Inequality and the Rise of Finance
A domestic perspective

Dario Laudati*

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Abstract

This paper studies the causes behind the rise of the financial sector observed in the United States from the 1980s. The rise of the capital share is taken as a primitive structural change. Such change induces non-trivial dynamics in the income and wealth distributions, which leads to higher inequality. Workers borrow to finance part of their consumption. Investors own capital, and allocate their savings between risky and risk-free assets. Investors face difficulties to hedge part of their portfolio risks with enough risk-free assets, thus generating a "safe asset shortage". Financial intermediaries step in to manufacture privately-produced safe assets for investors by transforming the debt of the workers (the borrowers). As the capital share increases, it makes investors better-off and risky capital assets more attractive. The investors contemporaneously increase their demand for risky assets and safe assets to hedge their positions. As a result, the risk-free interest rate decreases, which lowers the unit cost of issuing debt for the workers, and allows households indebtedness to grow. With more assets to intermediate and lower interest rates, financial intermediaries increase production. The financial sector rises as a result. The theory allows for a feedback effect between higher asset valuations and inequality. I present a host of stylized facts, and a model to quantitatively replicate several major macro-financial trends and run policy experiments. Finally, empirical evidence of model predictions and channels is provided for both the U.S. and in a panel of advanced economies.

Keywords: Growth of finance, inequality, shadow banking system, savings glut, safe asset shortage.

JEL codes: E21, E44, E51, G11, G23, G51, N22.

*PhD candidate at the University of Southern California, Department of Economics. E-mail: laudati@usc.edu. I am highly indebted to the unwavering support of my advisor, Vincenzo Quadrini, and my committee members: Caroline Betts, Wenhao Li, Hashem Pesaran, Romain Rancière. I would also like to thank for all their feedback and support: Pablo Kurlat, Marianne Andries, Thomas Chaney, Robert Dekle, Zhan Gao, Kristy Jansen, Erica Jiang, Mete Kilic, Robert Metcalfe, Monica Morlacco, Simon Quach, David Zeke; and the countless seminar speakers I had a chance to talk to for their valuable comments. I thank also all the seminar participants who commented previous versions of the paper, and my discussant, Thomas Ash. I acknowledge the travel grants support received from the USC Graduate School, and the Institute for Humane Studies publication accelerator grant No. 017397.

1 Introduction

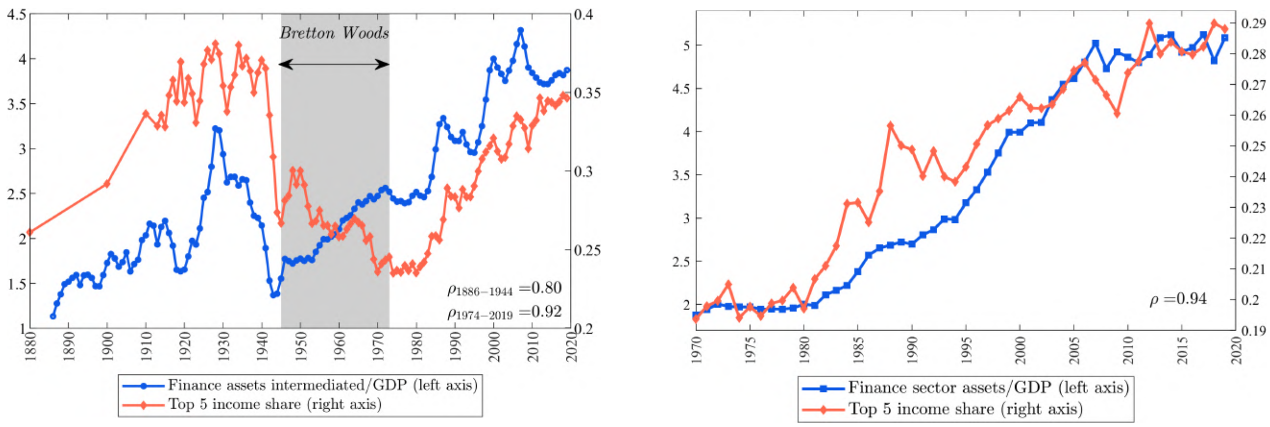
The largest industry of the U.S. economy by value added is the one composed by Finance, Insurance, and Real Estate (*FIRE*). This was not always the case. After a period of mild growth following WWII, the size of the financial sector strongly increased from the early 1980s before reaching a plateau in the aftermath of the Great Financial Crisis of 2008. A similar trend over time can be noticed both in the amount of financial assets intermediated relative to GDP, and in the wage premium earned by workers in the financial sector vis-à-vis the ones employed elsewhere. Despite the economic significance of the rise of finance, no consensus in the macroeconomics and finance literature has been reached about the explanations of such growth (Philippon and Reshef, 2013; Philippon, 2015).

This paper highlights the importance of analyzing the rise of the financial sector in conjunction with the endogenous rise of other non-banking financial intermediaries. The rise of finance is expressed in terms of assets intermediated by the financial sector as a share of nominal output. However, such growth has not been characterized by a mere rise of the same institutions and instruments that existed before the 1980s. Rather, it has been led mostly by the explosive growth of other non-bank financial institutions, which often go under the name of "shadow banking system". The shadow banking system is composed of a network of institutions, operations, and instruments that replicate the same credit functions banks perform, but without relying on the traditional structure of depository chartered banks. In the theory I propose, the emergence of the shadow banking system occurs endogenously when not enough risk-free financial assets are available for investors – what goes under the name of "safe assets shortage" (Caballero, Farhi, and Gourinchas, 2017). In this respect, the approach is consistent with the hypothesis advanced by part of the finance literature (Gorton, 2017). However, I do not take the financial phenomenon in isolation, and I treat the safe asset shortage as a proximate cause.

I seek a root cause explanation by looking at the structural transformations happening in the broader macro-economy. In the theory I propose, a secular change in the production technology of the economy – resulting from the rise of the capital share and the decline of the labor share (Elsby, Hobijn, and Şahin, 2013) –, generates an increase in inequality in two ways. First, it modifies the income distribution between workers and capital-owners. Second, it leads to higher inequality among capital-owners themselves. If the returns on capital are uncertain, and it is not possible to perfectly insure away such risks, then when the amount of capital under management increases, larger capital gains and losses can occur. As a result, the dispersion of wealth profiles increases. The increase in inequality plays a pivotal role to pin down the rise of the financial economy. The last connection partly relates to the recent seminal work by Mian, Straub, and Sufi (2021a). However, this paper differs from the previous along several dimensions. First, it proposes a novel connection between the production technological shifts and the rise of finance. Second, it emphasizes that higher inequality leads to a larger financial sector because of its interactions with a lack of public safe assets. Taking seriously the portfolio allocation choices of capital owners, higher inequality generates a domestically-driven safe asset shortage, which ultimately creates the conditions for the shadow banking system to emerge. Third, as aforementioned, it looks at the change in finance size and the rise of other financial intermediaries as inextricably related. The growth of the sector becomes intertwined with the rise of new financial intermediaries in response to the changes in the macroeconomic environment. Throughout this study I maintain the importance of looking at domestic factors when going back to the 1980s even though international forces have become increasingly important over the past twenty years. In short, the theory nests a financial system into a broader macroeconomic environment, and studies its behavior when the economy undergoes structural transformations.

The model allows also for a feedback mechanism. Higher inequality leads to more savings and a larger demand across all asset classes. Capital goods rise in value following higher demand, which makes their owners wealthier and with even more savings to intermediate. This aspect increases the dispersion of the wealth distribution even more, thereby reinforcing the mechanism.

Figure 1: Net and gross measures of financial assets intermediated as a share of GDP and top 5 percent income share in the United States



(**a**) Inequality and net measure of finance (**b**) Inequality and gross measure of finance

Notes: In Panel (a) the *net* size of the financial sector up to 2010 refers to the domestically held claims adjusted to account for informational quality produced by Philippon (2015). The series is spliced up to 2019 by accounting for the size of the domestically held liabilities of the financial sector as a share of GDP. The top 5 percent income share refers to the pre-tax and transfers measure for lack of post-tax measure going very far back in time. Data over the periods 1880-1900, 1900-1910, and 1910-1913 are linearly interpolated. In Panel (b), the *gross* measure of domestic financial sector assets is plotted against the post-tax and transfers measure of inequality. *Sources*: Data used to splice the financial series on the left panel, and to construct the financial series on the right panel, are retrieved from the Financial Accounts of the Federal Reserve Board. Data on inequality are retrieved from the World Inequality Database. Data on nominal GDP are downloaded from the Bureau of Economic Analysis. See Tables A.6 and A.7 in Section A.6 of the Appendix for details on the variables sources and construction.

Historically speaking, when looking at the *longue durée* — the connection between inequality and finance seems to be systematically at play when financial markets are left largely free of shackles. Figure 1a helps visualizing the pattern of inequality, measured by the income share of the top 5 per cent, and the *domestic* financial system in the United States over the period 1880-2020.[1] The two series strongly co-move for almost a century and a half, except for the thirty years from 1944-1973 following the Bretton Woods Accords of July 1944. During this period, Western economies attempted to immobilize financial markets in the hope that financial stability could be gained as a result. In this respect, more than the limitations to speculative international capital *per se* (coming in the form of "hot money"), the post-WWII world was characterized by outright *financial repression* at the domestic level. As mentioned by Eichengreen and James (2003),

[1]The period of inequality from 1880 to 1913 is consistent with the estimates obtained from the income approach followed by Lindert and Williamson (2016). The pictures would look very similar if the top 1 or 10 per cent were chosen.

in the decades following the 1930s: "Financial markets were suppressed, and banks became the agents of governments' industrial policies. The role of policy became to supersede rather than to support the markets. [...] As memories of the Great Depression faded and the inefficiencies of financial repression became evident, the notion that the allocation of financial resources was a task for the market, familiar from the nineteenth century, enjoyed a rebirth." In the rest of the paper, I will focus precisely on the post 1970s world. Panel (b) shows that the relationship between gross total financial sector assets and inequality from the 1970s is almost perfect. The two series correlate at 94 per cent and share the same hockey-stick pattern. However, the paper maintains that it is not deregulation *per se* to create an increase in the financial sector; rather, it only enables larger macroeconomic forces to be fully displayed in the financial economy by reducing the number of frictions. Also, as shown later, the tight relationship between inequality and finance seems to be true more in general for a host of advanced economies.

The paper is mostly quantitative in spirit, allowing for a model and its quantification, and a series of policy experiments. An empirical section in the paper and another in the appendix will further test the theoretical mechanisms and implications.

In the model, I take the observed change in the production technology of the economy, represented by the lower labor share, as the first primitive force. A change in the factor income shares is connected with a change in individual income inequality as a result of two channels at play. On the one hand, capital ownership is not equally accessible to all households; on the other hand, capital is idiosyncratically risky. When the labor share decreases, the households owning labor experience lower earnings; at the same time, the households owning capital experience an increase in their dispersion. To understand the latter aspect, it is key to clarify the role of idiosyncratic risks. Individual-specific shocks induce each capital owner to experience different market outcomes: Some obtain capital gains, some capital losses, and all of them cannot foresee in advance their ex-post position. After the capital share increases, capital owners own more assets. However, the ones hit by negative shocks experience larger losses than before while the ones experiencing positive shocks obtain larger capital gains than before. Therefore, the overall dispersion increases also among capital owners, and inequality rises as a result of both effects. The effects of inequality, then, are reverberated across the financial economy.

From a financial point of view, the workers are the borrowers of the economy: The agents that issue debt to finance part of their consumption (Mian, Straub, and Sufi, 2021a). The capital owners, instead, are the investors that need to allocate their savings, i.e., they face a portfolio composition problem. Investors can choose between buying risky assets (capital goods) and safe assets. Safe assets are provided up to a sub-optimal amount by the government by issuing public debt. Given that markets are incomplete (there are not enough Arrow-Debreu securities for each possible shock hitting the agents), investors display "precautionary motives" — they dislike owning a larger fraction of uninsurable risks.

Investors' precautionary motives play a pivotal role for the macro-financial dynamics. A larger capital share is reflected in capital assets promising higher dividend returns. Therefore, when the capital share rises, not only part of the investors get richer, but they would also like to hold more capital assets. However, investors realize that aiming for such higher returns come at the cost of owning a larger portion of risks. Precautionary motives induce investors to always demand more of both risky and safe assets at the same time, thereby maintaining relative stable portfolio shares (in line with the evidence by Gorton, Lewellen, and Metrick, 2012). In other words, a larger amount of capital owned comes with higher risks in the portfolio, which generates a simultaneous hedging demand for safe assets. When the supply of safe and liquid assets is not perfectly elastic (as it is the case in reality), a larger hedging demand compresses the risk-free interest rate to clear the markets.

A low interest rates environment creates the ideal conditions for other non-bank financial institutions – shadow banks – to step in (Sarto and Wang, 2022). When risk-free interest rates decrease, they allow the borrowers – the workers – to finance part of their consumption at lower costs. This aspect makes workers more willing to issue debt and increase their leverage. The shadow banking system transforms the debt of the workers to manufacture privately-produced safe assets for the investors. Effectively, a constrained supply of public safe assets crowds in shadow banks to fill the slack, as found in the literature (Krishnamurthy and Vissing-Jorgensen, 2015). In this respect, financial intermediaries are able to complete a market and create "gains from trade". However, they do so by financing a higher amount of debt issued by the workers. Therefore, the gains from trade come with an increase in the leverage in the system, and a lower risk-absorbing capacity.[2]

The proposed mechanism features also an interesting feedback loop between finance and inequality. Given that a larger capital share generates higher returns (higher dividends) from risky assets, the demand for risky assets pushes the price of capital assets upwards. But higher asset valuations effectively induce an even larger fraction of savings under management of the investors, which reinforces the mechanism illustrated above.

In sum, I take a structural change in the production function of the economy as a first point to go from factor income inequality to personal income inequality. More specifically, a higher capital share generates more income and wealth inequality. Consequently, the amount of savings to intermediate rises, and a portfolio allocation problem on how to invest such savings between risky and safe assets emerges. If the supply of safe assets is constrained, the real interest rates fall to clear the markets. The lower the interest rates fall, the more the workers wish to lever up and issue debt because the costs of doing so become lower. Such conditions create the perfect environment for other non-bank financial institutions – the shadow banking system – to step in and fill the gap by transforming the debt that the workers wish to issue to finance their consumption into quasi-safe assets that investors wish to hold to hedge their risks. The financial sector rises in size as a result of that.

The paper does not see the rise of the capital share as the only reason behind the rise of inequality, let alone of finance.[3] However, by micro-founding it in such a way, it unveils a new

[2]The model does not feature aggregate risks to maintain the growth and the financial stability issues separate. Also, the model structure does not warrant to delve into welfare computations; however, these two forces of larger attained consumption and investment possibility frontiers vis-à-vis losses from endogenous financial instability should be considered if one were to pursue such exercise.

[3]In fact, "capital" should be intended more in general — e.g., at the very least according to the notion of "human capitalists" in the spirit of Eisfeldt, Falato, and Xiaolan (2023).

unexplored connection between a change in the technology of the economy and its financial system. Furthermore, it is able to replicate and connect in one single, parsimonious, and internally-consistent framework: The endogenous rise of inequality, the compression of real interest rates, the rise of households indebtedness, the higher leverage in the economy, the change in size and composition of the financial sector, and the feedback loop between inequality and market-based finance.[4]

Quantitatively, taking the periods 1970-1979 and 2010-2019 as the initial and final steady states, the model is able to explain 15 per cent of the growth of finance, when the inequality measure increases by 13 per cent as a result of the corresponding capital share increase. In terms of real interest rates, the model can explain up to 22 per cent of such compression over time when the same relatively small increase in inequality is obtained. The portfolio shares between risky and safe assets fall surprisingly in line with the values observed in the data even though they are not targeted and they are not the main objective of study.

In the empirical section, I test the extent to which we can find statistically significant evidence of the lockstep movements between inequality and finance over the past century — in this respect, I build on the work by Müller and Watson (2018) on co-variability. I do find evidence that in the pre- and post-Bretton Woods world the two series systematically co-moved *in growth rates*. Such result can be thought to be in the same spirit as the "great ratios" hypotheses related to the Kaldor facts.

Furthermore, I run more empirical analyses to test the importance of the "mechanism", i.e., the role of market-based vs. bank-based financial structure, by analyzing a panel of advanced economies. I follow the approach by Rancière, Tornell, and Westermann (2008), and I find more evidence about the importance of considering a market-based financial sector as a key aspect to think at the two-way relationship between finance and inequality.

[4]See Mian and Sufi (2018) for a discussion on the importance of understanding whether the following patterns where connected at all: (*i*) The rise of households indebtedness; (*ii*) The compression of the risk-free interest rate; and (*iii*) The rise of finance itself (seen as amount of assets intermediated).

Literature. This work relates and tries to bridge different literature strands in macroeconomics and finance. First, the rise of finance has been acknowledged to be an important area of study after the Great Financial Crisis (*GFC*) through detailed data work by Philippon and Reshef (2012, 2013), and Philippon (2015). Such effort naturally engendered a quest for theories to explain the trends. Gennaioli, Shleifer, and Vishny (2014) provided an initial attempt by means of a neo-classical growth model augmented with asset managers, where the key model device is based on trust placed in assets managers, which rising over time justifies higher fees paid to institutional investors. However, this line of research overall did not gain sufficient traction to provide additional answers from a theoretical standpoint. Rather, in the post-GFC world researchers have preferred to investigate the extent to which the increase in finance has been "excessive" (Arcand, Berkes, and Panizza, 2015, among others).[5] This work places the stream of literature on the explanations for the secular rise of finance back to the fore, and contributes to it by providing a hypothesis on its root causes. In this respect, it takes a positive angle rather than a normative one by not addressing the issue about whether the size of the current financial sector is excessive or not.

Second, the paper relates to the macroeconomic consequences of higher inequality.[6] Kumhof, Rancière, and Winant (2015) established a link between increased inequality and higher financial crises probabilities. Here, I do not look at the financial fragility component *per se* (even though the model does deliver higher leverage and lower capital buffers), but rather at structural explanations for the secular rise of finance. More recently, inequality has been studied in conjunction with the rise of households indebtedness and richer households savings in a series

[5]See Cochrane (2013) for a rebuttal of this exercise. See Brunnermeier et al. (2021) for a novel way of empirically identifying the effects of financial deepening on output in the U.S..

[6]The debate on the *causes* leading to higher inequality is still open. Stansbury and Summers (2018) document an increasing gap between productivity and wages since at least 1973. Many other works have highlighted: the importance of changes in the taxation regimes adopted (e.g. Piketty and Zucman, 2014), "China shocks" and off-shoring of jobs to lower income countries (Autor, Dorn, and Hanson, 2016, for a review), the rise of automation and capital-enhancing technologies (Acemoglu and Restrepo, 2022), the rise of college premium, and de-unionization. Such list is not meant to be exhaustive and potentially a combination of all the previous items and others is important to explain the rise of inequality. See Hubmer, Krusell, and Smith (2021) for a quantitative assessment of the different drivers explaining the rise in wealth inequality.

of papers by Mian, Straub, and Sufi (2021a,b,c). Methodologically, I contribute to this latter literature by not relying on non-homotheticicities but on precautionary motives. I leave the savings rates constant over time and across households to focus on the increase in the absolute amount of money under management by investors, i.e. the change in the *levels* of savings. Even though non-homotheticicities are not strictly needed to generate the results here, allowing for that will further amplify and reinforce the effects shown.[7] However, a more important distinction arises from a conceptual point of view. In this paper, I work out a theory for the endogenous private production of safe assets needed to explain the rise of finance. In my framework, the rise of finance can only be understood as the joint interaction of higher savings to be allocated by investors when markets are incomplete and the concurrent safe assets shortage – something missing elsewhere, and yet key here.

A host of other studies focus on the connection between inequality and other specific macro-financial trends covered in this work. Favilukis (2013) and Auclert and Rognlie (2017, 2020) focus on the macroeconomic implications of increased inequality connecting it with aggregate demand and decrease in real interest rates. A broader set of papers looks at the effects of inequality for asset pricing. Lansing (2015), and Markiewicz and Raciborski (2022) look at the implications of rising inequality (generated by higher capital income share) on lower interest rates and equity risk premium. Recently, Fagereng, Gomez, Gouin-Bonenfant, Holm, Moll, and Natvik (2023) and Gomez (2023) look at the aspects of inequality linked to asset valuations. Panageas (2020) carries out a literature review and attempts to reconcile the most seminal studies on the matter. Also, the specific effects of higher income inequality on households debts dynamics have been studied by Iacoviello (2008) and Coibion, Gorodnichenko, Kudlyak, and Mondragon (2020), among others. Azzimonti, de Francisco, and Quadrini (2014) investigate the higher demand for *public* debt stemming from higher inequality in an international setting.[8] In this respect, this paper has the benefit of encompassing different relevant aspects in a single

[7]See also Fagereng et al. (2021) for an important study on wealth-related non-homotheticicities.

[8]See Benhabib and Bisin (2018) for review the literature on theories and empirics surrounding wealth inequality.

framework.

This paper clearly relates also to the broader safe assets shortage and "savings glut" literature. The early literature on these topics is rather rich but almost exclusively focused on the international dimension of the issue. More recently, Caballero and Farhi (2018) and Barro, Fernández-Villaverde, Levintal, and Mollerus (2022) focus on the U.S., and look at the macroeconomic implications that stem from acute safe assets shortages reaching some diverging conclusions on the importance of public safe assets to mitigate such issue. See also Caballero, Farhi, and Gourinchas (2017) for a review. More similar to this paper, Ordoñez and Piguillem (2021) also address the macroeconomic importance of the savings glut from a domestic point of view by taking a demographic angle.

The recent macro-finance literature has also produced several works to place the safe assets demand – and the insurance function of banking liabilities – at the center of stage by looking at them as an extension of money instruments (Krishnamurthy and Vissing-Jorgensen, 2012; Brunnermeier and Sannikov, 2016; Quadrini, 2017; Kiyotaki and Moore, 2019; Krishnamurthy and Li, 2023; among others).

Other aspects of the finance literature are also important to mention. On the one hand, the paper speaks to the causes behind the rise of the asset management industry (Greenwood and Scharfstein, 2013) by linking it to inequality; on the other hand, the emergence of the shadow banking system has been conjectured to be linked to the higher demand for safe assets (Gorton, 2017), which is in line with what shown here. In a recent paper, Sarto and Wang (2022) assess the connection between the rise of shadow banking and lower interest rates, as theorized here.

The paper is structured as follows. Section 2 describes key stylized facts to place the study in perspective. Section 3 describes the macro-finance model proposed. Section 4 explains the model properties and the calibration exercise, and Section 5 assesses its quantitative performance. Section 6 provides empirical evidence of the relations and channels between inequality and finance. Section 7 concludes. Additional stylized facts, proofs, results, and data description are available in the Appendix.

2 Stylized facts and background

A number of stylized facts consistent with the proposed narrative can help to provide descriptive evidence of the mechanism investigated.

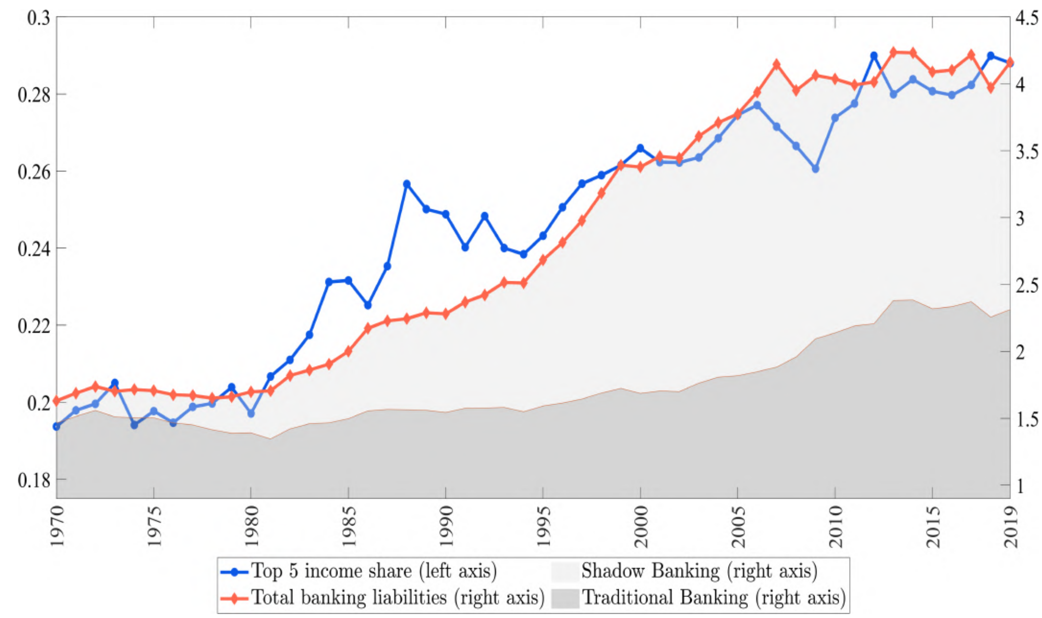
The rise of finance from 1980s has been characterized by the burgeoning rise of "other non-bank financial institutions" and instruments. The literature has often called this broad universe with the name of "shadow banking" or "parallel banking" system. Albeit being more lightly regulated than the traditional banking system, and not enjoying an explicit safety net from the government, shadow banking should not be interpreted as a world catering to "shady" and illegal activities. Instead, it relates to the creation of credit instruments by non-depository institutions (say, mortgages issued by finance companies) ultimately funded with short-run money-like instruments such as repurchase agreements (RePos) and money markets mutual funds (MMMFs) shares which differ from the publicly-guaranteed bank deposits. To this extent, I will sometimes prefer to refer to the shadow banking system as the "market-based banking" system to reflect the intrinsic banking nature of this network of transactions generated through market mechanisms.

In Figure 2, I follow the approach by Adrian and Ashcraft (2016) to construct a measure of market-based banking and traditional banking activities.[9] The figure shows their time trends from the 1970 to 2019 vis-à-vis income inequality.[10] The total amount of financial liabilities issued by the banking sector (in orange) grew as a fraction of GDP from less than two in the 1970s to more than four in the 2010s. Over a thirty years time span, the sector more than doubled before reaching a new steady state. The share of income in the hands of the top 5 per cent of the income distribution (in blue), on the other hand, rose from a steady level of about 0.2 in the 1970s to almost 0.3 forty years later. However, what is striking is that most of the growth has been driven by market-based banking institutions. The sector was very small as a fraction

[9] In their work, the authors call it accordingly to the traditional name "shadow banking system".

[10] In the literature, the top 5 per cent of the income distribution is found to be the fraction of the population that mostly gained over time. Therefore, I will maintain the top 5 per cent income share as the preferred measure of inequality. However, the results are not sensitive to the choice of either the top 1 or top 10 per cent.

Figure 2: Top 5 percent income share and total banking liabilities split by traditional and market-based banking components in the United States over the period 1970-2019



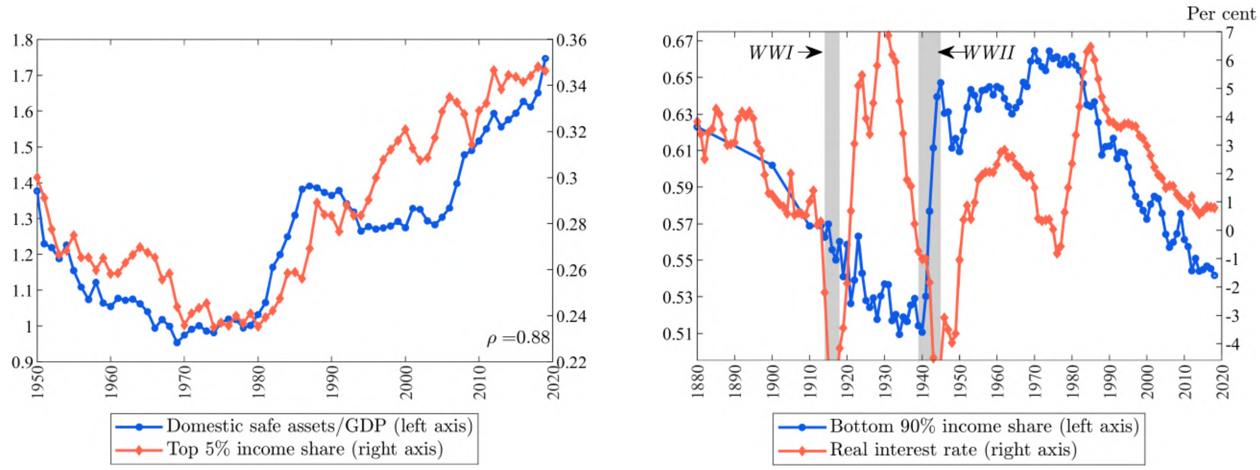
Notes: Top 5 percent income share refers to the post-tax measure. All banking variables are considered as percentage of nominal GDP. The measures of traditional and shadow banking levels refer to: traditional credit and maturity transformation, and shadow credit and maturity transformation as constructed by Adrian and Ashcraft (2016). *Sources*: Data on inequality are retrieved from the World Inequality Database. Data on nominal GDP are downloaded from the Bureau of Economic Analysis. Data on banking liabilities are retrieved from the Financial Accounts of the Federal Reserve Board. See Tables A.6 and A.7 in Section A.6 of the Appendix for details on the variables sources and construction.

of GDP until the 1980s, and skyrocketed afterwards becoming twice as large as the amount of national output before stabilizing in the aftermath of the latest financial crisis. The traditional banking system, on the other hand, has been virtually flat from the the 1970s almost until the 2000s, and only increased in the run-up of 2008 before reaching a plateau thereafter. As argued before, it seems that most of the growth in banking is linked to the rise of other non-financial institutions rather than banking activities traditionally intended.[11]

Figure 3 complements the previous plot on the supply of credit by showing the importance of macro factors for the equilibrium levels of safe assets. Panel (a) looks at the change in the safe assets in the economy in relation to inequality. It is evident that for the whole post-WWII

[11]Similarly, it is possible to show that the size of market-based banking out of traditional banking tracks the rise of inequality.

Figure 3: United States domestically-held safe assets out of nominal output and top 5 percent income share over the periods 1950–2019 (left); and bottom 90 percent of the income distribution and real interest rates over the period 1880-2018 (right)



(**a**) Inequality and the domestic rise of finance

(**b**) Bottom 90 per cent and real interest rates

Notes: The measure of domestically-held safe assets is composed by: time and savings deposits, money-market mutual funds, commercial paper, and repurchase agreements. The top 5 per cent refer to the post-tax and transfers measure of the income distribution. The real interest rate plotted is the 7-years moving average measure to reduce the year-to-year cyclical component. The bottom 90 percent income share refers to the pre-tax measure due to data limitations over the very long run. *Sources*: Data on the safe assets are retrieved from the Financial Accounts of the Federal Reserve Board. Data on nominal GDP are downloaded from the Bureau of Economic Analysis. Data on inequality are retrieved from the World Inequality Database. Real interest rates are retrieved from Schmelzing (2020) publicly available replication files. See Tables A.6 and A.7 in Section A.6 of the Appendix for details on the variables sources and construction.

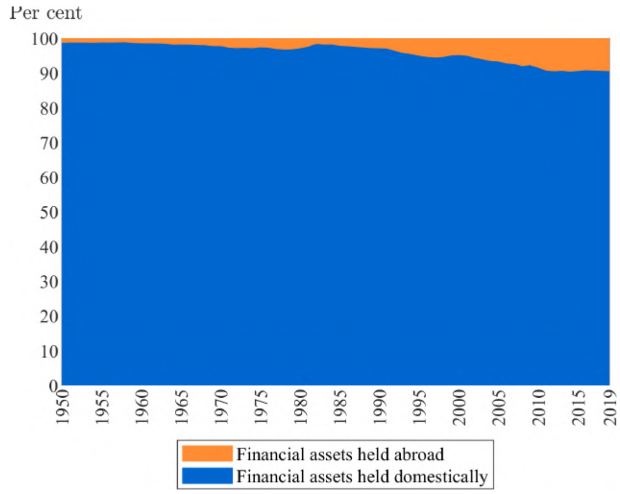
period, as inequality moved – the production of domestically-held safe assets closely mirrored the same path.[12] The overall correlation for a 70 years time span is 88 per cent, and the two series only mildly diverge from the mid-1990s to the mid-2000s. This should be the case if higher inequality generates a higher demand for safe assets in the hands of the investors in order to hedge potential risks from their investments.

As a corollary of such statement, I investigate the extent to which real interest rates have similarly followed. Thanks to the work by economic historians, I am able to go back as far as 1880.[13] Except for the interwar period, during which real interest rates were severely distorted by war financing, related inflation bouts and the Great Depression, real interest rates have indeed fol-

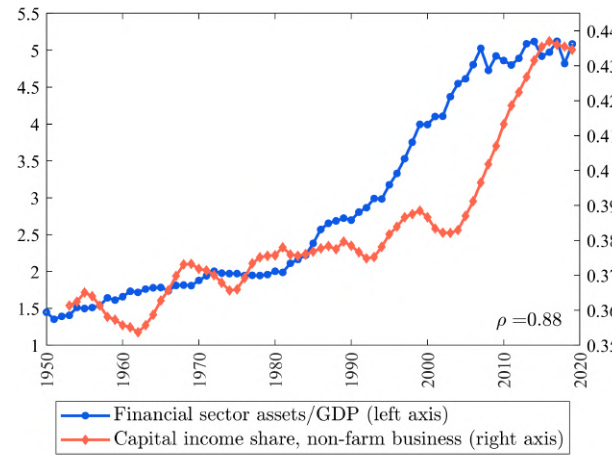
[12]The picture is the net measure after removing the foreign claims on U.S. safe assets.

[13]The graph depicts the long-run interest rates by Schmelzing (2020), but almost identical results are obtained if plotting the data by Jordà, Schularick, and Taylor (2017).

Figure 4: Decomposition of the Unites States financial assets held domestically vis-à-vis in the rest of the world (left); and financial sector assets out of nominal output and capital share non-farm business (right) in the United States over the period 1950–2019



(**a**) Financial claims held domestically and abroad



(**b**) Capital share and the domestic rise of finance

Notes: The capital share refers to one minus the labor share (non-farm business). The measure refers to the 7-years moving average in order to focus on the trend and reduce the cyclicality of the flow variable. The size of the financial sector on the left side refers to the domestically held claims. *Sources*: Data on labor share are retrieved from the Bureau of Labor Statistics. Data on nominal GDP are downloaded from the Bureau of Economic Analysis. Data on the financial sector assets (both domestic and foreign) are retrieved from the Financial Accounts of the Federal Reserve Board. See Tables A.6 and A.7 in Section A.6 of the Appendix for details on the variables sources and construction.

lowed a very similar pattern as inequality. This is true not only for the post-WWII period but also for the pre-WWI.[14]

After WWII, the world has become more globalized not only in terms of international trade but also financially. Therefore, it is interesting to investigate whether such massive rise in finance has been driven by international forces. Panel 4a looks at this by decomposing each U.S. financial instrument according to the location of the owners of the claims — domestic vs. rest of the world —, as provided by the Financial Accounts of the Federal Reserve. It is true that the share of finance has progressively moved more in the hands of foreigners over time, however, foreigners have been holding at most 10 per cent of the total financial claims over the past

[14]I focus on the bottom 90 rather than the bottom 95 to be consistent with the literature even though results would be very similar in the latter case. Notice also that Rogoff, Rossi, and Schmelzing (2022) recently confirmed from a quantitative perspective the implausible nature of the demographic trend in itself to explain the decline of real interest rates over the very long run.

decades. Also, notice that until the mid-1990s the share was not larger than it was back in the 1970s. The acceleration began in the 1990s, and became more pronounced in the 2000s – in line with the arguments on foreign reserves accumulation happening after the Mexican and Asian Financial Crisis of 1994 and 1997, and the entering of China in the World Trade Organization in 2002.[15]

The theory connects the rise of the capital share with the increase in inequality. However, the literature has not previously investigated the extent to which a change in the production technology is linked in any way with a change in the size of the financial sector. Panel (b) in Figure 4 displays the joint occurrence of the rise of the capital share and the one of finance. More specifically, it is possible to see that the capital share increases from the mid-1970s until the GFC. The rise of finance, measured as size of total liabilities of the domestic financial sector over nominal GDP, moves very closely with the dynamics of the changes in technology. It is relatively flat until the 1980s, and it grows dramatically after that. The correlation between the two series is 88 per cent for the whole sample. In a recent work — Eisfeldt, Falato, and Xiaolan (2023) estimate the importance of equity payouts to workers for the distribution of the factor shares. When properly accounting for the share of profits rebated back to workers as part of their compensation, the picture is even starker. See Figure A.2 in Section A.1 of the Appendix.[16]

With that in hand, it is of interest to generate a theoretical framework that is able to rationalize such joint movements in a more formal fashion.

3 A macro-finance model

The current section builds a theoretical framework to analyze the mechanisms described in the introduction. The model is set in discrete time, and agents live over the time horizon $t \in \{0, 1, \dots\}$. The model features a representative firm, two sets of heterogeneous households

[15] Figure A.1 in the Appendix shows that the same cannot be said for U.S. Treasuries. In this case, the fraction held by foreigners over the past two decades has fluctuated between 30 and over 40 per cent.

[16] I thank the authors for kindly sharing their data with me.

— investors and workers —, a financial technology (representing the market-based banking system), and a Government budget constraint. I abstract from the traditional banking sector, as it was relatively constant over time. Therefore, one could think at this as a time-invariant technology whose output is normalized to zero.

Firms. Firms are price-takers, and maximize profits statically every period. They employ two factors of production, capital and labor, and they produce a final good, y_t, whose price I take as numéraire. Capital is represented by a non-reproducible stock, k_t, which is owned by the investors. Labor, N_t, is inelastically supplied by the workers.[17] Firms combine the two factors according to a Cobb-Douglas production function facing constant returns to scale. The time-varying capital share is represented by α_t, and the labor share is $1-\alpha_t$.

The rented capital is remunerated at rate, d_t, which represents the dividends pay-off of the capital stock. Labor is paid according to the wage schedule, w_t. The amount of capital is normalized to one. Similarly, a constant population (and labor force) is normalized to one. The problem of the firms is provided in ($\mathscr{P}_F$):

$$\max_{k_t, N_t} \; y_t - d_t k_t - w_t N_t \quad \text{sub} \;\; y_t = k_t^{\alpha_t} N_t^{1-\alpha_t} \tag{$\mathscr{P}_F$}$$

As a result of labor being inelastically supplied for a constant population, the production of final output is $y_t = 1 \;\; \forall t$. It follows that the amount of dividends earned by capital-owners and the wages earned by laborers correspond to the factor shares of capital and labor, respectively: $d_t = \alpha_t, \;\; w_t = (1-\alpha_t)$.

Households. Households (both investors and workers) discount future levels of utility by the same discount factor $\tilde{\beta} \in (0,1)$. The dynastic structure features a constant survival probability, $\delta \in (0,1)$; therefore, a constant fraction of the population $(1-\delta)$ exits every period. This fraction

[17] Workers do not have access to financial markets, therefore markets are segmented. On the other hand, investors do not supply labor to maintain a parsimonious structure.

is re-born with average income at each time t to ensure that the total population and assets in the economy are constant.[18] The exit probability ensures the stationarity of the model.[19] The "effective" discount rate is defined as: $\beta \triangleq \tilde{\beta}\delta$. Both agents have homothetic preferences and maximize utility derived from personal consumption.

— Investors/Capital-owners. Investors face two joint problems: A consumption-savings decision, and a portfolio allocation problem. In other words, in each period investors need to decide the amount to allocate to consumption vis-à-vis savings, and contemporaneously determine how to invest their savings across different financial asset classes. They maximize their utility according to simple log-preferences. The assets space is composed of three assets: risky, public safe assets, and privately-produced quasi-safe assets. The recursive problem faced by investors is represented by the Bellman equation in ($\mathscr{P}_I$):

$$V_{it}^{(I)}(b_{it}, m_{it}, k_{it}) = \max_{\substack{c_{it}^{(I)}, b_{i,t+1}, \\ m_{i,t+1}, k_{i,t+1}}} \left\{ \log\left(c_{it}^{(I)}\right) + \underbrace{\tilde{\beta}\delta}_{\triangleq \beta} \, \mathbb{E}_t \left[V_{it}^{(I)}(b_{i,t+1}, m_{i,t+1}, k_{i,t+1}) \right] \right\} \qquad (\mathscr{P}_I)$$

$$\text{sub } \; c_{it}^{(I)} + p_{Kt}k_{i,t+1} + q_{Bt}b_{i,t+1} + q_{Mt}m_{i,t+1} =$$
$$= \underbrace{(p_{Kt}(1+\epsilon_{it}) + d_t)k_{it} + b_{it} + (1+\zeta_{it}^M)m_{it}}_{\triangleq A_{it}}$$

The problem for the investors features four control variables and three state variables. The control variables are consumption in the current period, $c_{it}^{(I)}$, and investment decisions over next period in: Risky capital shares, $k_{i,t+1}$, public safe assets, $b_{i,t+1}$, and private quasi-safe assets, $m_{i,t+1}$. The total value of wealth for each household i is A_{it}, and it is obtained by summing the latter three elements evaluated at prices. Notice that the assets distribution is not a state variable, — this stems from the fact that the model features aggregation, as pertaining to the

[18] In this respect, one can see the infinitely-lived agents set-up as a simple type of an overlapping generation model.
[19] This is a standard approach in the macroeconomic literature to prevent the accumulation of all the income by a single individual, and it will become clearer from the law of motion of assets.

class of models described by Angeletos (2007) with idiosyncratic capital shocks. The returns on capital and quasi-safe assets are subject to idiosyncratic shocks. The shocks on capital are drawn from a distribution such that: $F_\epsilon \sim (0, \sigma_\epsilon)$, and the ones on quasi-safe assets from $F_\zeta \sim (0, \sigma_\zeta)$. Both distributions are assumed to be uniform for simplicity.

Investors own the capital stock of the economy ($k_t = \int_i k_{it} \ di$), and each investor i owns a share of the capital of the economy, k_{it}. Capital is risky. Each investor is hit by idiosyncratic shocks on their capital holdings, and risks cannot be insured away with *ad-hoc* contingent claims. It follows that perfect diversification is not attainable, and that investors become ex-post heterogeneous after the shocks are realized even if they start as ex-ante identical.[20] Therefore, the model allows for a full-fledged assets distribution with some investors becoming zero-wealth holders and others extremely wealthy. The model does not allow for aggregate uncertainty, thus, the total supply of capital is known with certainty. The capital stock is priced at value p_{Kt}, and it pays off non-storable dividends, d_t, every period. Given that the shocks hit the *shares* of capital, this can be seen as leading to a stochastic variation in the value of individual capital holdings. This is also isomorphic to idiosyncratic depreciation (or appreciation) rates of the individual capital shares.

Safe assets, b_{it}, are risk-free instruments issued by the Government. They generate perfect insurance and they are provided in positive but limited net supply, $\bar{b}$.

Privately-issued quasi-safe assets, m_{it}, are created by the implicit financial sector by transforming the debt of the workers in exchange for a fee. Hence, investors fund the debt of the workers. A classical no-arbitrage condition holds in the aggregate such that $\mathbb{E}[R_{Mt}] = \mathbb{E}[R_{Bt}]$. In other words, the model continues to feature no aggregate uncertainty, and some funds are able to provide small returns while others marginally "break the buck". Given the complete absence of risk on the Government-guaranteed safe assets, this ensures that a safety discount on

[20]Guvenen, Pistaferri, and Violante (2022) show that the volatility of income earnings for top quantiles is larger than for the lower quantile. See Figure A.6 in the Appendix for the results for the whole population and divided by age cohort and gender.

public assets is achieved endogenously.[21] However, the degree of uncertainty is small enough not to lead to substantial changes in the equilibrium outcome as a result of this modeling choice. All prices and returns are endogenously determined by trading on their respective markets.

Log preferences induce linear policy functions.[22] Consumption and assets holdings policy functions can be written as a linear function of the total assets owned by investors:

$$c_{it}^{(I)} = (1-\beta)A_{it} \tag{1}$$

$$q_{Bt}b_{i,t+1}^{(I)} = \beta\phi_{1t}A_{it} \tag{2}$$

$$q_{Mt}m_{i,t+1}^{(I)} = \beta\phi_{2t}A_{it} \tag{3}$$

$$p_{Kt}k_{i,t+1}^{(I)} = \beta(1-\phi_{1t}-\phi_{2t})A_{it} \tag{4}$$

where ϕ_{1t}, ϕ_{2t}, and $(1-\phi_{1t}-\phi_{2t})$ are the portfolio shares of public safe assets, private safe assets, and risky assets, respectively. It is important to stress that such portfolio shares are endogenously determined as a result of risk-reward decisions that investors make in equilibrium. The expressions for ϕ_{1t}, ϕ_{2t} are provided in Equations (5) and (6), and solved for numerically.

Lemma 1. *Investors allocate their savings endogenously to safe, and quasi-safe assets so that the following conditions are satisfied:*

$$1 = \mathbb{E}_t\left[\frac{R_{B,t+1}}{\phi_{1t}R_{B,t+1} + \phi_{2t}R_{M,t+1} + (1-\phi_{1t}-\phi_{2t})R_{i,t+1}}\right] \tag{5}$$

$$1 = \mathbb{E}_t\left[\frac{R_{M,t+1}}{\phi_{1t}R_{B,t+1} + \phi_{2t}R_{M,t+1} + (1-\phi_{1t}-\phi_{2t})R_{i,t+1}}\right] \tag{6}$$

with $R_{i,t+1} = (p_{K,t+1}(1+\epsilon_{i,t+1}) + d_{t+1})/p_{Kt}$.

[21] The existence of safe and quasi-safe assets will make easier to conduct comparable quantitative counterfactual exercises later on.

[22] Log preference with total capital depreciation and aggregation lead to a Brock and Mirman (1972) world with analytically derivable policy functions.

Proof. See Section A.2 in the Appendix.

The following lemma states the assets law of motion for the modeled economy, which – from the perspective of the single investor – effectively looks like a CAPM setting.

Lemma 2. *The model features a two factors structure for investors, where Equation (7) represents the law of motion of assets for each agent:*

$$A_{i,t+1} = \beta A_{it} \left[\phi_{1t} R_{B,t+1} + \phi_{2t} R_{M,t+1} + (1 - \phi_{1t} - \phi_{2t}) R_{i,t+1}\right] \tag{7}$$

with $R_{i,t+1} = (p_{K,t+1}(1 + \epsilon_{i,t+1}) + d_{t+1})/p_{Kt}$.

Proof. See Section A.2 in the Appendix.

Moving on to the model mechanics, it is important to stress the importance of precautionary demand for safe assets by investors. The idiosyncratic and non-insurable shocks on capital create such demand to hedge against risk exposure. None of the investors has informational advantage before shocks get realized, therefore, their ex-ante preferences on portfolio composition are identical. Before the shocks are realized investors are equally attempting to hedge negative shocks regardless of their net worth. In fact, shocks on larger capital stocks generate potentially larger losses in absolute levels, which induce a hedging demand as a result of risk-aversion.[23] Once the idiosyncratic shocks are realized, an ex-post distribution of investors is formed. In equilibrium, the model will feature a baseline degree of inequality where a portion of agents that faced a series of negative shocks will have an arbitrarily small amount of assets while a much smaller fraction of agents that faced a series of positive shocks will hold a large fraction of the economy's assets.

A change in the technological structure of the economy, where α_t increases, induces a larger return on capital (seen as higher dividends) in the hands of the investors. When capital promises higher dividend payoffs, a fraction of investors becomes richer. However, as they get richer and

[23] A similar argument is proposed by Di Tella (2019) to justify regulation of financial intermediaries.

they own a larger amount of assets, they hold also a larger share of the risk in the economy. Therefore, two opposite effects emerge as capital promises higher gains. On the one hand, higher expected returns push investors to tilt their portfolios more towards risky assets, as this could ensure to harvest a greater amount of valuable fruits in the future. In this respect, it follows that the trading activity of shares surges, and p_{Kt} increases to absorb the excess demand. Effectively, there is a stock market boom. On the other hand, higher returns come with higher risks. Risk aversion under incomplete markets gives rise to precautionary motives. As such, investors buy jointly both shares of risky, safe, and quasi-safe assets in order to minimize the potential losses from negative idiosyncratic shocks. This type of market incompleteness leads to increased trading activity also for the safe and quasi-safe assets. Consequently, safe assets prices also rise (higher q_{Bt}, q_{Mt}), and returns get compressed. In this respect, the portfolio tilting towards the risky share gets partially dampened. In equilibrium, the share of risky assets holdings increases as a result of higher expected dividends.

It is also important to notice that the model features a *feedback effect*. As higher capital returns generate higher demand, the price of risky assets p_{Kt} increases. Hence, capital valuations increase, and induce investors to become effectively wealthier, and thus with higher savings to invest back in the system.

— Workers. The fringe of labor-owning households maximizes its intertemporal utility derived from consumption, $c_t^{(W)}$, and chooses an optimal amount of loans to borrow, l_{t+1}. In order to pay for the interest on loans and for consumption, the workers inelastically supply labor, N_t, to the final good firms at the competitive wage, w_t. Labor earnings are assumed to be deterministic, thus workers effectively do not feature either idiosyncratic or aggregate risk. The constrained optimization presented in ($\mathscr{P}_W$) describes the problem faced by workers.

$$\begin{aligned} V_t^{(W)}(l_t) &= \max_{c_t^{(W)}, l_{t+1}} \left\{ u(c_t^{(W)}) + \beta \mathbb{E}_t \left[V_t^{(W)}(l_{t+1}) \right] \right\} \qquad (\mathscr{P}_W) \\ \text{sub} \quad & c_t^{(W)} + l_t + \frac{\lambda}{2} q_{Lt} \left(l_{t+1} - \underline{L}/\lambda \right)^2 + T_t^{(W)} = q_{Lt} l_{t+1} + w_t N_t \end{aligned}$$

The amount of debt that workers can take on is limited by the quadratic costs on the left hand side of the budget constraint. This represents a "soft" borrowing constraint where each additional unit of debt gets more expensive to issue, and can be thought of as the costs that financial intermediaries would impose on workers for greater monitoring. The parameter λ governs the steepness of such borrowing constraint — the larger the value, the steeper the costs, and therefore the more stringent the conditions for workers.[24]

The parameter $\underline{L}$ contributed to the formation of the wedge that allows to obtain an implicit representation of the financial sector.[25] It contributes to the return spread per unit of debt earned by financial intermediaries to transform the debt issued by the workers into quasi-safe assets, m_{it}, held by investors. In this baseline set-up, the earnings per unit of finance are thus assumed to be constant.

Lump-sum taxes, $T_t^{(W)}$, are paid by the workers in order to finance the budget of the Government. Taxes are borne by the workers because a Ricardian equivalence problem would emerge in case rich households were to be taxed in the same fashion.[26] However, quantitatively they play a very marginal role for the overall behavior of the system.

To understand why workers would like to issue debt in the first place, one needs to look at the mechanics of the model. The precautionary demand for quasi-safe assets by the investors leads to a reduction of the real interest rate below the inverse of the effective discount factor (which is the shadow price of debt for the workers under complete markets). As such, it is always advantageous for workers to issue debt and increase consumption at the proposed market rates.

The larger the precautionary demand for (quasi-)safe assets, the more interest rates decrease, and the larger the amount of debt issued by households. However, notice that this mechanism also allows for an increase in the *leverage* of the system. Lower interest rates induce workers households to raise an amount of funds which becomes relatively bigger as a share of

[24]This type of borrowing constraint modeling is isomorphic to a penalty function in the utility function, and sometimes modeled as such in the macro literature.
[25]It is normalized to separate the direct effects of moving $\underline{L}$ with respect to the unit cost λ.
[26]The intuition for this stems from the fact that rich households earn an interest on safe assets, therefore if they were to be taxed by the same amount the two effects would cancel out.

total income as debt gets progressively cheaper.

A soft borrowing constraint produces an upward-sloping supply curve for debt rather than an inelastic vertically-sloped curve generated for the case of a strict threshold. An upward sloping supply curve has the advantage of allowing both prices and quantities of debt to move rather than fixing any of the two.[27]

Government balanced budget constraint. The Government issues debt to be taken on by investors, and balances its budget by imposing a lump-sum tax on the workers every period. However, in each period it is constrained in terms of maximum amount of debt securities and guarantees it can issue.

$$T_t^{(W)} + q_{Bt} b_{t+1} - b_t = 0 \quad \text{sub} \;\; b_t \leq \bar{b}_t \qquad \forall t \tag{$\mathscr{P}_G$}$$

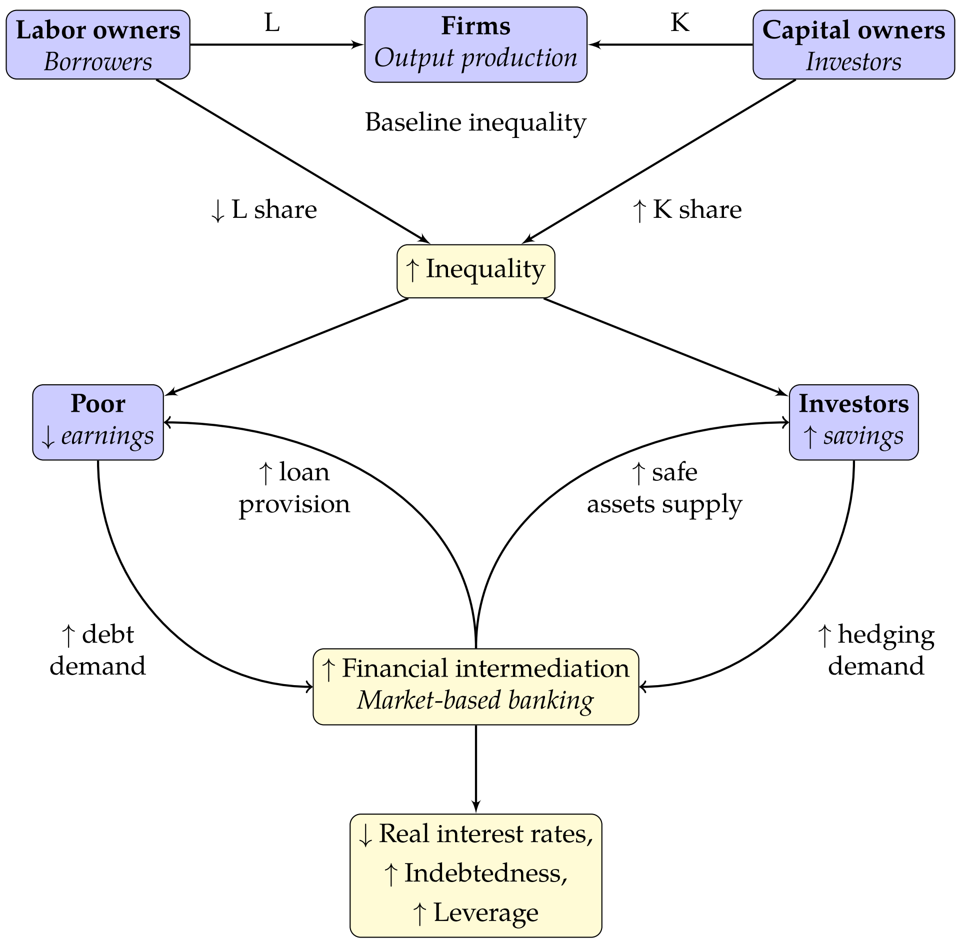
Financial technology. The implicit financial sector transforms the debt of the workers into quasi-safe assets for the investors according to a simple linear technology $l_{t+1} = m_{t+1}\ \forall t$.

Market clearing. In equilibrium, the total number of capital shares has to sum to the normalized size of the capital stock: $\int_i k_{it} \ di = k_t = 1, \ \forall t$. Markets for the shares of capital clear endogenously at price p_{Kt}. The market for safe assets is cleared at price q_{Bt} for the amount provided exogenously $\int_i b_{it} = \bar{b}_t \ \forall t$. The total amount of debt issued by the workers is equalized to the amount of quasi-safe assets invested by the investors, thus $\int_i m_{it} = l_t$, and the market-clearing prices are $q_{Mt} = q_{Lt}, \ \forall t$. The labor force is constant, and labor is inelastically supplied: $N_t = 1$, remunerated at wage $w_t = 1 - \alpha_t$. Capital is rented at price $d_t = \alpha_t$. Final output is valued at price equal to one by construction (the numéraire), and consumed by both households. See Section A.2 in the Appendix for a complete characterization of the competitive equilibrium.

To help visualize the model structure, Figure 5 provides a representation of the model.

[27]Without constraints, the price schedule of debt would be flat, and interest rates would be mechanically independent from the amount of debt in the economy.

Figure 5: Visual representation of the model



Note: Placeholders in yellow stand for the trends the model captures. Placeholders in blue stand for market participants in the economy. Text outside of placeholders helps motivating the driving forces and initial set-up.

4 Model properties and Calibration

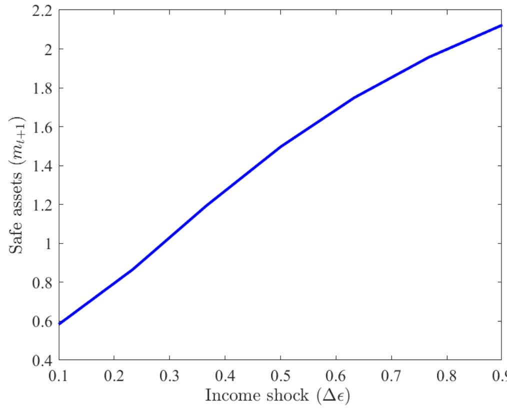
In order to familiarize with the main properties of the model, in this section I show the most important moments relationships through simulations. Subsequently, I delve into the explanation of the actual calibration used to carry out the quantitative analyses in Section 5. Without loss of generality, for the simulation results only — I further simplify the model structure by assuming that the government does not issue any public bonds ($\bar{b} = 0$), and that the private safe assets produced by the financial sector are perfectly safe. All the properties would go through if we were to generalize such conditions, as in the exposition provided in the previous section.

4.1 Model properties

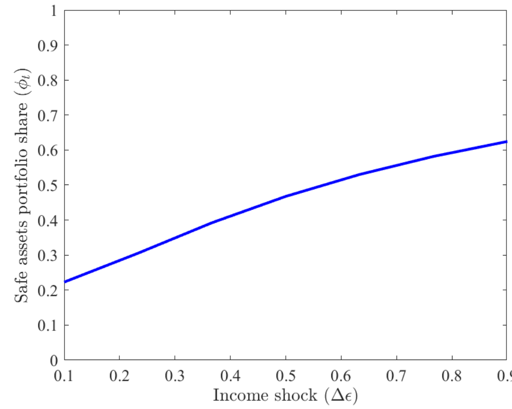
The simulation results are presented in Figure 6. In Panels (a) and (b), I show the effect of changing capital income volatility. In Panel (a), we can see that when capital income becomes more volatile, investors demand more safe assets. This is due to the effect of precautionary motives under incomplete markets, which leads to investors demanding privately produced safe assets to hedge their risks. Panel (b) shows that – when income becomes more volatile – not only the absolute amount of safe assets increases, but also the portfolio share tilts more towards safety (ϕ surges). Given how widely different the shock scenarios considered are, however, the portfolio shares prove to be rather sticky. This is a property that holds generally true regardless of the parametrization.

In Panels (c)-(f), I hold the volatility of the income shocks constant, and I study the effects of a structural change in the technology of the economy – the capital share, α. In Panel (c), I show that the real interest rates fall as a result of higher capital in the hands of the investors. This is due to investors understanding that – when more savings need to be allocated – investing in capital comes with risks, which need to be hedged. The larger the amount of savings, the larger the amount of risk coming from capital holdings (in absolute levels), the larger the demand for safe assets. With a non-perfectly elastic safe assets supply, interest rates fall. The larger the safe assets demand, the stronger the fall in interest rates.

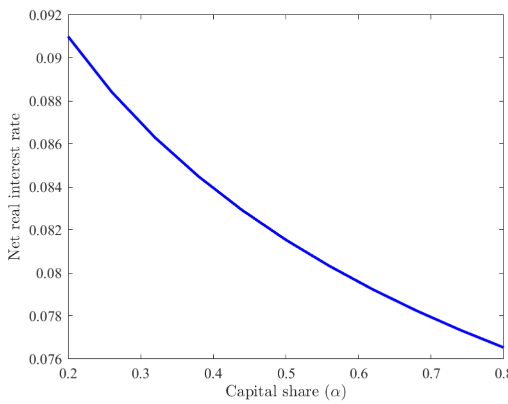
Figure 6: Relevant moments of interest for model properties



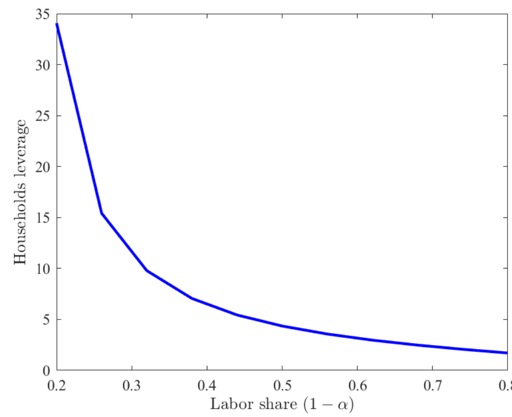
(a) Safe assets production as a function of income volatility



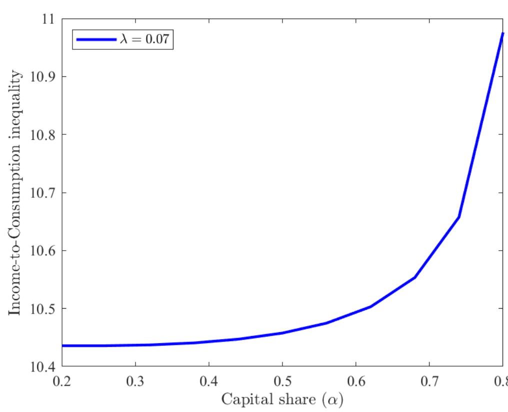
(b) Safe assets portfolio share as a function of income volatility



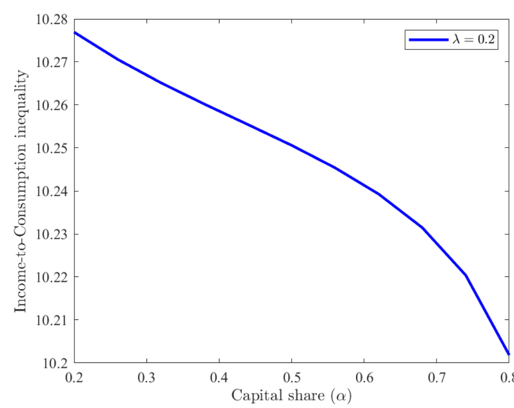
(c) Real interest rates as a function of the capital share



(d) Households indebtedness as a function of the labor share



(e) Income vs. consumption inequality as a function of the capital share with low debt issuance costs



(f) Income vs. consumption inequality as a function of the capital share with high debt issuance costs

Note: For Panels (a)-(d), the model parameters are: $\beta = 0.96$, $\delta = 0.94$, $\lambda = 0.02$, $\underline{L} = 0.01$. For Panels (a) and (b), $\alpha = 0.2$; for Panels (c) and (d), $\Delta\epsilon = 0.4$. Other model parameters would not change the shape of the curves, i.e. the relationships between the variables of interest. For Panels (e) and (f), $\underline{L} = 0.1$ $\Delta\epsilon = 0.4$. All shocks are assumed to be drawn from *iid* uniform distributions $U(1-\Delta\epsilon, 1+\Delta\epsilon)$.

Panel (d) shows the effect of the compression of interest rates on households leverage.[28] The more relative wages decrease for the workers, the more they lever up their positions. In this case, the quantitative magnitudes depend quite strongly on the parametrization but not the qualitative behavior. When earnings for workers are higher, they decrease their leverage.

In Panel (e) and (f), I explore a feature of the model that it is not the main focus of the paper but represents a conundrum in the literature: The relationship between income and consumption inequality between capital-owners (in aggregate), and labor-owners. The literature has had some hard times to explain why consumption inequality has decreased so much less that income inequality.[29] The panels aforementioned suggest that this could be the result of the costs of issuing debt. When debt is particularly cheap to issue (low λ) income inequality increases faster than consumption inequality. In other words, the costs of serving one's debt falls faster than the decrease in income, and this allows the workers to sustain higher levels of consumption through debt. Conversely, when financial intermediaries charge high costs to issue extra units of credit, the relationship becomes negative. In this case, income falls more rapidly, and workers can afford progressively smaller consumption sets. This feature speaks to idea that there can be bright and dark sides of financial innovation – as higher consumption bundles can be attained at the costs of increased fragility (Beck, Chen, Lin, and Song, 2016) – when the distribution becomes more unequal (Kumhof et al., 2015). I move now to the calibration exercises needed to bring the model to the data.

4.2 Calibration

The model performance is tested by looking at its predictions across steady states. More specifically, for the baseline model I first target the level of inequality, financial intermediation as a

[28]Households leverage is computed as the amount of debt issued, $q_{Mt}m_{t+1}$, divided by the net disposable income after paying the interests on debt, $w_t - (R_{Mt} - 1)m_{t+1}$. I plotted it against the labor share, rather than the capital share, because the labor share represents workers' wages, and it makes the figure more intuitive.

[29]Income-to-consumption inequality is computed as: $A/(w - (R_{Mt} - 1)m_{t+1})$ divided by $c^{(I)}/c^{(W)}$. The first term is the ratio between investors' income and workers income net of debt costs. See Meyer and Sullivan (2022) for a key study on consumption inequality.

Table 1: Calibrated parameters

Calibrated parameters	*Value*	*Source*
Capital share, 1970-1979 (α_1)	0.373	Bureau of Labor Statistics
Capital share, 2010-2019 (α_2)	0.435	Internal calibration
Idiosyncratic variance (σ_ϵ)	0.605	CRSP
Safe assets to GDP, 1970-1979 ($q_B b_1/y$)	0.638	Flow of Funds, BEA
Safe assets to GDP, 2010-2019 ($q_B b_2/y$)	0.654	Flow of Funds, BEA
Debt issuance variable cost (λ)	0.022	Internal calibration
Debt issuance fixed cost ($\underline{L}$)	-0.0320	Internal calibration
Discount factor ($\tilde{\beta}$)	0.9407	Internal calibration
Survival rate (δ)	0.9747	Internal calibration
Quasi-safe asset max. loss (χ_M)	0.050	Internal calibration

share of GDP, and real interest rates over the period 1970-1979 consistent with the capital share that I see in the data. This is taken as a first steady state. Subsequently, I introduce a structural change in α_t (the model reduced-form parameter leading to higher capital share) consistently with the estimates from the Bureau of Labor Statistics. Even though the theoretical approach is more interested in the effects of inequality (overall, regardless of the source) on the rise of finance, I follow a conservative approach that generates only a fraction of the overall inequality seen in the data in order to understand how far the current micro-foundations can bring the model performance, and unveil a new macro-finance relationship.

More specifically, the performance of the model is assessed by looking at how well other dimensions of interest can be predicted, namely the financial sector and the real interest rates. A few further moments endogenously generated by the model are provided such as the share of risky assets, and the price level of capital.

The model features some parameters externally calibrated in the data, and a few free parameters internally calibrated to match the moments of interest. See Table 1. The capital share is computed as $1 - \ell_t$, where ℓ_t is the non-farm business sector labor income share shown in Figure 4. The construction of idiosyncratic volatility (σ_ϵ) is based on daily returns available on CRSP; it follows the asset pricing literature on the matter (see Fu, 2009), and it is explained in detail in Section A.6 of the appendix. The share of publicly available safe assets $q_{Bt}b_{t+1}/y_t$ is obtained from the U.S. Financial Accounts as the sum of Treasuries, municipal bonds, checking and time deposits held by households as a fraction of nominal output. This amount has been fairly constant over time, and speaks to the evidence shown in in Figure 2.[30] The discount factor $\tilde{\beta}$ is taken to be as close as possible to the inverse of the net average real interest rate across the two periods of the AAA corporate bonds;[31] δ, is chosen to perfectly match the initial inequality moment.[32]

The other parameters left are internally calibrated to obtain the desired initial conditions for financial intermediation and interest rate. In this respect, one needs to calibrate the debt issuance variable cost for workers (λ), the debt issuance fixed cost ($\underline{L}$), and the maximum gains or loss on the quasi-safe assets, χ_M. The initial steady state is solved by using the aforementioned policy function conditions (Equations (1)-(4) in the previous section), the endogenous portfolio shares in Equations (5) and (6), the budget constraint and the Euler equation of the workers emerging from ($\mathscr{P}_W$), the government budget constraint, and the market clearing conditions.

Given aggregation, the equilibrium values of $\{\phi_1^*, \phi_2^*, p^*, m^*, b^*, k^*\}$ are then used to compute the income distribution according to the law of motion in Equation (7). If the chosen values of the parameters do not allow to match the initial level of inequality, they need to be fine-tuned until inequality, and the two other moments are matched. The model predicts a small fraction of the population to have negative asset values, in this respect, I use to the estimates from the Survey of Consumer Finances.

As part of the baseline quantitative exercise, I keep all parameters fixed except the one used to generate inequality, α, in order to assess the behavior of the system under the new (higher) inequality steady state.

[30] I am implicitly assuming that the majority of bank deposits are safe because Government-guaranteed through tax-payers revenues. Figure A.3 of the Appendix helps showing that the increase in safe assets production has not followed the public nor the traditional banking sector.

[31] Given that the Treasury securities price *level* is affected by foreign demand, I choose the yield of the next best substitute to mimic the behavior of quasi-safe assets real interest rate over time. Overall the two series correlate at over 98 per cent for the 1970-2019 period.

[32] This decision follows the extreme parsimonious nature of the model.

5 Quantitative results and policy experiments

Quantitative analyses based on the calibration provided above are carried out to test the model performance: I call this the baseline scenario. A set of counterfactuals is then provided to assess the behavior of the system under different policy regimes.

5.1 Baseline scenario

Table 2 presents the results for the quantitative exercise conducted comparing the 1970-1979 period to the following one spanning over 2010-2019, as a result of the structural change in the technology parameter, α. The model correctly predicts all the directions of the moments of interest: Higher inequality, higher financial intermediation as a share of output, lower real interest rates, and a rather stable portfolio composition.[33]

The increase in capital share is able to deliver 13 per cent of the increase in inequality seen in the data. As a result, also all the other moments of interest increase much less than necessary. The rise of financial intermediation responds by explaining 14.7 per cent of the increase seen in the data; while the real interest rates decrease from 3.5 to 3.2 per cent (22 per cent of the variation). In this respect, it is more than plausible that other macroeconomic factors are at play to exacerbate the safe asset shortage and the reduction in interest rates.

A quick note on the risky asset portfolio share is in order. This appears to be surprisingly in line with the one in the data. Given that this is not a moment the model tries neither to target nor to predict, it is remarkable that the share of risky assets is not too far away from the one measured in the data — 0.686 vs. 0.652 for the first period, and 0.703 vs. 0.654, for the second. Such share is thought to be rather constant over time, albeit with changes in the contributions of its components. Although the model does not allow for such share to be constant when risky assets promise higher returns (as in this case), it is still worth mentioning that numbers seem to be close to the real ones.

[33] A perfect stability in the portfolio composition share – as seen in the data – is impossible to attain in the current model by construction.

Table 2: Quantitative results for the baseline model

	1970-79		2010-2019	
Targeted moment	Model	Data	Model	Data
Capital share	0.373	0.373	0.435	0.435
Non-Targeted moments	Model	Data	Model	Data
Top 5% wealth share	0.509	0.509	0.520	0.593
Financial intermediation ($q_{Mt}m_{t+1}/y_t$)	0.832	0.832	0.955	1.664
Real interest rate (R_{ft})†	0.035	0.035	0.032	0.023
Risky assets share ($1-\phi_1-\phi_2$)	0.686	0.652	0.703	0.654

Notes: † Results refer to the period 1970-1991 in order to allow the real interest rates process to stabilize to pre-Volcker shocks.

5.2 Dividends taxes

As a first counterfactual experiment, I allow the government to tax also investors on their dividends gains with a proportional tax, τ_t. In this first scenario, I do not allow the government to issue more public bonds as a result of higher taxation but, rather, to effectively redistribute its revenues to workers – which now will endogenously receive a negative tax (a subsidy), $T^{(W)}$. The modified budget constraint of the investors' problem ($\mathscr{P}_I$) can be re-written as in Equation (8):

$$c_{it}^{(I)} + p_{Kt}k_{i,t+1} + q_{Bt}b_{i,t+1} + q_{Mt}m_{i,t+1} = \left[(p_{Kt}(1+\epsilon_{it}) + d_t(1-\tau_t))\right]k_{it} + b_{it} + (1+\zeta_t)m_{it} \tag{8}$$

while the modified Government budget constraint is represented as follows:

$$T_t^{(W)} + \tau_t d_t - b_t + q_{Bt}b_{t+1} = 0 \qquad \text{sub} \quad b_t \leq \bar{b} \tag{9}$$

The first column of the counterfactuals in Table 3 shows the results of such policy for a tax of 10 percent on the dividends gains after the change in α has occurred. As can be seen, the share of income held by the top 5 per cent increases up to 0.513 rather than 0.520. In other

Table 3: Counterfactual results

	Baseline		Counterfactuals	
Moments	1970-79	2010-19	$\tau = 0.10$	$\bar{b} = 1.464$
Top 5% wealth share	0.509	0.520	0.513	0.433
Financial intermediation ($q_{Mt}m_{t+1}/y_t$)	0.832	0.955	0.871	0.477
Real interest rate (R_{ft})	0.035	0.032	0.034	0.044
Risky assets share ($1 - \phi_1 - \phi_2$)	0.686	0.703	0.691	0.631

words, inequality would have increased by 60 per cent less than in the baseline scenario. This is not entirely surprising given that the rise in the dividends itself is not particularly strong for the case analyzed. If anything, as evident for larger shocks, it speaks to the fact that the effect of subsidies in this model is not very strong because most of the action happens on the investors side. As a consequence of a smaller increase in inequality the financial sector would have increased up to 0.871 times national output rather than 0.955 seen before. Interest rates would have been almost completely untouched by such shift going from 3.5 to 3.4 per cent. The portfolio share in risky assets would have been overall similar as a result of still substantial gains (0.691 in the counterfactual vis-à-vis 0.703 found before).

Overall, the lower dividend gains produce an expected decrease in inequality (by construction), and a reduction in the amount of loanable funds which decrease the surge of finance, and put a lower pressure on real interest rates.

5.3 Unconstrained public safe assets supply

As a follow up exercise, I maintain a dividend tax of $\tau = 0.10$, but I allow the government to issue as much debt as demanded by the investors in the form of public safe assets. To help comparing the results with the 2010-19 baseline scenario, I fix the lump-sum taxes that were imposed on the workers in the baseline scenario, $\overline{T}^{(W)}$. Thus, the new Government budget constraint can be represented as: $\overline{T}^{(W)} + \tau_t d_t + q_{Bt} b_{i,t+1} - b_{it} = 0$. Results are provided in the last column on the right of Table 3.

The first key insight is that — when allowing the government to issue debt at will —, the supply expands dramatically: from 0.638 to 1.464 times the national output.[34] By construction, such a large increase in quantities is possible because of a flattening of the (previously rigid) supply of public bonds. As a result, the model now predicts an actual increase in real interest rates with respect to the initial steady state: 4.4 per cent rather than 3.5. However, what is more interesting is that such an expansion of public safe assets massively reduces the level of inequality allowing it to decrease from 0.520 to 0.433. This stark result is the by-product of safe assets becoming more attractive (because of higher interest rates paid on debt), which reduces the "search for yield" for investors – as reflected in a lower portfolio share of risky assets. In other words, if the real interest rates do not change much, then the incentive to move away from them is severely dampened. If that is the case, the feedback effect prevents investors to becomes wealthier as a result of higher asset prices valuations. Investors do not tilt their portfolios towards risky assets as before, and this does not induce capital to appreciate in value.

The financial sector decreases as a result of fewer loanable funds to be privately intermediated: from 0.955 to 0.477 times the national output. This happens because funds are now being diverted towards public bonds — and it is consistent with literature on crowding-out of public vs. private safe assets (Krishnamurthy and Vissing-Jorgensen, 2015).

An important note of *caution* should be used when interpreting these results. The model does not speak to the importance of removing all fiscal discipline, thereby satisfying investors demands. Rather, it speaks to the feedback effects of the "reach for yield" and the large opportunity costs of holding safe assets when money yields are exceptionally compressed.[35]

[34] In this case, the *ceteris paribus* assumption is crucial. I am allowing for all the extra supply to be taken up by the U.S. households rather than by foreigners.

[35] See Acharya and Dogra (2022) on the welfare effects of increasing the public safe assets amount in a context where investments are allowed and monetary policy is constrained by the zero lower bound.

6 Empirical analyses

In the empirical section, I study the predictions of the theoretical framework in two different ways. In Section 6.1, I investigate the extent to which finance and inequality have been intertwined in the United States over the very long run by using data for the longest time span available for this type of exercise, i.e., from 1913 to 2019. In this respect, I use the novel econometric techniques of "co-variability" proposed by Müller and Watson (2018).

Subsequently, Section 6.2 tests the model mechanism itself behind the rise of finance. The model implies the rise of finance happened through market-based banking mechanisms, not traditional banking instruments. Given that banking structures can be very different across countries, I lever on the identifying mechanism technique proposed by Rancière, Tornell, and Westermann (2008) to test whether the industrial organization of banking plays a crucial role to generate an expansion of credit. Results are consistent with this interpretation in terms of feedback effects.

6.1 The long-run co-variability of inequality and finance

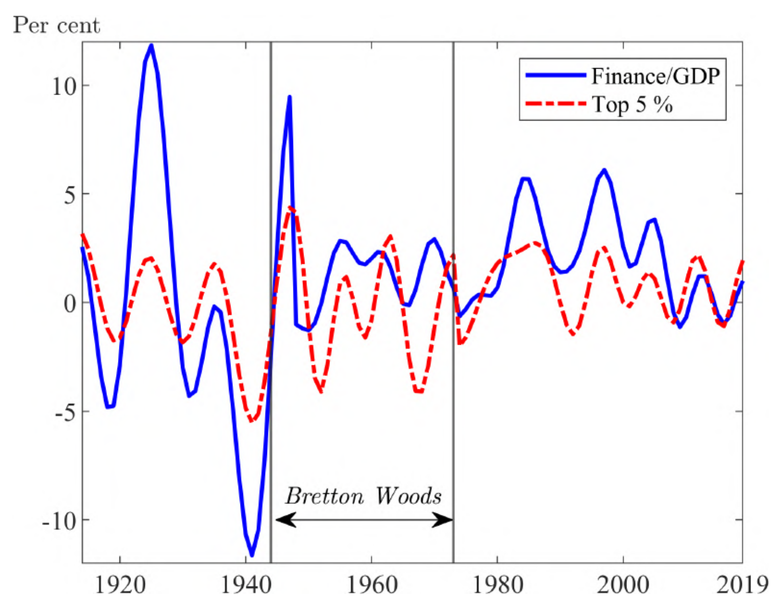
In the current subsection, I investigate the extent to which the inequality and financial series have proportionally co-moved over the long-run. As noted by Chudik, Pesaran, and Smith (2023), over the very long-run, major events such as wars, pandemics, or other regime-shifting episodes may induce problems when estimating the long-run coefficients across time series even when the series are co-integrated. To this extent, having a clear understanding about the nature of the historical process connected to Bretton Woods (seen as a double regime shift), I tranche the over hundred years period of data in three sub-periods. The long-run co-variability analysis of Müller and Watson (2018) is applied for the sample periods: 1913-1943, 1947-1972, and 1973-2019, separately.[36]

[36]The data between 1880-1913 cannot be utilized here because they rely on linear interpolations at decade level, which would spuriously affect the results. The second period starts from 1947 to use internally-consistent data from the Federal Reserve Financial Accounts, which extends to today, rather than the one by Philippon (2015), which stops in 2010. The latter series is used only for the first sample of the analysis as it represents the best

Given an integrated process $z_t \sim I(d)$, where d is the degree of integration, Müller and Watson's approach allow for any degree of integration such that $d \in (-0.5, 1.5)$. To tie my hands in the most conservative way, I take the inequality process and the financial assets as a share of GDP in rates of change — *de facto* imposing the processes to be stationary and $I(0)$. In this way, I study the extent to which a given per cent increase in inequality is linked to a given per cent of the financial sector over time.

The exponential smoothing filter to isolate the long-run variation from cycles is chosen to be 7-years in the post-WWII world, while a longer 11-years cyclicality is used to account for the Great Depression event in the first part of the sample. In this case, the choice is consistent with the choice of the authors in their paper. The long-run projections are presented in Figure 7.[37]

Figure 7: Long Run Projections



It seems rather evident that the timing of the cycles in the pre-/post-Bretton Woods world is identical with the one of the financial sector, although the latter reacts more than proportionally to the former in the pre-Bretton Woods era. A result that is clearly driven also from the credit boom effect before 1929, and the subsequent dramatic collapse. Yet, even accounting for such

historical quantification going back in time.

[37] For matters of the picture purpose only, the initial period is extended to 1946 using Philippon (2015) data. Results would be extremely similar by removing the last three years, and leaving a discontinuity between 1944-1946.

Table 4: Long-run co-variability results over the three relevant sub-periods

	1913-1943		
	ρ	$\hat{\beta}$	$\sigma_{y\|x}$
Point estimate	0.643	1.487	0.053
67% Conf. Interval	(0.343, 0.841)	(0.833, 2.141)	(0.039, 0.078)
90% Conf. Interval	(0.011, 0.950)	(0.258, 2.736)	(0.033, 0.118)
67% Bayes Set	(0.343, 0.841)	(0.833, 2.141)	(0.039, 0.078)
90% Bayes Set	(0.011, 0.916)	(0.313, 2.736)	(0.033, 0.108)
	1947-1973		
	ρ	$\hat{\beta}$	$\sigma_{y\|x}$
Point estimate	0.022	0.048	0.016
67% Conf. Interval	(-0.282, 0.380)	(-0.215, 0.312)	(0.012, 0.023)
90% Conf. Interval	(-0.474, 0.589)	(-0.451, 0.537)	(0.010, 0.030)
67% Bayes Set	(-0.282, 0.380)	(-0.215, 0.312)	(0.012, 0.023)
90% Bayes Set	(-0.474, 0.589)	(-0.432, 0.537)	(0.010, 0.030)
	1974-2019		
	ρ	$\hat{\beta}$	$\sigma_{y\|x}$
Point estimate	0.568	0.963	0.018
67% Conf. Interval	(0.379, 0.734)	(0.601, 1.328)	(0.014, 0.023)
90% Conf. Interval	(0.144, 0.824)	(0.330, 1.967)	(0.012, 0.028)
67% Bayes Set	(0.379, 0.734)	(0.601, 1.328)	(0.014, 0.023)
90% Bayes Set	(0.144, 0.824)	(0.330, 1.640)	(0.012, 0.028)

Note: ρ refers to long run correlation coefficient, $\hat{\beta}$ refers to the long run regression coefficient of finance responding to changes in inequality, and $\sigma_{y|x}$ is the related standard errors of the regressions.

spectacular rise and fall of finance, the two similarly co-move. The series become much more independent during the financial repression and strong re-distributive period from the 1940s to the early 1970s, before going back to move synchronously in the following period until today.

Table 4 presents the results for the ρ coefficients, referring to the long-run correlation coefficients, and the $\hat{\beta}$ coefficients, referring to the long-run best linear prediction of the long-run projections of finance growth by the long-run projection of inequality growth. The $\sigma_{y|x}$ coefficient refer to the average variance of the prediction error (with y being the finance to GDP ratio, and x the effect of inequality). As evident, for the post Bretton Woods world the relationship is almost perfect: $\hat{\beta} = 0.963$. In other words, the size of the financial sector responded almost 1-to-1 the increase in the top 5 per cent income share. Such coefficient becomes virtually zero, and largely not statistically significant for the 1947-1972 period (as expected), while it suggests an overshooting over the period 1913-1943 ($\hat{\beta} = 1.487$) — probably as a result of the large shock due to the Great Depression.

The long-run correlation coefficients are also high for the periods of *laissez-faire* (0.643 pre-Bretton Woods, and 0.568 post-Bretton Woods), and as strong as the relationship between TFP growth and output growth found in other long-run econometrics works. See Müller and Watson (2018) empirical section itself.

6.2 Testing for the identifying mechanism across advanced economies

The previous subsection provided evidence on the degree of long-run co-variability between inequality and finance. Figure 8 looks at the correlation between loans issued and inequality over the very long run, and suggests that the relationship is there for a host of advanced economies for the period before and after the Bretton Woods regime (1912-1943, 1974-2019), but not during the Bretton Wood era. However, the model provides sharper predictions that can be tested by levering on a panel of countries.

By levering on the MacroHistory database by Jordà, Schularick, and Taylor (2017), I can study whether the impact of inequality on credit holds more in general outside the United States. Inequality has increased in a rather pervasive but not uniform fashion across advanced economies, which ensures enough variation to test the model prediction of higher inequality leading to a larger financial sector.[38] In the recent literature, the demographic element has been mentioned to be a potential important element for the rise of credit. To address this point, I also insert a demographic variable (old-dependency ratio) to keep track of aging.

Furthermore, the model predicts that a feedback effect is at play, but that this holds true

[38] Countries such as Belgium, France, and Spain have experienced almost no increase in inequality over time. Conversely, Denmark, Germany, and Italy went through impressive distributional changes. Other countries have followed yet other patterns – almost proceeding in waves like Austria or the Netherlands.

because of an increase in asset prices valuations. In order for that to be true, contracts need to be continuously priced as in a market-based economy. However, credit systems around the developed world fall into two broad categories: Bank-based – more typical of continental Europe and Japan –, and market-based financial systems – more common in Anglo-Saxon countries.[39] In bank-based economies, the asset pricing valuation effect is much less pronounced as contracts are not traded at market prices, while this tends to be the case by construction in a market-based economy. In order to address this point more concretely, I take advantage of the identifying mechanism approach proposed by Rancière, Tornell, and Westermann (2008), who test the relationship between financial crises and growth by exploiting the interaction of skewness effects typical of financial crises, and politico-economic proxies. I proceed along in a similar spirit by interacting the dependent variables of interest with a dummy variable that accounts for the fact that a country may have a market-based financial system.

In line with the literature on growth equations, I run the regressions provided in Equations (10) and (11) through FGLS estimation (Feasible Generalized Least Squares) allowing for heteroskedastic error structure, and country-specific autocorrelated error structure. More specifically, I run:

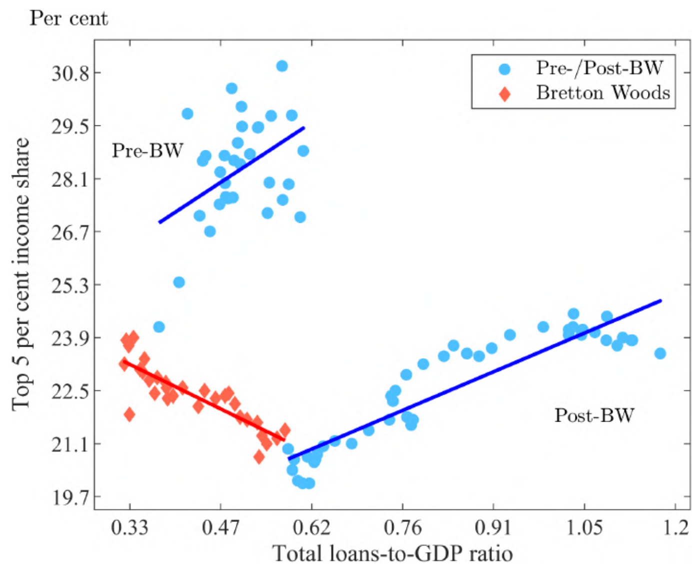
$$\Delta y_{it} = \sum_{s=2}^{5} \beta_s \Delta x_{i,t-s} + \beta_0 + \kappa_t + \gamma' X_{it} + \epsilon_{it}, \tag{10}$$

$$\Delta y_{it} = \sum_{s=2}^{5} \beta_s \Delta x_{i,t-s} + \sum_{s=2}^{5} \beta_s \Delta x_{i,t-s} \mathbb{1}(i \in A) + \beta_0 + \kappa_t + \gamma' X_{it} + \epsilon_{it} \tag{11}$$

where κ_t is the time fixed effects, and X_{it} is the matrix of domestic and international control variables. For the regressions studying the direct effect of inequality on finance, the variables $\{y_{it}, x_{it}\}$, are the growth of lending activity and the top 5 per cent of the income share, respectively; they switch when studying the feedback mechanism. This structure can be effectively thought as a Granger non-causality test in a panel setting. It follows that the dependent variables of interest are not taken contemporaneously to avoid spurious effects. The number of lags

[39]See Levine (2002) for a classic reference on the matter.

Figure 8: Total loans to GDP ratio, and top 5 per cent income share for a panel of 18 advanced economies over the period 1912-2019



Notes: Each dot in the figure represents results for one year. The (x,y)-coordinates are obtained by regressing the variables of interest (inequality and credit) on time-year fixed effects, and country fixed effects. More specifically, I run separately the regression: $y_{it} = c_i + \kappa_t + \epsilon_{it}$, with y_{it} being: first, log of the top 5 per cent income share, and then, the log of total loans to GDP ratios. The figure reports the year fixed effects for the two regressions. Standard errors are robust, clustered at country level. The pre-Bretton Woods period is 1912-1943; the Bretton Woods period is 1944-1973; and the post-Bretton Woods period is 1974-2019. The blue and red lines represent linear best fits over the periods considered. The sample of countries is: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The actual values for loans to GDP and top 5 per cent income inequality corresponding to the specific time-year fixed effects coefficients have been used on the axes to facilitate the understanding of the true levels of the variables. *Sources*: Loans and nominal GDP data are from the the macro-history data base by Jordà, Schularick, and Taylor (2017). The top 5 per cent income share is the pre-tax and transfers measure from the World Inequality database.

is chosen following the suggestion by Hamilton (2018) in order for relatively slow-moving variables to fully manifest their effect, but it is robust to adjacent lag orders. In the latter equation, A is the set of Anglo-Saxon countries in which the market-based finance practices are dominant. Therefore, the dummy variable equals one to accommodate for financial market structure differences. In this case, A includes: Australia, Canada, the United Kingdom, and the United States.[40]

In Table 5.a, it is possible to notice that an increase in inequality is a predictor of a size in

[40] The Financial Development Index by the IMF broadly supports this distinction once one normalizes the measure between 0 and 1.

Table 5.a: Regression results for the effects of inequality on total loans issuance for a host of 18 economies over the period 1974-2019

	Total loans							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 5 income share	0.273**	0.266**	0.247**	0.279**	0.318**	0.266**	0.237**	0.218*
	(0.122)	(0.111)	(0.109)	(0.111)	(0.130)	(0.118)	(0.116)	(0.117)
Top 5 income share ×					-0.267	-0.035	0.034	0.378
Mkt-based dummy					(0.285)	(0.233)	(0.225)	(0.230)
Old dependency ratio	-0.346	-0.387*	-0.419*	-0.454*	-0.350	-0.391*	-0.424*	-0.463**
	(0.287)	(0.235)	(0.226)	(0.233)	(0.269)	(0.118)	(0.247)	(0.225)
Time fixed effect	✓	✓	✓	✓	✓	✓	✓	✓
Domestic controls		✓	✓	✓		✓	✓	✓
Globalization controls			✓	✓			✓	✓
USA excluded				✓				✓
Countries/Obs.	18/654	18/653	18/653	17/608	18/654	18/653	18/653	17/608

Table 5.b: Regression results for the effects of total loans on inequality for a host of 18 economies over the period 1974-2019

	Top 5 income share							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total loans	-0.020	-0.007	-0.011	-0.012	-0.060**	-0.044	-0.052*	-0.043
	(0.027)	(0.027)	(0.027)	(0.028)	(0.030)	(0.029)	(0.029)	(0.031)
Total loans ×					0.132***	0.127***	0.129***	0.120***
Mkt-based dummy					(0.038)	(0.037)	(0.036)	(0.038)
Time fixed effect	✓	✓	✓	✓	✓	✓	✓	✓
Domestic controls		✓	✓	✓		✓	✓	✓
Globalization controls			✓	✓			✓	✓
USA excluded				✓				✓
Countries/Obs.	18/726	18/725	18/725	17/680	18/726	18/725	18/725	17/680

Notes: All variable (controls included) are taken as growth rates. The coefficients shown represent the total effect of the four years lags considered in Equations (10) and (11). Total loans is the overall measure of banking activity retrieved from the MacroHistory database by Jordà, Schularick, and Taylor (2017). The old-dependency ratio is the population aged 65+ as a share of the working age population. The controls are the same in both the upper and lower panels. The domestic controls include: real GDP per capita, real money supply growth, real government expenditures, and real investment to output ratio. The globalization controls are: real trade openness (import+exports), and real total external financial liabilities from the 2022 updated version of Lane and Milesi-Ferretti (2018). The Market-based dummy includes: Australia, Canada, the U.K., and the U.S.. The list of 18 countries is composed by: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the U.K., and the U.S.A.. All the domestic and trade controls are retrieved from Jordà, Schularick, and Taylor (2017). $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$ Numbers in parentheses are FGLS standard errors. *Sources*: See Tables A.6 and A.7 in Section A.6 of the Appendix for details on the variables sources and construction.

banking activities. Such estimates are very robust to a number of different specifications with domestic and international variables used as controls. The elasticity is systematically around 0.25, i.e., an increase of one percent of the top 5 per cent income share generates a 0.25 per cent increase in the amount of credit generated. The coefficients are stable and strong in terms of statistical significance. The demographic factor, on the other hand, is either non-significant, or negative and significant. The estimates hint to an increase in credit activity when economies get younger rather than all the way round. Interestingly, the fact that economies are bank- or market-based does not matter for the direct channel. In other words, when system become more unequal they generate a larger amount of banking activities regardless of the specifics of the intermediation sector when looking at 18 different developed economies over time. The results are consistent with the idea that higher inequality generates an increase in the amount of savings to intermediate by financial intermediaries.

Table 5.b looks at the feedback mechanism – and the identifying mechanism for the feedback effect itself. As predicted in the model, an increase in the credit sector generates higher inequality only if these securities can be continuously priced, and thus appreciate and generate a wealth effect for its owners. The results are in line with such prediction. On average, when pooling all countries together there is no feedback mechanism. In this respect, this is similar to what most literature has found: the causality link from finance to inequality is elusive. See Demirgüç-Kunt and Levine (2009). However, when interacting the credit variable with the dummy capturing the market-based banking structure, results become strongly significant and extremely stable across specifications. A result that corroborates the theoretical prediction, and that may be further tested in the future by the literature.

7 Concluding remarks

In this paper, I bring back to the fore the question about what generated the massive increase in the financial sector intermediation that has occurred in the United States from the early 1980s.

I claim that the growth in size needs to be understood in conjunction with the endogenous rise of the shadow banking sector.

The paper claims that the rise in inequality observed over the same period may be responsible for such increase, and studies such relationship when the production technology of the economy changes. The paper builds the first connection, to my knowledge, between a change in the technological structure and a change in the size and composition of the financial sector. In the theoretical mechanism, a rise in the capital share generates higher inequality that accounts not only for the phenomena aforementioned but also for parallel macro-financial trends: Lower interest rates, higher households indebtedness, and higher leverage in the system. The model features also a feedback effect that goes from higher asset prices valuations to higher inequality.

The stylized facts provide descriptive evidence of such joint behaviors. In this respect, the levels of correlation seem to be particularly high and persistent in the very long run except for periods of structural change such as Bretton Woods.

With that in hand, I build a macro-finance model in which a rise in the share of income and wealth held by the top 5 per cent share of the population generates an increase in the funds to invest and allocate across both risky and safe assets. When safe assets are not abundant, precautionary motives lead to compressed real interest rates. A low interest rate environment decreases the costs of issuing debt, thus, facilitating higher indebtedness of the workers. In this scenario, financial intermediaries can step in to manufacture privately-produced safe assets that the government is not able to supply.

Quantitatively, I study the rise of inequality as resulting merely from a change in the technological structure of the economy, and look at how far the results can go. Through the lenses of the model, the rise of the capital share accounts only for a fraction of the overall rise in inequality (13 per cent), but it is still able to explain more than 15 per cent of the overall growth of finance. The model can explain up to 22 per cent of the decline in real interest rates. A broader set of structural changes in the economy consistent with the full rise of inequality (such as college premium) may lead to much stronger results.

Finally, the empirical section corroborates both the long-run co-variability between inequality and finance in the post-1970s world, and the importance of the market-based mechanisms to induce or dampen the effect of inequality on credit production.

Although the paper is not structured to delve into welfare analyses of the problem at stake, the good news arising from it is that there is room for policy to potentially affect the macroeconomic consequences of banking and its feedback effects.

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Appendix to

Inequality and the Rise of Finance

A domestic perspective

Dario Laudati

November 27, 2023

The Appendix is structured as follows. Section A.1 describes additional stylized facts to complete the picture provided in the main body of the paper. Sections A.2 and A.3 provide model's proofs, a full-fledged characterization of the equilibrium conditions, and the computation strategy description. Section A.4 derives theoretical results for the structural VAR and the impulse response functions. Section A.5 describes additional results. Details on data sources and construction can be found in Section A.6.

A.1 Additional facts

Figure A.1 shows that the share of U.S. Treasuries owned domestically vs. by the rest of the world. The latter component has surged spectacularly from the mid-1990s – when it was below 20 per cent – until the Great Financial Crisis (*GFC*) of 2010, when it reached a peak of over 40 per cent. In more recent times, this has partially reverted to fall back in a range of about 30 per cent.

Figure A.2 shows the time series of the financial sector assets to GDP, and the rise of the capital share accounting for the equity payouts rebated to the workers by using the data by

Eisfeldt, Falato, and Xiaolan (2023).[1] The pattern is very similar even without accounting for the cyclicality of the measure ($\rho = 0.92$).

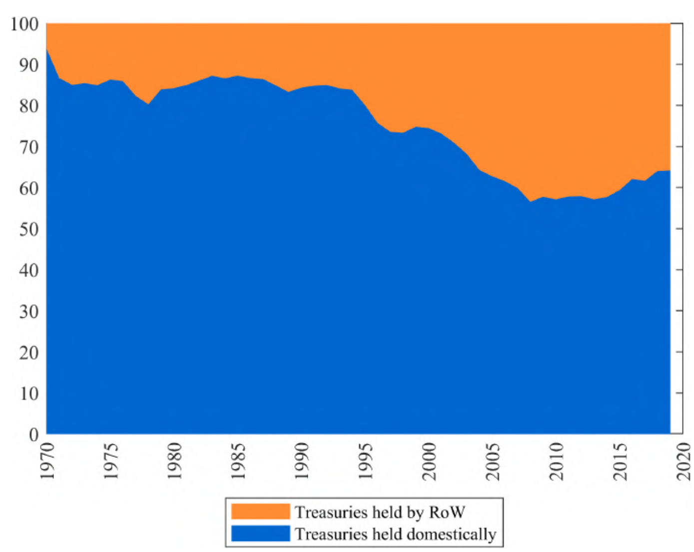
Figure A.3 shows that the increase of market-based banking with respect to the traditional banking system is strictly correlated with the increase of private safe assets production with respect to traditional banking safe assets. The correlation between the two series is 97 per cent.

Figure A.4 plots the increase in inequality vis-à-vis the portfolio share of U.S. households invested with to institutional investors. As inequality increases, the portfolio share directed to asset managers has similarly increased.

Figure A.5 plots the relationship between the top 5 percent income share and the credit to GDP for 18 economies over a period from 1970-2019. The plot is presented for each data point, and presented in a quantile fashion to reduce the visual burden. Each dot represents 5 per cent of observations. The relationship seems to be quite strong across geographies and over time.

Figure A.6 plots the income volatility process using the data by Guvenen, Pistaferri, and Violante (2022). The level is particularly high for the very top quantile of the distribution.

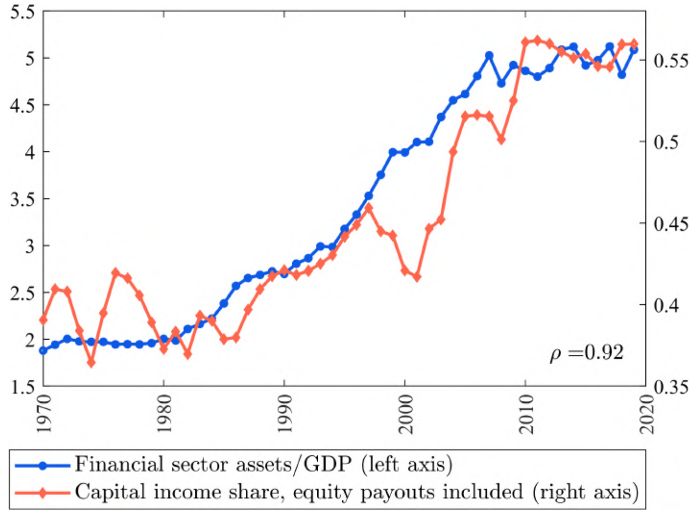
Figure A.1: Share of U.S. Treasuries held domestically vis-à-vis abroad over the period 1970–2019



Notes: See Tables A.6 and A.7 in Section A.6 of the appendix for details on the variables sources and construction.

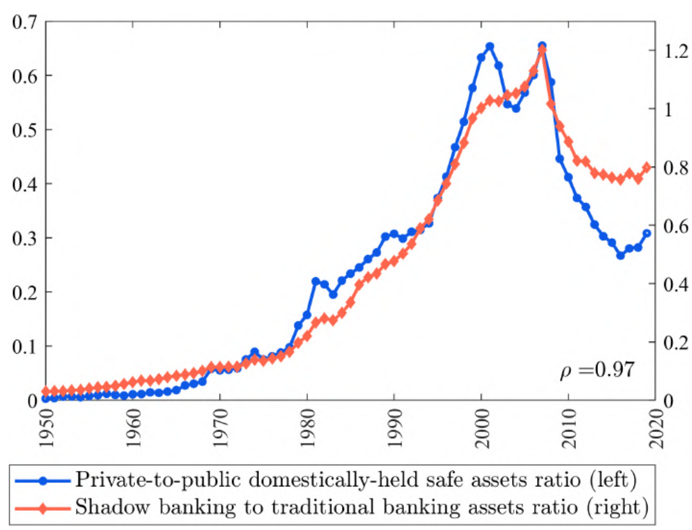
[1] I am grateful to the authors for sharing their data with me.

Figure A.2: Domestic financial sector assets as a share of national output and capital income share accounting for equity payouts to workers in the United States over the period 1970-2019



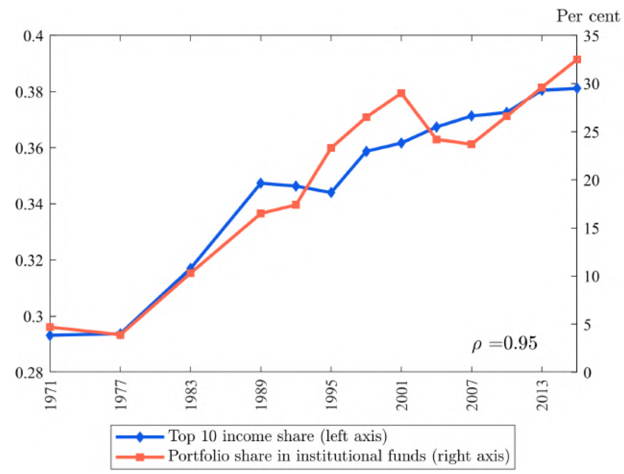
Notes: The capital share accounting for the equity payouts is from Eisfeldt, Falato, and Xiaolan (2023). The top 5 per cent income share is from the World Inequality Database, and considered post tax and transfers.

Figure A.3: Domestically-held private safe assets as a share of domestically-held public safe assets, and shadow banking sector as a share of traditional banking sector in the United States over the period 1950-2019



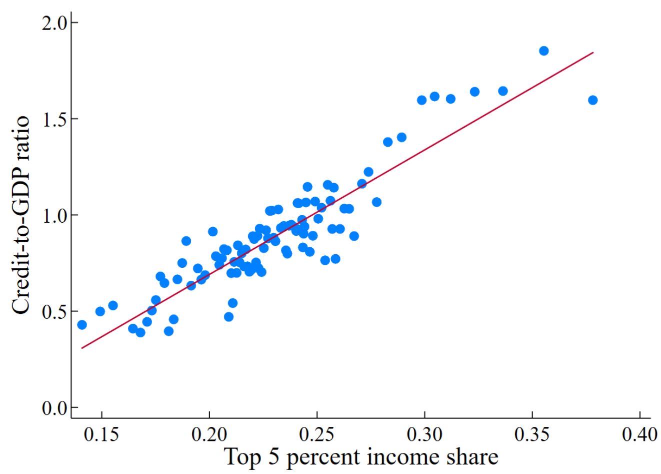
Notes: The private safe assets are composed of: market mutual funds, commercial paper, and RePos. The public safe assets are composed of: Treasuries, checking, and savings and time deposits. Both aggregates refer to domestically held claims. See Tables A.6 and A.7 in Section A.6 of the appendix for details on the variables sources and construction.

Figure A.4: Top 10 percent share of the income distribution and households' portfolio share invested in institutional investors (left), and corresponding domestic safe assets demand (right) in the United States over the period 1971-2019



Notes: Top 10 percent income share refers to the post-tax measure. The portfolio share in institutional funds mimics the one built by Jordà et al. (2019). The safe assets demand is the computed as the sum of the assets of the financial assets bearing money-like characteristics. *Sources*: Data on inequality are retrieved from the World Inequality Database. Data on nominal GDP are downloaded from the Bureau of Economic Analysis. Data on households' portfolio shares are from the extended Survey of Consumer Finances (SCF+). Data on the demand for safe assets are retrieved from the Financial Accounts of the Federal Reserve Board. See Tables A.6 and A.7 in Section A.6 of the Appendix for details on the variables sources and construction.

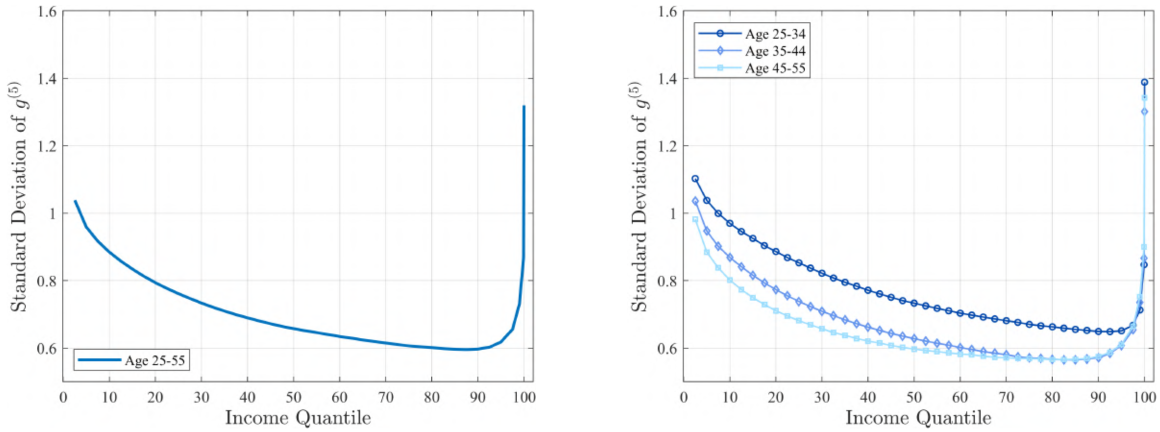
Figure A.5: Quantile plot showing the correlation between top 5 per cent share of the income distribution and credit to GDP (in logs) for 18 economies over the period 1970-2019



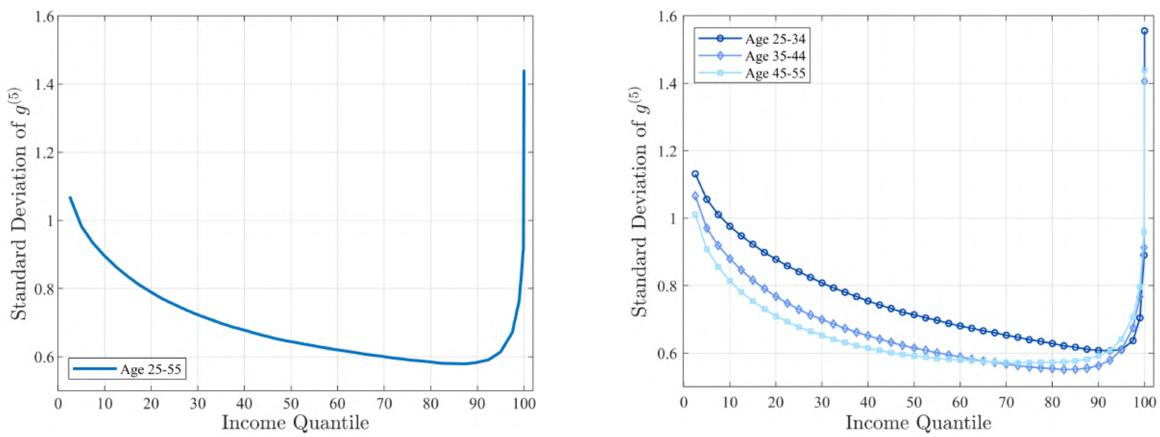
Notes: Each dot represents a bin of one per cent across all the inequality-credit pairs. The line of best fit is constructed as the correlation between all the credit and inequality pairs in the panel. *Sources*: Credit data is obtained from the Bank of International Settlements. See Table A.6 in Section A.6 of the appendix for details on the variables sources.

Figure A.6: Income volatility by income level in the United States across quantiles over the period 1998-2019

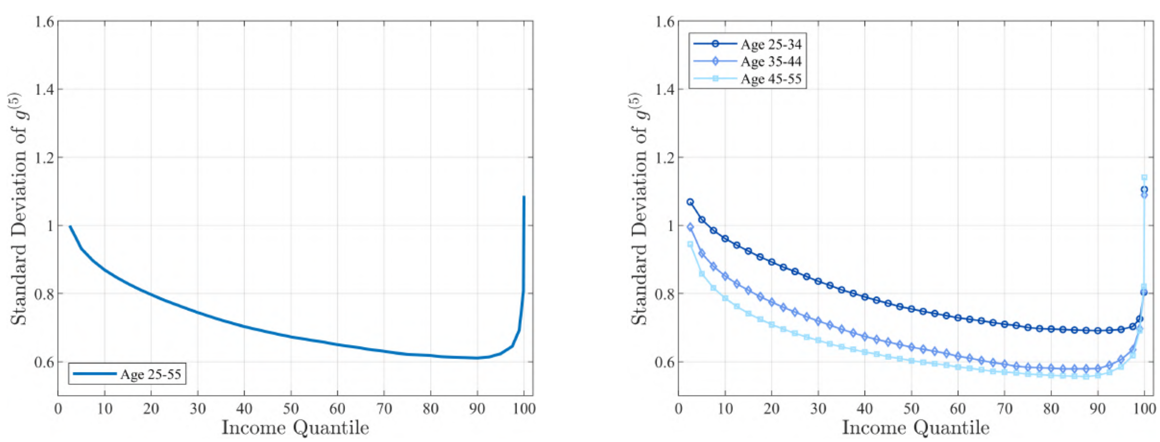
Panel A: Total population across genders



Panel B: Male population



Panel C: Female population



Source: Guvenen et al. (2022). *Notes:* See the cited paper for variables description and construction.

A.2 Model derivations

Equilibrium definition. A sequential market equilibrium for the economy presented in Section 3 of the paper is a set of prices $\{p_{Kt}, q_{Bt}, q_{Mt}, q_{Lt}, d_t, w_t\}_{t=0}^{\infty}$ and quantities $\{c_t^{(I)}, k_t^{(I)}, b_t^{(I)}, m_t^{(I)}, l_t, c_t^{(P)}, \phi_{1t}, \phi_{2t}\}_{t=0}^{\infty}$ such that:

1. Investors maximize their utility and the returns on their portfolio according to Problem ($\mathscr{P}_I$) at the optimal prices.

2. Workers maximize their utility according to Problem ($\mathscr{P}_W$) at the optimal prices.

3. Firms are price-takers and statically maximize their profits from Problem ($\mathscr{P}_F$) given optimal factor prices d_t^*, w_t^*.

4. Price-taker financial intermediaries transform debt into safe assets according to a linear technology $l_t = m_t$, at optimal prices $q_{Lt}^* = q_{Mt}^*$.

5. The Government budget constraint holds with equality in each period at the optimal price q_{Bt}^*, subject to a constraint $\bar{b}$.

6. Markets for goods, risky capital, safe assets, quasi-safe assets, and labor clear.

Optimality conditions. The model features aggregation (Angeletos, 2007), therefore the overall amount of assets for each agent, $A_{it} = (p_{Kt}(1+\epsilon_{it}) + d_t)\, k_{it} + b_{it} + \chi_{it}^M m_{it}$, is a sufficient state variable. Log preferences ensure that consumption is a constant fraction $(1-\beta)$ of income. The overall policy function for savings is therefore βA_{it}, which one can segment according to three different shares — one for each of the financial assets. It follows that investors' policy functions are:

$$c_{it}^{(I)} = (1-\beta)A_{it} \tag{A.1}$$

$$q_{Bt} b_{i,t+1}^{(I)} = \beta \phi_{1t} A_{it} \tag{A.2}$$

$$q_{Mt} m^{(I)}_{i,t+1} = \beta \phi_{2t} A_{it} \tag{A.3}$$

$$p_{Kt} k^{(I)}_{i,t+1} = \beta (1 - \phi_{1t} - \phi_{2t}) A_{it} \tag{A.4}$$

By taking the FOCs of the Problem ($\mathscr{P}_I$) with respect to $c^{(I)}_{it}$ and $b^{(I)}_{i,t+1}$, the Euler Equation of Investors pinning down the marginal decisions between intertemporal consumption and safe bonds can be written as:

$$q_{Bt} = \beta \mathbb{E}_t \left[\frac{c^{(I)}_{it}}{c^{(I)}_{i,t+1}} \right] \tag{A.5}$$

Substitute Equation (A.1) twice in (A.5) and obtain:

$$q_{Bt} = \beta \mathbb{E}_t \left[\frac{\cancel{(1-\beta)} A^{(I)}_{it}}{\cancel{(1-\beta)} A^{(I)}_{i,t+1}} \right]$$

Use the definition of $A^{(I)}_{is} = (p_{Ks}(1+\epsilon_{is}) + d_s) k_{is} + b_{is} + \chi^M_{is} m_{is}$ for $s = t+1$, and plug back in the previous equation.

$$q_{Bt} = \beta \mathbb{E}_t \left[\frac{A^{(I)}_{it}}{(p_{K,t+1}(1+\epsilon_{i,t+1}) + d_{t+1}) k_{i,t+1} + b_{i,t+1} + \chi^M_{i,t+1} m_{i,t+1}} \right] \tag{A.6}$$

Substitute the policy functions analytic forms in (A.2), (A.3), (A.4) and Equation (A.6) to obtain:

$$\begin{aligned} q_{Bt} &= \cancel{\beta} \mathbb{E}_t \left[\frac{\cancel{A_{it}}}{(p_{K,t+1}(1+\epsilon_{i,t+1}) + d_{t+1}) \cancel{\beta A_{it}} \frac{(1-\phi_{1t}-\phi_{2t})}{p_{Kt}} + \cancel{\beta A_{it}} \frac{\phi_{1t}}{q_{Bt}} + \cancel{\beta A_{it}} \frac{\phi_{2t}}{q_{Mt}} \chi^M_{i,t+1}} \right] \\ q_{Bt} &= \mathbb{E}_t \left[\frac{1}{\phi_{1t} R_{Bt} + \phi_{2t} R_{Mt} + (1-\phi_{1t}-\phi_{2t}) R_{t+1}} \right] \\ 1 &= \mathbb{E}_t \left[\frac{R_{Bt}}{\phi_{1t} R_{Bt} + \phi_{2t} R_{Mt} + (1-\phi_{1t}-\phi_{2t}) R_{t+1}} \right] \end{aligned} \tag{A.7}$$

where $R_{Bt} = 1/q_{Bt},\ R_{Mt} = \chi^M_{it}/q_{Bt}$, and $R_{t+1} = [p_{K,t+1}(1+\epsilon_{i,t+1}) + d_{t+1}]/p_{Kt}$.

Similarly, by taking the FOCs with respect to consumption and quasi-safe assets ($m_{i,t+1}$), it is possible to write the implicit optimal condition for ϕ_{2t}:

$$1 \quad = \quad \mathbb{E}_t \left[\frac{R_{Mt}}{\phi_{1t} R_{Bt} + \phi_{2t} R_{Mt} + (1 - \phi_{1t} - \phi_{2t}) R_{t+1}} \right] \tag{A.8}$$

□

The optimal condition for the workers is:

$$q_{Lt} = \beta \frac{u'(c_{t+1}^{(W)})}{u'(c_t^{(W)})} (1 - \underline{L} + \lambda l_{t+1}) \tag{A.9}$$

Market Clearing Conditions.

$$b_{t+1} = \bar{b} \quad \forall t \tag{A.10}$$

$$l_{t+1} = m_{t+1} \iff q_{Mt} = q_{Lt} \quad \forall t \tag{A.11}$$

$$k_{t+1} = 1 \quad \forall t \tag{A.12}$$

$$L_t = 1 \quad \forall t \tag{A.13}$$

The price of consumption is taken as numéraire.

Proof of Lemma 2.

The law of motion for the assets distribution follows from the definition of assets for the economy:

$$A_{it} \triangleq (p_t(1 + \epsilon_{it}) + d_t) k_{it} + b_{it} + + \chi_{it}^M m_{it} \qquad \forall t$$
$$\Rightarrow A_{i,t+1} = (p_{t+1}(1 + \epsilon_{i,t+1}) + d_{t+1}) \, k_{i,t+1} + b_{i,t+1} + \chi_{i,t+1}^M m_{i,t+1}$$

By re-arranging and plugging the policy functions into the previous equation, we can re-write it as:

$$
\begin{aligned}
A_{i,t+1} &= (p_{K,t+1}(1+\epsilon_{i,t+1}) + d_{t+1})\frac{\beta A_{it}(1-\phi_{1t}-\phi_{2t})}{p_{Kt}} + \frac{1}{q_{Bt}}\phi_{1t}\beta A_{it} + \frac{\chi^M_{i,t+1}}{q_{Mt}}\phi_{2t}\beta A_{it} \\
&= \beta A_{it}\left[(1-\phi_{1t}-\phi_{2t})R_{i,t+1} + \phi_{1t}R^B_{t+1} + \phi_{2t}R^M_{i,t+1}\right] \qquad \text{(A.14)}
\end{aligned}
$$

□

A.3 Numerical solution

The model features “aggregation”, therefore the income distribution is not a relevant variable to pin down the equilibrium prices and quantities. I can proceed then to solve numerically in two parts. First, I compute the steady state abstracting from the income distribution of agents. In this case, I solve a system of non-linear equations around the steady state. The system is composed by the policy functions (A.1)-(A.4), the optimal conditions for portfolio shares (A.7) and (A.8), the Euler equation (A.9) and the budget constraint for the workers problem, and the market clearing conditions (A.10)-(A.12), which can be solved for $\{c^{(P)}_t, \phi_{1t}, \phi_{2t}, p_{Kt}, k_{t+1}, q_{Mt}, m_{t+1}, q_{Bt}, b_{t+1}, q_{Lt}, l_{t+1}\}$.

With that in hand, I use the steady state values for $\{p^*_{Kt}, q^*_{Mt}, q^*_{Bt}, \phi^*_{1t}, \phi^*_{2t}\}$, and plug them in the law of motion in Equation (A.14) to solve for the ergodic income distribution.[2] The algorithm to find the distribution proceeds according to the following steps:

- Guess an initial asset distribution, $\widetilde{M}_t$, over a grid, $\tilde{A}_t$, with an arbitrarily small bin size, $\tilde{\mu}$.

  Let the grid lower bound be a scalar $\underline{A} > 0$ arbitrarily close to zero for all t. Choose an upper bound for the grid $\bar{A}_t$ large enough to include at least the true total income of the economy, A^*, computed before.

  Let $\tilde{m}_t$ be the initial distribution mass for a bin located on the grid point $\tilde{a}_{mt} \in \tilde{A}_t$ such that $\sum_{\tilde{m}=1}^{\overline{M}_t} \tilde{m}_t = 1\ \forall t$.

[2]Such procedure is isomorphic, yet computationally faster, than the contemporaneous solution for the distribution and the steady state variables.

- Let every bin, $\tilde{m}_t$, be hit by idiosyncratic shocks, $\epsilon_{i,t+1},\ i \in \{1, 2, \dots I\}$. Compute the new asset values $\tilde{a}_{i,m,t+1}$ for each $\tilde{m}_t$ (originally located in position $\tilde{a}_{i,m,t}$) using the assets law of motion in (A.14).

- Allocate each shock realization on the new grid $\tilde{A}_{t+1}$. To do so, assume $\epsilon \sim U[\underline{\epsilon}, \bar{\epsilon}]$, then each shock realization will carry a weight $1/I$ to be multiplied by the original probability mass, $\tilde{m}_t$, associated with each grid point, $\tilde{a}_{mt}$. In other words, each shock realization moves a mass m_t/I.

  - If $\tilde{a}_{i,m',t+1} < \underline{A}$, then allocate all of the distribution weight carried by the realization, m_t/I, to the first point on the grid, $\underline{A}$.
  - If $\underline{A} < \tilde{a}_{i,m',t+1} < \bar{A}_t$, then allocate a part, ω, of the weight, m_t/I, to the grid point $\tilde{a}_{m',t+1}$ and $(1-\omega)$ to $\tilde{a}_{m'+1,t+1}$ according the their distance from the grid points $\omega = 1 - (\tilde{a}_{i,m',t+1} - \tilde{a}_{m',t+1})/\mu$. In this way, each original weight is split according to the linear distance between the two most adjacent grid points.[3]
  - If $\tilde{a}_{i,m',t+1} > \bar{A}_t$, then add new grid points to the previous grid, $\tilde{A}_t$ to form a new grid $\tilde{A}_{t+1}$. The number of new points to add depends on how far away the top realizations fall with respect to $\bar{A}_t$: $(\tilde{a}_{i,m',t+1} - \bar{A}_t)/\mu$ gives the number of grid points to add. Compute the specific weights ω for each bin between the new adjacent grid points according to the procedure illustrated above.

- Sum all probability masses, $m_{i,t+1}$, for each new grid point, $a_{m,t+1}$ on the new grid $\tilde{A}_{t+1}$ to achieve a new distribution $\widetilde{M}_{t+1}$.

- Remove a fraction $(1-\delta)$ from each bin to account for the survival rate δ.

- Re-allocate the fraction of population $(1-\delta)$ to the individuals with average value on the grid to ensure that no income destruction occurs.

[3] To be sure, the "point of departure" on the initial grid $\tilde{a}_{m,t}$ is not necessarily the same as the "point of arrival" in the new grid $\tilde{a}_{m',t+1}$.

- If the average income value falls between two grid points, allocate them with a weight that is proportional to the distance to their closest point — as explained above.

- Check if the new and the old distribution coincide up to an arbitrarily small scalar: $\widetilde{M}_t \approx \widetilde{M}_{t+1}$.
  - If not, impose $\widetilde{M}_t = \widetilde{M}_{t+1}$, and start the loop over.
  - Else, convergence has been reached. The sought-after stationary distribution has been found.

- Make sure that the total level of income for the economy corresponds to the true value: $\widetilde{M} * \tilde{A} = A^*$. If not, change the initial distribution guess $\tilde{A}_t$, and start over.

- Repeat by refining the grid to make sure the result is robust.

In other words, to find the stationary distribution I guess an initial distribution for the equilibrium values, and I subsequently operate an asymmetric grid expansion (for the right tail) until equilibrium is found. The grid expansion is asymmetric because – on the one hand – Inada conditions prevent agents from consuming negative amounts; therefore, even agents with a complete streak of negative shock realizations will be able to obtain a strictly positive asset level albeit arbitrarily close to zero. On the other hand, lucky agents with a complete streak of positive income shocks may become arbitrarily rich *ex-post*. To avoid the distribution from depending excessively on the last bin of rich lucky agents, the expanding distribution spreads the lucky agents over new bins according to their income level. In this way, agents are appropriately allocated to their actual income rather than be approximated by an arbitrary last bin of an otherwise fixed grid. The initial guess of the distribution can be slightly changed to begin with in order to make sure that the overall income of the economy corresponds to the steady state levels. However, robustness checks have proved that the sensitivity to such changes is very low.

A.4 Empirical derivations

A.4.1 Theoretical derivations

SVARX Impulse response functions. To compute the impulse response functions (*IRFs*), the canonical approach is followed. Take Equation (A.24) in the paper, which I report here for completeness:

$$\begin{aligned}\mathbf{z}_t &= \mathbf{A}_0^{-1}\mathbf{a}_z + \mathbf{A}_0^{-1}\boldsymbol{\beta}_0'\omega_t + \mathbf{A}_0^{-1}\boldsymbol{\beta}_1'\omega_{t-1} + \mathbf{A}_0^{-1}\mathbf{A}_1\mathbf{z}_{t-1} + \mathbf{A}_0^{-1}\mathbf{v}_t \\ &= \widetilde{\mathbf{a}}_z + \widetilde{\boldsymbol{\beta}}_0'\omega_t + \widetilde{\boldsymbol{\beta}}_1'\omega_{t-1} + \widetilde{\mathbf{A}}_1\mathbf{z}_{t-1} + \mathbf{u}_t \end{aligned} \tag{A.15}$$

with $\widetilde{\mathbf{a}}_z = \mathbf{A}_0^{-1}\mathbf{a}_z, \widetilde{\boldsymbol{\beta}}_j = \mathbf{A}_0^{-1}\boldsymbol{\beta}_j \quad j \in \{0,1\}, \widetilde{\mathbf{A}}_1 = \mathbf{A}_0^{-1}\mathbf{A}_1$, and $\mathbf{u}_t = \mathbf{A}_0^{-1}\mathbf{v}_t$. Assume that $\mathbf{z}_t$ is stationary, and define:

$$\begin{aligned}\mathbf{G}(L) &= \left(\mathbf{I} - \widetilde{\mathbf{A}}_1 L\right)^{-1} \\ &= \sum_{\ell=0}^{\infty} \mathbf{G}_\ell L^\ell \end{aligned} \tag{A.16}$$

with L being the lag operator. The stationary nature of the variables allow for the VAR structure to be represented in the canonical $MA(\infty)$ fashion for $m = 4$ being the number of endogenous variables.

$$\begin{aligned}\mathbf{G}_0 &= \mathbf{I}_m \\ \mathbf{G}_1 &= \widetilde{\mathbf{A}}_1\mathbf{G}_0 \\ \mathbf{G}_2 &= \widetilde{\mathbf{A}}_1\mathbf{G}_1 \\ &\dots \\ \mathbf{G}_\ell &= \widetilde{\mathbf{A}}_1\mathbf{G}_{\ell-1} \qquad\qquad \ell = 3, 4, \dots\end{aligned}$$

The process can thus be re-written more compactly as:

$$\begin{aligned}\mathbf{z}_t &= \mathbf{G}(L)\left[\widetilde{\mathbf{a}}_z + \widetilde{\boldsymbol{\beta}}_0'\omega_t + \widetilde{\boldsymbol{\beta}}_1'\omega_{t-1} + \mathbf{u}_t\right] \\ &= \mathbf{G}(1)\mathbf{a}_z + \sum_{\ell=0}^{\infty}\mathbf{G}_\ell\widetilde{\boldsymbol{\beta}}_0\omega_{t-\ell} + \sum_{\ell=0}^{\infty}\mathbf{G}_\ell\widetilde{\boldsymbol{\beta}}_1\omega_{t-\ell-1} + \sum_{\ell=0}^{\infty}\mathbf{G}_\ell\mathbf{u}_{t-\ell} \end{aligned} \tag{A.17}$$

Inequality shock. I first consider a change in the degree of inequality from period t to $t+h$ based on the information in $t-1,\ \Omega_{t-1}$. Since the model is agnostic about the model generating ω_t, I consider a scenario analysis under which I compare the expected outcomes of two inequalities regimes from t to $t+h$; a baseline regime which I denote by $\omega_{t+h}^{(0)}$ for $h=0,1,\ldots,H$, and compare its macro-financial effects with an alternative policy $\omega_{t+h}^{(1)}$ for $h=0,1,\ldots,H$. Using Equation (A.17), we have:

$$\begin{aligned}&\mathbb{E}\left(\mathbf{z}_{t+H}|\Omega_{t-1},\omega_{t+h}^{(1)},\ h=0,1,\ldots,H\right) - \mathbb{E}\left(\mathbf{z}_{t+H}|\Omega_{t-1},\omega_{t+h}^{(0)},\ h=0,1,\ldots,H\right) \\ &= \widetilde{\boldsymbol{\beta}}_0\left(\omega_{t+H}^{(1)} - \omega_{t+H}^{(0)}\right) + \sum_{\ell=1}^{H}\left(\mathbf{G}_\ell\widetilde{\boldsymbol{\beta}}_0 + \mathbf{G}_{\ell-1}\widetilde{\boldsymbol{\beta}}_1\right)(\omega_{t+H-\ell}^{(1)} - \omega_{t+H-\ell}^{(0)})\end{aligned}$$

For the practical case in which inequality is shocked by one standard deviation for one period only, $\sqrt{\sigma_{\omega\omega}}$, one can write: $\omega_t^{(1)} = \omega_t^{(0)} + \sqrt{\sigma_{\omega\omega}}$ and $\omega_{t+h}^{(1)} = \omega_{t+h}^{(0)} \quad h \geq 1$, which allows to write the IRF as:

$$\mathcal{IR}_\omega(h) = \sqrt{\sigma_{\omega\omega}}\,(\mathbf{G}_h\boldsymbol{\beta}_0' + \mathbf{G}_{h-1}\boldsymbol{\beta}_1') \qquad h=0,1,2,\ldots \tag{A.18}$$

Endogenous shocks. The IRF for the vector $\mathbf{z}_t$ over a horizon, h, after a structural shock, $\sqrt{\sigma_{jj}}$, can be defined as:

$$\mathcal{IR}_{\mathbf{z}}(h,\sqrt{\sigma_{jj}},\Omega_{t-1}) = \mathbb{E}(\mathbf{z}_{t+h}|\mathbf{u}_{jt} = \sqrt{\sigma_{jj}};\Omega_{t-1}) - \mathbb{E}(\mathbf{z}_{t+h}|\mathbf{u}_{jt} = 0;\Omega_{t-1}), \tag{A.19}$$

where Ω_{t-1} is the information set available at time $t-1$. It easily follows from the definition in (A.19) that the impact of a one-standard deviation structural shock to variable $j = \{\Delta s_t, \Delta i_t, \Delta debt_t, \Delta mbb_t\}$, can be written as:

$$\mathcal{IR}_{\mathbf{z}}(h) = \sqrt{\sigma_{jj}}(\mathbf{G}_h \mathbf{A}_0^{-1} \mathbf{e}_j) \qquad h = 0, 1, \ldots, H \tag{A.20}$$

with $\mathbf{e}_j$ is the j^{th} vector of the standard basis of the system.

A.4.2 Bootstrapping technique

To compute the IRFs and the associated confidence bands, I follow a bootstrap method by simulating the in-sample values of $\mathbf{z}_t$ in Equation (A.15). The endogenous variables are grouped in the vector $\mathbf{z}_t$ (composed of m policy variables), a vector of constants $\mathbf{a}_{zt}$, and a vector of residuals $\mathbf{v}_t$. The procedure to obtain the bootstrap replications is as follows:

1. Generate the simulated residuals $\left\{\mathbf{u}_t^{(r)}, r = 1, 2, \ldots, R\right\}$ by re-sampling with replacement from the estimated residuals of each equation separately $\{\widehat{\mathbf{u}}_t, t = 2, 3, \ldots, T\}$, where $R = 3,000$ is the number of random samples.

2. Let $\mathbf{z}_{1980}^{(r)} = \mathbf{z}_{1980} \ \ \forall r$, and compute:

$$\mathbf{z}_t^{(r)} = \widehat{\mathbf{A}}_0^{-1}(\widehat{\mathbf{a}}_z + \widehat{\boldsymbol{\beta}}_0 \omega_t + \widehat{\boldsymbol{\beta}}_1 \omega_{t-1} + \widehat{\mathbf{A}}_1 \mathbf{z}_{t-1}^{(r)} + \mathbf{v}_t^{(r)}) \qquad t = 1981, \ldots, 2019$$

3. Use the data computed at Point 2 to estimate the bootstrapped coefficients for each replication:

$$\mathbf{z}_t^{(r)} = \widehat{\mathbf{A}}_0^{-1,(r)} \left(\widehat{\mathbf{a}}_z^{(r)} + \widehat{\boldsymbol{\beta}}_0^{(r)} \omega_t + \widehat{\boldsymbol{\beta}}_1^{(r)} \omega_{t-1} + \widehat{\mathbf{A}}_1^{(r)} \mathbf{z}_{t-1}^{(r)} + \mathbf{v}_t^{(r)}\right)$$

A.5 Testing for theory predictions

In this section, I investigate to what extent the channels proposed are backed by data for the US. The empirical exercise uses the theoretical mechanism explained before to test the channels leading to the expansion of finance stemming from higher inequality. With a theory in hand and several consequential steps, the natural framework to study such consequential steps is to use a structural VAR (*SVAR*). I can augment the SVAR with an exogenous component (*SVARX*), which allows to be agnostic about the primitive causes and model generating a rise in inequality in the real world.[4] In this respect, I take advantage of the method proposed by Hamilton (2018) and used in the applied macro-history literature on "credit booms" to identify macro inequality shocks. The short run restrictions on the ordering of the endogenous variables, on the other hand, are provided by the model previously used.

I proceed to explain the construction of macro inequality shocks, first, in Section A.5.1, and subsequently move to the description of the SVARX model and its results in terms of point estimates and impulse response functions (*IRFs*) in Section A.5.2.

A.5.1 Identifying macro inequality shocks

Inequality shocks for the macro-economy may be the by-product of different components that could generate some disconnect between micro and macro shocks. In order to maintain the macro-financial perspective proposed here, it is important to remain in the domain of macroeconomic data.

In order to identify such shock over time, I propose to build on the methodology explained by Hamilton (2018), and used by Richter, Schularick, and Wachtel (2021) and Verner (2022) to identify "credit booms" from a historical perspective. In this respect, I run the following set of regressions, where $Ineq_t$ is the top 10 per cent of the income distribution post taxes and

[4] As explained in the introduction, we know that to be the combination of multiple factors, and such decomposition is beyond the scope of the paper. However, when I try to include inequality as an endogenous variables, other shocks are not able to explain the rise of the top 10 per cent share.

transfers:

$$Ineq_{t+h} = \alpha + \sum_{\ell=0}^{3} \beta_\ell Ineq_{t-\ell} + \epsilon_{t+h} \qquad h = 1, 2, \ldots \tag{A.21}$$

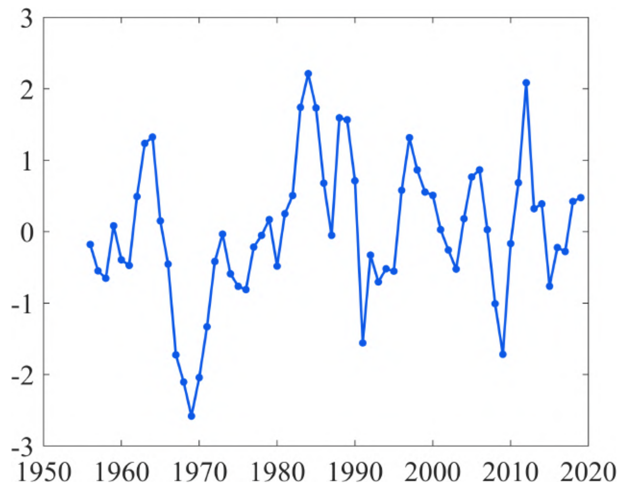
Subsequently, use the predicted values to generate the residuals of the regression ($\hat{\epsilon}_t = Ineq_t - \widehat{Ineq_t}$), to tell apart the shocks, ω_t, above/below trend, and normalize them to capture their intensity, as in Equation (A.22):

$$\omega_t \triangleq \frac{\hat{\epsilon}_t}{\sigma(\hat{\epsilon}_t)} \tag{A.22}$$

The chosen horizon, h^*, in Equation (A.21) is based on the nature of cyclicality of the inequality variable. Hamilton (2018) suggests a number anywhere between $h = 2$ and $h = 5$, according to the persistence. I stick to the choice of Richter et al. (2021), and set $h^* = 3$ although results are similar for adjacent values. However, differently from the literature on credit booms, I do not build a dummy variable for positive shocks only. This is due to the importance of both positive and negative (redistributive) inequality shocks, and because this allows to see the dynamic nature of inequality as an actual process rather than an event (which on the other hand is appropriate of credit booms).

Figure A.7 illustrates the result of such macro inequality shocks. As it is evident, the proposed technique picks the largest inequality shocks happening from the beginning of the 1980s, and – in a decreasing fashion – all the way to the early 2000s, before a major spike in the aftermath of the Great Financial Crisis of 2008 (when unemployment and the real economy started to be progressively affected by the Wall Street crash) before stabilizing around zero. In terms of negative inequality shocks, the current approach is also good at pinning down some of the redistribution plans happening in the 1960s, and the fall in the midst of the crisis of 2008 itself when stock prices collapsed mostly hurting richer households.

Figure A.7: Normalized inequality shocks for the United States over the period 1957-2019



A.5.2 Structural model with short run restrictions

With a number of stylized facts at hand, a theoretical framework to connect them, and a measure of inequality shocks, it is possible to test the extent to which such "chain reaction" relationships are present in the data in a more formal way than stylized facts.

I build a structural vector autoregression framework in the original spirit of Sims (1980) augmented with exogenous components. The structural ordering of variables is built as follows. The first variable to react to an increase in inequality (ω_t) is the amount of safe assets demanded by (typically rich) households (s_t) as a result of a larger pool of loanable funds to invest. This compresses the interest rates (i_t), and facilitates the amount of debt issued by (typically poor) households as a share of GDP ($debt_t$), which ultimately pushes up the amount of assets intermediated by the market-based banking system (mbb_t).[5]

The endogenous variables are taken in first difference of the logs to avoid any serial correlation to produce spurious results.[6] The vector of the endogenous variables, $\mathbf{z}_t$, can thus be written as $\mathbf{z}_t = (\Delta s_t, \Delta i_t, \Delta debt_t, \Delta mbb_t)'$. The ordering of the variables is ensured in the canonical form by a lower-triangular matrix $\mathbf{A}_0$, where the coefficient below the diagonal are left

[5]Safe assets are here considered as privately produced to avoid spurious results coming from foreign countries buying Treasuries for other hedging purposes. The variables $\{s_t, debt_t, mbb_t\}$ are taken as a fraction of national output.

[6]Except for the interest rate, which has to be evaluated in absolute first differences.

unrestricted. The model does not necessitate more than one lag, and can thus be written as in Equation (A.23):

$$\mathbf{A}_0\mathbf{z}_t = \mathbf{a}_z + \boldsymbol{\beta}_0\omega_t + \boldsymbol{\beta}_1\omega_{t-1} + \mathbf{A}_1\mathbf{z}_{t-1} + \mathbf{v}_t \tag{A.23}$$

where $\mathbf{a}_z$ is the vector of $m \times 1$ constants (m being the number of endogenous variables), $(\boldsymbol{\beta}_0, \boldsymbol{\beta}_1)'$ are the coefficient associated to contemporaneous and lagged responses to inequality shocks, $\mathbf{A}_1$ is the $m \times m$ matrix of coefficients of the lagged variables on the contemporaneous ones, and $\mathbf{v}_t$ is the $m \times 1$ vector of residuals. Given that the model is stationary, it is then possible to invert the matrix $\mathbf{A}_0$, and obtain the vector of structural shocks $\mathbf{u}_t = \mathbf{A}_0^{-1}\mathbf{v}_t$.

$$\begin{aligned} \mathbf{z}_t &= \mathbf{A}_0^{-1}\mathbf{a}_z + \mathbf{A}_0^{-1}\mathbf{B}\boldsymbol{\omega} + \mathbf{A}_0^{-1}\mathbf{A}_1\mathbf{z}_{t-1} + \mathbf{A}_0^{-1}\mathbf{v}_t \\ &= \widetilde{\mathbf{a}}_z + \widetilde{\mathbf{B}}\boldsymbol{\omega} + \widetilde{\mathbf{A}}_1\mathbf{z}_{t-1} + \mathbf{u}_t \end{aligned} \tag{A.24}$$

where $\mathbf{B} = (\boldsymbol{\beta}_0, \boldsymbol{\beta}_1)$, $\boldsymbol{\omega} = (\omega_t, \omega_{t-1})'$, $\widetilde{\mathbf{a}}_z = \mathbf{A}_0^{-1}\mathbf{a}_z$, $\widetilde{\mathbf{B}} = \mathbf{A}_0^{-1}\mathbf{B}$, $\widetilde{\mathbf{A}}_1 = \mathbf{A}_0^{-1}\mathbf{A}_1$. The structural shocks, $\mathbf{v}_t = (\mathbf{v}_{\Delta s,t}, \mathbf{v}_{\Delta i,t}, \mathbf{v}_{\Delta debt,t}, \mathbf{v}_{\Delta mbb,t})'$ are assumed to be serially uncorrelated with zero means, $\mathbb{E}(\mathbf{v}_t) = 0$, and mutually uncorrelated with the diagonal covariance matrix $\mathbb{E}(\mathbf{v}_t\mathbf{v}_t') = \Sigma = Diag(\sigma^2_{\Delta s,t}, \sigma^2_{\Delta i,t}, \sigma^2_{\Delta debt,t}, \sigma^2_{\Delta mbb,t})$. The results are available in Table A.1.

In Column (1), it is possible to see that inequality has a contemporaneous impact on the private safe assets demand with an elasticity virtually equal to one. For each per cent rise in the inequality variable, there is a one per cent rise in the demand of safe assets, which is qualitatively in line with what is expected from theory.[7] The process of private safe assets is also positively auto-correlated although nor particularly persistent, $0.445(0.136)$. More interestingly, an increase in interest rates also generates almost a one-to-one increase in demand of safe assets. As safe assets become more attractive, the demand for them rises with an elasticity between the two of $1.073(0.279)$.

[7] Notice that the units of measure of the variation in the shock variables are different because they are normalized by the standard deviation.

Table A.1: Yearly estimates of the SVARX model for the U.S. with domestic variables ordered as: Private safe assets, interest rates, households debt, market-based banking system, estimated over the period 1980–2019

	Δs_t	Δi_t	$\Delta debt_t$	Δmbb_t
	(1)	(2)	(3)	(4)
ω_t	0.012^{**}	0.005^{*}	-0.001	-0.004
	(0.006)	(0.003)	(0.005)	(0.012)
ω_{t-1}	-0.003	-0.002	0.011^{**}	0.013
	(0.006)	(0.003)	(0.005)	(0.012)
Δs_t		0.130	0.056	0.888^{**}
		(0.088)	(0.153)	(0.347)
Δi_t			-0.622^{**}	0.479
			(0.297)	(0.718)
$\Delta debt_t$				0.854^{**}
				(0.407)
Δs_{t-1}	0.445^{***}	-0.232^{***}	-0.022	-0.779^{**}
	(0.136)	(0.079)	(0.150)	(0.339)
Δi_{t-1}	1.073^{***}	0.309^{*}	0.200	-0.546
	(0.279)	(0.170)	(0.300)	(0.685)
$\Delta debt_{t-1}$	0.233	0.134	0.757^{***}	-0.344
	(0.155)	(0.082)	(0.142)	(0.446)
Δmbb_{t-1}	-0.041	-0.034	-0.093	0.436^{**}
	(0.080)	(0.041)	(0.069)	(0.161)
Residual serial	0.755	2.088	0.002	0.255
correlation test	[0.385]	[0.148]	[0.969]	[0.614]
Adjusted R^2	0.532	0.265	0.507	0.383

Notes: The system variables are ordered as $\Delta s_t, \Delta i_t, \Delta debt_t, \Delta mbb_t$, where $\Delta s_t = \ln(S_t/S_{t-1})$ is the rate of change of the private safe assets to nominal output; $\Delta i_t = i_t - i_{t-1}$ is the absolute change of the federal funds rate; $\Delta debt_t = \ln(D_t/D_{t-1})$ is the rate of change of the households debt to nominal output; Δmbb_t is the rate of change of the market-based banking system as a fraction of the nominal output. The current and lagged inequality shocks are represented by ω_t, ω_{t-1}, and described in Section A.5.1. Numbers in parentheses are least-squares standard errors, and those in square brackets are p-values. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$. "Residual serial correlation test" is the Breusch–Godfrey LM test of serially uncorrelated errors with lag order of the test set to 1 to accommodate yearly frequency. See the Appendix for information on the construction of all the endogenous variables.

Column (2) finds evidence for the effects of private safe assets demand on the compression of money yield. In this case, a one per cent rise in safe assets demand compressed the interest rates by about -0.232, which is statistically highly significant. Inequality seems to lead to slightly higher interest rates; however, this is only marginally significant.

As inequality pushes up private safe assets, and interest rates get compressed, households are found to take on more debt, as predicated by theory. Column (3) establishes not only the strong and contemporaneous link between lower interest rates and higher indebtedness, $-0.622(0.297)$, but also a lagged, and statistically strong effect of inequality directly on higher indebtedness. In this case, the elasticity is also close to one.

Finally, the marked-based banking system surges both as a direct contemporaneous rise of higher debt available to recycle, $0.854(0.407)$, and as higher private safe assets demand, 0.888(0.347), although this latter component is shown to "overshoot" given that it partially reverts back in the following period, $-0.779(0.339)$.

The adjusted R^2 are high in all cases, while no residual serial correlation is left in the system, which allows to analyze the dynamic responses through the IRFs provided in Figure A.8.

Panel A of the figure shows the results following a one standard deviation shock in the inequality measure.[8] Such shock generates an increase in 1 per cent in the safe assets demand on impact before ceasing to be significant two years ahead. The interest rates seem to increase on impact before being compressed as a direct consequence of higher inequality but the results are barely significant therefore justifying further the chosen order. On the other hand, there is a direct lagged impact of inequality on households debt (as a share of nominal output), which increases by about 1 per cent one year ahead before losing significance three years after the shock. The direct effects on market based banking are positive but not statistically significant at 90 per cent confidence levels.

Panel B illustrates that the private safe assets demand displays autocorrelation. A one standard deviation generates a two percent rise on impact, which dies down only after two years. Interest rates get slightly compressed by 0.5 per cent after one year, and results are still significant three years ahead before reverting back to normal. The effects of households debt are largely not significant as a direct consequence of higher private safe assets demand, while – interestingly – the shadow banking system does rise immediately by about 2 per cent even though

[8]For the IRFs, I facilitate the interpretation of the inequality shock by transforming the standard deviation of the inequality shock variable, ω, into a one standard deviation shock of the log difference in the original top 10 share inequality variable by means of the correspondent coefficient of variation. In this way, it is possible to interpret the shocks in Panel A as shocks in the per cent change of the top 10 per cent income share. However, the two standard deviations were very close to begin with.

the results are not persistent.

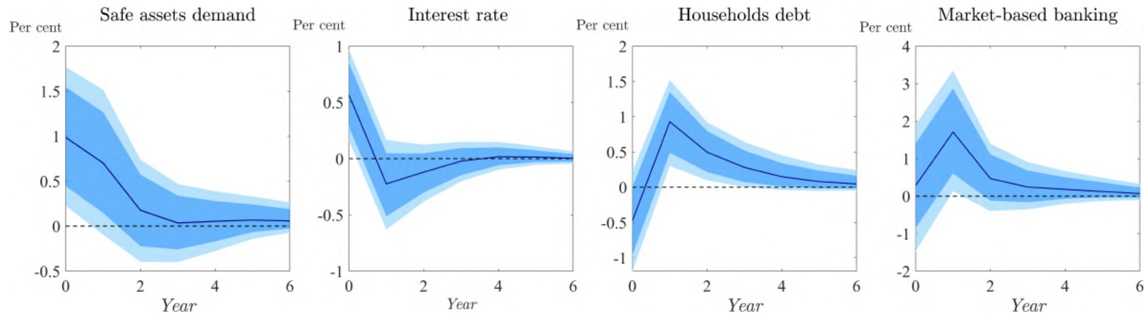
An increase in interest rates is shown to increase the appetite for safe assets demand, which rises but more than 1 per cent one year ahead. Results are precise, as shown by the small confidence interval bands, and they continue to be so until after the second year. Interest rates are clearly autocorrelated. More interestingly for the purpose of the paper, households indebtedness gets compressed immediately by about 0.6 per cent as a result of a one standard deviation increase in interest rates. By having the long-run dynamics of the interest rate decreasing over time, this is in line with the expansion of debt as a fraction of GDP.

Panel D shows that higher indebtedness fosters a surge of the market-based banking — 2 per cent rise on impact and results persistent for the next three years before dying down. As expected, higher current indebtedness also predicts higher future indebtedness as shown in the third plot, while feedback effects on interest rates and safe assets demand do not appear to exist.

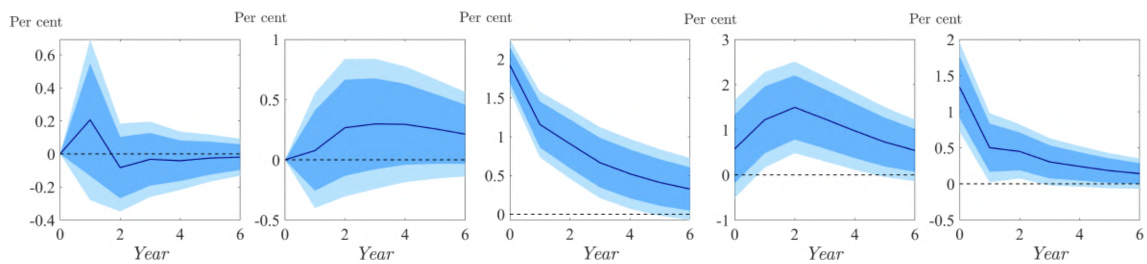
Finally, Panel E shows no feedback effects of higher market-based banking activities on the other variables of study. Shocking the shadow banking system by one standard deviation only predicts higher shadow banking activities in the future: a large 4 per cent increase on impact but short-lived, as the effects only last until year 1.

Figure A.8: Impulse response functions for the structural VAR model

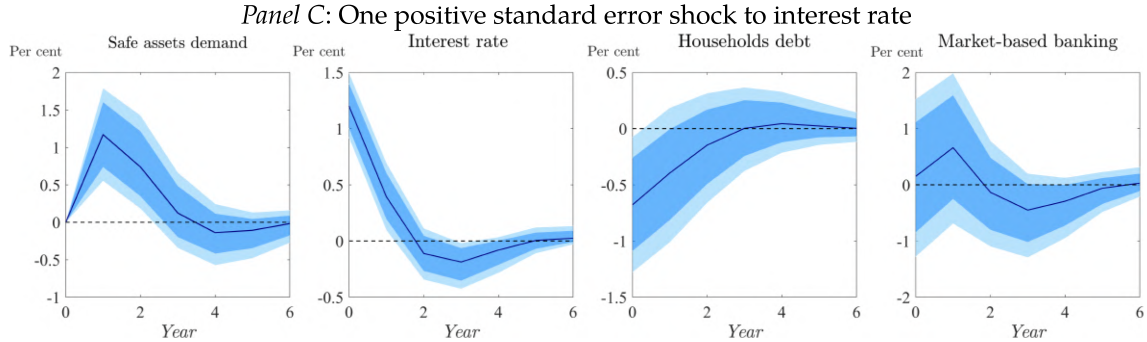
Panel A: One positive standard error shock to the inequality variable



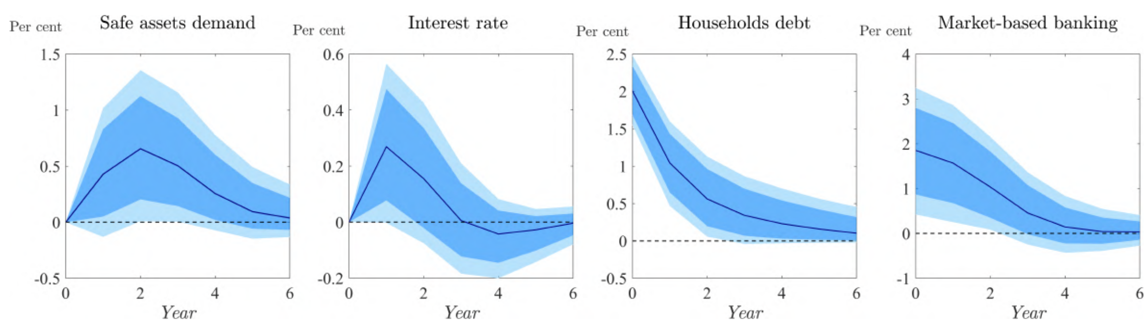
Panel B: One positive standard error shock to private safe assets to GDP



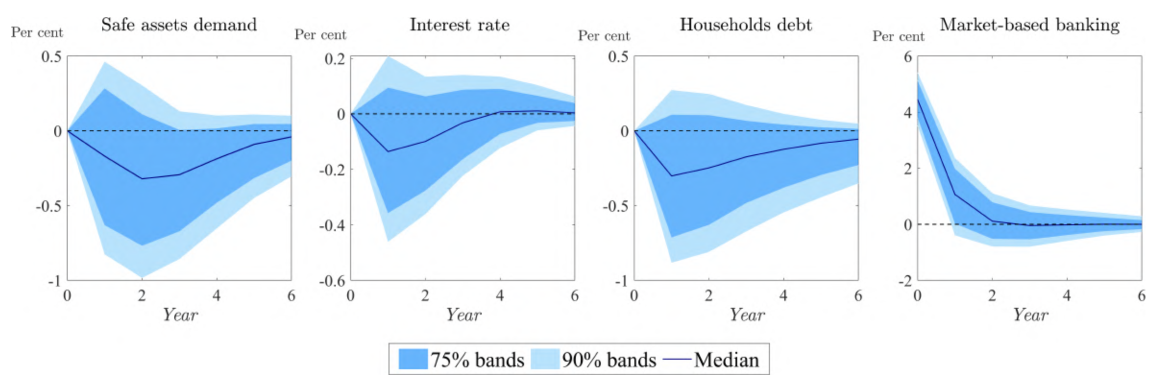
Panel C: One positive standard error shock to interest rate



Panel D: One positive standard error shock to households debt



Panel E: One positive standard error shock to market-based banking



Overall, the empirical evidence seems to support quite strongly both the theoretical mechanism previously constructed, and the causal ordering of variables.[9]

A.5.3 Panel data robustness analyses

In order to provide further evidence to the empirical results in a panel setting showed in Tables 5.a and 5.b, I run a series of robustness checks with country fixed effects, clustered standard errors at country level, and dependent variables auto-regressive components:

$$\Delta y_{it} = \delta \Delta y_{i,t-1} + \sum_{s=2}^{5} \beta_s \Delta x_{i,t-s} + \beta_{0,i} + \kappa_t + \gamma' X_{it} + \epsilon_{it}, \tag{A.25}$$

$$\Delta y_{it} = \delta \Delta y_{i,t-1} + \sum_{s=2}^{5} \beta_s \Delta x_{i,t-s} + \sum_{s=2}^{5} \beta_s \Delta x_{i,t-s} \mathbb{1}(i \in A) + \beta_{0,i} + \kappa_t + \gamma' X_{it} + \epsilon_{it} \tag{A.26}$$

As such the panel is dynamic, and the long run effects can be computed as: $\theta_i = \sum_{s=2}^{5} \beta_s / (1-\delta)$. The results are provided in Tables A.2 and A.3. The tables show that the long-run coefficients are the just as large as the ones found in the body of the paper for the direct channel (around 0.29). Furthermore, the inclusion of the market based dummy variable is not important. The short-run effects are about half the magnitude of the long-run effects (0.15) – consistent with the idea that it may take time to fully manifest – and sometimes less precise than the long-run counterparts.

About the feedback effects, the results are again not true in general. More credit activity does not seem to lead to more inequality, unless a dummy accounting for the market-based system and the pricing effects of asset valuation is included.

In light of the potential bias arising from the auto-regressive component in a panel setting, I repeat the analysis with the Arellano-Bond estimator in Tables A.4 and A.5. Results are consistent therefore the bias tends to zero rapidly enough.

[9] The only point slightly away from what theory predicts is an initial contemporaneous effect of inequality on higher interest rates before being compressed back. Such dynamics is however only marginally significant.

Table A.2: Regression results for the short- and long-run effects of total loans on inequality for a host of 18 economies over the period 1970-2019

	Total loans							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 5 income share	0.593***	0.344***	0.283**	0.293**	0.638***	0.389***	0.319**	0.296**
(*Long run effect*)	(0.167)	(0.131)	(0.123)	(0.134)	(0.185)	(0.140)	(0.135)	(0.138)
Top 5 income share ×					-0.295	-0.292	-0.237	-0.018
Mkt-based dummy (*Long run*)					(0.401)	(0.375)	(0.392)	(0.329)
Top 5 income share	0.242***	0.157**	0.133*	0.139*	0.258***	0.176**	0.150**	0.140*
(*Short run effect*)	(0.076)	(0.068)	(0.065)	(0.070)	(0.078)	(0.071)	(0.068)	(0.071)
Top 5 income share ×					-0.119	-0.132	-0.111	-0.008
Mkt-based dummy (*Short run*)					(0.154)	(0.166)	(0.180)	(0.156)
Time fixed effect	✓	✓	✓	✓	✓	✓	✓	✓
Domestic controls		✓	✓	✓		✓	✓	✓
Globalization controls			✓	✓			✓	✓
USA excluded				✓				✓
R^2	0.588	0.637	0.641	0.642	0.591	0.638	0.643	0.643
Countries/Obs.	18/674	18/673	18/669	17/620	18/674	18/673	18/669	17/620

Table A.3: Regression results for the short- and long-run effects of total loans on inequality for a host of 18 economies over the period 1970-2019

	Top 5 income share							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total loans	-0.071*	-0.039	-0.042	-0.049	-0.112***	-0.075**	-0.076**	-0.076**
(*Long run effect*)	(0.040)	(0.036)	(0.037)	(0.039)	(0.038)	(0.051)	(0.037)	(0.038)
Total loans ×					0.228***	0.204***	0.183***	0.187***
Mkt-based dummy (*Long run*)					(0.051)	(0.042)	(0.044)	(0.043)
Total loans	-0.074*	-0.041	-0.045	-0.052	-0.117***	-0.081**	-0.083**	-0.082*
(*Short run effect*)	(0.040)	(0.037)	(0.039)	(0.041)	(0.039)	(0.038)	(0.039)	(0.040)
Total loans ×					0.239***	0.221***	0.199***	0.202***
Mkt-based dummy (*Short run*)					(0.050)	(0.041)	(0.044)	(0.043)
Time fixed effect	✓	✓	✓	✓	✓	✓	✓	✓
Domestic controls		✓	✓	✓		✓	✓	✓
Globalization controls			✓	✓			✓	✓
USA excluded				✓				✓
R^2	0.185	0.213	0.237	0.238	0.214	0.243	0.267	0.271
Countries/Obs.	18/732	18/731	18/727	17/678	18/732	18/731	18/727	17/678

Table A.4: Regression results for the short- and long-run effects of total loans on inequality using the Arellano-Bond estimator for a host of 18 economies over the period 1970-2019

	Total loans							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 5 income share	0.593***	0.344***	0.283**	0.293**	0.638***	0.389***	0.319**	0.296**
(*Long run effect*)	(0.156)	(0.122)	(0.114)	(0.124)	(0.172)	(0.129)	(0.125)	(0.127)
Top 5 income share ×					-0.295	-0.292	-0.237	-0.018
Mkt-based dummy (*Long run*)					(0.372)	(0.347)	(0.362)	(0.302)
Top 5 income share	0.242***	0.157**	0.133**	0.139**	0.258***	0.176***	0.150**	0.140**
(*Short run effect*)	(0.071)	(0.063)	(0.060)	(0.065)	(0.072)	(0.066)	(0.063)	(0.065)
Top 5 income share ×					-0.119	-0.132	-0.111	-0.008
Mkt-based dummy (*Short run*)					(0.143)	(0.153)	(0.166)	(0.143)
Time fixed effect	✓	✓	✓	✓	✓	✓	✓	✓
Domestic controls		✓	✓	✓		✓	✓	✓
Globalization controls			✓	✓			✓	✓
USA excluded				✓				✓
R^2	0.588	0.637	0.641	0.642	0.591	0.638	0.643	0.643
Countries/Obs.	18/656	18/655	18/651	17/603	18/656	18/655	18/651	17/603

Table A.5: Regression results for the short- and long-run effects of total loans on inequality using the Arellano-Bond estimator for a host of 18 economies over the period 1970-2019

	Top 5 income share							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total loans	-0.077**	-0.042	-0.044	-0.051	-0.114***	-0.078**	-0.077**	-0.077*
(*Long run effect*)	(0.039	(0.036	(0.037	(0.039	(0.039	(0.060	(0.038	(0.039
Total loans ×					0.232***	0.213***	0.192***	0.202***
Mkt-based dummy (*Long run*)					(0.060	(0.047	(0.048	(0.047
Total loans	-0.080**	-0.045	-0.047	-0.055	-0.120***	-0.084**	-0.084**	-0.083**
(*Short run effect*)	(0.040	(0.038	(0.039	(0.041	(0.040	(0.040	(0.040	(0.041
Total loans ×					0.243***	0.230***	0.208***	0.218***
Mkt-based dummy (*Short run*)					(0.059	(0.046	(0.048	(0.046
Time fixed effect	✓	✓	✓	✓	✓	✓	✓	✓
Domestic controls		✓	✓	✓		✓	✓	✓
Globalization controls			✓	✓			✓	✓
USA excluded				✓				✓
R^2	0.185	0.213	0.237	0.238	0.214	0.243	0.267	0.271
Countries/Obs.	18/732	18/731	18/727	17/678	18/732	18/731	18/727	17/678

A.6 Data sources and construction

Idiosyncratic volatility. To compute the idiosyncratic risk on capital used in the calibration exercise, I use CRSP data on returns of stocks listed on the New York Stock Exchange (NYSE), the Nasdaq, and the American Stock Exchange (AMEX) over the period 1970-2019. Furthermore, by following the approach by Fu (2009), I retrieve data on Fama-French 3 market factors from Professor French website.

The steps of the procedure can be described as follows:

1. Retrieve stock returns from CRSP data for the stock exchanges listed above at *daily* frequency.

2. Retrieve daily data on T-bills and Fama-French 3 market factors — Equity premium, High-minus-Low (*HML*), Small-minus-Large (*SML*) —, and merge the data sets.

3. Run the following cross-section regressions at monthly frequency for all the trading days available:

$$R_{idm} - R^{f}_{dm} = \beta_{0i} + \beta_{1i}(R^{M}_{dm} - R^{f}_{dm}) + \beta_{2i}HML_{dm} + \beta_{3i}SML_{dm} + \epsilon_{idm} \quad \forall i, m$$

   where $i = 1, \ldots, N$ identifies the firm, and $d = 1, \ldots, D$ identifies the day of the month $m = 1, \ldots, M$. Compute and store the residuals $\hat{\epsilon}_{idm}$.

4. Compute the daily standard deviation, $\hat{\sigma}_{idm}$, of $\hat{\epsilon}_{idm} \quad \forall i, m$, and transform it into monthly volatility $(\hat{\sigma}_{im})$ by multiplying it for the square root of the firm-specific number of trading days in the month, D_{im}.

5. Average the monthly volatility across firms for each month: $\hat{\sigma}_m = \sum_{i=1}^{N} \hat{\sigma}_{im}$.

6. To find the idiosyncratic volatility over a period of time such as the steady states 1970-1979 and 2010-2019, annualize the monthly volatility $(\hat{\sigma}_y = \sqrt{12}\hat{\sigma}_m)$, and average the volatility over time for the horizon of interest.

Table A.6: Variables description and sources

Variable	*Variable details*	*Source*
Top 10 percent income share	US Top 10 % post-tax national income share, equal split ("sdiinc 992 j US")	World Inequality Database
Bottom 90 percent income share	1- Top 10 income share	Author's computation from the previous line
Top 10 percent wealth share	Top 10 % net wealth – Revised Saez and Zucman series, September 2020 update (smoothed top 10% tax units in 2017 based on DFA)	Saez and Zucman (2020)
Domestic financial sector	See variable construction	Federal Reserve Board, Financial Accounts of the US - Z.1 Tables
Foreign claims on US financial sector	See variable construction	Federal Reserve Board, Financial Accounts of the US - Z.1 Tables
US Nominal GDP	Gross Domestic Product, Billions of Dollars, Annual, Not Seasonally Adjusted	U.S. Bureau of Economic Analysis*
US Real GDP	Real Gross Domestic Product, Billions of Chained 2012 Dollars, Annual, Not Seasonally Adjusted	U.S. Bureau of Economic Analysis*
Nominal GDP (developed countries)	Gross Domestic Product in current LCU (NY.GDP.MKTP.CN)	World Bank
Banking liabilities	See variable construction	Federal Reserve Board, Financial Accounts of the US - Z.1 Tables
Quality-adjusted finance output in levels	Stock of outstanding intermediated assets adjusted for quality (fin all ck)	Philippon (2015) online appendix
Portfolio share in institutional funds	Household balance sheet composition in the US. Agricultural land, pension, insurance and investment fund claims.	Survey of Consumer Finances (SCF+)**
Safe assets demand	See variable construction	Federal Reserve Board, Financial Accounts of the US - Z.1 Tables
Treasuries, domestic holdings	Federal Government; Treasury Securities; Liability, Level (FL893161705A)	Federal Reserve Board, Financial Accounts of the US - Z.1 Tables
Treasuries, foreign holdings	Rest of the World; Treasury Securities; Asset, Market Value Levels (LM263061105A)	Federal Reserve Board, Financial Accounts of the US - Z.1 Tables
Credit (developed countries)	Credit to Private non-financial sector from all sectors at market value, Domestic currency - Adjusted for breaks	Bank of International Settlements

Top 10 pc income share (developed countries)	Pre-tax national income share, equal split ("sptinc992j")	World Inequality Database
Labor Income share	Share of Labour Compensation in GDP at Current National Prices for United States, Ratio, Annual, Not Seasonally Adjusted	Penn World Table 10.01
Nominal interest rate	Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity, Quoted on an Investment Basis, Percent, Annual, Not Seasonally Adjusted	Federal Reserve Board, Financial Accounts of the US - H.15 Tables
Consumer price index	Consumer Price Index: Total All Items for the United States, Index 2015=100, Annual, Seasonally Adjusted	Organization for Economic Co-operation and Development
Households outstanding debt	Households and Nonprofit Organizations; Total Liabilities, Level, Millions of Dollars, Annual, Not Seasonally Adjusted	Federal Reserve Board, Financial Accounts of the US - Z.1 Tables
Idiosyncratic volatility	Stock prices idiosyncratic volatility	See the paragraph on idiosyncratic volatility of Section A.6
Risky asset prices	Monthly average Standard and Poor's 500 nominal value divided by US consumer price index	www.officialdata.org/us/stocks/s-p-500/

Notes: All values for which no specific geographic definition is provided refer to the United States. Codes in parentheses refer to the Financial Accounts series code number. Countries included among developed economies: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the UK, USA.
*Accessed through FRED – Federal Reserve Economic Data, St. Louis Fed. **Accessed through Jordà et al. (2019).

Table A.7: Construction of macro-financial variables with series references

Variable	*Variable construction details*
Inflation	Rate of change of Consumer Price Index
Real interest rate	Nominal interest rate minus inflation
Treasuries, held abroad	Rest of the World; Treasury Securities; Asset, Market Value Levels, Millions of Dollars, Annual, Not Seasonally Adjusted (LM263061105A)
Treasuries, total outstanding amount	All Sectors; Treasury Securities; Asset, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL893061105A)
Financial sector claims, held domestically	Domestic Financial Sectors; Total Financial Assets, Level (FBTFASA027N) *minus* Money Market Funds; Private Foreign Deposits; Asset, Level (BOGZ1FL633091003A)
Traditional Banking	Following Adrian and Ashcraft (2016), it is the sum of traditional maturity transformation and traditional credit transformation expressed as the sum of the following
	Domestic Financial Sectors; Net Interbank Transactions; Liability, Level (FL794110005A)
	Private Depository Institutions; Checkable Deposits; Liability, Level (FL703127005A)
	Private Depository Institutions; Total Time and Savings Deposits; Liability, Level (FL703130005A)
	Life Insurance Companies; Life Insurance Reserves; Liability, Level (FL543140005A)
	Insurance Companies and Pension Funds; Pension Entitlements; Liability, Level (FL583150005A)
	U.S.-Chartered Depository Institutions; Corporate and Foreign Bonds; Liability, Level (FL763163005A)
	Holding Companies; Corporate and Foreign Bonds, Including Other Borrowings; Liability, Level (FL733163003A)
	Domestic Financial Sectors; Depository Institution Loans N.E.C.; Liability, Level (FL793168005A)
Market-based Banking	Following Adrian and Ashcraft (2016), it is the sum of shadow maturity transformation and shadow credit transformation expressed as the sum of the following:
	Money Market Funds; Total Financial Assets, Level (MMMFFAA027N)
	Domestic Financial Sectors; Federal Funds and Security Repurchase Agreements; Liability, Level (FL792150005A) - U.S.-Chartered Depository Institutions, Including IBFs; Federal Funds; Liability, Level (FL762152005A) - Foreign Banking Offices in the U.S., Including IBFs; Federal Funds; Liability, Level (FL752152005A)

	Domestic Financial Sectors; Open Market Paper; Liability, Level (FBMPLIA027N)
	Domestic Financial Sectors; Trade Payables; Liability, Level (FL793170005A)
	Domestic Financial Sectors; Taxes Payable (Net); Liability, Level (FL793178005A)
	Security Brokers and Dealers; Corporate and Foreign Bonds; Liability, Level (FL663163003A)
	GSEs and Agency- and GSE-Backed Mortgage Pools; U.S. Government Agency Securities; Liability, Level (GSEMPUA027N)
	Issuers of Asset-Backed Securities; Corporate and Foreign Bonds; Liability, Level (FL673163005A)
	Finance Companies; Corporate and Foreign Bonds; Liability, Level (FL613163005A)
	Real Estate Investment Trusts; Corporate and Foreign Bonds; Liability, Level (FL643163005A)
	Equity Real Estate Investment Trusts; Total Mortgages; Liability, Level (REITMIA027N)
	Mutual Funds; Mutual Fund Shares; Liability, Market Value Levels (LM653164205A)
	Other Financial Business; Corporate and Foreign Bonds where the proceeds are down-streamed to broker-dealer subsidiaries by investment banks that are holding-company parents; Liability, Level (FL503163005A)
	Domestic Financial Sectors; Other Loans and Advances; Liability, Level (FL793169005A)
Total Banking liabilities	Sum of Traditional Banking liabilities and Market-based Banking liabilities
Safe assets demand, Total	Sum of total claims of the following components:
	All Sectors; Open Market Paper; Liability, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL893169175A)
	All Sectors; Federal Funds and Security Repurchase Agreements; Asset, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL893169175A)
	Money Market Funds; Total Financial Assets, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (MMMFFAA027N)
	Private Depository Institutions; Total Time and Savings Deposits; Liability, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL703130005A)
	Domestic Financial Sectors; Checkable Deposits and Currency; Liability, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL793120005A)
	All Sectors; Treasury Securities; Asset, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL893061105A)

Safe assets demand, Rest of the world	Sum of rest of the world holdings of the following:
	Rest of the World; Commercial Paper; Asset, Market Value Levels, Millions of Dollars, Annual, Not Seasonally Adjusted (LM263069103A)
	Rest of the World; Security Repurchase Agreements; Asset, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL262051003A)
	Rest of the World; U.S. Money Market Fund Shares; Asset, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (ROWMMMA027N)
	Rest of the World; U.S. Total Time and Savings Deposits; Asset, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (ROWTDAA027N)
	Rest of the World; U.S. Checkable Deposits and Currency; Asset, Level, Millions of Dollars, Annual, Not Seasonally Adjusted (FL263020005A)
	Rest of the World; Treasury Securities; Asset, Market Value Levels, Millions of Dollars, Annual, Not Seasonally Adjusted (LM263061105A)
Safe assets demand, Domestic	Safe assets demand (Total) - Safe assets demand (Rest of the world)
Private safe assets demand	Domestically held MMMF, Commercial paper, Repos, Time deposits. Using previous codes for brevity: (FL703130005A) + (MMMFFAA027N) + (FL893169175A) + (FL893169175A) - [(ROWMMMA027N) + (ROWTDAA027N) + (FL262051003A) + (LM263069103A)]
Financial assets, Rest of the world	Sum of the following components:
	Federal Government; Special Drawing Rights (SDRs) Allocations; Liability, Market Value Levels (LM313111303A)
	Rest of the World; Net Interbank Transactions with Banks in Foreign Countries; Asset, Level (ROWNIBA027N)
	Rest of the World; U.S. Checkable Deposits and Currency; Asset, Level (FL263020005A)
	Rest of the World; U.S. Total Time and Savings Deposits; Asset, Level (ROWTDAA027N)
	Rest of the World; U.S. Money Market Fund Shares; Asset, Level (ROWMMMA027N)
	Rest of the World; Security Repurchase Agreements; Asset, Level (FL262051003A)
	Rest of the World; Commercial Paper; Asset, Market Value Levels (LM263069103A)
	Rest of the World; Treasury Securities; Asset, Market Value Levels (LM263061105A)
	Rest of the World; Agency- and GSE-Backed Securities; Asset, Market Value Levels (LM263061705A)

	Rest of the World; Municipal Securities; Asset, Level (ROWMLAA027N)
	Rest of the World; Corporate Bonds; Asset, Market Value Levels (LM263063005A)
	Rest of the World; U.S. Nonfinancial Business Loans; Asset, Level (ROWNEAA027N)
	Rest of the World; U.S. Corporate Equities; Asset, Market Value Levels (LM263064105A)
	Rest of the World; U.S. Mutual Fund Shares; Asset, Market Value Levels (LM263064203A)
	Rest of the World; Trade Receivables; Asset, Market Value Levels (LM263070005A)
	Life Insurance Companies; Assumed Life Insurance Reserve Credit from Non-U.S. Insurers; Liability, Level (FL543141905A)
	Life Insurance Companies; Assumed Pension Entitlement Reserve Credit from Non-U.S. Insurers; Liability, Level (FL543151905A)
	Rest of the World; Assumed Policy Payables by U.S. Reinsurers from Non-U.S. Insurers; Liability, Level (FL263076005A)
	Rest of the World; Foreign Direct Investment in U.S.; Asset (Current Cost), Market Value Levels (LM263092001A)
	Rest of the World; U.S. Mortgage-Backed Securities and Other U.S. Asset-Backed Bonds; Asset, Market Value Levels (LM263063603A)
Financial assets, Total	Sum of the following components:
	All Sectors; U.S. Official Reserve Assets; Liability, Market Value Levels (LM893111005A)
	Federal Government; Treasury Currency; Liability, Level (FL313112003A)
	Domestic Financial Sectors; Net Interbank Transactions; Liability, Level (FL794110005A)
	Domestic Financial Sectors; Checkable Deposits and Currency; Liability, Level (FL793120005A)
	Private Depository Institutions; Total Time and Savings Deposits; Liability, Level (FL703130005A)
	Money Market Funds; Total Financial Assets, Level (MMMFFAA027N)
	All Sectors; Federal Funds and Security Repurchase Agreements; Liability, Level (FL892150005A)
	All Sectors; Open Market Paper; Liability, Level (FL893169175A)
	Federal Government; Treasury Securities; Liability, Level (FL313161105A)
	All Sectors; U.S. Government Agency Securities; Liability, Level (FL893161705A)

Domestic Nonfinancial Sectors; Municipal Securities; Liability, Level (FL383162005A)
Domestic Financial Sectors; Corporate and Foreign Bonds; Liability, Level (FBCFLIA027N)
Domestic Financial Sectors; Depository Institution Loans N.E.C.; Liability, Level (FL793168005A)
Rest of the World; Depository Institution Loans N.E.C.; Liability, Level (ROWDIPA027N)
Domestic Financial Sectors; Other Loans and Advances; Liability, Level (FL793169005A)
Equity Real Estate Investment Trusts; Total Mortgages; Liability, Level (REITMIA027N)
Financial sector Trade Payables: All Sectors; Trade Payables; Liability, Level (FL893170005A) - Nonprofit Organizations; Trade Payables; Liability, Level (FL163170005A) - Nonfinancial Corporate Business; Trade Payables; Liability, Level (NCBPLIA027N) - Nonfinancial Noncorporate Business; Trade Payables; Liability, Level (NNBTPTA027N)
All Sectors; Life Insurance Reserves; Liability, Level (FL893140005A)
All Sectors; Pension Entitlements; Liability, Level (FL893150005A)
Federal Government; Total Miscellaneous Liabilities, Level (FL313190005A)
State and Local Government Employee Defined Benefit Retirement Funds; Claims of Pension Fund on Sponsor; Asset, Level (FL223073045A)
Monetary Authority; Total Miscellaneous Liabilities, Level (FL713190005A)
U.S.-Chartered Depository Institutions; Total Miscellaneous Liabilities, Level (FL763190005A)
Foreign Banking Offices in the U.S.; Total Miscellaneous Liabilities, Level (FL753190005A)
Banks in U.S.-Affiliated Areas; Unidentified Miscellaneous Liabilities, Level (FL743193005A)
Credit Unions; Unidentified Miscellaneous Liabilities, Level (FL473193005A)
Property-Casualty Insurance Companies; Total Miscellaneous Liabilities, Level (FL513190005A)
Life Insurance Companies; Total Miscellaneous Liabilities, Level (FL543190005A)
Government-Sponsored Enterprises; Total Miscellaneous Liabilities, Level (FL403190005A)
Finance Companies; Total Miscellaneous Liabilities, Level (FL613190005A)
Real Estate Investment Trusts; Unidentified Miscellaneous Liabilities, Level (FL643193005A)
Security Brokers and Dealers; Total Miscellaneous Liabilities, Level (FL663190005A)
Holding Companies; Unidentified Miscellaneous Liabilities, Level (FL733193005A)

	Other Financial Business; Total Miscellaneous Liabilities, Level (FL503190005A)
	Rest of the World; Total Miscellaneous Liabilities, Level (FL263190005A)
	Mutual Funds; Mutual Fund Shares; Liability, Market Value Levels (LM653164205A)