms both save and borrow, and the composition of each side varies systematically with observable characteristics.

1.1 Why Model Gross Balance Sheets

Many macroeconomic models assign saving and borrowing to separate sectors.[3] In the data, however, the same households and firms commonly do both. Saving and borrowing are therefore joint choices on a single balance sheet rather than activities performed by disjoint groups. Figure 3 shows that household debt remains common throughout the financial-wealth distribution, including among households with substantial assets, and that larger debts become more prevalent as wealth rises. Firms exhibit the same coexistence: panels (b) and (c) show positive financial assets and interest-bearing debt throughout the size distribution. Firms do not exhaust liquid assets before borrowing or retire debt before accumulating financial claims; instead, they choose both sides of the balance sheet jointly.

The model must therefore allow households and firms to hold both assets and liabilities rather than assigning them to saver and borrower roles. This design treats saving and credit as joint balance-sheet choices, so a single characteristic can move the two sides in different directions, and it allows banks and markets to serve different functions on each side.

1.2 Characteristics Shape Balance-Sheet Composition

Balance-sheet composition varies systematically across types. Among households, wealth and age shape saving and borrowing in distinct ways (Figure 4). Wealthier households hold less of their financial wealth in deposits and more in equity and private business claims, yet rely more on banks conditional on borrowing. Age profiles are nonlinear: deposit shares

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

are U-shaped, equity shares are hump-shaped, and the bank share of household debt rises with age before flattening. Appendix B.I reports the corresponding balance-sheet levels and multivariate regressions that control for financial risk-taking, sophistication, and saving motives. Firm size likewise predicts composition on both sides of the balance sheet (Figure 5). Larger firms hold less of their liquid assets in deposits and finance less of their debt with bank loans; industry shifts these margins as well.

These facts require the model to track gross balance sheets and type-specific demand on both sides. The imperfect correlation between bank funding and lending shares (Figure 1) further requires intermediaries to carry their own balance sheets and set funding and lending margins separately. Changes in household and firm composition can then shift aggregate financial structure even when the financial environment is fixed.

2 Model

The model traces funds through the gross balance sheets of four sectors: households and firms that save and borrow, the intermediaries that supply the instruments they use, and the government and foreign sectors that supply and absorb securities. Both households and firms are heterogeneous, while intermediaries have multiple types. Figure 6 enumerates the claims that exist in this economy. Each sector's balance sheet shows what it holds and what it issues, so every block in the figure is an asset to one sector and a liability to another, and the figure as a whole is the list of assets whose returns the model has to determine. Households and firms hold positions on both sides of their balance sheets, and their characteristics determine both the scale and the composition of those positions. Intermediaries also hold one another's claims. Banks hold securities alongside loans, and the mortgage-backed and corporate securities that fund nonbank lending are held by banks as well as by households and foreign investors. A dollar of saving can therefore reach a borrower through more than one intermediary, so the bank and market-based channels are linked rather than parallel.

Each of those claims carries a return, and those returns are the model's prices. Households and firms take them as given and choose quantities; banks, which face downward-sloping demand for their own deposits and loans, set their four product rates; and the returns on Treasuries, agency MBS, corporate bonds, equity, and nonbank-lender securities adjust until the demand for each claim equals its supply. Aggregating these heterogeneous balance-sheet choices yields aggregate demand curves for financial claims. Their level helps determine equilibrium financial structure, while their slopes around that equilibrium help determine

how rates and quantities respond to shocks. This section states each block in turn and then defines equilibrium.

2.1 Households

The model contains a population of households indexed by i, who differ in net worth and in the preference parameters introduced below. Endowed with net worth w^i, Household i chooses consumption c^i, a dollar holding $q^i_{s,j}$ 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: 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 the return services of the household's saving claims, $\mathcal{S}^i$. We now give 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 σ^h is the common elasticity of substitution between consumption and saving returns, and (γ^i_c, γ^i_s) are the type's weights on consumption and saving.

Saving services aggregate differentiated asset classes:

$$\mathcal{S}^i \equiv \left(\sum_{j \in J^h_S} \alpha^i_j (r^h_j q^i_{s,j})^{\frac{\sigma^h_S - 1}{\sigma^h_S}}\right)^{\frac{\sigma^h_S}{\sigma^h_S - 1}}, \tag{3}$$

where α^i_j are type-specific weights, r^h_j the class return, and σ^h_S the across-class elasticity.

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

Within each nondeposit class—Treasuries, agency MBS, corporate bonds, equity, and MMF shares—securities are homogeneous and perfectly substitutable. Deposits are the exception: they are differentiated across the banks that supply them, so r^h_{dep} and $q^i_{s,\text{dep}}$ are themselves indices over individual banks. Section 2.3 states that within-class nest, which is common to households and firms and is what makes bank-level demand downward sloping. The structure captures imperfect substitution across claims with different risk, liquidity, and convenience services, and across differentiated bank products.

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

$$\mathcal{B}^i \equiv \left(\sum_{j \in J^h_B} \beta^i_j (q^i_{b,j})^{\frac{\sigma^h_B - 1}{\sigma^h_B}} \right)^{\frac{\sigma^h_B}{\sigma^h_B - 1}}. \tag{4}$$

Nonbank loans are homogeneous, while bank borrowing is again an index over individual banks, given by the same within-class nest. Here β^i_j is the type's weight on borrowing technology j and σ^h_B the elasticity across borrowing classes. The CES structure captures the idea that lending technologies expand the budget constraint differentially because they finance different assets: agency mortgages can finance a modestly priced home but not other purchases.

Four objects vary across types: the consumption–saving weights (γ^i_c, γ^i_s), the saving-class weights α^i_j, the borrowing-class weights β^i_j, and debt-service capacity $\bar{D}^i$. Households are otherwise identical, so every difference in behavior across types traces to these four objects and to net worth w^i.

For notational convenience, let $D^i \equiv \sum_{j \in J^h_B} q^i_{b,j} r^h_j$ denote total debt service and $S^i \equiv \sum_{j \in J^h_S} q^i_{s,j}$ total dollar saving. Solving the program yields the household's demand for each saving and borrowing instrument together with the corresponding return and borrowing-cost indices; Appendix B.II provides the derivation. Summing 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, a dollar holding $q^i_{a,j}$ 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 the cash flow accruing to insiders,

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

Total assets $A^i = K^i + F^i$ are real capital plus financial assets $F^i = \sum_{j \in J^f_A} q^i_{a,j}$, and the constraint is the balance sheet: assets are funded by effective debt $\mathcal{D}^i$ and outside equity, in effective-funding units. Here R^i_A is the effective return on assets, R^i_D the effective cost of debt, and Φ^i a financing friction; outside equity is supplied competitively at required return r_E, so Π^i_E is the cash flow accruing to all equityholders and Π^i_I what remains for insiders. We now give the friction Φ^i, the aggregator behind R^i_A, and the aggregator behind 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 η_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.I derives this condition and the conditional asset and debt demands.

Turn to the asset side. Return services are built in two layers: an inner nest across financial-asset classes, and an outer nest between real capital and the financial composite. Financial return services are

$$\mathcal{F}^i = \left(\sum_{j \in J^f_A} \gamma^i_j (r^f_j q^i_{a,j})^{\frac{\sigma^f_F - 1}{\sigma^f_F}} \right)^{\frac{\sigma^f_F}{\sigma^f_F - 1}}, \tag{8}$$

where γ^i_j is a type-specific weight and σ^f_F is the elasticity across financial classes. As on the household side, deposits are differentiated across the banks that supply them, so r^f_{dep} and

$q^i_{a,\text{dep}}$ are indices over individual banks, given by the within-class nest in Section 2.3.

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

$$\mathcal{A}^i = \left[\alpha^i_{\text{real}}(r^i_{\text{real}}K^i)^{\frac{\sigma^f_A-1}{\sigma^f_A}} + \alpha^i_{\text{fin}}(R^i_{\text{fin}}F^i)^{\frac{\sigma^f_A-1}{\sigma^f_A}}\right]^{\frac{\sigma^f_A}{\sigma^f_A-1}}. \tag{9}$$

Here r^i_{real} is the type-specific return on real capital, R^i_{fin} is the financial return index dual to $\mathcal{F}^i$, and σ^f_A is the outer asset elasticity. At the optimum, $\mathcal{A}^i = R^i_A A^i$, so R^i_A is the dual return index of the outer aggregator and is the effective asset return entering the objective. Appendix C.I provides the price indices, demand functions, and the normalization that maps relative 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 that household borrowing has:

$$\mathcal{D}^i = \left(\sum_{j\in J^f_B}\beta^i_j(q^i_{b,j})^{\frac{\sigma^f_D-1}{\sigma^f_D}}\right)^{\frac{\sigma^f_D}{\sigma^f_D-1}}, \tag{10}$$

where β^i_j is the type's weight on lender class j and σ^f_D is the elasticity across debt classes. Accounting debt $B^i \equiv \sum_{j\in J^f_B} q^i_{b,j}$ generally differs from the effective aggregate $\mathcal{D}^i$, which is why the balance-sheet constraint in (6) is stated in effective-funding units. Bank borrowing is likewise an index over individual banks, given by the same within-class nest.

Two objects remain: the scale at which each type operates, and the aggregation from types to markets. All i-level quantities denote type-level aggregates: each type contains a continuum of atomistic firms, and homothetic choices make aggregation within a type immediate. An individual firm takes all 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 V^i equals assets and Tobin's q is one,

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

which holds exactly when the return the assets generate equals the return the financing demands. Substituting the optimal equity share into the zero-profit condition expresses that

required 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 rates therefore set scale through a chain. The bank and nonbank loan rates and the cost of equity fix the debt-cost index R_D^i, which fixes the required return $R_A^{\text{req},i}$; the condition $R_A^i = R_A^{\text{req},i}$ then pins down the return on real capital r_{real}^i through the asset nest (9); and r_{real}^i pins down capital along the type's schedule. Decreasing returns enter only at that last step,

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

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 fast the return declines with scale. Equivalently, in log form,

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

where the intercept ζ_t^i is the type's log productivity, or scale, term. A higher ζ_t^i shifts the schedule up, so the type holds more real capital at any given required return; the cross-type profile of ζ_t^i therefore governs the firm-size distribution and is the object perturbed by the firm-size comparative static in Section 4. A rise in bank credit costs therefore raises $R_A^{\text{req},i}$ by more for bank-dependent types, and produces a larger contraction in their real assets. Appendix C.I derives (11) and (12).

Five objects vary across types: the outer asset weights $(\alpha_{\text{real}}^i, \alpha_{\text{fin}}^i)$, the financial-class weights γ_j^i, the debt-class weights β_j^i, the reference equity share $\bar{s}^i$, and the productivity intercept ζ_t^i. Firms are otherwise identical, so every difference in behavior across types traces to these five objects.

Summing across types gives the corresponding firm aggregates, at the class level and at the level of the individual bank:

$$\begin{aligned} Q_{a,j}^f &= \sum_i q_{a,j}^i, & Q_{b,j}^f &= \sum_i q_{b,j}^i, \\ Q_{a,\text{dep},k}^f &= \sum_i q_{a,\text{dep},k}^i, & Q_{b,b,k}^f &= \sum_i q_{b,b,k}^i. \end{aligned} \tag{15}$$

2.3 Intermediaries

Three kinds of intermediary stand between savers and borrowers. Banks take deposits from households and firms, lend to both, and hold securities alongside those loans. Money market funds issue shares against a portfolio of short-term claims. Nonbank lenders make loans to one sector each and finance them by issuing securities. The three differ in how they are priced: banks have market power in each of their four products, while money market funds and nonbank lenders are competitive and earn zero profit. Only bank pricing therefore carries a wedge between the return on a bank's assets and the rates it posts.

Banks. The model contains N_j differentiated banks serving each sector $j \in \{h, f\}$, households and firms. A bank sets prices, not quantities: it faces the deposit and loan demand curves the within-class nests imply, so D_B^j and L_B^j denote the schedules $D_B^j(r_{\text{dep},B}^j)$ and $L_B^j(r_{b,B}^j)$, with the argument suppressed throughout. It chooses deposit rates $(r_{\text{dep},B}^h, r_{\text{dep},B}^f)$ and loan rates $(r_{b,B}^h, r_{b,B}^f)$ to maximize net cash flow to inside equity,

$$\begin{aligned} \max_{\{r_{\text{dep},B}^j\},\{r_{b,B}^j\}} \quad \Pi_B = \sum_{j\in\{h,f\}} \Big[(r_B^S - r_{\text{dep},B}^j - c_{\text{dep},B}^j)D_B^j + (r_{b,B}^j - r_B^S - c_{b,B}^j)L_B^j\Big] \\ - \mathcal{L}(S_B, D_B^h, D_B^f) - \mathcal{K}(E_B, L_B^h, L_B^f) + r_B^S E_B, \\ \text{subject to} \quad L_B^h + L_B^f + S_B = D_B^h + D_B^f + E_B, \end{aligned} \tag{16}$$

where the constraint is the balance sheet. Assets are household and firm loans (L_B^h, L_B^f) and a liquid-security composite S_B containing reserves, Treasuries, agency MBS, corporate bonds, and NBL securities, with net payoff r_B^S per dollar invested; deposits (D_B^h, D_B^f) and an exogenous quantity of inside equity E_B finance them. Here $c_{\text{dep},B}^j$ and $c_{b,B}^j$ are per-unit operating costs, and $\mathcal{L}$ and $\mathcal{K}$ are shadow costs of deviating from target liquidity and capital ratios. Each schedule sums the within-class demands of sector j at the rate the bank posts, and securities S_B then adjust residually through the balance sheet. The bank internalizes these schedules—that is what makes its problem a pricing problem—but takes the class index and the aggregate class quantity as given, so the elasticity it perceives is the within-class one rather than the across-class elasticity that governs substitution between deposits and MMF shares or between bank and nonbank credit.

The liquid composite is itself a CES portfolio over marketable assets—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 γ_B^j is the weight on asset j and η_B the elasticity across them. 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 it is the price through which a change in security supply reaches loan rates in Section 6.

Banks are symmetric and each is small in its own product market, so all post the same rates, each serves $1/N_j$ of every class, and none internalizes the effect of its rate on the class index. The subscript B therefore denotes the consolidated banking sector: quantities are sector totals, while the pricing wedges below are those that within-class competition implies for an individual bank. Appendix D.I derives the asset-level demands S_j^B implied by the composite below.

The shadow costs penalize deviations from the target 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 λ and κ are the target liquidity and capital ratios and β_L and β_K govern how costly it is to miss them.

Households and firms view individual banks as imperfect substitutes within each deposit and loan class. This is the within-class nest left open in Sections 2.1 and 2.2. It takes one form for both sectors: for a sector-j agent, with q_{dep}^i its deposit class total ($q_{s,\text{dep}}^i$ for households, $q_{a,\text{dep}}^i$ for firms) and $q_{b,b}^i$ its bank borrowing,

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

where $\mathcal{N}_j$ is the set of N_j banks serving sector j, $q_{\text{dep},k}^i$ and $q_{b,b,k}^i$ are the agent's deposit at and borrowing from bank k, and $r_{\text{dep},k}^j$ and $r_{b,k}^j$ are that bank's rates. The $N_j^{-1/\sigma}$ factors normalize the aggregators so that each class index equals the common bank rate in a symmetric

equilibrium and bank-level demands sum to the class total.

Since each bank takes the within-class price index and the aggregate class quantity as given, the first-order conditions of (16) are then a markdown on deposits and a markup on loans over the marginal value of funds,

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

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

The wedges are the two objects the government-borrowing exercise turns on: a rise in r^S_B passes into loan rates amplified by $\sigma_{L,j}/(\sigma_{L,j}-1)$, and the regulatory terms move with the balance sheet.

Eight parameters describe the bank: the within-class elasticities $\sigma_{D,j}$ and $\sigma_{L,j}$, the per-unit operating costs $c^j_{\text{dep},B}$ and $c^j_{b,B}$, the target ratios λ and κ, and the shadow-cost curvatures β_L and β_K. Because banks are symmetric, none varies across institutions, so all cross-sectional variation in the model comes from the household and firm objects above; what banks contribute is the pricing wedge, not heterogeneity.

Money market funds and nonbank lenders. MMFs own 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 is 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 D.I provides the complete MMF and NBL portfolio, funding, and aggregation systems.

2.4 Government and the Rest of the World

Two sectors are exogenous to the intermediation problem but essential to it: the consolidated government, which fixes the net supply of safe assets, and foreign investors, who absorb a large share of U.S. marketable claims.

Government. The government consolidates the fiscal and monetary authorities. 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, $p_j = 1/(1+r_j)$, α_j^W is the asset weight, σ^W is the substitution elasticity, and M^W is exogenous foreign financial wealth. Here q_j^W is the beginning-of-period dollar value of foreign holdings, rather than the number of payoff units. The foreign sector 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 gross foreign demand.

2.5 Equilibrium

An equilibrium is a vector of returns and quantities such that households, firms, banks, MMFs, NBLs, the government, 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. These conditions jointly determine asset prices, intermediary balance sheets, and the scale and financing composition of household and firm activity.

3 Estimation

We estimate the model bottom-up: the household and firm demand systems from micro-data, and the intermediary parameters from bank and nonbank pricing. Aggregate demand for each instrument is the sum of the estimated individual schedules over the observed population.

3.1 Data

Estimation combines four data sources. The Survey of Consumer Finances (SCF) provides twelve triennial household balance-sheet cross sections from 1989 to 2022, including net worth, age, financial assets by class, and borrowing from bank and nonbank lenders. For estimation, we aggregate households into fine net-worth–age cells and use each cell's mean net worth and age as continuous regressors; when solving the model, we evaluate the fitted demand surfaces at each household's individual net worth and age. The Census Quarterly Financial Report (QFR) provides firm balance sheets from 1980 onward. Its industry and size categories yield twenty-one corporate industry–size cells; adding the noncorporate sector gives the twenty-two firm types in the model. The Financial Accounts provide sector-level quantities, aggregate asset-class holdings, and Federal Reserve balance-sheet instruments, while bank balance sheets and product rates discipline the intermediary block.

Because the SCF and QFR understate aggregate financial positions—the SCF misses part of the wealth distribution and the QFR excludes corporations below its size threshold—we reconcile each source to the Financial Accounts before estimation. For each asset and liability class, we estimate a single multiplicative scalar, common across all households or firms and constant over time, to minimize the squared distance between population-weighted survey aggregates and their Financial Accounts counterparts. These scalars adjust market levels without altering the cross-sectional composition that identifies heterogeneous demand. For Treasuries, agency MBS, corporate bonds, and equity, household holdings are instead measured residually as total supply less holdings of the rest of the world, the Federal Reserve, money market funds, banks, and nonbank lenders, so these markets clear by construction. The time-invariant scaling matches aggregates on average rather than year by year.

We use the full available sample for each regression and anchor the general-equilibrium model in 2019, when balance-sheet quantities, household and firm cross sections, and the rate environment are jointly observed. The historical and cross-country exercises then evaluate the same estimated demand systems under alternative distributions of household and firm characteristics.

3.2 Empirical Strategy

Identification draws on three sources of variation. Time-series movements in relative returns identify substitution elasticities; cross-sectional differences in portfolios and financing at common prices identify how demand varies with household and firm characteristics; and equilibrium conditions recover the remaining wedges, costs, and levels.

Substitution elasticities. For each CES nest, we estimate relative demand in ratio form: the log quantity ratio of two classes on their log relative return, with class fixed effects absorbing the demand weights. Because quantities and returns are jointly determined, we instrument relative returns with monetary-policy variation: Federal Reserve holdings of Treasuries and agency MBS for the household and firm nests, joined by the federal funds rate for the intermediary and foreign blocks and by FOMC monetary-policy surprises for firms' real–financial margin. The identifying assumption is that these policy-driven movements change relative returns through the supply of claims and the policy rate, without responding to or directly shifting private demand. Substitution across individual banks is the exception, because our data record class-level rather than bank-specific rates, so we recover the within-class elasticities from the pass-through of banks' shadow funding cost into posted deposit and loan rates. Appendix B.III through Appendix D.II report each block's estimating equation, instrument, and first stage.

Characteristic-dependent demand. Conditional on the elasticities, cross-sectional variation identifies how demand varies with characteristics. Within a survey year, households face common national asset-class and lender rates, so cross-sectional differences in portfolio and borrowing shares cannot reflect differences in the rates households face; they identify how relative demand weights vary with net worth and age. Firm cells likewise face common class-level rates, so variation across industry and size cells identifies the weight surfaces on both sides of the firm balance sheet. Household debt-service capacity and firms' preferred equity shares are identified from borrowing and leverage levels by separate equations.

Two properties of this design carry the rest of the paper. First, characteristics enter the demand weights while the substitution elasticities are common across types, so types differ in what they demand at common prices but respond alike to price changes; reweighting the population therefore moves both the level and the slope of aggregate demand, the two objects Section 4 traces. Second, the counterfactuals require the estimated mapping from characteristics to weights to be stable across populations, not that characteristics cause portfolio choice: the weights summarize systematic covariation between demand and observables, and Sections 5 and 6 push historical, cross-country, and counterfactual distributions through this fixed mapping.

Equilibrium wedges and levels. Holding the behavioral parameters fixed, two-step GMM applied to the bank pricing conditions (20)–(21) identifies liquidity and capital targets, their shadow-cost parameters, and constant product margins. We calibrate the curvature of the firm capital schedule, η_K, and recover sector-level asset-service normalizations and type-specific productivity by inverting the firm first-order conditions at observed capital. Bank, MMF, and NBL operating costs are similarly recovered by inverting pricing or zero-profit conditions at observed rates. These inversions make observed quantities and prices consistent with the estimated behavioral parameters without using the recovered objects to identify those parameters.

3.3 Estimates

Households. Household heterogeneity enters four objects: the consumption–saving weights (γ_c^i, γ_s^i), the portfolio weights α_j^i, the bank–nonbank borrowing weights β_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 weight χ_k^i/χ_l^i, with $\chi \in \{\gamma, \alpha, \beta\}$, we estimate

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

Age enters quadratically in every nest because the profiles in Section 1 have interior turning points—deposit shares are U-shaped in age and equity shares hump-shaped—which a linear term cannot represent. Net worth enters linearly in the weights and quadratically in capacity, where debt service rises with wealth at a diminishing rate. Each saving class carries its own

intercept, but the gradients are estimated in one pooled regression and are common across classes apart from separate bond and equity loadings, so $\chi^{w}_{k,l}$, $\chi^{a}_{k,l}$, and $\chi^{a2}_{k,l}$ are constant within those groups. Consumption, deposits, and nonbank loans are the respective baseline alternatives.

Table 1 reports the estimates. The saving and borrowing elasticities are $\widehat{\sigma}^{h}_{S} = 1.49$ and $\widehat{\sigma}^{h}_{B} = 1.55$, implying positive but incomplete substitution across saving classes and between bank and nonbank credit. Higher net worth raises the relative weight on all nondeposit assets, especially MMF shares and equity, while also raising the relative weight on bank borrowing. Age shifts portfolios away from equity and raises bank reliance at older ages. These estimates reproduce the opposite asset- and liability-side wealth gradients in Figure 4. The outer consumption–saving elasticity is $\widehat{\sigma}^{h} = 0.91$, placing consumption and saving slightly on the complementarity side. Debt-service capacity rises with net worth at a diminishing rate and declines after middle age; it governs borrowing scale, whereas $(\alpha^{i}_{j}, \beta^{i}_{j})$ govern composition. Appendix B.III reports the underlying regressions.

Firms. Firm heterogeneity enters the financial-asset weights γ^{i}_{j}, the debt weights β^{i}_{j}, the outer asset weights α^{i}_{j}, and the reference equity share $\bar{s}^{i}$. Let x^{i} denote centered log firm size. For $\chi \in \{\gamma, \beta, \alpha\}$, we estimate

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

Table 2 reports the estimates. The financial-asset and debt elasticities are $\widehat{\sigma}^{f}_{F} = 1.75$ and $\widehat{\sigma}^{f}_{D} = 1.81$. Larger firms place more weight on MMF shares relative to deposits and less weight on bank loans relative to nonbank debt, matching Figure 5. The outer elasticity, $\widehat{\sigma}^{f}_{A} = 0.85$, implies that real and financial assets are gross complements. The leverage regression yields $\widehat{\eta}_{E} = 2.56$: because the optimal equity share satisfies $s^{i}_{E} = \bar{s}^{i} + (R^{i}_{D} - r_{E})/\eta_{E}$, a one-percentage-point widening of the debt-cost spread over equity raises the equity share by about 0.4 percentage points. The fitted reference share declines modestly with size near the mean. We set $\eta_{K} = 0.33$, implying a long-run capital elasticity of approximately $1/\eta_{K} = 3$, and recover each cell's productivity intercept from

$$\zeta^{i}_{t} = \log r^{i}_{\text{real},t} + \eta_{K} \log K^{i}_{t}.$$

The intercept ζ_t^i is an equilibrium shifter rather than an estimated preference parameter. Appendix C.II 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 reserves, Treasuries, agencies, corporate bonds, and NBL claims. The within-bank loan elasticities are 2.49 for households and 2.57 for firms, while the corresponding deposit elasticities are 1.41 and 6.55. Equivalently, a one-unit change in banks' shadow funding cost passes through by 1.67 and 1.64 to household and firm loan rates, but only by 0.29 and 0.85 to deposit rates. Banks therefore amplify loan-rate movements and attenuate deposit-rate movements, especially for households.

The MMF and household-NBL funding elasticities are also high, at 14.6 and 15.2, so both reallocate across their funding instruments at close to constant cost; the firm-NBL elasticity of 4.9 implies a steeper funding cost as that sector expands. 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.II reports the intermediary specifications and coefficient mappings; Appendix E and Appendix Table A11 report the remaining portfolio calibration and foreign-investor estimates.[5]

Three features of these estimates drive the results that follow. The across-class elasticities are positive but modest, so characteristics move composition rather than being arbitraged away. The wealth and age gradients run in opposite directions on the two sides of the household balance sheet, which is what lets one characteristic move funding and credit differently. And the bank pass-through asymmetry—amplified into loan rates, attenuated into deposit rates—is what makes deposit and credit markets absorb the same shock differently in Sections 4 through 6.

Equilibrium fit. Since 2019 general equilibrium is not targeted directly in estimation, we use equilibrium rates and quantities as untargeted moments to assess the model fit in Figure 7. The model reproduces the broad ordering of returns and the main relative spreads: for example, the bank loan spread over Treasuries is 2.78 percentage points, compared with

[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.

3.14 in the data, and the equity premium is 5.56 percent, compared with 6.61 percent. Equilibrium rates are generally somewhat higher than observed. The model also captures the broad composition of financial quantities. Focusing on the intermediary shares central to the paper, it generates a bank deposit share of 17.3 percent, compared with 20.5 percent in the data, and a bank share of private-sector financing—household and firm debt plus outside firm equity—of 15.7 percent, compared with 19.2 percent, while similarly reproducing the broad composition of firm financing.

4 How Composition Shapes Aggregate Financial Demand

We next use the estimated demand system to construct aggregate demand curves for each bank product and trace how household and firm composition reshapes them. These curves aggregate the estimated type-specific schedules over the population and isolate the demand channel: they show how changes in household and firm composition shift demand at a given own rate, separately from the rate adjustment that clears the market. Because types differ in both demand levels and price sensitivities, composition can change both the level and slope of aggregate demand even though no type's schedule changes and the supply-side environment is held fixed. A change in the level of demand captures the initial displacement at a given rate, while the slope determines how much the subsequent equilibrium rate adjustment offsets that displacement. Both therefore shape equilibrium quantities and bank shares. The same slopes, evaluated around a given equilibrium, also help determine how rates and quantities respond to shocks. We begin with deposits and bank credit, the two sides of bank intermediation, and then trace how compositional shifts affect equilibrium rates and bank shares.

4.1 Aggregate Demand Curves

Aggregate demand for each bank product sums the type-specific schedules estimated in Section 3. At any point on the curve, its local elasticity is therefore a quantity-share-weighted average of the type-level responses to that same rate change. Reweighting household and firm types can consequently change both the level and slope of aggregate demand even when individual demand schedules are unchanged. We trace these schedules in conditional general equilibrium. For deposits, we scale the household and firm deposit rates by a common multiple of their 2019 equilibrium values while allowing all other markets to clear; a multiplier of one recovers the 2019 equilibrium. We construct the bank-loan schedule analogously.

Appendix F details the procedure and accuracy checks.

Figure 8 shows a sharp difference between the two sides of bank intermediation. At the 2019 equilibrium, the own-rate elasticity of deposit demand is 0.32, while that of bank-loan demand is -1.02. Deposit demand is therefore relatively insensitive to rates, consistent with households and firms valuing the nonprice services of deposits, whereas borrowers substitute more readily toward nonbank finance, equity, or lower total borrowing. This difference matters for how compositional shifts translate into equilibrium: deposit-rate adjustment offsets little of a demand displacement, so most of the effect appears in deposit quantities and banks' share of saving; loan-rate adjustment offsets much more, so credit-side shifts are absorbed more strongly in rates. Whether the latter translates into banks' share of financing also depends on the accompanying change in credit supply.

4.2 The Two Sides Respond to Different Characteristics

We vary three real-sector characteristics: household net worth, household age, and firm productivity. We increase their population means and, separately, increase wealth concentration, age dispersion, and the concentration of productive activity among large firms while holding the corresponding mean fixed. Across all exercises, the estimated characteristic-dependent demand functions remain unchanged; only the distribution of household and firm characteristics varies, with equilibrium prices and quantities adjusting accordingly. Appendix F details the transformations.

Figure 9 shows a sharp asymmetry across the two sides of financial intermediation. The upper panels report banks' share of each market. Household characteristics primarily determine banks' share of private-sector saving, whereas firm characteristics primarily determine banks' share of private-sector financing. Wealth concentration generates the largest response on the saving side, while concentration of productive activity among large firms generates the largest response on the financing side.

This asymmetry is an equilibrium result, not a feature of the design. Households and firms both save and borrow, so every characteristic shift propagates to both sides of intermediation. Aggregate balance-sheet shares, however, determine where these shifts have their first-order effects on financial structure. Households account for nearly all private-sector financial assets but only about one-quarter of private financing. Household characteristics therefore directly reshape almost the entire saving side, whereas their direct effect on borrower composition is limited; their broader effect on financing operates mainly through equilibrium funding costs, which can move borrowing substantially without materially changing banks' share of

private-sector financing. Firms occupy the opposite position: they account for roughly three-quarters of private financing but little private-sector saving. Firm characteristics therefore directly reshape the financing side, while their effect on saving operates mainly through securities returns that induce households to rebalance their portfolios. Appendix Table A12 reports these aggregate shares.

The lower panels report equilibrium deposit and loan rates. Comparing these rate responses with the share responses in the upper panels shows how each initial demand displacement translates into the new equilibrium. Deposit demand is inelastic, so deposit rates offset little of a shift and most of the adjustment appears in deposit quantities and banks' share of saving. Bank-credit demand is close to unit-elastic, so loan rates absorb much more of a displacement and tend to stabilize banks' share of private-sector financing. A change in borrower composition is different: reallocating activity toward firms that rely less on banks can move the bank share without a comparable change in total financing. Appendix Figures A5, A6, and A7 trace these demand displacements and their general-equilibrium repricing.

Households. At fixed prices, household characteristics directly shift both portfolio and borrowing demand. Wealthier households allocate less of their financial wealth to deposits, so greater wealth concentration shifts saving toward market claims; older households allocate relatively more toward deposits, so an older population shifts saving toward banks. Higher mean net worth combines this portfolio effect with a large increase in total saving. On the borrowing side, debt-service capacity rises with net worth and declines after middle age, so the same characteristics also shift household credit demand. Because households dominate aggregate saving but account for a smaller share of financing, these changes have their largest direct effect on the saving side; their broader effect on financing operates importantly through equilibrium funding costs.

General-equilibrium prices then propagate these household shifts across markets. Higher mean net worth raises aggregate saving and lowers Treasury and equity returns, making deposits more attractive relative to securities and roughly doubling the outward displacement of deposit demand, from about 20 to 40 percent. Aging works through a different portfolio rebalancing: older households demand more fixed income and less equity, lowering Treasury yields while raising equity returns. These movements have opposing effects on deposits, but the Treasury effect dominates because Treasury supply is fixed whereas equity issuance adjusts endogenously as firms substitute between equity and debt. The resulting repricing widens the deposit-demand displacement from about 6 to 11 percent. Wealth concentration

instead redistributes a fixed amount of wealth, moves securities returns little, and therefore generates much less additional repricing.

In all three cases, the final deposit-rate adjustment is small because deposit demand is inelastic, so most of the displacement survives into quantities and banks' share of saving. The same household shifts reach the financing side through the cost of funds. Higher mean net worth, for example, lowers market rates and the bank loan rate, expanding bank lending. This also illustrates why bank quantities and bank shares need not move together: higher net worth raises deposits in dollars even as deposits fall as a share of saving because total financial assets grow faster.

Firms. Firm characteristics also affect both sides of intermediation, but their direct effect is concentrated on financing. At fixed prices, larger firms rely less on bank loans and more on market financing, so concentrating productive activity among large firms shifts financing away from banks. Higher mean productivity instead expands financing demand across firms without changing borrower composition, generating the largest initial displacement of bank-credit demand among the six exercises. Because firms account for most private-sector financing but little private-sector saving, these changes enter primarily through financing demand and reach the saving side indirectly through the returns required to clear securities markets.

This indirect saving-side channel operates through general-equilibrium repricing. Higher productivity raises securities returns and financing costs, reducing the initial bank-credit displacement from about 32 to 9 percent before the loan market clears. Because bank-credit demand is approximately unit-elastic, the subsequent loan-rate adjustment absorbs most of what remains, leaving equilibrium lending little changed. The same increase in securities returns induces households to shift away from deposits. Although firms themselves demand more deposits at fixed 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.

Concentrating productive activity among large firms produces much less repricing. Because aggregate financing demand is broadly unchanged, securities returns and the bank loan rate move little, allowing the reallocation away from bank loans to survive largely into banks' share of private-sector financing. The same reweighting also makes aggregate bank-credit demand more elastic because larger firms substitute more readily between bank and market finance.

Taken together, these exercises show how household and firm composition reshapes the aggregate financial demand system. Changes in composition alter both the level and slope of aggregate demand even when the underlying type-specific demand functions and supply-side environment are unchanged. Changes in the level capture the initial displacement in demand at a given rate, while the slope determines how much equilibrium repricing offsets that displacement. Both therefore shape the financial structure that emerges in equilibrium. The same demand slopes, evaluated at that equilibrium and jointly with the equilibrium structure, also help determine how shocks are transmitted through rates and quantities. The next two sections quantify these two implications using historical and cross-country variation in financial structure and a common government-borrowing 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 provide 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]

[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.

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-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 move in the same direction. 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 G). 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 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

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

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. Economies with more activity concentrated among large firms place greater weight on 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 turn to the second implication of the aggregate financial demand system: how a common shock is transmitted across economies with different 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. New Treasuries can be absorbed directly by households and foreign investors, or indirectly through banks and money market funds (MMFs) that hold Treasuries against deposits and fund shares. Household composition determines how much of the additional Treasury supply is absorbed directly and how much instead passes through intermediary balance sheets. When more government debt is absorbed through intermediaries, the shock passes through additional intermediation wedges, amplifying the displacement and repricing

of private credit. Household and firm composition then determine how strongly the resulting changes in financing costs and asset returns affect investment and consumption.

6.1 Absorption and Transmission in the 2019 Economy

In the 2019 economy, most additional Treasuries are absorbed directly by ultimate savers. Households and foreign investors absorb 69% of the issuance, while banks and MMFs intermediate the remaining 31%; banks alone absorb 14% (Figure 13). Direct absorption primarily operates through market repricing. Intermediated absorption additionally reallocates intermediary balance sheets, where government securities compete with private claims. Although banks absorb a modest share of the issuance, their lending contracts by \$1.22 for each additional dollar of securities they hold. The response therefore extends beyond a dollar-for-dollar substitution of Treasuries for loans: higher Treasury supply reprices banks' broader securities portfolio and induces a larger reallocation from private lending toward securities.

This balance-sheet adjustment amplifies the repricing of bank credit. Additional Treasury supply raises the return on banks' securities portfolio and therefore the opportunity cost of lending. Banks pass this higher marginal cost into loan rates with a markup, so bank credit reprices more strongly than nonbank credit. Banks' portfolio return rises by about 33 basis points, while household and firm bank loan rates rise by about 52 and 51 basis points, respectively (Table 4). The amplification comes primarily from loan-market power rather than tighter regulatory constraints, which relax slightly as securities replace loans on bank balance sheets.[8] Given the approximately unit-elastic bank-credit demand estimated above, this repricing translates into a substantial contraction in bank lending.

The increase in financing costs reduces firm investment by 4.7% (Table 5). Higher returns on firms' liquid assets provide some offset, but the increase in the cost of bank credit, nonbank credit, and equity dominates. The incidence depends on firms' financing structure: investment falls by 6.0% among smaller and noncorporate firms, which rely more heavily on bank credit, compared with 3.8% among large corporations. Government borrowing therefore affects firms according to their exposure to the financial claims that reprice most.

Aggregate household consumption, by contrast, changes little, rising by 0.13%. Higher borrowing costs tighten debt capacity, while higher returns on financial assets benefit savers, and the two effects nearly offset in the aggregate. Their incidence is nevertheless heterogeneous. Consumption falls for leveraged, non-wealthy young households, while older and

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

wealthier households benefit from higher saving returns. Government borrowing therefore redistributes from households exposed primarily as borrowers toward those exposed primarily as savers even when its aggregate consumption effect is small. These results hold the value of securities outstanding at the time of the shock fixed. Appendix H.III incorporates the capital losses generated by the equilibrium repricing: rates and investment are essentially unchanged, 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 constructed 1980 economy, changing household and firm composition while holding the financial environment fixed. The comparison isolates two roles of real-sector heterogeneity: saver composition determines how government debt is absorbed and hence how strongly financial prices respond, while borrower composition determines exposure to the resulting changes in financing costs.

Saver composition first changes the absorption route. The younger and poorer 1980 household sector absorbs only 12% of the new Treasuries directly, about half the 2019 share. More of the debt therefore reaches intermediary balance sheets: bank absorption doubles, to 28%, and intermediaries' combined share rises to 41% (Figure 13). Financial repricing is correspondingly stronger: banks' securities return rises by 53 basis points and bank loan rates by about 0.8 percentage points, each roughly 1.6 times its 2019 response (Figure 14).

Borrower composition then determines the real exposure to this repricing. Firm investment falls by 5.4%, 0.7 percentage points more than in 2019.The larger decline is driven less by a larger bank-credit shock than by greater exposure to it: smaller, bank-dependent firms hold 79% of 1980 capital, against 37% in 2019. Household consumption turns from the small 2019 gain into a decline of 0.05%. Higher borrowing costs matter more because leveraged young households carry more of consumption (59% against 48%) and cut more (-0.34% against -0.19%; Table 5).

The same shock, under an unchanged financial environment, thus generates different absorption, repricing, and real effects because the savers and borrowers differ. The composition that determines financial structure also determines its response to shocks.

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.

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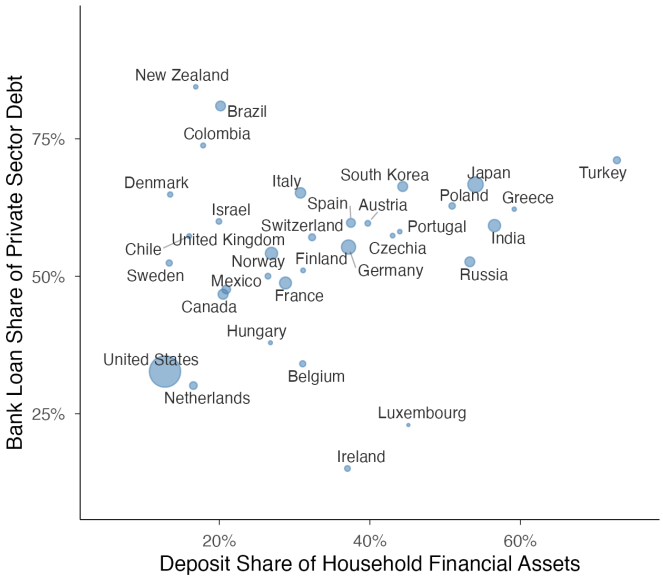
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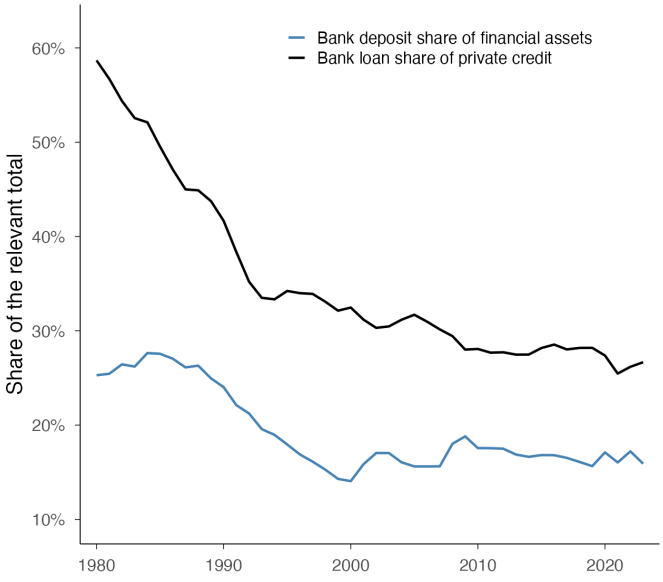
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Figure 1: Variation in the bank share of financial intermediation

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.



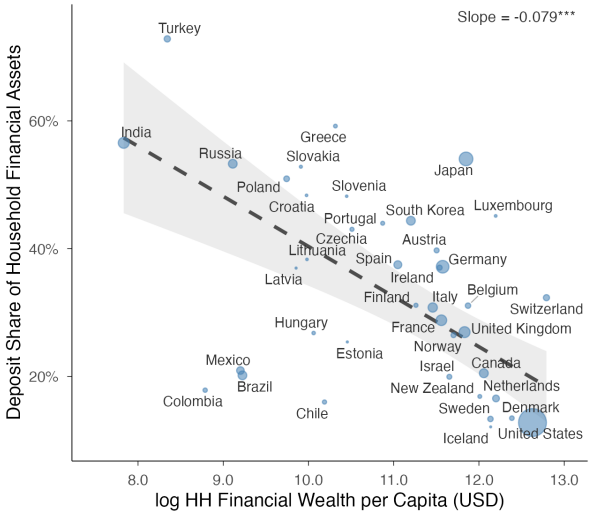
(a) Bank reliance across countries



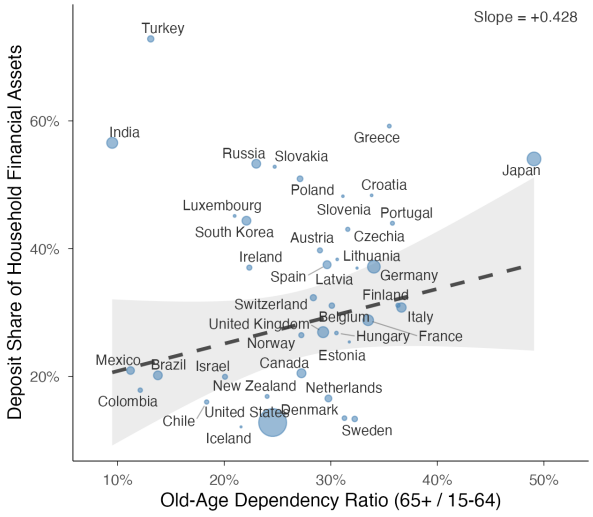
(b) Bank reliance in the United States over time

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

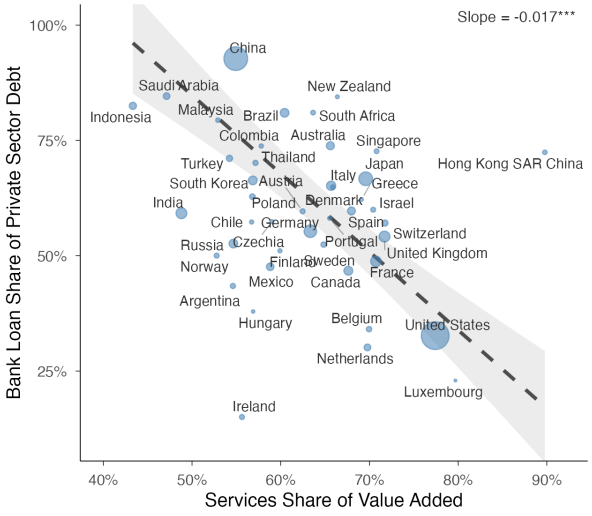
Panels (a) and (b) plot the deposit share of household financial assets against household financial wealth and the old-age dependency ratio. Panels (c) and (d) plot banks' share of credit to the private nonfinancial sector against the services share of value added and the value-added share of firms with 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.



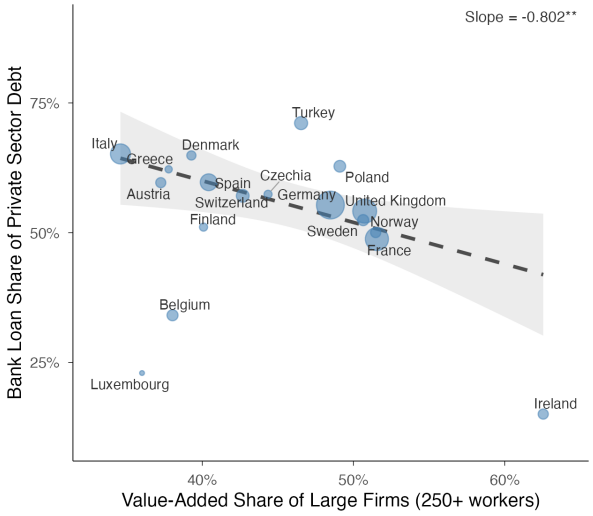
(a) Household financial wealth per capita



(b) Old-age dependency ratio



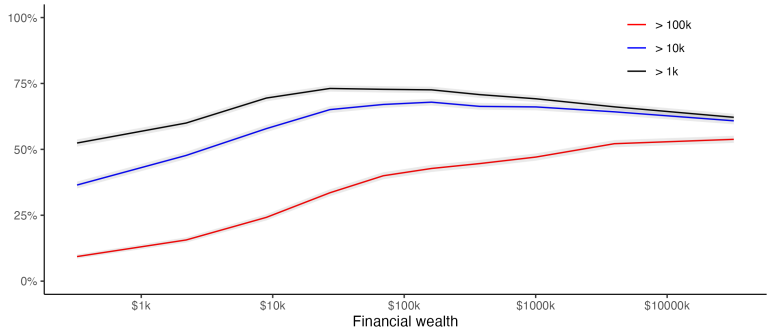
(c) Services share of value added



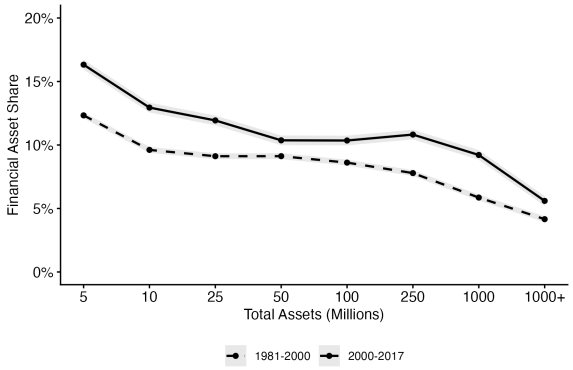
(d) Large-firm share of value added

Figure 3: Households and firms hold assets and debt simultaneously

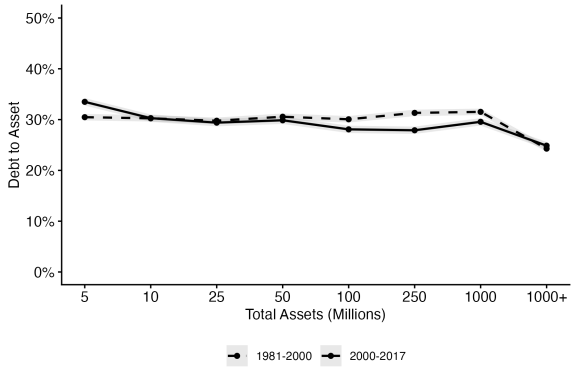
Panel (a): share of households with total borrowing above $1,000, $10,000, and $100,000, by decile of financial wealth (Survey of Consumer Finances, pooled waves). Borrowing is bank plus nonbank borrowing, excluding government, credit card, and pension debt. Financial wealth is financial assets plus 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



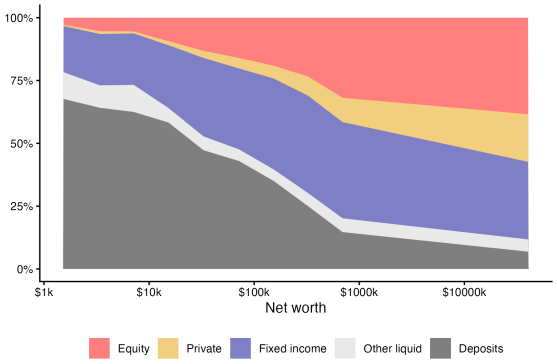
(b) Firm financial-asset share, by size



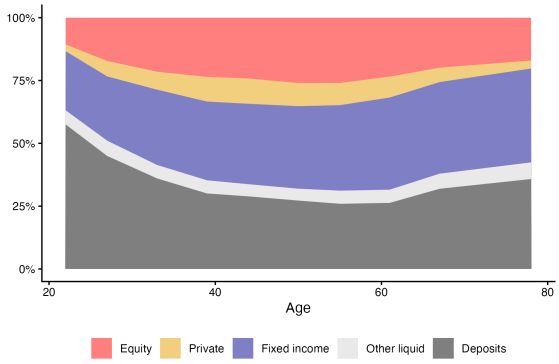
(c) Firm leverage, by size

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

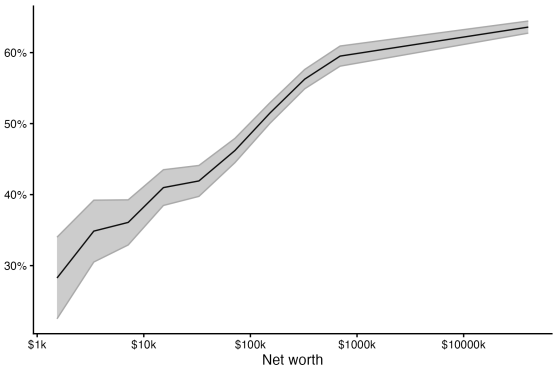
Panels (a) and (b) plot portfolio shares of augmented financial wealth, defined as financial assets plus private business interests. Panels (c) and (d) plot bank loans as a share of total household borrowing, among households with total borrowing above $1,000. Source: Survey of Consumer Finances.



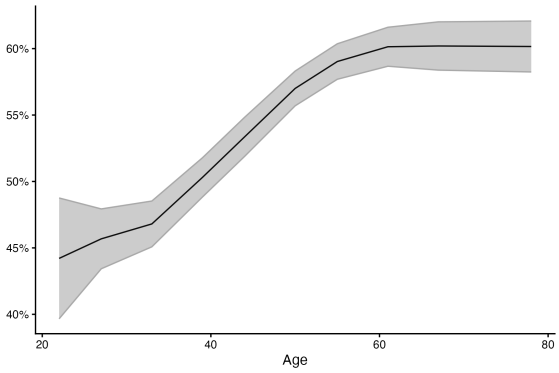
(a) Portfolio shares by net worth



(b) Portfolio shares by age



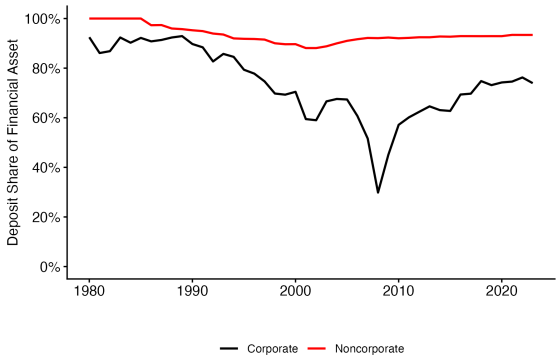
(c) Bank share of borrowing by net worth



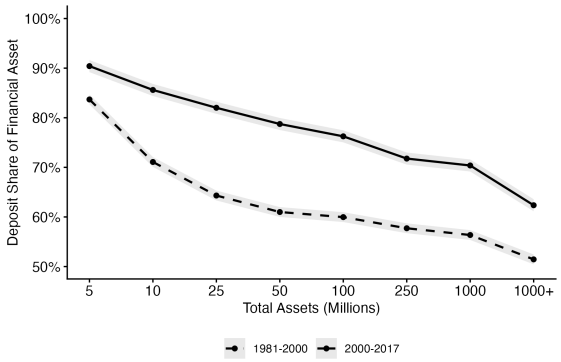
(d) Bank share of borrowing by age

Figure 5: Firm deposit and bank-loan shares

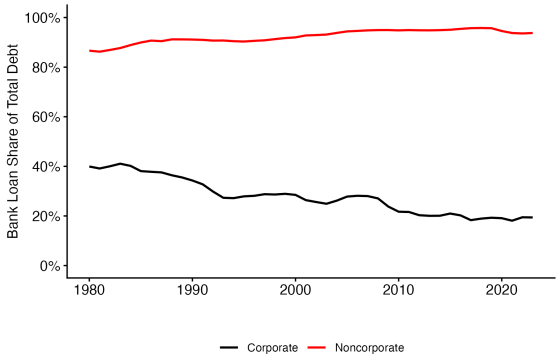
Panels (a) and (b) plot deposits as a share of financial assets. Panels (c) and (d) plot bank loans as a share of total debt. The left panels report aggregates over time; the right panels split firms by size. Source: Census Quarterly Financial Report.



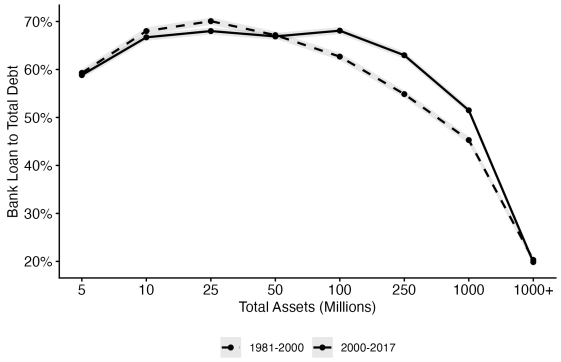
(a) Deposit share: time series



(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.

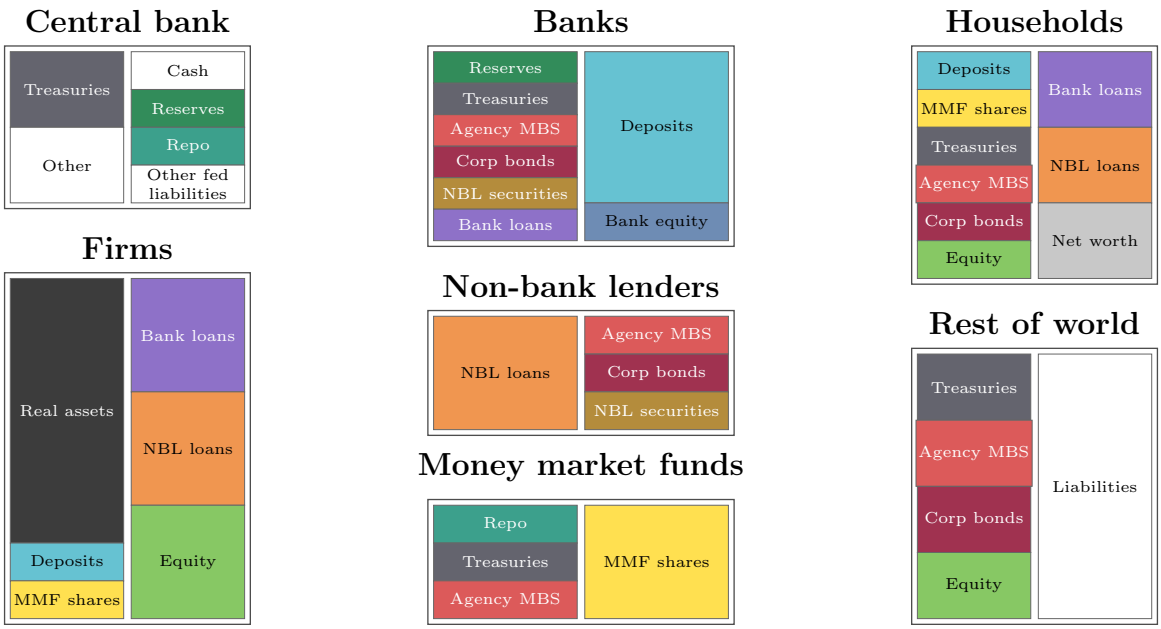
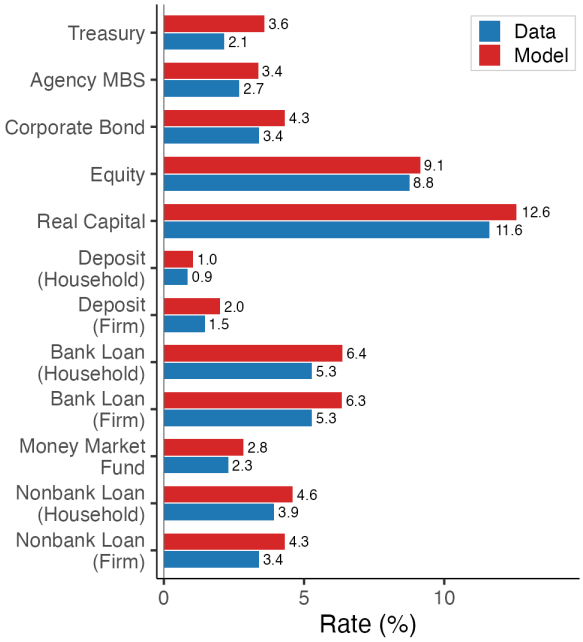
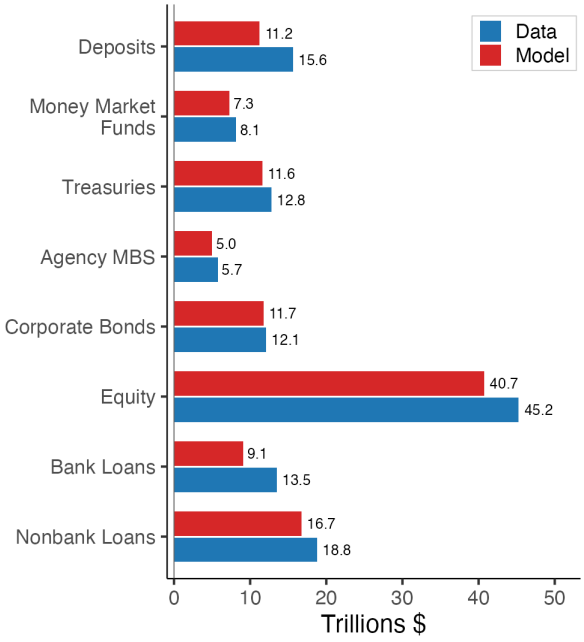


Figure 7: Equilibrium and observed prices and quantities, 2019

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.



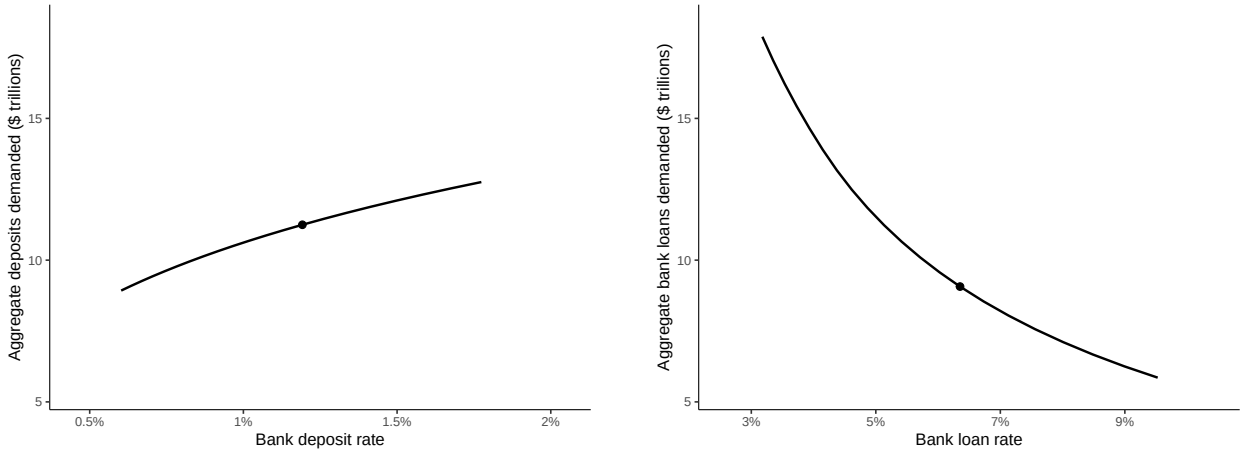
(a) Rates



(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.

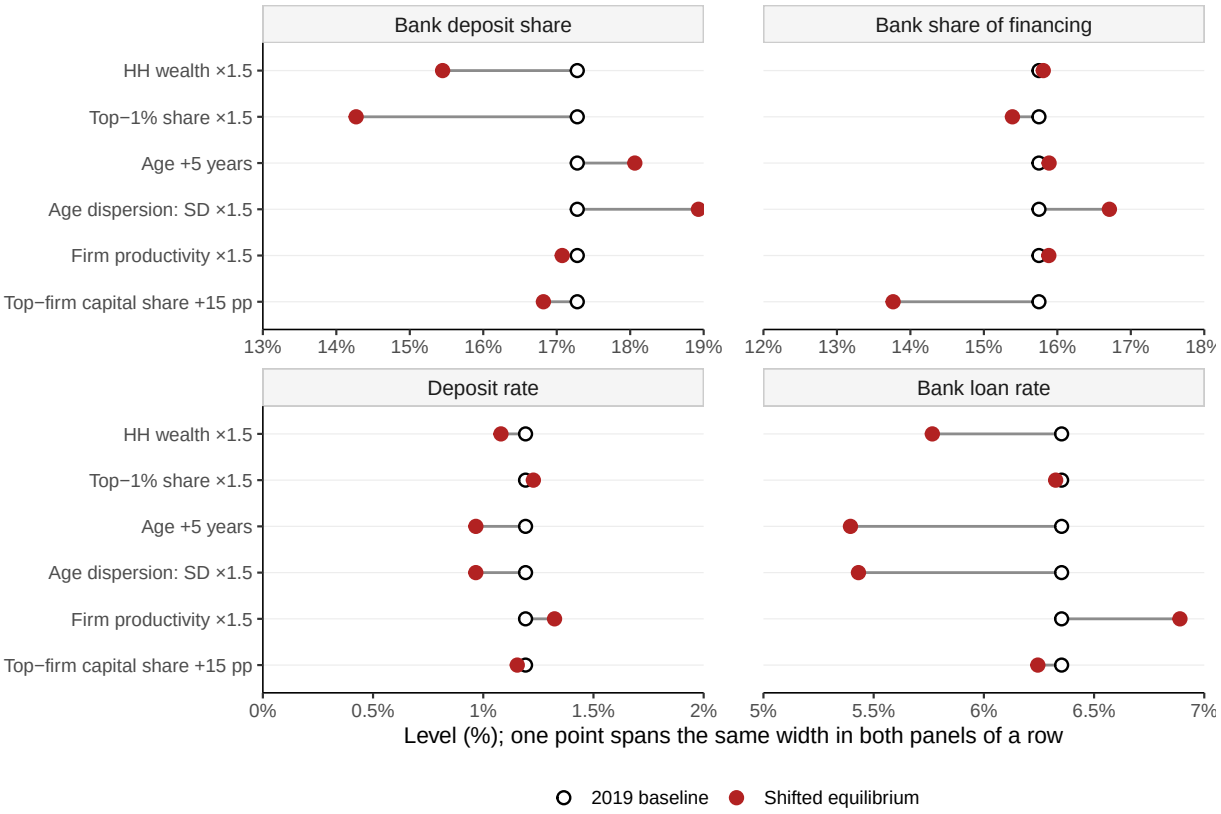
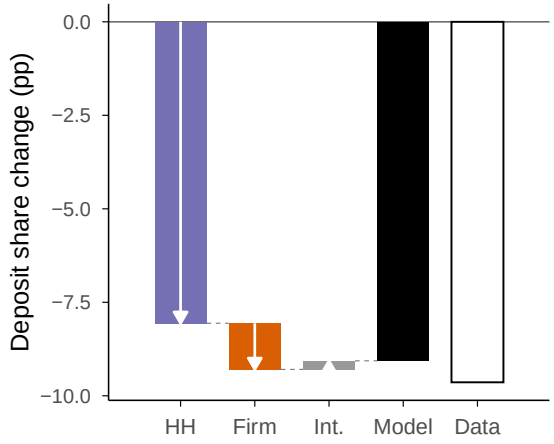
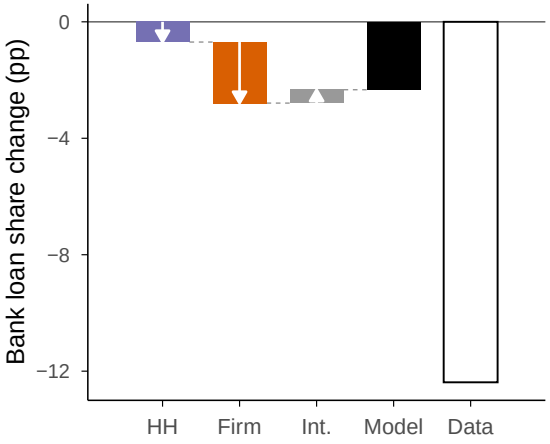


Figure 10: 1980-to-2019 real-sector channels

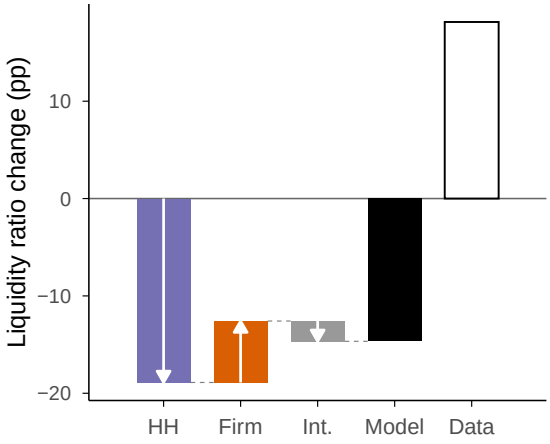
Household, firm, and interaction contributions to each outcome, computed as the 2019 value minus the 1980 value, so a negative bar is a decline over the period. The first three bars decompose the model's change into the household distribution, the firm distribution, and their interaction; the solid black 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



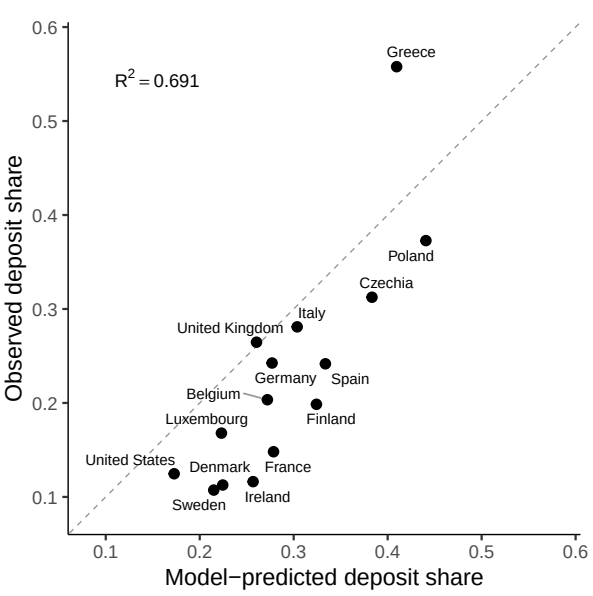
(b) Bank share of private-sector financing



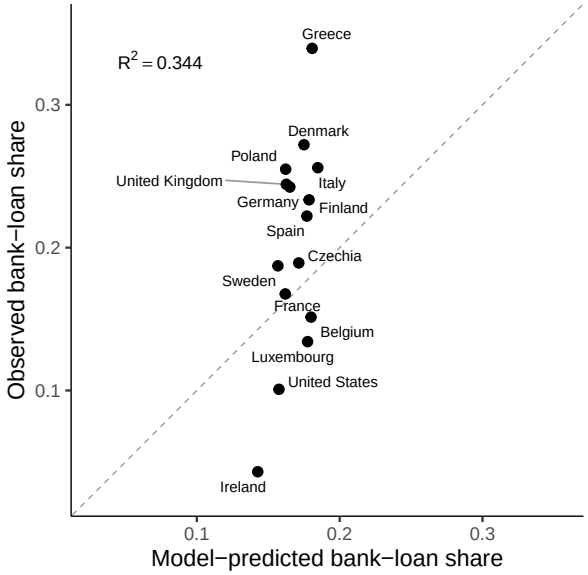
(c) Liquidity ratio

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.

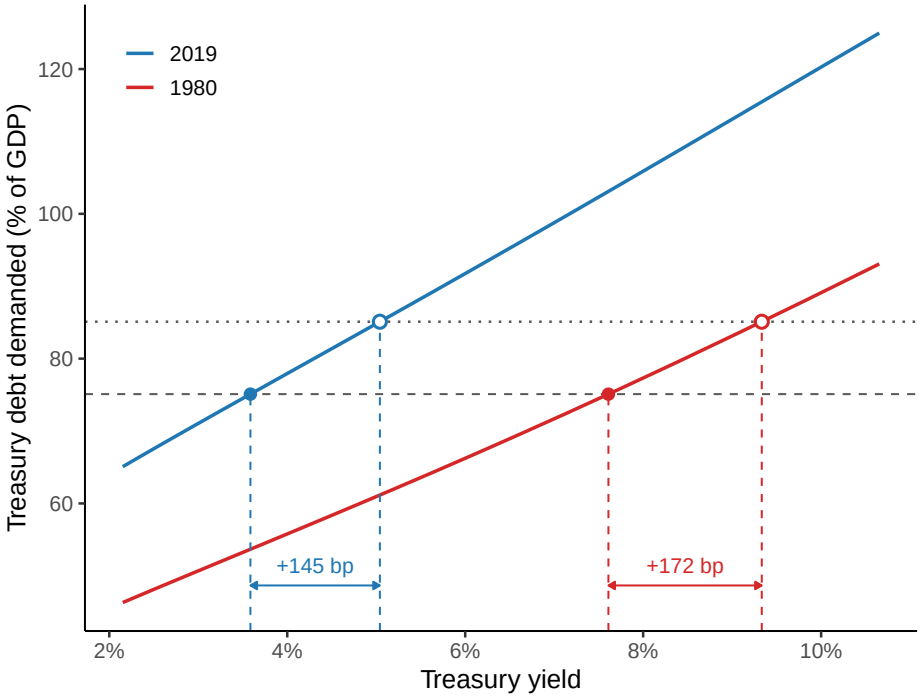


Figure 13: Government borrowing: absorption of the new Treasury supply

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.

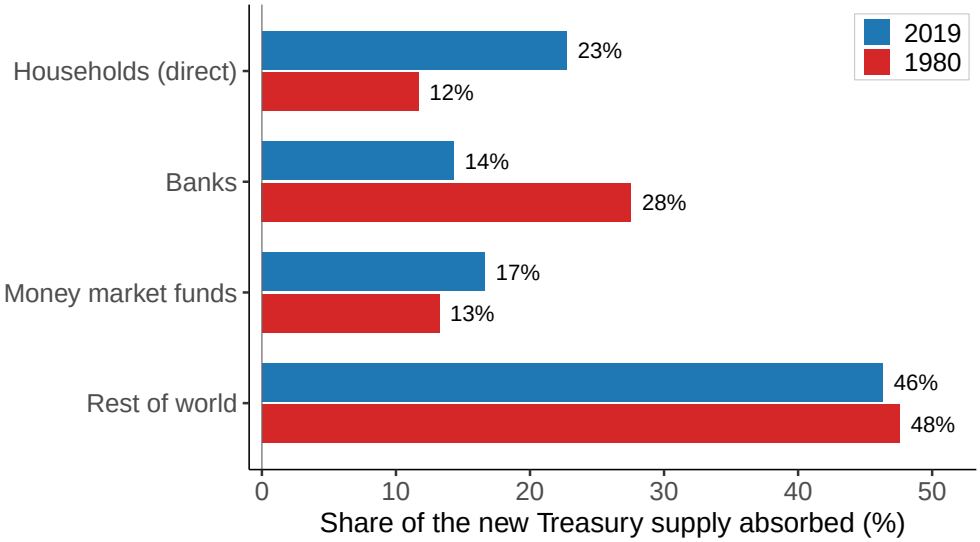
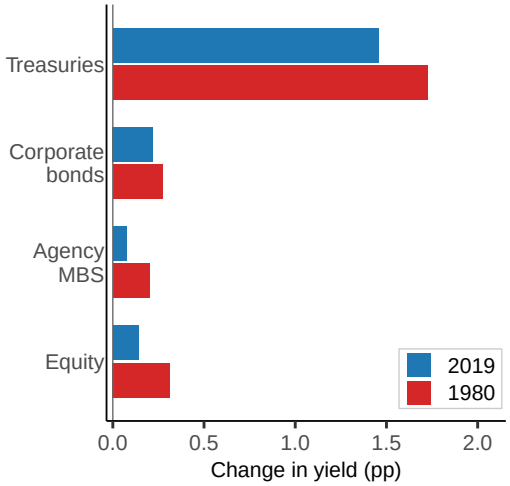
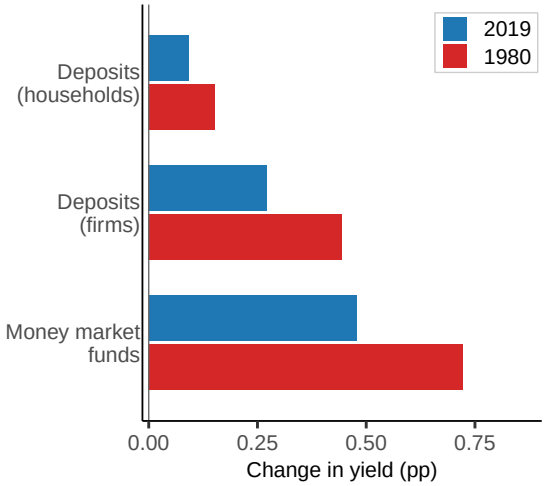


Figure 14: Government borrowing: price responses

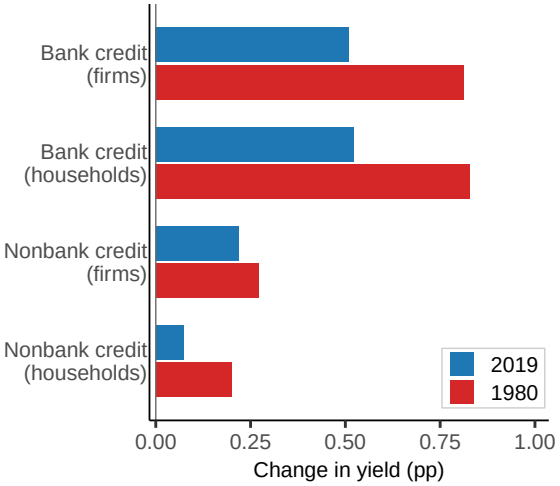
Each bar is the change in an equilibrium yield, in percentage points, under the same Treasury-supply shock used in Figure 13: marketable supply rises by ten percent of GDP with Federal Reserve holdings fixed. Blue bars are the 2019 economy and red bars the constructed 1980 economy. Panel (a) reports 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		
σ^h	Consumption–savings elasticity	0.908
γ_s^w	Loading on log net worth	0.186
γ_s^a	Loading on age	−0.071
γ_s^{a2}	Loading on age squared	0.037
Savings Nest (Relative to Deposits)		
σ_S^h	Across-class elasticity	1.492
α_{MMF}^w	MMF on log net worth	0.485
α_{bond}^w	Bond on log net worth	0.237
α_{equity}^w	Equity on log net worth	0.469
α_{MMF}^a	MMF on age	−0.041
α_{bond}^a	Bond on age	0.024
α_{equity}^a	Equity on age	−0.167
α_{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)		
σ_B^h	Across-class elasticity	1.547
β_b^w	Loading on log net worth	0.125
β_b^a	Loading on age	0.019
β_b^{a2}	Loading on age squared	0.014
Borrowing Constraint		
δ^0	Debt-service intercept	10.474
δ^w	Loading on log net worth	0.470
δ^{w2}	Squared log net worth	−0.038
δ^a	Loading on age	−0.396
δ^{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 η_E use the IV estimates, while η_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)		
σ_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)		
σ_D^f	Across-class debt elasticity	1.806
β_b^{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)		
σ_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		
η_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]
η_K	Real-capital decreasing-returns curvature (calibrated)	0.330
ζ_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		
η_B	Securities CES elasticity	22.774
a_{res}	Reserve weight	0.480
a_{tre}	Treasury weight	0.121
a_{age}	Agency weight	0.280
a_{cor}	Corporate bond weight	0.097
a_{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		
λ	Liquidity ratio target	0.398
κ	Capital ratio target	0.173
β_L	Liquidity cost parameter	0.022
β_K	Capital cost parameter	0.078
Nonbanks		
η_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	
	ε_s	Absorbed (%)	ε_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 H.

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.I 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.II 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.III 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.IV 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 both variants are 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.V 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}^{intan} be total intangible investment and VA_{ct}^{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.VI 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 World 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.VII 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 α_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.VIII 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.

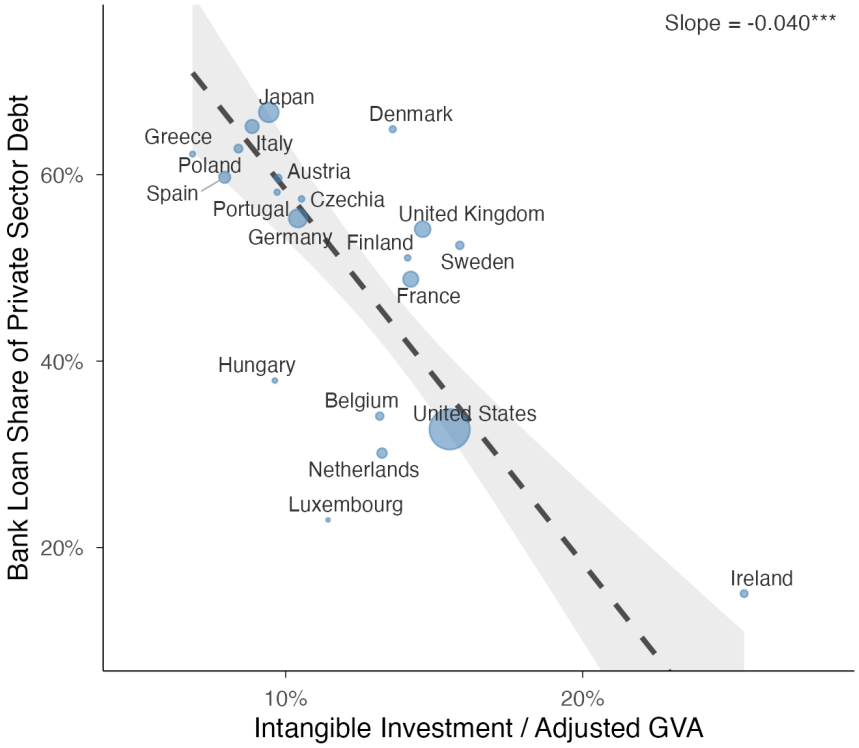


Figure A1: Bank-loan share and intangible-investment intensity. The bank-loan share and intangible-investment intensity use country means over 2018–2022. Bubble area is proportional to nominal GDP; the dashed line is a GDP-weighted OLS fit and the shaded region is its 95% confidence interval. The panel 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

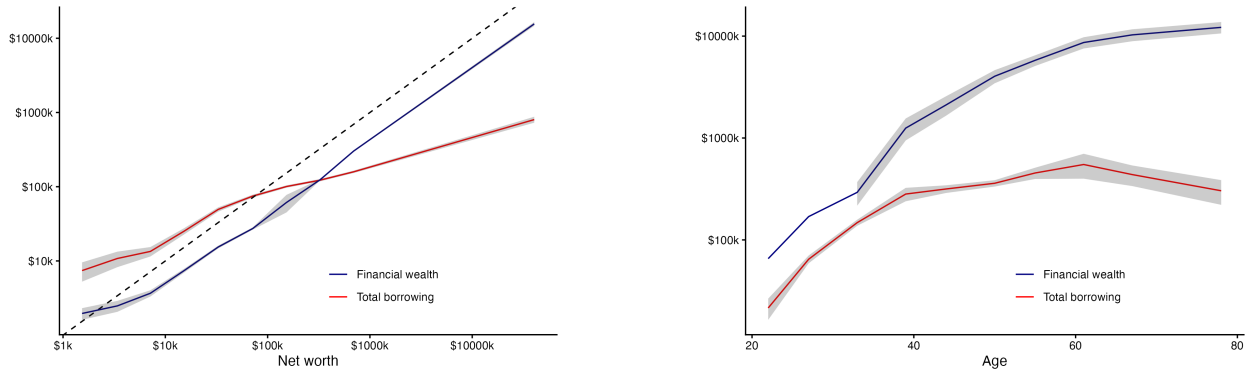
The R^2 values in columns (2) and (4) should not be compared mechanically with those in columns (1) and (3) because adding firm concentration changes the estimation sample. The legal-origin and firm-concentration variables are time invariant, so the specifications include year fixed effects but not country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

B Household Sector: Supplemental Material

This section provides the household evidence, derivations, and estimation details supporting Section 2.1.

B.I Motivating Facts

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

B.II Model Specification and Derivations

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_{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:

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

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

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 passthrough.

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

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

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

B.III Model Estimation

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

$$\log\left(\frac{Q^h_{s,k,t}}{Q^h_{s,l,t}}\right) = \sigma^h_S \log\left(\frac{\bar{\alpha}_k}{\bar{\alpha}_l}\right) + (\sigma^h_S - 1)\log\left(\frac{r^h_{k,t}}{r^h_{l,t}}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{39}$$

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 (39) 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):

$$\log\left(\frac{Q^h_{b,k,t}}{Q^h_{b,l,t}}\right) = \sigma^h_B \log\left(\frac{\bar{\beta}_k}{\bar{\beta}_l}\right) - \sigma^h_B \log\left(\frac{r^h_{k,t}}{r^h_{l,t}}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{40}$$

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 σ^h_S, equation (34) rearranges so that the preference weights are the regressand:

$$\frac{1}{\sigma^h_S}\left[\log\left(\frac{q^i_{s,k,t}}{q^i_{s,l,t}}\right) - (\sigma^h_S - 1)\log\left(\frac{r^h_{k,t}}{r^h_{l,t}}\right)\right] = \log\left(\frac{\alpha^i_k}{\alpha^i_l}\right) + \tilde{\varepsilon}^i_{k,l,t}, \tag{41}$$

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

$$\log\left(\frac{\alpha^i_k}{\alpha^i_l}\right) = \alpha^0_{k,l} + \alpha^w_{k,l}\widetilde{w}^i + \alpha^a_{k,l}\widetilde{a}^i + \alpha^{a2}_{k,l}(\widetilde{a}^i)^2. \tag{42}$$

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 (42) continuously.

Deposits are the base class. One pooled regression recovers all class pairs: class indicators estimate the intercepts $\alpha^0_{k,l}$, 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),

$$\frac{1}{\sigma^h_B}\left[\log\left(\frac{q^i_{b,k,t}}{q^i_{b,l,t}}\right)+\sigma^h_B\log\left(\frac{r^h_{k,t}}{r^h_{l,t}}\right)\right]=\log\left(\frac{\beta^i_k}{\beta^i_l}\right)+\tilde{\varepsilon}^i_{k,l,t}, \tag{43}$$

with

$$\log\left(\frac{\beta^i_k}{\beta^i_l}\right)=\beta^0_{k,l}+\beta^w_{k,l}\widetilde{w}^i+\beta^a_{k,l}\widetilde{a}^i+\beta^{a2}_{k,l}(\widetilde{a}^i)^2. \tag{44}$$

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^i_s from (34) is observed. The outer nest (38) gives the estimating equation

$$\log\left(\frac{\mathcal{S}^i}{c^i}\right)=\sigma^h\log\left(\frac{\gamma^i_s}{\gamma^i_c}\right)+\sigma^h\log R^i_s+\tilde{\varepsilon}^i, \tag{45}$$

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, $c^i = w^i_{\text{FOF}} + \mathcal{B}^i - \mathcal{S}^i/R^i_s$, spending net worth plus borrowing net of dollar saving. Here w^i_{FOF} is the FOF-consistent net worth $w^i_{\text{FOF}} = \text{networth}^i_{\text{SCF}} + (\widetilde{S}^i - S^i_{\text{raw}}) - (\mathcal{B}^i - \mathcal{B}^{i,\text{raw}})$, where $\widetilde{S}^i$ (S^i_{raw}) 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 $\log R^i_s$ 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^i_s differently across cells because the Stage-2 weights differ.

Borrowing constraint. The Stage-1 elasticity σ^h_B and the Stage-2 weights β^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), $\mathcal{B}^i R^i_b = \bar{D}^i$. We estimate its empirical counterpart by projecting log debt service $\log(\mathcal{B}^i R^i_b)$ 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. σ_S^h and σ_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. σ^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.

Detailed estimation tables. Tables A4 and A5 report the full regression output underlying the parameter summary in Table 1.

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 (41), 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 (43). Columns (3)–(4) are OLS and IV for the outer nest (45); the IV slope identifies σ^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

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

C Firm Sector: Supplemental Material

This section provides the firm derivations, calibration, and estimation details supporting Section 2.2.

C.I Model Specification and Derivations

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

$$\frac{\Pi_I^i}{A^i} = R_A^i - R_D^i(1 - s_E^i) - r_E s_E^i - \frac{\eta_E}{2}(s_E^i - \bar{s}^i)^2. \tag{46}$$

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

$$R_D^i - r_E - \eta_E(s_E^i - \bar{s}^i) = 0, \qquad \frac{\partial^2(\Pi_I^i/A^i)}{\partial(s_E^i)^2} = -\eta_E < 0. \tag{47}$$

Solving the first-order condition gives

$$s_E^i \equiv \frac{E^i}{A^i} = \bar{s}^i + \frac{R_D^i - r_E}{\eta_E}, \qquad 0 < s_E^i < 1. \tag{48}$$

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

$$P^i = \left((\alpha_{\text{real}}^i)^{\sigma_A^f}(r_{\text{real}}^i)^{\sigma_A^f - 1} + (\alpha_{\text{fin}}^i)^{\sigma_A^f}(R_{\text{fin}}^i)^{\sigma_A^f - 1}\right)^{\frac{1}{\sigma_A^f - 1}}, \tag{49}$$

and the optimal choice of real and financial investment is

$$K^i = A^i(\alpha_{\text{real}}^i)^{\sigma_A^f}\left(\frac{r_{\text{real}}^i}{P^i}\right)^{\sigma_A^f - 1}, \qquad F^i = A^i(\alpha_{\text{fin}}^i)^{\sigma_A^f}\left(\frac{R_{\text{fin}}^i}{P^i}\right)^{\sigma_A^f - 1}. \tag{50}$$

Within the financial nest,

$$R^i_{\text{fin}} = \left(\sum_{j \in J^f_A} (\gamma^i_j)^{\sigma^f_F} (r^f_j)^{\sigma^f_F - 1} \right)^{\frac{1}{\sigma^f_F - 1}}, \qquad q^i_{a,j} = F^i (\gamma^i_j)^{\sigma^f_F} \left(\frac{r_j}{R^i_{\text{fin}}} \right)^{\sigma^f_F - 1}. \tag{51}$$

For the deposit class ($j = \text{dep}$), the class-level return r^f_{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:

$$r^f_{\text{dep}} = \left(\frac{1}{N_f} \sum_{k \in \mathcal{N}_f} (r^f_{\text{dep},k})^{\sigma_{D,f} - 1} \right)^{\frac{1}{\sigma_{D,f} - 1}}, \qquad q^i_{a,\text{dep},k} = \frac{q^i_{a,\text{dep}}}{N_f} \left(\frac{r^f_{\text{dep},k}}{r^f_{\text{dep}}} \right)^{\sigma_{D,f} - 1}. \tag{52}$$

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

$$R^i_D = \left(\sum_{j \in J^f_B} (\beta^i_j)^{\sigma^f_D} (r^f_j)^{1 - \sigma^f_D} \right)^{\frac{1}{1 - \sigma^f_D}}, \qquad q^i_{b,j} = \mathcal{D}^i (\beta^i_j)^{\sigma^f_D} \left(\frac{r_j}{R^i_D} \right)^{-\sigma^f_D}. \tag{53}$$

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:

$$r^f_b = \left(\frac{1}{N_f} \sum_{k \in \mathcal{N}_f} (r^f_{b,k})^{1 - \sigma_{L,f}} \right)^{\frac{1}{1 - \sigma_{L,f}}}, \qquad q^i_{b,b,k} = \frac{q^i_{b,b}}{N_f} \left(\frac{r^f_{b,k}}{r_b} \right)^{-\sigma_{L,f}}. \tag{54}$$

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 passthrough.

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

$$R_A^{\text{req},i} = R_D^i(1 - s_E^i) + r_E s_E^i + \frac{\eta_E}{2}(s_E^i - \bar{s}^i)^2. \tag{55}$$

Using equation (48) 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 Π_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:

$$K^i = \bar{K}^i \left(\frac{r_{\text{real}}^i}{\bar{r}_{\text{real}}^i} \right)^{-1/\eta_K}. \tag{56}$$

The type-specific return r_{real}^i adjusts until $z_s P^i$, with P^i given by (49), 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 φ multiplies the unit-normalized index P^i in equation (49) by $\varphi^{\sigma_A^f/(\sigma_A^f-1)}$ while leaving the conditional asset shares (50) 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

$$R_A^i = z_s\, P^i, \tag{57}$$

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 (11) continues to hold exactly—nor an additive return wedge, which would enter the leverage response through a different channel. We calibrate z_{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_{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_{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_{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.II Model Estimation

Stage 1. For any two financial-asset classes k and l, equation (51) implies

$$\log\left(\frac{Q_{a,k,t}^f}{Q_{a,l,t}^f}\right) = \sigma_F^f \log\left(\frac{\bar{\gamma}_k}{\bar{\gamma}_l}\right) + (\sigma_F^f - 1)\log\left(\frac{r_{k,t}^f}{r_{l,t}^f}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{58}$$

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 (53) is

$$\log\left(\frac{Q_{b,k,t}^f}{Q_{b,l,t}^f}\right) = \sigma_D^f \log\left(\frac{\bar{\beta}_k}{\bar{\beta}_l}\right) - \sigma_D^f \log\left(\frac{r_{k,t}^f}{r_{l,t}^f}\right) + \tilde{\varepsilon}_{k,l,t}, \tag{59}$$

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 $-\sigma_D^f$ 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:

$$\frac{1}{\sigma_F^f}\left[\log\left(\frac{q_{a,k,t}^i}{q_{a,l,t}^i}\right) - (\sigma_F^f - 1)\log\left(\frac{r_{k,t}^f}{r_{l,t}^f}\right)\right] = \log\left(\frac{\gamma_k^i}{\gamma_l^i}\right) + \tilde{\varepsilon}_{k,l,t}^i \tag{60}$$

and

$$\frac{1}{\sigma_D^f}\left[\log\left(\frac{q_{b,k,t}^i}{q_{b,l,t}^i}\right) + \sigma_D^f \log\left(\frac{r_{k,t}^f}{r_{l,t}^f}\right)\right] = \log\left(\frac{\beta_k^i}{\beta_l^i}\right) + \tilde{\varepsilon}_{k,l,t}^i. \tag{61}$$

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

$$\log\left(\frac{\gamma_k^i}{\gamma_l^i}\right) = \gamma_{k,l}^0 + \gamma_{k,l}^{\text{size}} x^i + \gamma_{k,l}^{\text{size}^2}(x^i)^2 + \gamma_{k,l}^{\text{ind}(i)} + \epsilon_{k,l}^{\gamma,i}, \tag{62}$$

$$\log\left(\frac{\beta_k^i}{\beta_l^i}\right) = \beta_{k,l}^0 + \beta_{k,l}^{\text{size}} x^i + \beta_{k,l}^{\text{size}^2}(x^i)^2 + \beta_{k,l}^{\text{ind}(i)} + \epsilon_{k,l}^{\beta,i}. \tag{63}$$

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_{fin}^i from (51) is observed. The outer asset nest (50) gives the estimating equation

$$\log\left(\frac{K_t^i}{F_t^i}\right) = \sigma_A^f \log\left(\frac{\alpha_{\text{real}}^i}{\alpha_{\text{fin}}^i}\right) + (\sigma_A^f - 1)\log\left(\frac{r_{\text{real},t}}{R_{\text{fin},t}^i}\right) + \tilde{\varepsilon}_t^i, \tag{64}$$

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

$$\log\left(\frac{\alpha_{\text{real}}^i}{\alpha_{\text{fin}}^i}\right) = \alpha^0 + \alpha^{\text{size}} x^i + \alpha^{\text{size}^2}(x^i)^2 + \alpha^{\text{ind}(i)} + \epsilon^{\alpha,i}. \tag{65}$$

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

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

The size interactions deliver cross-sectional variation in the local return that monetary-policy time series alone cannot: the same shock moves R^i_{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 $\log(\text{Size}_M)$ 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 (48). Writing $s^i_{E,t} \equiv E^i_t/A^i_t$,

$$s^i_{E,t} = \bar{s}^i + \frac{R^i_{D,t} - r_{E,t}}{\eta_E} + \tilde{\varepsilon}^i_t. \tag{66}$$

The reference equity share is parameterized as

$$\bar{s}^i = s^0 + s^{\text{size}} x^i + s^{\text{size}^2} (x^i)^2 + s^{\text{ind}(i)}. \tag{67}$$

Define the endogenous spread $X^i_t \equiv R^i_{D,t} - r_{E,t}$. Because $r_{E,t}$ is endogenous in general equilibrium, the first stage instruments the entire spread, $X^i_t = \pi Z^i_t + \text{controls} + u^i_t$, 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 η_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 η_K, the firm-type productivity shifter is recovered by inverting the supply schedule at observed quantities,

$$\zeta^i_t = \log r^i_{\text{real},t} + \eta_K \log K^i_t, \tag{68}$$

where $r^i_{\text{real},t}$ is recovered from the type's required asset return (12) and the asset-service condition (57). The recovered shifter makes observed quantities consistent with the model-

implied type-specific required returns. The value of η_K therefore governs counterfactual quantity responses.

Identification. σ_F^f and σ_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. σ_A^f and the common curvature η_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.

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.

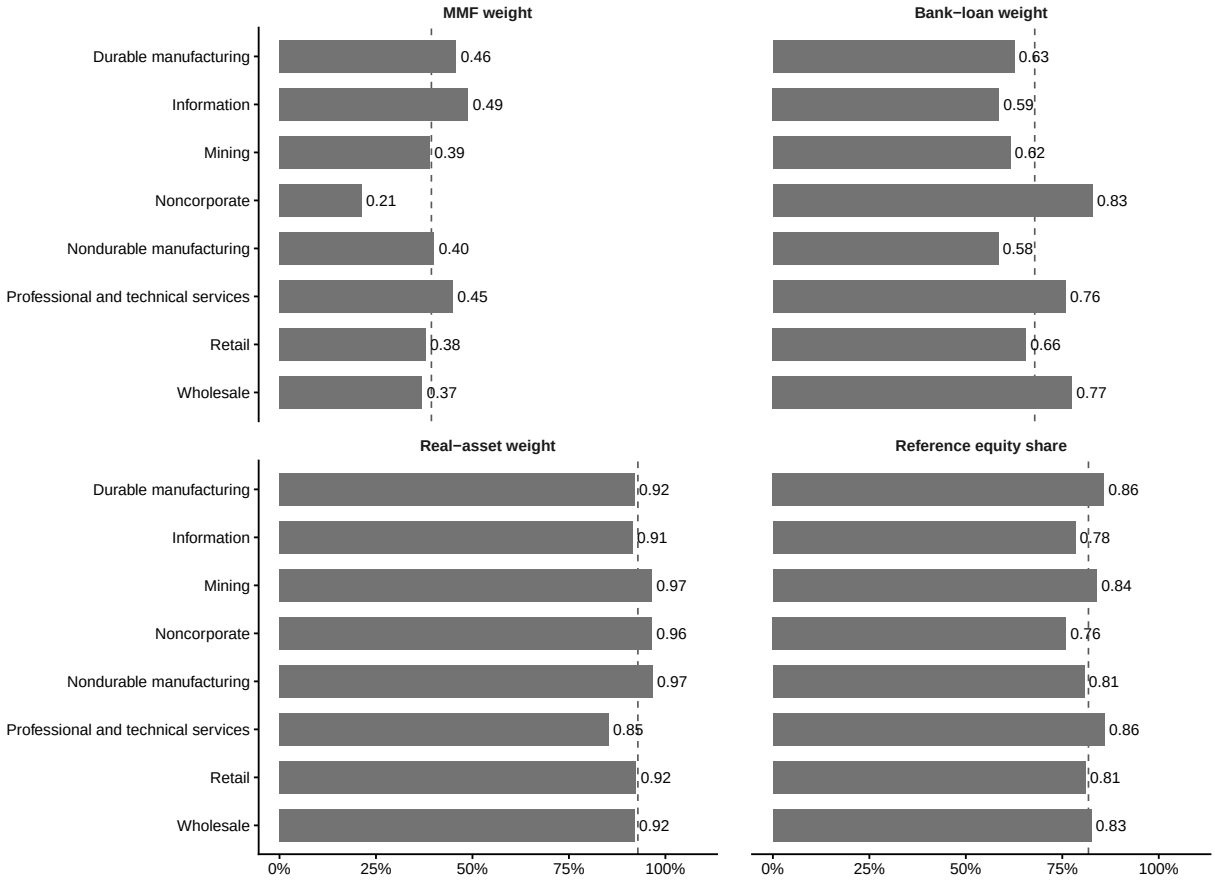


Figure A3: Firm preference weights by industry and sector. The panels report residual-free fitted MMF, bank-loan, and real-asset weights and the reference equity share at mean-centered log size $x = 0$. CES weights are normalized to sum to one within their respective nests. Dashed vertical lines show 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 ζ_t^i across the industry–size cells. They rise with firm size within manufacturing and are highest for the non-corporate and services groups, reflecting the capital each type operates at its required return. The firm-size comparative static in Section 4 raises ζ_t^i for the large-firm cells and lowers it for the rest, holding aggregate productivity-implied capital fixed.

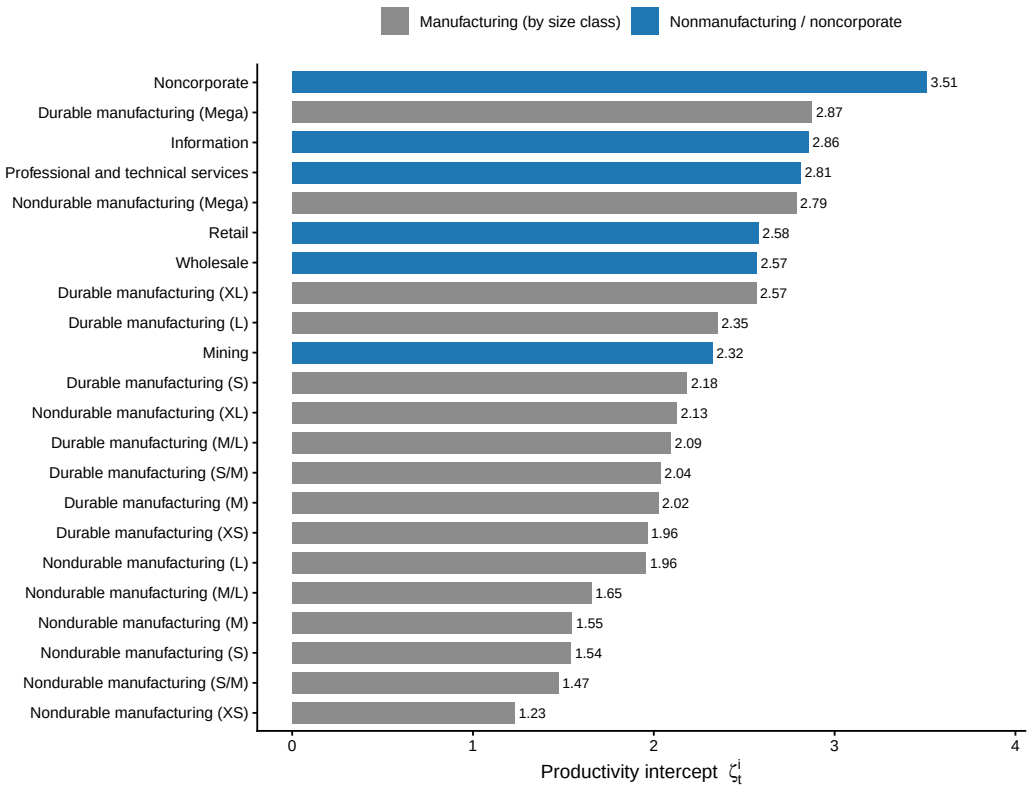


Figure A4: Firm productivity intercepts by industry and size (2019). Each bar is the calibrated intercept ζ_t^i of the type-level real-return supply schedule (13), recovered by inverting the schedule at observed capital, $\zeta_t^i = \log r_{\text{real},t}^i + \eta_K \log K_t^i$ (equation (68)). Manufacturing cells are shown by size class; the remaining industries enter at the sector level.

Detailed estimation tables. Tables A6 and A7 report the full regressions underlying the main-text parameter summary.

Table A6: Firm across-class substitution. Columns (1)–(2) are OLS and IV for the financial-asset nest (58); the IV slope on the relative return identifies $\sigma_F^f - 1$. Columns (3)–(4) are OLS and IV for the debt nest (59); 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 (64); the IV slope identifies $\sigma_A^f - 1$. Columns (6)–(7) are OLS and IV for the equity-share equation (66); 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 Intermediaries: Supplemental Material

This section provides the intermediary derivations and estimation details supporting Section 2.3.

D.I Model Specification and Derivations

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,

$$P_B = \left(\sum_{j \in J_B} \gamma_B^j (1 + r_j)^{1-\eta_B} \right)^{\frac{1}{1-\eta_B}}, \qquad S_j^B = \gamma_B^j \left(\frac{p_j}{P_B} \right)^{-\eta_B} \frac{S_B}{P_B}. \tag{69}$$

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

$$D_B^j = \delta_{D,j} D^j \left(\frac{r_{\text{dep},B}^j}{R_{D,j}} \right)^{\sigma_{D,j}-1}, \tag{70}$$

$$L_B^j = \delta_{L,j} L^j \left(\frac{r_{b,B}^j}{R_{L,j}} \right)^{-\sigma_{L,j}}. \tag{71}$$

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^j_B, 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 ω_B is the bank's market share within deposits and σ^j_{across} is the sector's across-class elasticity, equal to σ^h_S for households and σ^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 (16) 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^M_j, $j \in J_M \equiv \{o, h, g\}$. Each asset has beginning-of-period price p_j. The portfolio delivers $\mathcal{S}_M$ units of end-of-period payoff according to

$$\mathcal{S}_M(\{S^M_j\}_j) = \left(\sum_{j \in J_M} (\gamma^j_M)^{1/\eta_M} (S^M_j)^{\frac{\eta_M - 1}{\eta_M}} \right)^{\frac{\eta_M}{\eta_M - 1}}, \qquad S_M = \sum_{j \in J_M} p_j S^M_j. \tag{72}$$

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

$$P_M = \left(\sum_{j \in J_M} \gamma^j_M (1 + r_j)^{1 - \eta_M} \right)^{\frac{1}{1 - \eta_M}}, \qquad S^M_j = \gamma^j_M \left(\frac{p_j}{P_M} \right)^{-\eta_M} \frac{S_M}{P_M}. \tag{73}$$

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^{ud}_M. MMF profit per unit of assets is

$$\Pi_M = \underbrace{(1 + r_M)}_{\text{portfolio payoff}} - \underbrace{(1 + r^{ud}_M)}_{\text{investor payoff}} - \underbrace{c_M}_{\text{operating cost}}. \tag{74}$$

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

$$S_M = D^{ud}_M \equiv Q^h_{s,\text{mmf}} + Q^f_{a,\text{mmf}}, \tag{75}$$

where $Q^h_{s,\text{mmf}}$ and $Q^f_{a,\text{mmf}}$ 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 $(1 + r^k_n)L_{L,k}$.

The household lender's financing composite contains $j \in J_h \equiv \{\text{sec}, \text{nbl}\}$, where h denotes broadly held securities financed by household loans, such as Agency MBS, and n denotes NBL securities held by banks. The firm lender's composite contains $j \in J_f \equiv \{\text{sec}, \text{nbl}\}$, where c 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^k_n.

Each NBL type issues $S^j_{L,k}$ 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

$$\mathcal{S}_{L,k} = \left(\sum_{j \in J_k} (\gamma^j_{L,k})^{1/\eta_{L,k}} (S^j_{L,k})^{\frac{\eta_{L,k}-1}{\eta_{L,k}}} \right)^{\frac{\eta_{L,k}}{\eta_{L,k}-1}}. \tag{76}$$

Cost minimization for a given amount of effective funding yields

$$P_{L,k} = \left(\sum_{j \in J_k} \gamma^j_{L,k} (1 + r_j)^{1-\eta_{L,k}} \right)^{\frac{1}{1-\eta_{L,k}}}, \qquad S^j_{L,k} = \gamma^j_{L,k} \left(\frac{1 + r_j}{P_{L,k}} \right)^{-\eta_{L,k}} \mathcal{S}_{L,k}. \tag{77}$$

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

$$\Pi_{L,k} = (1 + r^k_n) - (1 + \tilde{r}^k_n) - c^k_n. \tag{78}$$

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:

$$\mathcal{S}_{L,h} = Q^h_{b,n}, \qquad \mathcal{S}_{L,f} = Q^f_{b,n}, \tag{79}$$

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

D.II Model Estimation

Estimating the bank securities CES. Let $V^B_j \equiv p_j S^B_j$ denote the beginning-of-period dollar value of asset j. The bank's CES portfolio of liquid securities with common elasticity η_B then satisfies, from (69),

$$\log\left(\frac{V^B_j}{V^B_{\text{res}}}\right) = \log\left(\frac{\gamma^j_B}{\gamma^{\text{res}}_B}\right) + (1-\eta_B)\log\left(\frac{p_j}{p_{\text{res}}}\right). \tag{80}$$

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-passthrough equations of the form

$$r^j_{b,B} = \frac{\sigma_{L,j}}{\sigma_{L,j}-1}\big(c^j_{b,B} + \tilde{r} + \text{wedge}\big), \qquad j \in \{h, f\}, \tag{81}$$

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 passthrough coefficient: loan rates are instrumented with the federal funds rate and deposit rates with monetary-policy surprises. The passthrough 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 passthrough 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 (73),

$$\log\left(\frac{V_j^M}{V_o^M}\right) = \log\left(\frac{\gamma_j^M}{\gamma_o^M}\right) + (1-\eta_M)\log\left(\frac{p_j}{p_o}\right). \tag{82}$$

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

$$\log\left(\frac{S_{\text{sec}}^{L,h}}{S_{\text{nbl}}^{L,h}}\right) = \log\left(\frac{\gamma_{\text{sec}}^{L,h}}{\gamma_{\text{nbl}}^{L,h}}\right) - \eta_{L,h}\log\left(\frac{\bar{p}_{\text{age}}}{\bar{p}_{\text{nbl}}}\right), \tag{83}$$

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

$$c_{M,t} = r_{M,t} - r_{M,t}^{ud}, \tag{84}$$

$$c_{L,k,t} = r_{n,t}^k - \tilde{r}_{n,t}^k. \tag{85}$$

Identification. The portfolio elasticities η_B, η_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 passthrough 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.

Detailed estimation tables. Tables A8–A10 report the underlying OLS and IV specifications summarized in the main-text parameter table.

Table A8: Bank securities portfolio (CES demand). OLS and IV estimates of (80) 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 passthrough (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 passthrough 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 (82) (columns 1–2), the household-NBL funding system (83) (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

E Other Sectors and Equilibrium: Supplemental Material

This section provides the government and rest-of-world estimation and the market-clearing conditions supporting Section 2.5.

E.I Government and Rest-of-World Demand

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 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.

Rest-of-world estimation. With Treasuries as the numeraire, the demand system (22) implies

$$\log\left(\frac{q_j^W}{q_{\text{tre}}^W}\right) = \log\left(\frac{\alpha_j^W}{\alpha_{\text{tre}}^W}\right) + (1-\sigma^W)\log\left(\frac{p_j}{p_{\text{tre}}}\right), \tag{86}$$

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 (86) 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 $1-\sigma^W$. The regression is used to estimate σ^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.

Table A11: Rest-of-World CES demand. OLS and IV estimates of (86), 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.II Equilibrium Conditions

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 (50)–(53), the equity-ratio condition (48), and the zero-profit required-return condition (12). Banks satisfy the balance-sheet constraint in (16), liquid-asset demand (69), 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

$$\begin{aligned}
V_{L,h}^h &= A_f + V_h^H + V_h^W + V_h^M + V_h^B, && \text{(agency MBS)} \\
\bar{T} &= T_f + V_g^H + V_g^W + V_g^M + V_g^B, && \text{(Treasuries)} \\
V_{L,f}^c + X_c^W &= V_c^H + V_c^W + V_c^B, && \text{(corporate bonds)} \\
V_{L,h}^n + V_{L,f}^n &= V_n^B, && \text{(NBL securities)} \\
E^F + X_e^W &= V_e^H + V_e^W. && \text{(equity)}
\end{aligned} \tag{87}$$

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 (87).

F Demand-Curve Construction and Additional Shifts

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.

F.I 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 $m \in [1/2, 2]$.

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.

F.II 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.

F.III 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

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**

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 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.

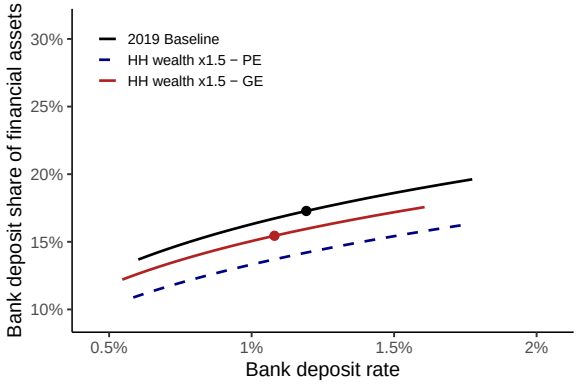
F.IV Firm Shifts

Firm characteristics enter through the cell-level productivity intercepts ζ_t^i of the capital schedule; Figure A7 reports both exercises. Because ζ_t^i is a log intercept, adding $\eta_K \log \mu$ to every cell multiplies every cell's capital schedule by μ 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

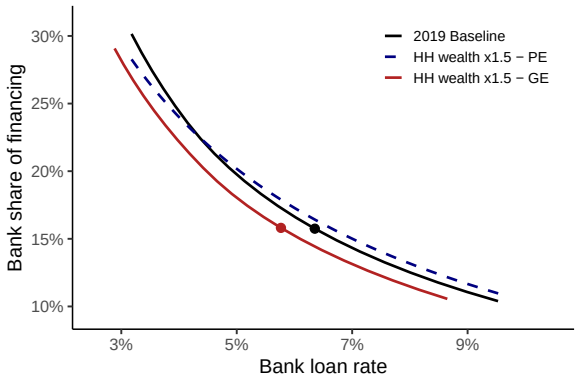
$$\mu_{\text{top}} = \frac{\tau^*}{\tau_0}, \qquad \mu_{\text{rest}} = \frac{1-\tau^*}{1-\tau_0},$$

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

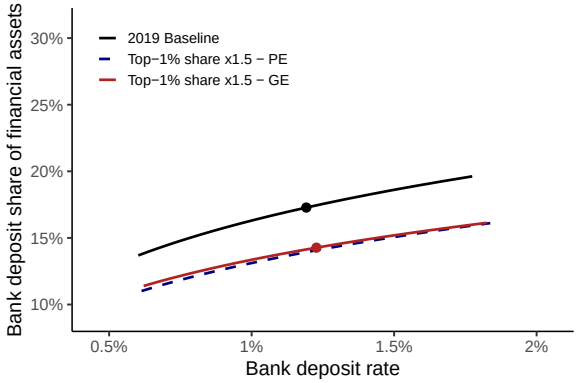
The vertical axis is banks' share of the market named in each panel, and the two columns share one scale, so their slopes are comparable. Each panel shows the 2019 baseline schedule (black), the shifted schedule at baseline cross-prices (navy dashed, PE), and the shifted schedule with all other markets 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.



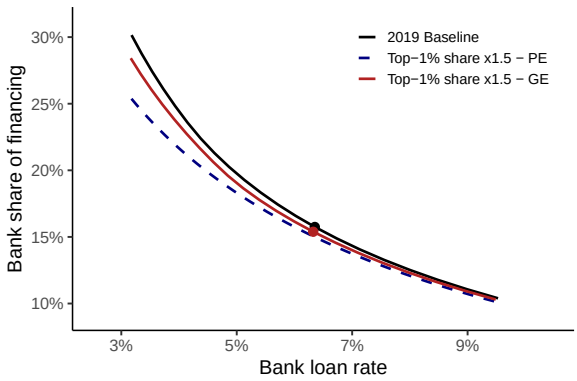
(a) Net worth: deposit



(b) Net worth: loan



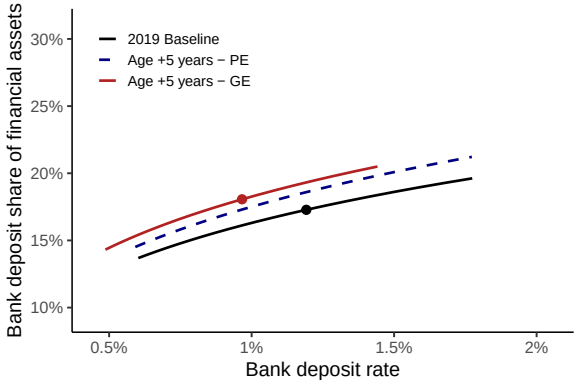
(c) Top-1% share: deposit



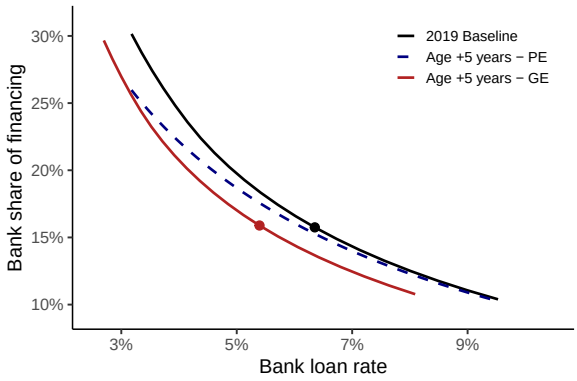
(d) Top-1% share: loan

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

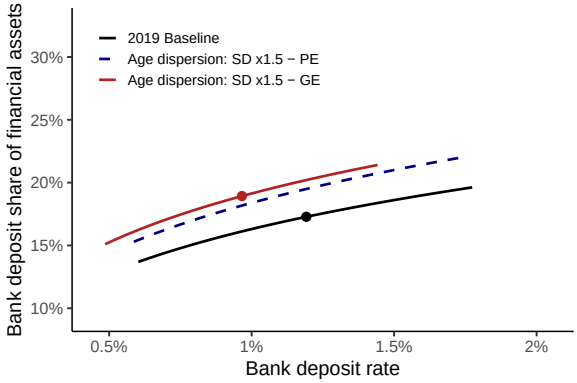
The vertical axis is banks' share of the market named in each panel, and the two columns share one scale, so their slopes are comparable. Each panel shows the 2019 baseline schedule (black), the shifted schedule at baseline cross-prices (navy dashed, PE), and the shifted schedule with all other markets 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.



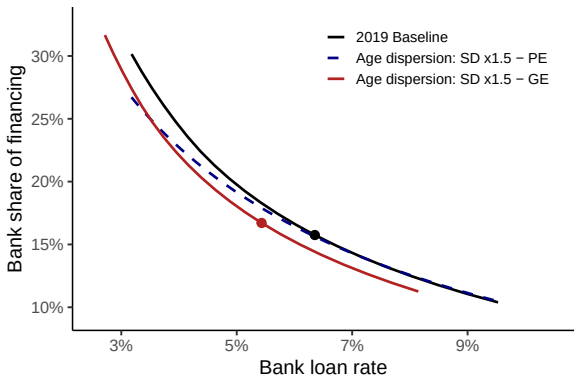
(a) Age level: deposit



(b) Age level: loan



(c) Age dispersion: deposit

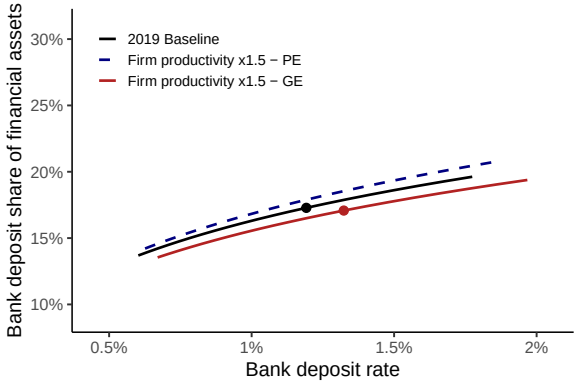


(d) Age dispersion: loan

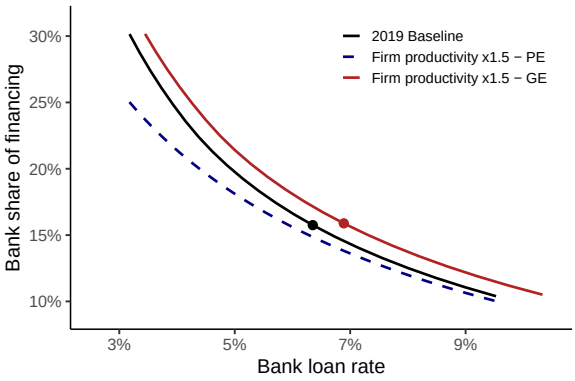
where τ_0 is the baseline large-firm share of capital and τ^* its target. These capital multipliers raise the large-firm share to τ^* while leaving aggregate capital at baseline cell prices unchanged and preserving relative capital shares within each group, so the exercise moves composition and nothing 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

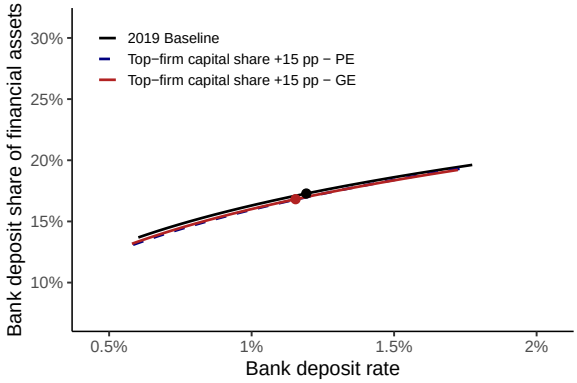
The vertical axis is banks' share of the market named in each panel, and the two columns share one scale, so their slopes are comparable. Each panel shows the 2019 baseline schedule (black), the shifted schedule at baseline cross-prices (navy dashed, PE), and the shifted schedule with all other markets 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 value-added share of large firms by 15 percentage points at fixed aggregate capital.



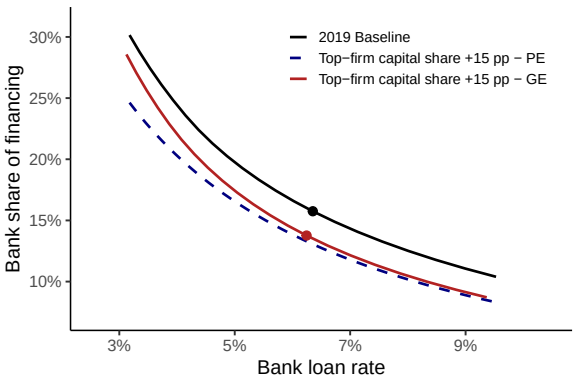
(a) Productivity: deposit



(b) Productivity: loan



(c) Top-firm share: deposit



(d) Top-firm share: loan

G Additional Results for the Historical Application

Figure A8 reports the price counterpart to the quantity and balance-sheet outcomes in Figure 10. The decomposition uses the same four equilibria and reports each rate or spread as its 2019 value minus its constructed 1980 value.

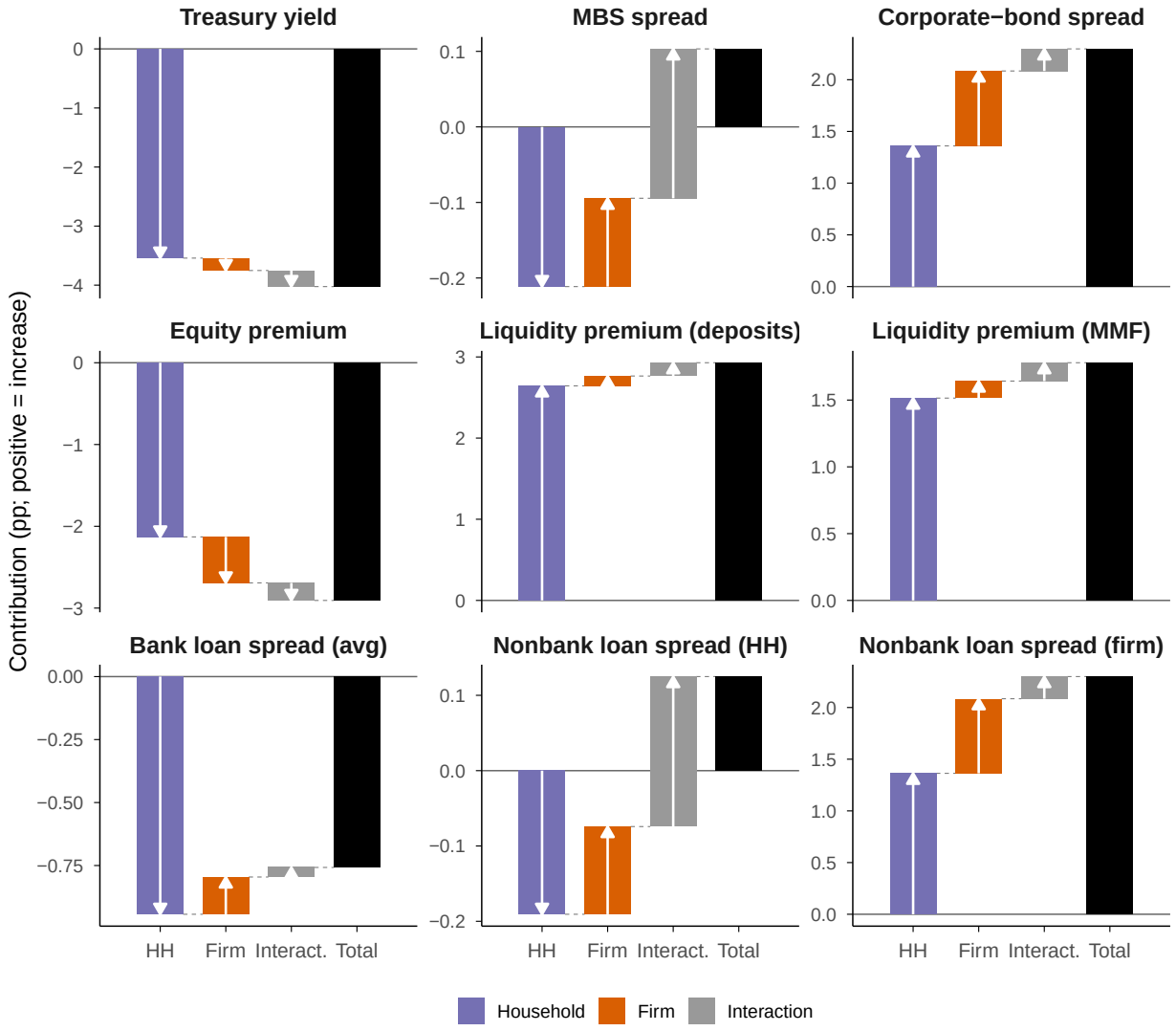


Figure A8: 1980-to-2019 equilibrium rates and spreads. Household, firm, and interaction contributions to each rate or spread, computed as the 2019 value minus the 1980 value (positive = higher in 2019). The first panel reports the Treasury yield; the others report spreads over it. Deposit and bank-loan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

H Government Borrowing: Supplemental Material

This section derives the first-order decomposition used in Section 6 to read the real responses of firm investment and household consumption through the model's channels. All exposures are evaluated at the baseline equilibrium and $d\log r$ denotes the equilibrium change in a rate between the baseline and counterfactual solves.

H.I 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 (57) at fixed z_s, and using the CES share expressions (50),

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

By the envelope theorem on the leverage first-order condition (48), 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 ω_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

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

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,

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

where Λ_c^g 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 Λ_c^g 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 $\sum_g w_g \sum_c \Lambda_c^g$ 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

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

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

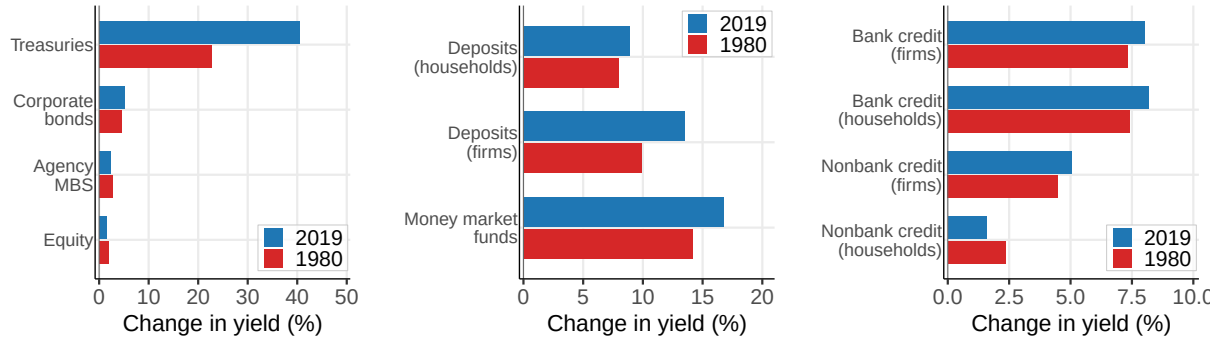
Here r_B^S is the return on the bank's liquid-securities portfolio and therefore the opportunity cost of lending; its one-for-one pass-through is the interest-rate channel. Loan-market power scales the same change by $1/(\sigma_{L,j} - 1)$, so amplification is larger the less substitutable banks

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.

H.II 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.



(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`.

H.III 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 $P = 1/(1+r)$, 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, non-wealthy young households (-0.19%), while older and wealthier households gain 0.3–0.5% from higher saving returns. Revaluation instead falls on 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

[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.

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			
Δr_{tre} (pp)	+1.45	+1.47	+0.02
Δr_b^h (pp)	+0.52	+0.53	+0.01
Δr_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			
Δr_{tre} (pp)	+1.72	+1.76	+0.04
Δr_b^h (pp)	+0.83	+0.87	+0.05
Δr_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