Financing Private Credit*

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Abstract

Using data on balance sheets of both financial and nonfinancial sectors of the economy, we use a "demand system" approach to study how lender composition and willingness to provide credit affect the relationship between credit expansions and real activity. A key advantage of jointly modeling the demand for and supply of credit is the ability to evaluate equilibrium elasticities of credit quantities with respect to variables of interest. We document that the sectoral composition of lenders financing a credit expansion is a key determinant for subsequent real activity and crisis probability. We show that banks and nonbanks respond differentially to changes in macroeconomic conditions, with bank credit more sensitive to economic downturns. Our results thus suggest that secular changes in the structure of the financial sector will affect the dynamics of credit boom-bust cycles.

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1 Introduction

A large literature since the global financial crisis has established that private credit expansions predict negative real outcomes. While the original focus was on household credit expansions, recent papers have found that the composition of nonfinancial corporate borrowing is a key determinant of subsequent economic activity. Instead of focusing on the composition of borrowing, in this paper we study the sources of financing that originate the credit expansion. We do so by bringing a demand-system asset pricing approach to the question of credit expansions to study both the demand and supply sides of credit in the economy.

Just as nonfinancial firms have a pecking order in mind when selecting how to raise funding for their activities, determining the *demand* for credit through different types of credit instruments, financial institutions also have preferences for which types of credit instruments they hold, determining the *supply* of credit. In this paper, we argue that one of the determinants of the mix of funding for nonfinancial corporations at the economy level is the composition of the financial sector. We formalize this intuition by introducing a credit supply model to study sources of variation in the share of intermediated credit as well as overall credit borrowed by nonfinancial corporations across 9 countries.

We model financial institutions' willingness to supply credit at the country-institution type level to match international financial sector holdings of nonfinancial firms' loans and corporate bonds, collected from individual countries' financial national accounts. Following the demand system approach of Koijen and Yogo (2019a), we model lender sectors' preferences for nonfinancial firm loans and corporate bonds as a function of the relative credit spreads between bonds and loans but also, crucially, on macroeconomic conditions. This allows us to study the question of *who* finances credit expansions through *which* credit instruments more carefully, separating out the impact of macroeconomic conditions on both the demand for and supply of credit from the impact of growth of financial sectors and from the impact of changing preferences for different types of credit on both the borrower and the lender side of the economy.

We start by documenting that the composition of lenders financing a credit expansion matters for subsequent real activity. In particular, expansions in non-bank credit have a shorter-lived negative predictive relation with future average real GDP growth than expansions in bank credit. Moreover, expansion in non-bank credit predict a lower probability of extreme negative growth realizations 3 – 4 years out while expansions in bank credit predict a higher crisis probability at the same horizons. Thus, credit booms financed by non-banks appear to have a less pernicious effect on future real outcomes.

We then turn to studying how the financial sectors' willingness to lend and nonfinancial sector's willingness to borrow through corporate bonds and loans translate into overall credit growth, as well as the market clearing interest rates on bonds and loans. We show that credit growth is higher when the composition of credit is tilted towards loan financing. Since banks are the major provider of credit through loans around the world, this suggests that one of the channels through which bank credit has a particularly negative effect on subsequent GDP growth is by tilting the composition of nonfinancial credit towards loans and, in turn, increasing the overall rate of debt growth.

The credit demand-supply system we estimate allows us to estimate elasticities of both the demand and supply of credit with respect to credit spreads and macroeconomic conditions. We show that increases in corporate bond yields correspond, in equilibrium, to increases in the share of intermediated credit, declines in the speed of credit expansion, and substitutions by the banking sector, insurance and pension funds, and foreign credit from loans into bonds.

Putting these results together, we conduct a case study of the history of credit expansions in the U. S. We document that the financing of U. S. credit expansions has shifted from bank-based to non-bank-based sources of funding. As banks and non-banks respond differentially to changes in macroeconomic conditions, this shift leads to a decreased sensitivity of credit expansions to macroeconomic fundamentals over time.

This paper contributes to the literature on credit cycles. A number of papers, such as Schularick and Taylor (2012), Gourinchas and Obstfeld (2012), Mian et al. (2017), and Greenwood et al. (2022), have found that expansions in the quantity of private credit predict negatively subsequent real outcomes. While recent papers (e.g. Müller and Verner, 2023; Ivashina et al., 2024) have focused on the importance of borrower composition, we focus instead on the composition of the financial sector that is financing the credit expansion. Unlike Diebold and Richter (2023), who investigate whether locally-financed credit booms are less costly in terms of future real outcomes than foreign-financed booms, we instead study the differential implications of credit booms financed by bank versus non-bank financial institutions.

The main contribution of this paper to the literature on credit cycles is a decomposition of credit growth into demand and supply components. We do so through the lens of a demand-based asset pricing model for the portfolio allocations of the lender sectors in the economy. The seminal Koijen and Yogo (2019a) paper estimates the demand system of institutional investors for long positions in U. S. equities. The demand system approach has since been applied to a variety of settings, including exchange rates and yield determination (Koijen and Yogo, 2020), impact of Euro-area quantitative easing (Koijen et al., 2017), institutional holdings of U. S. corporate bonds (Bretscher et al., 2020), corporate bond issuance (Siani, 2022), and institutional demand for U. S. fixed income assets (Boyarchenko and Shachar, 2019). We deviate from this literature by focusing on the joint determination of the credit supply by the financial sectors and the credit demand of the nonfinancial sector. This allows us to decompose the overall variation in credit growth into contributions from the size and portfolio allocation decisions of the lenders in the economy and contributions from the nonfinancial sector's demand for credit through particular types of instruments.

This paper also provides new evidence on the relationship between the stance of monetary policy and aggregate credit supply in the economy. Several empirical studies show that when interest rates are low, both bank (Jiménez et al., 2017; Maddaloni and Peydró, 2011; Dell'Ariccia et al., 2017; Ioannidou et al., 2015; Paligorova and Santos, 2017; Altunbas et al., 2022) and non-bank (Choi and Kronlund, 2018; Di Maggio and Kacperczyk, 2017; Chodorow-Reich, 2014; Hau and Lai, 2016) financial institutions engage in increased risk taking by "reaching for yield" (Rajan, 2006). Relative to that literature, we focus on the impact of *systematic* conduct of monetary policy as measured by long-run deviations of the real policy rate from the natural rate of interest. This approach has the advantage of capturing the intuition that financial vulnerabilities in the economy buildup gradually over time and are not the result of a one-time deviation of monetary policy.[1]

This paper also speaks to the literature on international corporate credit provision. In a series of papers, Cetorelli and Goldberg (2011, 2012b,a) show that global banks manage liquidity on a global scale, reducing cross-border lending to both the nonfinancial and financial sectors in response to contractionary domestic shocks. In the same spirit, Avdjiev et al. (2018) present a case study of past episodes of financial stress in Asia, illustrating the cross-border nature of the procyclical risk-taking propensity of financial intermediaries through the composition of liabilities. Avdjiev et al. (2017) show that the composition and drivers of international bank lending and international bond issuance has changed since the financial crisis, with the responsiveness of international bank lending to global risk conditions declining considerably post-crisis and becoming similar to that of international debt securities. Blanchard et al. (2017) argue that the composition of corporate credit also determines whether capital inflows are expansionary or contractionary for a small open economy, with capital inflows through bank lending reducing the overall cost of financing for productive firms. This literature has focused on cross-border credit flows, while our paper focuses on within-country corporate

[1] See Boyarchenko et al. (2022) for a more detailed discussion of the extant empirical literature on the impact of monetary policy on aggregate financial stability and risk taking.

credit provision by different parts of the financial sector and is thus complementary to these earlier studies.

Finally, this paper is related to the recent literature on balance sheet management by insurance companies. Koijen and Yogo (2015) show that, during the financial crisis, life insurers managed the size of their balance sheet by selling long-term policies at deep discounts relative to actuarial values, exploiting regulation that allowed them to record less than a dollar of reserve per dollar of future insurance liability. At the same time, insurance companies changed the composition of their liabilities by increasing the fees on variable annuities, reducing the sales of such products (Koijen and Yogo, 2018). On the asset composition side, Chodorow-Reich et al. (2018) argue that insurance companies act as asset insulators, holding assets for the long-run to protect their equity from fluctuations in market asset values. Extending this intuition, Boyarchenko and Shachar (2019) document that corporate issuers cater to these preferences by fragmenting their overall bond issuances into multiple individual issues and issuing privately-traded debt. Unlike these earlier studies that utilize insurance-company-level balance sheet data, we focus on the cyclical properties of the balance sheet of the aggregate insurance company sector, and on how it contrasts with the cyclical properties of the balance sheet of the aggregate bank and shadow bank sectors.

The rest of the paper is organized as follows. In Section 2, we document novel facts about how the financial sector financing a credit expansion is a fundamental determinant of subsequent real activity. We describe the data sources and summarize the main properties of the data in Section 3. We introduce our supply system approach to credit provision in Section 4. Section 5 then presents the basic credit supply system estimates and elasticities with respect to key variables of interest. We return to the question of how changes in lender composition and allocations to nonfinancial credit translate into credit expansions in Section 6. Section 7 concludes.

2 Boom financing and real activity predictability

In this section, we document that the composition of *lending* during a credit expansion matters for subsequent real outcomes. While recent studies have studied different dimensions of heterogeneity in *borrowers* during credit expansions, we emphasize the importance of differentiating which financial subsector is driving *lending* during a credit expansion.

Figure 1 shows that expansions in bank credit are most of the time not coincident with non-bank credit expansions. As the figure shows, a large number of country-year observations are quite far from the 45-degree line. The figure also shows two additional features of bank vs. non-bank lending that are worth noting. First, although there are periods in which both bank debt and non-bank debt move in the same direction (i.e. they have the same sign), a considerable number of country-year observations feature opposite signs. That is, one type of lending is expanding while the other is contracting, which suggests a substitution between bank and non-bank lending.

Second, overall booms in private credit can be driven by either bank or non-bank expansions. In Figure 1, the blue diamonds highlight the country-years that correspond to the start of booms in overall private credit following the definition of credit booms in Verner (2022). As the figure shows, a number of booms are financed by just one type of lender. That is, we observe a number of country-year observations identified as the beginning of a credit boom with very little subsequent expansion in one type of lending.

Given these features of bank and non-bank lending expansions, a natural question to ask is whether real activity outcomes are different depending on who is financing the credit expansions. We begin by considering whether expansions in bank credit predict future average real GDP growth differentially from expansions in non-bank credit by estimating

$$\Delta_{t,t+h}\text{rgdp}_{c,t} = \alpha_{c,h} + \beta_{b,h}\Delta_{t-3,t}\text{bank credit}_{c,t} + \beta_{n,h}\Delta_{t-3,t}\text{non-bank credit}_{c,t} + \epsilon_{c,t+h}, \quad (1)$$

where $\alpha_{c,h}$ is a country fixed-effect, $\Delta_{t,t+h}\text{rgdp}_{c,t}$ is h-year cumulative real GDP growth, and $\Delta_{t-3,t}\text{bank credit}_{c,t}$ and $\Delta_{t-3,t}\text{non-bank credit}_{c,t}$ are three year changes in the ratio of bank and non-bank credit to GDP, respectively. Table 1 reports the estimated coefficients from this regression, together with Hodrick (1992) standard errors around the point estimates. Focusing on the distinction between bank and non-bank lending, Table 1b shows that, at horizons of up to 3 years, expansions in either bank or non-bank credit predict an overall contraction in real GDP relative to the level at the end of the credit expansion. At longer horizons, however, the statistical significance of expansions in non-bank credit for cumulative real GDP growth disappears and, at horizons longer than 5 years, the point estimate even becomes positive. This reversal suggests that expansions in bank lending may have a differentially adverse effect on future real activity than expansions in non-bank lending.

The literature on credit cycles has argued that credit expansions not only negatively predict future real GDP growth but also positively predict *extreme* real GDP contractions. We evaluate whether expansions in bank credit predict extreme future real GDP growth outcomes differentially from expansions in non-bank credit by estimating a complimentary log-log probability model for the probability of annual real GDP growth falling below -2%

$$\mathbb{P}\left(e_{c,t+h}=1\right)=1-\exp\left(-\exp\left(\alpha_{c,h}+\beta_{b,h}\Delta_{t-3,t}\text{bank credit}_{c,t}+\beta_{n,h}\Delta_{t-3,t}\text{non-bank credit}_{c,t}\right)\right), \tag{2}$$

where $e_{c,t+h}$ is an indicator equal to 1 if real GDP growth in country c between years $t+h-1$ and $t+h$ is less than -2%. Table 2 reports the results from the complimentary log-log specification (2). Expansions in both bank and non-bank credit predict a higher probability of extreme negative real GDP growth in the near-term (1 year). However, the probability of a crisis three or four years out is lower following non-bank credit expansions, while bank credit expansions continue to positively predict extreme growth outcomes even at these longer horizons. Comparing the results in Table 2b with those in Table 2a further suggests that distinguishing between expansions in different types of credit is important for understanding crisis predictability.

Put together, the results in Tables 1 and 2 suggest that whether a credit boom is financed by bank or non-bank lenders matters for both the future average real GDP growth and the probability of extreme negative real GDP growth outcomes. In this paper, we explore how variation in the composition of the financial sector across countries and over time translates into overall credit booms and the relative expansions in bank and non-bank credit. We focus in particular on nonfinancial firm borrowing, collecting national accounts data on both nonfinancial and financial sectors' balance sheets, and studying the general equilibrium sensitivities of debt growth to aggregate conditions through the lens of a credit supply-demand model.

3 Data description

In this paper, we combine data on aggregate liabilities and aggregate holdings of instruments from national financial accounts with granular data on nonfinancial corporate bond pricing. We now describe each of these datasets in turn, as well as the macroeconomic conditions data used in our estimation.

3.1 National financial accounts data

One of the contributions of this paper is to provide stylized facts on nonfinancial corporate credit and which sectors hold nonfinancial corporate credit across a range of advanced economy countries. We use national financial accounts data to collect information on the composition of credit borrowed by the nonfinancial sector as well as the holdings of nonfinancial corporate credit by lender sectors in the economy. In particular, we use balance sheet data for the nonfinancial corporate sector, monetary financial institutions (MFIs), insurance companies and pension funds (Ins/PF), non-money market mutual funds (MF), other financial institutions (OFIs), households and non-profit institutions serving households (HH/NPISH), and the external sector (rest of the world, RoW) from 9 large economies: the United States, Canada, the United Kingdom, Germany, France, Italy, Spain, Japan, and Australia. Notice that we include the balance sheets of the household sector which, due to data collection conventions, usually includes hedge funds. To maintain compatibility of the national accounts data across countries, we use the national accounts reported using the most recent version of the United Nations System of National Accounts (2008 SNA, see United Nations, 2009) or the European System of Accounts (ESA 2010, see also Eurostat, 2013), which is broadly consistent with 2008 SNA, as appropriate.

Although national financial accounts are available on a quarterly basis for the countries in our sample, we use annual data, corresponding to the fourth quarter of each year. The within-year variation in national financial accounts is uninformative from the perspective of understanding how credit booms – which usually take multiple years to develop – are financed. National financial accounts under 2008 SNA also start in different years for the countries in our sample, ranging from 1952 for the U. S. to 2005 for Japan. We keep the longest history possible for each country and restrict our estimation sample to end before the COVID-19 pandemic. Note that, for Germany and Italy, the data on holdings of nonfinancial corporate debt instruments by the financial sectors starts considerably later than the rest of the data for those countries (2013 and 2012, respectively).

National financial accounts report securities on both the asset and the liabilities side of the balance sheet using different valuation bases depending on the instrument type. For the most part, loans are reported on a book value basis, while debt instruments are reported on a market value basis. In our estimation, we account for the different valuation basis of the loans and bonds reported in the holdings data. In national financial accounts, nonfinancial corporate loans include both bank loans and commercial mortgages, while nonfinancial corporate debt instruments include corporate bonds and open market paper (more commonly known as commercial paper). For simplicity, we will refer to debt instruments as corporate bonds throughout the paper.

Given our focus on the choice between bond and loan financing, a key variable of interest is the share of intermediated credit, which we define as the ratio between loans outstanding and the sum of bonds and loans outstanding. Figure 3 plots the time series of the share of intermediated credit for the 9 countries in our sample. The figure shows that there is substantial variation both across time and countries. For instance, the U. S. share is relatively constant at around 50% until the 1990's but has since dropped to around 40%. Meanwhile, the share for the rest of the countries in our sample is considerably higher, averaging around 80%. This is consistent with the well-documented fact that the U. S. relies on bank financing to a much lower extent than other countries. Furthermore, even for the set of countries that have historically relied more on bank financing, the share of intermediated credit has been declining over the past 30 years.

In terms of the holders of nonfinancial credit, we follow the ECB convention and define monetary financial institutions (MFIs) as credit institutions, deposit-taking corporations other than credit institutions, and money market funds. This definition of MFIs includes the monetary authority or central bank. While a subset of our countries report the central bank balance sheet separately, the central bank balance sheet data only starts in 2015 for member countries of the European Union, and is not available through the national financial accounts for United Kingdom for all the years in our sample. Likewise, the United Kingdom does not separate the insurance company sector from the pension fund sector in national financial accounts.

Figure 4 plots the total assets by sector for each country in our sample.[2] As the figure

[2] Figure A.1 reports the sizes of each sector as a percent of total lender sectors' assets.

shows, the size of the financial sector as a whole has increased considerably over the sample period. Moreover, when comparing the composition of the financial sector across countries, we observe substantial heterogeneity. At least three facts are worth noting: first, the large increase in the size of the household sector (which, in national accounts, includes hedge funds) over time, particularly in the U. S. Second, the relative size of the MFI sector is vastly different across countries. For instance, while in Japan it comprises over 40% of the total assets of the financial sector, in countries like the U. S. or Canada that share is lower than 25%. Third, the size of the rest of the world sector also varies substantially across countries. In countries like the U. K. and Spain, the sector amounts to around 30% of the financial sector, while in the U. S. and Japan the share is lower than 10%.

For all the countries in our sample, the national financial accounts data is available at the sectoral level for both the asset and the liability side of the balance sheet, which allows us to observe at the sectoral level who is borrowing and who is lending using which instruments. Where available (United States, Australia and member countries of the European Union), we use the "who-to-whom" version of national accounts, which directly measures how much funding flows from one sector of the economy to another. For Canada, the United Kingdom, and Japan, we impute the holdings of nonfinancial corporate credit instruments from the corresponding overall credit instruments held based on the share of nonfinancial credit outstanding relative to the total domestic credit outstanding at the instrument type level.[3]

Which sectors hold nonfinancial corporate bonds and loans? Figure 5 and Figure 6 plot the time series of the shares of total bonds and loans held by each financial sector. Starting with the holders of nonfinancial corporate bonds, we again observe substantial heterogeneity across countries. The rest of the world and insurance and pension funds hold most of the bonds outstanding in all countries with the exception of Japan where the banking sector holds more than 50% of the bonds. In terms of changes in the time series, we observe that in

[3] For Canada and the United Kingdom, we exclude debt instruments issued by non-residents from the holdings data directly.

the U. S. the share of bonds held by mutual funds has been increasing while the share held by insurance and pension funds has been noticeably shrinking. Moreover, the share of bonds held by the rest of the world has been increasing, consistent with the notion of increasing financial integration.

In terms of the holders of nonfinancial corporate loans, Figure 6 shows that across time and countries the banking sector is the overwhelming holder of loans. It is worth noting that, while OFIs are a significant player in some countries (U. S., U. K, Canada, Italy, and Japan), OFIs hold a negligible share of loans in the rest of the countries in our sample.

3.2 Security-level bond market data

We use security-level bond market data for two purposes in this paper. First, as discussed above, national financial accounts report outstanding bond amounts in market value terms. We thus use secondary market prices to impute book values from the market values reported. Second, as discussed in Section 4, we construct an instrument for bond yields using primary bond market data.

We follow Boyarchenko and Elias (2023) in putting together a granular dataset of firms' primary market issuances, secondary market quotes, and firm financial information. In particular, for corporate bonds, we collect primary market (offering) pricing information from a combination of SDC Platinum New Issues database (capturing information on global corporate bonds) and Mergent FISD (capturing issuance by U. S. companies). The consolidated primary bond market dataset contains information on offering amounts and yields, as well as bond and issuer characteristics such as issuer and parent domicile, issuer industry, currency of issuance, coupon type, coupon rate, coupon payment frequency, bond seniority, and call and put provisions.

We augment the primary bond market information with secondary bond market quotes from

ICE Global Bond Indices and the Lehman Warga Fixed Income database. In particular, we collect the underlying constituents at a monthly frequency from Lehman Warga, the ICE Global Corporate Index and ICE Global High Yield Corporate Index.[4] The underlying constituents data includes effective option-adjusted spread and duration for each bond-day, as well as bond and issuer characteristics, such as issuer domicile, issuer industry, currency of issuance, coupon type and rate, bond seniority, and call and put provisions. Using local-currency fixed-coupon bonds issued by nonfinancial firms domiciled in each country, we construct the annual time series of country-level average bond price, bond duration, and bond yield as the amount-outstanding weighted average of prices, durations, and yields, respectively, as of December of each year.

3.3 Macroeconomic data

We rely on standard sources for the macroeconomic data used in our estimation. In particular, we measure inflation as the annual change in the total CPI, as provided by the IMF. We measure the slack in economic activity using the output gap, produced by the OECD. We use on 10-year government benchmark yields obtained from Haver Analytics to measure long-term sovereign rates.

Finally, we collect information on bank loan interest rates from a variety of sources. We start with bank loan rates as provided by the IMF. For the U. K., we supplement that data with bank loan rates from the "millenium of macroeconomic data" provided by the Bank of England. We collect longer histories of bank loan rates for Germany, Australia, Japan, and Canada from the corresponding national central banks. Where possible, we use the loan rates for loans to nonfinancial firms and adjust the overall level of the data prior to the IMF data to match with the level of the loan rates provided by the IMF at the point of overlap. For France, Italy, and Spain, we collect longer histories of bank loan rates from the ECB.

[4] The Lehman Warga Fixed Income database begins in 1973 but covers primarily U. S. bonds. Hence, starting at the inception of ICE indices in 1998, we switch to using only the ICE indices.

Figure 7 plots the time series of loan rates and size-weighted average secondary market corporate bonds yields for the 9 countries in our sample. The figure shows that, while the level of both loan rates and corporate bond yields has been declining over time in line with the overall secular decline in interest rates, there is time series and cross-country variation in both the overall levels as well as the spread between corporate bond market yields and bank loan interest rates.

4 A supply system approach to credit provision

In this paper, we take a supply system approach to estimating how aggregate economic conditions affect the supply of credit to the real economy.

4.1 Nonfinancial sector

Consider an economy with a nonfinancial sector that is financed by a mixture of bank loans, corporate bonds, and other liabilities. Denote by TD_t the total debt (bank loans and corporate bonds) of the nonfinancial sector at date t and by ι_t loans as a share of total debt so that

$$TD_t = L_t + P_{b,t}B_t; \quad \iota_t = \frac{L_t}{L_t + P_{b,t}B_t}.$$

Here, L_t is the face value of loans outstanding, B_t is the face value of bonds outstanding, and $P_{b,t}$ is the average secondary market price of the bonds outstanding.

We assume that ι_t, the share of (bank) intermediated credit in the economy, is given by a logistic function of the equilibrium bond and loan yields

$$\iota_t = \frac{\gamma_{l,t}}{1 + \gamma_{l,t}}, \tag{3}$$

where

$$\log \gamma_{l,t} = \gamma_0 + \gamma_p \left(y_{b,t} - y_{l,t} \right) + \gamma_m' X_{m,t-1} + \gamma_d D_{b,t} + \eta_t.$$

Here, η_t is a demand shock driving the nonfinancial corporate sector's preferences over loans and bonds, with $\mathbb{E}\left[\eta_t\right] = 0$, and $\gamma_p \geq 0$. Notice that, with these assumptions, we have

$$\log \frac{\iota_t}{1 - \iota_t} = \log \gamma_{l,t}.$$

We assume that total debt, as a fraction of nominal GDP, grows over time as a function of macroeconomic conditions and the share of intermediated credit, so that

$$\Delta \left(\frac{TD}{GDP} \right)_t \equiv \Delta \psi_t = \beta_0 + \beta_m' X_{m,t-1} + \beta_\iota \left(\log \gamma_{l,t} + \log P_{b,t} \right) + \epsilon_t,$$

where $X_{m,t-1}$ is a vector of macroeconomic conditions as of the previous year and ϵ_t is a latent demand shock for debt.

4.2 Financial subsectors

There are N financial subsectors that provide credit to the nonfinancial corporate sector in the economy, indexed by $i = 1, \ldots, N$. Each financial subsector i has total assets $\mathcal{A}_{i,t}$ that it allocates between nonfinancial corporate loans, nonfinancial corporate bonds, and other assets. Denote by $w_{j,i,t}$ the fraction of assets that subsector i allocates to debt instrument j. Following Koijen and Yogo (2019b), we model the portfolio allocations to bonds and loans as a characteristics-based credit supply system. In particular, we represent

$$w_{b,i,t} = \frac{\delta_{b,i,t} P_{b,t}}{1 + \delta_{b,i,t} P_{b,t} + \delta_{l,i,t}}; \quad w_{l,i,t} = \frac{\delta_{l,i,t}}{1 + \delta_{b,i,t} P_{b,t} + \delta_{l,i,t}},$$

where

$$\log \delta_{l,i,t} = \delta_{0,l,i} + \delta_{p,l,i} \left(y_{b,t} - y_{l,t} \right) + \delta_{m,l,i} \vec{X}_{m,t-1} + \delta_{d,l,i} D_{b,t} + u_{l,i,t} \tag{4}$$

$$\log \delta_{b,i,t} = \delta_{0,b,i} + \delta_{p,l,i} \left(y_{b,t} - y_{l,t} \right) + \delta_{m,b,i} \vec{X}_{m,t-1} + \delta_{d,b,i} D_{b,t} + u_{b,i,t}. \tag{5}$$

Notice that the share equation for the allocation to bonds includes an extra $P_{b,t}$ term that recognizes that, while loans are reported in national financial accounts on a book value basis, bonds are reported on a market value basis. We refer to $u_{j,i,t}$ as the latent supply of debt of type j by sector i, which captures the willingness of sector i to provide credit with the unobserved characteristics of debt type j. We normalize the mean of the latent supply $u_{j,i,t}$ to be 0 for each subsector i, so that the intercept $\delta_{0,j,i}$ in (4)–(5) is identified. The intercept $\delta_{0,j,i}$ and latent supply $u_{j,i,t}$ thus play different roles in the asset allocation of financial subsector i. While $\delta_{0,j,i}$ determines the willingness of subsector i to hold security i relative to the willingness of subsector i to invest in other asset types, $u_{j,i,t}$ captures the relative willingness to provide credit through bonds relative to loans. Notice that, by construction, the sum of the portfolio shares equals 1, so that we can represent the share of assets allocated to other instruments as

$$w_{0,i,t} = \left(1 + \delta_{b,i,t} P_{b,t} + \delta_{l,i,t}\right)^{-1},$$

so that

$$\log \frac{w_{b,i,t}}{w_{0,i,t}} = \log \delta_{b,i,t} + \log P_{b,t}; \quad \log \frac{w_{l,i,t}}{w_{0,i,t}} = \log \delta_{l,i,t}.$$

4.3 Market clearing

In equilibrium, the nonfinancial sector bonds and loans outstanding have to be held by the financial subsectors. That is,

$$(1-\iota_t)\,TD_t = \sum_{i=1}^{N} w_{b,i,t}\mathcal{A}_{i,t}; \quad \iota_t TD_t = \sum_{i=1}^{N} w_{l,i,t}\mathcal{A}_{i,t}. \tag{6}$$

The market clearing conditions imply equilibrium conditions for the promised payments on nonfinancial corporate debt, $y_{b,t}$ and $y_{l,t}$, and thus allow us to determine the elasticities of the promised payments with respect to macroeconomic fundamentals. In particular, taking logs of both sides of the market clearing conditions, we have

$$gdp_t + \log\left(\psi_{t-1} + \Delta\psi_t\right) + \log\left(1-\iota_t\right) = \log\left(\sum_{n=1}^{N} w_{b,n,t}\mathcal{A}_{n,t}\right)$$
$$gdp_t + \log\left(\psi_{t-1} + \Delta\psi_t\right) + \log \iota_t = \log\left(\sum_{n=1}^{N} w_{l,n,t}\mathcal{A}_{n,t}\right).$$

For future use, denote also the share of loans and bonds outstanding supplied by sector n, respectively, as

$$\lambda_{l,n,t} \equiv \frac{w_{l,n,t}\mathcal{A}_{n,t}}{\sum_{k=1}^{N} w_{l,k,t}\mathcal{A}_{k,t}}; \quad \lambda_{b,n,t} \equiv \frac{w_{b,n,t}\mathcal{A}_{n,t}}{\sum_{k=1}^{N} w_{b,k,t}\mathcal{A}_{k,t}}.$$

In Appendix A, we use the market clearing conditions to derive the elasticities of the bond yield, the loan rate, and the average bond duration to macroeconomic conditions. In turn, we use these derivatives to compute the elasticities of our objects of interest – demand for credit by the nonfinancial corporate sector and the supply of credit by the financial sectors – with respect to macroeconomic conditions and bond and loan rates. These elasticities are determined by the estimated parameters of the credit demand-supply system and, more importantly, by the share of bonds and loans supplied by each financial sector, as well as the asset allocation of each financial sector to bonds and loans.

4.4 Granular instrumental variables

The credit demand and supply system described above features bond and loan prices (in yield form) on both sides of the system. In our estimation, we will use a granular instrumental variable approach to instrument for the spread between bond yields and loan interest rates. In particular, consider the bond yields and loan rates on individual securities represented as

$$y_{i,l,t+1} = \phi_l^s \Delta l_{t+1} + \lambda_{i,l}\xi_{l,t+1} + \upsilon_{i,l,t+1}$$
$$y_{i,b,t+1} = \phi_b^s \Delta b_{t+1} + \lambda_{i,b}\xi_{b,t+1} + \upsilon_{i,b,t+1},$$

where Δl_{t+1} and Δb_{t+1} are (log) growth rates of aggregate bond and loan outstanding, $\xi_{l,t+1}$ and $\xi_{b,t+1}$ are aggregate factors, and $\upsilon_{i,l,t+1}$ and $\upsilon_{i,b,t+1}$ are shocks idiosyncratic to each security. The Gabaix and Koijen (Forthcoming) granular instrumental variables approach uses the fact that securities' sizes – security-level amount outstanding in our implementation – are not the same across securities, so that a size-weighted average yield is not the same as an equal-weighted average yield. Denote by $\vec{\omega}_{l,t+1}$ and $\vec{\omega}_{b,t+1}$ the vector of amount outstanding weights. Then, on a size-weighted basis, we have

$$y_{l,t+1} = \phi_l^s \Delta l_{t+1} + \vec{\omega}_{l,t+1}' \vec{\lambda}_l \xi_{l,t+1} + \upsilon_{\omega,l,t+1}$$
$$y_{b,t+1} = \phi_b^s \Delta b_{t+1} + \vec{\omega}_{b,t+1}' \vec{\lambda}_b \xi_{b,t+1} + \upsilon_{\omega,b,t+1},$$

where $\upsilon_{\omega,l,t+1}$ and $\upsilon_{\omega,b,t+1}$ are the size-weighted average idiosyncratic shocks. Similarly, we can represent the equal-weighted yields as

$$\bar{y}_{l,t+1} = \phi_l^s \Delta l_{t+1} + \bar{\lambda}_l \xi_{l,t+1} + \bar{\upsilon}_{l,t+1}$$
$$\bar{y}_{b,t+1} = \phi_b^s \Delta b_{t+1} + \bar{\lambda}_b \xi_{b,t+1} + \bar{\upsilon}_{b,t+1}.$$

The difference between the size-weighted and the equal-weighted yields thus removes the influence of the changes in aggregate amounts of bond and loan outstanding from the corresponding yield equations.

We construct the GIV for bond spreads at a country-year level as the difference between amount-outstanding weighted average primary market duration-matched spread and equal-weighted average primary market duration-matched spread for all the nonfinancial, fixed coupon corporate bond issuances in a given country-year. We use local currency bonds only, matching bonds to the country of the ultimate corporate parent, following the procedure in Boyarchenko and Elias (2023). One potential concern with amount-outstanding weighted average credit spreads is that larger firms can potentially have larger securities outstanding, and this could mean that larger securities represent a significant part of overall debt issuance. Figure A.2 shows, however, that there is little correlation between firm and bond size.

5 Estimation results

In this section, we describe the approach we take to estimate the credit demand-supply system in more detail, and present the basic results on the elasticities of the demand for credit and the supply of credit with respect to bond yields and loan rates.

5.1 Estimation approach

The credit demand-supply system described in the previous section can be summarized as a set of four estimation equations. From the nonfinancial sector's side, the demand for credit and the relative preference between borrowing using loans and using corporate bonds are described by

$$\Delta\psi_t = \beta_0 + \beta_m' X_{m,t-1} + \beta_\iota \left(\log \frac{\iota_t}{1-\iota_t} + \log P_{b,t} \right) + \epsilon_t$$

$$\log \frac{\iota_t}{1-\iota_t} = \log \gamma_{l,t} = \gamma_0 + \gamma_p \left(y_{b,t} - y_{l,t} \right) + \gamma_m' X_{m,t-1} + \gamma_d D_{b,t} + \eta_t.$$

For a given financial sector, that sector's holdings of corporate bonds and loans relative to the rest of the assets are summarized by

$$\begin{aligned}
\log \frac{w_{l,n,t}}{1-w_{l,n,t}-w_{b,n,t}} &= \log \delta_{l,n,t} \\
&= \delta_{0,l,n} + \delta_{p,l,n} \left(y_{b,t} - y_{l,t} \right) + \delta_{m,l,n} \vec{X}_{m,t-1} + \delta_{d,l,n} D_{b,t} + u_{l,n,t} \\
\log \frac{w_{b,n,t}}{1-w_{l,n,t}-w_{b,n,t}} - \log P_{b,t} &= \log \delta_{b,n,t} \\
&= \delta_{0,b,n} + \delta_{p,b,n} \left(y_{b,t} - y_{l,t} \right) + \delta_{m,b,n} \vec{X}_{m,t-1} + \delta_{d,b,n} D_{b,t} + u_{b,n,t}.
\end{aligned}$$

Estimating this system requires identifying assumptions as the bond and loan interest rates are determined jointly with the latent demand for credit ϵ_t, the latent relative preference for borrowing through loans η_t, the latent credit supply shocks $\{u_{l,n,t}\}$ and $\{u_{b,n,t}\}$, and the overall state of the economy. The baseline identification assumption is

$$\mathbb{E} \left[\begin{array}{c} \epsilon_t \\ \eta_t \\ u_{l,n,t} \\ u_{b,n,t} \end{array} \middle| X_{m,t-1}, \iota_t, y_{b,t} - y_{l,t} \right] = \vec{0}, \tag{7}$$

so that lagged macroeconomic conditions and the contemporaneous intermediated credit share choice of the nonfinancial corporate sector are exogenous to the overall supply of credit and the financial sectors' allocation across bonds and loans.

We relax the identification assumption (7) using the granular instrumental variable approach as described in greater detail in Section 4. In particular, we use the GIV constructed from primary market corporate bond spreads to instrument both the spread between bond and loan rates ($y_{b,t} - y_{l,t}$) and the log relative share of intermediated credit ($\log \gamma_{l,t}$). Using the GIV, the identification assumption becomes

$$\mathbb{E}\left[\begin{array}{c|c} \epsilon_t & \\ \eta_t & \\ u_{l,n,t} & X_{m,t-1}, z_t \\ u_{b,n,t} & \end{array}\right] = \vec{0}, \tag{8}$$

where z_t is the primary market GIV.

We estimate (8) sector-by-sector and, in the case of the financial sectors, instrument-by-instrument, pooling across the countries and the time series observations in our sample. We exclude the pandemic and post-pandemic years (2020 – 2022) from our estimation both because the majority of jurisdictions in our sample provided emergency credit support to the nonfinancial sector during the COVID-19 pandemic and to avoid a potentially outsized effect of the post-pandemic inflation experience on our point estimates. We include country fixed effects in the estimation o account for cross-country heterogeneity in overall credit growth, the share of intermediated credit, and the composition of the financial sectors.

Table 3a reports the estimated coefficients and the results of the F-test from the first stage IV regressions of the bond-loan spread and the log-share of intermediated credit. The table shows that the instrument constructed with primary market data is a relevant instrument for both variables of interest. Turning next to the estimation of the nonfinancial sectors demand for credit, the first column of Table 3b shows that the share of intermediated credit increases in the (instrumented) bond-loan spread. That is, when bonds are expensive relative to loans, the nonfinancial sector increases the share of loans in their total amount of credit borrowed. Moreover, the first column also shows that the share of intermediated credit increases with the 10-year sovereign bond yield perhaps capturing an increased preference for shorter duration instruments (loans) when long rates are high.

The second column of Table 3b shows that, in turn, the growth in total debt to GDP increases with the (instrumented) share of intermediated credit. That is, years with a higher share of borrowing through loans are associated with higher overall debt growth. Together with the results discussed in the context of Table 1, the results here suggest that one of the channels through which bank credit has a particularly negative effect on subsequent GDP growth is by tilting the composition of nonfinancial credit towards loans and, in turn, increasing the overall rate of debt growth. The second column of Table 3b also shows that, as expected, debt growth is higher when real activity is higher and inflation is lower. Perhaps more surprisingly, the point estimate on the long rate is not statistically significant once we control for the share of intermediated credit.

Table 4 reports the estimation results of the lender side of our system. Starting with Table 4b, we see that the sectors that are major holders of loans (MFI, OFIs, and RoW) decrease their share of loans when bonds pay more relatively to loans (when the bond-loan spread is high). On the other hand, the HH/NPISH sector seems to be contrarian, increasing the relative allocation to loans when the (instrumented) bond-loan spread is high. In a similarly contrarian fashion, Table 4a shows that MF, Ins/PF, and RoW decrease their relative allocation to bonds when the (instrumented) bond-loan spread is high. The rest of the sectors do not adjust their relative bond holdings in response to changes in the bond-loan spread. As we saw in Table 3b, the nonfinancial sector decreases their borrowing through bonds when the bond-loan spread is high. The results in Table 4a thus suggest that mutual funds, insurance companies, pension funds, and the external sectors are the lenders that adjust their holdings to accommodate the decreased demand for bond financing.

Table 4 also shows that the MFIs, Ins/PF, and OFIs increase the overall provision of credit to the nonfinancial sector when long rates are high, as the estimated coefficient on the 10 year sovereign yield is positive in both the loan and bond allocation equations for these sectors. The HH/NPISH sector reallocates lending from loans to bonds as long rates increase, while the external sector increases its allocation to loans. Notably, the rest of the controls – the lagged output gap, lagged inflation, and the average duration of corporate bonds outstanding – are not systematically statistically significant predictors of the lender sectors' allocation to bonds and loans. The HH/NPISH sector exhibits an overall dislike for duration, reducing their overall lending to the nonfinancial sector when bond duration is high, while the MFIs reallocate from bonds into loans when bond duration increases.

A potential concern with the results in Table 4 is the definition of the MFI sector – which includes central banks in our baseline estimation – and of the insurance and pension fund sector. In Appendix Table A.3 we show, however, that the estimated coefficients for the MFI sector excluding central banks ("MFIexCB") are similar to those for the overall MFI sector. Likewise, the coefficients estimated separately for the insurance company sector and the pension fund sector are similar to the coefficients estimated for the overall insurance and pension fund sector.

While the point estimates discussed in this section give a partial equilibrium estimate of the sensitivity of demand for credit and supply of credit to macroeconomic conditions and credit spreads, a full general equilibrium understanding of how these variables respond to macroeconomic conditions requires computing elasticities. We describe the elasticities implied by our point estimates in the next subsections, starting with nonfinancial sector's borrowing and then moving to the financial sector's lending. In computing the elasticities, we only use the coefficients that are statistically significant at at least the 90% confidence level, and set the rest of the coefficients (that is, those for which the point estimates are not statistically significant at conventional levels) to 0.

5.2 Aggregate conditions and credit spreads

As shown in Appendix A, we compute all elasticities of interest by first computing the elasticities of the loan rate and the bond duration with respect to the bond yield, and then the elasticities of the bond yield with respect to aggregate conditions. Together with the share of intermediated credit in the economy, the share of loans and bonds provided by each lender sector, and the asset allocation of each lender sector to nonfinancial corporate bonds and loans, these three basic types of elasticities provide the information necessary to compute all subsequent elasticities.

Figure 8 plots the time series of the country-level elasticities of the loan rate (8a) and bond duration (8b) with respect to the bond yield. In equilibrium, loan rates increase more than one-for-one when bond yields increase. Loan rate elasticity with respect to bond yields is smallest (closest to 1) for the U. S. and largest for the U. K., Germany, and Japan. Bond duration decreases when bond yields increase, with a one percentage point increase in bond yields corresponding to a half year decrease in duration on average in the U. S. and more than 1.5 years decrease in duration on average in Australia, Japan, and the U. K. It is worth emphasizing that, in computing these elasticities, we use the pooled coefficient estimates, so that the cross-country and time series variation in the implied elasticities is due to heterogeneity in the composition of the financial sectors and in the willingness of the financial sectors to lend through either bonds or loans to the nonfinancial corporate sector.

Figure 9 then plots the time series of the country-level elasticities of the bond yield (first column), loan rates (second column), and bond duration (third column) to aggregate conditions. Bond yields and loan rates increase when long term rates increase, with a less than one-for-one passthrough. The elasticity of credit rates with respect to the 10 year sovereign yield is again lowest in the U. S., highlighting the unique nature of credit provision in the U. S. Consistent with the absence of a partial equilibrium effect of macroeconomic conditions (output gap and inflation) on the portfolio allocation choices of the financial sectors, the output gap and inflation have a much smaller effect on credit spreads than long term rates do, with bond yields and loan rates increasing when inflation is higher and the output gap is more negative. Moreover, the elasticities with respect to the macroeconomic conditions have decreased over our sample period.

5.3 Nonfinancial sector borrowing and aggregate conditions

Figure 10 plots the time series of the elasticity of intermediated credit with respect to macroeconomic conditions and the bond yield. Starting with Panel (a), we observe that the elasticity of the share of intermediated credit with respect to the bond yield is consistently negative across time and countries. That is, as borrowing through bonds becomes more expensive, firms borrow a higher share through bonds. While this result seems counterintuitive, it is explained by the fact that loan rates move more than one-for-one with bond yields, as shown in Figure 8a. In other words, in equilibrium, when bond yields go up, loan rates go up relatively more, making bonds relatively cheaper than loans. The elasticity of the share of intermediated credit with respect to the bond yields is economically meaningful. Relative to a cross-country sample average share of intermediated credit of around 70%, a one percentage point increase in the bond yield decreases the share by between 1 and 3 percentage points.

In contrast, increases in the 10 year sovereign yields (Panel b) increase the share of intermediated credit. That is, the direct positive effect of long rate changes dominates the indirect negative effect through changes in the bond-loan spread. The share of intermediated credit also increases when the output gap is smaller (Panel c) and when inflation is higher (Panel d), but the magnitude of the elasticities of the share of intermediated credit with respect to macroeconomic conditions is an order of magnitude smaller than the magnitude of the elasticity with respect to long rates (and two orders of magnitude smaller than the elasticity with respect to bond yields).

Figure 11 then plots the time series of the elasticity of total debt to GDP with respect to macroeconomic conditions and the bond yield. Increases in both the bond yield and the 10 year sovereign yield lead to slowdowns in credit growth. This result holds across time and countries. However, some differences are worth noting. First, outside the U. S., the sensitivities to both yields are considerably higher, so that credit growth is more responsive to the price of corporate bonds and long-term government bonds. Second, the sensitivity to bond yields has increased considerably over the sample period for all countries. Except for the U. S., the responsiveness of credit growth to sovereign yields has also increased considerably.

5.4 Financial sector lending and aggregate conditions

We now turn to the elasticities of the portfolio shares of each financial sector with respect to the bond yield. Figure 12 plots the time series of sensitivities of bond weights to bond yields. The figure shows that most sectors in most countries have a positive elasticity. That is, they increase the allocation to bonds when bond yields increase. OFIs in all countries and MF, Ins/PF, and (at times) the RoW in the U. S. display negative elasticities. As discussed above, the U. S. financial sector looks like an outlier when compared to the financial sectors of the rest of the countries in our sample. These estimated elasticities are economically meaningful. For example, relative to the sample of average of 5% of Ins/PF assets allocated to bonds, a 1 percentage point increase in the bond yield increases the allocation to bonds by up to 30 basis points.

Similarly, Figure 13 plots the elasticity of the portfolio allocation to loans with respect to the bond yield. MFI, Ins/PF, and RoW in all countries have a negative elasticity. That is, those sectors reduce their allocation to loans when bond yields go up. MF in all countries except the U. S. also display a negative elasticity. On the other hand, HH/NPISH and OFIs seem to increase their loan allocation when bond yields go up.

Overall, the results discussed above can be summarized as follows. HH/NPISH increase their overall allocation to corporate credit when bond yields go up. MFI, Ins/PF, and RoW are substituting from loans into bonds as bond yields increase. Finally, OFIs substitute from bonds into loans. All together, these results show substantial heterogeneity in how different financial sectors manage their bond and loan holdings in response to changes in the relative prices of bonds and loans. How such heterogeneity affects credit growth and boom financing overall is the subject of the next section.

6 Financial sectors and boom financing

The results in the previous section show that lender sectors respond differentially to aggregate conditions and that the sensitivity of each sector's choice to provide credit to nonfinancial firms with respect to government yields and corporate credit spreads varies over time and across countries. In this section, we return to the question of the extent to which the composition of the lender sectors in the economy affects credit growth in the economy.

6.1 Motivating example

We begin by illustrating how changes in financial sectors' balance sheets and allocations contribute to overall credit growth using a simple accounting exercise, which attributes the growth in total nonfinancial firm credit relative to nominal GDP to either growth in the size of sectors that are large suppliers of credit or to reallocation of financial sectors' portfolios to providing credit to nonfinancial firms

$$\Delta\hat{\psi}_t = \sum_{n=1}^{N} \left\{ (w_{b,n,t} + w_{l,n,t}) \frac{A_{n,t}}{GDP_t} - (w_{b,n,t-1} + w_{l,n,t-1}) \frac{A_{n,t-1}}{GDP_{t-1}} \right\}$$
$$= \sum_{n=1}^{N} \left\{ (w_{b,n,t} + w_{l,n,t}) \left(\frac{A_{n,t}}{GDP_t} - \frac{A_{n,t-1}}{GDP_{t-1}} \right) + ((w_{b,n,t} + w_{l,n,t}) - (w_{b,n,t-1} + w_{l,n,t-1})) \frac{A_{n,t-1}}{GDP_{t-1}} \right\}.$$

We use the U. S. as a case study for evaluating how financial sectors' growth and portfolio allocation decisions translate into changes in the overall credit supplied to the nonfinancial firm sector. The top panel of Figure 14 plots the time series of annual changes in nonfinancial firm debt outstanding as a ratio to nominal GDP, together with changes in the credit supplied (as a fraction of nominal GDP) for each of the 6 financial subsectors. Historically, most of the adjustments in the credit borrowed by nonfinancial firms in the U. S. were due to a changing amount of credit provided by MFIs. Starting in the late 1980s, however, changes in credit provided by domestic non-bank financial institutions have become a more important source of variation in overall nonfinancial firm credit borrowed. Bank and non-bank financial institutions furthermore had a differential response to the global financial crisis, with credit provided by MFIs and OFIs contracting sharply and Ins/PF, MFs, and HH/NPISH partially offsetting that credit contraction. This finding is consistent with the HH/NPISH sector capturing investments by hedge funds and hedge funds acting as contrarian investors, as well as with the Chodorow-Reich et al. (2021) intuition that insurance companies act as "asset insulators" and do not necessarily sell securities with depressed valuations during the financial crisis.

The remaining panels of Figure 14 decompose changes in credit provision by each individual sector into changes in bonds and loans held due to changes in total assets of the corresponding sector ($w_{b,n,t}\Delta A_{n,t}$ and $w_{l,n,t}\Delta A_{n,t}$, respectively) and changes in the allocation to bonds and loans ($\Delta w_{b,n,t} A_{n,t-1}$ and $\Delta w_{l,n,t} A_{n,t-1}$, respectively). It is worth highlighting three features of these charts. First, most sectors adjust the provision of credit to the nonfinancial sector primarily through either overall asset growth or through adjustments in the allocation to their preferred credit instrument. For example, insurance companies and pension funds adjust provision of credit to the nonfinancial firm sector by adjusting both their absolute holdings of corporate bonds (adjustments due to changes in the size of the Ins/PF sector) and by adjusting the portfolio allocation to corporate bonds. In contrast, MFIs primarily adjust provision of credit to the nonfinancial firm sector by adjusting both their absolute holdings of loans (adjustments due to changes in the size of the MFI sector) and by adjusting the portfolio allocation to corporate loans.

Second, for most of the years in our sample, MFIs adjust their holdings of nonfinancial firm loans primarily because of changes to the total assets of the MFI sector. However, during economic recessions, not only do the total assets of the MFI sector decline (and thus the dollar holding of loans under the counterfactual of a constant portfolio share of loans), but also the MFI sector allocates a smaller fraction of their assets to loans to nonfinancial firms. That is, credit provision by the banking sector declines during economic downturns both because total assets of the banking sector shrink and because the banking sector allocates a smaller proportion of assets to providing firm credit.

Finally, the figure shows that the global financial crisis was additionally characterized by a contraction in both the size of the OFI sector, as well as a decrease in the allocation of assets towards loans. In contrast, the historical overall dynamics of credit provision by OFIs were not generally different around recessions.

6.2 Variance decomposition

While the simple accounting exercise above provides an indication of how different sectors contribute to overall debt growth in the economy, we are interested in how changes in aggregate conditions and demand- and supply-side factors translate into changes in the equilibrium pricing of bonds and loans and therefore into changes in overall debt-to-GDP and the share of intermediated credit. To answer this question, we borrow once again the techniques from the demand-based asset pricing literature and introduce variance decompositions of total credit growth and the growth in the share of intermediated credit and proceed as follows. First, from the market clearing conditions (6) for the markets for corporate bonds and loans, we can represent the market clearing bond price $P_{b,t}$ and loan interest rate $y_{l,t}$ as implicit functions of macroeconomic conditions gdp_t and $X_{m,t-1}$, lagged total debt to GDP ψ_{t-1}, average bond time-to-maturity $T_{b,t}$, average bond coupon payments $C_{b,t}$, the vector of financial sector assets $\vec{A}_t$, latent demand for debt ϵ_t, latent demand for loans over bonds η_t, and latent supply of loans $\vec{u}_{l,t}$ and bonds $\vec{u}_{b,t}$

$$\begin{aligned}
P_{b,t} &= \Pi_b\left(\text{gdp}_t, X_{m,t-1}, \psi_{t-1}, T_{b,t}, C_{b,t}, \vec{A}_t, \epsilon_t, \eta_t, \vec{u}_{l,t}, \vec{u}_{b,t}\right)\\
y_{l,t} &= \Upsilon_l\left(\text{gdp}_t, X_{m,t-1}, \psi_{t-1}, T_{b,t}, C_{b,t}, \vec{A}_t, \epsilon_t, \eta_t, \vec{u}_{l,t}, \vec{u}_{b,t}\right).
\end{aligned}$$

In our variance decomposition, we will group aggregate conditions (other than the level of the 10 year sovereign yield) into a single vector of macroeconomic conditions

$$\mathcal{M}_t = \left[\text{gdp}_t \quad \text{output gap}_{t-1} \quad \text{inflation}_{t-1}\right],$$

so that we can represent

$$\begin{aligned}
P_{b,t} &= \Pi_b\left(\mathcal{M}_t, \text{10 year sov}_t, \psi_{t-1}, T_{b,t}, C_{b,t}, \vec{A}_t, \epsilon_t, \eta_t, \vec{u}_{l,t}, \vec{u}_{b,t}\right)\\
y_{l,t} &= \Upsilon_l\left(\mathcal{M}_t, \text{10 year sov}_t, \psi_{t-1}, T_{b,t}, C_{b,t}, \vec{A}_t, \epsilon_t, \eta_t, \vec{u}_{l,t}, \vec{u}_{b,t}\right).
\end{aligned}$$

We can thus decompose changes in the equilibrium prices of bonds and loans into changes due to changes in macroeconomic conditions, the long-term interest rate, the level of total debt to GDP, bond remaining time to maturity and coupon, financial sector assets, and the latent demand and supply of bonds and loans. Each of these components is additive so that, for example, the change in the bond price due to changes in bond maturity is given by

$$\begin{aligned}\Delta P_b\left(T_{b,t+1}\right) = {} & \Pi_b\left(\mathcal{M}_{t+1}, 10 \text{ year sov}_{t+1}, \psi_t, T_{b,t+1}, C_{b,t}, \vec{A}_t, \epsilon_t, \eta_t, \vec{u}_{l,t}, \vec{u}_{b,t}\right) \\ & - \Pi_b\left(\mathcal{M}_{t+1}, 10 \text{ year sov}_{t+1}, \psi_t, T_{b,t}, C_{b,t}, \vec{A}_t, \epsilon_t, \eta_t, \vec{u}_{l,t}, \vec{u}_{b,t}\right).\end{aligned}$$

We use the market clearing conditions to solve for the counterfactual bond prices and loan interest rates under each of these counterfactual scenarios. The counterfactual bond price, maturity and coupon then give us a counterfactual bond yield (and hence bond-loan spread) and bond duration.

The counterfactual evolution of macroeconomic conditions, long-term interest rates, total debt to GDP, bond remaining time to maturity and coupon, financial sector assets, latent demand and supply, and the corresponding counterfactual market clearing prices then imply counterfactuals for total debt to GDP and the share of intermediated credit. We can thus represent growth in total debt to GDP as

$$\begin{aligned}\Delta\psi_{t+1} = {} & \Delta\psi\left(\mathcal{M}_{t+1}\right) + \Delta\psi\left(10 \text{ year sov}_{t+1}\right) + \Delta\psi\left(\psi_t\right) + \Delta\psi\left(T_{b,t+1}\right) + \Delta\psi\left(C_{b,t+1}\right) \\ & + \Delta\psi\left(A_{MFI,t+1}\right) + \Delta\psi\left(A_{OFI,t+1}\right) + \Delta\psi\left(A_{NBFI,t+1}\right) + \Delta\psi\left(A_{RoW,t+1}\right) + \Delta\psi\left(A_{Other,t+1}\right) \\ & + \Delta\psi\left(\epsilon_{t+1}\right) + \Delta\psi\left(\eta_{t+1}\right) + \Delta\psi\left(u_{l,MFI,t+1}\right) + \Delta\psi\left(u_{l,OFI,t+1}\right) + \Delta\psi\left(u_{l,NBFI,t+1}\right) \\ & + \Delta\psi\left(u_{l,RoW,t+1}\right) + \Delta\psi\left(u_{l,Other,t+1}\right) + \Delta\psi\left(u_{b,MFI,t+1}\right) \\ & + \Delta\psi\left(u_{b,OFI,t+1}\right) + \Delta\psi\left(u_{b,NBFI,t+1}\right) + \Delta\psi\left(u_{b,RoW,t+1}\right) + \Delta\psi\left(u_{b,Other,t+1}\right) + \Delta\psi_t.\end{aligned}$$

Here, we have grouped mutual funds, insurance companies and pension funds, and the household (hedge fund) sectors into a single non-bank financial intermediary (NBFI) sector, and the small balancing sectors (holdings by the nonfinancial corporate sector itself and the overall government sector) into the "other" sector. Taking the covariance of both sides of the above with $\Delta\psi_{t+1}$ then gives us the variance decomposition of growth in total debt to

GDP. Similarly, we can represent the change in the share of intermediated credit as

$$
\begin{aligned}
\iota_{t+1} - \iota_t = {} & \iota\left(\mathcal{M}_{t+1}\right) + \iota\left(10 \text{ year sov}_{t+1}\right) + \Delta\psi\left(\psi_t\right) + \iota\left(T_{b,t+1}\right) + \iota\left(C_{b,t+1}\right) \\
& + \iota\left(A_{MFI,t+1}\right) + \iota\left(A_{OFI,t+1}\right) + \iota\left(A_{NBFI,t+1}\right) + \iota\left(A_{RoW,t+1}\right) + \iota\left(A_{Other,t+1}\right) \\
& + \iota\left(\epsilon_{t+1}\right) + \iota\left(\eta_{t+1}\right) \\
& + \iota\left(u_{l,MFI,t+1}\right) + \iota\left(u_{l,OFI,t+1}\right) + \iota\left(u_{l,NBFI,t+1}\right) + \iota\left(u_{l,RoW,t+1}\right) + \iota\left(u_{l,Other,t+1}\right) \\
& + \iota\left(u_{b,MFI,t+1}\right) + \iota\left(u_{b,OFI,t+1}\right) + \iota\left(u_{b,NBFI,t+1}\right) + \iota\left(u_{b,RoW,t+1}\right) + \iota\left(u_{b,Other,t+1}\right).
\end{aligned}
$$

Taking the covariance of both sides with $\iota_{t+1} - \iota_t$ likewise gives us the variance decomposition of changes in the share of intermediated credit.

6.3 Contributions to growth in total debt to GDP

Table 5 reports the variance decomposition of the growth in debt-to-GDP, $\Delta\psi_t$, into contributions from aggregate conditions and demand and supply conditions. The first column, "All", reports the panel variance decomposition using all pre-2020 country-year observations in the sample. The remaining 5 columns report the time-series variance decomposition using pre-2020 annual observations within each country.

Starting with the top row, which reports the contribution of the lagged growth in debt-to-GDP, we see that, in the full panel, lagged growth in debt-to-GDP explains 43.5% of the overall variation, so that growth in debt-to-GDP is somewhat persistent. The other major contributor to the panel variance decomposition is the latent demand for debt, ϵ, which explains 49% of the overall variation in the growth of debt-to-GDP.

Turning to the variation across countries, we see that variation in the overall macroeconomic environment explains 40% of the variation in debt-to-GDP growth in the U. S. but a much smaller fraction of the debt-to-GDP growth variance in the rest of the countries. Moreover, the latent demand for debt contributes much less (-10%) in the U. S. than in the rest of the countries, highlighting that debt grows in a different way in the U. S. than even the rest of the large advanced economies.

Consider finally the contributions of the different financial sectors to debt-to-GDP growth. Table 5 shows that the growth in assets of the individual financial sectors contributes little overall to the variation in debt-to-GDP growth. Banking sector asset growth in the U. S., U. K., and Australia explains around 4% of the total variation in each country's debt-to-GDP growth, while growth in the NBFI sector in the U. S. and Canada explains an additional 1%. The latent supply of loans $\vec{u}_l$ and bonds $\vec{u}_b$, however, explains a substantial amount of the variance of debt-to-GDP growth but with opposite signs. That is, latent supply of loans is positively correlated with growth in debt-to-GDP while the latent supply of bonds is negatively correlated. Moreover, which sector's latent supply matters is different across loans and bonds. For example, in the U. S., the latent supply of loans by the MFIs and OFIs explains almost 11% of the overall variance in debt-to-GDP growth, while it is the latent supply of bonds by the external sector that explains -11% of the overall variance.

6.4 Contributions to changes in the share of intermediated credit

We now consider the variance decomposition in the annual change in the share of intermediated credit, reported in Table 6. In contrast to the variance decomposition of debt-to-GDP growth we saw in Table 5, variation in macroeconomic conditions no longer represents a large percentage of the overall variance in most of the countries in our sample. Instead, variation in the level of long-term (sovereign) yields explains a substantial fraction of the overall variation in the share of intermediated credit, ranging from 35% in the panel to 14% in the U. K. and as much as 54% in France. This is not surprising given the long-duration nature of corporate bonds and the sensitivity of corporate bond pricing to long-term rates.

Also, unlike the variance decomposition of the growth in debt-to-GDP, the size of the financial sector explains a large fraction of the variance of changes in the share of intermediated credit. Across the economies in our sample, changes in the sizes of the banking and OFIs sectors are positively correlated with changes in the share of intermediated credit. These two sectors together explain almost 20% of the variance in the U. S. and 30% of the variance in the overall panel.

Finally, there is substantial variation across countries in how lagged debt-to-GDP and the latent demand for intermediated credit η contribute to changes in the share of intermediated credit. While lagged debt-to-GDP is negatively correlated with changes in the share of intermediated credit in the U. S. and Australia, the correlation is positive in the rest of the countries in our sample, hinting again at different modes of credit growth across countries. In terms of the variation due to the latent demand for intermediated credit, we see that outside of Canada and France this variation explains upwards of 40% of the overall variation in the share of intermediated credit. In Canada, in contrast, variation in latent demand for intermediated credit explains less than 5% of the variance of the share of intermediated credit and is negatively correlated with the share of intermediated credit in France.

7 Conclusion

Our paper documents that who *lends* to finance private credit expansions matters for subsequent real outcomes. We use a demand asset pricing model to link the willingness of financial sectors to provide credit to nonfinancial firms to macroeconomic fundamentals and to decompose credit expansions into contributions from demand-side and supply-side factors. We show that the sensitivity of the provision of credit through loans and corporate bonds to changes in the macroeconomic environment depends crucially on the composition of the financial sector. Monetary financial institutions and shadow banks primarily provide credit through loans, while insurance companies and pension funds primarily provide credit through corporate bonds. Thus, the differential sensitivities in bank and non-bank balance sheet health to prolonged periods of loose monetary policy, together with cross-country heterogeneity in bank-dependence of the financial sector, translate into different patterns of overall credit provision and a different share of intermediated credit over time. With continuing post-crisis expansion of corporate credit accompanied by a diminished role of banks as both lenders in the loan market and investors in debt securities (Aldasoro and Ehlers, 2018), understanding how lender composition and borrower demand for different credit instruments come together to finance credit cycles is crucial from a financial stability perspective.

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Table 1: Average real GDP growth predictability. This table reports the estimated coefficients from the predictive regression of cumulative h year real GDP growth. Private credit measured as the sum of household credit and nonfinancial corporate credit. Non-bank credit measured as the difference between overall private credit and private credit provided by banks. Hodrick (1992) standard errors reported in parentheses below point estimates. All regressions include country fixed effects. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(a) Predictability with total debt

	Current	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y
$\Delta_{t-3,t}$ private credit	-0.03	-0.04	-0.08	-0.12	-0.15	-0.16	-0.16	-0.15	-0.16	-0.15	-0.16
	(0.01)***	(0.01)***	(0.02)***	(0.02)***	(0.03)***	(0.04)***	(0.04)***	(0.05)***	(0.06)***	(0.07)**	(0.08)**
Adj. R-sqr.	-0.01	0.01	0.03	0.04	0.04	0.02	0.01	-0.00	-0.01	-0.01	-0.02
N. of obs	1,468	1,442	1,409	1,376	1,343	1,310	1,277	1,244	1,211	1,178	1,145

(b) Predictability based on provider of credit

	Current	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y
$\Delta_{t-3,t}$ bank credit	-0.00	-0.03	-0.08	-0.14	-0.21	-0.26	-0.29	-0.32	-0.35	-0.36	-0.37
	(0.01)	(0.01)**	(0.02)***	(0.03)***	(0.04)***	(0.06)***	(0.07)***	(0.08)***	(0.09)***	(0.11)***	(0.13)***
$\Delta_{t-3,t}$ non-bank credit	-0.06	-0.05	-0.09	-0.09	-0.06	-0.01	0.03	0.08	0.10	0.13	0.16
	(0.02)***	(0.01)***	(0.02)***	(0.04)**	(0.05)	(0.05)	(0.06)	(0.06)	(0.08)	(0.09)	(0.12)
Adj. R-sqr.	0.01	0.02	0.03	0.05	0.05	0.04	0.04	0.03	0.02	0.01	0.00
N. of obs	1,450	1,424	1,391	1,358	1,325	1,292	1,259	1,226	1,193	1,160	1,127

Table 2: Crisis predictability. This table reports the estimated coefficients from the complimentary log-log regression of the probability of a crisis in h years' time. Crisis defined as year-over-year real GDP growth falling below 2%. Private credit measured as the sum of household credit and nonfinancial corporate credit. Non-bank credit measured as the difference between overall private credit and private credit provided by banks. All regressions include country fixed effects. Hodrick (1992) standard errors reported in parentheses below point estimates. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(a) Predictability with total debt

	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y
$\Delta_{t-3,t}$ private credit	0.03	0.02	0.01	0.01	0.00	0.01	0.00	0.00	-0.00	0.00
	(0.00)***	(0.01)***	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Pseudo log-likelihood	-335.01	-334.84	-332.20	-325.67	-324.03	-319.02	-317.03	-314.73	-307.38	-304.99
N. of obs	1,545	1,512	1,479	1,446	1,413	1,380	1,347	1,314	1,281	1,248

(b) Predictability based on provider of credit

	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y
$\Delta_{t-3,t}$ bank credit	0.03	0.04	0.04	0.04	0.01	0.01	0.01	0.02	0.02	0.01
	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)*	(0.01)
$\Delta_{t-3,t}$ non-bank credit	0.03	-0.02	-0.04	-0.04	-0.01	0.00	-0.00	-0.01	-0.04	-0.01
	(0.01)***	(0.01)	(0.02)*	(0.02)**	(0.02)	(0.01)	(0.02)	(0.02)	(0.04)	(0.02)
Pseudo log-likelihood	-330.90	-326.07	-321.00	-315.50	-319.43	-315.18	-312.96	-310.08	-300.70	-300.52
N. of obs	1,527	1,494	1,461	1,428	1,395	1,362	1,329	1,296	1,263	1,230

Table 3: GIV first stage and nonfinancial sector demand for credit. This table reports the estimated F-statistics from the first stage IV regression of the bond-loan spread and the log share of intermediated credit on the GIV constructed from primary bond market data (Table 3a), together with the estimated coefficients from the instrumented regressions of the share of intermediated credit and the growth in total debt relative to GDP on macroeconomic conditions and the bond-loan spread (Table 3b). Share of intermediated credit defined as the ratio of loans outstanding to the sum of bond and loans outstanding. Hodrick (1992) standard errors reported in parentheses below point estimates. All regressions include country fixed effects. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(a) GIV First Stage

	Bond-loan spread	Log share int. credit
PM bond GIV	-0.17	-0.04
	(0.05)***	(0.02)**
F-stat	9.15	98.73
N. of obs	222	214

(b) Nonfinancial sector demand for credit

	Log share int. credit	$\Delta TD/GDP$
Bond-loan spread	0.30	
	(0.10)***	
10Y sov	0.06	-0.33
	(0.03)**	(0.26)
L.output gap	0.06	0.76
	(0.02)***	(0.17)***
L.inflation	0.03	-0.52
	(0.03)	(0.28)*
Bond duration	0.07	
	(0.06)	
Log share int. credit		5.06
		(2.68)*
F-stat	10.41	18.08
First-stage F-stat	22.57	27.11
N. of obs	201	201

Table 4: Credit supply by financial sectors. This table reports the estimated coefficients from the instrumented regressions of the relative share of financial assets of lender sectors allocated to nonfinancial corporate bonds (Table 4a) and loans (Table 4b) on the bond-loan spread and macroeconomic conditions. "MFI" are monetary financial institutions including central banks, "MF" are non-money market mutual funds, "Ins/PF" are insurance companies and pension funds, "OFIs" are other financial institutions, "HH/NPISH" are households and non-profit institutions serving households, "RoW" is the external sector (rest of the world). Hodrick (1992) standard errors reported in parentheses below point estimates. All regressions include country fixed effects. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(a) Corporate bonds

	HHNPISH	MFI	MF	InsPF	OFIs	RoW	NonFin	Gvt
Bond-loan spread	-0.02	-0.14	-0.13	-0.21	-0.06	-0.28	-0.10	-0.17
	(0.09)	(0.12)	(0.08)*	(0.07)***	(0.18)	(0.07)***	(0.06)	(0.07)**
10Y sov	0.22	0.08	0.04	0.11	0.30	0.03	0.12	0.01
	(0.05)***	(0.03)**	(0.04)	(0.04)***	(0.07)***	(0.04)	(0.03)***	(0.05)
L.output gap	-0.03	0.07	0.03	0.01	0.05	-0.03	-0.03	0.05
	(0.02)	(0.03)**	(0.03)	(0.03)	(0.07)	(0.02)*	(0.02)	(0.03)*
L.inflation	-0.05	-0.05	-0.01	-0.06	-0.02	-0.01	-0.05	-0.09
	(0.07)	(0.05)	(0.04)	(0.05)	(0.12)	(0.03)	(0.03)	(0.06)
Bond duration	-0.22	-0.12	0.07	0.00	0.17	-0.05	0.02	-0.22
	(0.08)***	(0.07)*	(0.08)	(0.06)	(0.12)	(0.08)	(0.07)	(0.09)**
F-stat	9.09	8.66	2.37	6.74	6.21	3.11	3.85	4.30
First-stage F-stat	26.16	26.16	26.16	26.16	26.16	26.16	25.07	25.63
N. of obs	162	162	162	162	162	162	147	157

(b) Loans

	HHNPISH	MFI	MF	InsPF	OFIs	RoW	NonFin	Gvt
Bond-loan spread	0.23	-0.12	0.47	0.04	-0.21	-0.15	-0.23	-0.00
	(0.12)*	(0.06)*	(0.38)	(0.07)	(0.10)**	(0.08)*	(0.07)***	(0.08)
10Y sov	-0.23	0.13	-0.02	0.19	0.10	0.17	0.15	0.05
	(0.06)***	(0.01)***	(0.09)	(0.05)***	(0.03)***	(0.04)***	(0.04)***	(0.03)*
L.output gap	0.03	0.01	0.10	-0.05	0.03	-0.00	-0.03	-0.05
	(0.04)	(0.02)	(0.08)	(0.04)	(0.03)	(0.02)	(0.02)	(0.02)***
L.inflation	-0.02	-0.02	-0.03	0.04	-0.05	0.04	0.02	0.01
	(0.08)	(0.02)	(0.08)	(0.06)	(0.04)	(0.04)	(0.04)	(0.03)
Bond duration	-0.20	0.05	0.11	0.09	-0.06	0.20	0.09	-0.07
	(0.12)	(0.03)	(0.26)	(0.07)	(0.06)	(0.07)***	(0.07)	(0.05)
F-stat	4.25	28.39	1.26	8.60	7.81	4.96	6.98	3.33
First-stage F-stat	16.99	24.80	11.08	24.49	24.80	24.80	25.07	24.80
N. of obs	141	169	120	160	169	169	147	169

Table 5: Variance decomposition of growth in total debt to GDP. This table reports the variance decomposition of annual growth in debt to GDP growth into aggregate conditions and demand and supply-side effects.The "All" column reports the panel variance decomposition using all the pre-pandemic country-year observations. The rest of the columns report time-series variance decomposition within each country using pre-pandemic observations only.

	All	US	CA	GB	FR	AU
Lag	43.56	57.35	15.83	28.63	3.40	41.94
Macro	4.48	39.95	1.75	7.83	12.23	4.88
10Y sov.	1.31	-1.52	-0.37	-0.64	-2.15	1.25
Lag ψ	-0.74	1.32	0.08	0.25	-0.11	-2.13
Bond maturity	-0.33	0.50	-0.25	0.72	-0.40	-1.49
Bond coupon	-0.02	-0.08	-0.20	0.04	0.09	0.08
Bank assets	2.19	4.02	0.26	3.71	0.81	4.34
OFI assets	0.11	0.78	-0.16	0.35	-0.05	0.09
NBFI assets	-0.04	1.20	1.02	0.02	1.28	-0.50
RoW assets	-0.56	0.71	-0.37	-1.78	0.30	-1.02
Other assets	0.19	-0.07	-0.09	0.18	0.25	0.10
ϵ	49.12	-10.00	81.45	63.50	83.46	47.62
η	0.00	-0.71	1.54	1.36	-0.48	-2.68
Bank u_l	1.48	4.32	3.42	1.74	-0.45	-0.90
OFI u_l	0.97	6.48	2.70	1.50	0.08	-0.19
NBFI u_l	0.27	1.33	0.31	0.02	0.86	0.24
RoW u_l	2.10	3.15	1.92	1.65	0.28	3.53
Other u_l	0.76	-0.03	1.43	0.69	1.29	0.38
Bank u_b	0.51	1.28	-0.23	1.45	-0.70	0.36
OFI u_b	-0.37	-0.45	-0.06	-0.97	-0.25	-0.05
NBFI u_b	-0.89	1.73	-4.12	-3.99	-0.32	2.42
RoW u_b	-3.98	-11.39	-5.52	-6.18	0.97	1.59
Other u_b	-0.09	0.13	-0.35	-0.08	-0.38	0.11

Table 6: Variance decomposition of changes in the share of intermediated credit. This table reports the variance decomposition of changes in the share of intermediated credit into aggregate conditions and demand and supply-side effects.The "All" column reports the panel variance decomposition using all the pre-pandemic country-year observations. The rest of the columns report time-series variance decomposition within each country using pre-pandemic observations only.

	All	US	CA	GB	FR	AU
Macro	-5.87	0.03	-18.84	-4.52	-6.46	-11.19
10Y sov.	34.88	42.82	30.69	14.29	54.21	33.03
Lag ψ	0.49	-6.84	25.84	22.84	9.17	-17.61
Bond maturity	0.03	0.10	1.32	2.06	3.74	-2.37
Bond coupon	-0.05	-0.39	-0.23	0.18	0.16	-0.08
Bank assets	24.57	11.75	9.65	69.00	20.43	14.91
OFI assets	5.78	7.72	6.04	13.02	0.49	1.02
NBFI assets	-0.79	-1.67	-1.59	-0.34	-0.12	2.48
RoW assets	2.64	-0.04	-6.12	11.42	3.33	4.13
Other assets	1.67	-0.08	-0.47	-0.56	-1.60	3.96
ϵ	2.44	6.86	-9.76	-17.51	0.73	20.64
η	34.09	49.31	4.68	88.48	-23.16	43.49
Bank u_l	-7.88	-11.18	13.37	-72.56	-1.32	20.69
OFI u_l	0.19	-5.57	27.10	-16.87	-0.15	0.76
NBFI u_l	2.55	5.80	0.99	0.48	-0.38	2.62
RoW u_l	4.37	9.16	15.04	-15.01	2.57	-5.08
Other u_l	3.53	-0.90	2.21	0.90	38.75	-6.94
Bank u_b	0.20	-0.06	0.13	2.27	-0.12	-0.16
OFI u_b	-0.08	-0.23	0.02	0.45	0.01	-0.33
NBFI u_b	-2.63	-6.55	0.15	0.26	-0.62	-1.65
RoW u_b	0.19	0.17	-0.30	1.73	0.30	-2.34
Other u_b	-0.32	-0.21	0.08	-0.01	0.03	0.03

Figure 1. Bank and non-bank credit booms. This figure plots annual changes in the ratio of bank-financed private credit to GDP against changes in the ratio of non-bank-financed private credit to GDP. Blue diamonds indicate years that are the start of credit booms in overall private credit, with credit booms identified as in Verner (2022). Source: BIS.

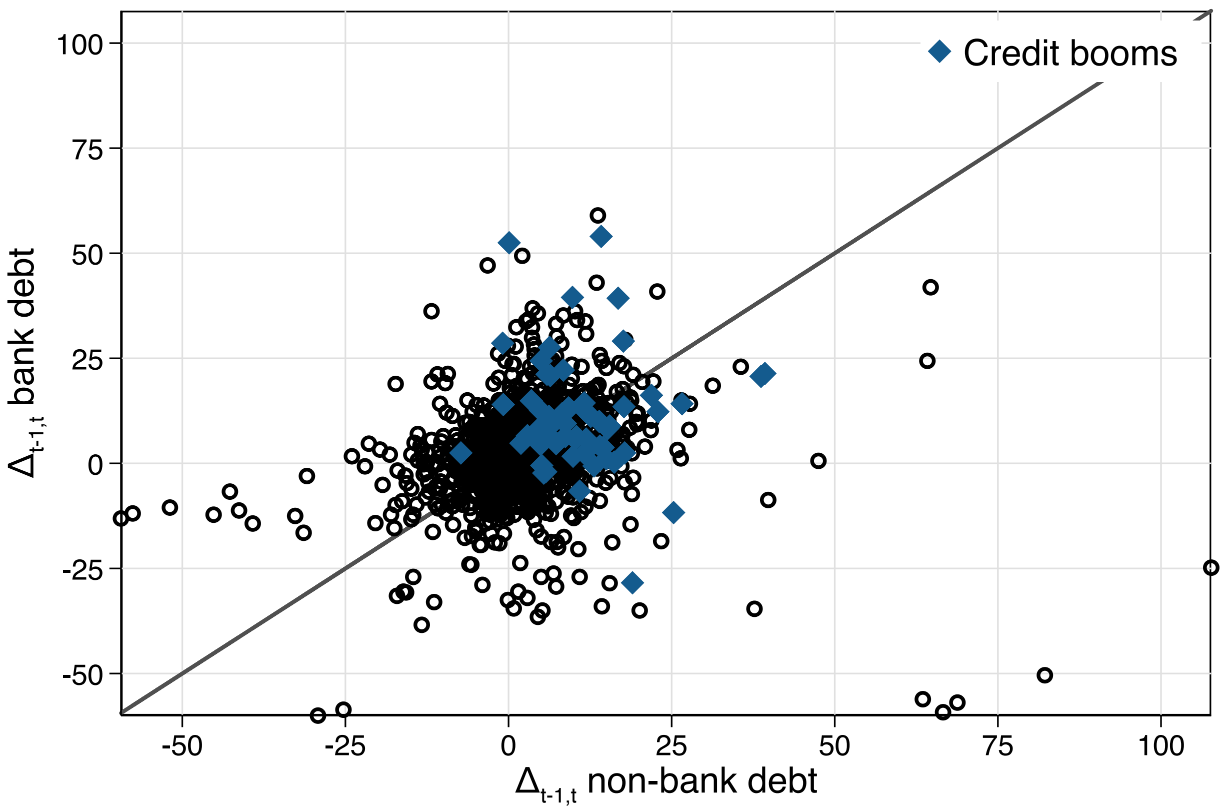


Figure 2. Nonfinancial firm debt to GDP over time. This figure plots the time series of total debt borrowed by nonfinancial firms relative to nominal GDP. Source: BIS.

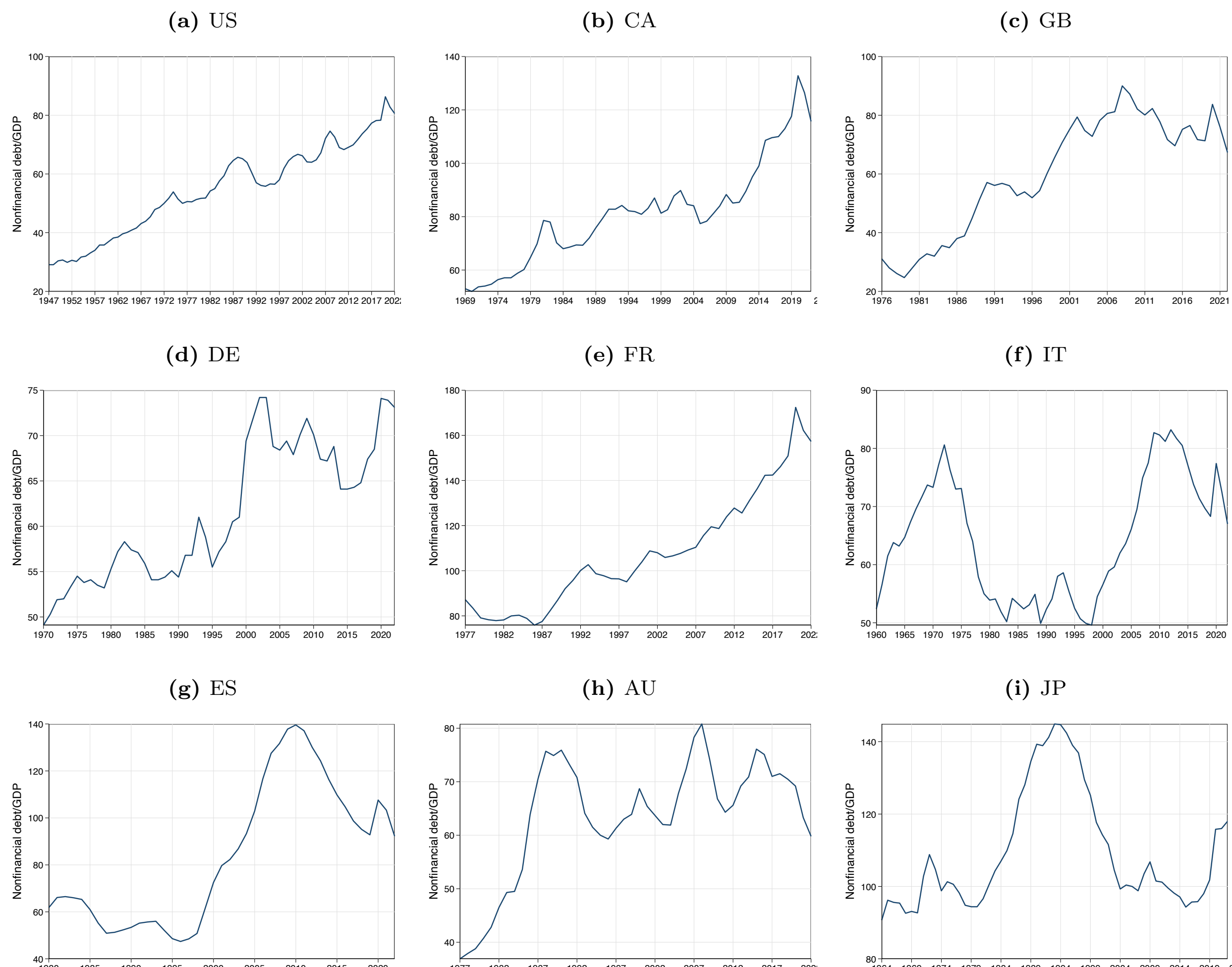


Figure 3. Share of intermediated credit over time. This figure plots the time series of the economy-wide share of intermediated credit in nonfinancial firms' total debt. Intermediated credit defined as the ratio between loans outstanding and the sum of loans and bonds outstanding. Source: national financial accounts of the corresponding countries.

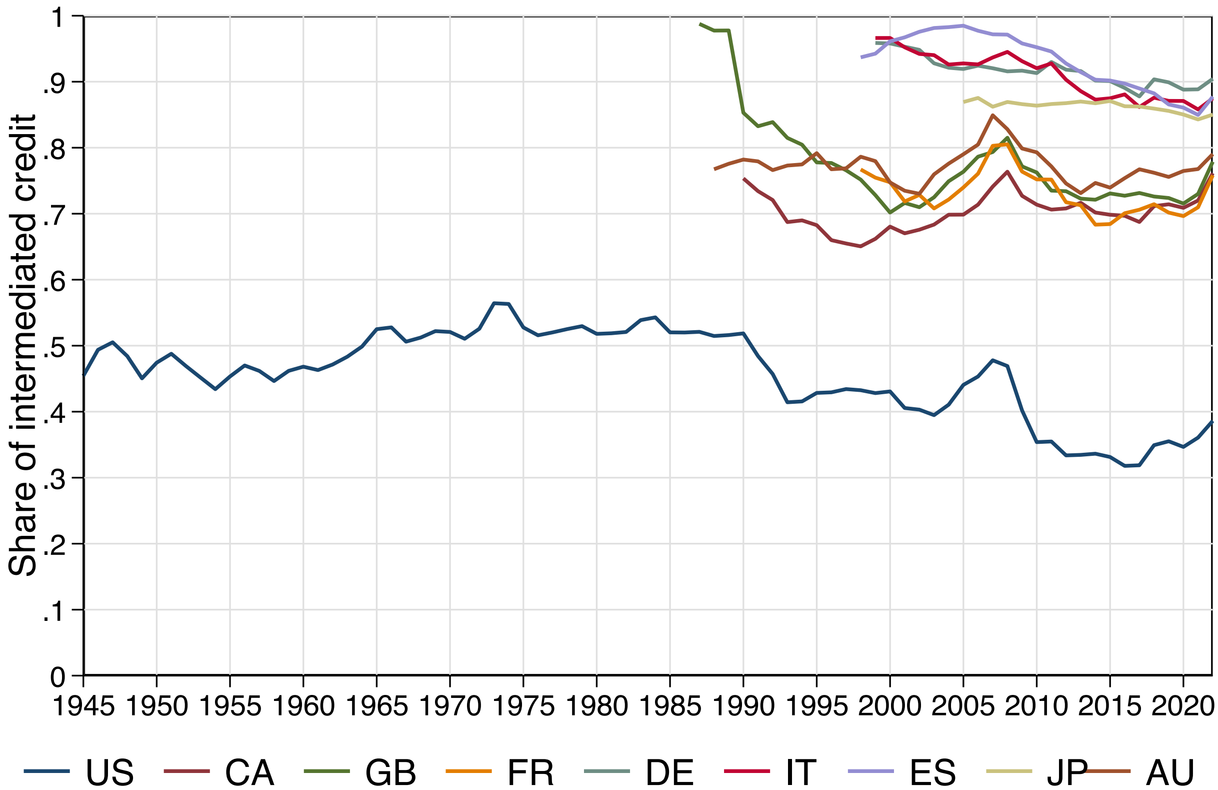


Figure 4. Financial subsector size over time. This figure plots the time series of total financial assets of financial subsectors. “MFI” are monetary financial institutions including central banks, “MF” are non-money market mutual funds, “Ins/PF” are insurance companies and pension funds, “OFIs” are other financial institutions, “HH/NPISH” are households and non-profit institutions serving households, “RoW” is the external sector (rest of the world). Source: national financial accounts of the corresponding countries.

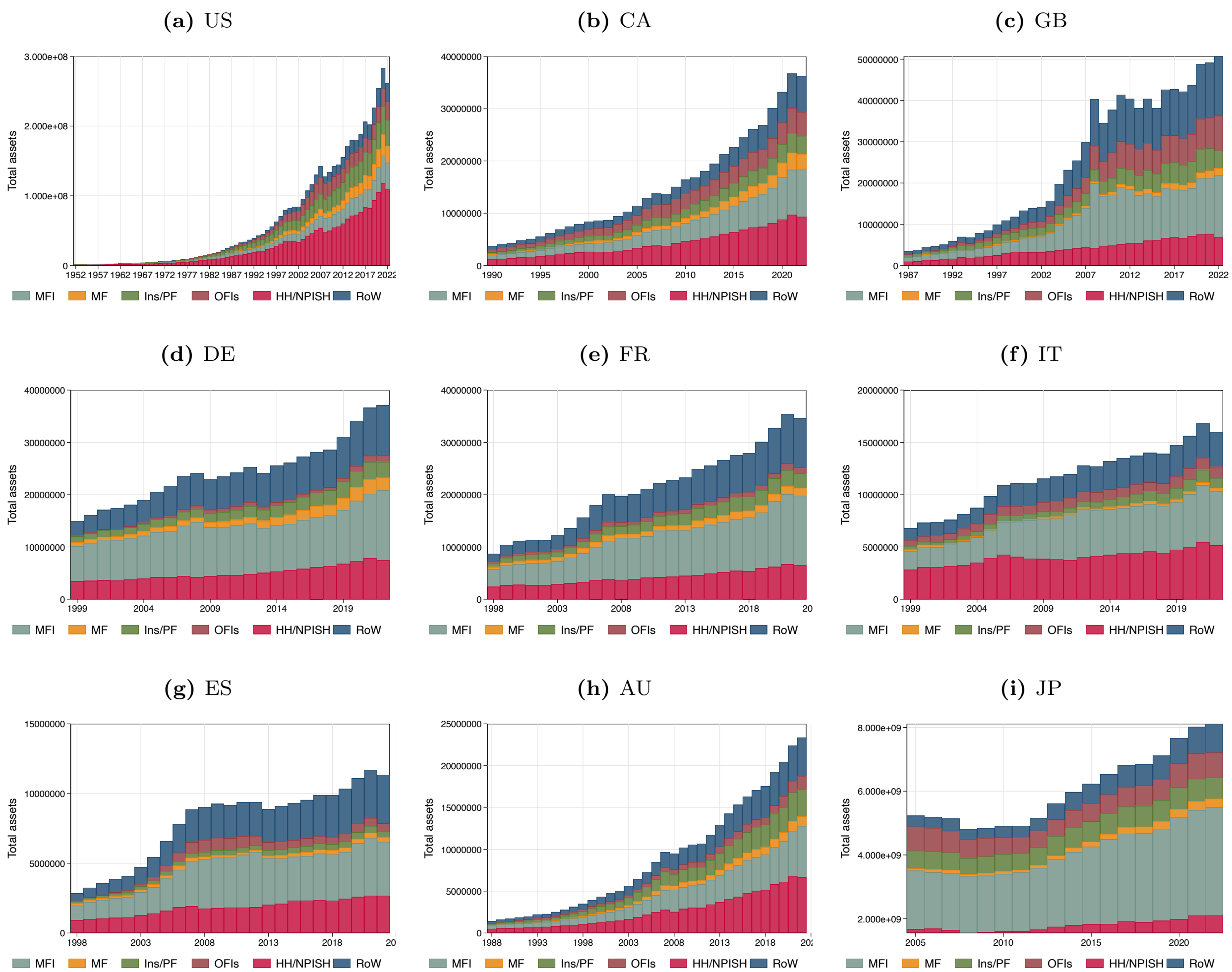


Figure 5. Fraction of bonds outstanding held by each subsector. This figure plots the time series of the share of nonfinancial corporate sector debt instruments outstanding held by each financial subsector. Debt instruments include corporate bonds and open market (commercial) paper. "MFI" are monetary financial institutions including central banks, "MF" are non-money market mutual funds, "Ins/PF" are insurance companies and pension funds, "OFIs" are other financial institutions, "HH/NPISH" are households and non-profit institutions serving households, "RoW" is the external sector (rest of the world). Source: national financial accounts of the corresponding countries.

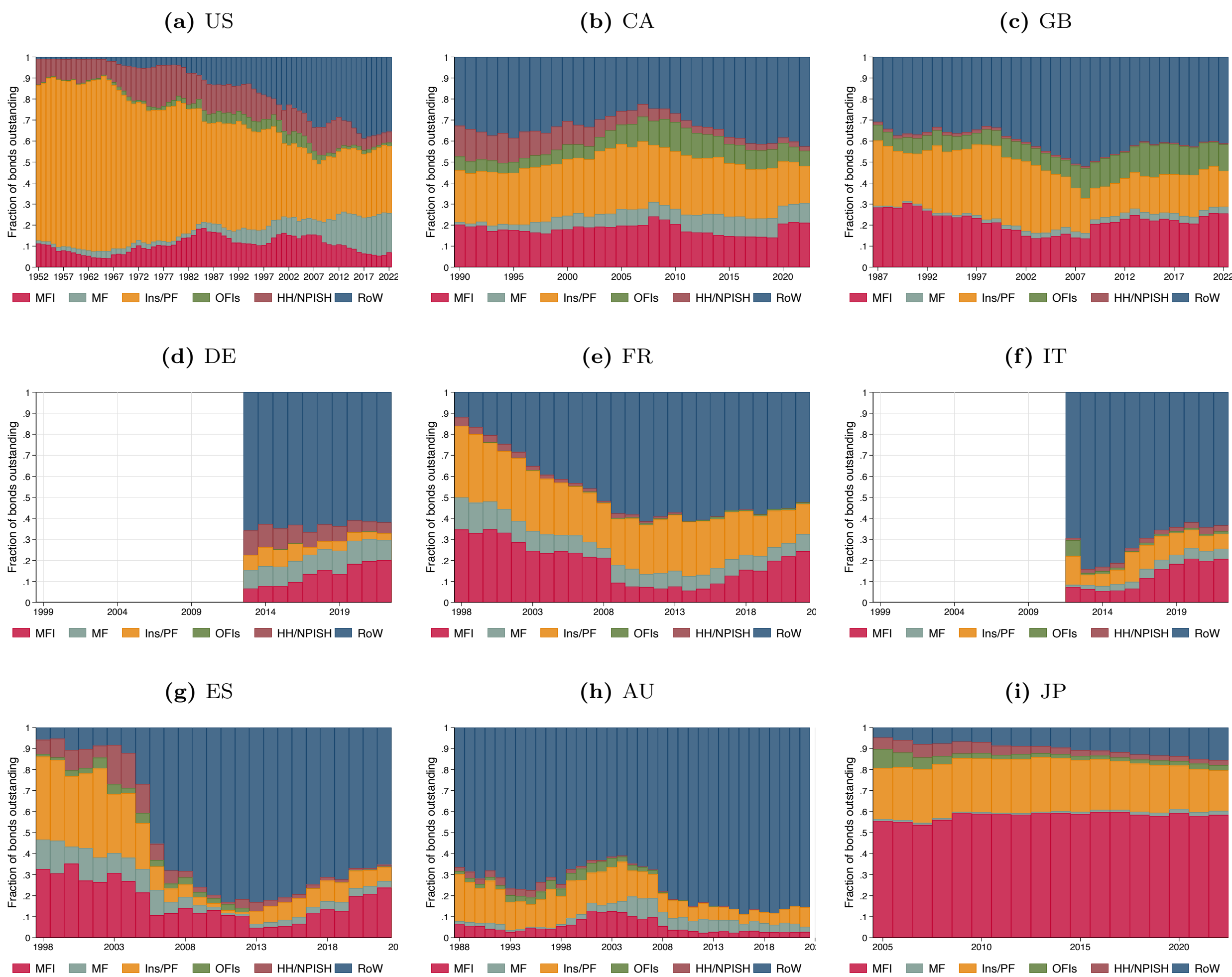


Figure 6. Fraction of loans outstanding held by each subsector. This figure plots the time series of the share of nonfinancial corporate sector loans outstanding held by each financial subsector. Loans outstanding includes bank loans and commercial mortgages. “MFI” are monetary financial institutions including central banks, “MF” are non-money market mutual funds, “Ins/PF” are insurance companies and pension funds, “OFIs” are other financial institutions, “HH/NPISH” are households and non-profit institutions serving households, “RoW” is the external sector (rest of the world). Source: national financial accounts of the corresponding countries.

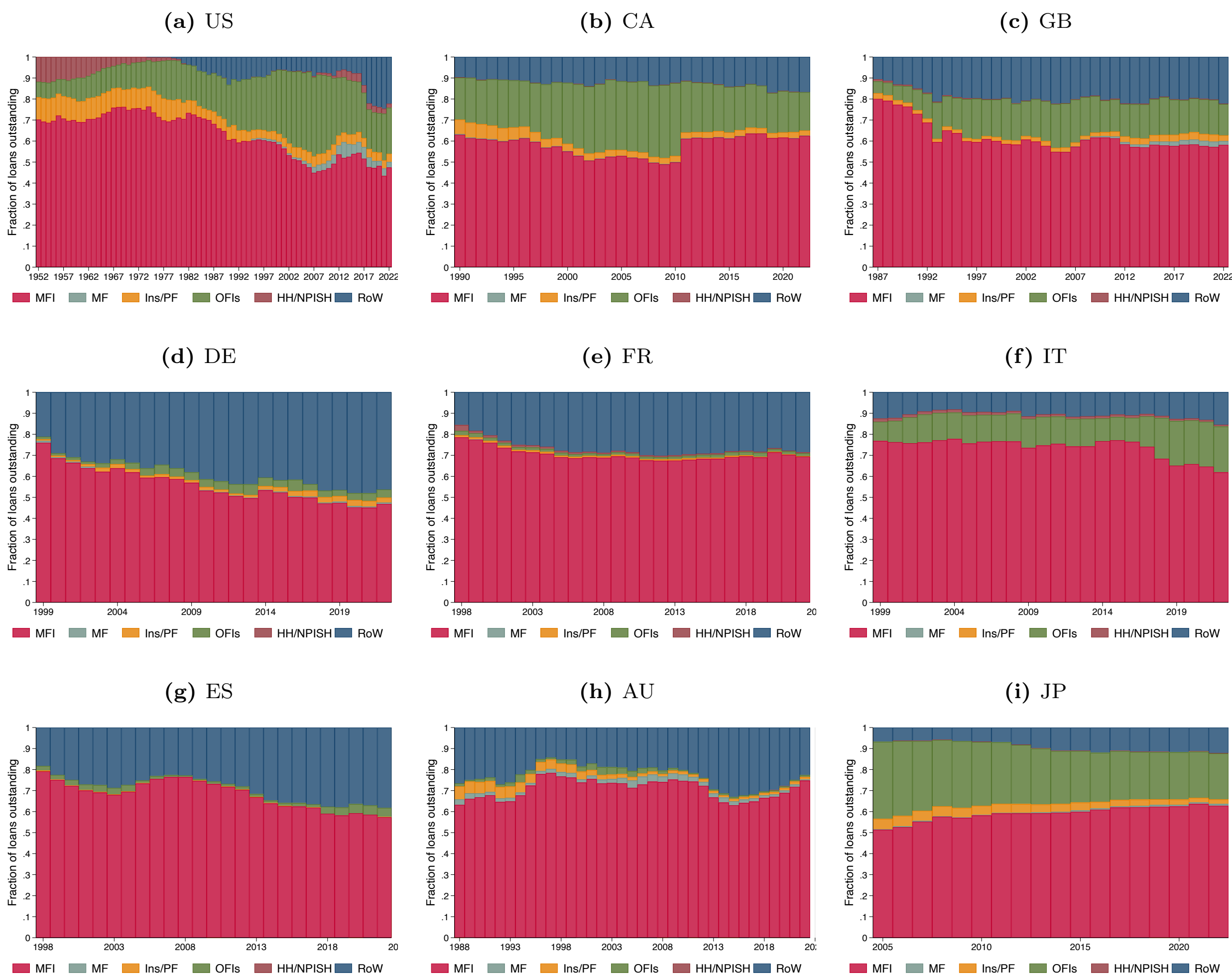


Figure 7. Interest rates on nonfinancial corporate credit. This figure plots the time series of bank loan interest rates together with the size-weighted average yield on fixed coupon corporate bonds issued by nonfinancial firms domiciled in the corresponding country in local currency. Sources: IMF, ECB, Bank of England, Bundesbank, Bank of Japan, Boyarchenko and Elias (2023).

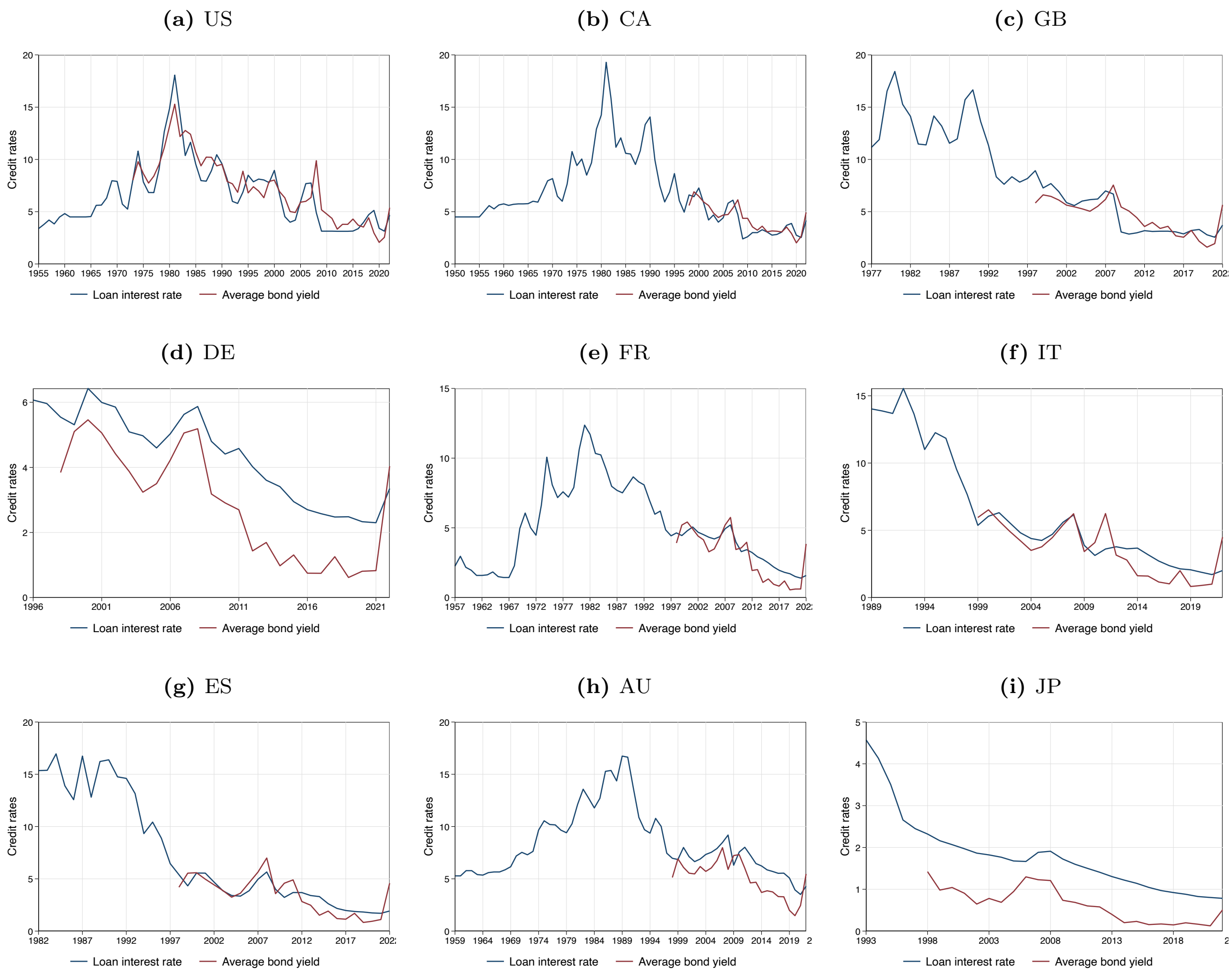


Figure 8. Elasticities of loan rate and bond duration with respect to bond yields. This figure plots the time series of the elasticities of the loan interest rate $y_{l,t}$ and average bond duration $D_{b,t}$ with respect to the bond yield $y_{b,t}$.

(a) $y_{b,t} \rightarrow y_{l,t}$ **(b)** $y_{b,t} \rightarrow D_{b,t}$

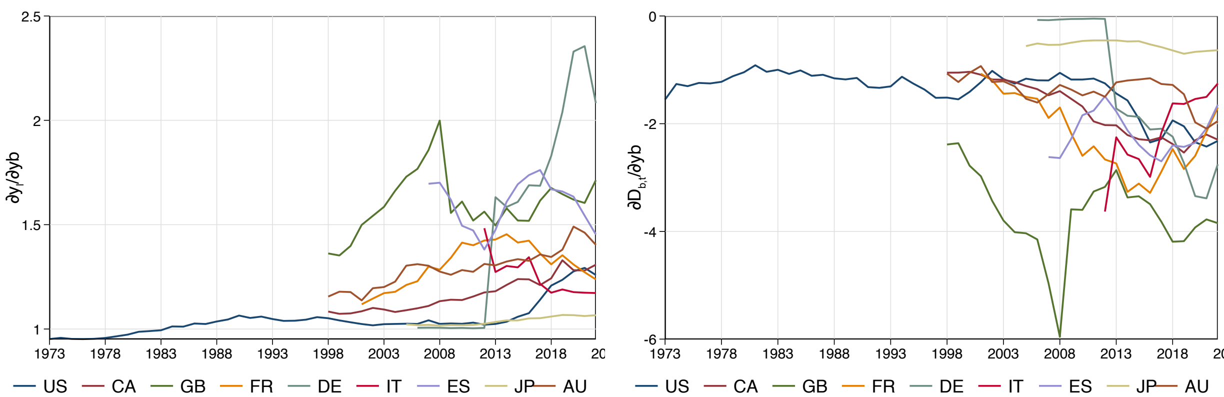
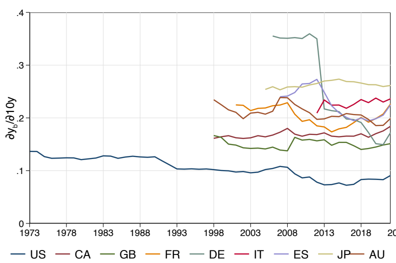
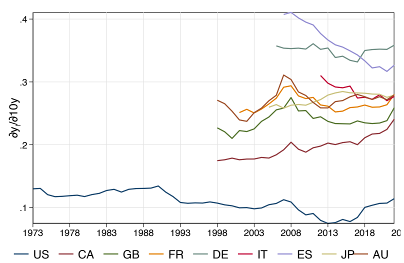


Figure 9. Elasticities of credit spreads and bond duration with respect to macroeconomic conditions. This figure plots the time series of the elasticities of the bond yield $y_{b,t}$, the loan interest rate $y_{l,t}$, and average bond duration $D_{b,t}$ with respect to the the contemporaneous 10 year sovereign yield, lagged output gap, and lagged inflation.

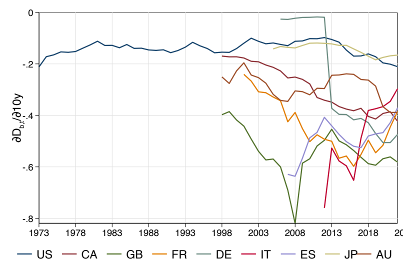
(a) $y_{10} \rightarrow y_{b,t}$



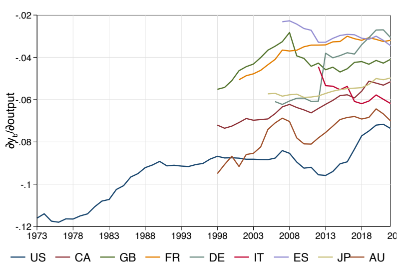
(b) $y_{10} \rightarrow y_{l,t}$



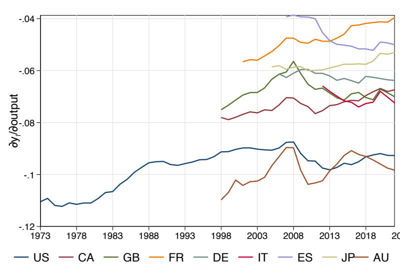
(c) $y_{10} \rightarrow D_{b,t}$



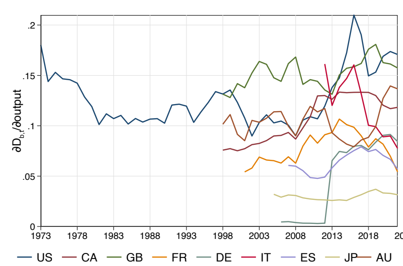
(d) L.output gap$\rightarrow y_{b,t}$



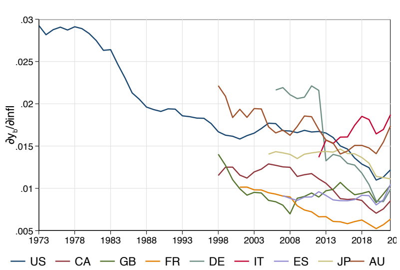
(e) L.output gap$\rightarrow y_{l,t}$



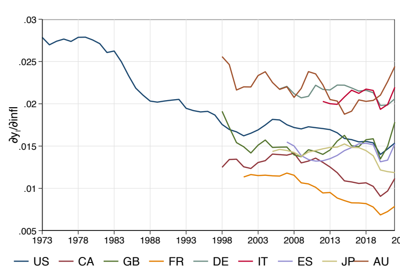
(f) L.output gap$\rightarrow D_{b,t}$



(g) L.inflation$\rightarrow y_{b,t}$



(h) L.inflation$\rightarrow y_{l,t}$



(i) L.inflation$\rightarrow D_{b,t}$

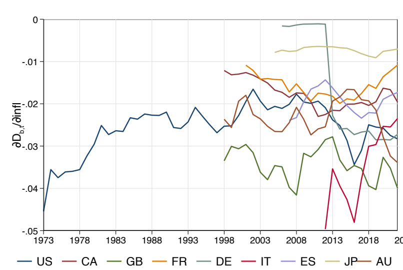
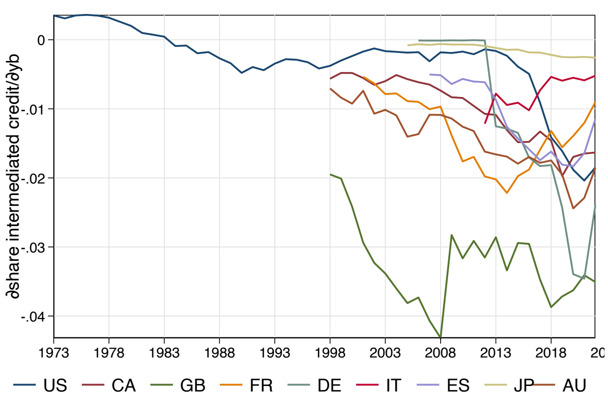
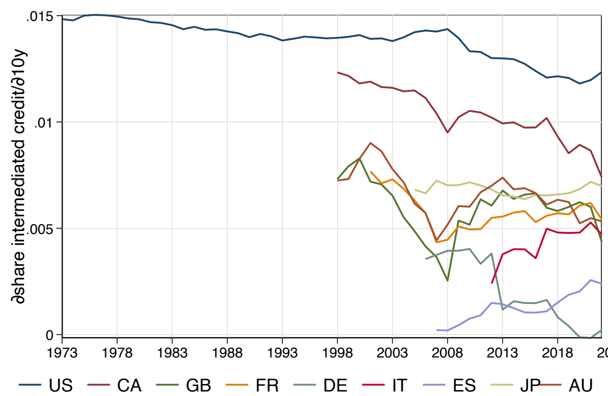


Figure 10. Elasticities of the share of intermediated credit with respect to aggregate conditions. This figure plots the time series of the elasticities of the share of intermediated credit with respect to the contemporaneous corporate bond yield, the contemporaneous 10 year sovereign yield, the lagged output gap, and lagged inflation. Share of intermediated credit defined as the ratio of loans outstanding to the sum of bond and loans outstanding.

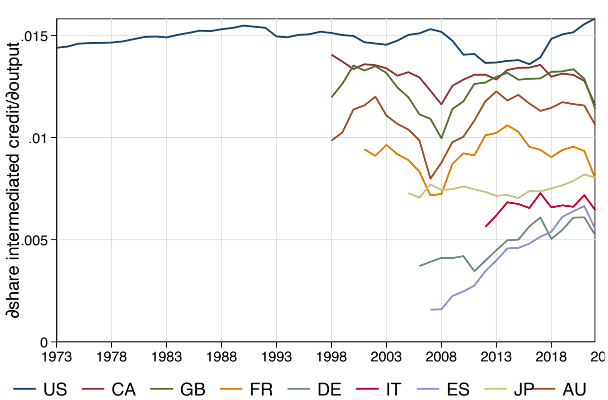
(a) $y_{b,t} \rightarrow$ share intermediated credit



(b) $y_{10} \rightarrow$ share intermediated credit



(c) L.output gap→ share intermediated credit



(d) L.inflation→ share intermediated credit

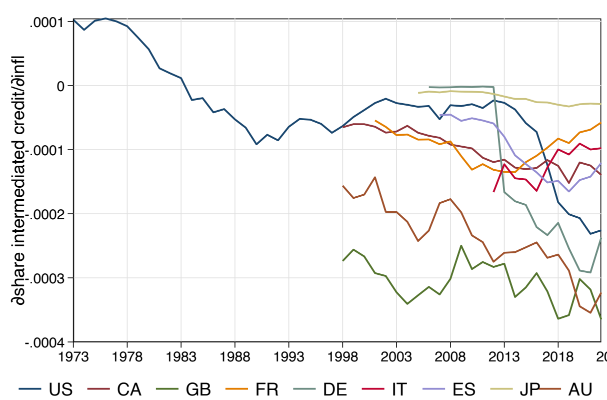
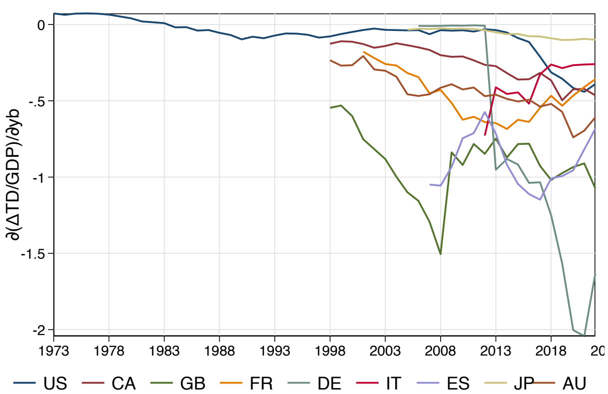
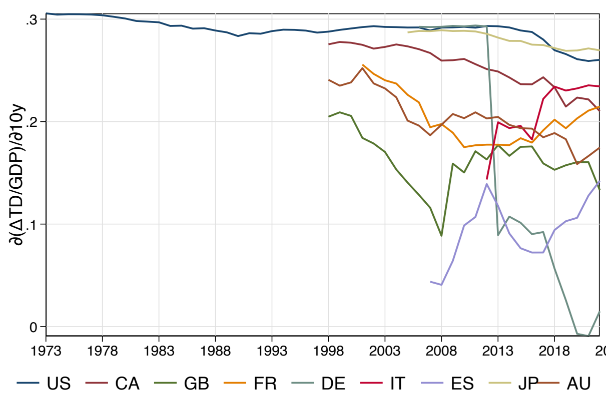


Figure 11. Elasticities of growth in debt over GDP with respect to aggregate conditions. This figure plots the time series of the elasticities of one year growth in nonfinancial corporate debt over GDP with respect to the contemporaneous corporate bond yield, the contemporaneous 10 year sovereign yield, the lagged output gap, and lagged inflation.

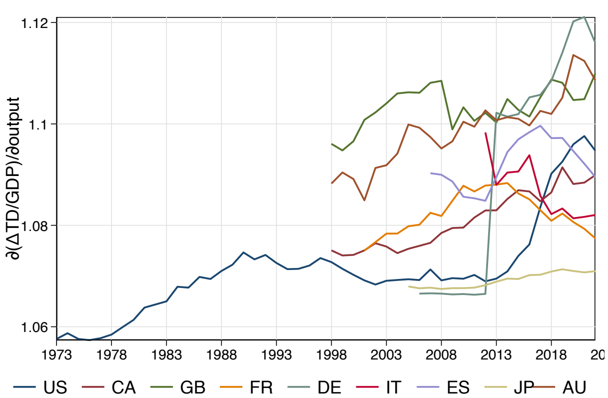
(a) $y_{b,t} \rightarrow \Delta(TD/GDP)_t$



(b) $y_{10} \rightarrow \Delta(TD/GDP)_t$



(c) L.output gap$\rightarrow \Delta(TD/GDP)_t$



(d) L.inflation$\rightarrow \Delta(TD/GDP)_t$

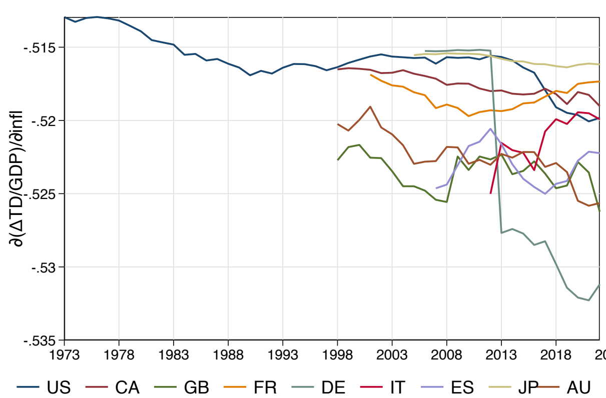


Figure 12. Elasticities of sector-level fraction of assets in bonds with respect to bond yields. This figure plots the time series of the elasticities of sector-level fraction of assets in bonds with respect to the contemporaneous corporate bond yield.

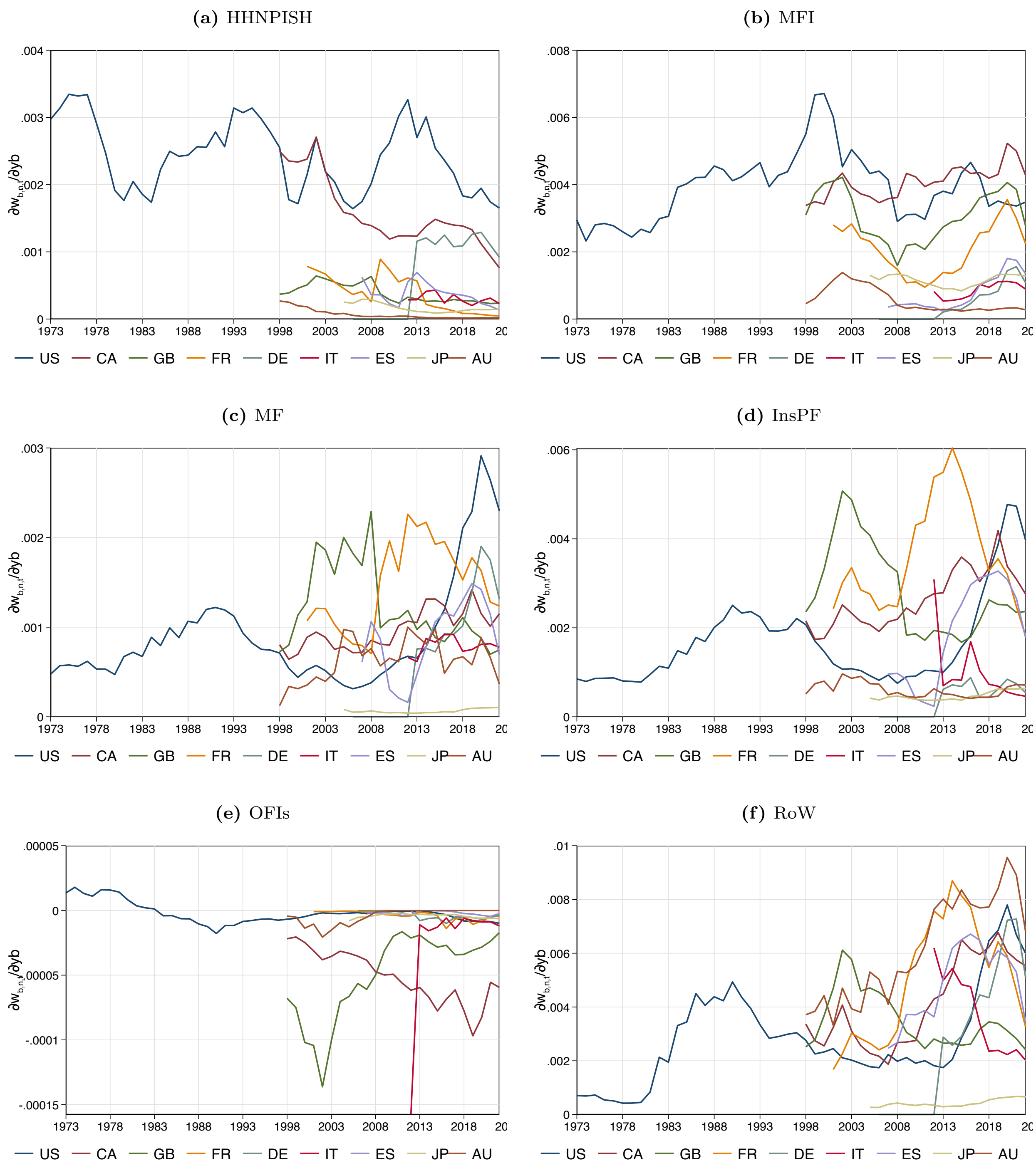
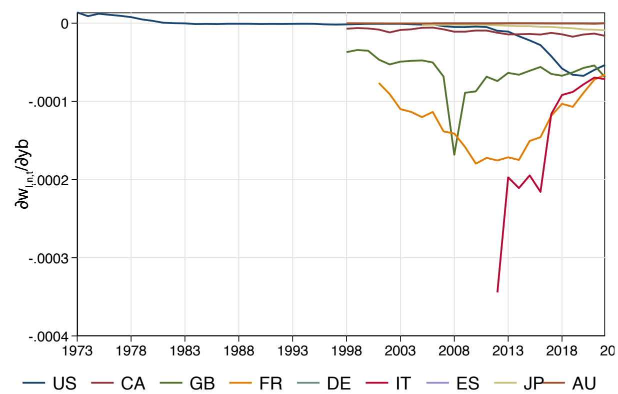
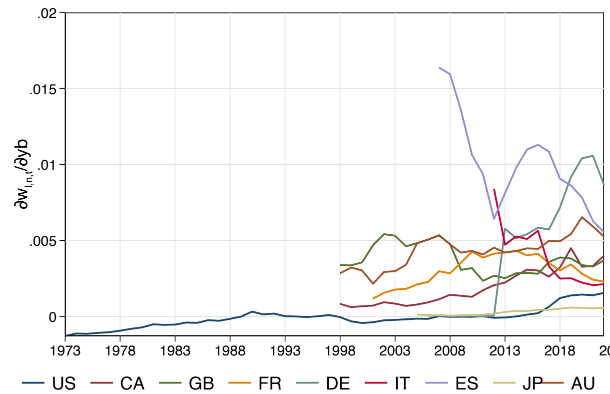


Figure 13. Elasticities of sector-level fraction of assets in loans with respect to bond yields. This figure plots the time series of the elasticities of sector-level fraction of assets in loans with respect to the contemporaneous corporate bond yield.

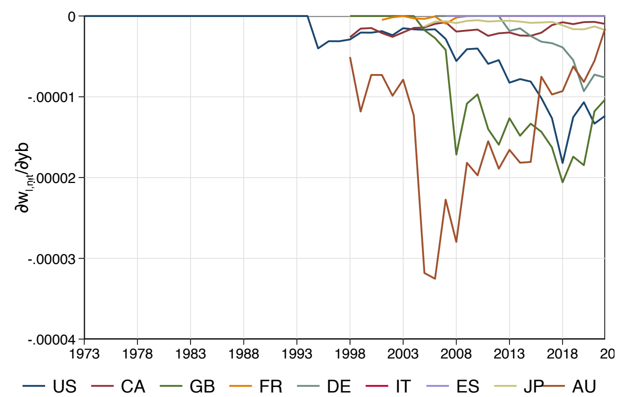
(a) HHNPISH



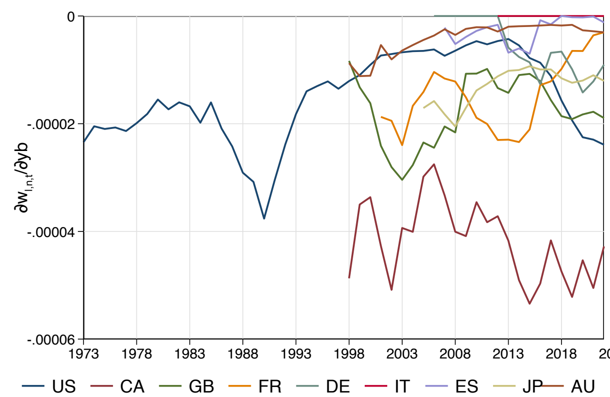
(b) MFI



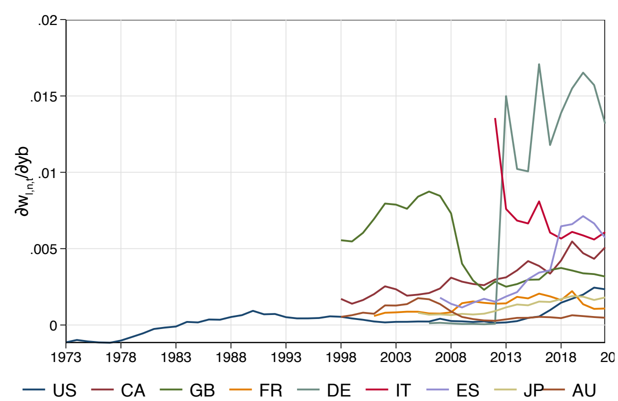
(c) MF



(d) InsPF



(e) OFIs



(f) RoW

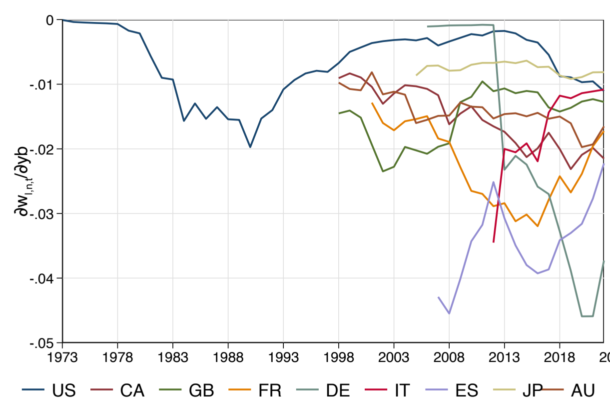
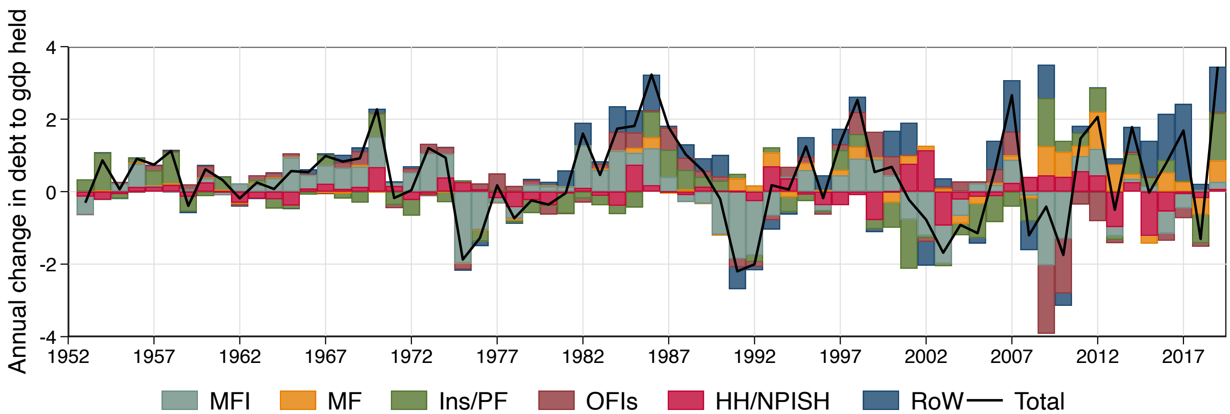
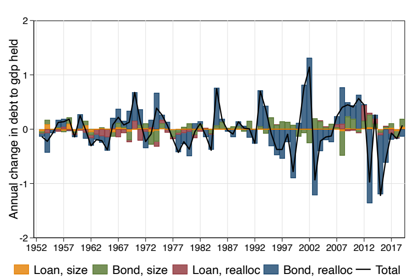


Figure 14. Total debt growth decomposition in the U. S. This figure plots the time series of total nonfinancial firm credit-to-GDP growth decomposed into changes of credit supplied by each financial subsector, as well as the decomposition of the change in credit supplied by each sector into changes due to changes in the total assets of the financial sector ("loan, size" and "bond, size") and changes due to changes in the portfolio shares of bonds and loans in overall assets for each financial sector ("loan, realloc" and "bond, realloc"). Debt instruments include corporate bonds and open market (commercial) paper. "MFI" are monetary financial institutions including central banks, "MF" are non-money market mutual funds, "Ins/PF" are insurance companies and pension funds, "OFIs" are other financial institutions, "HH/NPISH" are households and non-profit institutions serving households, "RoW" is the external sector (rest of the world). Source: enhanced national financial accounts of the U. S.

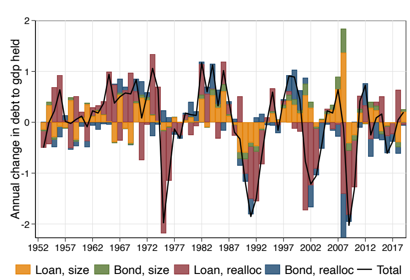
(a) Overall



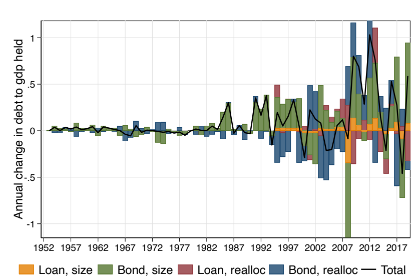
(b) HHNPISH



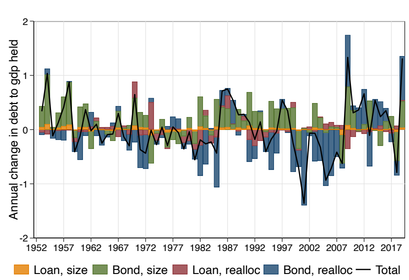
(c) MFI



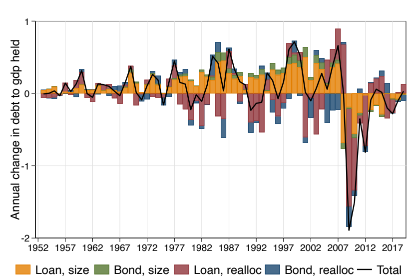
(d) MF



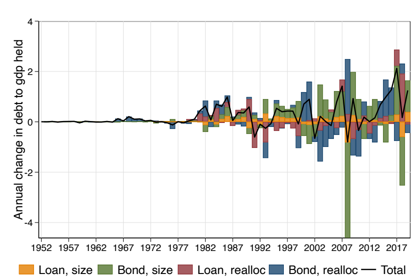
(e) InsPF



(f) OFIs



(g) RoW



A Proofs

A.1 Elasticities derivation

Recall that the market clearing conditions are given by

$$gdp_t + \log\left(\psi_{t-1} + \Delta\psi_t\right) + \log\left(1 - \iota_t\right) = \log\left(\sum_{n=1}^{N} w_{b,n,t}\mathcal{A}_{n,t}\right)$$
$$gdp_t + \log\left(\psi_{t-1} + \Delta\psi_t\right) + \log\iota_t = \log\left(\sum_{n=1}^{N} w_{l,n,t}\mathcal{A}_{n,t}\right)$$

We will use the following results.

$$\begin{aligned}
\frac{\partial \log\psi_t}{\partial(\cdot)} &= \psi_t^{-1}\frac{\partial\Delta\psi_t}{\partial(\cdot)} \\
&= \psi_t^{-1}\left(\sum_k\left(\beta_{k,m} + \beta_\iota\gamma_{k,m}\right)\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \beta_\iota\gamma_p\left(\frac{\partial y_{b,t}}{\partial(\cdot)} - \frac{\partial y_{l,t}}{\partial(\cdot)}\right) - \beta_\iota\frac{D_{b,t}}{1+y_{b,t}}\frac{\partial y_{b,t}}{\partial(\cdot)} + \beta_\iota\gamma_d\frac{\partial D_{b,t}}{\partial(\cdot)}\right) \\
\frac{\partial\log\iota_t}{\partial(\cdot)} &= \left(1-\iota_t\right)\frac{\partial\log\gamma_{l,t}}{\partial(\cdot)} = \left(1-\iota_t\right)\left(\sum_k\gamma_{k,m}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \gamma_p\left(\frac{\partial y_{b,t}}{\partial(\cdot)} - \frac{\partial y_{l,t}}{\partial(\cdot)}\right) + \gamma_d\frac{\partial D_{b,t}}{\partial(\cdot)}\right) \\
\frac{\partial\log\left(1-\iota_t\right)}{\partial(\cdot)} &= -\iota_t\frac{\partial\log\gamma_{l,t}}{\partial(\cdot)} = -\iota_t\left(\sum_k\gamma_{k,m}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \gamma_p\left(\frac{\partial y_{b,t}}{\partial(\cdot)} - \frac{\partial y_{l,t}}{\partial(\cdot)}\right) + \gamma_d\frac{\partial D_{b,t}}{\partial(\cdot)}\right)
\end{aligned}$$

$$\begin{aligned}
\frac{\partial\log\left(\sum_{n=1}^N w_{l,n,t}\mathcal{A}_{n,t}\right)}{\partial(\cdot)} &= \sum_{n=1}^N\lambda_{l,n,t}\left(1-w_{l,n,t}\right)\left[\sum_k\delta_{k,m,l,n}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \delta_{p,l,n}\left(\frac{\partial y_{b,t}}{\partial(\cdot)} - \frac{\partial y_{l,t}}{\partial(\cdot)}\right) + \delta_{d,l,n}\frac{\partial D_{b,t}}{\partial(\cdot)}\right] \\
&\quad - \sum_{n=1}^N\lambda_{l,n,t}w_{b,n,t}\left[\sum_k\delta_{k,m,b,n}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \left(\delta_{p,b,n} - \frac{D_{b,t}}{1+y_{b,t}}\right)\frac{\partial y_{b,t}}{\partial(\cdot)} - \delta_{p,b,n}\frac{\partial y_{l,t}}{\partial(\cdot)}\right] \\
&\quad - \sum_{n=1}^N\lambda_{l,n,t}w_{b,n,t}\delta_{d,l,n}\frac{\partial D_{b,t}}{\partial(\cdot)} \\
\frac{\partial\log\left(\sum_{n=1}^N w_{b,n,t}\mathcal{A}_{n,t}\right)}{\partial(\cdot)} &= \sum_{n=1}^N\lambda_{b,n,t}\left(1-w_{b,n,t}\right)\left[\sum_k\delta_{k,m,b,n}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \left(\delta_{p,b,n} - \frac{D_{b,t}}{1+y_{b,t}}\right)\frac{\partial y_{b,t}}{\partial(\cdot)}\right] \\
&\quad + \sum_{n=1}^N\lambda_{b,n,t}\left(1-w_{b,n,t}\right)\left(\delta_{d,l,n}\frac{\partial D_{b,t}}{\partial(\cdot)} - \delta_{p,b,n}\frac{\partial y_{l,t}}{\partial(\cdot)}\right) \\
&\quad - \sum_{n=1}^N\lambda_{b,n,t}w_{l,n,t}\left[\sum_k\delta_{k,m,l,n}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \delta_{p,l,n}\left(\frac{\partial y_{b,t}}{\partial(\cdot)} - \frac{\partial y_{l,t}}{\partial(\cdot)}\right) + \delta_{d,l,n}\frac{\partial D_{b,t}}{\partial(\cdot)}\right].
\end{aligned}$$

In the above, we have used the definition of duration, so that,

$$\frac{\partial P_{b,t}}{\partial(\cdot)} = \frac{\partial P_{b,t}}{\partial y_{b,t}}\frac{\partial y_{b,t}}{\partial(\cdot)} = -P_{b,t}\frac{D_{b,t}}{1+y_{b,t}}\frac{\partial y_{b,t}}{\partial(\cdot)}.$$

From loan market clearing, we thus have

$$\begin{aligned}
&\sum_k \left(\frac{\beta_{k,m}}{\psi_t} + \left(\frac{\beta_\iota}{\psi_t} + (1-\iota_t)\right)\gamma_{k,m}\right)\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} - \frac{\beta_\iota}{\psi_t}\frac{D_{b,t}}{1+y_{b,t}}\frac{\partial y_{b,t}}{\partial(\cdot)} \\
&+ \left(\frac{\beta_\iota}{\psi_t} + (1-\iota_t)\right)\gamma_p\left(\frac{\partial y_{b,t}}{\partial(\cdot)} - \frac{\partial y_{l,t}}{\partial(\cdot)}\right) + \left(\frac{\beta_\iota}{\psi_t} + (1-\iota_t)\right)\gamma_d\frac{\partial D_{b,t}}{\partial(\cdot)} \\
&= \sum_{n=1}^{N}\lambda_{l,n,t}(1-w_{l,n,t})\left[\sum_k \delta_{k,m,l,n}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \delta_{p,l,n}\left(\frac{\partial y_{b,t}}{\partial(\cdot)} - \frac{\partial y_{l,t}}{\partial(\cdot)}\right) + \delta_{d,l,n}\frac{\partial D_{b,t}}{\partial(\cdot)}\right] \\
&- \sum_{n=1}^{N}\lambda_{l,n,t}w_{b,n,t}\left[\sum_k \delta_{k,m,b,n}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)} + \left(\delta_{p,b,n} - \frac{D_{b,t}}{1+y_{b,t}}\right)\frac{\partial y_{b,t}}{\partial(\cdot)} - \delta_{p,b,n}\frac{\partial y_{l,t}}{\partial(\cdot)} + \delta_{d,b,n}\frac{\partial D_{b,t}}{\partial(\cdot)}\right].
\end{aligned}$$

Collecting like terms, we can rewrite the above as

$$\begin{aligned}
&\underbrace{\left[\left(\frac{\beta_\iota}{\psi_t} + (1-\iota_t)\right)\gamma_p - \frac{\beta_\iota}{\psi_t}\frac{D_{b,t}}{1+y_{b,t}} - \sum_{n=1}^{N}\lambda_{l,n,t}\left\{(1-w_{l,n,t})\delta_{p,l,n} - w_{b,n,t}\left(\delta_{p,b,n} - \frac{D_{b,t}}{1+y_{b,t}}\right)\right\}\right]}_{\equiv\alpha_{b,l,t}}\frac{\partial y_{b,t}}{\partial(\cdot)} \\
&+ \underbrace{\left[\left(\frac{\beta_\iota}{\psi_t} + (1-\iota_t)\right)\gamma_d - \sum_{n=1}^{N}\lambda_{l,n,t}\left\{(1-w_{l,n,t})\delta_{d,l,n} - w_{b,n,t}\delta_{d,b,n}\right\}\right]}_{\equiv\alpha_{d,l,t}}\frac{\partial D_{b,t}}{\partial(\cdot)} \\
&- \underbrace{\left[\left(\frac{\beta_\iota}{\psi_t} + (1-\iota_t)\right)\gamma_p - \sum_{n=1}^{N}\lambda_{l,n,t}\left\{(1-w_{l,n,t})\delta_{p,l,n} - w_{b,n,t}\delta_{p,b,n}\right\}\right]}_{\equiv\alpha_{l,l,t}}\frac{\partial y_{l,t}}{\partial(\cdot)} \\
&= \sum_k \underbrace{\left[\sum_{n=1}^{N}\lambda_{l,n,t}\left\{(1-w_{l,n,t})\delta_{k,m,l,n} - w_{b,n,t}\delta_{k,m,b,n}\right\} - \left(\frac{\beta_{k,m}}{\psi_t} + \left(\frac{\beta_\iota}{\psi_t} + (1-\iota_t)\right)\gamma_{k,m}\right)\right]}_{\equiv\alpha_{k,m,l,t}}\frac{\partial X_{k,m,t-1}}{\partial(\cdot)}.
\end{aligned}$$

Similarly, from bond market clearing we have

$$\underbrace{\left[\left(\frac{\beta_\iota}{\psi_t}-\iota_t\right)\gamma_p-\frac{\beta_\iota}{\psi_t}\frac{D_{b,t}}{1+y_{b,t}}-\sum_{n=1}^{N}\lambda_{b,n,t}\left\{\left(1-w_{b,n,t}\right)\left(\delta_{p,b,n}-\frac{D_{b,t}}{1+y_{b,t}}\right)-w_{l,n,t}\delta_{p,l,n}\right\}\right]}_{\equiv\alpha_{b,b,t}}\frac{\partial y_{b,t}}{\partial\left(\cdot\right)}$$

$$+\underbrace{\left[\left(\frac{\beta_\iota}{\psi_t}-\iota_t\right)\gamma_d-\sum_{n=1}^{N}\lambda_{b,n,t}\left\{\left(1-w_{b,n,t}\right)\delta_{d,b,n}-w_{l,n,t}\delta_{d,l,n}\right\}\right]}_{\equiv\alpha_{d,b,t}}\frac{\partial D_{b,t}}{\partial\left(\cdot\right)}$$

$$-\underbrace{\left[\left(\frac{\beta_\iota}{\psi_t}-\iota_t\right)\gamma_p-\sum_{n=1}^{N}\lambda_{b,n,t}\left\{\left(1-w_{b,n,t}\right)\delta_{p,b,n}-w_{l,n,t}\delta_{p,l,n}\right\}\right]}_{\equiv\alpha_{l,b,t}}\frac{\partial y_{l,t}}{\partial\left(\cdot\right)}$$

$$=\sum_k\underbrace{\left[\sum_{n=1}^{N}\lambda_{b,n,t}\left\{\left(1-w_{b,n,t}\right)\delta_{k,m,b,n}-w_{l,n,t}\delta_{k,m,l,n}\right\}-\left(\frac{\beta_{k,m}}{\psi_t}+\left(\frac{\beta_\iota}{\psi_t}-\iota_t\right)\gamma_{k,m}\right)\right]}_{\equiv\alpha_{k,m,b,t}}\frac{\partial X_{k,m,t-1}}{\partial\left(\cdot\right)}.$$

Starting from the derivative with respective to $y_{b,t}$, we have the following system for the derivatives of the loan rate and duration with respect to $y_{b,t}$

$$\begin{bmatrix}-\alpha_{d,l,t} & \alpha_{l,l,t}\\ -\alpha_{d,b,t} & \alpha_{l,b,t}\end{bmatrix}\begin{bmatrix}\frac{\partial D_{b,t}}{\partial y_{b,t}}\\ \frac{\partial y_{l,t}}{\partial y_{b,t}}\end{bmatrix}=\begin{bmatrix}\alpha_{b,l,t}\\ \alpha_{b,b,t}\end{bmatrix},$$

so that

$$\frac{\partial D_{b,t}}{\partial y_{b,t}}=-\left(\alpha_{l,b,t}\alpha_{d,l,t}-\alpha_{l,l,t}\alpha_{d,b,t}\right)^{-1}\left(\alpha_{l,b,t}\alpha_{b,l,t}-\alpha_{l,l,t}\alpha_{b,b,t}\right)$$
$$\frac{\partial y_{l,t}}{\partial y_{b,t}}=\left(\alpha_{l,b,t}\alpha_{d,l,t}-\alpha_{l,l,t}\alpha_{d,b,t}\right)^{-1}\left(\alpha_{d,b,t}\alpha_{b,l,t}-\alpha_{d,l,t}\alpha_{b,b,t}\right).$$

We can then use the chain rule and bond market clearing to represent

$$\alpha_{k,m,b,t}=\left(\alpha_{b,b,t}+\alpha_{d,b,t}\frac{\partial D_{b,t}}{\partial y_{b,t}}-\alpha_{l,b,t}\frac{\partial y_{l,t}}{\partial y_{b,t}}\right)\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}},$$

so that

$$\begin{aligned}\left(\alpha_{l,b,t}\alpha_{d,l,t}-\alpha_{l,l,t}\alpha_{d,b,t}\right)\alpha_{k,m,b,t}&=\left(\alpha_{b,b,t}\left(\alpha_{l,b,t}\alpha_{d,l,t}-\alpha_{l,l,t}\alpha_{d,b,t}\right)\right.\\&\left.-\alpha_{d,b,t}\left(\alpha_{l,b,t}\alpha_{b,l,t}-\alpha_{l,l,t}\alpha_{b,b,t}\right)-\alpha_{l,b,t}\left(\alpha_{d,b,t}\alpha_{b,l,t}-\alpha_{d,l,t}\alpha_{b,b,t}\right)\right)\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}}\\&=2\alpha_{l,b,t}\left(\alpha_{b,b,t}\alpha_{d,l,t}-\alpha_{d,b,t}\alpha_{b,l,t}\right)\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}}.\end{aligned}$$

Thus,

$$\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}} = \frac{\left(\alpha_{l,b,t}\alpha_{d,l,t} - \alpha_{l,l,t}\alpha_{d,b,t}\right)}{2\alpha_{l,b,t}\left(\alpha_{b,b,t}\alpha_{d,l,t} - \alpha_{d,b,t}\alpha_{b,l,t}\right)}\alpha_{k,m,b,t}.$$

From loan market clearing we instead have

$$\alpha_{k,m,l,t} = \left(\alpha_{b,l,t} + \alpha_{d,l,t}\frac{\partial D_{b,t}}{\partial y_{b,t}} - \alpha_{l,l,t}\frac{\partial y_{l,t}}{\partial y_{b,t}}\right)\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}},$$

so that

$$\begin{aligned}
\left(\alpha_{l,b,t}\alpha_{d,l,t} - \alpha_{l,l,t}\alpha_{d,b,t}\right)\alpha_{k,m,l,t} &= \left(\alpha_{b,l,t}\left(\alpha_{l,b,t}\alpha_{d,l,t} - \alpha_{l,l,t}\alpha_{d,b,t}\right)\right. \\
&\quad \left.-\alpha_{d,l,t}\left(\alpha_{l,b,t}\alpha_{b,l,t} - \alpha_{l,l,t}\alpha_{b,b,t}\right) - \alpha_{l,l,t}\left(\alpha_{d,b,t}\alpha_{b,l,t} - \alpha_{d,l,t}\alpha_{b,b,t}\right)\right)\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}} \\
&= 2\alpha_{l,l,t}\left(\alpha_{b,b,t}\alpha_{d,l,t} - \alpha_{b,l,t}\alpha_{d,b,t}\right)\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}}.
\end{aligned}$$

Or, equivalently,

$$\frac{\partial y_{b,t}}{\partial X_{k,m,t-1}} = \frac{\left(\alpha_{l,b,t}\alpha_{d,l,t} - \alpha_{l,l,t}\alpha_{d,b,t}\right)}{2\alpha_{l,l,t}\left(\alpha_{b,b,t}\alpha_{d,l,t} - \alpha_{d,b,t}\alpha_{b,l,t}\right)}\alpha_{k,m,l,t}.$$

For the bond market clearing and loan market clearing to give us the same derivatives, we thus must have

$$\frac{\alpha_{k,m,l,t}}{\alpha_{l,l,t}} = \frac{\alpha_{k,m,b,t}}{\alpha_{l,b,t}}$$

Table A.1: Average real GDP growth predictability. This table reports the estimated coefficients from the predictive regression of cumulative h year real GDP growth. Private credit measured as the sum of household credit and nonfinancial corporate credit. Non-bank credit measured as the difference between overall private credit and private credit provided by banks. Hodrick (1992) standard errors reported in parentheses below point estimates. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(a) Predictability with total debt

	Current	1Y	2Y	3Y	4Y	5Y
Δ_3 firm credit	-0.06	-0.06	-0.09	-0.10	-0.10	-0.07
	(0.01)***	(0.01)***	(0.03)***	(0.03)***	(0.04)**	(0.05)
Δ_3 hh credit	0.05	0.05	0.02	-0.06	-0.16	-0.30
	(0.02)**	(0.02)**	(0.05)	(0.07)	(0.08)*	(0.10)***
Adj. R-sqr.	-0.01	-0.00	-0.01	-0.01	0.00	0.02
N. of obs	399	376	356	336	315	296

(b) Predictability based on credit instrument

	Current	1Y	2Y	3Y	4Y	5Y
Δ_3 loans	-0.06	-0.08	-0.11	-0.12	-0.12	-0.10
	(0.02)***	(0.02)***	(0.03)***	(0.04)***	(0.04)***	(0.05)**
Δ_3 bonds	-0.04	0.05	0.06	0.05	0.07	0.13
	(0.06)	(0.05)	(0.08)	(0.11)	(0.15)	(0.17)
Δ_3 hh credit	0.05	0.07	0.05	-0.03	-0.13	-0.26
	(0.03)**	(0.03)**	(0.05)	(0.07)	(0.09)	(0.11)**
Adj. R-sqr.	-0.01	0.03	0.01	-0.00	0.01	0.03
N. of obs	399	376	356	336	315	296

Table A.2: Crisis predictability. This table reports the estimated coefficients from the complimentary log-log regression of the probability of a crisis in h years' time. Crisis defined as year-over-year real GDP growth falling below 2%. Private credit measured as the sum of household credit and nonfinancial corporate credit. Non-bank credit measured as the difference between overall private credit and private credit provided by banks. Hodrick (1992) standard errors reported in parentheses below point estimates. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(a) Predictability with total debt

	1Y	2Y	3Y	4Y	5Y
Δ_3 firm credit	0.03	-0.00	-0.01	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Δ_3 hh credit	-0.04	0.01	0.03	0.04	0.03
	(0.03)	(0.03)	(0.03)	(0.04)	(0.05)
Pseudo log-likelihood	-124.63	-122.05	-114.78	-112.39	-110.48
N. of obs	411	388	366	346	326

(b) Predictability based on credit instrument

	1Y	2Y	3Y	4Y	5Y
Δ_3 loans	0.05	0.01	-0.01	-0.02	-0.02
	(0.02)**	(0.02)	(0.02)	(0.02)	(0.02)
Δ_3 bonds	-0.14	-0.12	-0.06	0.00	0.02
	(0.05)***	(0.05)***	(0.06)	(0.07)	(0.06)
Δ_3 hh credit	-0.06	-0.01	0.02	0.04	0.04
	(0.03)**	(0.03)	(0.04)	(0.05)	(0.05)
Pseudo log-likelihood	-117.47	-118.49	-114.21	-112.29	-110.23
N. of obs	411	388	366	346	326

Table A.3: Credit supply by financial sectors. This table reports the estimated coefficients from the instrumented regressions of the relative share of financial assets of lender sectors allocated to nonfinancial corporate bonds (Table A.3a) and loans (Table A.3b) on the bond-loan spread and macroeconomic conditions. "MFI" are monetary financial institutions including central banks, "MF" are non-money market mutual funds, "Ins/PF" are insurance companies and pension funds, "OFIs" are other financial institutions, "HH/NPISH" are households and non-profit institutions serving households, "RoW" is the external sector (rest of the world). Hodrick (1992) standard errors reported in parentheses below point estimates. All regressions include country fixed effects. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

(a) Corporate bonds

	HHNPISH	MFI	MFIexCB	MF	InsPF	Ins	PF	OFIs	RoW	NonFin	Gvt
Bond-loan spread	-0.02	-0.14	0.02	-0.13	-0.21	-0.26	-0.09	-0.06	-0.28	-0.10	-0.17
	(0.09)	(0.12)	(0.07)	(0.08)*	(0.07)***	(0.11)**	(0.07)	(0.18)	(0.07)***	(0.06)	(0.07)**
10Y sov	0.22	0.08	0.17	0.04	0.11	0.11	0.10	0.30	0.03	0.12	0.01
	(0.05)***	(0.03)**	(0.03)***	(0.04)	(0.04)***	(0.04)**	(0.04)**	(0.07)***	(0.04)	(0.03)***	(0.05)
L.output gap	-0.03	0.07	-0.02	0.03	0.01	0.01	0.03	0.05	-0.03	-0.03	0.05
	(0.02)	(0.03)**	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.07)	(0.02)*	(0.02)	(0.03)*
L.inflation	-0.05	-0.05	0.00	-0.01	-0.06	-0.07	-0.06	-0.02	-0.01	-0.05	-0.09
	(0.07)	(0.05)	(0.07)	(0.04)	(0.05)	(0.05)	(0.05)	(0.12)	(0.03)	(0.03)	(0.06)
Bond duration	-0.22	-0.12	-0.14	0.07	0.00	0.04	0.13	0.17	-0.05	0.02	-0.22
	(0.08)***	(0.07)*	(0.07)**	(0.08)	(0.06)	(0.09)	(0.07)*	(0.12)	(0.08)	(0.07)	(0.09)**
F-stat	9.09	8.66	18.94	2.37	6.74	4.38	4.48	6.21	3.11	3.85	4.30
First-stage F-stat	26.16	26.16	8.04	26.16	26.16	23.90	18.48	26.16	26.16	25.07	25.63
N. of obs	162	162	113	162	162	140	121	162	162	147	157

(b) Loans

	HHNPISH	MFI	MFIexCB	MF	InsPF	Ins	PF	OFIs	RoW	NonFin	Gvt
Bond-loan spread	0.24	-0.12	-0.10	0.49	0.05	-0.07	0.70	-0.21	-0.14	-0.23	-0.02
	(0.12)**	(0.06)*	(0.04)**	(0.39)	(0.07)	(0.09)	(0.31)**	(0.10)**	(0.07)**	(0.07)***	(0.08)
10Y sov	-0.22	0.13	0.14	0.00	0.16	0.16	0.09	0.11	0.15	0.12	0.07
	(0.06)***	(0.01)***	(0.01)***	(0.07)	(0.04)***	(0.04)***	(0.07)	(0.03)***	(0.04)***	(0.04)***	(0.03)***
L.output gap	0.04	0.01	-0.01	0.11	-0.04	-0.02	0.16	0.02	-0.00	-0.03	-0.05
	(0.04)	(0.02)	(0.02)	(0.10)	(0.04)	(0.03)	(0.05)***	(0.03)	(0.02)	(0.02)	(0.02)***
L.inflation	-0.01	-0.02	0.00	-0.04	0.06	0.01	0.10	-0.06	0.04	0.03	0.00
	(0.08)	(0.02)	(0.02)	(0.08)	(0.06)	(0.07)	(0.11)	(0.04)	(0.04)	(0.04)	(0.03)
Bond duration	-0.17	0.07	0.05	0.15	0.04	-0.10	0.34	-0.04	0.15	0.06	-0.02
	(0.11)	(0.03)***	(0.03)	(0.22)	(0.07)	(0.08)	(0.18)*	(0.05)	(0.06)***	(0.05)	(0.05)
F-stat	3.73	42.28	35.46	0.39	5.66	8.03	4.38	8.39	4.48	6.61	3.66
First-stage F-stat	16.44	23.14	6.49	9.72	23.79	21.15	15.98	23.14	23.14	23.28	23.14
N. of obs	154	189	93	125	167	144	125	189	189	167	189

Figure A.1. Financial subsector size as a fraction of total lender sectors' assets over time. This figure plots the time series of total financial assets of financial subsectors as a fraction of the total financial assets across all financial lender sectors.. "MFI" are monetary financial institutions including central banks, "MF" are non-money market mutual funds, "Ins/PF" are insurance companies and pension funds, "OFIs" are other financial institutions, "HH/NPISH" are households and non-profit institutions serving households, "RoW" is the external sector (rest of the world). Source: national financial accounts of the corresponding countries.

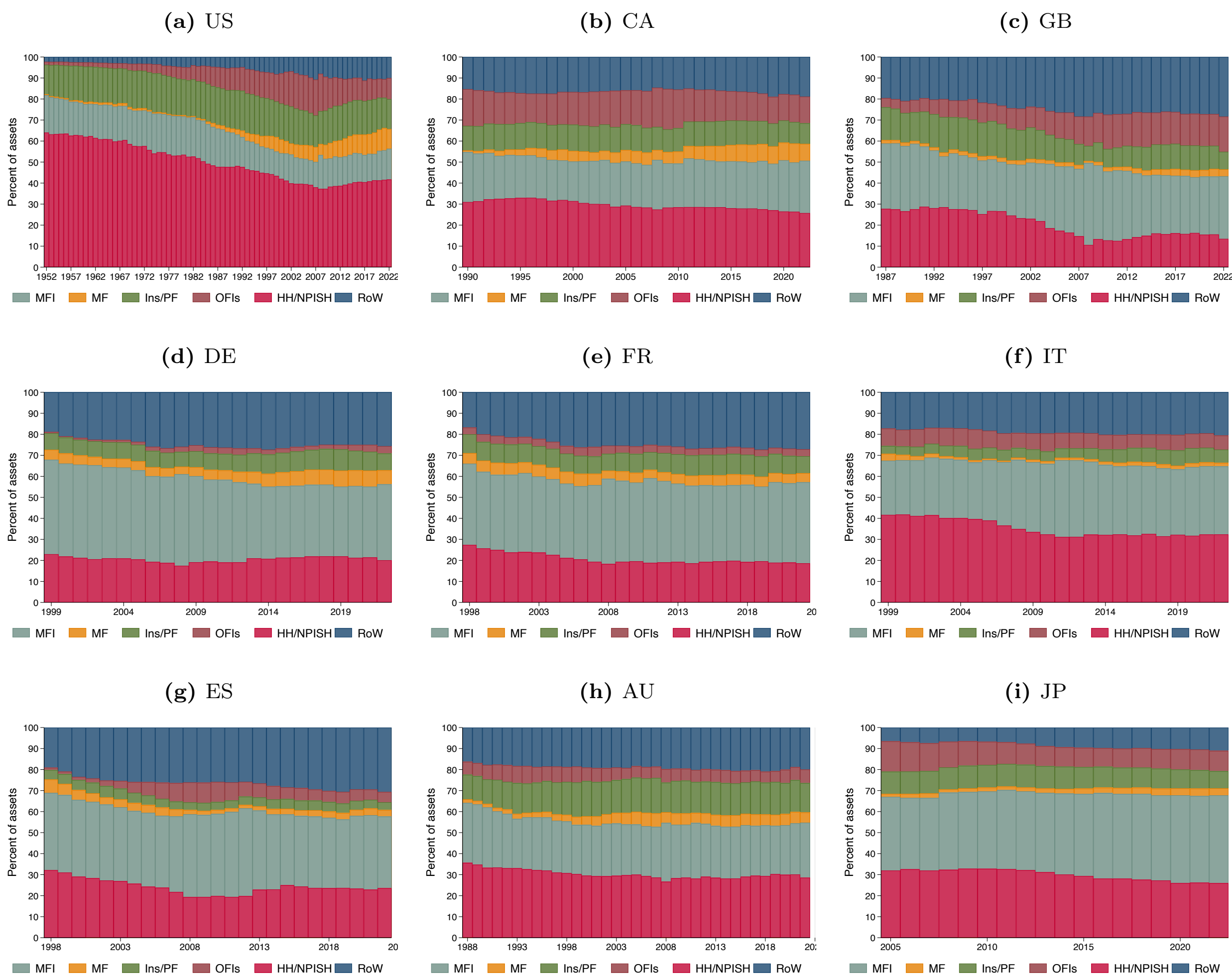


Figure A.2. Firm versus bond size distribution. This figure plots the distribution of weights based on bond size (amount outstanding) versus those based on firm size (total assets). Sample includes primary market, fixed coupon bond issuances of nonfinancial firms domiciled in the respective country. Source: Mergent FISD, SDC Platinum, Worldscope, Compustat.