Market-based finance and the business cycle

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Abstract

This paper examines empirically how market-based finance intersects with the business cycle. We first construct and publish a new timeseries dataset spanning 17 developed economies which distinguishes corporate debt security financing from bank lending to corporates, and also accounts for debt security issuance from financing companies who channel funding to a non-financial parent. We then assess the role of these different sources of credit in business cycle developments. Rapid growth in debt security financing helps to predict recessions unrelated to financial crises across the sample, and all types of recessions in economies with a higher share of market-based credit. We also find that strong growth of market-based credit prior to recessions is associated with a stronger subsequent recovery than rapid pre-recession growth in bank lending, and present evidence suggesting that this may at least partially be linked to the 'spare tyre' role of market-based finance. Together, our results highlight the important role that market-based finance plays in macroeconomic booms and busts.

Keywords: market-based finance, corporate debt, business cycle, recessions, financial crises
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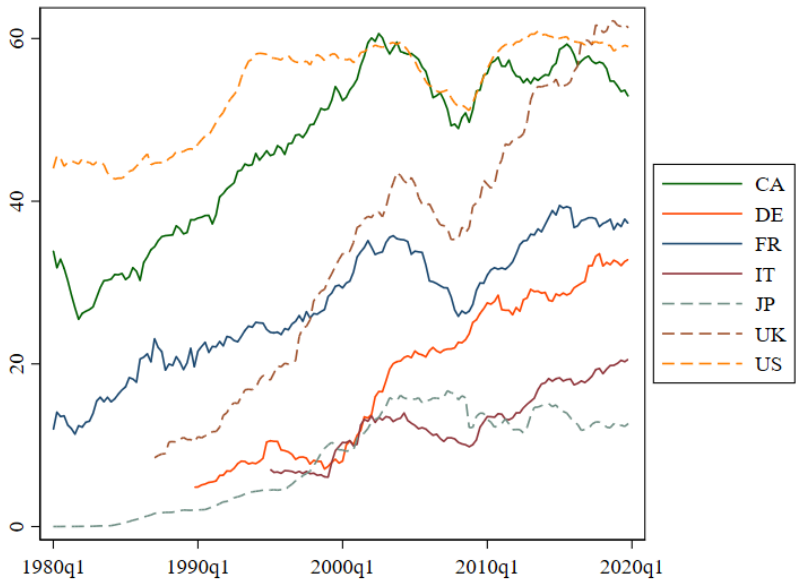
1 Introduction

Since the 1980s, there has been a structural change in the financial sector of many advanced economies, with the share of market-based finance in total financial system assets growing materially (FSB, 2022). This has been associated with non-financial corporates (NFCs) increasingly tapping capital markets as a source of debt financing relative to borrowing from banks (see Figure 1).

Figure 1: Share of market-based credit to NFCs in G7 countries (in %)



Notes: "Share of market-based credit" defined as share of NFC debt securities in NFC debt securities and NFC bank loans. Series for other countries from our sample are depicted in Figure A.1.

A wide cross-country literature explores the role of credit – and within that bank credit – in contributing to economic and financial booms, busts and recoveries (e.g. see Schularick and Taylor (2012), Claessens et al. (2012)), Jordà et al. (2017), Mian et al. (2017). But the specific role of market-based finance in business cycle dynamics remains relatively underexplored, partly due to gaps in long-run, cross-country time series on the share of debt security financing and bank loans in total corporate credit.

This paper fills this gap by distinguishing bank-based and market-based sources of credit to the non-financial corporate (NFC) sector and examining their differing role in business cycle dynamics. To do so, we first construct a novel time series dataset of NFC credit across 17 devel-

oped economies, which distinguishes corporate debt security financing (market-based corporate credit) from bank lending to corporates (bank-based corporate credit). We publish this NFC credit dataset alongside this paper.

By compiling together different cross-country and national data sources, our time series stretch back to at least the late 1980s for most countries in the sample and further back in some cases. Our data for debt security financing also embeds a new methodological approach to account for non-domestic NFC debt issuance. In particular, many large companies use intra-group foreign financing vehicles, which issue debt abroad and channel the proceeds (e.g. via internal loans) to their non-financial parents (Coppola et al., 2021; Beck et al., 2023)). Such debt issuance is generally not included in national credit data, although it can materially affect the level and dynamics of debt security issuance at the country level. Our dataset adjusts for this.

We then examine empirically the interplay between the different types of NFC credit, alongside household credit to facilitate comparisons with the literature, and business cycle dynamics from two different perspectives. First, we assess the role of market-based credit in the build-up phase prior to the start of a recession. In doing so, we also examine the distinction between all types of recession and 'normal' recessions (see Jordà et al. (2022)) unrelated to the global financial crisis (GFC) or systemic financial crises more generally. Second, we examine the link between the dynamics of different types of credit during phases of economic expansion and subsequent growth after a recession starts, distinguishing household and corporate credit in the vein of Jordà et al. (2022), but also separating market-based and bank-based credit to NFCs.

In our first exercise, we assess the predictive power of different types of credit growth for subsequent recessions using binary response models (logit and probit). We confirm previous findings in the literature that strong growth in household and aggregate NFC credit predicts recessions in-sample. This is in line with economic intuition that strong or excessive growth in private credit makes the economy more vulnerable, as it increases the debt burden on households and corporates. This potentially makes them more susceptible to adverse shocks that may lead

them to spend or invest less in an effort to maintain their interest payments.

Splitting the components of NFC credit into market-based credit and bank loans and looking across the entire sample, we find that rapid growth in debt security financing helps to predict recessions unrelated to systemic banking crises, while strong growth in bank credit helps to predict all types of recessions. This result is consistent with the notion that debt security issuance may remain relatively subdued during a bank lending boom, in which strong bank risk taking encourages corporates to borrow particularly from banks while also ultimately precipitating a financial crisis.

At the same time, it is interesting to consider whether the prevailing financing structure of the economy matters for the results since several economies in the sample have very little market-based finance. Focusing only on economies with a genuine mix of financing sources, we find that rapid market-based credit growth becomes a strong predictor of all types of recessions. And strikingly, the effect of banking sector credit turns insignificant despite still comprising between about 40 and 75 per cent of NFC financing in these economies. These findings are in line with the rationale that in economies with a mix of financing, a larger share of NFCs finance themselves via markets, so that market-based credit can play an important role in fuelling economic booms with rising corporate indebtedness that ultimately end in recessions, including in some cases recessions associated with systemic financial crises. But they also highlight that in such economies, volatility in market-based credit may be more important for business cycle dynamics even if the majority of corporate credit is still sourced from banks.

In our second application, we show that the pre-recession split between bank- and market-based credit to NFCs also matters for explaining the path of the subsequent recession and recovery. We apply the local projections approach of Jordà et al. (2022) to our novel dataset. We confirm their finding that strong growth in aggregate NFC credit before business cycle peaks does not result in a significant drag on subsequent GDP growth whereas rapid pre-recession growth in household credit is associated with a weaker recovery. But splitting NFC debt into

bank- and market-based credit, we find that their result does not hold for bank-based credit to NFCs: strong pre-recession growth in bank lending to NFCs tends to deepen recessions and acts as a drag on subsequent economic growth, weighing materially on the speed of recovery. By contrast, rapid growth of market-based credit prior to recessions does not act as a drag on economic growth in the recovery period and, if anything, is associated with a slightly shallower recession than the average.

These results could suggest that forbearance and debt overhang issues are relevant for all borrowers from banks, irrespective of whether they are households or corporates. They are also consistent with Jordà et al. (2022)'s finding that the costs of debt restructuring and liquidations can have an adverse effect on recoveries but may suggest that the type of financing (market-based versus bank-based) could matter alongside the legal system (common versus civil law) in explaining these costs, since the nature of market-based finance may force quicker liquidations. At the same time, the results may also be linked to the 'spare tyre' role of market-based finance during recoveries, as also discussed by Grjebine et al. (2018). In particular, our data show that pre-recession growth in bank loans to NFCs tends to be stronger in economies with very little debt security financing. Therefore, the weaker economic path following rapid bank NFC credit growth could be attributed to a more limited scope for market-based finance to step in and support corporate lending during the recession and recovery periods in these economies. Consistent with this, we present evidence showing that on average in our sample, market-based credit is indeed an important substitute for bank loans during recoveries, thereby acting as a 'spare tyre' which is likely to support the economy when bank lending may be subdued.

Taken together, our results highlight the important role that market-based finance plays in macroeconomic booms and busts. In economies with a genuine mix of financing, rapid growth in debt security financing may be more relevant for subsequent recession risk than rapid growth in bank lending to NFCs. At the same time, unlike other types of credit growth, rapid growth of market-based credit prior to recessions does not weigh adversely on the economy during the recession and recovery period. And market-based finance can also fulfil a valuable 'spare tyre'

role during economic downturns when bank lending may be subdued.

From a public policy perspective, these results highlight the value of deepening capital markets in countries predominantly reliant on bank-based finance. At the same time, given that procyclical market-based finance may contribute to recession risks, they highlight the importance of ensuring that debt markets are stable and resilient throughout the cycle. As non-bank financial institutions are important investors in debt security markets, enhancing their resilience from a macroprudential perspective, with a view to reducing procyclicality and limiting excessive risk-taking among those institutions, could help to promote more stable and resilient market-based credit to NFCs throughout the cycle. In turn, this could help to stabilise the macroeconomy. Our results also suggest that strong pre-recession growth of bank loans to NFCs may later be associated with debt overhang issues and can act as a drag on economic recovery. Therefore, it seems equally important from a macroeconomic perspective to implement macroprudential policies to mitigate procyclicality and risk-taking with respect to bank lending to NFCs.

Our paper expands on the growing literature exploring the links between credit and business cycle dynamics. It is well documented that growth in aggregate credit can fuel economic boom and bust cycles which may lead to financial crises (Fisher (1933), Minsky (1986) and, more recently, Schularick and Taylor (2012), Jordà et al. (2013), Aikman et al. (2015)). And high aggregate credit growth is often found to be the strongest predictor of financial crises (Borio and Lowe (2002); Borio and Drehmann (2009), Drehmann and Juselius (2014); Bluwstein et al. (2023)). While many earlier studies consider credit as broad aggregates, more recent research also assesses the role of certain credit components. For instance, Mian et al. (2017) find that household debt booms predict recessions; while Jordà et al. (2017) find that mortgage debt is associated with more severe recessions. Looking at a large sample of economies over the period 1940–2014, Ivashina et al. (2024) show that corporate debt plays a relevant role in boom-bust cycles, financial crises, and sluggish macroeconomic recoveries. And evaluating the path of the recession and recovery as a function of how much corporate debt grew leading up to the recession

peak, Jordà et al. (2022) find that the effects of past corporate credit booms are negligible as compared to household credit booms, which weigh adversely on the recovery path.

We largely confirm those earlier findings for broad credit and loans to households and corporates. But our main contribution to the literature derives from our new focus on distinguishing market-based and bank-based credit to NFCs in exploring the links between credit, recessions and crises. And our analysis is supported by a newly constructed dataset that also accounts for debt security issuance from financing companies who channel funding to a non-financial parent.

In this respect, our paper is most closely related to strands of the literature which explore the role of different types of NFC credit in business cycle dynamics. Grjebine et al. (2018) distinguish corporate bond financing from bank loans in a quarterly panel of countries from 1989 to 2013 to examine the substitution between loans and bonds during recoveries. While this closely relates to our brief examination of the 'spare tyre' explanation for the differing dynamics of post-peak recessions and recoveries, they do not consider the impact of pre-recession market and bank-based credit growth, which is our main focus. A distinction between bank- and market-based credit similar to ours has also been used recently in a study by Barauskaitė et al. (2022) covering the five largest euro area countries since 1999. Using a Bayesian VAR framework, the authors show that both loan supply and market-based finance supply shocks play an important role for GDP growth variations but they do not investigate business cycle *dynamics* (e.g. boom and bust phases) as we do in this paper. Finally, a study by Müller and Verner (2023) distinguishes between recipient industries of corporate credit and shows that rapid growth of credit to non-tradable industries predicts a boom-bust pattern in output and indicates a higher risk of future banking crisis. These findings help explain corporate vulnerabilities, which may to some degree be correlated with the sources of credit which we assess, for instance, if firms in the non-tradable sector rely more on bank-based funding than firms in the tradable sector.

The remainder of the paper is organised as follows. Section 2 describes how we compile the credit data set and derive business cycle dates. Section 3 presents the results for the two

empirical exercises, while Section 4 concludes.

2 Data

In this section, we first describe the constructing of our new credit dataset, in which we split NFC credit into market-based and bank-based credit (Section 2.1). We also explain the adjustment of market-based NFC credit, which we do in order to account for NFC issuance of debt securities through foreign financing vehicles (Section 2.1.1), and present some facts about the importance of market-based credit across countries and over time (Subsection 2.1.2). Second, we explain how we define the business cycle dates (Subsection 2.2) and, third, we elaborate on the control variables we use in our models (Subsection 2.3). In addition, Appendix A.1 contains a number of tables, illustrative case studies and other details about the data we use and assemble.

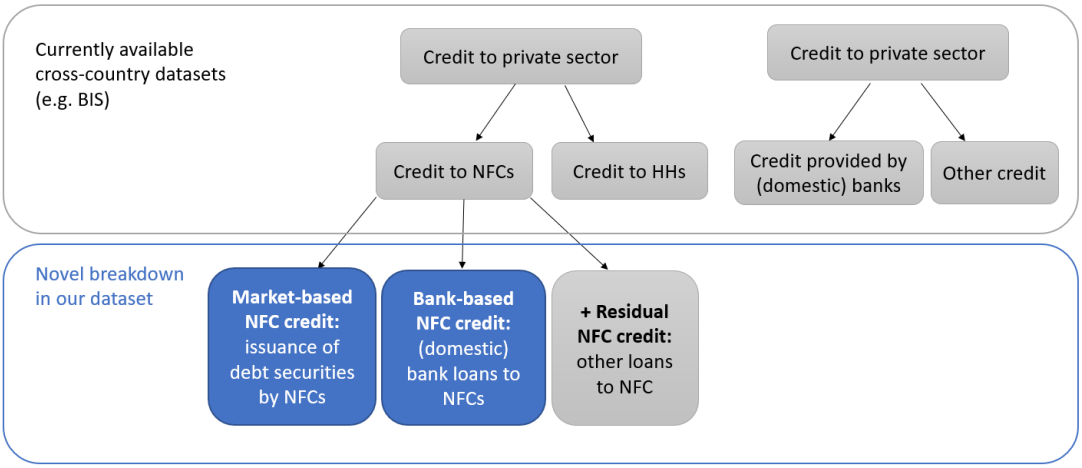
2.1 A novel NFC credit dataset

Currently available cross-country datasets on credit to the private non-financial sector (households and NFCs), such as the credit statistics from the BIS, provide either the breakdown into credit to households and credit to NFCs or the breakdown into credit provided by domestic banks and other credit (calculated as a residual).[1] Other related datasets are collected by central banks and market supervisors at global level to assess various types of non-bank financial intermediation across financial sectors and countries (Claessens et al. (2023)). However, such data are not sufficient to analyse the developments of market-based and bank-based credit provided to NFCs. To overcome this limitation, we construct a new cross-country dataset that splits credit to NFCs into market-based credit, bank-based credit and a residual (see Figure 2), while also publishing this dataset alongside this paper. In addition, in our regressions we also use household credit, which we obtain from the BIS.

More specifically, we construct quarterly time-series of NFC and household credit for a global

[1] See `https://data.bis.org/topics/TOTAL_CREDIT`

Figure 2: Novel breakdowns in our dataset



Notes: 'Credit to private sector' refers to credit granted to households and NFCs either through loans or through investment in debt securities issued by NFCs. 'Other credit' refers to credit to the two private sectors (i.e. households and NFCs) provided by non-bank financial institutions, non-financial sectors (e.g. other NFCs) and foreign banks. 'Other loans to NFCs' refers to loans to NFCs from non-bank financial institutions, non-financial sectors and foreign banks.

sample of 17 developed economies, where NFC credit is broken down into (nominal) outstanding debt securities issued by NFCs, loans to NFCs granted by domestic banks and a residual NFC credit. The countries covered are Australia (AU), Belgium (BE), Canada (CA), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Ireland (IE), Italy (IT), Japan (JP), the Netherlands (NL), Norway (NO), Portugal (PT), Sweden (SE), the United Kingdom (UK) and the United States (US).[2] Since we aim to analyse the dynamics in credit provision by markets and banks, our dataset covers debt securities and loans but excludes other types of NFC financing such as financing through equity, trade credit or securitised loans. As we analyse credit as a share of GDP, we also collect quarterly GDP data from the OECD.

The dataset is constructed using BIS credit data, ECB's quarterly sector accounts (QSA), securities issues statistics (SEC) and MFI's balance sheet items (BSI) statistics, the Debt Capital Markets (DCM) dataset of Dealogic, Bloomberg and various national data sources. Where sensible, we combine the data sources and apply approximations to derive longer time-series. As a result, our data with the NFC credit breakdown reaches back to the late 1980s for most countries. The US data include the longest time-series (data since Q1-1945), while the avail-

[2]The sample of countries is the same as in Jordà et al. (2022) with the exception of Switzerland, which is missing in our sample.

ability of this breakdown is the shortest for Denmark (data since Q1-2003; see also Table A.2 in Appendix A.1.1). The dataset currently ends in the last quarter of 2019, implying that the Covid pandemics is not covered.

When splitting NFC credit into NFC debt securities and bank loans to NFCs, we obtain a residual that includes loans from non-bank financial institutions (e.g. financing vehicles), non-financial sectors and foreign banks.[3] Loans from foreign banks are likely to be fairly small which is the case for the euro area countries in our sample (see ECB (2022), Section 3.3). Therefore, we assume that our time series for domestic bank loans capture the lion's share of bank lending and simply refer to the series as "bank loans" throughout the rest of the paper. Where possible, we also exclude from the residual loans from foreign financing vehicles belonging to the same corporate group (see below). As a result, the residual is likely to mostly include loans between NFCs, which are often provided intra-group, and credit provided by the rest of the world, for which there is no further sectoral break-down available.[4] Since this paper focuses on credit intermediation by the financial sector rather than on loan dynamics within corporate groups, we include the residual as a control variable in our regressions.

For more information about the data sources, the exact time span and the data adjustments we apply to construct our credit dataset, see Tables A.1 and A.2 in Appendix A.1.1. To illustrate these adjustments, Sections A.1.2 and A.1.3 present two case studies, in which we show how we derive the time series for bank loans to UK and DE NFCs. The latter case study shows, for instance, why distinguishing bank loans from total loans matters.

2.1.1 Adjusting for issuance through foreign financing vehicles

Our data on market-based NFC credit account for NFC issuance of debt securities through foreign financing vehicles. For larger NFCs in some countries, it is a common practice to issue debt

[3] As Norway reports debt securities in market values for the compilation of the total NFC credit in BIS statistics, the residual here also includes valuation effects.

[4] This is at least the case for the euro area countries in our sample, where granular sectoral data on domestic credit provision are available.

securities via financial entities belonging to the same corporate group but located in a different country.[5] The proceeds of the issuance is then transferred to the parent company, for example, in the form of internal loans. In public credit statistics, such issuance is generally not attributed to the NFC sector of the parent company's domicile for two reasons. First, foreign financing vehicles are not classified as NFCs, but as financial corporations and, second, they are attributed to the home country of the foreign financing vehicle. This contributes to a biased picture of financing flows between countries (see also Coppola et al. (2021) and Beck et al. (2023)) and an underestimation of the importance of market-based NFC credit for some countries.

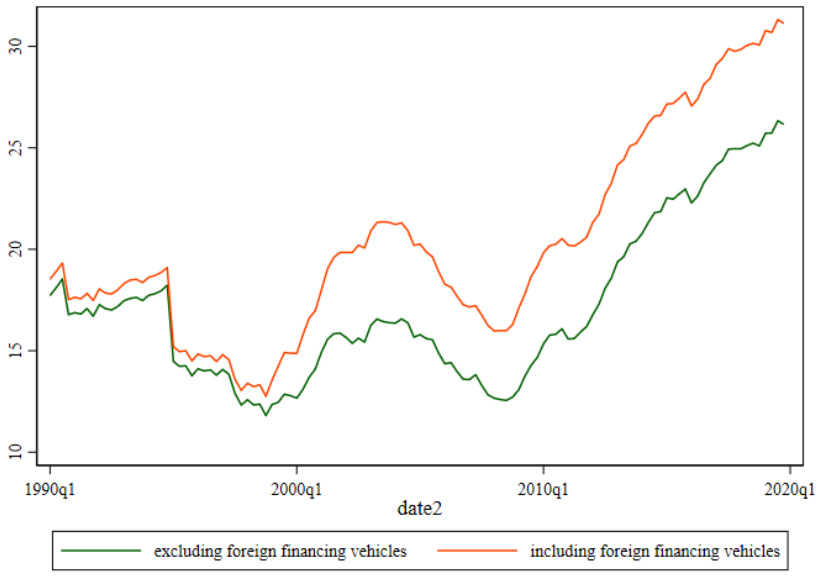
We address this issue by complementing our data collection with information obtained through Dealogic. More specifically, we construct aggregates of bond issuance from foreign financing vehicles that are subsidiaries of NFCs domiciled in our 17 sample countries and add them to the direct issuance of debt securities by NFCs. We do so by aggregating the debt security deals that were settled but have not yet matured, taking into account early expiry of bonds with embedded options with information obtained from Bloomberg.

Such adjustment becomes particularly material in euro area countries after the introduction of the euro, i.e., after the removal of foreign exchange risk (see Figure 3). It is the largest for Germany, where the share of market-based credit to NFCs is on average 11 percentage points higher since the introduction of the Euro in 1999 when issuance through foreign financing vehicles is added. This difference is also material for Spain and Portugal (6 percentage points), Belgium and Italy (4 percentage points), Ireland and the United Kingdom (2 percentage points), while it is well below 1 percentage point for the rest of the sample.

For more details about the exact steps we apply for this adjustment, see Section A.1.4 in Appendix A.1. This section also provides summary statistics on the impact of this adjustment for all countries in our sample (Table A.3), while Section A.1.5 then elaborates on Germany - a country, for which the adjustment is the most significant.

[5]This practice is likely driven by tax optimisation considerations.

Figure 3: Share of market-based in total NFC credit in euro area countries (in %)



Notes: Average across all euro area countries in our sample (BE, DE, ES, FI, FR, IE, IT, NL, PT). Breaks in the timeseries before 2000 are related to the changing composition of countries. NL enters the sample in Q4-1990, IT in Q1-1995, ES and IE in Q3-1997.

We do also further adjustments using data from Dealogic. In several countries, Dealogic data allows us to extend the time-series of outstanding debt securities (IE, PT, SE, UK) and to obtain outstanding debt securities in notional value, where such information is not available from official sources (JP, NO, UK). Including debt securities in notional value as opposed to market value ensures that changes in amounts are not driven by valuation effects, but only reflect the credit financing available to the NFC sector. This is important, as discount rates, and thereby bond valuations, vary alongside risk-free rates and risk premia over the business cycle, which would likely confound our results.[6]

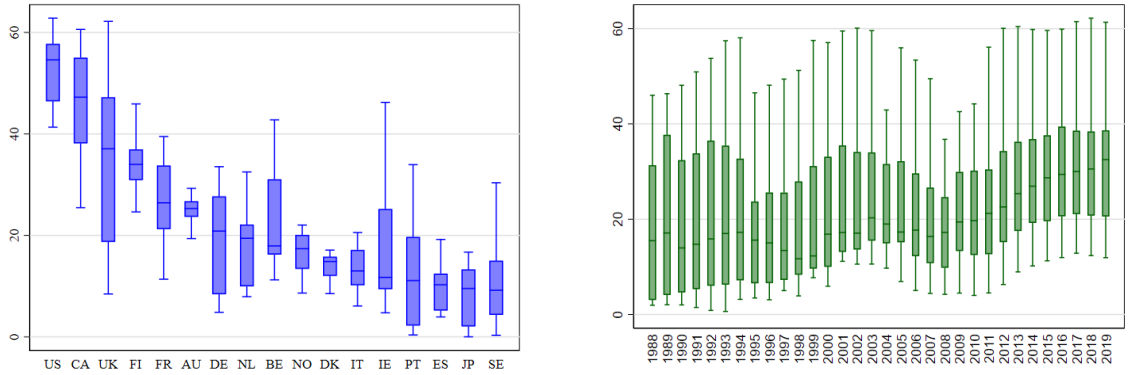
2.1.2 Market-based credit across countries and over time

Overall, the importance of market-based credit, measured as the share of outstanding debt securities in debt securities and bank loans, varies significantly by country and over time. Throughout

[6]Due to data limitations, the time series on outstanding debt securities for Australian NFCs is still in market value. However, we verified that Australia is not driving our results.

the whole time series, the US has a median share of 55% implying that US NFCs are more reliant on debt securities than on bank loans (see Figure 4 (a)). At the higher end of the spectrum are also Canada (47%), Finland (34%), the UK (37%), France (26%) and Australia (25%) (we refer to these later on as 'economies with mixed financing'), while all remaining countries in our sample have the median share close to or below 20%. In particular, economies such as Sweden (9%), Japan (10%), Spain (10%) and Portugal (11%) are highly bank dominated. Over time, the median market-based share across countries has grown from around 15% in 1988 to 33% at the end of 2019. The latest period of consistent growth has started after the end of the Global Financial Crisis (GFC) with the median market-based share growing by 16 percentage points since then (see Figure 4 (b)).

Figure 4: Share of market-based credit to NFCs (in %)



(a) by country (b) over time

Notes: "Share of market-based credit" defined as share of NFC debt securities in NFC debt securities and NFC bank loans. The time-series chart in panel (b) is based on end-of-the-year data (4th quarter) and includes several structural breaks, owing to an increasing number of countries in our sample (see Table A.2 in Appenix A.1.1).

2.2 Business cycle dates

For our analysis, we need to supplement our credit data with information on the business cycle, which we take to be the cyclical fluctuations in GDP in the spirit of Burns and Mitchell (1946). For this, we need to obtain peak and trough dates in GDP for all countries in our sample at a quarterly frequency. A recession is then defined as the period between a peak and the subsequent trough in a country's business cycle. To cover as many recessions as possible, we combine

two sources and complement them with our own estimations. For the US, we use business cycle peaks and troughs provided by the National Bureau of Economic Research (NBER). For AU, CA, DE, ES, FR, IT, JP, SE, UK, we use dates provided by the Economic Cycle Research Institute (ECRI), which aims at reproducing the NBER methodology for 22 major developed and developing economies.[7] For the remaining countries (BE, DK, FI, IE, NL, NO, PT), we estimate business cycle peaks and troughs by applying the Harding and Pagan (2002) procedure, which is a quarterly version of the Bry and Boschan (1971) algorithm that is widely used in the literature (e.g. Jordà et al. (2013)).

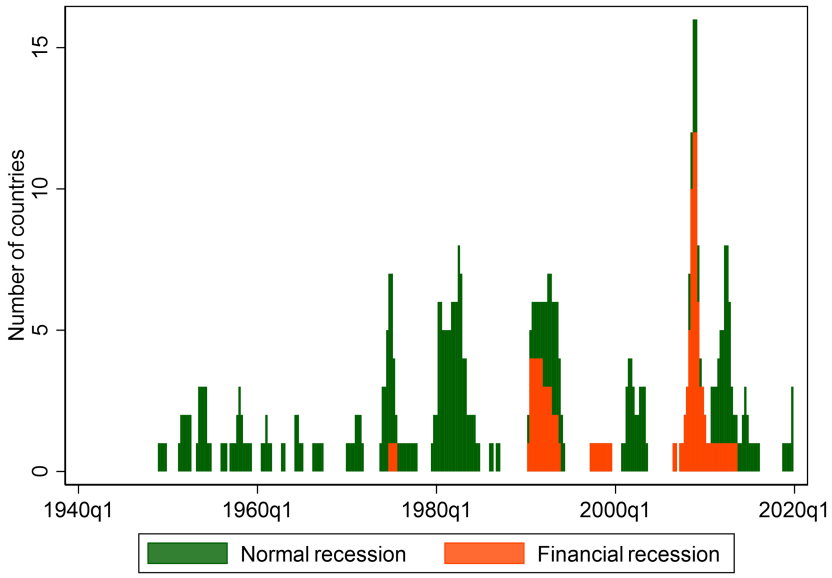
Following Jordà et al. (2022) and others, we distinguish between *financial* and *normal* recessions. We categorize a recession as a financial recession, if it starts eight quarters before or after a systemic banking crisis as defined by Laeven and Valencia (2020) or Jordà et al. (2017); otherwise, we call it a normal recession. The reason for using this symmetric eight-quarter window is that recessions can lead to financial crises and vice versa. For some crises, the start date is only available at annual frequency. In these cases, we assume the crisis started in the third quarter of the same year.[8]

In total, our data collection includes 87 recessions (see Figure 5). Recessions often appear in clusters in multiple countries at the same time. The period around the Global Financial Crisis (GFC) stands out for seeing all but one of our 17 countries simultaneously in a recession, where most of these recessions (12) are also classified as financial recessions. For a detailed list of all recession dates including information on the type of recession and the data sources, from which the recession dates were taken, see Table A.4 in Appendix A.1.

[7] See `https://www.businesscycle.com/`.

[8] This applies to crises in Australia in 1989, Denmark in 1987, Spain in 1977, Italy in 1990, the UK in 1974 and 1991, and the US in 1988.

Figure 5: Number of countries in a recession



2.3 Control variables

We enrich our dataset with macroeconomic variables, which we use to control for potentially confounding effects in our models in Section 3. For our recession prediction models (Subsection 3.1), these are the yield curve slope (calculated as long-term interest rates minus short-term interest rates), eight-quarter difference in government gross debt as a share of GDP, eight-quarter realised inflation, eight-quarter change in real stock prices, eight-quarter change in broad money, eight-quarter change in current account, and the level of long-term interest rates. When assessing the impact of pre-recession credit growth on the subsequent recovery path (Subsection 3.2), these are eight-quarter realised inflation and eight-quarter difference in investment-to-GDP ratios. As data sources, we use the Organisation for Economic Co-operation and Development (OECD), Federal Reserve Economic Data (FRED) and the Jordà-Schularick-Taylor Macrohistory Database database (JST database). For further information on data sources and transformations / approximations applied, see Table A.5 in A.1.

In some cases, the timeseries of the control variables are shorter than those for our credit and business cycle data, which limits the time span, on which we can run our models. Therefore, the number of recessions in our models tend to be lower than the total stated in Subsection 2.2. For

example, the time series for the US used in our models does not start in 1947 when our credit data is available but only in Q3-1964, when also all our control variables become available.[9] For transparency, we report the number of recessions covered by our models in the regression tables in Section 3.

3 Empirical results

We empirically assess the dynamics in market-based finance over the business cycle from two different perspectives. First, we assess the predictive properties of different credit components during the build-up phase prior to a recession start (Subsection 3.1). Second, we investigate to what extent credit growth prior to the recession start has an effect on the economic growth after a business cycle peak (Subsection 3.2).

3.1 Recession prediction

Strong or excessive growth in credit has been shown to predict financial crisis and recessions. While a wide cross-country literature explores the role of credit – and within that bank credit – in contributing to economic and financial booms, busts and recoveries, the specific role of market-based finance in predicting recessions remains relatively underexplored. Our approach distinguishes between different types of credit, with a particular focus on debt securities issuance by corporate borrowers.

Model

In the first step, we run binary response models to assess whether strong growth in household and NFC credit help predict recessions. Specifically, we model the probability of a recession as

$$Prob(Rec_{i,t+h}) = \alpha_i + \beta^{NFC}\Delta_8 x_{it}^{NFC} + \beta^{H}\Delta_8 x_{it}^{H} + \gamma w_{it} + \epsilon_{it}, \tag{1}$$

where $Rec_{i,t+h}$ is a dummy variable indicating whether country i is in a recession h quarters

[9] Other time periods that are excluded due to availability of controls from the baseline models in Subsection 3.1 that split NFC credit into sub components are CA (Q1-1971 to Q4-1971, DK (Q1-2019 to Q4-2019), PT (Q3-1986 to Q4-1989) and SE (Q1-2019 to Q4-2019). Baseline models in Subsection 3.2 are not further affected by the availability of control variables.

ahead from time t or not, x_{it}^{NFC} denotes the share of NFC credit in country i's GDP at time t, x_{it}^{H} is the share of household credit in country i's GDP at time t and Δ_8 is a eight quarter (i.e., two-year) difference. w_{it} includes macroeconomic controls (yield curve slope, eight-quarter difference in government gross debt as a share of GDP, eight-quarter realised inflation, eight-quarter change in real stock prices, eight-quarter change in broad money, eight-quarter change in current account, and the level of long-term interest rates) and the interaction between NFC and household credit to control for potential non-linear effects of our variables of interest in the model.[10] Furthermore, α_i denote country fixed effects, ϵ_{it} is an error term and all regressors are standardised.

In the second step, we amend the model and split NFC credit into its three components: NFC bank loans, NFC debt securities and the residual NFC credit. We divide all the three NFC credit components by GDP to derive their GDP shares and denote them in the model as $x_{it}^{NFC\_BL}$, $x_{it}^{NFC\_DS}$ and $x_{it}^{NFC\_Res}$, respectively:

$$Prob(Rec_{i,t+h}) = \alpha_i + \beta^{NFC\_BL}\Delta_8 x_{it}^{NFC\_BL} + \beta^{NFC\_DS}\Delta_8 x_{it}^{NFC\_DS} + \beta^{NFC\_Res}\Delta_8 x_{it}^{NFC\_Res} + \beta^{H}\Delta_8 x_{it}^{H} + \gamma w_{it} + \epsilon_{it} \quad (2)$$

We expand the vector of control variables, w_{it}, accordingly by including interactions among all three NFC credit components and household credit as these are found jointly significant across all our model specifications. Again, we also standardise all regressors.

In the baseline regressions, we set $h = 8$ but also run robustness checks using $h = 4$ and $h = 12$. Hence, in the baseline regressions, we aim at predicting recessions in the next two years or, put differently, we focus on the credit developments during a build-up phase of eight quarters prior to a recession. As our baseline estimation method, we use logit, while we test the robustness of this choice by using probit. Finally, since the recession dates that we model are likely to be autocorrelated over time and also correlated with recession dates in other countries,

[10] Both variables are interacted as the standardised eight quarter difference in the share to GDP.

we use Driscoll-Kraay standard errors that help overcome both these issues, while also accounting for potential heteroscedasticity in the model. This approach follows Greenwood et al. (2022).

To avoid our results being biased by the dynamics during recessions and recoveries, we exclude those periods from our regressions in line with Bussiere and Fratzscher (2006). While the recession phases vary in length depending on the peaks and troughs of the business cycle, we fix the length of recovery phases to four quarters after the end of a recession.

Estimation results

Starting with the estimation of model 1, we find that strong growth in NFC credit and household credit tends to precede business cycle peaks (column (1) of Table 1). These results are in line with the economic intuition that strong or excessive growth in corporate credit makes the economy more vulnerable as it increases the debt burden on corporates, potentially making them more susceptible to adverse shocks that may lead them to cut back on investment and employment. Similarly, rapid growth in household credit can lead to excessive household indebtedness, which in turn decreases their ability to withstand shocks (e.g. from rising interest rates, higher unemployment) and increases the risk of foreclosures, causing individuals to spend less and save more (see e.g., Mian and Sufi (2014); Mian et al. (2017)).

From the set of control variables, the slope of the yield curve turns out as a strong predictor with a highly significant negative coefficient. This is in line with findings from the literature that an inverted yield curve is a strong signal for an approaching recession with the economic intuition that a recession would lead to monetary policy easing ahead, which is why long-term rates are lower than short-term rates. Regarding other control variables that are significant, both government debt and negative current account balance are other sources of credit for the economy, whose growth can fuel excessive indebtedness, thus increasing the probability of a recession.

We now turn to estimating model 2 with the split of NFC credit into its sub components in columns (2) to (4) of Table 1. From a conceptual point of view, rapid growth in either

Table 1: Model results - by type of recession

Recession starts within eight quarters	Total NFC credit All recessions	NFC credit sub-components All recessions	GFC excluded	Normal rec.
Model:	(1)	(2)	(3)	(4)
Variables				
NFC credit	0.417*			
	(0.098)			
NFC bank loans		1.157***	1.331***	1.67***
		(0)	(0.001)	(0)
NFC debt securities		0.28	0.549**	0.632*
		(0.168)	(0.018)	(0.059)
Residual NFC credit		-0.604*	-0.871	-0.847
		(0.071)	(0.155)	(0.195)
Household credit	0.499*	0.674***	0.702**	0.787**
	(0.053)	(0.002)	(0.02)	(0.016)
Slope	-17.794***	-25.098***	-25.634***	-26.278***
	(0.001)	(0)	(0)	(0)
Government debt	0.565	0.18	-0.006	-0.066
	(0.114)	(0.685)	(0.99)	(0.876)
CPI	0.3	-0.227	0.861	0.741
	(0.622)	(0.71)	(0.157)	(0.343)
Stocks	-0.114	-0.239	-0.457**	-0.408*
	(0.636)	(0.366)	(0.045)	(0.07)
M3	0.505	0.333	-0.608	-0.606
	(0.108)	(0.433)	(0.204)	(0.282)
Current account	-0.098***	-0.103	-0.074**	0.052
	(0.005)	(0.148)	(0.04)	(0.808)
LT interest rates	0.026	1.045	3.804	2.835
	(0.991)	(0.648)	(0.169)	(0.315)
Interactions (private credit)	Yes	Yes	Yes	Yes
Country fixed-effects	Yes	Yes	Yes	Yes
Observations	1,802	1,571	1,294	977
Number of countries	17	17	14	11
Number of recessions	52	45	32	28
Pseudo R^2	0.253	0.357	0.373	0.338

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: Coefficients obtained by logit models with Driscoll-Kraay (L=12) standard-errors. P-values depicted in parentheses. We exclude the GFC in column (3) and financial recessions in column (4) by dropping the observations of the respective build-up phases. All recessions and recovery periods are dropped from the sample. Controls have been modified as described in Subsection 2.3. All regressors have been standardized. The sample size is a result of the availability of credit data (see Table A.1 in Appendix A) and the control variables (see Section 2.3).

bank-based or market-based credit (or both) increases NFC indebtedness, so that both credit components have the potential to be significant predictors of recessions.

This is also found to be the case for bank-based credit across all types of recessions. Such

results are largely unsurprising and in line with the literature: a rapid banking sector credit growth is likely to fuel an economic boom until the start of a recession, which is often associated with a banking crisis, especially if banks have taken on a lot of risk during the credit expansion. Strong growth in NFC indebtedness can either contribute to a recession build-up, which then can translate into a banking crises, as banks get hit by defaults from the corporate sector. Or alternatively, it is evidence of exuberance and increased risk-taking in the banking sector, which can lead to banking crises, which are often followed by recessions, owing to contraction in bank credit supply.

However, since banks might be relatively less exposed to strong market-based credit growth, such growth does not necessarily increase bank vulnerabilities. As a result, market-based credit is less likely to be relevant for explaining financial recessions linked to systemic banking crises than bank credit, while its role is expected to increase when such recessions are dropped from the sample. Our results are in line with this intuition since the estimated coefficient of market-based credit is found insignificant in column (2), when all recessions are included. This result is also consistent with the notion that debt security issuance may remain relatively subdued during a bank lending boom, in which strong bank risk taking encourages corporates to borrow particularly from banks while also ultimately precipitating a financial crisis. However, the estimated coefficient of market-based credit increases in size and becomes significant, when we exclude financial recessions related to the GFC (column 3) and all financial recessions (column 4), suggesting that rapid growth in market-based credit also increase NFC indebtedness and make the economy more vulnerable to (normal) recessions. These results are novel in literature.

Our results are not only statistically but also economically meaningful. Based on models (3) and (4) in Table 1, we calculate that a one standard deviation above the mean growth in debt securities increases the probability that a recession starts within the next two years by 9 and 13 percentage points respectively (on average for our sample of countries).[11] At the same time, based on models (2), (3) and (4) of the same table, a one standard deviation in growth in bank

[11] As our models include country fixed-effects, the effects differ across countries. We first calculate the increase in probability by country and then take the average.

loans increases such probability by around 19, 19 and 29 percentage points respectively.

To test whether the effects of bank-based and market-based credit change with the prevailing financing structure of the economy in addition to the type of recession, we zoom-in onto countries with a genuine mix of financing sources, i.e. economies where both market-based and bank-based credit represent a substantial source of financing. To select these economies, we use the median share of market-based credit as depicted in Figure 4: if this share exceeds 25%, we classify them as 'economies with mixed financing'. Six countries (US, CA, UK, FI, FR, AU) in our sample satisfy this criterion.[12] Singling out these countries also make sense visually in Figure 4 as the median market-based share for the remaining countries typically stays below 20%, with some countries having very little market-based finance (see also Section 2).

Compared to columns (2) to (4) in Table 1, we expect the effects of market-based credit to be stronger because a larger share of NFCs finances themselves via markets in such economies, so that market-based credit can play an important role in fuelling economic booms with rising corporate indebtedness that ultimately end in recessions, including potentially even recessions associated with systemic financial crises. This is confirmed in Table 2, where rapid market-based credit growth is estimated to be a strong and highly significant predictor of all types of recessions. Strikingly, the estimates of bank-based credit become insignificant, despite still comprising between about 40 and 75 per cent of NFC financing in these economies. Overall, these results highlight that in economies with mixed financing, volatility in market-based credit may be more important for business cycle dynamics even if the majority of corporate credit is still sourced from banks.

In addition to looking at the type of recession and economy, we run robustness tests on different lengths of the build-up phase. Instead of a eight-quarter (two-years) build-up phase, we also examine four- (one-year) and twelve-quarter (three-year) build-up phases. We find that rapid growth in bank loans and debt securities tend to be better predictors for four-quarter build-

[12] We don't set an upper limit for the median share of market-based credit as it does not exceed 55% even for the US, which is the country with the highest median share of market-based credit in our sample.

Table 2: Model results - economies with mixed financing

Recession starts within eight quarters Model:	All recessions (1)	GFC excluded (2)	Normal recessions (3)
Variables			
NFC bank loans	0.125	0.227	0.74
	(0.948)	(0.887)	(0.732)
NFC debt securities	1.351**	1.743***	1.938***
	(0.01)	(0.007)	(0.002)
Household credit	2.014***	2.256***	2.615***
	(0.002)	(0.001)	(0.002)
Controls	Yes	Yes	Yes
Country fixed-effects	Yes	Yes	Yes
Observations	740	716	513
Number of countries	6	6	4
Number of recessions	18	15	13
Pseudo R^2	0.521	0.554	0.495

* significant at 10%, ** significant at 5%, ***significant at 1%

Notes: Coefficients obtained by logit models with Driscoll-Kraay (L=12) standard-errors. P-values depicted in parentheses. Controls include macroeconomic controls (yield curve slope, eight-quarter difference in government gross debt as a share of GDP, eight-quarter realised inflation, eight-quarter change in real stock prices, eight-quarter change in broad money, eight-quarter change in current account, and the level of long-term interest rates), the NFC credit residual and interactions between all private credit components. We exclude the GFC in column (2) and financial recessions in column (3) by dropping the observations of the respective build-up phases. All recessions and recovery periods are dropped from the sample. All regressors have been standardized. Economies with mixed financing are the six countries (US, CA, UK, FI, FR, AU), for which the median market-based share as depicted in Figure 4 (a) exceeds 25%. The sample size is a result of the availability of credit data (see Table A.1 in Appendix A) and the control variables (see Section 2.3).

up phases, while household credit turns more significant for build-up phase of twelve quarters (see Tables A.6 and A.7 in the Appendix). In addition, our baseline results are by and large robust to using probit model instead of logit, with market-based NFC credit being significant in the full sample of countries across all types of recessions (see Table A.8). Similarly, our results are robust to the exclusion of the US, i.e. the country with the highest share of market-based credit and the longest timeseries.[13]

3.2 Impact of pre-recession credit growth on subsequent recovery path

Several studies examine how the shape of the path of recession and recovery following a business cycle peak depends on the dynamics in credit growth during the period before the peak. Jordà

[13]Results without the US are available upon request.

et al. (2022) finds no significant impact of growth in (aggregate) NFC credit, unless the cost of debt restructuring and liquidation is considered, which in turn tend to correlate with traditions of civil law (high cost) and common law (low costs). Müller and Verner (2023) shows that credit expansions to the non-tradable sector lead to subsequent slower growth. Making use of our rich data set, we investigate an additional dimension to that question by assessing how the shape of the recession and recovery path after a business cycle peak depends on the growth in different credit components before the recession starts.

Model

In line with the approach of Jordà et al. (2022), we run local projections to model the economic growth h quarters after a business cycle peak p depending on pre-recession growth in total NFC and household credit as follows:

$$\Delta_h y_{t(p)} = \alpha_h + \alpha_{hi} + \beta_h^{NFC} \Delta_{16} x_{it(p)}^{NFC} + \beta_h^{H} \Delta_{16} x_{it(p)}^{H} + \gamma_h w_{it(p)} + \epsilon_{it(p)} \tag{3}$$

where $\Delta_h y_{t(p)}$ denotes the cumulative log changes in real GDP h quarters after a business cycle peak p, $\Delta_{16} x_{it(p)}^{NFC}$ and $\Delta_{16} x_{it(p)}^{H}$ are the 16-quarter (4-year) changes in NFC and household credit respectively normalised to GDP before a business cycle peak. Controls $w_{it(p)}$ include the current and two lagged values of annual GDP growth [14], eight-quarter realised inflation and eight-quarter change in investment-to-GDP ratios. All regressors are de-meaned by their full-sample averages by country, except for the lagged values of GDP growth. α_h is the average real GDP growth in $t + h$ and α_{hi} are country fixed effects normalised to sum to zero. Standard errors are clustered at the country level.[15]

[14] Put differently, we control for GDP growth over twelve quarters prior to a business cycle peak by including (i) GDP growth over the four quarters before a business cycle peak, (ii) GDP growth between the 8th and 4th quarter before a business cycle peak and (iii) GDP growth between the 12th and 8th quarter before a business cycle peak. Given that we include lags of the dependent variable in the model as controls, the model we run is an augmented local projections model.

[15] While our data is quarterly, the higher frequency (as compared to Jordà et al. (2022)) does not increase the number of observations, as this depends on the number of business cycle peaks in a given time period. Consider the start of the recession related to the GFC in the US: in our quarterly data set, this recession starts in Q1-2008, while in an annual data set, it would start in 2008. But in both cases, this recession is related to one business cycle peak p.

Second, we take advantage of the richness of our data and expand the model by splitting the aggregate NFC credit into its components:

$$\Delta_h y_{t(p)} = \alpha_h + \alpha_{hi} + \beta_h^{NFC\_BL}\Delta_{16}x_{it(p)}^{NFC\_BL} + \beta_h^{NFC\_DS}\Delta_{16}x_{it(p)}^{NFC\_DS} + \beta_h^{H}\Delta_{16}x_{it(p)}^{H} + \gamma_h w_{it(p)} + \epsilon_{it(p)} \quad (4)$$

where $\Delta_{16}x_{it(p)}^{NFC\_BL}$ and $\Delta_{16}x_{it(p)}^{NFC\_DS}$ denote the 16-quarter changes in NFC bank loans and NFC debt securities before a business cycle peak respectively, while we also include the 16-quarter growth in the residual NFC credit prior to a business cycle peak as an additional control variable.

Estimation results

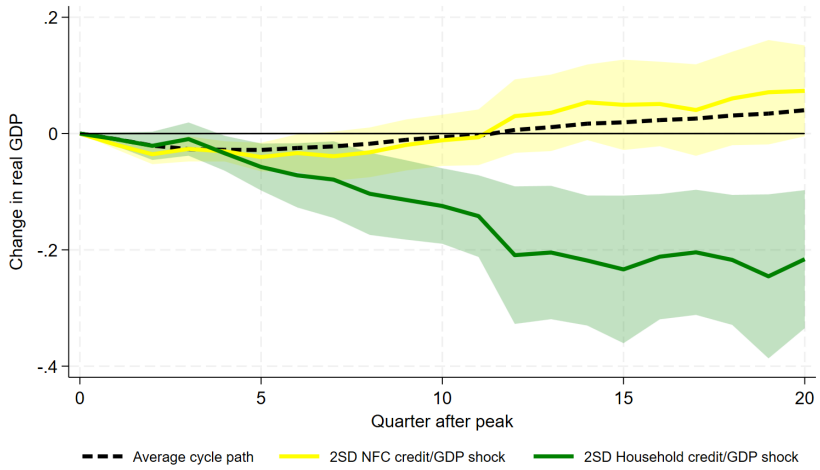
For model 3, we obtain results in line with Jordà et al. (2022). In particular, we confirm their finding that a strong pre-recession growth in household credit is associated with a significantly weaker economic performance after the business cycle peak, while strong growth in aggregate NFC credit before the peak does not result in a significant drag on subsequent GDP growth.

Moving to model 4, we split the (aggregate) NFC credit into bank- and market-based credit and report the results in Figure 7 and Table 4.[16] Interestingly, the business cycle paths after a peak following rapid growth in these two credit components differ significantly. Rapid growth of market-based credit prior to recessions continues to be associated with a typical recovery and, if anything, with a slightly shallower recession than the average. Conversely, and complementing the result of Jordà et al. (2022), we find that rapid pre-recession growth in bank loans to NFCs acts as a drag on subsequent economic growth, weighing materially on the speed of recovery.

In addition, strong growth in household credit prior to recessions is still found to be a drag on the recovery but only in the long term, while it tends to contribute to a shallower recession in the first four quarters after a business cycle peak. The differences in the results with and

[16] For the full regression tables including all h values of models 3 and 4, see Tables A.9 and A.10.

Figure 6: Change in real GDP since business cycle peak - aggregate NFC and household credit (16-quarter growth)



Notes: The figure shows the average business cycle path after a peak (i.e. recession and recovery; shaded line) and the effects on this path of a two-standard-deviation-above-average-growth in NFC and household credit (normalised to GDP; yellow and green lines respectively) calculated over 16 quarters before a business cycle peak. Shaded areas represent the 90% confidence interval. Estimates based on regressions in Table 3.

without the NFC credit split, including the results for household credit, are likely to be driven by omitted variable bias in the regressions without the split. In particular, as bank loans and household credit are highly correlated (correlation around 0.6 in our sample), omitting bank loans from the regressions with aggregate NFC credit is likely to have a confounding effect on the estimates obtained for household credit.

Regarding the size of the estimates, our results for rapid pre-recession growth in both bank loans and household credit suggest severe consequences for the business cycle path after a peak. Assuming a two standard deviations (18.4 percentage points) above-average household credit growth over four years prior to the peak, we estimate the real GDP to be around 7.6% lower five years after the peak compared with a 4.0% increase in real GDP in a typical after-peak path. Similarly, in case of a two standard deviations (18.2 percentage points) above-average pre-recession bank loan growth, the real GDP is estimated to be 4.0% lower five years after the peak.[17] At the same time, a two standard deviations (5 percentage points) above-average

[17]The confidence intervals around our estimates at the end of these five years are relatively wide (owing to the small sample, on which the regressions are based) and include 0, so that recovery to the same level of real GDP cannot be ruled out.

Table 3: Impact of pre-recession growth in household and aggregate NFC credit: Local projections, with macro controls - 16 quarter growth

	h = 4	h = 8	h = 12	h = 16	h = 20
	(1)	(2)	(3)	(4)	(5)
Variables					
NFC credit	-0.008	-0.043	0.070	0.081	0.097
	(0.793)	(0.571)	(0.535)	(0.531)	(0.484)
Household credit	-0.027	-0.380**	-0.951***	-1.038***	-1.132***
	(0.739)	(0.045)	(0.003)	(0.000)	(0.000)
Constant	-0.025***	-0.022**	-0.012	-0.004	0.007
	(0.000)	(0.011)	(0.452)	(0.824)	(0.731)
Observations (Number of cycles)	47	46	46	46	46
Number of countries	16	16	16	16	16

* significant at 10%, ** significant at 5%, ***significant at 1%

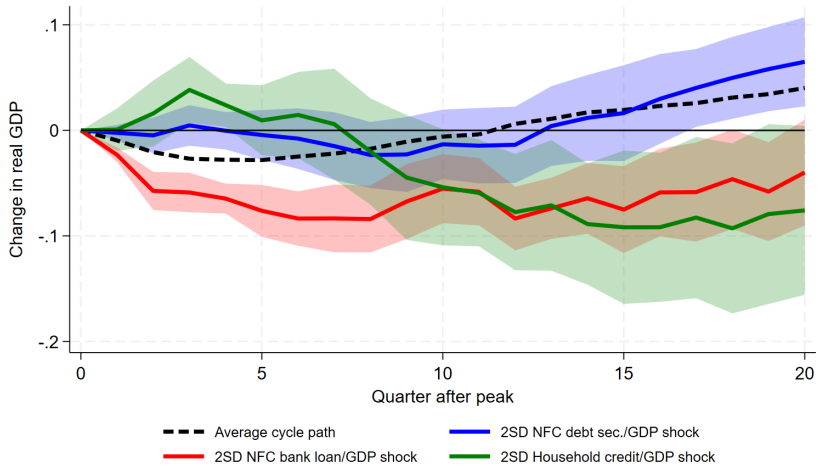
Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the 16 quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak. To ensure consistency between samples, included recessions match the ones from Table 4. Business cycle peaks included in model (1) are BE-2008q2, CA-1981q2, CA-1990q1, CA-2008q1, DE-2001q1, DE-2008q2, DK-2008q3, ES-2008q1, FI-2008q3, FR-1982q2, FR-1992q1, FR-2002q3, FR-2008q1, FR-2011q2, IE-2007q1, IE-2012q1, IT-2007q3, IT-2011q2, JP-1992q2, JP-1997q1, JP-2000q3, JP-2008q1, JP-2010q3, JP-2012q1, JP-2014q1, NL-2008q3, NL-2011q3, NO-2001q2, NO-2008q3, NO-2012q1, NO-2014q2, NO-2018q3, PT-2008q2, PT-2010q3, SE-1990q2, SE-2008q2, UK-2008q2, US-1953q2, US-1957q3, US-1960q2, US-1969q4, US-1973q4, US-1980q1, US-1981q3, US-1990q3, US-2001q1, US-2007q4. NO-2018q3 drops out of the sample in columns (2) to (5). Australia is not included due to debt securities not being available in the four years before any business cycle peak.

pre-recession growth in NFC debt securities is associated with a 7.6% increase in real GDP in five years after the peak, but this difference is not found to be significantly different - at least not in statistical sense - from the typical real GDP gain of 4.0% over this period.

To test the robustness of our results to the choice of the 16-quarter period, on which pre-recessions credit growth is calculated, we also run regressions including 12 and 20-quarter pre-recession credit growth and report the results in the Appendix (see Figures A.6 and A.7 and Tables A.11, A.12, A.13 and A.14). Overall, the results confirm that rapid pre-recession growth in both bank-based and household credit is associated with a deeper recession and a slower subsequent recovery, while the results for market-based credit point to the opposite.[18]

[18]Note that throughout our local projection exercise, we are using a relatively sparse regression set-up (following the approach of Jordà et al. (2022)) with a limited number of explanatory variables. This is to maintain a sufficient sample size / degrees of freedom to run meaningful estimations. Similarly, in line with Subsection 3.1, it would be interesting to further investigate the potential differences in results, when singling out the six economies with

Figure 7: Change in real GDP since business cycle peak - NFC bank loans, NFC debt securities and household credit (16-quarter growth)



Notes: The figure shows the average business cycle path after a peak (i.e. recession and recovery; shaded line) and the effects on this path of a two-standard-deviation-above-average-growth in NFC debt securities, NFC bank loans and household credit (normalised to GDP; blue, red and green lines respectively) calculated over 16 quarters before a business cycle peak. Shaded areas represent the 90% confidence interval. Estimates based on regressions in Table 4.

Table 4: Impact of pre-recession growth in household and NFC credit components: Local projections, with macro controls - 16 quarter growth

	h = 4	h = 8	h = 12	h = 16	h = 20
	(1)	(2)	(3)	(4)	(5)
Variables					
NFC debt securities	0.431**	-0.092	-0.311	0.104	0.388
	(0.011)	(0.758)	(0.366)	(0.796)	(0.334)
NFC bank loans	-0.194***	-0.351***	-0.473***	-0.433***	-0.422***
	(0.000)	(0.001)	(0.000)	(0.001)	(0.009)
Household credit	0.229***	-0.011	-0.370**	-0.508***	-0.513**
	(0.000)	(0.935)	(0.012)	(0.007)	(0.017)
Constant	-0.037***	-0.034***	-0.016	-0.005	0.002
	(0.000)	(0.000)	(0.224)	(0.800)	(0.921)
Observations (Number of cycles)	47	46	46	46	46
Number of countries	16	16	16	16	16

* significant at 10%, ** significant at 5%, ***significant at 1%

Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the 16 quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak. Included business cycle peaks match the ones in Table 3.

a genuine mix of financing sources. However, this is not feasible due to the low number of observations in the corresponding regressions.

These results could suggest that forbearance and debt overhang issues are relevant for all borrowers from banks, irrespective of whether they are households or corporates. They are also consistent with Jordà et al. (2022)'s finding that the costs of debt restructuring and liquidations can have an adverse effect on recoveries but may suggest that the type of financing (market-based versus bank-based) could matter alongside the legal system (common versus civil law) in explaining these costs since the nature of market-based finance may force quicker liquidations.

At the same time, the results may also be linked to the 'spare tyre' role of market-based finance during recoveries. In particular, our data show that bank NFC credit growth prior to the business cycle peaks tend to be stronger in economies with very little debt security financing (bank NFC credit growth of 4.9%) as compared to the six economies with a genuine mix of financing (bank NFC credit growth of 3.4%). Therefore, the weaker economic path following rapid bank NFC credit growth could be attributed to a more limited scope for market-based finance to step in and support corporate lending during the recession and recovery periods in these economies.

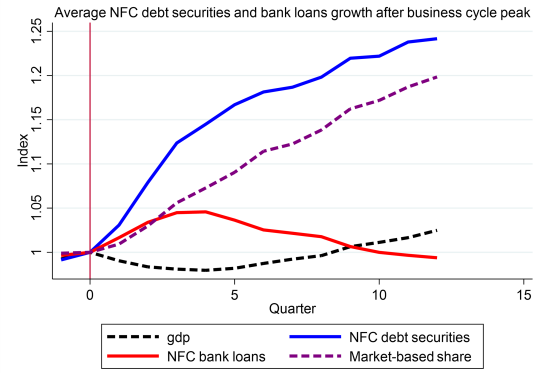
To support this intuition, we examine whether market-based credit substitutes bank loans during recoveries in our novel credit data set, thereby potentially acting as a 'spare tyre' for the economy when bank lending may be subdued. Figure 8 indeed shows that NFC debt securities (the blue line) tend to experience significantly stronger growth after a business cycle peak than NFC bank loans (the red line), implying a growth in the market-based share (the dotted purple line). This trend especially accelerates during the second year after the recession start, which on average corresponds to the recovery phase of the business cycle.

We follow Grjebine et al. (2018) and test the depicted relationship more formally in the following linear regressions:

$$\hat{x}_{t,k,i} = \alpha + \alpha_i + Dummy_{\{recession;recovery\}} + \epsilon_{it} \tag{5}$$

with $\hat{x}_{t,k,i}$ either the deviation of NFC debt securities, NFC bank loans or market-based share

Figure 8: Average NFC debt securities and bank loans growth after a business cycle peak



with respect to their value at the business cycle peak, α_i country fixed effects and ϵ_{it} standard errors clustered at the country level.

	(1) NFC debt securities	(2) NFC bank loans	(3) Market-based share
Recession	0.056***	0.081***	-0.037**
	(0.018)	(0.007)	(0.014)
Recovery	0.138***	0.067***	0.034**
	(0.018)	(0.007)	(0.015)
Constant	1.046***	0.957***	1.084***
	(0.009)	(0.003)	(0.007)
Observations	1,154	1,176	1,092
R-squared	0.052	0.147	0.014
Number of country_g	17	17	17

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Substitution effects during recovery phase

We confirm that also in our novel credit data set, there is evidence of a substitution effect from bank loans to debt securities during the recovery phase, as debt securities issuance recovers more strongly than banks' loan growth. The coefficient of the recovery phase dummy in the model explaining the dynamics of NFC debt securities is around twice as large as the coefficient in the one for NFC bank loans (columns (1) and (2) of Table 5). F-tests confirmed that the difference between both coefficients is highly statistically significant.

4 Conclusions

What is the role of market-based finance in explaining boom and bust dynamics, and subsequent recoveries? We consider two distinct perspectives on how market-based credit to NFCs can intersect with the business cycle by exploiting a new timeseries dataset spanning 17 developed economies which distinguishes corporate debt security financing from bank lending to corporates, and also accounts for debt security issuance from financing companies who channel funding to a non-financial parent.

First, we find that rapid growth in market-based credit helps to predict recessions unrelated to systemic banking crises, while strong growth in bank credit helps to predict all types of recessions. This result is consistent with the notion that debt security issuance may remain relatively subdued during a bank lending boom, in which strong bank risk taking encourages corporates to borrow particularly from banks while also ultimately precipitating a financial crisis. We also find that the financing structure of the economy affects this result: the importance of market-based credit growth for business cycle dynamics is larger in economies with mixed financing, i.e., in economies in which the non-financial corporate sector obtains a substantial share of funding via both bank loans and the issuance of debt securities. Strikingly, rapid banking sector credit growth no longer appears to be associated with subsequent recessions in these economies despite still comprising between about 40 and 75 per cent of NFC financing. This highlights that in such economies, volatility in market-based credit may be more important for business cycle dynamics even if the majority of corporate credit is still sourced from banks.

Second, using local projections, we show that strong growth of market-based credit prior to recessions is associated with a stronger subsequent recovery than rapid pre-recession growth in bank-based credit. Conversely, and complementing the result of Jordà et al. (2022), we find that rapid growth in bank loans to NFCs acts as a drag on economic growth during recessions and recoveries. This is consistent with their finding that the costs of debt restructuring and liquidations can have an adverse effect on recoveries but may suggest that the type of financing (market-based versus bank-based) could matter alongside the legal system (common versus

civil law) in explaining these costs since the nature of market-based finance may force quicker liquidations. At the same time, we argue that our findings may also be linked to the 'spare tyre' role of market-based finance during recoveries, in particular in economies with a genuine mix of financing, and present evidence showing that in our sample, market-based credit indeed acts as an important substitute for bank loans during recoveries.

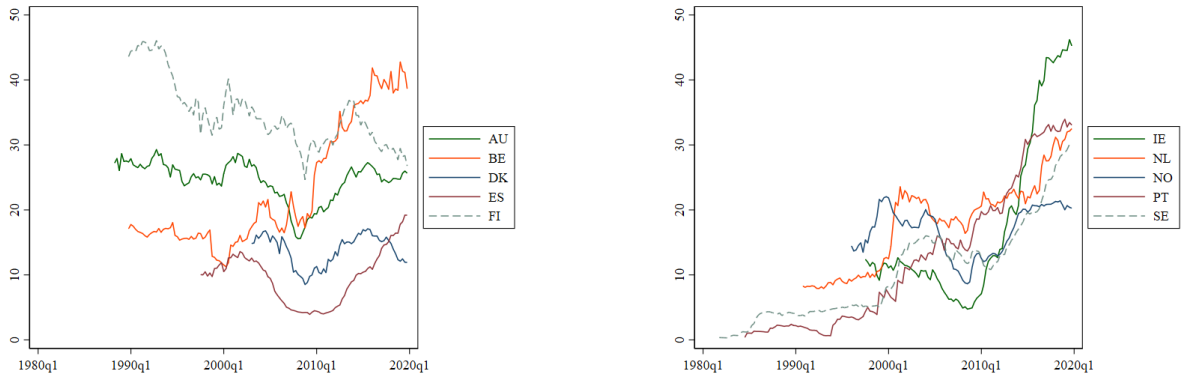
Our results highlight the important role that market-based finance plays in macroeconomic booms and busts. Market-based credit matters not only for the stability of NFC funding, but it has also an important bearing on the real economic cycle. From a public policy perspective, it is important to ensure that debt markets are resilient and can support debt funding to NFCs throughout the cycle.

A Appendix

A.1 Data appendix

A.1.1 A novel NFC credit dataset

Figure A.1: Share of market-based credit to NFCs in countries other than G7 countries (in %)



Notes: "Share of market-based credit" defined as share of NFC debt securities in NFC debt securities and NFC bank loans. The upward shift in Q1-2016 in the time series for BE is due to a large issuance.

Table A.1: NFC credit dataset: data sources, time span and data adjustments

Australia		
Debt securities	BIS (*Q2-1988*)	
Bank loans	Reserve Bank of Australia (*Q3-1976*)	Includes commercial bank lending to the business sector, which might be broader than bank lending to the NFC sector
Belgium		
Debt securities	ECB (SEC) (*Q4-1989*)	
Bank loans	BIS Macro-economic series (*Q1-1980*)	
Canada		
Debt securities	BIS (*Q1-1968*)	
Bank loans	Bank of Canada (*Q1-1969*)	
Germany		
Debt securities	ECB (SEC) (*Q4-1989*)	

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Bank loans	Bundesbank (*Q4-1970*), ECB (QSA) (*Q1-1999*)	The original data from 1970 to 1998 are non-public and were provided by Bundesbank. Data before 1990 refer to Western Germany only, are available at annual frequency only and we derive quarterly time series by linear interpolation. We adjust the series for two breaks, a break between Q4-1989 and Q4-1990 (German reunification) and a break between Q4-1998 to Q1-1999 (data source change), by subtracting the size of the breaks from previous quarters.
Denmark		
Debt securities	BIS (*Q4-2002*)	The series start in Q4-2002 and does not consider the two initial quarters (Q2- and Q3-2002) because of a break between Q3-2002 and Q4-2002.
Bank loans	ECB (BSI) (*Q1-2003*)	
Spain		
Debt securities	ECB (SEC) (*Q1-1990*)	The series entails a break at the end of 2012 due to a statistical reclassification of entities. To remove it, we use the outstanding amounts until November 2011 and for later months derive monthly outstanding amounts by accumulating transactions, using the corresponding quarterly sub-series in our dataset.
Bank loans	ECB (BSI) (*Q3-1997*)	
Finland		
Debt securities	ECB (SEC) (*Q4-1989*)	
Bank loans	BIS Macro-economic series (*Q4-1988*)	
France		
Debt securities	Banque de France (*Q4-1977*), ECB (SEC) (*Q4-1989*)	
Bank loans	Banque de France (here and here) (*Q4-1977*), ECB (QSA) (*Q1-1999*)	To extend the time series up to Q4-1977, data points before Q1-1996 are estimated by applying the share of MFI loans in total loans in Q1-1996 to total loan figures before Q1-1996. To remove a break in the time series for total loans between Q4-1995 and Q1-1996 (data source change), we subtract the size of the break from previous quarters.
Ireland		
Debt securities	Dealogic (*Q3-1989*)	Dealogic is used to obtain longer time-series
Bank loans	ECB (BSI) (*Q3-1997*)	Data from Q3-1997 to Q4-1998 are based on non-public Eurosystem estimates.
Italy		

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Debt securities	ECB (SEC) (*Q4-1989*)	
Bank loans	Banca d'Italia (*Q1-1995*), ECB (QSA) (*Q1-1999*)	
Japan		
Debt securities	Dealogic (*Q1-1980*)	Dealogic is used to obtain notional values
Bank loans	Bank of Japan (*Q1-1980*)	We do three adjustments. First, to remove a break in the time series for total loans in Q1-2005 (data source and frequency change), we subtract the size of the break from previous years. Second, to extend the time series up to 1980, data points before 2005 are estimated by applying the share of MFI loans in total loans in Q1-2005 to total annual loan figures before 2005. Finally, data from 1980 to 2004 is available at annual frequency only and we derive quarterly series by linear interpolation.
Netherlands		
Debt securities	ECB (SEC) (*Q4-1989*)	
Bank loans	BIS Macro-economic series (*Q4-1990*)	
Norway		
Debt securities	Dealogic (*Q2-1982*)	Dealogic is used to obtain notional values
Bank loans	Statistics Norway (*Q1-1996*)	
Portugal		
Debt securities	Dealogic (*Q3-1984*)	Dealogic is used to obtain longer time-series
Bank loans	BIS Macro-economic series (*Q4-1979*)	
Sweden		
Debt securities	Dealogic (*Q4-1981*)	Dealogic is used to obtain longer time-series
Bank loans	BIS Macro-economic series (*Q4-1980*)	
United Kingdom		
Debt securities	Dealogic (*Q2-1980*)	Dealogic is used to obtain longer time-series and notional values

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Bank loans	Office for National Statistics: ONS national accounts (*Q1-1987*) and UK flows of funds total financial accounts matrices (*Q1-1997 - Q2-2019*)	To extend the time series, we combine two different sources. From the first one, we take total loans to NFCs available since Q1-1987. The second one is experimental data from Q1-1997 until Q2-2019 and includes total loans to private NFCs and public corporations and a further break down by sector granting these loans. From the second source, we calculate the share of MFI loans in total loans and apply these shares to the total loans from the first source between Q1-1997 and Q2-2019. We also apply the share in Q1-1997 to previous quarters and the share in Q2-2019 to subsequent quarters.
United States		
Debt securities	FRED (*Q1-1947*)	Data prior to Q4-1951 is available at annual frequency only. We derive quarterly time series up to Q1-1947 by linear interpolation.
Bank loans	BIS Macro-economic series (*Q1-1947*)	Data prior to Q4-1951 is available at annual frequency only. We derive quarterly time series up to Q1-1947 by linear interpolation.

Note: The quarters in parentheses denote the start date of the corresponding series. All time series end in Q4-2019. ECB (BSI) is the ECB's MFI Balance Sheet Items Statistics, ECB (SEC) is the ECB's Securities Issues Statistics, ECB (QSA) is the ECB's and Eurostat's Quarterly Sector Accounts. BIS is the Bank for International Settlements. Data from "BIS Macro-economic series" was accessed via the ECB's Statistical Data Warehouse. FRED stands for Federal Reserve Economic Data. In addition to the sources stated above, we use Dealogic data to derive estimates for debt security issuance by foreign financing vehicles for all countries, except for CA and NO, for which the data are of low quality or show insignificant amounts (see Sections 2.1.1 and A.1.4). This table includes Dealogic as a source, only if the Dealogic data were used to obtain longer time series than those available from public data sources or if public data sources provided only market values. Most of the dataset was assembled in Autumn 2020, so that potential data revisions since then might not be included. In addition to NFC bank loans and debt securities, our NFC credit dataset also uses total NFC credit from the BIS data on Credit to the non-financial sector. The dataset is published alongside this paper.

Table A.2: NFC credit dataset: overview of country coverage over time

Date	Number of countries	List of countries
1945q4	1	**US**
1969q1	2	US, **CA**
1977q4	3	US, CA, **FR**
1980q1	4	US, CA, FR, **JP**
1981q4	5	US, CA, FR, JP, **SE**
1984q3	6	US, CA, FR, JP, **SE, PT**
1987q1	7	US, CA, FR, JP, SE, PT, **UK**
1988q2	8	US, CA, FR, JP, SE, PT, UK, **AU**
1989q4	11	US, CA, FR, JP, SE, PT, UK, AU, **BE, DE, FI**
1990q4	12	US, CA, FR, JP, SE, PT, UK, AU, BE, DE, FI, **NL**
1995q1	13	US, CA, FR, JP, SE, PT, UK, AU, BE, DE, FI, NL, **IT**
1996q1	14	US, CA, FR, JP, SE, PT, UK, AU, BE, DE, FI, NL, IT, **NO**
1997q3	16	US, CA, FR, JP, SE, PT, UK, AU, BE, DE, FI, NL, IT, NO, **ES, IE**
2003q1	17	US, CA, FR, JP, SE, PT, UK, AU, BE, DE, FI, NL, IT, NO, ES, IE, **DK**

Note: The date indicates the starting date, for which data on both market-based and bank-based credit are available in a given country/list of countries. The country/countries joining the sample at this starting date are depicted in bold.

A.1.2 Case study - Bank loans to UK NFCs

As the first example to illustrate the data adjustments outlined in Table A.1, we discuss how we derive bank loans to UK NFCs. To estimate a long run series, we combine two different sources from the Office for National Statistics:

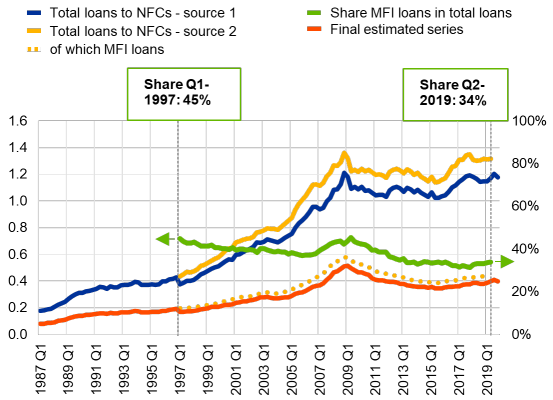
- ONS national accounts (Source 1): provides information on total loans to NFCs available since Q1-1987, but not split by sector providing these loans (see the blue line in Figure A.2).
- UK flow of funds total financial accounts matrices (Source 2): experimental data, which include the split, but the data are only available from Q1-1997 until Q2-2019 (see the solid and dotted yellow lines in Figure A.2, which denote total NFC loans and MFI loans to NFCs respectively).

Using the second source, we calculate the share of MFI loans in total loans (green line) and apply the share to the total loans from the first source (blue line) between Q1-1997 and Q2-2019 to estimate bank (MFI) loans to NFCs. We also apply the share in Q1-1997 (45%) to total loans in previous quarters (Q1-1987 to Q4-1996) and the share in Q2-2019 (34%)to total loans in subsequent quarters (Q3 and Q4-2019). The red line is our final estimated series.

A.1.3 Case study - Bank loans to German NFCs

As the second example, we explain how we derive series for bank loans. To derive an estimate for bank loans to German NFCs, we combine three different data sets (ECB QSA data since Q1-1999 and two datasets - one annual since Q4-1970 and one quarterly since Q4-1990 - from the Bundesbank) and adjust for two structural breaks in the series (see the blue line and the vertical lines in the left panel of Figure A.3):

Figure A.2: Bank loans to UK NFCs

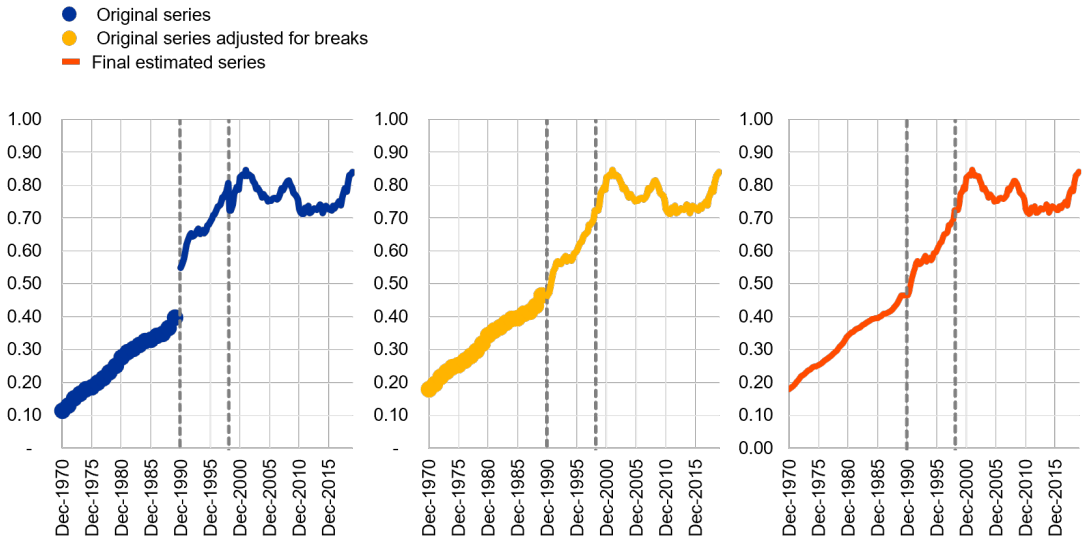


Notes: Unit of left-hand scale is GBP trillion. Source 1 refers to ONS national accounts. Source 2 refers to UK flow of funds total financial accounts matrices.

- the break between Q4-1989 and Q4-1990 due to German reunification (data before 1990 refer to Western Germany only)
- the break between Q4-1998 to Q1-1999 due to data source change

Specifically, we subtract the size of the breaks from previous quarters to derive smoother time series (see middle panel / yellow line in Figure A.3). Moreover, as data prior to Q4 1990 from the Bundesbank are available at annual frequency only, we derive quarterly time series up to Q4-1970 by linear interpolation. This leads us to the final estimated series (see right panel / the red line in Figure A.3).

Figure A.3: Bank loans to DE NFCs

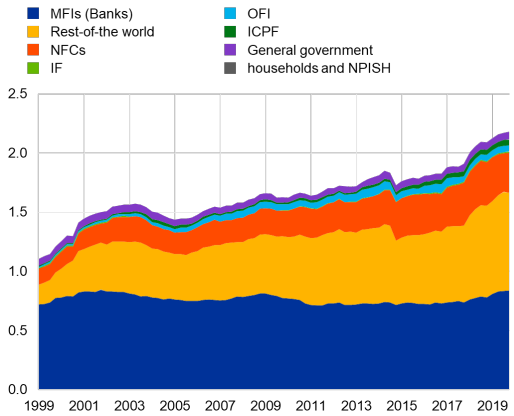


Notes: Unit is EUR trillion.

Figure A.4 depicts the split of total loans to German NFCs broken down by sectors providing these loans. Loans granted by non-bank sectors such as those provided by non-financial sectors (e.g. NFCs)

are significant, which implies that it is important to distinguish between total loans and loans granted by banks. As our newly constructed credit dataset includes this distinction, it also enables to conduct a more detailed analysis compared to other available cross-country data sets, as outlined in Subsection 2.1.

Figure A.4: DE NFC loans



Notes: Unit is EUR trillion. Based on ECB (QSA) data.

A.1.4 Issuance via foreign financing vehicles: methodology

As described in Section 2, we augment the data on outstanding debt securities with data from the commercial data provider Dealogic on foreign financing vehicle issuance. In this Section, we explain in more detail how we derive these amounts.

Dealogic offers granular information on single debt security issuance since the early 1980s. This includes information on the issuance and the issuing company. We identify debt securities issued by foreign financing conduits as deals for which the following two criteria hold:

- Company Type is a financing vehicle ("Finance vehicle-Priv sector indust/util")
- "Company nationality" and "Company Nationality of Incorporation" differ

We then aggregate the deal or tranche values of single issuance of debt securities that have been settled but have not yet matured for each country in our sample. While doing so, we also take into account information on whether the debt securities have embedded options, which could imply that the issued amount has been repaid prior to the maturity date, triggered either by the issuing company executing a call option to repay the debt earlier or by the investor executing a put option to be repaid earlier.

Dealogic includes the information on whether a debt issuance includes such an embedded option. We use Bloomberg to obtain the information on whether the debt security has been called and when (Fields "CALLABLE", "CALLED", "CALLED_DT"). Bloomberg does not offer the same information for debt securities with put options, but information on whether the option has been executed or not ("PUT_EXPIRED").

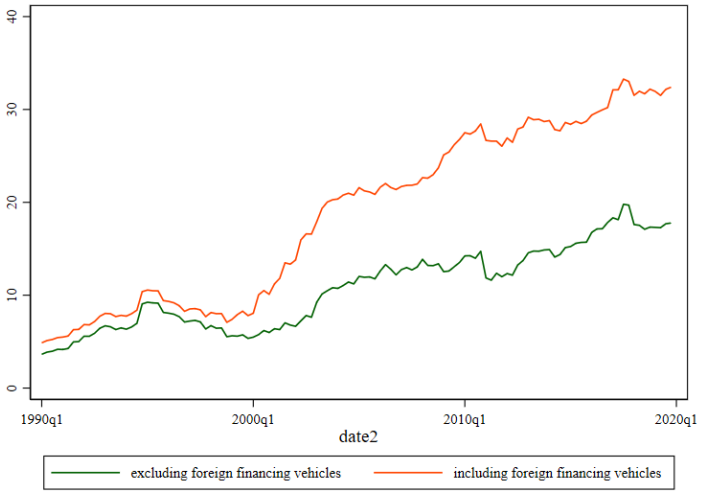
Table A.3 shows the impact of this adjustment for all countries in our sample. The issuance via foreign financing vehicles is particularly significant in some euro area countries such as DE, PT, ES and BE, with a growing impact after the introduction of the Euro.

A.1.5 Issuance via foreign financing vehicles: Case Study - Germany

Figure A.5 shows the significant impact of including issuance through foreign financing vehicles (conduits) on the share of market-based credit in Germany.

In the case of Germany, one example of a financing conduit is "Deutsche Telekom International Finance B. V.". The "Company nationality" is German, but the "Nationality of Incorporation" is Dutch, so that the values in these two fields differ (see Section A.1.4). On the website, this entity is described as a fully owned subsidiary of Deutsche Telekom AG with the business purpose to take on credit from banks and capital markets and to transfer this funding to Deutsche Telekom AG and its other subsidiaries in the form of internal loans. Deutsche Telekom AG issues loan guarantees for this entity.[19]

Figure A.5: Share of market-based in total NFC credit in Germany (in %)



[19] See https://www.telekom.com/de/investor-relations/fremdkapital/deutsche-telekom-international-finance-b-v-

Table A.4: Recession dates, classification and sources

Country	Start date	End date	Classification	Source
AU	Q3-1951	Q3-1952	normal recession	ECRI
AU	Q1-1956	Q3-1956	normal recession	ECRI
AU	Q1-1961	Q3-1961	normal recession	ECRI
AU	Q3-1974	Q1-1975	normal recession	ECRI
AU	Q3-1982	Q2-1983	normal recession	ECRI
AU	Q3-1990	Q4-1991	financial recession	ECRI
BE	Q3-2008	Q1-2009	financial recession related to GFC	BBQ
CA	Q3-1953	Q2-1954	normal recession	ECRI
CA	Q1-1957	Q1-1958	normal recession	ECRI
CA	Q3-1981	Q4-1982	normal recession	ECRI
CA	Q2-1990	Q1-1992	normal recession	ECRI
CA	Q2-2008	Q3-2009	normal recession	ECRI
DE	Q2-1966	Q2-1967	normal recession	ECRI
DE	Q4-1973	Q3-1975	normal recession	ECRI
DE	Q2-1980	Q4-1982	normal recession	ECRI
DE	Q2-1991	Q2-1994	normal recession	ECRI
DE	Q2-2001	Q3-2003	normal recession	ECRI
DE	Q3-2008	Q1-2009	financial recession related to GFC	ECRI
DE	Q4-2019		normal recession	ECRI
DK	Q3-2006	Q4-2006	financial recession related to GFC	BBQ
DK	Q4-2008	Q2-2009	financial recession related to GFC	BBQ
ES	Q2-1980	Q2-1984	normal recession	ECRI
ES	Q1-1992	Q4-1993	normal recession	ECRI
ES	Q2-2008	Q3-2013	financial recession related to GFC	ECRI
FI	Q2-1964	Q3-1964	normal recession	BBQ
FI	Q2-1990	Q4-1992	financial recession	BBQ
FI	Q4-2008	Q2-2009	normal recession	BBQ
FR	Q1-1958	Q2-1959	normal recession	ECRI
FR	Q4-1974	Q2-1975	normal recession	ECRI
FR	Q4-1979	Q2-1980	normal recession	ECRI
FR	Q3-1982	Q4-1984	normal recession	ECRI
FR	Q2-1992	Q3-1993	normal recession	ECRI
FR	Q4-2002	Q2-2003	normal recession	ECRI
FR	Q2-2008	Q1-2009	financial recession related to GFC	ECRI
FR	Q3-2011	Q4-2012	normal recession	ECRI
IE	Q2-2007	Q4-2009	financial recession related to GFC	BBQ
IE	Q2-2012	Q4-2012	normal recession	BBQ
IT	Q2-1964	Q1-1965	normal recession	ECRI
IT	Q1-1971	Q3-1971	normal recession	ECRI
IT	Q3-1974	Q2-1975	normal recession	ECRI
IT	Q3-1980	Q3-1982	normal recession	ECRI
IT	Q2-1992	Q4-1993	financial recession	ECRI
IT	Q4-2007	Q1-2009	financial recession related to GFC	ECRI
IT	Q3-2011	Q4-2014	normal recession	ECRI
JP	Q2-1953	Q4-1954	normal recession	ECRI
JP	Q1-1974	Q1-1975	normal recession	ECRI
JP	Q3-1992	Q1-1994	normal recession	ECRI
JP	Q2-1997	Q3-1999	financial recession	ECRI
JP	Q4-2000	Q2-2003	normal recession	ECRI

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Country	Start date	End date	Classification	Source
JP	Q2-2008	Q1-2009	normal recession	ECRI
JP	Q4-2010	Q2-2011	normal recession	ECRI
JP	Q2-2012	Q1-2013	normal recession	ECRI
JP	Q2-2014	Q3-2014	normal recession	ECRI
JP	Q4-2019		normal recession	ECRI
NL	Q4-1962	Q1-1963	normal recession	BBQ
NL	Q4-1986	Q1-1987	normal recession	BBQ
NL	Q4-2008	Q2-2009	financial recession related to GFC	BBQ
NL	Q4-2011	Q3-2012	normal recession	BBQ
NO	Q1-1986	Q2-1986	normal recession	BBQ
NO	Q3-2001	Q1-2002	normal recession	BBQ
NO	Q4-2008	Q1-2009	normal recession	BBQ
NO	Q2-2012	Q3-2012	normal recession	BBQ
NO	Q3-2014	Q1-2016	normal recession	BBQ
NO	Q4-2018		normal recession	BBQ
PT	Q3-2008	Q1-2009	financial recession related to GFC	BBQ
PT	Q4-2010	Q4-2012	normal recession	BBQ
SE	Q1-1971	Q4-1971	normal recession	ECRI
SE	Q4-1975	Q4-1977	normal recession	ECRI
SE	Q2-1980	Q2-1983	normal recession	ECRI
SE	Q3-1990	Q3-1993	financial recession	ECRI
SE	Q3-2008	Q1-2009	financial recession related to GFC	ECRI
UK	Q2-1951	Q3-1952	normal recession	ECRI
UK	Q4-1974	Q3-1975	financial recession	ECRI
UK	Q3-1979	Q2-1981	normal recession	ECRI
UK	Q3-1990	Q1-1992	financial recession	ECRI
UK	Q3-2008	Q1-2010	financial recession related to GFC	ECRI
US	Q1-1949	Q4-1949	normal recession	NBER
US	Q3-1953	Q2-1954	normal recession	NBER
US	Q4-1957	Q2-1958	normal recession	NBER
US	Q3-1960	Q1-1961	normal recession	NBER
US	Q1-1970	Q4-1970	normal recession	NBER
US	Q1-1974	Q1-1975	normal recession	NBER
US	Q2-1980	Q3-1980	normal recession	NBER
US	Q4-1981	Q4-1982	normal recession	NBER
US	Q4-1990	Q1-1991	normal recession	NBER
US	Q2-2001	Q4-2001	normal recession	NBER
US	Q1-2008	Q2-2009	financial recession related to GFC	NBER

Note: NBER is the National Bureau of Economic Research, ECRI is the Economic Cycle Research Institute. BBQ indicates that we estimated start and end date of this recession applying the Harding and Pagan (2002) procedure to GDP data between Q1-1960 and Q4-2019 (BBQ stands for Bry-Boschan quarterly algorithm).

Table A.3: Difference in market-based share including and excluding issuance of foreign financing vehicles

Country	In Q4-2019	Average over available time period	Average since introduction of the Euro
DE	14.6%	7.9%	10.8%
PT	9.3%	3.5%	6%
ES	7.7%	5.4%	5.7%
BE	7%	2.8%	3.7%
UK	3.1%	2.3%	2%
IE	2.5%	2.2%	2.2%
IT	2.5%	3.8%	4.4%
FI	1%	0.3%	0.2%
NL	0.6%	0.4%	0.4%
FR	0.5%	0.3%	0.4%
US	0.5%	0.2%	0.4%
AU	0.2%	0.6%	0.5%
JP	0%	0.1%	0.1%
SE	0%	0.3%	0.3%

Note: Countries are ordered according to the difference in Q4-2019. Dealogic data for Canada was not used due to low quality. For Norway, the Dealogic data set indicates that there are no issuances of foreign financing vehicles affiliated with Norwegian corporates, and for Denmark, amounts are tiny.

Table A.5: Overview of macro-economic controls

Variable	Sources	Definition / transformation	Approximations
Yield curve slope	JST database (for JP, PT, SE), OECD (for all other countries)	Long-term interest rate minus short-term interest rate	Long-term and short-term interest rates for JP, PT and SE from JST database are at annual frequency and have been linearly interpolated to match the quarterly frequency
Government gross debt	JST database	eight-quarter difference in government gross debt as a share of GDP	Available only at annual frequency and linearly interpolated to match quarterly frequency
CPI	OECD and FRED (US)	eight-quarter realised inflation	
Stocks	OECD	eight-quarter % change in real stock prices	
M3	OECD	eight-quarter % change in M3	
Current account	JST database	eight-quarter % change in current account	
LT interest rates	JST database (JP, PT, SE), OECD (other countries)	Long-term interest rate	Long-term interest rates for JP, PT and SE from JST database are at annual frequency and have been linearly interpolated to match the quarterly frequency
Investment-to-GDP ratio	JST database	eight-quarter difference in investment-to-GDP ratio	Available only at annual frequency and linearly interpolated to match quarterly frequency

Note: JST database is the Jordà-Schularick-Taylor Macrohistory Database, we used version R6, see also Jordà et al. (2017) for further information. OECD stands for Organisation for Economic Co-Operation and development, FRED is the Federal Reserve Economic Data.

A.2 Robustness checks: Recession prediction

Table A.6: Model results - split by type of recession and with a zoom-in on economies with mixed financing - **One-year build-up phase**

Recession starts within four quarters	Total NFC credit	NFC credit sub-components			Economies with mixed financing
	All recessions	All recessions	GFC excluded	Normal recessions	All recessions
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
NFC credit	0.607**				
	(0.013)				
NFC bank loans		1.125***	1.126***	1.18***	0.796
		(0)	(0.002)	(0.003)	(0.731)
NFC debt securities		0.192	0.342*	0.354*	1.382**
		(0.215)	(0.064)	(0.056)	(0.033)
Household credit	0.102	0.035	0.043	0.086	1.458**
	(0.61)	(0.869)	(0.868)	(0.755)	(0.014)
Controls	Yes	Yes	Yes	Yes	Yes
Country fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	1,802	1,571	1,330	1,009	740
Number of countries	17	17	14	11	6
Number of recessions	52	45	32	28	18
Pseudo R^2	0.241	0.304	0.308	0.283	0.479
Convergence	TRUE	TRUE	TRUE	TRUE	TRUE

* significant at 10%, ** significant at 5%, ***significant at 1% Notes: Coefficients obtained by logit models with Driscoll-Kraay (L=6) standard-errors. P-values depicted in parentheses. Controls include macroeconomic controls (yield curve slope, eight-quarter difference in government gross debt as a share of GDP, eight-quarter realised inflation, eight-quarter change in real stock prices, eight-quarter change in broad money, eight-quarter change in current account, and the level of long-term interest rates), the NFC credit residual and interactions between all private credit components. We exclude the GFC in column (3) and financial recessions in column (4) by dropping the observations of the respective build-up phases. All recessions and recovery periods are dropped from the sample. All regressors have been standardized. Economies with mixed financing in column (5) are the six countries (US, CA, UK, FI, FR, AU) with the highest median market-based share as depicted in Figure 4 (a).

Table A.7: Model results - split by type of recession and with a zoom-in on economies with mixed financing - **Three-year build-up phase**

Recession starts	Total NFC credit	NFC credit sub-components			Economies with mixed financing
within twelve quarters	All recessions	All recessions	GFC excluded	Normal recessions	All recessions
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
NFC credit	0.325*				
	(0.098)				
NFC bank loans		0.882**	0.657*	0.682*	-0.005
		(0.011)	(0.076)	(0.054)	(0.996)
NFC debt securities		0.107	0.199	0.2	0.975*
		(0.723)	(0.51)	(0.521)	(0.064)
Household credit	0.796***	0.929***	0.977***	1.026***	2.181***
	(0.002)	(0)	(0)	(0)	(0)
Controls	Yes	Yes	Yes	Yes	Yes
Country fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	1,802	1,571	1,440	1,309	740
Number of countries	17	17	16	15	6
Number of recessions	52	45	43	40	18
Pseudo R^2	0.279	0.382	0.361	0.340	0.540
Convergence	TRUE	TRUE	TRUE	TRUE	TRUE

* significant at 10%, ** significant at 5%, ***significant at 1% Notes: Coefficients obtained by logit models with Driscoll-Kraay (L=18) standard-errors. P-values depicted in parentheses. Controls include macroeconomic controls (yield curve slope, eight-quarter difference in government gross debt as a share of GDP, eight-quarter realised inflation, eight-quarter change in real stock prices, eight-quarter change in broad money, eight-quarter change in current account, and the level of long-term interest rates), the NFC credit residual and interactions between all private credit components. We exclude the GFC in column (3) and financial recessions in columns (4) by dropping the observations of the respective build-up phases. All recessions and recovery periods are dropped from the sample. All regressors have been standardized. Economies with mixed financing in column (5) are the six countries (US, CA, UK, FI, FR, AU) with the highest median market-based share as depicted in Figure 4 (a).

Table A.8: Model results - split by type of recession and with a zoom-in on economies with mixed financing - **Probit**

Recession starts	Total NFC credit	NFC credit sub-components			Economies with mixed financing
within eight quarters	All recessions	All recessions	GFC excluded	Normal recessions	All recessions
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
NFC credit	0.235*				
	(0.079)				
NFC bank loans		0.64***	0.768***	0.908***	0.112
		(0)	(0.002)	(0)	(0.902)
NFC debt securities		0.17*	0.284***	0.302**	0.653**
		(0.091)	(0.005)	(0.047)	(0.021)
Household credit	0.284**	0.346***	0.32*	0.354**	1.044***
	(0.041)	(0.004)	(0.057)	(0.045)	(0.002)
Controls	Yes	Yes	Yes	Yes	Yes
Country fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	1,802	1,571	1,294	977	740
Number of countries	17	17	14	11	6
Number of recessions	52	45	32	28	18
Pseudo R^2	0.256	0.351	0.362	0.319	0.518
Convergence	TRUE	TRUE	TRUE	TRUE	TRUE

* significant at 10%, ** significant at 5%, ***significant at 1% Notes: Coefficients obtained by probit models with Driscoll-Kraay (L=12) standard-errors. P-values depicted in parentheses. Controls include macroeconomic controls (yield curve slope, eight-quarter difference in government gross debt as a share of GDP, eight-quarter realised inflation, eight-quarter change in real stock prices, eight-quarter change in broad money, eight-quarter change in current account, and the level of long-term interest rates), the NFC credit residual and interactions between all private credit components. We exclude the GFC in column (3) and financial recessions in column (4) by dropping the observations of the respective build-up phases. All recessions and recovery periods are dropped from the sample. All regressors have been standardized. Economies with mixed financing in column (5) are the six countries (US, CA, UK, FI, FR, AU) with the highest median market-based share as depicted in Figure 4 (a).

A.3 Robustness checks: Impact of pre-recession growth on subsequent recovery path

Table A.9: **Impact of pre-recession growth in NFC and household credit: Local projections, with macro controls Baseline model (16 quarter growth in credit)**

	h = 1	h = 2	h = 3	h = 4	h = 5	h = 6	h = 7	h = 8	h = 9	h = 10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables										
NFC credit	-0.028**	-0.044	0.002	-0.008	-0.036	-0.026	-0.049	-0.043	-0.026	-0.017
	(0.042)	(0.150)	(0.966)	(0.793)	(0.414)	(0.657)	(0.511)	(0.571)	(0.741)	(0.833)
Household credit	-0.001	-0.002	0.077	-0.027	-0.129	-0.208	-0.252	-0.380**	-0.457**	-0.524***
	(0.974)	(0.980)	(0.316)	(0.739)	(0.232)	(0.161)	(0.154)	(0.045)	(0.013)	(0.003)
Constant	-0.008***	-0.011***	-0.024***	-0.025***	-0.027***	-0.025***	-0.026***	-0.022**	-0.022**	-0.018*
	(0.002)	(0.003)	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.011)	(0.025)	(0.094)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations (Number of cycles)	49	47	47	47	47	46	46	46	46	46
Number of countries	16	16	16	16	16	16	16	16	16	16

	h = 11	h = 12	h = 13	h = 14	h = 15	h = 16	h = 17	h = 18	h = 19	h = 20
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Variables										
NFC credit	-0.007	0.070	0.072	0.107	0.088	0.081	0.043	0.086	0.107	0.097
	(0.930)	(0.535)	(0.537)	(0.353)	(0.523)	(0.531)	(0.759)	(0.549)	(0.501)	(0.484)
Household credit	-0.611***	-0.951***	-0.952***	-1.040***	-1.117***	-1.038***	-1.016***	-1.097***	-1.236***	-1.132***
	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Constant	-0.019	-0.012	-0.007	-0.007	-0.006	-0.004	-0.003	0.001	0.005	0.007
	(0.136)	(0.452)	(0.673)	(0.697)	(0.758)	(0.824)	(0.884)	(0.941)	(0.826)	(0.731)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations (Number of cycles)	46	46	46	46	46	46	46	46	46	46
Number of countries	16	16	16	16	16	16	16	16	16	16

* significant at 10%, ** significant at 5%, ***significant at 1%

Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the 16 quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak. To ensure consistency in samples, included recessions match the ones from Table A.10.

Table A.10: **Impact of pre-recession growth in NFC credit components: Local projections, with macro controls Baseline model (16 quarter growth in credit components)**

	h = 1 (1)	h = 2 (2)	h = 3 (3)	h = 4 (4)	h = 5 (5)	h = 6 (6)	h = 7 (7)	h = 8 (8)	h = 9 (9)	h = 10 (10)
Variables										
NFC debt securities	0.113	0.250	0.494***	0.431**	0.373*	0.266	0.112	-0.092	-0.189	-0.114
	(0.116)	(0.122)	(0.007)	(0.011)	(0.097)	(0.328)	(0.713)	(0.758)	(0.576)	(0.715)
NFC bank loans	-0.072***	-0.194***	-0.168***	-0.194***	-0.253***	-0.310***	-0.324***	-0.351***	-0.299***	-0.260**
	(0.001)	(0.001)	(0.005)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)	(0.009)	(0.013)
Household credit	0.046	0.162*	0.288***	0.229***	0.166*	0.174	0.124	-0.011	-0.150	-0.212
	(0.396)	(0.054)	(0.001)	(0.000)	(0.062)	(0.111)	(0.381)	(0.935)	(0.345)	(0.151)
Constant	-0.009***	-0.020***	-0.034***	-0.037***	-0.038***	-0.040***	-0.040***	-0.034***	-0.024***	-0.025***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.006)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations (Number of cycles)	49	47	47	47	47	46	46	46	46	46
Number of countries	16	16	16	16	16	16	16	16	16	16

	h = 11 (11)	h = 12 (12)	h = 13 (13)	h = 14 (14)	h = 15 (15)	h = 16 (16)	h = 17 (17)	h = 18 (18)	h = 19 (19)	h = 20 (20)
Variables										
NFC debt securities	-0.168	-0.311	-0.108	-0.082	-0.046	0.104	0.226	0.293	0.371	0.388
	(0.620)	(0.366)	(0.764)	(0.833)	(0.914)	(0.796)	(0.519)	(0.428)	(0.329)	(0.334)
NFC bank loans	-0.287***	-0.473***	-0.448***	-0.430***	-0.498***	-0.433***	-0.445***	-0.408***	-0.487***	-0.422***
	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.007)	(0.001)	(0.009)
Household credit	-0.245*	-0.370**	-0.363**	-0.468***	-0.491**	-0.508***	-0.479**	-0.547**	-0.502**	-0.513**
	(0.071)	(0.012)	(0.029)	(0.002)	(0.012)	(0.007)	(0.020)	(0.011)	(0.028)	(0.017)
Constant	-0.028**	-0.016	-0.012	-0.009	-0.008	-0.005	-0.005	-0.000	-0.003	0.002
	(0.011)	(0.224)	(0.382)	(0.568)	(0.633)	(0.800)	(0.794)	(0.992)	(0.874)	(0.921)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations (Number of cycles)	46	46	46	46	46	46	46	46	46	46
Number of countries	16	16	16	16	16	16	16	16	16	16

* significant at 10%, ** significant at 5%, ***significant at 1%

Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the 16 quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak.

Table A.11: Impact of pre-recession growth in household and aggregate NFC credit: Local projections, with macro controls - **12 quarter growth**

	h = 4	h = 8	h = 12	h = 16	h = 20
	(1)	(2)	(3)	(4)	(5)
Variables					
NFC credit	-0.089*	-0.170**	-0.008	0.081	0.076
	(0.094)	(0.020)	(0.923)	(0.456)	(0.547)
Household credit	0.002	-0.346**	-1.054***	-1.170***	-1.243***
	(0.983)	(0.028)	(0.000)	(0.000)	(0.000)
Constant	-0.023***	-0.023**	-0.015	-0.006	0.007
	(0.000)	(0.011)	(0.343)	(0.773)	(0.727)
Observations (Number of cycles)	49	48	48	48	48
Number of countries	16	16	16	16	16

* significant at 10%, ** significant at 5%, ***significant at 1%

Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the 12 quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak. To ensure consistency between samples, included recessions match the ones from Table A.12.

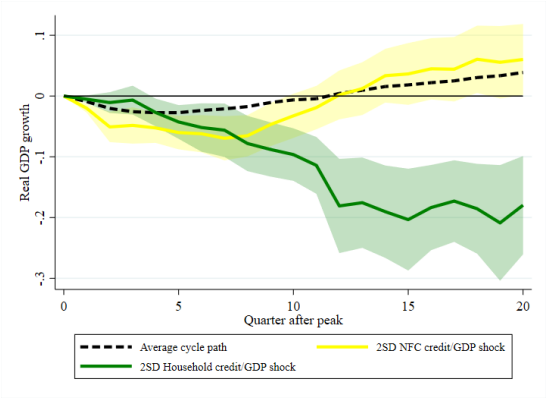
Table A.12: Impact of pre-recession growth in household and NFC credit components: Local projections, with macro controls **12 quarter growth**

	h = 4	h = 8	h = 12	h = 16	h = 20
	(1)	(2)	(3)	(4)	(5)
Variables					
NFC debt securities	0.320	-0.277	-0.344	0.384	0.445
	(0.105)	(0.578)	(0.434)	(0.312)	(0.135)
NFC bank loans	-0.253***	-0.384***	-0.418***	-0.315**	-0.357***
	(0.000)	(0.000)	(0.000)	(0.013)	(0.002)
Household credit	0.287***	0.023	-0.389**	-0.483***	-0.463***
	(0.000)	(0.879)	(0.021)	(0.007)	(0.003)
Constant	-0.037***	-0.035***	-0.023**	-0.017	-0.005
	(0.000)	(0.000)	(0.028)	(0.245)	(0.762)
Observations (Number of cycles)	49	48	48	48	48
Number of countries	16	16	16	16	16

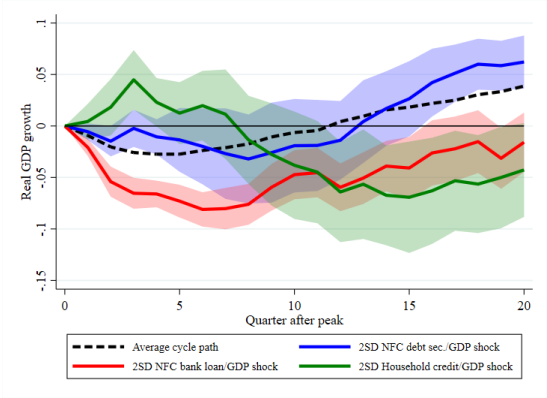
* significant at 10%, ** significant at 5%, ***significant at 1%

Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the twelve quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak.

Figure A.6: Real GDP growth after business cycle peak, average and +2SD responses - **12 quarter growth**

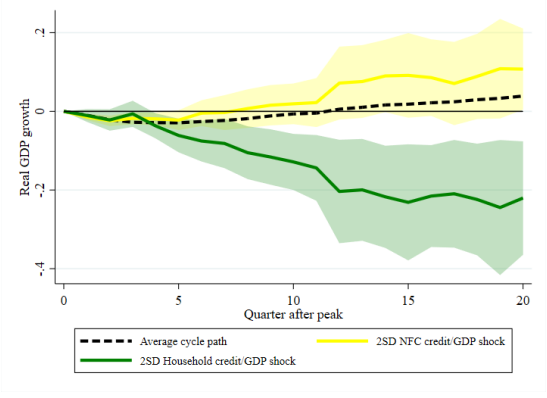


(a) NFC and household credit

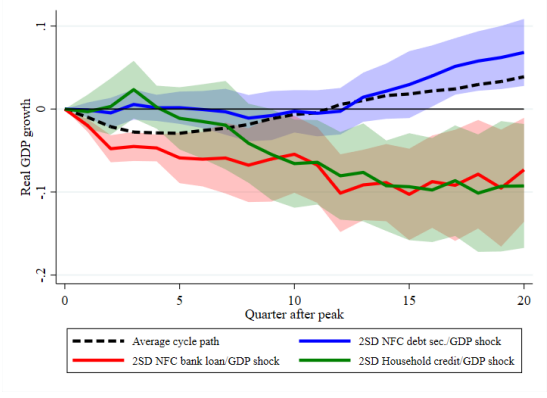


(b) NFC bank loans and debt securities

Figure A.7: Real GDP growth after business cycle peak, average and +2SD responses - **20 quarter growth**



(a) NFC and household credit



(b) NFC bank loans and debt securities

Table A.13: Impact of pre-recession growth in household and aggregate NFC credit: Local projections, with macro controls - **20 quarter growth**

	h = 4	h = 8	h = 12	h = 16	h = 20
	(1)	(2)	(3)	(4)	(5)
Variables					
NFC credit	0.025	0.064	0.167	0.161	0.172
	(0.314)	(0.391)	(0.239)	(0.280)	(0.274)
Household credit	-0.030	-0.316**	-0.765***	-0.867***	-0.948***
	(0.672)	(0.034)	(0.009)	(0.003)	(0.003)
Constant	-0.026***	-0.023**	-0.007	-0.000	0.013
	(0.000)	(0.020)	(0.710)	(0.988)	(0.603)
Observations (Number of cycles)	46	45	45	45	45
Number of countries	16	16	16	16	16

* significant at 10%, ** significant at 5%, ***significant at 1%

Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the twenty quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak. To ensure consistency between samples, included recessions match the ones from Table A.14.

Table A.14: Impact of pre-recession growth in household and NFC credit components: Local projections, with macro controls **20 quarter growth**

	h = 4	h = 8	h = 12	h = 16	h = 20
	(1)	(2)	(3)	(4)	(5)
Variables					
NFC debt securities	0.409***	0.102	-0.111	0.245	0.398
	(0.002)	(0.655)	(0.631)	(0.419)	(0.231)
NFC bank loans	-0.082*	-0.221*	-0.480***	-0.491***	-0.503***
	(0.063)	(0.069)	(0.000)	(0.001)	(0.003)
Household credit	0.114**	-0.083	-0.314***	-0.436***	-0.481***
	(0.048)	(0.434)	(0.007)	(0.002)	(0.004)
Constant	-0.035***	-0.031***	-0.014	-0.005	0.006
	(0.000)	(0.000)	(0.303)	(0.817)	(0.775)
Observations (Number of cycles)	46	45	45	45	45
Number of countries	16	16	16	16	16

* significant at 10%, ** significant at 5%, ***significant at 1%

Note: Robust standard errors. P-values reported in parentheses. As controls, we include growth in residual NFC credit over the twenty quarters before the business cycle peak, eight-quarter realised inflation, eight-quarter difference in investment-to-GDP ratios, and four-quarter real GDP growth over the twelve quarters prior to a business cycle peak.

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