Income Inequality, Financial Intermediation, and Small Firms*

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Abstract

This paper shows that rising income inequality reduces job creation at small firms. High-income households save relatively less in the form of bank deposits while small firms depend on banks. We argue that a higher share of income accruing to top earners therefore erodes banks' deposits base and their lending capacity for small businesses, thus reducing job creation. Exploiting variation in top incomes across US states and an instrumental variable strategy, we establish that a 10 percentage point (p.p.) increase in the income share of the top 10% reduces the net job creation rate of small firms by 1.5–2 p.p., relative to large firms. The effects are stronger at smaller firms and in bank-dependent industries. Rising top incomes also reduce bank deposits and increase deposit rates, in line with a reduction in the supply of household deposits. We then build a general equilibrium model with heterogeneous households that face a portfolio choice between high-return investments and low-return deposits that insure against liquidity risk. Banks use deposits to lend to firms of different sizes subject to information frictions. We study job creation across firm sizes under counterfactual income distributions.

JEL classification: D22, D31, G21, L25.

Keywords: income inequality, job creation, small businesses, bank lending, household heterogeneity, financial frictions.

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1 Introduction

Since the 1970s the share of income accruing to high-income households in the United States has increased substantially. Today the top 10% income share stands at around 50% (Saez, 2019). Several studies investigate the causes of rising top incomes or their consequences for households (Mian, Straub and Sufi, 2020), and addressing inequality has become a central issue of discussion among policy makers. However, research on the effects of income inequality on firms is scarce. This limits our understanding of how inequality affects the real economy and makes it difficult to assess policy proposals that address widening income disparities.

This paper studies the link between top income shares and job creation at small firms. We propose a novel mechanism through which rising top income shares alter the relative availability of credit for firms of different sizes. Our channel rests on two empirical observations. First, high-income households hold a lower share of their financial wealth in the form of deposits than low-income households. Instead, top earners invest in financial assets such as stocks or bonds (Wachter and Yogo, 2010). Second, banks' access to deposits affects their ability to grant loans (Ivashina and Scharfstein, 2010; Gilje, Loutskina and Strahan, 2016; Drechsler, Savov and Schnabl, 2017) and small firms are more affected by changes in credit supply than large firms (Chodorow-Reich, 2014; Liberti and Petersen, 2019).[1]

Based on these observations we argue that rising top income shares reduce the supply of household deposits available to banks. In turn, the relative amount of funding for small firms declines and their job creation falls, relative to large firms. The first part of this paper tests the hypothesis empirically. The second part builds a structural general equilibrium model to study job creation across firm sizes under counterfactual income distributions.

Our empirical analysis exploits variation in top income shares across US states from 1980 to 2015, combined with a Bartik-style instrumental variable (IV) strategy and granular fixed effects. We establish that a 10 percentage point (p.p.) increase in the top 10% income share significantly reduces the net job creation rate of small firms by around 1.5 p.p., relative to large firms.[2] To put our results into perspective, the average increase in the state-level income share of the top 10% from 1980 to 2010 was around 10 p.p., so net job creation at small firms would have been around 1.5 p.p. higher in 2010 if top income shares had remained at their 1980 levels. Relative to an average net job creation rate of small firms of 4.2% during the 1980s, the effect is economically sizeable.

To mitigate concerns about omitted variable bias or reverse causality, we predict the actual evolution in state-level top 10% income shares with each state's 1970 top 10% income share adjusted for the national growth in the income share. Specifically, we compute the 'leave-one-out' national growth of top income shares by excluding each respective state from the nationwide changes used to adjust initial income shares in that state. The predicted income shares are then used as an IV for the actual shares. This leave-one-out Bartik approach excludes the possibility that unobservable state-specific

[1] Small firms are informationally opaque and banks have a comparative advantage in screening and monitoring, which is why small firms depend more on banks than large firms (Petersen and Rajan, 1994). Consequently, a large literature shows that changes in credit supply matter relatively more for smaller firms (Becker and Ivashina, 2014; Jiménez, Ongena, Peydró and Saurina, 2017; Bottero, Lenzu and Mezzanotti, 2020). We also show that banks raise the majority of their deposits in their headquarters state.

[2] In the baseline specification, small firms are defined as firms with one to nine employees.

shocks at the firm size-level could induce changes in income shares.

We further control for observable and unobservable time-varying characteristics that could affect job creation within each state through granular fixed effects, exploiting variation at the state-firm size-year level. State*time fixed effects absorb, for example, the differential effects of technological change or globalization in each state over time, two common explanations behind the rise in income inequality (Cowell and Van Kerm, 2015). When possible we include state*industry*time fixed effects that absorb common trends that affect industries within each state differentially. These include, for example, rising industry concentration or import competition.[3] Any unobservable factor that could simultaneously drive small firm job creation and top income shares would thus need to affect small and large firms within the same state and industry differently and above and beyond the set of controls and fixed effects included in our regressions.

We provide evidence for the underlying mechanism. First, we show that the magnitude of the effect is declining in firm size, consistent with the empirical evidence that small firms are more bank-dependent (Petersen and Rajan, 1994; Chodorow-Reich, 2014) and hence more affected by the relative decline in deposits. Second, we establish that a given increase in top incomes reduces net job creation at small relative to large firms by more in industries that rely more on banks as a source of financing. This finding further supports the argument that rising top incomes affect the availability of credit to small firms. Third, we show that effects are increasing in the income share threshold (10% vs 5% vs 1%), reflecting the fact that deposits as a share of financial assets decline steadily with income. For example, we find that a 10 p.p. increase in the share of the top 1% earners implies a stronger decline in available deposits, and hence job creation, than a similar increase in the share of the top 10% does.

To test explicitly whether our channel operates through a reduction in deposits, we use bank balance sheets data from the U.S. call reports. In bank-level regressions, we find that a rise in top income shares in banks' headquarters state significantly reduces the amount of deposits and increases banks' deposit expense. The fall in quantities and increase in prices is consistent with a reduction in households' supply of deposits induced by rising top income shares.[4] In line with state-level regressions, we show that the effect of rising top incomes on deposits and deposit rates increases in magnitude in the income threshold. We obtain similar results for the supply of commercial and industrial (C&I) loans: higher top income shares reduce loan quantities but increase interest income.[5]

We perform a set of additional tests. The effects we find are present both among new entrants and continuing small firms, but economically larger for continuing firms. Likewise, the number of small relative to large firms declines, and so does the relative reallocation rate. To rule out that top income shares affect job creation through changes in local demand, we exclude non-tradable industries from our regressions and find similar effects. Further, directly controlling for the differential impact of house prices on small and large firms does not change the results, suggesting that our findings are

[3]Our results also remain similar when we include a large set of state-level control variables interacted with a firm-size dummy, i.e., when we control for the differential effect of these controls on net job creation at small vs. large firms.

[4]An implicit assumption is that banks raise a significant share of their deposits in their headquarters state. We find that this is the case for 98% of deposits of the average bank.

[5]We further find that the effect of rising top income shares on the amount (rate) of deposits and loans is less pronounced among larger banks, consistent with larger banks relying less on local deposits.

not explained by possible confounding effects that work through the collateral channel (Chaney, Sraer and Thesmar, 2012; Adelino, Schoar and Severino, 2015).

Our results are robust to excluding individual states or years; remain unaffected when we exclude years of negative GDP growth or the great financial crisis; or exclude states that account for the majority of venture capital funding. We also show that the negative effects of rising top income shares on small firm job creation are larger in industries that depend more on external finance. Finally, controlling for measures of industry concentration or state-level spending on education does not affect our results.[6]

Based on this evidence, we build a structural general equilibrium model. The model serves two purposes. First, it allows us to formally examine the link between top incomes, financial intermediation, and small firm job creation in a tractable framework. Second, through the model we can quantitatively analyze job creation patterns under counterfactual income distributions and assess the relative importance of different frictions in the transmission.

The model features incomplete markets, heterogeneous households, heterogeneous firms, and financial intermediation subject to imperfect information. Heterogeneous households face a portfolio choice between high-return direct investments and low-return deposit holdings that insure against uncertain expenditure shocks. The liquidity need for insurance declines with income, so deposits become relatively less attractive for high-income households. There is a representative 'public' firm, which receives direct investments from households, as well as 'private' firms that are heterogeneous in their initial net worth (and hence size). Private firms borrow from a bank subject to an imperfect information problem, which prevents the bank from observing firms' productivity unless it incurs an auditing cost (Bernanke and Gertler, 1989; Bernanke, Gertler and Gilchrist, 1999). The aggregate amount of deposits available for bank financing determines bank lending rates and loan amounts granted to private firms. This in turn determines the amount of labor that these firms can hire.

The model captures key features of the stylized facts and empirical analysis. The composition of savings changes along the income distribution, reflecting the trade-off between liquid assets with low-return and illiquid high-return assets. With a higher share of aggregate income accruing to high-income households for whom expenditure risk matters relatively less, a larger fraction of savings flows into direct public firm investments instead of bank deposits.[7] The consequence is a reduction in the aggregate supply of deposits, in line with the empirical evidence that deposits decline and deposit rates increase as top income shares rise. With more difficult access to deposits, banks charge higher loan rates and grant fewer loans to bank-dependent businesses. As a result, private firms have fewer funds available for hiring workers. Importantly, the strength of this financial friction decreases in firm size: smaller firms, that is, those with lower net worth, are more dependent on outside funds. This makes the information asymmetry more relevant for their financing decision and renders external financing

[6]The fact that educational expenses do not explain our findings ensures that our channel is different from Braggion, Dwarkasing and Ongena (2020), who emphasize the importance of the provision of public goods, such as education, for entrepreneurship.

[7]In addition to changes in the *composition of savings*, in our model high-income households consume a smaller fraction of their income and thus have a higher *overall savings rate*. While this relation is not necessary for our main mechanism, it is consistent with empirical evidence. In particular, we generate savings rates that are increasing in permanent income, consistent with findings by Dynan, Skinner and Zeldes (2004) and Straub (2018).

more costly. The credit reduction arising from higher top income shares most strongly reduces labor demand by the smallest firms, in line with our empirical findings.

Contribution to the literature. Our main contribution is to study the consequences of rising top income shares for job creation.[8] A related strand of literature investigates the consequences of rising inequality for households. For example, inequality affects household consumption and savings in the short and long run (Auclert and Rognlie, 2017, 2020), and rising top incomes lead to an increase in the consumption of poorer households (Bertrand and Morse, 2016). Coibion, Gorodnichenko, Kudlyak and Mondragon (2020) show that low-income households in low-inequality areas accumulate more debt than their counterparts in high-inequality areas. Mian, Straub and Sufi (2020) argue that inequality has led to an increase in savings by rich households and fuelled the indebtedness of low-income households. While inequality and household savings also play a key role in our setting, we contribute novel insights on how their interaction affects firms and job creation.[9]

With respect to the nexus between inequality and the production side of the economy, a number of papers examine the effects of income inequality on growth in cross-country settings (Banerjee and Duflo, 2003; Berg and Ostry, 2017). Yet, little well-identified evidence exists on how inequality affects job creation. An exception are Braggion, Dwarkarsing and Ongena (2020), who empirically establish a negative effect of wealth inequality on entrepreneurship using micro data for the US since 2004. They provide evidence that higher wealth inequality reduces the provision of public goods and the political support for redistribution, and argue that these forces could explain the negative correlation.[10] To the best of our knowledge ours is the first paper to investigate the effects of rising income inequality on financing and job creation at small firms.[11]

2 Motivating evidence and hypotheses

This section first presents stylized facts on the relation between household income and savings in different types of financial assets. Second, it discusses the relevance of bank deposits for bank lending, and reviews findings on the importance of banks for small firms. Based on these observations, it then develops the main hypotheses.

[8] A series of papers studies the causes (rather than consequences) of income inequality. See Gordon and Dew-Becker (2008) and Cowell and Van Kerm (2015) for surveys on the causes of rising inequality in the US. Demirgüç-Kunt and Levine (2009) study how finance, in particular financial sector policy, affects inequality. Gabaix, Lasry, Lions and Moll (2016), Jones and Kim (2018), and Aghion, Akcigit, Bergeaud, Blundell and Hemous (2019) argue that entrepreneurship and innovation cause rising income inequality. Kohlscheen et al. (2021) document that consumption falls by more after recessions if inequality is higher.

[9] Our economic mechanism is consistent with Mian, Straub and Sufi (2020). In their channel, a fall in incomes reduces low-income households' net savings positions to the extent that they become net borrowers. In our mechanism, a fall in income also reduces low-income households' net savings positions, but increases their deposit share in savings. Since our model abstracts from household debt, gross and net positions are the same and remain positive.

[10] Braggion, Dwarkasing and Ongena (2018) analyze survey data and find that entrepreneurs are less likely to apply for a loan in areas with higher inequality, fearing that their applications will be turned down. They reason is that higher *wealth* inequality could curtail banks' credit supply to entrepreneurs.

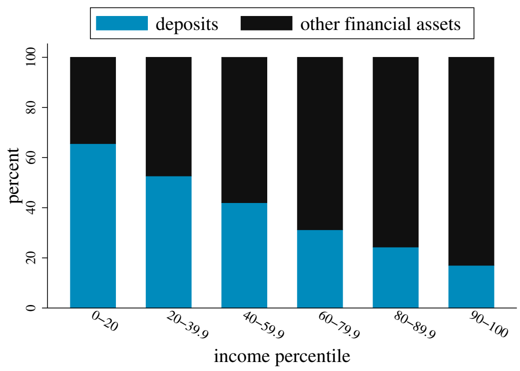
[11] Our findings on the negative effect of higher top income shares on net job creation at small firms add to the array of possible explanations behind the decline in economic dynamism over the last decades (Decker, Haltiwanger, Jarmin and Miranda, 2016; Sterk, Sedlacek and Pugsley, 2021).

2.1 Motivating evidence

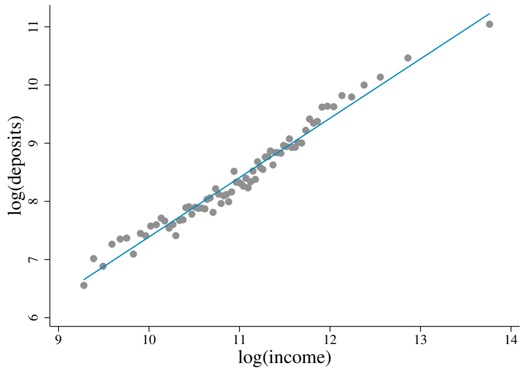
Household income and the allocation of financial assets. We study the allocation of financial asset across the household income distribution with data from the Survey of Consumer Finances (SCF) of the Federal Reserve. The SCF is a triennial cross-sectional survey on household assets and demographics.[12] We combine the survey waves from 1992 to 2007 (122,244 observations). The average (median) household has an income of $83,458 ($51,207) and $223,182 ($28,994) in total financial assets (all in 2016 dollars). Income is separated into six subgroups, which represent the following income percentiles: 0-19.9%, 20-39.9%, 40-59.9%, 60-79,9%, 80-89.9% and 90-100%. We compute the deposit share as the ratio of deposits to total financial wealth.[13] The Online Appendix provides detailed summary statistics.

Figure 1: **Household financial asset holdings across the income distribution**

(a) Deposit shares across income groups



(b) Absolute deposit holdings by income



Note: Panel (a) provides a breakdown of the allocation of households' financial wealth in deposits (defined as the sum of checking accounts, savings accounts, call accounts and certificates of deposit) and other financial assets (life insurance, savings bonds, money market (MM) deposits, money market mutual funds (MMMF) pooled investment funds, stocks, bonds, and other financial assets) by income group. Panel (b) provides a binned scatterplot with linear fit of the log of total household deposits (defined as the sum of checking accounts, savings accounts, call accounts and certificates of deposit) on the vertical axis and the log of total household income on the horizontal axis.

Figure 1, panel (a), shows that the share of financial assets held as deposits declines in income (see also Wachter and Yogo (2010); Guiso and Sodini (2013)). Deposits represent around two-thirds of financial wealth for the bottom income percentiles but less than one-fifth for the top income percentile. Instead, direct investments such as stocks, bonds, and other financial assets increase with household income, and so does stock market participation (Melcangi and Sterk, 2020).[14] As we show in the Online Ap-

[12]Two-thirds of respondents comprise a representative sample of U.S. households, while the remainder of respondents are oversampled from wealthy households. Sample weights allow us to correct for survey nonresponse and obtain a representative sample of U.S. households.

[13]We focus on financial assets, and exclude nonfinancial assets such as housing. The SCF defines financial wealth as 'liquid assets, certificates of deposit, directly held pooled investment funds, stocks, bonds, quasi-liquid assets, savings bonds, whole life insurance, other managed assets, and other financial assets'. Non-financial wealth includes 'all vehicles, value of primary residence, value of other residential real estate, net equity in nonresidential real estate, value of business interests, and other financial assets'.

[14]In the Online Appendix, we provide a finer breakdown of asset classes: deposits (checking accounts, savings accounts, call accounts and certificates of deposit), life insurance, savings bonds, money market deposits, money market mutual funds, pooled investment funds, stocks, bonds, and other assets.

pendix, the strong negative relation between incomes and deposit shares holds even within the top 10%. While the average household with an income of $150,000 holds around 20% of its financial assets in deposits, the share averages just 10% for households earning above $750,000.[15]

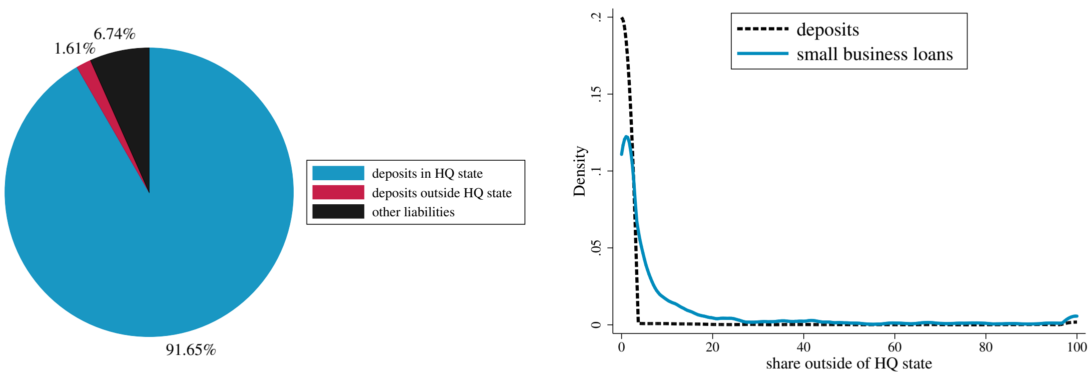
While panel (a) relates *relative shares* of financial asset holdings to income, panel (b) plots the *level* of deposit holdings against income and reveals a log-linear relationship. While high-income households hold relatively fewer deposits, the absolute amount of deposits increases with income. This pattern reflects that high-income individuals generally have more resources to save.

Bank deposits and lending to small firms. According to the Federal Deposit Insurance Corporation (FDIC), deposits account for 93% of total liabilities for the average bank between 1993 and 2015. This is illustrated in Figure 2, panel (a), and suggests that deposits are the major source of funding in the US banking system. Importantly, the same chart reveals that the average bank raises around 98% of its total deposits in its headquarters state. The strong reliance on local deposits is also reflected in the fact that only 2% of banks hold more than 10% of their deposits in branches outside their headquarters state (see panel (b), which plots he distribution of bank-year observations).[16] These patterns suggest that changes in the supply of household deposits in banks' headquarters state will affect banks' liabilities.

Figure 2: **Bank deposits and loans inside vs. outside headquarters state**

(a) Sources of US bank funding

(b) Distr. over deposit/loan shares outside HQ state



Note: Panel (a) provides a breakdown of banks' total liabilities into deposits held in branch located in the banks' headquarters state, deposits held in branch located outside the banks' headquarters state, and liabilities other than deposits. Numbers reflect the average across all banks and years in the sample. Panel (b) shows the distribution of bank-year observations on the y-axis against the share of deposits held in branches located outside the banks' headquarters state (black dashed line) and the share of CRA small business loans originated to borrowers outside the banks' headquarters state (blue solid line) on the x-axis. Data is provided by the FDIC SOD, CRA, and U.S. call reports.

Panel (b) also presents the distribution of banks' small business lending, based on data from the Community Reinvestment Act (CRA) from 1997 to 2015. The solid blue

[15] In the Online Appendix, we demonstrate that this relation is not explained by an extensive set of household-level controls, such as age, education level, occupation, and gender.

[16] The FDIC provides bank balance sheet data from 1993 in its Statistics of Depository Institutions (SDI). Generally, smaller banks depend more on deposits than larger banks, and the share of deposits raised outside of the headquarters state declines over time. Yet, even in 2015 the vast majority of banks rely on deposits as their main source of funding and raise almost all of their deposits in their headquarters state.

line plots the density of bank-year observations over the share of CRA loans outside banks' headquarters state. Similar to deposits, most banks extend the majority of their loans in their home state. Less than one-quarter of banks grant more than 25% of their CRA loans outside their headquarters state.[17]

Previous studies show that banks' access to deposits affects their ability to extend credit (Ivashina and Scharfstein, 2010; Drechsler, Savov and Schnabl, 2017), or provide causal evidence that changes in deposits affect bank' credit supply (Becker, 2007; Gilje, Loutskina and Strahan, 2016).[18] For example, Cortés and Strahan (2017) show that banks operating in counties exposed to natural disasters bid up deposit rates in other markets to fund the higher loan demand in shocked markets.[19]

The literature also highlights the importance of bank lending for small firms. Banks have a comparative advantage in screening and monitoring borrowers, which is especially relevant for smaller firms that are informationally opaque (Gorton and Winton, 2003; Liberti and Petersen, 2019). Consequently, smaller firms are often financially constrained and depend relatively more on bank lending (Petersen and Rajan, 1994; Abdulsaleh and Worthington, 2013), making their investment and employment more sensitive to changes in credit supply (Becker and Ivashina, 2014; Chodorow-Reich, 2014).[20]

The Online Appendix presents aggregate trends from the US Financial Accounts (Flow of Funds). Deposits as a share of household assets have fallen over the last few decades, while bonds and equities have increased. Similarly, the share of C&I loans in business sector liabilities has decreased, while the share of bonds and equities has risen (see Figure OA7).

2.2 Main hypotheses

Motivated by this evidence, we propose a novel economic channel that links household savings behavior to firm financing and job creation: as the income share of top earners rises, a relatively smaller share of total financial savings is held in the form of deposits and thus intermediated via banks. Since banks have a comparative advantage in screening and monitoring opaque firms, this leads to a relative decline in financing for small firms, which in turn have more difficulty in creating jobs. Instead, larger firms benefit as they can tap financial savings of household directly via the stock and bond market. In other words, a certain share of each dollar saved by households creates jobs in small firms through the banking system. As this share is lower for higher income households, more dollars in the hands of high- rather than low-income households leads to fewer jobs created by small firms, relative to large firms.

Screening and monitoring costs decrease in firm size (Liberti and Petersen, 2019)

[17]Note that banks subject to CRA reporting requirements are generally larger, so the share of actual small business lending outside the headquarters states is overstated, relative to the full sample of banks in the FDIC data.

[18]The importance of deposits can arise because banks cannot replace them with other source of funding (such as wholesale funding) without cost (Hanson, Shleifer, Stein and Vishny, 2015).

[19]For further literature on the importance of bank deposits, see also Gatev and Strahan (2006); Heider, Saidi and Schepens (2019); Doerr, Kabas and Ongena (2020); Duquerroy, Matray and Saidi (2020).

[20]See also Beck and Demirguc-Kunt (2006) and Jiménez, Ongena, Peydró and Saurina (2017). Coleman and Carsky (1999) show that 92.2% of firms surveyed in the 1993 National Survey of Small Business Finances use commercial banks to obtain credit. A frequent finding is that smaller banks have a comparative advantage in collecting local soft information and lend relatively more to smaller firms (Berger, Klapper and Udell, 2001; Berger, Miller, Petersen, Rajan and Stein, 2005; Berger and Black, 2011).

and some industries depend more on external financing than others (Rajan and Zingales, 1998). As rising top incomes reduce banks' ability to finance firms, we therefore expect their effect on job creation to be stronger for smaller firms, as well as for firms operating in bank-dependent industries. Further, the fact that deposits as a share of financial assets decline steadily with income implies that the magnitude of our channel should increase in the income share threshold (e.g. 10% vs 5% vs 1%). For example, a 10 p.p. increase in the share of the top 1% earners implies a stronger decline in available deposits than the same increase in the share of the top 10% would. Consequently, for a given increase in their share, job creation should also decline by more for higher income thresholds. The next section investigates these hypotheses empirically.

3 Empirical analysis

This section describes the data and the construction of our main variables. It then discusses our empirical strategy to identify how changes in top income shares affect job creation at small firms. Finally, it reports the main results as well as state- and bank-level evidence on the mechanism.

3.1 Data

State level. Frank (2009) provides annual data on income inequality and the share of income that accrues to the top 10%, 5%, 1%, and 0.1% for 48 states from 1917 to 2015. Income shares are derived from pretax adjusted gross income data reported in Statistics of Income published by the Internal Revenue Service (IRS). Income data include wages and salaries, capital income (dividends, interest, rents, and royalties), and entrepreneurial income. They exclude interest on state and local bonds and transfer income from federal and state governments.[21] These data provide the most comprehensive state-level information on income shares for a longer time period.

To measure job creation for firms in different size classes, we use data from the Business Dynamics Statistics (BDS), provided by the Center for Economic Studies. BDS provide detailed information on job creation for firms in 12 distinct size categories. We define our baseline measure of *very small firm* as firms with 1-9 employees, i.e., containing the distinct groups of firms with 1-4 and 5-9 employees. We further construct groups for firms with 10 to 99 employees, and 100-249 employees. Our main outcome variable is the net job creation rate (net JCR). As alternative outcome variables, we also use the job creation rate (JCR), the job creation rate by new establishments (JCR birth), as well as the log difference in employment.[22] BDS also provide a breakdown at the state–2-digit NAICS industry–firm size level, which we use when investigating the effect of top incomes on job creation in bank-dependent industries.

[21] Elwell, Corinth and Burkhauser (2019) show that while not accounting for cash services or in-kind transfers leads to an overstatement of measured inequality, the general rise in income inequality is similar regardless of whether one accounts for in-kind transfers.

[22] The net JCR is defined as job creation rate minus job destruction rate. The job creation (destruction) rate is defined as the 'count of all jobs created (destructed) within the cell over the last 12 months' in year t, divided by 'the average of employment for times t and $t-1$'. The JCR is defined as the 'count of all jobs created within the cell over the last 12 months' in year t, divided by 'the average of employment for times t and $t-1$'. JCR birth is defined as 'count of jobs created within the cell by establishment births over the last 12 months' in year t, divided by 'the average of employment for times t and $t-1$'.

We also collect yearly state-level information on total population, the share of the black population, the share of the population 60 and above (all three series are provided in the Census Bureau's Population Estimates), the log difference in income per capita (Bureau of Economic Analysis), the Gini index (Frank, 2009), and the unemployment rate (Bureau of Labor Statistics, Local Area Unemployment Statistics).

Bank level. Our bank-level data is from the U.S. Call Reports provided by the Federal Reserve Bank of Chicago, collapsed to the bank-year level (Drechsler, Savov and Schnabl, 2017). We obtain consistent data from 1985 to 2015 that contain information on the income statements and balance sheets of all commercial banks in the U.S. For each bank, we use the headquarters location to assign the respective evolution of state-level top incomes. We collect information on total deposits, deposit expenses over total deposits, total assets, the share of non-interest income, return on assets, and leverage (defined as total assets over equity). We further collect data on total C&I lending, as well as interest income on C&I loans over total C&I loans, both of which are available for a subset of banks.

We end up with a panel of 19,176 state–firm size–year observations for 47 distinct states from 1981 to 2015. Table 1, panel (a), provides descriptive statistics for our main state-level variables on the state-year level. Across the sample, the top 10% income share averages 40.5%. The top 5%, 1%, and 0.1% share average 29%, 14.9%, and 6.5%. Average net job creation at small firms (2.3%) exceeds average net job creation for all firms (1.8%). Growth in income per capita averages 4.7% over the sample period. Panel (b) provides information on the bank-level variables. Our sample contains a total of 18,092 unique banks (by RSSD ID). Banks' deposit expenses average less than 1%, their C&I interest income averages around 2%.

3.2 Empirical strategy and identification

Figure 3 previews our main result: a negative relation between top income shares and job creation at small firms. Panel (a) shows trends in the top 10% income share (black dashed line, right axis) and job creation at small firms (blue solid line, left axis) over time. While the top income share increases steadily, job creation at small firms is in secular decline. Panel (b) shows that the negative relation also occurs within states: the vertical axis plots job creation at small firms against the top 10% income share on the horizontal axis for each state-year cell. The blue line denotes a quadratic fit. There is a strong and significant negative relation: states with higher top income shares also see lower job creation rates among small firms.

To examine the relation between top incomes and small firm job creation formally, we estimate the following regression:

$$\begin{aligned} net\ jcr_{s,f,t} = {} & \beta_1\ top\ 10\%\ income\ share_{s,t-1} + \beta_2\ very\ small\ firm_f \\ & + \beta_3\ top\ 10\%\ income\ share \times very\ small\ firm_{s,f,t-1} \\ & + controls_{s,t-1} + \theta_{s,f} + \tau_{s,t} + \epsilon_{s,f,t}. \end{aligned} \tag{1}$$

The dependent variable *net jcr* measures the net job creation rate by firms in firm size category f that are located in state s in year t. $top\ 10\%\ income\ share_{s,t-1}$ is the share of income that accrues to the top 10% in state s, lagged by one period. $very\ small\ firm_f$

Table 1: **Descriptive statistics**

Panel (a): State level

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P50	P75
top 10% income share	1598	.405	.053	.252	.609	.368	.403	.436
top 5% income share	1598	.29	.053	.143	.515	.254	.286	.315
top 1% income share	1598	.149	.044	.061	.353	.119	.142	.167
Gini index	1598	.568	.046	.459	.711	.541	.566	.596
net job creation rate, firms 1-9	1598	.023	.041	-.178	.3	.001	.024	.045
net job creation rate, firms 10-99	1598	.019	.032	-.132	.189	.004	.021	.036
net job creation rate, firms 100-249	1598	.024	.036	-.139	.181	.004	.026	.045
net job creation rate total	1598	.018	.027	-.097	.144	.005	.02	.033
income per capita (in th)	1598	27.057	11.717	7.958	69.851	17.371	25.526	35.46
population (in th)	1598	5539.543	6164.385	418.493	38701.28	1332.213	3628.267	6450.632
% old population	1598	.125	.021	.029	.186	.114	.126	.137
% black population	1598	.119	.121	.002	.705	.027	.081	.162
Δ income p.c.	1598	.047	.031	-.104	.262	.031	.047	.064
unemployment rate	1598	.061	.021	.023	.154	.045	.057	.073

Panel (b): Bank level

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P50	P75
log(deposits)	243674	11.093	1.317	0	16.647	10.206	10.966	11.826
deposit expense (in %)	243674	.935	.511	.013	3.254	.547	.931	1.291
log(C&I loans)	112884	9.535	1.712	0	14.787	8.421	9.446	10.575
C&I interest (in %)	112884	2.049	.991	0	22.463	1.469	1.859	2.378
log(assets)	243674	11.437	1.373	6.878	21.423	10.515	11.289	12.163
non-interest income (in %)	243674	10.564	8.172	.327	62.203	5.628	8.679	13.023
return on assets (in %)	243674	2.137	2.6	-13.984	8.015	1.531	2.504	3.353
deposits/liabilities	243674	.946	.085	0	1	.934	.978	.99
capital/liabilities	243424	.1	.044	0	.999	.078	.092	.112

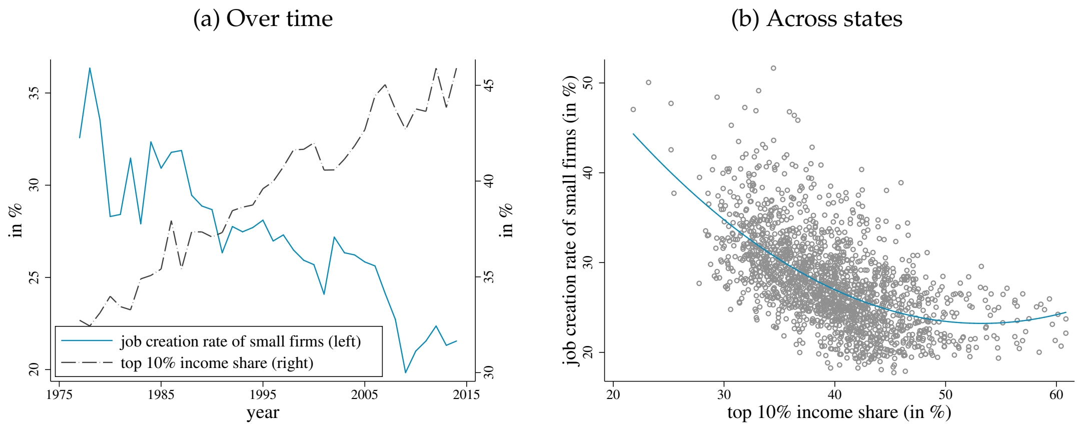
Note: This table provides summary statistics for the main variables at the state and bank level in panels (a) and (b). For variable definitions and details on the data sources, see the main text.

is a dummy with a value of one for the group of firms with one to nine employees. We include the following set of lagged state-level controls: average income per capita growth, log population, the unemployment rate, the share of population aged 60 and above, and the share of the black population. Standard errors are clustered at the state level to account for serial correlation among observations in the same state.

We include state (or state-firm size) fixed effects ($\theta_{s,f}$), which gives Equation 1 an interpretation in terms of changes: $\beta_3 < 0$ implies that an increase in the state-level share of income that accrues to the top 10% decreases job creation at small firms. By controlling for growth in *average* incomes, coefficient β reflects the effect of a change in state-level top income shares on net job creation, holding average state-level income growth constant.

Identification. Omitted variables or reverse causality could pose a threat to establishing a causal relation between top incomes and job creation at small relative to large firms. For example, an unobservable shock could trigger wage growth among large

Figure 3: **Top incomes and small business job creation are negatively correlated**



Note: Panel (a) shows the evolution of the top 10% income share, averaged across states, over time (black dashed line, left axis) and the evolution of job creation at small firms with one to nine employees (blue solid line, right axis) over time. Panel (b) provides a binned scatterplot with quadratic fit of the job creation rate on the vertical axis and the top 10% income share on the horizontal axis for each state-year cell in our sample. Source: Frank (2009) and BDS.

firms. If large firms employ a high share of top income earners, the unobservable shock would in turn influence the evolution of the top income share within a state.

For identification, we combine granular time-varying fixed effects with an instrumental variable strategy. First, we include state*time fixed effects ($\tau_{s,t}$) in Equation 1. These fixed effects control for observable and unobservable time-varying characteristics at the state level that could affect job creation, for example technological change or globalization – two common explanations behind the rise in income inequality.[23] Any unobservable factor that could simultaneously drive small firm job creation and top income shares hence needs to affect firms of different sizes within the same state. We further control for the marginal effect of a large set of state-level controls on job creation at small firms by interaction our state-level controls with the dummy *very small firm*.

To further address omitted variable bias or reverse causality, we construct an IV that is highly correlated with changes in a state's top income share, but is not otherwise associated with changes in local firms' employment. Specifically, we predict the top income share of a state based on the state's initial 1970 share adjusted for national growth of top income across the distribution. Importantly, we compute the 'leave-one-out' national growth of top incomes by excluding each respective state from the nationwide changes used to adjust initial income shares in that state. We then use the top income shares derived from this predicted distribution as an instrument for the actual top income shares.[24] This leave-one-out Bartik-style IV approach excludes the possibility that unobservable, state-specific shocks that affect firms of different sizes could be correlated with changes in state-level top income shares.[25]

[23]When we include state*time fixed effects, the coefficients on *top* 10% *income share*$_{s,t-1}$ and state-level controls are no longer separately identified.

[24]In other words, the initial income distribution in a state acts as a set of weights indicating how national growth in top incomes influences each state.

[25]Figure OA2 in the Online Appendix provides a visual illustration of our IV strategy. It shows that, while top income shares increased across the income distribution between 1970 and 2015, growth was higher at the upper end. Importantly, each top income share remained constant until around 1980. This

3.3 Main results

Table 2 reports results for Equation 1 and shows that rising top income shares reduce the net job creation at small firms, relative to large firms. Columns (1) to (4) report OLS estimates and enrich the specification with increasingly demanding fixed effects and controls. Column (1) uses state and year fixed effects and shows that rising top income shares are associated with higher net job creation on average ($\beta_1 > 0$). Small firms have higher average net job creation rates ($\beta_2 > 0$) than larger firms. However, rising top incomes significantly reduce net job creation rates of small firms ($\beta_3 < 0$), relative to larger firms. A 10 p.p. increase in the share of income that accrues to the top 10% income earners is associated with a decline in the net job creation rate of small firms by 1.62 p.p. (or 0.4 standard deviations), relative to larger firms.

Table 2: **Rising top incomes reduce small firm job creation**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					IV	IV	IV	IV
VARIABLES	net JCR	net JCR	net JCR	net JCR	net JCR	net JCR	net JCR	net JCR
top 10% income share	0.025				-0.114			
	(0.019)				(0.200)			
very small firm (1-9)	0.073***	0.073***	0.091***		0.110***	0.110***	0.133***	
	(0.008)	(0.008)	(0.018)		(0.010)	(0.010)	(0.022)	
top 10% × very small firm (1-9)	-0.162***	-0.162***	-0.122***	-0.150***	-0.253***	-0.253***	-0.225***	-0.309***
	(0.020)	(0.020)	(0.018)	(0.030)	(0.026)	(0.026)	(0.027)	(0.040)
Observations	16,450	16,450	16,450	16,450	16,450	16,450	16,450	16,450
R-squared	0.273	0.391	0.393	0.439				
State FE	✓	-	-	-	✓	-	-	-
State*Size FE	-	-	-	✓	-	-	-	✓
Year FE	✓	-	-	-	✓	-	-	-
State*Year FE	-	✓	✓	✓	-	✓	✓	✓
Controls	✓	-	× tiny	× tiny	✓	-	× tiny	× tiny
Cluster	State	State	State	State	State	State	State	State
F-stat	-	-	-	-	150.02	152.36	88.24	198.56

Note: This table reports results from OLS and 2SLS regression Equation 1 at the state-firm size-year level. The dependent variable is the net job creation rate. *top* 10% *income share* is income share that accrues to the top 10% in state *s*, lagged by one period. It is instrumented with the Bartik instrument in columns (5)–(8). *very small firm* is a dummy with a value of one for the group of firms with one to nine employees. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1. F-stat refers to the first-stage F-statistic.

The inclusion of time-varying fixed effects at the state level in column (2) does not change coefficients in a statistically or economically meaningful way, although the R-squared increases by 12 p.p. To account for the marginal effect of state-level controls on job creation at small relative to large firms, column (3) further interacts all control variables with the dummy $very\ small\ firm_f$ (individual coefficients unreported). Finally, column (4) adds state-firm size fixed effects to account for time invariant factors that affect firm size groups in a given state. We hence account for unobservable factors

suggests that the initial 1970 income shares were not determined by (unobservable) factors that were already in operation before the 1970s and that could render our IV strategy based on pre-determined shares invalid. We show a strong and highly significant positive relation between actual and predicted state-level top 10% income shares, suggesting that a sizeable share of the increase in state-level top income shares after 1970 was driven by national trends, rather than by state-specific changes. The coefficient for the first-stage relationship at the state-year level is 0.75 ($t = 70.80$; $R^2 = 0.70$)).

at the state-firm size level, unobservable time-varying characteristics at the state level, and the marginal effect of our set of control variables on small firm job creation. The coefficient on the interaction term remains significant and similar in magnitude across columns. In the most-demanding specification in column (4), a 10 p.p. increase in the share of income that accrues to the top 10% is associated with a decline in the relative net job creation rate of small firms by 1.5 p.p.

The stability of the coefficient across specifications is remarkable in light of the increase in R-squared by almost 17 p.p. as we move from column (1) to (4). The fact that the estimated coefficient remains stable suggests that the effect of rising top incomes on job creation at small firms is orthogonal to further unobservables, e.g. to self-selection and omitted variables (Altonji, Elder and Taber, 2005; Oster, 2019).

These results are reinforced in columns (5)–(8), in which we instrument the actual top income shares with our Bartik IV. Across specifications, 2SLS results are similar in sign and significance to their OLS counterparts – so our estimates allow for a causal interpretation. A 10 p.p. increase in the share of income that accrues to the top 10% leads to a decline in the relative net job creation rate of small firms by 2.25 p.p. to 3.09 p.p. Coefficients in columns (5)–(8) are lager in magnitude than their counterparts in columns (1)–(4). However, they are comparable once we account for differences in the variation of our explanatory variables: increasing the *actual* top 10% income share by one standard deviation (0.053) decreases job creation at small firms by 0.65 p.p. in column (3). Increasing the *predicted* top 10% income share by one standard deviation (0.039) decreases job creation at small firms by 0.87 p.p. in column (7).[26]

Table 2 hence suggests that rising top incomes cause a decline in job creation at small firms, relative to large firms. To put our results into perspective, the average increase in the state-level income share of the top 10% from 1980 to 2010 was around 10 p.p. Based on the estimated coefficient in column (4), relative net job creation at small firms would have been 1.5 p.p. higher in 2010 if top incomes would have remained at their 1980 levels.[27] Relative to average job creation at small firms during the 1980s, which equalled 4.2%, the effect is large in magnitude.

3.4 Evidence on the mechanism

In what follows we provide evidence that rising top incomes reduce small businesses' net job creation through their effect on bank deposits. We first show that the effect of rising top income shares on job creation is declining in firm size, as larger firms are subject to fewer informational frictions and hence less dependent on banks; and that the negative effect of a rise in the top 10% income share affects small firms by more in industries that depend more on bank finance. We further show that small firm job creation declines by more for a given increase in the income share of the top 5% or 1% than for the top 10%, as the share of deposits declines in household income (see Figure OA1, panel b). We then estimate bank-level regressions and establish that rising top incomes in banks' headquarters states reduce the amount of deposits and increase banks' interest expense on deposits. Further, higher top income shares decrease the

[26]Were our OLS estimates explained by reverse causality, we would expect smaller coefficients in our IV regressions. Instead, the relatively larger IV estimates suggests that our instrument might be correcting for measurement error that biases OLS estimates towards zero.

[27]Another way to illustrate the effect is the following: a 10 p.p. difference in top 10% income shares reflects moving from Florida ($share = 0.37$) to New York ($share = 0.45$) in 2014.

supply of and increase interest income on banks' C&I loans.

Firm size and top income thresholds. Banks have a comparative advantage in screening and monitoring opaque firms. As small firms are informational more opaque (Liberti and Petersen, 2019) they depend more on banks as a source of credit than larger firms (Cowell and Van Kerm, 2015) and are hence more affected by changes in banks' credit supply (Becker and Ivashina, 2014; Chodorow-Reich, 2014). If rising top incomes reduce available funding for banks, the relative effect of a given increase in top income shares on job creation should decline in firm size. Table 3 shows this to be the case. We estimate 2SLS variants of Equation 1 in which we instrument actual top incomes shares with our Bartik IV. All regressions include state*size and state*time fixed effects and thus absorb common state-level trends as well as unobservable time-invariant characteristics within each state–firm size cell. Column (1) shows that the effect of rising top incomes on job creation is stronger for smaller firms: while a 10 p.p. increase in the top 10% income share reduces net job creation by 3.6 p.p. for very small firms with 1-9 employees, net job creation declines by 0.66 p.p. and 0.42 p.p. for for small (10-99 employees) and medium (100-249 employees) firms, relative to firms with more than 250 employees.

Table 3: **Firm size, income thresholds, and bank dependence**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
						low BD	high BD
VARIABLES	net JCR	net JCR	net JCR	net JCR	net JCR	net JCR	net JCR
top 10% × very small firm (1-9)	-0.360***			-0.490***	-0.493***	-0.367***	-0.752***
	(0.032)			(0.031)	(0.030)	(0.029)	(0.046)
top 10% × small firm (10-99)	-0.066***						
	(0.017)						
top 10% × medium firm (100-249)	-0.042**						
	(0.020)						
top 5% × very small firm (1-9)		-0.326***					
		(0.025)					
top 1% × very small firm (1-9)			-0.410***				
			(0.033)				
Observations	16,450	16,450	16,450	298,834	298,759	97,260	88,112
State*Size FE	✓	✓	✓	✓	✓	✓	✓
State*Year FE	✓	✓	✓	✓	-	-	-
State*Naics*Year FE	-	-	-	-	✓	✓	✓
Cluster	State	State	State	State	State	State	State
F-stat	129.31	166.18	100.79	332.67	332.20	334.88	329.38

Note: This table reports results from 2SLS regression Equation 1 at the state-firm size-year level in columns (1)–(3) and Equation 2 at the state-industry-firm size-year level in columns (4)–(7). The dependent variable is the net job creation rate. *top X% income share* is the share of income that accrues to the top X% in state *s*, lagged by one period. *very small firm* is a dummy with a value of one for the group of firms with one to nine employees. *small firm* is a dummy with a value of one for the group of firms with ten to 99 employees. *medium firm* is a dummy with a value of one for the group of firms with 100 to 249 employees. *BD* denotes the industry-level dependence on banks, split by the median. Standard errors are clustered at the state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. F-stat refers to the first-stage F-statistic.

As discussed in Section 2, a given increase in the top 10% income share should reduce deposits – and hence financing for small firms – by relatively less than a similar increase for the top 5% or top 1%, because the latter hold even fewer deposits as share of their financial wealth. Redistributing $1,000 of aggregate income to the e.g. top 5% should thus reduce deposits by relatively more than giving it to the top 10%. To test this prediction, columns (2)–(3) report results for 2SLS regressions, but use different income thresholds as explanatory variable. Column (2) uses the top 5% and column (3) the top 1% income share as explanatory variable. Compared to baseline results in Table 2, a similar increase in top income shares leads to an increasingly negative effect on job creation by very small firms the higher the income threshold. For a 10 p.p. increase in each income share, relative net job creation at very small firms declines by 3.26 p.p. for the top 5% and by 4.1 p.p. for the top 1%. This compares to a 1.62 p.p. decline for the top 10% income share.[28]

Bank-dependent industries. If an industry depends more on banks as a source of financing, a contraction in credit supply should hurt firms in this industry by more than firms in other industries. Consequently, when top income shares rise, we expect job creation at small firms in bank-dependent industries to decline by more than for firms operating in industries that depend less on banks. To test this hypothesis, we compute each industry's bank dependence (BD) from the 2007 Survey of Business Owners (SBO). The survey provides firm-level information on sources of business start-up and expansion capital, as well as two-digit NAICS industry codes. We restrict the sample to firms with fewer than 100 employees that were founded before 1990. For each industry i we compute the fraction of young firms out of all firms that reports using bank loans to start or expand their business (Doerr, 2021). In the average industry one-third of firms obtain bank credit, with a standard deviation of 10%.[29]

We obtain data on job creation at the state-industry-firm size-year level from the BDS, constructed analogously to our baseline data. We then estimate the following regression equation:

$$\begin{aligned} net\ jcr_{s,i,f,t} = \ & \gamma_1\ top\ 10\%\ income\ share_{s,t-1} + \gamma_2\ very\ small\ firm_f \\ & + \gamma_3\ top\ 10\%\ income\ share \times very\ small\ firm_{s,f,t-1} \\ & + \theta_{s,f} + \tau_{s,i,t} + \epsilon_{s,i,f,t}. \end{aligned} \tag{2}$$

As above, the dependent variable $net\ jcr_{s,i,f,t}$ is the net job creation rate of firms of size f in state s and industry i in year t. $top\ 10\%\ income\ share_{s,t-1}$ is the share of income that accrues to the top 10% in state s, instrumented with the Bartik IV. Standard errors are clustered at the state level. Relative to Equation 1, the key difference is that we now can control for time-varying confounding factors at the state-industry level through granular state*industry*year fixed effects ($\tau_{s,i,t}$). These absorb any differential effect that industry-wide changes could have in different states. For example, rising import competition could affect firms in Ohio to a different degree than firms located in Nebraska. Similarly, we account for differential effects of changes in top incomes on

[28] Figure OA1, panel (b) in the Online Appendix shows that the deposit share in financial wealth declines from around 0.2 to 0.1 as we move from the top 10% to the top 5% in the income distribution, but then declines at a lower pave as we move to the top 1%. The effects we find for net job creation at small firms across top income thresholds are directly in line with this pattern.

[29] Industries with the highest values of bank dependence are manufacturing (31–33), wholesale trade (42), transportation and warehousing (48–49) and management of companies and enterprises (55). Industries with the lowest values are finance and insurance (52), educational services (61), and arts, entertainment, and recreation (71).

all firms within a given industry in each state. We estimate Equation 2 separately for industries in the bottom (low BD) and top (high BD) tercile of bank dependence. If an increase in the share of income that accrues to the top 10% decreases job creation among small firms by more in bank-dependent industries, we expect $\gamma_3^{high\ BD} < \gamma_3^{low\ BD}$.

Columns (4)–(7) in Table 3 report results for the state-industry-firm size-year level regression (2). Column (4) confirms that a rising top income share reduces job creation at small firms, relative to large firms. Similar to (1), column (4) includes state*size and state*year fixed effects to control for any unobservable changes within a given state-firm size cell and for common time-varying shocks at the state level. Column (5) exploits the rich variation in the data and uses state*industry*year fixed effects instead of state*year fixed effects. The coefficient of interest remains identical in terms of sign, size and significance to column (4), indicating that unobservable trends that affect industries differentially within each state do not explain our findings. Finally, columns (6) and (7) split the sample into industries with low and high bank dependence. A 10 p.p. increase in top 10% incomes shares leads to a relative decline in employment among small firms of 3.67 p.p. in low-dependence industries. Among bank-dependent industries, the effect is twice as large. A 10 p.p. increase in top 10% incomes shares reduces employment among small firms by 7.52 p.p., relative to large firms[30]

Taken together, Table 3 provides evidence for our proposed mechanism: First, a rise in top income shares reduces job creation by more for smaller firms, i.e., those that are informationally opaque and depend more on banks as a source of financing. Second, as the share of deposits declines in household income, a relatively larger share of income accruing to the top 5% or 1% reduces available deposits and hence job creation at small firms more than a similar increase in the top 10% income share. And third, effects are stronger for small firms in bank-dependent industries.

Bank deposits and deposit rates. Our mechanism rests on the assertion that an increase in top income shares leads to a relative decline in bank deposits. This deposit supply channel predicts that higher top income shares suppresses the amount of bank deposits, while increasing interest rates on deposits. To provide direct evidence for this hypothesis, we estimate the following bank-level 2SLS regression:

$$\begin{aligned} y_{b,t} = {} & \delta\ top\ 10\%\ income\ share_{s,t-1} \\ & + controls_{b,t-1} + controls_{s,t-1} + \theta_b + \tau_t + \epsilon_{b,t}. \end{aligned} \tag{3}$$

The dependent variable $y_{b,t}$ is either the log amount of total deposits or the ratio of deposit expenses to total deposits of bank b headquartered in state s in year t. The share of income that accrues to the top 10% is measured at the bank headquarters state s, and instrumented with our Bartik IV. Controls include baseline state-level controls, as well as the bank-level log of total assets, the share of non-interest income, return on assets, deposits over liability, and the leverage ratio, all lagged by one period. Each regression includes bank (θ_b) and year (τ_t) fixed effects that control for time-invariant bank characteristics and aggregate trends. Standard errors are clustered at the headquarters state level. The inclusion of bank fixed effects implies an interpretation in changes. If, for example, rising top incomes reduce bank deposits, then we expect $\delta < 0$.

[30] As we show in the Online Appendix, the difference is highly significant. We obtain similar results when we split industries by their external financial dependence following Rajan and Zingales (1998).

An important assumption underlying Equation 3 is that banks raise a significant share of their deposits in their headquarters state. Figure 2, panel (b), shows that the average bank in the sample raises around 98% of its deposits in the headquarters state. The Online Appendix further shows that, while this ratio declines in bank size and over time, even in 2015 the vast majority of banks raise the lions share of their deposits in their headquarters state. However, if banks were to raise deposits outside their headquarters state, this would lead to an attenuation bias and coefficient δ would reflect a lower bound of the true estimate.

Table 4 shows that rising top incomes lead to a relative decline in deposits and an increase in the deposit rate (proxied by deposit expenses over total deposits).[31] Columns (1)–(3) use the log of total deposits as dependent variable. Column (1) shows that a 10 p.p. increase the (instrumented) top income share leads to a 23% decline in bank deposits for the average bank. The coefficient is significant at the 1% level. To put these results into perspective, the top 10% income share has increased by around 10 p.p. between 1980 and 2010. Over the same period, aggregate deposits as a share of household non-financial assets have declined by around 50%.[32] Columns (2) and (3) show that the effect is stronger when we use higher income thresholds (5% and 1%). This finding is consistent with the fact that the share of deposits out of financial assets declines in household income. The aggregate supply of deposits by households is thus expected to decline by more if the income share of the top 5% or top 1% increases by 10 p.p., compared to a similar increase for the top 10%.

Table 4: **Rising top incomes reduce bank deposits and loans, but increase rates**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	log(dep)	log(dep)	log(dep)	dep rate	dep rate	dep rate	log(CI)	CI rate
top 10% income share	-2.328***			2.652***			-2.405***	11.655**
	(0.576)			(0.645)			(0.657)	(4.843)
top 5% income share		-2.652***			2.912***			
		(0.764)			(0.800)			
top 1% income share			-4.928***			2.942***		
			(1.134)			(1.077)		
Observations	242,651	242,651	242,651	242,651	242,651	242,651	112,393	112,393
Bank FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Cluster	State	State	State	State	State	State	State	State
F-stat	48.70	30.00	12.50	48.70	30.00	12.50	35.02	27.59

Note: This table reports results from 2SLS regression Equation 3 at the bank-year level. The dependent variable the log amount of total bank deposits in columns (1)–(3) and the ratio of deposit expenses to total deposits in columns (4)–(6). In columns (7)–(8), the dependent variable is the log amount of total bank C&I lending and the ratio of C&I interest income to total C&I lending. *top X% income share* is the share of income that accrues to the top X% in state s, lagged by one period. All regressions include state and bank controls. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1. F-stat refers to the first-stage F-statistic.

[31] Note that the ratio of deposit expenses to deposits reflects the average expense on existing and new deposits and is hence less responsive to changes in the supply of deposits than the actual deposit rate offered to new customers.

[32] See Figure OA7 panel (a) in the Online Appendix.

Columns (4)–(6) use the deposit rate as dependent variable and show that the price of deposits increases significantly as top income shares rise. In column (4), a 10 p.p. increase in the predicted top income share increases the deposit rate by 0.26 basis points (28% of the mean and 0.51 standard deviations). Columns (5) and (6) show that rates increase by more the higher the income threshold. Table 4 thus shows that a rise in top income shares reduces the *quantity* of deposits, but increases their *price*. This pattern is consistent with a relative decline in the supply of local deposits by households as state-level top income shares rise.

Bank loans and loan rates. Finally, columns (7)–(8) of Table 4 show that higher top incomes also reduce banks' C&I lending and increase their interest income on C&I loans. This pattern suggests that rising top incomes, through their effect on the supply of bank deposits, affect banks' credit supply to firms, thereby hurting bank-dependent businesses more than those that can access financing without banks. While bank-level data on bank lending do not allow us to directly control for confounding factors, such as changes in loan demand, the observed pattern is in line with our mechanism.[33]

Bank size. The Online Appendix provides a number of additional bank-level results that support our mechanism. Table OA6 shows that the effects on deposit supply and loan supply (lower quantities and higher rates in response to higher top income shares) are significantly less pronounced for larger banks, as measured by log assets. Furthermore our state-level effects of top incomes on net job creation are stronger in states where the median bank is smaller, and in states that have more banks per capita. This is in line with the interpretation that smaller banks are more likely to finance themselves through local deposits and lend locally, rendering the deposit channel stronger in states with more small banks.

3.5 Alternative outcome variables and further tests

The Online Appendix provides results for several additional outcome variables. First, we show a relative decline in the number of small firms as top income shares increase, as well as a relative decline in their job reallocation rate. Second, the relative reduction in the gross job creation rate of small firms is slightly larger than that of the net job creation rate. This pattern arises since higher top incomes also lead to a modest reduction in the relative job destruction rate of small firms. This could have several reasons, including a compositional effect by which a tighter financing environment changes the composition of firms away from riskier small businesses. Third, job creation falls (in relative terms) both among new entrants (extensive margin) and continuing (intensive margin) small firms when top incomes rise, but that the effect among continuing firms is economically larger. The fact that the intensive margin responds more than the extensive margin could be driven by the fact that more income in the hands of high-income individuals may positively affect new business creation through a separate net worth channel. For example, Hurst and Lusardi (2004) provide a study on how the propensity to become a business owner is related to wealth.[34]

[33] More granular data on bank lending in the US is only available for more recent time periods, which limits the scope to test our channel.

[34] Azoulay, Jones, Kim and Miranda (2020) show that successful entrepreneurs are likely middle-aged (and hence less likely to be low-income).

We further show that our results are robust to excluding each individual state or sample year. They remain unaffected when we directly control for the differential effect of house prices on small and large firms, suggesting that our results are not due to a collateral channel through which house prices affect small and large firms to a different extent (Chaney, Sraer and Thesmar, 2012; Adelino, Schoar and Severino, 2015). Our findings also remain similar when we exclude years of negative GDP growth or the great financial crisis; exclude states that account for over 80% of total venture capital funding; control for inequality in addition to top income shares; or exclude non-tradable industries. We also show that the negative effects of rising top income shares on small firm job creation are larger in industries that depend more on external finance. Finally, controlling for measures of industry concentration or state-level spending on education does not affect our results. The fact that educational expenses do not explain our findings ensures that our channel is different from Braggion, Dwarkarsing and Ongena (2020), who emphasize the importance of public goods, such as education, for entrepreneurship.

4 Structural model

This section introduces a theoretical model to formalize the link between top income shares, financial intermediation and small firm job creation. The model features incomplete markets, heterogeneous households and firms, and a banking sector. It allows us to study a general equilibrium interaction between a portfolio choice problem of households who are heterogeneous in their income and liquidity risk, and the financing problem of heterogeneous firms. We use the model to study the effects of counterfactual evolutions of top income shares and assess the relative importance of different frictions in the transmission.

4.1 Model setup

There are three periods $t = 1, 2, 3$. The economy is populated by a continuum of households, a representative 'public' firm, a continuum of 'private' firms, as well as a representative bank.

4.1.1 Households

There is a unit mass of households, indexed by i, who differ in terms of their endowment income $y_{i,1}$. Altering the exogenous distribution of $y_{i,1}$ across households allows us to generate varying top income shares. In the first period, households decide how much to consume and how much to save out of their income. They also decide how to allocate their savings: households can make deposits at a bank or invest directly in the capital of the public firm. These two assets differ in their returns, given by r^d and r^k.

Deposits and direct investments also differ in their liquidity. We assume that only bank deposits are liquid. That is, households can withdraw their deposits in the second period but cannot liquidate their direct capital holdings.[35] At the beginning of the

[35] There are household investments such as direct stock holdings that are relatively liquid. However, in the US a large share of equity holdings are held indirectly, for example through (illiquid) pension accounts (Melcangi and Sterk, 2020). Furthermore, private equity holdings, which are widespread among

second period, household i faces a stochastic expenditure shock $\ell_i \sim [0, \bar{\ell}_i]$.[36] To cover this liquidity shock, households have an incentive to hold deposits even if the expected rate of return on capital is higher. Without sufficient deposits, banks give an overdraft credit up to an exogenous level $\underline{d}$ at an interest rate that exceeds the deposit rate by a premium r^p. Markets are incomplete in the sense that households are prohibited from insuring each other against their idiosyncratic liquidity risk.[37]

In the third period, a fraction f of households are randomly matched to jobs created by firms. If employed, households inelastically supply one unit of labor and receive the exogenous real wage w.[38] In addition to the real wage, households receive the return on their savings, as well as profits of firms depending on the ownership structure in the economy (which we explain below). After the third period households consume all of their remaining resources.

Formally, V_t denotes the household's value function in period t. The first period problem is characterized as follows:

$$V_1(y_{i,1}) = \max_{\{c_{i,1},k_{i,1},d_{i,1}\}} u(c_{i,1}) + \beta \mathbb{E}\left[V_2(k_{i,1}, d_{i,1}|\ell_i)\right] \tag{4}$$

subject to

$$c_{i,1} + k_{i,1} + d_{i,1} = y_{i,1}, \tag{5}$$

where $u(\cdot)$ is the utility function. $y_{i,1}$, $c_{i,1}$, $k_{i,1}$, and $d_{i,1}$ denote period-1 income, consumption, direct capital investment, and deposits. β is the discount factor. For the second period,

$$V_2(k_{i,1}, d_{i,1}|\ell_i) = \max_{\{c_{i,2},d_{i,2}\}} u(c_{i,2}) + \beta \mathbb{E}_2\left[V_3(k_{i,1}, d_{i,2}|e_i)\right] \tag{6}$$

subject to

$$c_{i,2} + \ell_i + d_{i,2} = d_{i,1} \tag{7}$$
$$d_{i,2} > -\underline{d}, \tag{8}$$

where $c_{i,2}$ is the second period consumption and $d_{i,2}$ denotes deposits carried over from the second to the third period. $\underline{d}$ is the overdraft limit for the household's deposit account. e_i is the household's employment status next period.

Finally, the household's period $t = 3$ is described by the value function

$$V_3(k_{i,1}, d_{i,2}|e_i) = u(c_{i,3}) \tag{9}$$

high income earners, are typically also less liquid than bank deposits.

[36]Modeling a liquidity shock as a sudden expenditure rather than as an exogenous reduction in income is in line with the empirical evidence provided by Fulford (2015).

[37]Our setup is akin Diamond and Dybvig (1983). In their three-period setting, consumers can turn out to be two discrete types: 'early types' who desire to consume in the middle period or 'late types' who desires to consume in the final period. Our setting generalizes this notion in the sense that the realization of ℓ_i falls inside an continuous interval that determines household types in terms of their intermediate period liquidity requirements.

[38]As we will describe below, firms decide on hiring in the first period and produce in the third period, after a productivity shock has realized. In our calibration the total labor supply (exogenous) exceeds labor demand (endogenous), so that $0 < f < 1$. A given household makes period-1 decisions without knowing her employment status in the final period but taking f as given.

and the budget constraint

$$c_{i,3} = we_i + (1 + r^k - \delta)k_{i,1} + \{1 + r(d_{i,2})\}d_{i,2} + \Pi + \widetilde{\Pi}, \tag{10}$$

where Π is the public firm's profit and $\widetilde{\Pi}$ are private firms' profits. The employment status can take values $e_i = 0$ (unemployed) or $e_i = 1$ (employed). The return on deposits $r(d_{i,2})$ depends on whether the household holds a positive balance or is in overdraft.

$$r(d_{i,2}) = \begin{cases} r^d & \text{if } d_{i,2} \geq 0 \\ r^d + r^p & \text{if } d_{i,2} < 0, \end{cases} \tag{11}$$

where r^d is the deposit rate and r^p is the borrowing premium. The Online Appendix provides the households' optimality conditions.

4.1.2 The public firm

There is a representative firm which operates the following production technology:

$$Y = ZK^{\alpha_1}L^{\alpha_2}, \tag{12}$$

where $\alpha_1 + \alpha_2 \leq 1$. Z is the stochastic productivity. The firm starts with an initial capital stock K_0 and accumulates additional capital by attracting direct capital investment of amount $K - K_0$ from households. In addition, the firm decides the amount of the labor L it hires, before productivity realizes and production takes place in the third period. Its maximization problem is formally described as

$$\max_{K,L} \mathbb{E}\Big[ZK^{\alpha_1}L^{\alpha_2} - r^k(K - K_0)\Big] - wL + (1 - \delta)K_0, \tag{13}$$

with profits given by $\Pi = ZK^{\alpha_1}L^{\alpha_2} - r^k(K - K_0) - wL + (1 - \delta)K_0$. The firm is 'public' in the sense that households have full access to information about it and there are no agency conflicts when households undertake direct capital investments into this firm.[39] Investors receive the marginal product of capital as payout in the third period:

$$r^k = \alpha_1 ZK^{\alpha_1 - 1}L^{\alpha_2}. \tag{14}$$

4.1.3 Private firms

In addition to the representative public firm, the economy is populated by a mass of private firms, indexed by j. These firms differ in their initial holding of production factor $\widetilde{h}_{1,j} \in [\underline{h}, \bar{h}]$. $\widetilde{h}$ can be thought of as capital, but differs from the public firm's K: household's cannot directly trade $\widetilde{h}$ on a market. We refer to $\widetilde{h}$ as *private capital*. We denote the mass of private firms holding amount x of initial private capital with $p(x)$ such that $\int_{\underline{h}}^{\bar{h}} p(x)dx = \tilde{\mu}$, where $\tilde{\mu}$ is the total mass of private firms. Production takes place in the third period according to the following production technology:

$$\widetilde{Y}_j = \widetilde{Z}_j \widetilde{h}_{3,j}^{\theta_1} \widetilde{L}_j^{\theta_2}, \tag{15}$$

[39]Strictly speaking, households purchase capital, which they then rent out to the firm. This serves as a stand-in for the various types of non-deposit investment undertaken disproportionately by higher-income households.

where $\widetilde{Z}_j$, $\widetilde{h}_{3,j}$, and $\widetilde{L}_j$ are idiosyncratic productivity, private capital holdings at the beginning of the third period, and total labor input of firm j.

The only source of financing for private firms are bank loans at interest rate r^l. These need to be taken out to finance both the acquisition of additional private capital – that is, the difference between $\widetilde{h}_{3,j}$ and $\widetilde{h}_{1,j}$ – as well as the payroll $w\widetilde{L}_j$. Formally speaking, firm j's total economic profits generated in period $t = 3$ are:

$$\widetilde{\Pi}_j = \widetilde{Z}_j \widetilde{h}_{3,j}^{\theta_1} \widetilde{L}_j^{\theta_2} - (1 + r^l) w \widetilde{L}_j - (1 + r^l)(\widetilde{h}_{3,j} - \widetilde{h}_{1,j}) + (1 - \tilde{\delta}) \widetilde{h}_{3,j}. \tag{16}$$

We assume that production inputs are chosen before productivity is realized. Maximizing expected profits, we obtain[40]

$$\widetilde{h}_3^* = \mathbb{E}\left[\widetilde{Z}_j\right]^{\frac{1}{1-\theta_1-\theta_2}} \left(\frac{\theta_1}{r^l + \tilde{\delta}}\right)^{\frac{1-\theta_2}{1-\theta_1-\theta_2}} \left\{\frac{\theta_2}{(1 + r^l) w}\right\}^{\frac{\theta_2}{1-\theta_1-\theta_2}} \tag{17}$$

$$\widetilde{L}^* = \left\{\frac{\theta_2 \mathbb{E}\left[\widetilde{Z}_j\right] (\widetilde{h}_3^*)^{\theta_1}}{(1 + r^l) w}\right\}^{\frac{1}{1-\theta_2}}. \tag{18}$$

Note that $\widetilde{h}^*$ and $\widetilde{L}^*$ do not directly depend on the initial capital holding $\widetilde{h}_1$. That is, for a given level of the loan rate, all private firms desire the same amount of capital accumulation and job creation. However, since each firm is endowed with a different level of the initial private capital, the required amount of bank lending is different for each firm. Furthermore, the optimal level of private firm capital depends on the loan rate r^l. Below, we show that in the loan market equilibrium, the loan rate will negatively depend on initial capital (or net worth).

Finally, we assume that the ex-post realization of $\widetilde{Z}_j$ is private information to firm j. Lenders are only able to verify this realization by incurring a cost. This information friction gives private firms an incentive not to tell the truth when repayment to their lender is due in period $t = 3$. The solution to this problem is a risky debt contract, described in the next section.

4.1.4 Banking sector and lending contract

There is a representative bank that operates in a perfectly competitive environment. It takes deposits from households and grants loans to small firms.[41] On deposits, the bank pays interest rate r^d. It lends at rate r^l by writing an individual contract with each private firm j. For ease of notation, we drop subscript j in this subsection.

The lending relationship with private firms is impeded by an information problem. We assume a 'costly state verification' setting in the spirit of Bernanke and Gertler (1989) and Bernanke, Gertler and Gilchrist (1999).[42] In particular, only the private firm itself can observe its realized productivity, while the bank can verify it only through a costly audit. Thus, a private firm has an incentive to misreport its productivity to reduce the amount of repayment. A financial contract must take into account this incentive problem.

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[40] The details are shown in the Online Appendix.

[41] We assume that the public firm prefers direct capital investments to debt-financing for reasons that we do not explicitly model.

[42] See also the seminal work of Townsend (1979).

Optimal risky debt contract. We focus on the case in which productivity can take on two values, $\widetilde{Z}_H$ and $\widetilde{Z}_L$, with probabilities $\widetilde{P}_H$ and $1-\widetilde{P}_H$. We refer the first case as 'good' state and the latter as 'bad' state. To verify firms' productivity realization, the bank needs to incur a fixed auditing cost γ^a. In this setting, the optimal financial contract can be derived by maximizing the firm profits subject to three constraints. First, the lending bank receives an expected return of no less than $1+r^d$. Second, the firm has no incentive to misreport. Third, random auditing is feasible. We provide the formal derivation of the optimal contract in the Online Appendix, and focus on the case in which the borrowing firm cannot guarantee to generate a return r^d for the bank in the bad state.[43] The optimal auditing probability P^{a*} and loan rate r^{l*} are

$$P^{a*} = \frac{(1+r^d)\{\widetilde{h}^*(r^{l*}) - \widetilde{h}_1 + w\widetilde{L}^*\} - \hat{\Pi}_B(r^{l*})}{\widetilde{P}_H\{\hat{\Pi}_G(r^{l*}) - \hat{\Pi}_B(r^{l*})\} - (1-\widetilde{P}_H)\gamma^a} \tag{19}$$

$$r^{l*} = \frac{P^{a*}\hat{\Pi}_G(r^{l*}) + (1-P^{a*})\hat{\Pi}_B(r^{l*})}{\widetilde{h}^*(r^{l*}) - \widetilde{h}_1 + w\widetilde{L}^*} - 1, \tag{20}$$

where $\hat{\Pi}_G$ and $\hat{\Pi}_B$ are the profits before repaying debt in the good and bad state, respectively. Under the parameterizations we study, private firms' profits are strictly higher when they borrow, so all private firms enter into a contract with the bank. Since the bank enters into a contract with each firm independently, auditing probability P^{a*} and loan rate r^{l*} vary across firms. Private firms with a smaller amount of initial capital face higher P^{a*} and r^{l*} than larger private firms.

From credit market equilibrium to general equilibrium. The loan rate, auditing probability and amount of borrowing are functions of the deposit rate r^d. Unlike in Bernanke and Gertler (1989), where the safe interest rate (outside return) is a fixed parameter, r^d in our model is endogenously determined by deposit demand and supply. It is thus affected by the household sector's portfolio allocation decisions. As a result, lower inequality and a higher aggregate demand for deposits will put downward pressure on the deposit rate so that optimal loan contracts with private firms imply a lower loan rate as well as larger amounts of borrowing. This in turn allows private firms to increase employment. The interplay between household portfolio allocation, bank lending and small firm hiring is the key relationship that our model formalizes.

4.1.5 Market clearing and model solution

Market clearing conditions. Households' direct capital investments and the public firm's initial capital stock equal the amount of capital used by the public firm:

$$\int_i k_i(y_{i,1})di + K_0 = K, \tag{21}$$

where K_0 is the public firm's initial capital stock, and $k_i(y_{i,1})$ is the optimal direct capital investment of household i with the initial endowment income $y_{i,1}$. Households' labor supply is fixed at 1 by assumption. Thus, the labor market clearing condition is

$$f \times L^S = f = L^D = L + \int_j \widetilde{L}_j dj = L + \widetilde{L}, \tag{22}$$

[43] There is also the "less interesting" case in which initial $\widetilde{h}$ is large enough to always repay. In this case, auditing does not occurs and $r^l = r^d$.

where f is the job-finding probability, L^S and L^D denote labor supply and demand. Finally, the deposit rate clears the deposit and loan market:

$$D = \int_i d_{i,1}(y_{i,1})di = \int_j \left\{ \widetilde{h}^*(\widetilde{h}_{1,j}) - \widetilde{h}_{1,j} + w\widetilde{L}_j(\widetilde{h}_{1,j}) \right\} dj \tag{23}$$

where D is the aggregate deposit and the right-hand side is the aggregate loan demand. The goods market clears by Walras' law.

Solution of the model. The Online Appendix provides the full solution algorithm, which consists of two nested loops. One in which a deposit rate is guessed to find the credit market equilibrium for a given deposit quantity, the other in which the public firms' capital stock is guessed to determined households choices, including direct investments and deposits. These are iterated until convergence.

4.2 Specification and calibration

4.2.1 Household liquidity risk and preferences

Our model captures household liquidity risk in the form of the expenditure shock ℓ_i. Figure 4 provides empirical evidence that the need to insure against liquidity (expenditure) shocks is stronger for lower income households. The figure analyzes the relation between income and the desired $ amount savings for *unexpected* liquidity needs reported by households.[44] Panel (a) provides a binscatter plot of the desired $ amount of liquidity holdings, scaled by income, on the vertical axis against log income on horizontal axis. The desired share of savings for liquidity falls sharply with income. It declines from around one for the poorest households to nearly zero for the richest. Panel (b) shows the same relation for the desired liquidity amount (in logs). This reveals that the absolute amount of reported liquidity need increases with income log-linearly.

Consistent with this empirical evidence, we model the negative relationship between income and the desire to insure against liquidity risk by defining the maximum realization of the expenditure shock $\bar{\ell}_i$ as follows:

$$\bar{\ell}_i = e^{\lambda_0} * y_{i,1}^{\lambda_1}, \tag{24}$$

with $\lambda_0 > 0$ and $0 < \lambda_1 < 1$. Equation 24 creates a log-linear relationship between income and the upper bound of the expenditure shock, which we can directly calibrate to the relationship shown in Figure 4, panel (b). We show below that this assumption generates a motive for holding a share of deposits in savings that decreases with income, consistent with our analysis in section 2.

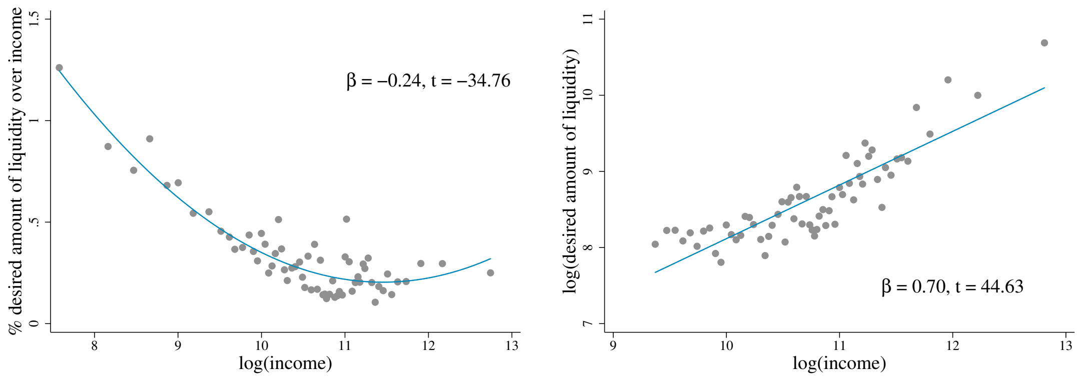
We specify the household utility function $u(\cdot)$ as a constant relative risk aversion (CRRA) function

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}, \quad \sigma \geq 0. \tag{25}$$

[44] This is based on a question in the SCF that is phrased "About how much do you think you (and your family) need to have in savings for emergencies and other unexpected things that may come up?".

Figure 4: **Direct evidence on household's liquidity needs by income**

(a) Desired liquidity share by income (b) Desired amount of liquidity by income



Note: Panel (a) provides a binscatter plot of the desired liquidity (defined as "About how much do you think you (and your family) need to have in savings for emergencies and other unexpected things that may come up?"), scaled by income, on the vertical axis and log income on the horizontal axis. Panel (b) shows the analogous relationship with the desired liquidity amount in logs rather than as a share of income. Source: 1993 Survey of Consumer Finances.

We explore the robustness of our results to different calibrations of the coefficient of relative risk aversion σ and the CRRA assumption.[45]

4.2.2 Calibration of initial income distribution and structural parameters

We study a version of the model with two types of households ($i = L, H$), which represent the bottom 90% and top 10% of the income distribution, so their mass is set to 0.9 and 0.1. We set $y_{L,1} = 5$ and $y_{H,1} = 20$. This implies a top 10% income share of roughly 30%, similar to the US in the 1980s. We perturb this initial distribution of income in our model experiments.

Table 5 summarizes our calibration. A few of the parameters are worth highlighting in particular. We set $\sigma = 3$, which generates savings that increase in income. For the liquidity shock, we set $\lambda_0 = 0.3$ and $\lambda_1 = 0.7$, in line with with the slope in the log-linear relationship between income and desired savings in the SCF. We calibrate the public firm to have a CRS technology with standard capital and labor shares.[46]

4.3 Characterization of central model features

We begin by characterizing the model in partial equilibrium. First, we examine household decisions for constant prices. Second, we analyze the credit market equilibrium for a range of deposit rates. Afterwards, we move to a general equilibrium analysis.

[45] For example, we investigate the model behavior under a power risk aversion (PRA) utility function (Xie, 2000). Formally, $u(c) = \frac{1}{\gamma}\left[1 - \exp\left\{-\gamma\left(\frac{c^{1-\sigma}-1}{1-\sigma}\right)\right\}\right], \sigma \geq 0, \gamma \geq 0$. This utility function nests a CRRA function, and in which both absolute as well as relative risk aversion decline in the level of consumption (and therefore income). This more general specification of preferences can be helpful when simultaneously targeting savings-to-income shares as well as deposits-to-savings shares across the income distribution. Guiso and Paiella (2008) and Dohmen, Falk, Huffman, Sunde, Schupp and Wagner (2011)

Table 5: **Model parameterization**

Symbol	Description	Value	Symbol	Description	Value
β	Discount factor	0.99	Z_L	Public firm productivity (low)	0
σ	Risk aversion	3	P_H	Prob. of good state (public firm)	0.5
μ_H	Mass of wealthy HHs	0.1	K_0	Initial k (public firm)	2
μ_L	Mass of poor HHs	0.9	θ_1	Private firm capital share	0.3
λ_0	Intercept (liquidity shock)	0.3	θ_2	Private firm labor share	0.65
λ_1	Slope (liquidity shock)	0.7	$\tilde{\delta}$	Private firm h depreciation	0.0278
w	Real wage	0.4	$\widetilde{Z}_H$	Private firm productivity (High)	2.2
μ	Mass of the public firm	0.547	$\widetilde{Z}_L$	Private firm productivity (low)	0.2
$\tilde{\mu}$	Mass of the private firms	0.453	$\widetilde{P}_H$	Prob. of good state (private firm)	0.5
α_1	Public firm capital share	0.7	$\underline{h}$	Min initial capital (private firm)	0.5
α_2	Public firm labor share	0.3	$\bar{h}$	Max initial capital (private firm)	1.5
δ	Public firm K depreciation	0	γ_A	Auditing cost	0.1
Z_H	Public firm productivity (high)	0.4525			

4.3.1 Household saving and portfolio allocation

To examine behavior of households in a partial equilibrium setting, we calibrate the household problem based on Table 5, but fix some of the equilibrium prices and quantities that come out of the firm and banking sector.[47] Figure 5 shows how household choices depend on the level of income y_1 (plotted on the horizontal axis). Note that the levels of consumption, deposit holdings and direct capital investment all rise with income, so we plot their shares out of income. Overall, households save a larger fraction of their income at higher levels of income. This is consistent with the empirical evidence on the relation between household savings rates and permanent income levels, as provided for example by Straub (2018).[48]

Crucially, as low-income households are more severely affected by liquidity risk, they save predominately in liquid deposits. With rising income, the expected liquidity shock becomes relatively smaller and the portfolio consists of a larger share of direct capital investments. Direct investments provide a higher return, but cannot be liquidated when the expenditure shock materializes. In the model, saving in deposits reflects a precautionary savings motive that arises from uninsurable idiosyncratic risk in the form of expenditure shocks. Motivated by empirical patterns, Equation 24 ensures that the relative magnitude of these shocks decreases with income. As a result, the precautionary savings motive is relatively less important for high-income household. To illustrate this, Figure 5 shows the household's decisions for our baseline calibration (dashed black lines) and for a more aggressive specification of the shock (colored areas). Higher liquidity is required on average across households (higher λ_0) and the

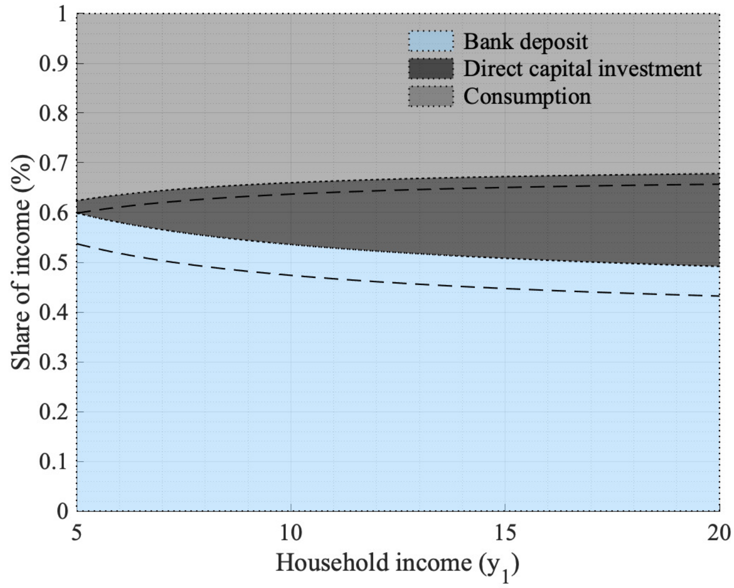
provide empirical evidence of a negative relationship between income and risk aversion.

[46]Our model can accommodate a DRS technology, which yields similar results.

[47]Specifically, we set the capital return r^k to 10% with 50% probability and 0% with 50% probability. Thus, the capital is not only illiquid but also risky (removing the uncertainty on the capital return does not change the results qualitatively). The deposit rate is set to 0.2%. We further assume that households receive the real wage w of 1 with the job-finding rate 0.8 (80%) and that total profit income is 1.

[48]As the central mechanism of our paper operates as a trend over several decades, the exogenous income in the model is assumed to be permanent income. Straub (2018) shows that savings shares increase in permanent income, as in Figure 5. See Dynan, Skinner and Zeldes (2004) for an earlier study on the relation between household income and savings. More recently Fagereng, Holm, Moll and Natvik (2019), show that the overall savings rate of households increases for higher percentiles in the income distribution, while the patterns are more nuanced for the wealth distribution.

Figure 5: **Household consumption and savings decisions as functions of income**



Note: This figure provides a summary of household decisions in partial equilibrium. It plots the household's policy functions for consumption, deposits holdings and direct capital investment, all scaled by the level of income. This is generated with $\lambda_0 = 0.4$, $\lambda_1 = 0.8$, which makes the liquidity risk more severe than in the baseline calibration. We superimpose the decisions in the baseline calibration with $\lambda_0 = 0.3$, $\lambda_1 = 0.7$ (see Table 5) as dashed black lines.

liquidity requirement is more elastic with respect to income (higher λ_1). A more severe liquidity shock has the two effects: first, total savings increase as a share of income for a given level of income. Second, deposits rise as a share of savings and thus as a share of income.[49]

4.3.2 Financial intermediation equilibria

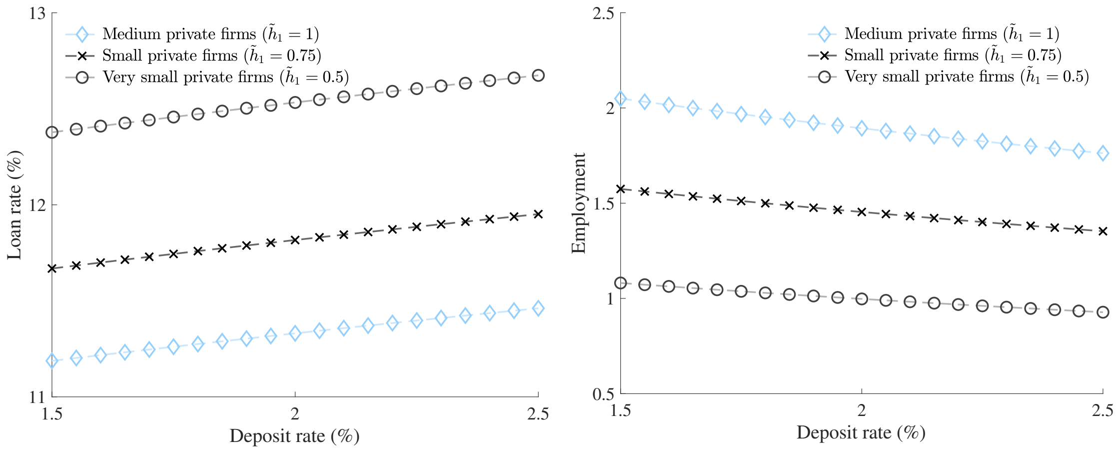
Equations (19) and (20) characterize the optimal contract between the bank and individual private firms: each private firm gets an individual contract with firm-specific loan amount, auditing probability, and loan rate. The latter affects how much labor private firms hire. The set of contracts constitutes the equilibrium in the loan market of the economy *for a given deposit rate r^d*. In general equilibrium, this rate moves endogenously with the demand for deposits by households. To illustrate this interplay, Panel (a) in Figure 6 plots the optimal loan rate as a function of the deposit rate, Panel (b) the associated amount of labor that firms hire. We consider three types of firms that differ in their initial endowment of private capital $\widetilde{h}_1$: a 'medium-sized' private firm ($\widetilde{h}_1 = 1$), a 'small' private firm ($\widetilde{h}_1 = 0.75$), and a 'very small' private firm ($\widetilde{h}_1 = 0.5$).

Three insights emerge from panel (a). First, an increase in the deposit rate leads to an increase in the loan rate across any firm size, which results from the zero profit condition in the banking sector. Second, smaller firms are charged higher loan rates. A larger initial capital stock, which represents the private firm owner's 'net worth'

[49]In other words, Figure 5 implies that in terms of level responses (rather than shares), the model generates a policy rule for deposits which is concave in income, but a policy rule for savings that is convex in income. Therefore the savings share increases but the deposit share decreases in income.

Figure 6: **Financial intermediation as a function of the deposit rate**

(a) Optimal loan rate across firm sizes (b) Optimal employment across firm sizes



Note: Panel (a) plots the optimal loan rate as a function of the deposit rate (see equation 20). Panel (b) plots private firm employment as a function of the deposit rate (see equation 18). In both panels, the relation ship is traced out for different values of initial private firm capital $\widetilde{h}_1$. We consider a 'medium-sized' private firm ($\widetilde{h}_1 = 1$) a 'small' private firm ($\widetilde{h}_1 = 0.75$) and 'very small' private firm ($\widetilde{h}_1 = 0.5$).

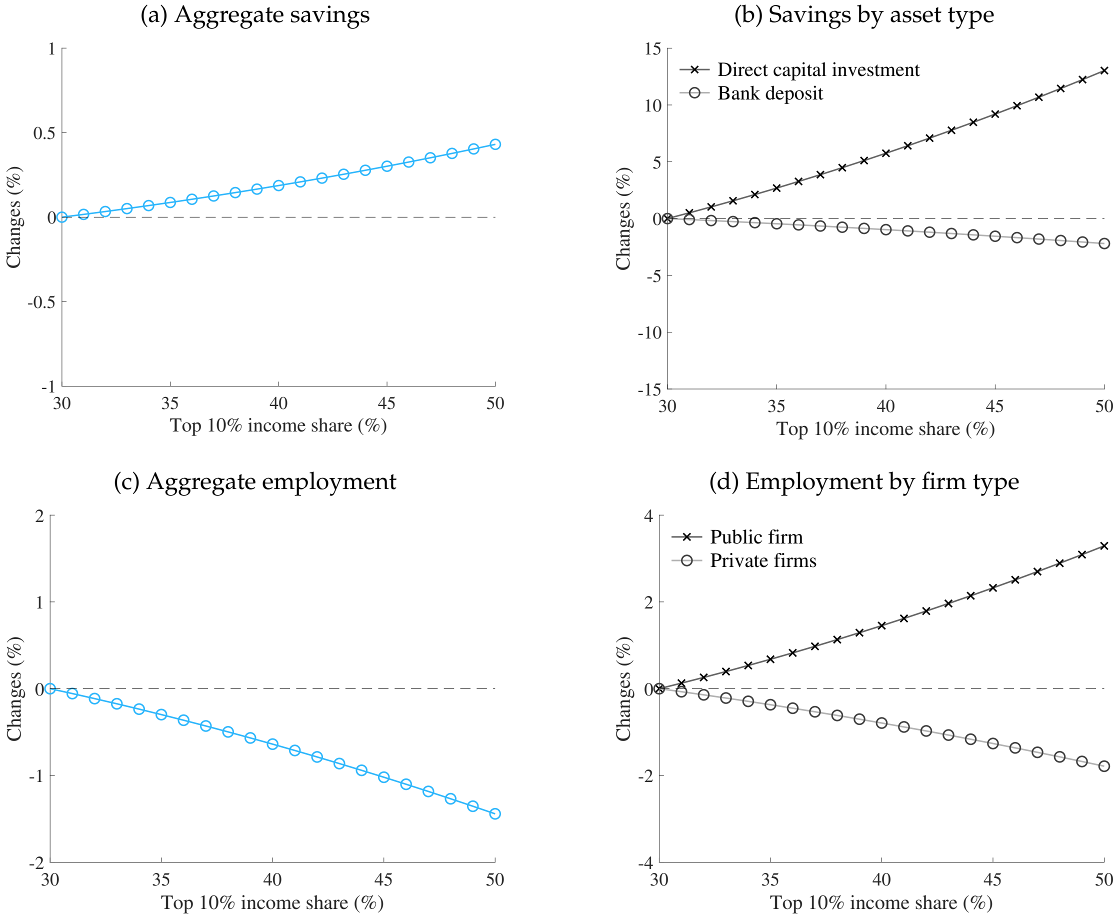
in the loan contract, alleviates the financial friction and makes external finance less costly. Third, the slope in the relation is steeper for smaller firms. Panel (b) shows that smaller firms, i.e. those with less net worth and thus more severe financial frictions, hire fewer workers. Further, as the deposit rate increases, employment declines across firm sizes. Taken together, Figure 6 illustrates how the deposit rate – which is driven by households' demand in general equilibrium – affects outcomes in the market for bank loans and thus employment across firm sizes.

4.4 Income redistribution experiments in general equilibrium

We now turn to our main model experiment, which consists of changing $y_{L,1}$ and $y_{H,1}$ to generate variation in the top 10% income share. We increase the top 10% income share from 30% to 50%, mimicking its evolution since 1980. We hold mean income constant in line with our empirical analysis.

Figure 7 shows the consequences of this change in the income distribution for different general equilibrium quantities. In all panels, we normalize variables to their level at the initial top 10% share and then trace how they change with a top income share that increases. Panel (a) presents the evolution aggregate savings, measured as the sum of direct capital investments and deposits for all households. As high-income households have a higher overall savings rate, an income distribution that is more tilted towards high income households implies higher aggregate savings. This is in line with existing studies on savings behavior across the income distribution, as referenced in the discussion of Figure 5. Panel (b) plots direct capital investment and bank deposits separately. If a higher share of income accrues to high-income households, for whom liquidity insurance considerations are relatively less important, less of aggregate income is saved in the form deposits, in line with the empirical facts. Instead, household savings flow directly into the capital of the public firm.

Figure 7: **General equilibrium consequences of different top income shares**



Note: The figure plots selected equilibrium quantities for different top 10% income shares. The calibration shown in Table 5 is used. The different top income shares are generated by varying $y_{L,1}$ and $y_{H,1}$, but keeping mean household income constant.

Panels (c) and (d) plot employment, again in the aggregate and based on a compositional breakdown. A higher top income share, and hence a lower amount of deposits available for banks, implies less job creation by private firms, for which bank financing is essential. As more resources are used to finance the public firm, it employs more workers. In the aggregate, as small firms account for a higher share of employment in the economy, total employment declines in the top income share.

The above analysis contrasts the effects on employment in the public firm relative to the whole private firm sector. To further investigate the small-firm job creation channel, Table 6 presents the change in employment across firm sizes within the private firm sector.[50] We use the same firm sizes as in Figure 6, based on variation in the initial private capital endowment ($\widetilde{h}_1 = \{0.5, 0.75, 1\}$). Table 6 provides the *level* of employment in the 30% and 50% top income share economy, as well as the associated percentage change. As the top income share increases, private firm sector employment declines by more for smaller firms. This differential effect follows from the credit market equilibrium, in

[50]We think of the public firm as a model stand-in for larger firms, say with above 500 employees. The range of private firms is intended to cover the smaller firm size buckets that we consider in the empirical analysis in section 3, but our calibration is still work in progress.

Table 6: **Job creation across firm sizes in general equilibrium**

Top 10% income share	**30%**	**50%**
Employment in average private firm ($\widetilde{h}_1 = 1$)	1.87	1.83
	– 1.78%	
Employment in small private firm ($\widetilde{h}_1 = 0.75$)	1.43	1.41
	– 1.80%	
Employment in very small private firm ($\widetilde{h}_1 = 0.5$)	0.98	0.97
	– 1.81%	

Note: Employment in general equilibrium across sizes of private firms (based on initial endowments) for different top 10% income shares. The calibration shown in Table 5 is used. The different top income shares are generated by varying $y_{L,1}$ and $y_{H,1}$, but keeping mean household income constant.

which smaller firms face a more severe financial friction due to lower net worth and higher costs of financing. Qualitatively, the pattern in Table 6 captures a key result from our empirical analysis: rising top income shares reduce small firm employment, and the effect is stronger the smaller the firm.

5 Conclusion

Exploiting variation across U.S. states from 1980 to 2015 and an instrumental variable strategy, this paper provides empirical evidence that an increase top income shares leads to a significant decline in net job creation at small firms, relative to larger firms. Our analysis of the underlying mechanism suggests that the effects works through a change in the nature of financial intermediation: rising top incomes reduce deposits available for banks to fund small firms, while increasing available funding for larger firms.

Our structural general equilibrium model clarifies how liquidity risk on the household side, in combination with financing frictions on the firm side, constitutes a mechanism that rationalizes the empirical findings. Furthermore, the model allows us to study job creation across the firm size distribution under a range of top income shares. We find that rising income inequality explains a sizeable share of the decline in job creation among small firms.

While existing studies have investigated the effects of rising top incomes on households, this paper provides the first evidence on the effects of rising top income shares on small businesses. Our empirical and theoretical insights help in understanding the broader economic consequences of rising inequality.

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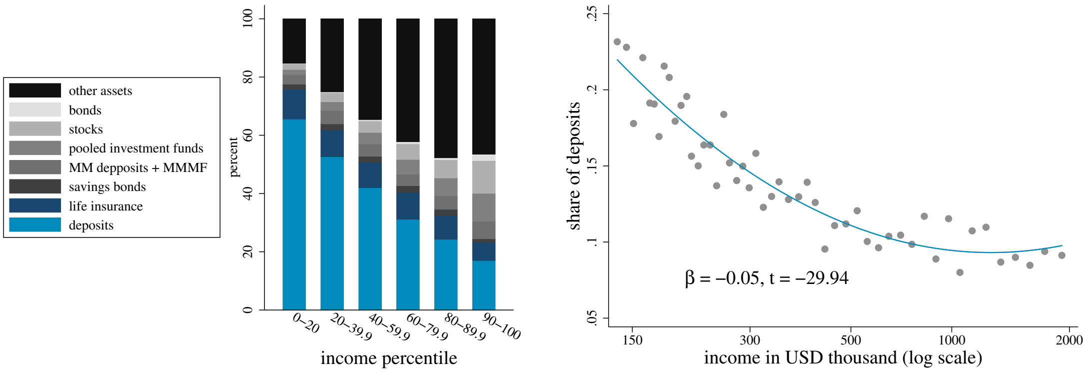
Online Appendix

Figure OA1: **Financial asset composition by household income**

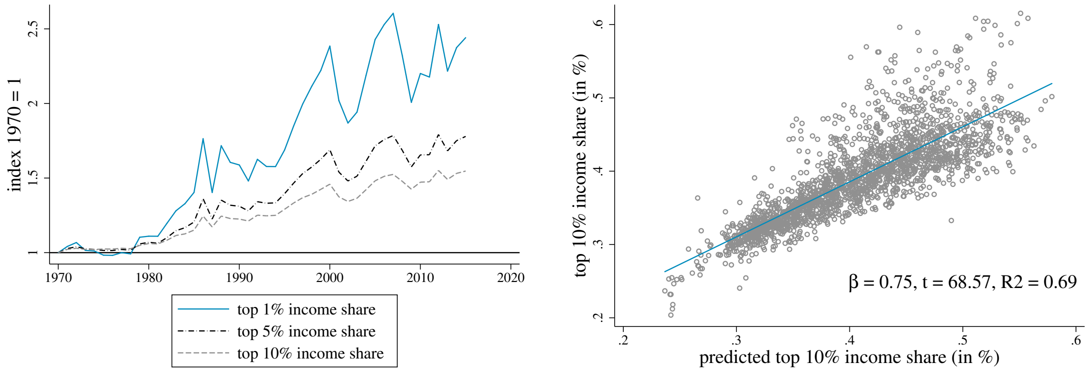
(a) Financial assets across income groups (b) Deposit share by income within top 10%



Note: Panel (a) provides a breakdown of the allocation of households' financial wealth by income group. Panel (b) provides a binned scatterplot with linear fit of the share of deposits over total financial assets on the vertical axis and log income on the horizontal axis for households with an income above USD 150,000. Source: Survey of Consumer Finances.

Figure OA2: **Bartik IV – aggregate trends and first stage**

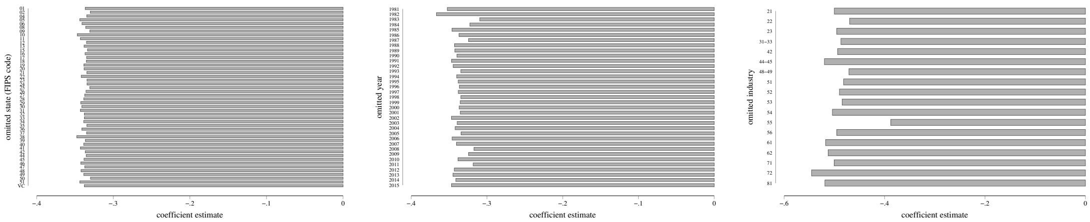
(a) Aggregate trends (b) First stage regression



Note: Panel (a) presents the evolution of different top income shares over the sample period. These remained relatively flat until 1980. Afterwards shares at the upper end of the income distribution grew more rapidly. Panel (b) illustrates the first stage of our IV strategy. It plots actual state-level top 10% income shares on the vertical axis and the predicted shares on the horizontal axis.

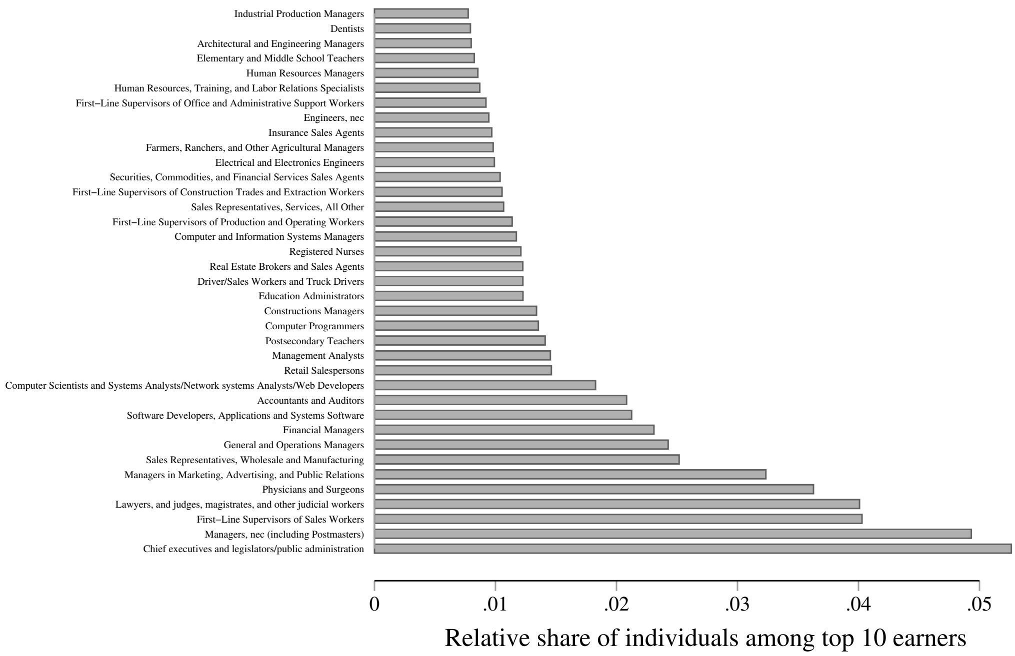
Figure OA3: **Stability of coefficients – excluding individual states, years, industries**

(a) States (b) Years (c) Industries



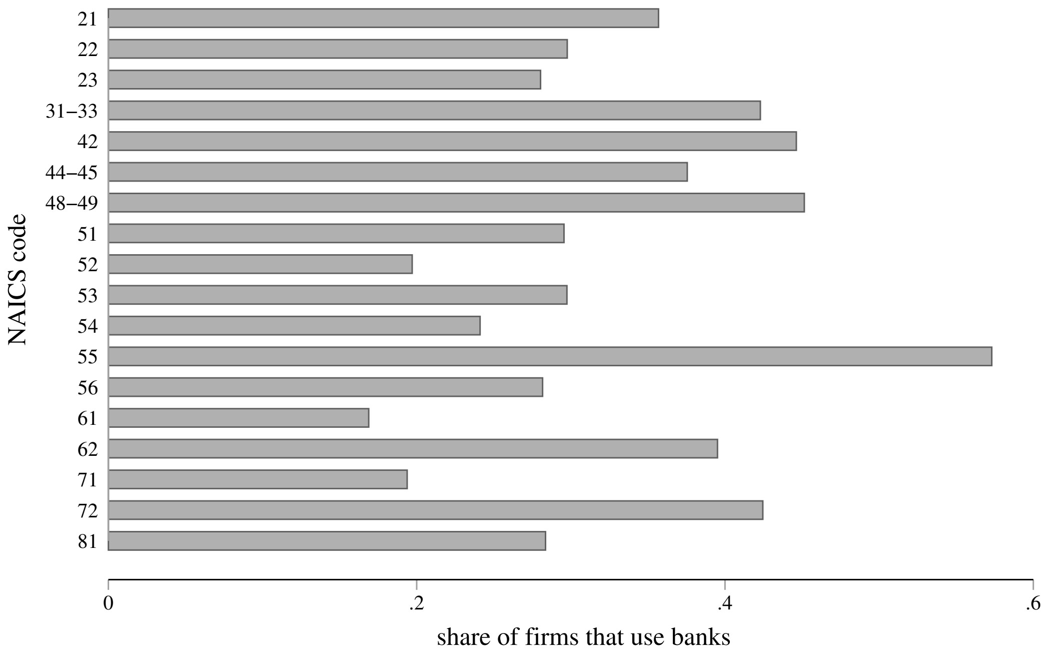
Note: all coefficients are significant at the 1% level..

Figure OA4: **Who are the top earners? IPUMS occupations 2002**



Note: This figure lists all occupations that represent at least 0.75% of all top 10% income earners in 2002. Source: IPUMS.

Figure OA5: **Share of firms that use banks**



Note: Source is the Survey of Business Owners.

Figure OA6: **Small business employment**

(a) Employment share

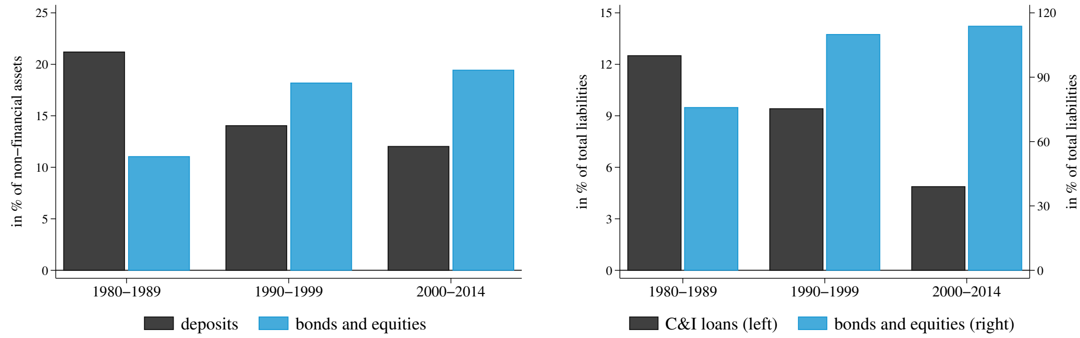
(b) Log employment

Note: Panel (a) plots employment in different firm size categories as share of aggregate employment over time. Panel (a) plots log employment in different firm size categories over time. Source: Business Dynamic Statistics 1977-2014.

Figure OA7: **Aggregate trends in deposits, loans, bonds and equities**

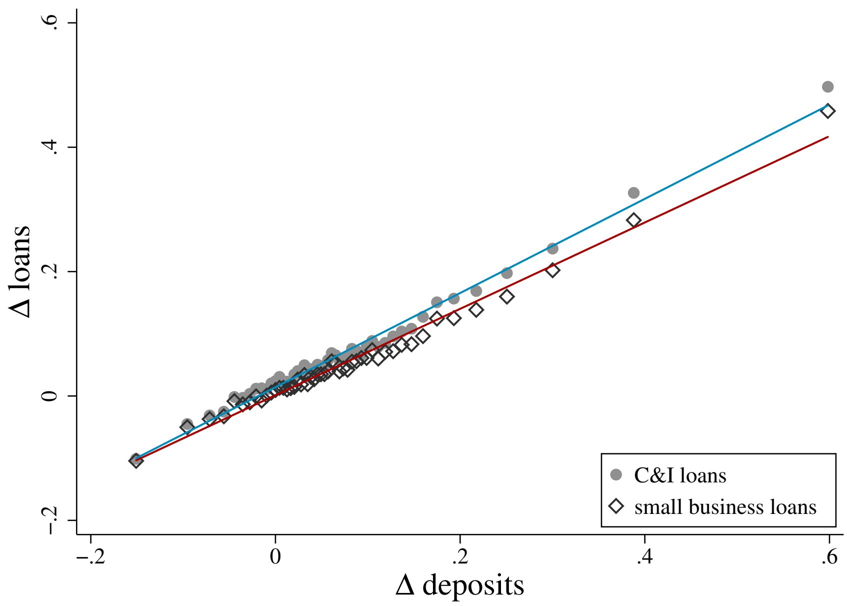
(a) Household sector assets

(b) Business sector liabilities



Note: Panel (a) plots deposits and bonds+equities as share of total household non-financial assets over time. Panel (b) plots C&I loans and bonds+equities as share of total non-financial corporate liabilities over time. Source: Financial Accounts of the United States.

Figure OA8: **Bank deposits and bank lending**



Note: Binscatter plot of the bank-level change in C&I and small business loans loans on the vertical axis against the bank-level change in deposits on the vertical axis. Source: Financial Accounts of the United States and FDIC Statistics of Depository Institutions.

Table OA1: **Descriptive statistics – SCF**

Variable	Obs	Mean	Std. Dev.	Min	Max	P25	P50	P75
income (in USD th)	129440	83.458	310.522	0	264543	25.782	51.207	91.095
total financial assets (in USD th)	122244	223.182	1488.795	.001	1368505	3.821	28.994	134.098
% deposits (checking+saving+call+cds)	122244	.41	.4	0	1	.046	.229	.915
% direct	122244	.59	.4	0	1	.085	.771	.954
% life insurance	122244	.089	.221	0	1	0	0	.023
% savings bonds	122244	.019	.089	0	1	0	0	0
% MM deppposits + MMMF	122244	.043	.145	0	1	0	0	0
% pooled investment funds	122244	.045	.144	0	1	0	0	0
% stocks	122244	.048	.148	0	1	0	0	0
% bonds	122244	.006	.053	0	.997	0	0	0
% other managed assets	122244	.022	.111	0	1	0	0	0
% residual assets	122244	.318	.362	0	1	0	.132	.653

Note: This table shows summary statistics for main variable from the Survey of Consumer Finances. For variable definitions and more details on the data sources, see the main text.

Table OA2: **Deposit holdings and household income – variation with controls**

VARIABLES	(1) % deposits	(2) % deposits	(3) % deposits	(4) % deposits	(5) % deposits
top 10% income group	-0.269***	-0.125***	-0.125***		
	(0.003)	(0.003)	(0.003)		
income percentile 20-39.9%				-0.129***	-0.097***
				(0.005)	(0.005)
income percentile 40-59.9%				-0.236***	-0.176***
				(0.005)	(0.005)
income percentile 60-79.9%				-0.344***	-0.257***
				(0.005)	(0.005)
income percentile 80-89.9%				-0.413***	-0.304***
				(0.005)	(0.006)
income percentile 90-100%				-0.486***	-0.359***
				(0.004)	(0.006)
Observations	122,244	122,244	122,244	122,244	122,244
R-squared	0.044	0.149	0.150	0.149	0.184
Controls	-	✓	✓	-	✓
Time FE	-	-	-	-	-
Survey wave FE	-	-	✓	-	✓

Note: This table shows that high income households hold fewer deposits as part of their total financial assets. We estimate $\%\ deposits_i = \mathbb{1}(top\ 10\%\ income\ group)_i + controls_i + \tau_t + \epsilon_i$,, where $\%\ deposits_i$ is the share of deposits out total financial wealth of household i (belonging to cohort t), and dummy $\mathbb{1}(top\ 10\%\ income\ group)_i$ takes on value one if the household belongs to the top income percentile. Column (1) shows that a household in the top income group holds on average 26.9% fewer of its assets in the form of deposits. Column (2) adds an extensive set of household-level controls: age, education level, number of kids, occupation, gender, race, marriage status, home ownership, and a dummy for business ownership. The coefficient declines in size to -12.5%, but remains highly significant at the 1% level. Column (3) adds cohort fixed effects (τ_t), but the coefficient of interest remains identical in terms of sign, size, and significance. Columns (4)-(5) include dummies for each income group, where the bottom 0-20% group of households is the omitted category. Hence, all coefficients indicate the share of deposits relative to the bottom income percentiles. Column (4) uses no controls, column (5) the full set of controls. Across specifications, coefficients decline in absolute magnitude as we add controls. Yet, all coefficients are decreasing with the respective income group, and they are economically large and statistically significant at the 1% level. In column (5), the second group holds 9.7% fewer assets in the form of deposits than the bottom group, while the fourth and sixth group hold 25.7% and 35.9% fewer financial assets in the form of deposits than the bottom group. Source: Survey of Consumer Finances. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table OA3: **Robustness tests – state-year level**

VARIABLES	(1) no crisis net JCR	(2) no GFC net JCR	(3) pre 2008 net JCR	(4) no VC net JCR	(5) net JCR	(6) edu sample net JCR	(7) edu sample net JCR	(8) HPI net JCR
top 10% × very small firm (1-9)	-0.334***	-0.318***	-0.271***	-0.341***	-0.281***	-0.422***	-0.658***	-0.487***
	(0.028)	(0.028)	(0.033)	(0.029)	(0.047)	(0.041)	(0.074)	(0.047)
Gini × very small firm (1-9)					-0.059			
					(0.053)			
education exp. × very small firm (1-9)							0.020***	
							(0.005)	
house price index × very small firm (1-9)								0.005
								(0.004)
Observations	14,800	15,510	12,690	15,050	16,450	10,120	10,120	10,120
State*Size FE	✓	✓	✓	✓	✓	✓	✓	✓
State*Year FE	✓	✓	✓	✓	✓	✓	✓	✓
State*Naics*Year FE	-	-	-	-	-	-	-	-
Cluster	State	State	State	State	State	State	State	State
F-stat	285.37	298.38	291.83	279.54	302.06	324.54	324.54	331.07

Note: This table reports 2SLS regressions at the state-year level. *top* 10% *income share* is the income share that accrues to the top 10% in state s, lagged by one period, and instrumented with the Bartik instrument. *very small firm* is a dummy with a value of one for the group of firms with one to nine employees. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Table OA4: **Robustness tests – state-industry-year level**

	(1)	(2)	(3)	(4)	(5)	(6)
			tradable	no FiUt		
VARIABLES	net JCR	net JCR	net JCR	net JCR	net JCR	net JCR
top 10% × very small firm (1-9)	0.182***	-0.424***	-0.586***	-0.465***	-0.389***	-0.364***
	(0.055)	(0.029)	(0.034)	(0.028)	(0.028)	(0.027)
bank dep. × very small firm (1-9)	0.837***					
	(0.073)					
top 10% × bank dep. × very small firm (1-9)	-2.020***					
	(0.183)					
ext. fin. dep. × very small firm (1-9)		0.048***				
		(0.009)				
top 10% × ext. fin. dep. × very small firm (1-9)		-0.112***				
		(0.021)				
markup × very small firm (1-9)					0.009***	
					(0.001)	
HHI × very small firm (1-9)						0.037***
						(0.008)
Observations	298,759	298,759	246,978	268,700	267,343	267,343
State*Size FE	✓	✓	✓	✓	✓	✓
State*Year FE	✓	✓	✓	✓	✓	✓
State*Naics*Year FE	✓	✓	✓	✓	✓	✓
Cluster	State	State	State	State	State	State
F-stat	332.20	331.75	333.06	303.53	307.10	307.10

Note: This table reports 2SLS regressions at the state-industry-year level. *top* 10% *income share* is the income share that accrues to the top 10% in state *s*, lagged by one period, and instrumented with the Bartik instrument. *very small firm* is a dummy with a value of one for the group of firms with one to nine employees. Standard errors are clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1.

Table OA5: **Alternative outcome variables**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	log(firms)	log(jc)	log(jc births)	log(jc cont)	log(jd)	jcr	jcr births	jdr	net jcr	real. rate
top 10% × very small firm (1-9)	-2.443***	-3.517***	-2.447***	-3.706***	-2.512***	-0.405***	-0.312***	-0.061***	-0.338***	-0.334***
	(0.198)	(0.297)	(0.269)	(0.311)	(0.270)	(0.027)	(0.023)	(0.012)	(0.028)	(0.030)
Observations	16,450	16,450	16,450	16,450	16,450	16,450	16,450	16,450	16,450	16,450
State*Size FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State*Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cluster	State	State	State	State	State	State	State	State	State	State

Note: This table reports 2SLS regressions. *top* 10% *income share* is the income share that accrues to the top 10% in state *s*, lagged by one period, and instrumented with the Bartik instrument. *very small firm* is a dummy with a value of one for the group of firms with one to nine employees. Standard errors are clustered at the state level. The first-stage F-statistics equals 302.06 in each column. *** p<0.01, ** p<0.05, * p<0.1.

Table OA6: **Call reports – bank size**

VARIABLES	(1) log(dep)	(2) dep rate	(3) log(CI)	(4) CI rate	(5) state-level net JCR	(6) state-level net JCR
top 10% income share	-13.331***	-12.971***	-20.017***	-43.645***		
	(0.919)	(0.827)	(2.459)	(3.523)		
top 10% × log(assets)	1.352***	1.269***	1.783***	4.175***		
	(0.033)	(0.038)	(0.087)	(0.138)		
top 10% × very small firm (1-9)					0.569	-0.459***
					(0.429)	(0.045)
very small firm (1-9) × log(median assets)					0.043**	
					(0.018)	
top 10% × very small firm (1-9) × log(median assets)					-0.089**	
					(0.040)	
very small firm (1-9) × log(banks pc)						-1.016***
						(0.185)
top 10% × very small firm (1-9) × log(banks pc)						2.692***
						(0.568)
Observations	242,651	242,651	112,393	112,393	16,100	16,100
Bank FE	✓	✓	✓	✓	-	-
Year FE	✓	✓	✓	✓	-	-
State*Size FE	-	-	-	-	✓	✓
State*Year FE	-	-	-	-	✓	✓
Cluster	State	State	State	State	State	State
F-stat	25.02	25.02	88.23	88.23	302.06	302.06

Note: This table reports 2SLS regressions. *top* 10% *income share* is the income share that accrues to the top 10% in state s, lagged by one period, and instrumented with the Bartik instrument. *very small firm* is a dummy with a value of one for the group of firms with one to nine employees. Standard errors are clustered at the state level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Model details

This Appendix provides additional details for the structural model in Section 4.

Household optimality conditions

Period $t = 1$. As long as household i invests in both assets ($k_{i,1} > 0$ and $d_{i,1} > 0$), the corresponding first order conditions are given by

$$\mathbb{E}\left[\frac{\partial V_2(k_{i,1}, d_{i,1}|\ell_i)}{\partial k_{i,1}}\right] = \mathbb{E}\left[\frac{\partial V_2(k_{i,1}, d_{i,1}|\ell_i)}{\partial d_{i,1}}\right] = u'(c_{i,1}). \tag{26}$$

Period $t = 2$. In order to characterize the household's choices in the interim period, let us define the amount of *deposit withdrawal* b_i as the difference between deposits brought into period $t = 2$ and deposits kept at the bank for period $t = 3$:

$$b_i \equiv d_{i,1} - d_{i,2}. \tag{27}$$

The first order condition associated with the amount of withdrawal is given by

$$u'(b_i - \ell_i) = \mathbb{E}_2\left[\frac{\partial V_3(k_{i,1}, d_{i,2}|e_i)}{\partial d_{i,2}}\right] + \Psi \tag{28}$$

where $u'(\cdot)$ is the marginal utility and Ψ is the Lagrange multiplier on the overdraft constraint. Note that $\Psi = 0$ when constraint is slack. If the overdraft constraint is binding, we have $b_i = d_{i,1} + \underline{\mathrm{d}}$, $d_{i,2} = -\underline{\mathrm{d}}$ and $\Psi = u'(d_{i,1} + \underline{\mathrm{d}} - \ell_i)$. Thus, we can compute the optimal amount of withdrawal for the given amount of deposit, capital, and realized liquidity shock as follows.

$$b^*(k_{i,1}, d_{i,1}|\ell_i) = \min\left\{\tilde{b}_i^*(k_{i,1}, d_{i,1}|\ell_i), d_{i,1} + \underline{\mathrm{d}}\right\} \tag{29}$$

where $\tilde{b}_i^*(k_{i,1}, d_{i,1}|\ell_i)$ is a solution to the following equation:

$$b_i = \ell_i + u'^{-1}\left\{\mathbb{E}_2\left[\frac{\partial V_3(k_{i,1}, d_{i,2}|e_i)}{\partial d_{i,2}}\right]\right\} \text{ with } d_{i,2} = d_{i,1} - b_i \tag{30}$$

where $u'^{-1}(\cdot)$ is the inverse function of the marginal utility function. By the Envelope Theorem, the partial derivative of the second period's value is given by

$$\frac{\partial V_2(k_{i,1}, d_{i,1}|\ell_i)}{\partial d_{i,1}} = \begin{cases} \mathbb{E}_2\left[\frac{\partial V_3(k_{i,1}, d_{i,1} - b_i^*(k_{i,1}, d_{i,1}|\ell_i))}{\partial d_{i,1}}\right] & \text{if } b^*(k_{i,1}, d_{i,1}|\ell_i) < d_{i,1} + \underline{\mathrm{d}} \\ u'(d_{i,1} + \underline{\mathrm{d}} - \ell_i) & \text{if } b^*(d_{i,1}, k_{i,1}|\ell_i) = d_{i,1} + \underline{\mathrm{b}} \end{cases} \tag{31}$$

$$\frac{\partial V_2(k_{i,1}, d_{i,1}|\ell_i)}{\partial k_{i,1}} = \mathbb{E}_2\left[\frac{\partial V_3(k_i i, 1, d_{i,1} - b^*(k_{i,1}, d_{i,1}|\ell_i))}{\partial k_{i,1}}\right] \tag{32}$$

Details on private firm

Maximizing $\mathbb{E}\left[\tilde{\Pi}_j\right]$ (equation (16) in the main text) with respect to labor gives

$$\tilde{L}_j(\tilde{h}_{3,j}|\tilde{Z}_j) = \left\{ \frac{\theta_2 \mathbb{E}\left[\tilde{Z}_j\right] \tilde{h}_{3,j}^{\theta_1}}{(1+r^l)w} \right\}^{\frac{1}{1-\theta_2}}. \tag{33}$$

With the above expression for the optimal amount of labor, we can write down the expected profit of the firm j as follows.

$$\begin{aligned}
\mathbb{E}\left[\tilde{\Pi}_j\right] &= \mathbb{E}\left[\tilde{Z}_j\right]\tilde{h}_{3,j}^{\theta_1}\tilde{L}_j^{\theta_2} - (1+r^l)w\tilde{L}_j - (1+r^l)(\tilde{h}_{3,j} - \tilde{h}_{1,j}) + (1-\delta)\tilde{h}_{3,j} \\
&= \mathbb{E}\left[\tilde{Z}_j\right]\tilde{h}_{3,j}^{\theta_1}\left\{ \frac{\theta_2 \mathbb{E}\left[\tilde{Z}_j\right] \tilde{h}_{3,j}^{\theta_1}}{(1+r^l)w} \right\}^{\frac{\theta_2}{1-\theta_2}} - (1+r^l)w\left\{ \frac{\theta_2 \mathbb{E}\left[\tilde{Z}_j\right] \tilde{h}_{3,j}^{\theta_1}}{(1+r^l)w} \right\}^{\frac{1}{1-\theta_2}} - (1+r^l)(\tilde{h}_{3,j} - \tilde{h}_{1,j}) \\
&\qquad + (1-\delta)\tilde{h}_{3,j} \\
&= (1-\theta_2)\mathbb{E}\left[\tilde{Z}_j\right]^{\frac{1}{1-\theta_2}}\left\{ \frac{\theta_2}{(1+r^l)w} \right\}^{\frac{\theta_2}{1-\theta_2}} \tilde{h}_{3,j}^{\frac{\theta_1}{1-\theta_2}} - (1+r^l)(\tilde{h}_{3,j} - \tilde{h}_{1,j}) + (1-\delta)\tilde{h}_{3,j}
\end{aligned} \tag{34}$$

The latter equation can be differentiated with respect to $\tilde{h}_{3,j}$ to get to equation (17) in the main text.

Details on optimal lending contract

The optimal lending (risky debt) contract is formally derived by choosing the loan rate r^l and the auditing probability P^a to solve the following constrained optimization problem:

$$\max_{\{P^a, r^l\}} \; (1-\tilde{P}_H)\left\{P^a\tilde{\Pi}^a + (1-P^a)\tilde{\Pi}_B\right\} + \tilde{P}_H\tilde{\Pi}_G \tag{35}$$

subject to

$$\begin{aligned}
(1-\tilde{P}_H)\Big[\hat{\Pi}_B - P^a(\tilde{\Pi}^a + \gamma^a) - (1-P^a)\tilde{\Pi}_B\Big] + \tilde{P}_H\{\hat{\Pi}_G - \tilde{\Pi}_G\} \\
\geq (1+r^d)(\tilde{h}^* - \tilde{h}_1 + w\tilde{L}^*)
\end{aligned} \tag{36}$$

and

$$\tilde{\Pi}_G \geq (1-P^a)\{\hat{\Pi}_G - \hat{\Pi}_B\}, \tag{37}$$

where $\tilde{\Pi}^a$ is the profit after repaying debt when the bad state is announced and the firm is audited, $\tilde{\Pi}_B$ is the profit after repaying debt when the bad state is announced, but the firm is not audited, and $\tilde{\Pi}_G$ is the profit after repaying debt when the good state is announced.[51] In contrast, $\hat{\Pi}_G$ and $\hat{\Pi}_B$ are the profit before repaying debt in the good

[51] In the good state, firms are always able to repay the debt. If firms cannot guarantee the rate of return of $1 + r^d$ even in the good state, banks would have not made a loan in the first place. Under the assumption that banks can invest in government bonds that gives an exogenous rate of return of $1 + r^d$, banks would have purchased bonds instead.

and bad state, which are given by

$$\hat{\Pi}_G = \left\{ \frac{\theta_2 \mathbb{E}\left[\tilde{Z}_j\right]}{(1+r^l)w} \right\}^{\frac{\theta_2}{1-\theta_2}} \tilde{Z}^H \tilde{h}_{3,j}^{\frac{\theta_1}{1-\theta_2}} + (1-\delta)\tilde{h}_{3,j} \tag{38}$$

$$\hat{\Pi}_B = \left\{ \frac{\theta_2 \mathbb{E}\left[\tilde{Z}_j\right]}{(1+r^l)w} \right\}^{\frac{\theta_2}{1-\theta_2}} \tilde{Z}^L \tilde{h}_{3,j}^{\frac{\theta_1}{1-\theta_2}} + (1-\delta)\tilde{h}_{3,j} \tag{39}$$

The constraint (36) is the participation constraint for the bank, which states that the bank needs to earn at least its financing cost in expectation. The constraint (37) is the truth-telling constraint on the firm.[52] Note that, as firms maximize the expected profits under the contract, the constraint (36) always binds.

To fully characterize the cointract, first consider the case in which $\hat{\Pi}_B \geq (1 + r^d)(\tilde{h}^* - \tilde{h}_1 + w\tilde{L}^*)$. In this case, the firm has enough initial capital stock $\tilde{h}_1$ and thus, it can ensure that the bank earns the gross rate of return $1 + r^d$ in any states. Thus, there is no need for auditing and the bank earns fixed return regardless of the realization of the states. That is, $P^a = 0$ and $r^l = r^d$.

The more interesting case is when the borrowing firm cannot provide the gross rate of return of $1 + r^d$ under the bad state. In this case, $\tilde{\Pi}_B$ and $\tilde{\Pi}^a$ should be zero as, under the equilibrium contract, the incentive constraint makes the firm tell the truth.[53] More over, the truth-telling constraint also should hold since the firm prefers to having as low auditing probability as possible.[54] Thus, the auditing probability P^a and the loan rate r^l are jointly determined by the two binding constraints. By using the fact that $\tilde{\Pi}_G = \hat{\Pi}_G - (1 + r^l)(\tilde{h}^* - \tilde{h}_1 + w\tilde{L}^*)$ and rearranging variables, we can derive the following expressions that implicitly define the optimal auditing probability and the loan rate.[55] This gives equations (19) and (20) in the main text.

Using these equations, we can compute the expected profit of the firm when there is incomplete collateralization as follows.

$$\begin{aligned} \tilde{\Pi}^e &= \tilde{P}_H(1 - P^{a*})\{\hat{\Pi}_G(r^{l*}) - \hat{\Pi}_B(r^{l*})\} \\ &= \tilde{P}_H(1 - P^{a*})\left\{\frac{w(1-\theta_2)}{\theta_2}\right\}\left\{\frac{\theta_2 \tilde{h}^*(r^{l*})^{\theta_1}}{w}\right\}^{\frac{1}{1-\theta_2}}\left(\tilde{Z}_H^{\frac{1}{1-\theta_2}} - \tilde{Z}_L^{\frac{1}{1-\theta_2}}\right) \end{aligned} \tag{40}$$

If the firm chooses not to borrow, it maintains its initial capital stock for the production in the third period. Denote the expected profit of the firm with the initial capital stock $\tilde{h}_{1,j}$ and no borrowing with $\tilde{\Pi}^{n,e}$. Then, the firm borrows only if

$$\tilde{\Pi}^e \geq \tilde{\Pi}^{n,e}. \tag{41}$$

[52]The implicit assumption in this equation is that the bank can take all the profit if the firm is found out to be lying about its state.

[53]Π_B is zero as r^l should be greater than or equal to r if the full collateralization is not feasible.

[54]A higher auditing probability implies a higher expected cost of the loan. Thus, to ensure that the bank's participation constraint holds, the loan rate needs to be higher. However, a higher loan rate lowers the expected profit of the borrowing firm. Thus, the firm wants to lower the auditing probability as long as the truth-telling constraint is not violated.

[55]Unlike the main example in Bernanke and Gertler (1989), the optimal capital holding $\tilde{h}^*$ and the realized profits are functions of the loan rate r^l and the auditing probability P^a as well.

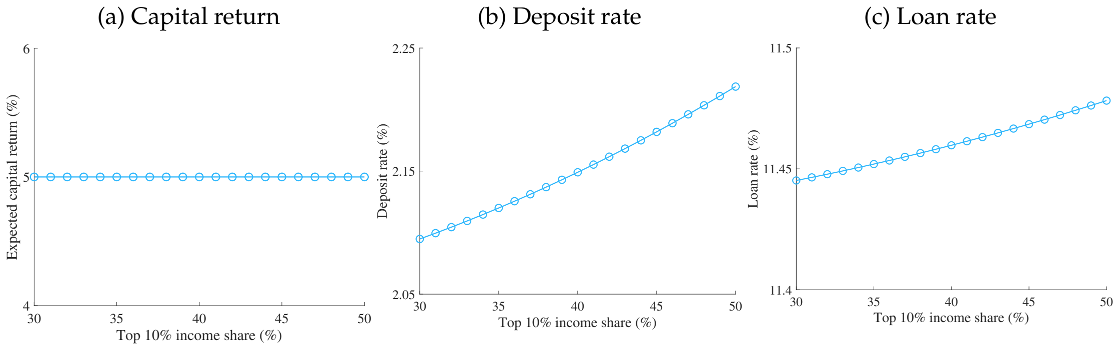
Under the parameterization we examined in this paper, private firms' profits are always higher when they borrow and thus all private firms enter into a contract with the bank.

Model solution algorithm

1. Guess the deposit rate r^d.
2. For a given guess for r^d, solve the contract problems on a grid for $\tilde{h}_{1,j}$, using the Newton method, and compute the aggregate job creation, $\tilde{L} = \int \tilde{L}_j(\tilde{h}_{1,j})dj$, the aggregate expected profit, and the aggregate loan amount, $\int \{\tilde{h}^*_{3,j}(\tilde{h}_{1,j}) - \tilde{h}_{1,j} + w\tilde{L}_j(\tilde{h}_{1,j}\}dj$.
3. Guess K.
4. For a given K, compute r^k, Π, and L as described in the main text.
5. Compute the job-finding rate.
$$f = \frac{\mu L + \tilde{\mu}\tilde{L}}{L^S} \tag{42}$$
6. With computed asset returns, profit income, and the job-finding rate, solve households' problem. Specifically, solve the following first order condition, using Brent's method, and check for a corner solution.
$$\mathbb{E}\left[\frac{\partial V_2(k_{i,1}, d_{i,1}|\ell_i)}{\partial k_{i,1}}\right] = \mathbb{E}\left[\frac{\partial V_2(k_{i,1}, d_{i,1}|\ell_i)}{\partial d_{i,1}}\right] = u'(c_{i,1}) \tag{43}$$
7. With solutions to households' problem, compute the aggregate K^S as follows.
$$K^S = \int_i k_{i,1}(y_{i,1})di \tag{44}$$
8. if $|K^S + K_0 - K|$ is smaller than a pre-specified threshold, proceed to the next step. Otherwise, update a guess for K , using Brent's method, and repeat $4 \sim 7$.
9. Compute the aggregate deposit (supply of loans) D^S.
$$D^S = \int_i d_{i,1}(y_{i,1})di \tag{45}$$
10. If $|\int \{\tilde{h}^*_{2,j}(\tilde{h}_{1,j}) - \tilde{h}_{1,j} + w\tilde{L}_j(\tilde{h}_{1,j})\}dj - D^S|$ is smaller than a pre-specified threshold, stop. Otherwise, we update a guess for r^d, and repeat the steps so far. For the update, use Brent's method.

Additional model figures

Figure OA9: **Equilibrium interest rates in the model**



Note: This figure plots r^k (Panel a), r^d (Panel b) and the average of r^l across private firms (Panel c) for the same variation of top income shares as Figure 7 in the main text.