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Zombies at Large? Corporate Debt Overhang and the Macroeconomy*

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ABSTRACT

What are the macroeconomic consequences of business credit booms? Are they as dangerous as household credit booms? If not, why not? We answer these questions by collecting data on non-financial business liabilities (primarily bank loans and corporate bonds) for 17 advanced economies over the past 150 years. Unlike household credit, business credit booms are rarely followed by macroeconomic hangovers. Data on debt renegotiation costs—instrumented by a

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country's legal tradition—show that frictions to debt resolution make recessions deeper and longer—an important factor in explaining the differences with household credit booms.

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1. Introduction

Debt levels of the U.S. non-financial business sector increased by about 20 percentage points in the past 30 years. They now stand at a historical high of 130% of GDP (Board of Governors of the Federal Reserve System, 2020). Corporate debt has also risen markedly around the world, especially in emerging markets (Abraham, Cortina, and Schmukler, 2020).[1] Many fear that the COVID-19 pandemic has aggravated this state of affairs. Emergency lending facilities have pushed business debt ratios even higher at a time when earnings have fallen, potentially amplifying the risks from debt overhang.

Do the lessons from the Global Financial Crisis apply to this business credit boom? It is not clear. As in many historical credit-boom episodes, stressed household balance sheets were key reasons for the depth of the recession and the slow recovery after 2008 (Mian and Sufi, 2010; Jordà, Schularick, and Taylor, 2013). Households saddled with mortgage debt needed time to repair their balance sheets following the housing crash. This time many see potential risks on the corporate side, raising a different set of questions about the macroeconomic effects of past debt accumulation.

Higher corporate debt shifts the balance of power between equity and bond holders and hence the risk profile of the projects the firm decides to invest in. In a seminal departure from the classic Modigliani and Miller (1958) theorem on the irrelevance of the firm's capital structure, Myers (1977) showed that default risk undermines the incentives to invest for indebted firms. It is possible than that some projects with positive net present value will not be realized as equity holders do not benefit in case of default. Debt overhang may depress any expenditure with delayed returns, such as hiring, training, advertising, or maintenance (Hennessey, 2004). The literature explores a variety of other channels by which a buildup of debt upsets the investment choices of firms.

At the microeconomic level, a large empirical literature has mostly focused on documenting mechanisms linking corporate debt and firm-level investment decisions and outcomes. Several papers show the adverse investment effects of debt overhang at the firm level (e.g. Lang, Ofek, and Stulz, 1996; Hennessey, 2004; Kalemli-Özcan, Laeven, and Moreno, 2020; Albuquerque, 2021). These studies suggest that highly levered firms invest less and grow slower. This is especially true when firms are financially vulnerable and dependent on external creditors who perceive investment opportunities to be bleak. Recent studies with European firm-level data, such as Kalemli-Özcan, Laeven, and Moreno (2020) and Popov,

[1] Throughout this paper, we use "business debt" and "corporate debt" interchangeably to refer to total debt of the non-financial corporate and non-corporate sectors.

Barbiero, and Wolski (2018) find conflicting evidence with respect to investment levels and efficiency effects of high corporate debt.

However, the conclusions from these and other studies are not easily extrapolated to a macroeconomic setting. Firm-level estimates will overstate aggregate effects. For example, financially constrained firms will likely leave room for competitors to pick up the slack. Moreover, existing micro evidence appears to be particularly strong for small- and medium-sized firms (Kuchler, 2020; Kalemli-Özcan, Laeven, and Moreno, 2020), which typically account for only a minor share of aggregate business credit.[2] The financing decisions of bigger corporations could thus greatly attenuate the aggregate effects of debt overhang.

Moreover, a credit boom may have a positive side. In an example of reverse causality, leverage ratios will be higher if asymmetric information leads to underpriced equity (Myers and Majluf, 1984). Such leverage could indicate prudent past investments. As these investments bear fruit, they will counteract the adverse effects of debt overhang at the macro level.

It is therefore unclear how these firm-level mechanisms aggregate into macroeconomic forces which might shape business cycle fluctuations. Business debt overhang could propagate, amplify, and prolong the effects of adverse business cycle shocks (Lamont, 1995; Occhino and Pescatori, 2015). It all depends on spillovers and feedback loops. Consequently, beyond individual firm-level behavior, we need a better understanding of the macroeconomic effects of corporate debt (Brunnermeier and Krishnamurthy, 2020).

New data and main findings: Aiming to resolve this tension between micro-founded, firm-level evidence and its broader economic implications, we directly investigate the macroeconomic repercussions of corporate credit build-ups. Given the disagreement on how to measure the business cycle, we concentrate on assessing how leverage build-ups in expansions relate to the severity of subsequent recessions. This requires that we assemble a new long-run dataset on non-financial business sector liabilities (bank loans, corporate bonds, trade credit, and other liabilities) for 17 advanced economies since the 19th century. A contribution in its own right, the new dataset is an enhancement to previous data collected by us and will be made publicly available.[3]

Data before WW2 mainly consist of business loans, though in some cases we were able to

[2]For example, in the US more than 80% of firms are—typically small—non-corporate businesses that jointly account for less than 25% of total non-financial sector leverage (Pomerleau, 2015; Board of Governors of the Federal Reserve System, 2020).

[3]The previously collected historical data are available at `www.macrohistory.net/database`.

augment these with corporate bond market data.[4] Data after WW2 builds on bank lending data from the Macrohistory Database (Jordà, Schularick, and Taylor, 2017), hand-collected data from Müller (2018), as well as financial accounts collected by the Bank of International Settlements (BIS) that capture the growing importance of non-bank lending channels.

Our results employ local projection methods (Jordà, 2005), and the weight of the evidence suggests that corporate debt overhang has negligible effects at the macro level. Business debt booms in an expansion say next to nothing about how the subsequent recession will turn out. This cannot be explained by whether or not the economy experiences a financial crisis, nor whether the level of debt relative to GDP is high or low. We provide context for all our results by investigating the effects of household debt booms in parallel, showing that such booms behave very differently (similar results for household debt were previously reported by, e.g. Jordà, Schularick, and Taylor, 2013; Mian, Sufi, and Verner, 2017).

While we cannot find any effects at the mean, one could argue that any connection between business debt and slow growth will show up mainly in the worst-case scenarios. We investigate this tail-risk nexus using quantile regression methods in the spirit of Adrian, Boyarchenko, and Giannone (2019); Adrian, Grinberg, Liang, and Malik (2018). We measure tail risk using quantile local projections (see, e.g., Linnemann and Winkler, 2016; Loria, Matthes, and Zhang, 2019; Stolbov and Shchepeleva, 2020). Again, we find no connection, in stark contrast to household credit booms, as Adrian, Boyarchenko, and Giannone (2019) and Adrian, Grinberg, Liang, and Malik (2018) report.

All these results from long-run global data are consistent with the earlier work of Giesecke, Longstaff, Schaefer, and Strebulaev (2014), which focused more narrowly on corporate bonds, and found that default events were only weakly correlated with business downturns over 150 years of U.S. history.

Our findings thus echo a venerable theoretical literature. In some models, high levels of debt may also have positive effects on recession trajectories, possibly explaining our results. For example, under limited liability, indebted firms might also have an incentive to gamble on otherwise unrealized risky projects (Admati, Demarzo, Hellwig, and Pfleiderer, 2018). Other mechanisms are also consistent with our results. Diamond and He (2014) emphasize the maturity structure of debt. Berkovitch and Kim (1990) discuss a range of contractual options for credit agreements to address problems of underinvestment. Similarly, repeated interaction with creditors may provide firms with an incentive to invest prudently even

[4]In most countries, the share of non-corporate business debt is a small fraction of corporate debt. See the data section below.

under debt overhang, since a reputation for maximizing firm value and minimizing default risk will lower risk premia (John and Nachman, 1985).

Restructuring costs and the legal environment: Importantly, we note that the possibility of underinvestment provides an incentive for owners and creditors to restructure debt. Underinvestment pushes the value of the firm below its potential, so that both sides could in principle buy out the other party and gain from implementing the efficient investment policy (Fama, 1978). Bergman and Callen (1991) argue that "running down assets" through underinvestment constitutes a credible and effective threat to bring creditors to the negotiation table. Indeed Favara, Morellec, Schroth, and Valta (2017) directly examine the role of national bankruptcy regimes, empirically. They show how differences in such regimes affect the investment behavior of firms near default, and highlight the role of frictions to debt renegotiation.

These papers thus highlight that frictions to debt renegotiation can have adverse effects at the micro-level. Is there similar evidence at the macro-level? On the household side, recent research points to the potentially large effects of household bankruptcy and debt restructuring (Auclert, Dobbie, and Goldsmith-Pinkham, 2019). However, corporate debt is quite different for at least two reasons. First, if the value of the firm's obligations is greater than the market value of assets, both owners and creditors gain from successful restructuring or reorganization, as noted above (see also, e.g. Fama, 1978; Aivazian and Callen, 1980). There are clear incentives for both to restructure the debt. Yet coordination frictions among many dispersed creditors, hold-out problems, asymmetric information, weak contract enforcement and other frictions can make such renegotiation difficult or even prevent it altogether (Gertner and Scharfstein, 1991; Philippon, 2010). The larger such frictions are, the more sand in the wheels of the process and, the greater the economic cost.

Second, firm liabilities are ultimately limited by firm assets. When the value of a firm drops below the market value of its assets, the difference will be erased upon liquidation. Assets will be freed up for other productive ends. Yet the liquidation process too can be more or less efficient. Poor creditor rights protection, or costly legal procedures can discourage or delay liquidation. These costs will affect the behavior of lenders at the margin, making them more likely to avoid the losses and keep insolvent "zombie" firms afloat. Inefficient liquidation increases the survival probability of zombie firms and their importance at the macro level.

In this regard, research by Peek and Rosengren (2005) describes the "evergreening" of loans by banks (i.e., rolling over loans of unprofitable firms to avoid formal loss provisioning) in an effort to stabilize the market share of unprofitable zombie firms. Such evergreening discourages the entry and growth of healthy competitors and eventually undermines productivity growth (Caballero, Hoshi, and Kashyap, 2008). The more heavily indebted the business economy gets as a whole, the more likely such unhealthy bank-business relationships become, threatening business dynamism and growth at the macro level.[5] More recent papers have also pointed to the two-way relationship between zombies and loose monetary conditions (Acharya, Crosignani, Eisert, and Eufinger, 2020; Hong, Igan, and Lee, 2021), and also the role of national insolvency regimes for preventing zombification (Andrews and Petroulakis, 2019).

This bounty of research suggests that in assessing the role of business debt at a macroeconomic level, it is important to quantify the role of debt renegotiation and restructuring costs. As noted by Auclert, Dobbie, and Goldsmith-Pinkham (2019), individual banks have no interest in restructuring household debt as such policies are beneficial only at the macro level. But this is clearly different for businesses. Such frictions are a natural mechanism that could explain the contrast between household and business debt overhang that we documented earlier.

We dig deeper into this issue by building on Djankov, McLiesh, and Shleifer (2007) and Djankov, Hart, McLiesh, and Shleifer (2008) to quantify country-level institutional frictions to corporate debt reorganization or liquidation for a subset of business cycles and corporate credit booms since the 1970s. Naturally, countries can adapt legislation to the economic experience. Hence, in order to account for this adaptation, we turn to a local projection instrument variable strategy (LP-IV). Specifically, we appeal to the exogenous variation of legal origins in the spirit of La Porta, López-de-Silanes, Shleifer, and Vishny (1997, 1998) and La Porta, López-De-Silanes, and Shleifer (2008). Using legal traditions as an instrument for debt renegotiation costs, we find that where institutions encourage efficient restructuring and liquidation, the drag from business debt booms is small, much as our previous results had already hinted. Nevertheless, and more interestingly, we find that in countries where frictions due to renegotiation costs are high the recovery from a business debt overhang can be just sluggish as with household debt overhang.

Our analysis carries the following policy implication. Frameworks that efficiently facilitate the restructuring or liquidation of debt reduce the macroeconomic fall-out of corporate

[5]Note how the zombification channel differs from the debt overhang channel in two important respects. Zombification undermines growth through a deterioration of the *quality* of investments, as funds *do flow* into unprofitable, highly leveraged firms that are unable to carry their debt burden otherwise. By contrast, debt overhang impairs growth through depressing the *quantity* of investment as highly leveraged firms are *denied access* to finance, and funds might flow elsewhere.

debt booms. Conversely, legal and regulatory frictions will precipitate debt overhang and corporate zombification, thus impairing productivity growth and slowing down the recovery after recessions (Caballero, Hoshi, and Kashyap, 2008; McGowan, Andrews, Millot, and Beck, 2018).

2. Data description

The basis for the analysis is a novel long-run dataset on business credit, including bond market debt and credit from non-bank intermediaries, covering 17 advanced economies since the nineteenth century.[6]

Specifically, we have been able to construct separate series for business debt for 9 countries in the pre-WW2 period. Data for the U.S. start in 1916 and build on the business sector debt data calculated by James and Sylla (2006), from which we deduct debt obligations of financial institutions. For other countries, we calculate bank credit to the non-financial business sector based on the assets of specialized commercial banks that provide loans to business and other corporate financing. As an example, for Germany we sum loans and advances extended to non-banks by joint-stock industrial banks as well as commercial credit unions. We identify similar proxies for business credit in other countries, as detailed in the appendix. The new data enhance the long-run dataset in Jordà, Schularick, and Taylor (2017), from which we take data on household bank credit as well as a long list of macroeconomic controls, updated to 2019.

We rely on comprehensive business data credit provided by the financial accounts and the Total Credit Database assembled by the Bank of International Settlements (BIS) for data after WW2.[7] These include secured and unsecured debt, of all maturities, and from all types of lenders, in addition to conventional bank lending contracts. Additional financial accounts data on non-financial business liabilities come from the OECD and Eurostat databases and individual publications such as Bonci and Coletta (2012) for Italian data, Roe (1971) and Office for National Statistics (2016) for U.K. data, and Deutsche Bundesbank (1983) and Deutsche Bundesbank (1994) for German data. All postwar U.S. data are from the Fed's financial accounts (Board of Governors of the Federal Reserve System, 2020).

As noted earlier, we use the terms "business debt" and "corporate debt" interchangeably throughout the paper to refer to all debt liabilities of all firms, whether corporate or

[6]The 17 advanced economies are the U.S., Japan, Germany, France, U.K., Italy, Canada, Netherlands, Belgium, Sweden, Australia, Spain, Portugal, Denmark, Switzerland, Finland, Norway.

[7]For details on its construction see Dembiermont, Drehmann, and Muksakunratana (2013).

non-corporate. Whenever available, our series include the debt liabilities of non-corporate businesses as well. Historical sources do not always allow for a clean separation of the two. Corporate debt is the dominant component. In the U.S., non-corporate businesses account for only one third of total non-financial business debt outstanding.

In total, there are 1,717 country-year observations for business sector debt, 480 of which correspond to the pre-WW2 period. The individual series are plotted in the the appendix, which also describes details of the construction and underlying sources, including the materials kindly shared by Müller (2018). The results presented in the paper always use the entire dataset, excluding the wartime years of WW1 and WW2. All findings are qualitatively and quantitatively similar when restricting the data to the post-WW2 period. For brevity, we place these results in the appendix.

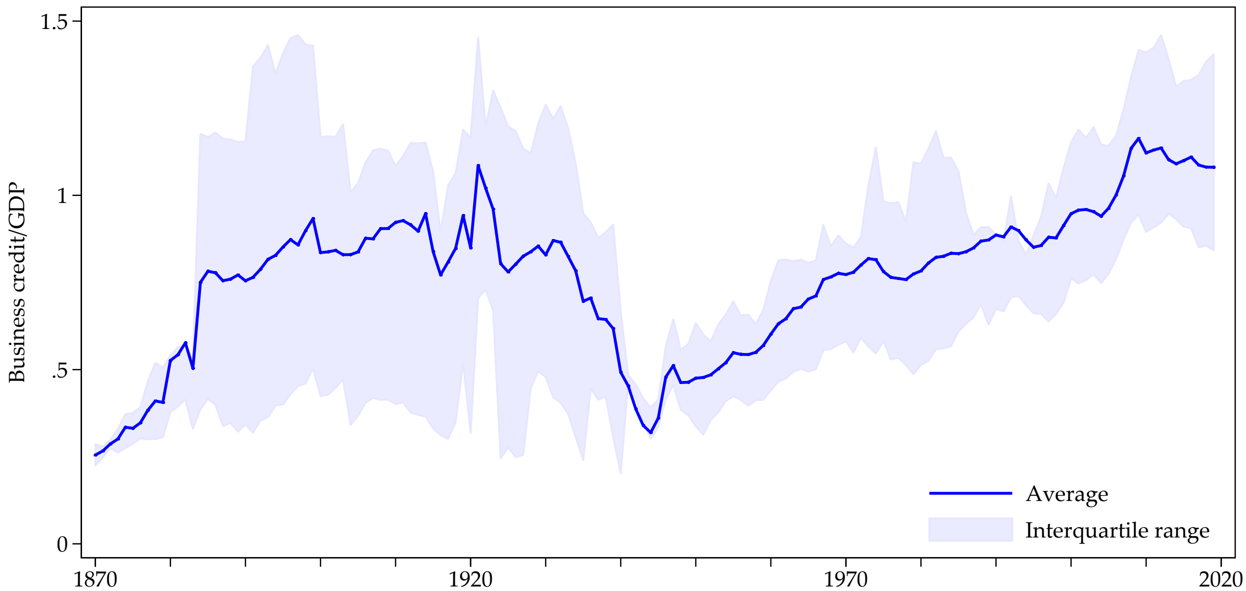
In corporate finance, the term "leverage" often refers to the ratio of debt to equity. However, we instead focus on the ratio of corporate debt to GDP. The reason is that several episodes that we investigate involve sudden and dramatic repricing of assets. Thus, debt and equity could both be shifting at the same time, making the traditional definition of leverage harder to interpret. For the ratio of debt to GDP, one can think of it as a cash-flow based measure of *leverage*, hence we will often just denote this ratio as *leverage.*

Figure 1 shows the evolution of business credit over the full sample, which starts in 1870. The figure plots the cross-country median and the inter-quartile-range of business credit relative to GDP—our measure of leverage. Historically, business credit has ranged between 50% and 100% of GDP for most advanced countries. The series trends upwards in the lead-up to WW1 before entering a period of high volatility in the interwar years, followed by a sharp reduction during WW2. Since then, business credit has doubled from about 50% to 100% of GDP today. On this measure, several countries are currently at their highest level in the past 150 years.

Another aspect of our empirical strategy requires that we identify business cycle turning points. Here we follow Jordà, Schularick, and Taylor (2013) and use the Bry and Boschan (1971) algorithm for all countries. At annual frequency and for the U.S., this algorithm reproduces almost exactly the NBER's dating. Briefly, the Bry and Boschan (1971) algorithm dates turning points as local maxima and minima of real GDP per capita data in levels. Minima are labeled as troughs and maxima as peaks. Recessions go from peak to trough, expansions from trough to peak.

Finally, we further separate recessions into two types. We will refer to *financial* recessions as those associated with a financial crisis in a ± 2 year window around a peak. The reason

Figure 1: *Business credit/GDP since 1870*



Notes: The figure shows non-financial business credit over GDP for our sample of 17 advanced economies. Interquartile range shown as the shaded region. See text.

is that financial crises sometimes lead to recessions, sometimes recessions lead to financial crises. All recessions not associated with a financial crisis are denoted *normal* recessions. The financial crisis chronology itself is based on the latest version of the Jordà, Schularick, and Taylor (2017) Macrohistory Database.[8]

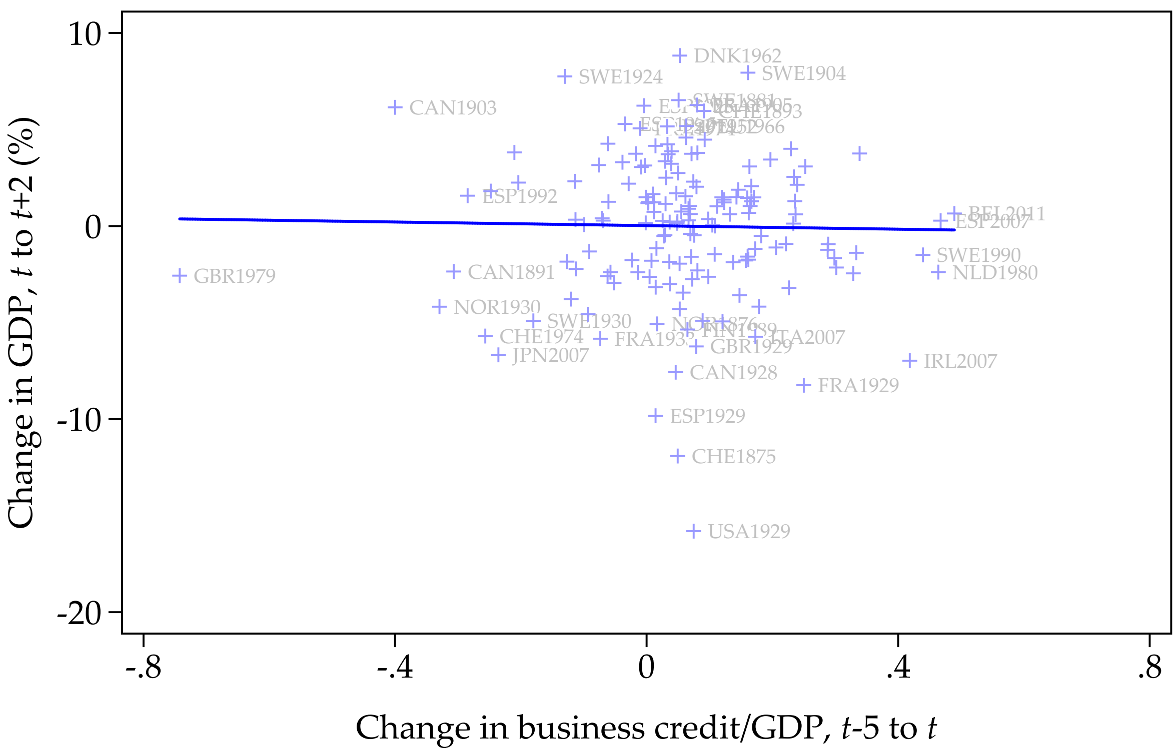
3. Do large business credit expansions make recessions worse?

As a way to motivate the question posed in this section, consider the simple correlation between business/household credit booms during the expansion, with the severity of the subsequent recession and the speed of the recovery. We do this by plotting, for each of the 150 business cycles in our dataset, the scatter of two-year GDP per capita log-difference in the first two years of the recession (from peak year t to $t+2$) against the five-year change in business credit relative to GDP in the preceding 5 years before the peak (from $t-5$ to t). This is presented in Figure 2, which highlights the absence of any such link.

Although Figure 2 is quite persuasive, it is a rather crude test in at least two respects. First, do we fail to see a relationship because high growth of business credit leads to shallower but longer-lasting recessions? Or perhaps recessions are deeper but with quicker recoveries? Or is it that recessions come in all shapes and sizes that have nothing to do with business

[8] http://www.macrohistory.net/database.

Figure 2: *Business credit expansions and recession severity*



Notes: The figure provides the scatter plot and regression fit line of 2-year real GDP per capita growth after business cycle peaks against the change in the credit/GDP ratio in the preceding 5 years. Each point is a cyclical peak or start of a recession. See text.

credit? Second, we may wonder whether factors other than business credit explain this correlation.

We solve these two issues by estimating the cumulative change in real GDP per capita from the start of the recession to h periods thereafter using local projections conditional on controls. In particular, let y_{it} denote log real GDP per capita multiplied by 100, observed for country i at time t. Our interest on the trajectory of recessions/recoveries means that we will focus on those time periods associated with a peak in economic activity and denoted $p = 1, \ldots, P$ where the index is understood to be specific to each country and hence it is not expressly indicated to avoid cluttered notation. Hence, we denote by $t = t(p)$ the time period associated with the p^{th} recession peak.

Thus, the outcome variable $y_{it(p)+h} - y_{it(p)}$ will measure the cumulative (log-form) percentage change in real GDP per capita, h horizons after the peak p, where we will display responses up to 5 years out. Using similar notation, $\Delta_5 x^j_{it(p)} \equiv x^j_{it(p)} - x^j_{it(p)-5}$, for $j = B, H$, denotes the 5-year change in Business, B, or Household, H, debt measured as a ratio to GDP. Hence, these variables are predetermined once the recession starts. In addition, the vector $\boldsymbol{w}_{it(p)}$ summarizes all other macroeconomic variables observed before the start of the recession. This vector includes the current plus two lagged values of real GDP growth, inflation, real investment growth, short-term interest rates on government debt, real household credit growth, and real business credit growth.

We make one remark. If, under the null, the history of medium-term credit growth did not matter then the last two credit variables and their lags listed in the vector of predetermined variables should be adequate controls, and should leave no explanatory power for our main variables of interest $\Delta_5 x^j_{it(p)}$, $j = B, H$. This is intentional: we set ourselves a higher hurdle over which to show that recession/recoveries after sustained credit booms are different.

With these variable definitions, we estimate the following local projections:

$$y_{it(p)+h} - y_{it(p)} = \alpha_h + \alpha_{hi} + \beta^B_h \Delta_5 x^B_{it(p)} + \beta^H_h \Delta_5 x^H_{it(p)} + \gamma_h \boldsymbol{w}_{it(p)} + \epsilon_{it(p)}, \quad \text{for } h = 1, \ldots, 5, \quad (1)$$

where α_{hi} are country-fixed effects normalized to sum to zero so that α_h is the average percentage change in real GDP per capita after a peak since we demean all regressors by their full-sample averages.[9] The coefficients of interest are β^j_h for $j = B, H$, each indicating how the expected future path of real GDP per capita varies with the behavior of credit (in the business and household sectors) during the expansion.

We do not interpret the coefficients β^j_h for $j = B, H$ causally since our interest is in comparing the typical trajectory in a recession/recovery given the behavior of business versus household credit in the preceding expansion. That said, the predetermined nature of our variables of interest and our rich set of controls reduce the chances that the differences could be explained by other factors.

3.1. Baseline results

Table 1 presents estimates of α_h, β^B_h, and β^H_h from our main specification.[10] Based upon these coefficient estimates, Figure 3 plots predicted trajectories or responses for the average recession as well as recessions preceded by a two-standard-deviation (above mean) expansion of business credit (about 14.4 percentage points). The peak year is normalized to zero and deviations in subsequent years are measured in log points times 100

[9]Applying the within transformation but adding sample means on both sides of the equation allows OLS to estimate α_h. Demeaning LHS regressors by sample averages prior to estimation yields the desired interpretation.

[10]Results omitting controls are shown in appendix Table A.14. They are qualitatively similar.

(approximate percentage changes). For comparison, we also show the responses for a corresponding two-standard-deviation expansion of household credit (approximately 34 percentage points).

The table presents formal tests, but Figure 3 makes it unequivocal that the effects of past corporate credit booms (especially once controlling for other macroeconomic aggregates) are negligible—in the economic and statistical senses—as compared to household credit booms. Recessions preceded by household credit expansions are not only deeper, but are followed by significantly slower recoveries. These findings are very much consistent with the existing evidence in Jordà, Schularick, and Taylor (2013); Reinhart and Rogoff (2014); Bordo and Haubrich (2017), for example.

To provide some texture to these results, a 10 percentage points (pps) increase in the business credit/GDP ratio in the expansion—a considerable rate of growth by historical standards—is not associated with a slower recovery. After 5 years from the start of the recession, GDP per capita is 4.2% higher compared with 4.0% observed in more normal times. In contrast, a 10 pps increase in household debt in the expansion is associated with dire consequences. The economy barely recovers (-0.1%) the level it had at the start of the recession 5 years later. Formal Wald tests confirm that the coefficients on business and household credit are significantly different from one another starting in year two.

These results are robust to introducing linear and quadratic time trends as well as to the exclusion of all recessions after 2007, that is, excluding data after the Global Financial Crisis. Moreover, we examine alternative definitions of our measure of credit booms. In particular, we looked at 3- and 10-year changes in credit/GDP (instead of 5-year changes), 3- and 5- year growth of real credit, and the measure proposed by Jordà, Schularick, and Taylor (2013). All corresponding estimates are tabulated in the appendix.

To go further, we also consider that a firm's default probability increases in the *level* of liabilities relative to cash flow. Extrapolating to the macroeconomy, one may suspect that the level of debt could modulate the aggregate risk confronted by an economy that sees a rapid increase in borrowing. We test this hypothesis by interacting credit booms with the *level* of credit/GDP. This is shown in Figure A.7 in the appendix. Interestingly, we do not find evidence that debt levels play an important role. At business credit/GDP levels one standard deviation above the country's historical standards, business credit booms predict recession outcomes which are statistically indistinguishable from both booms at low levels as well as average recessions.

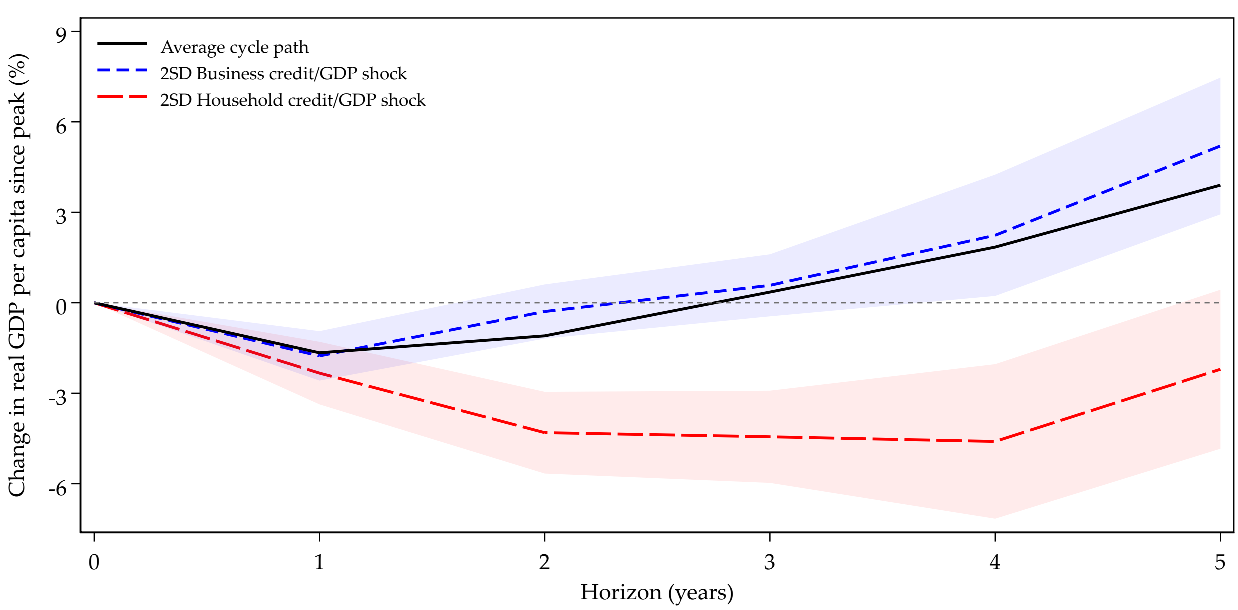
Table 1: *Credit booms and business cycle responses: local projections, with macro controls*

Dependent variable: Change in real GDP per capita since peak (log ×100)

	(1)	(2)	(3)	(4)	(5)
	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
Average cycle α_h	-1.66^{**}	-1.10^{**}	0.35	1.85^{**}	3.89^{**}
	(0.08)	(0.14)	(0.17)	(0.24)	(0.33)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	−0.32	2.49	0.70	1.22	4.01
	(1.29)	(1.41)	(1.62)	(3.17)	(3.57)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	−4.65	-22.15^{**}	-33.09^{**}	-44.44^{**}	-42.10^{**}
	(3.65)	(4.77)	(5.36)	(9.00)	(9.26)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.247	0.000	0.000	0.000	0.000
R^2	0.15	0.35	0.41	0.44	0.47
Cycles	150	150	150	150	149

Notes: Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$. Credit expansion denotes past 5-year change in credit/GDP ratio.

Figure 3: *Business and household credit, average and +2SD responses*



Notes: Figures show the predictive effects on growth of a two-SD credit expansion in the five years preceding the recession for business credit booms (left panels) and household credit booms (right panels). Estimates based on all business cycles in 17 advanced economies since 1870. Standard errors are clustered at the country level. Shaded areas denote the 95% confidence interval. See text.

3.2. Corporate debt and financial crises

Jordà, Schularick, and Taylor (2013) showed that the more credit built up in the expansion, the deeper the recession and the slower the recovery, in both normal and financial crisis recessions. One may suspect that perhaps corporate debt does matter in a recession associated with a financial crisis, but not otherwise. We investigate this issue by stratifying the local projections reported in the baseline case as follows. We classify recessions into two bins: "financial" recessions defined as recessions where a financial crisis occurs within a two-year window, and all other recessions labeled as "normal" recessions. We then examine how each type of credit build-up, business versus household, affects the subsequent response path in each type of recession.

Figure 4 presents the results of this analysis. Panel (a) shows the results for business credit, and panel (b) for household credit. In both cases, as is well-known, financial recessions are deeper and last longer than normal recessions. The effect of a business credit boom (characterized by credit growth two standard deviations above the mean, as before) is essentially zero, economically and statistically speaking. The trajectories do not change one way or the other. In contrast, the effects are very sizable when we look at household credit. A credit boom during the expansion (again, measured by credit growing two standard deviations above the mean) makes either type of recession much more severe economically speaking. The effects may even be somewhat larger in a financial crisis, although the uncertainty bands are large enough to prevent any forceful conclusions on this issue.

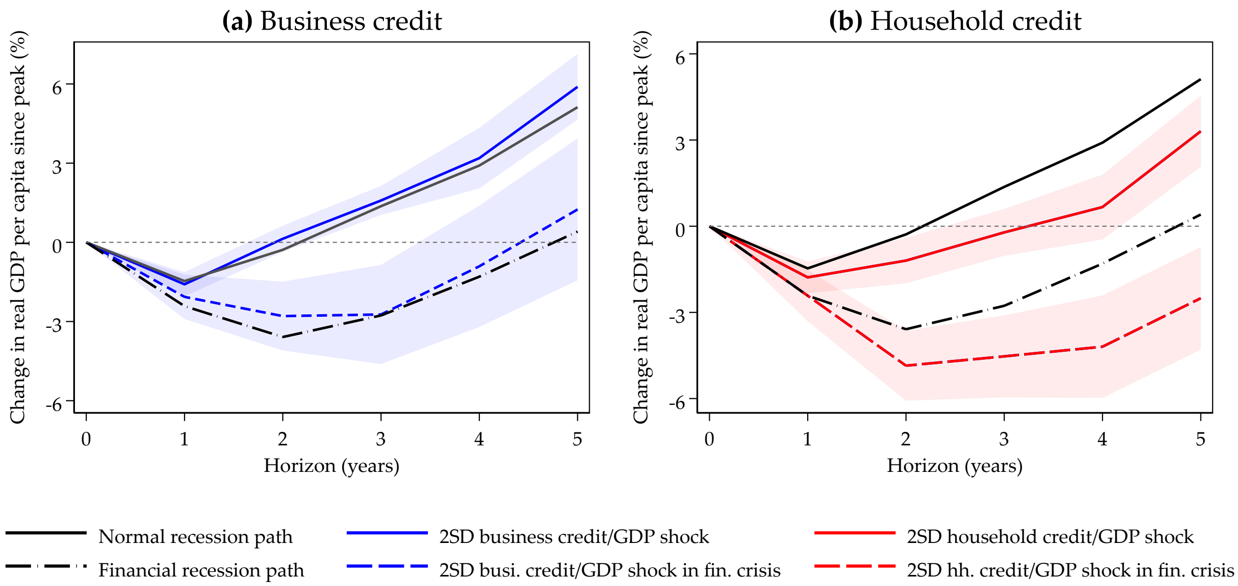
3.3. The macroeconomic effects of credit booms

We have seen how debt booms relate to the business cycle as measured by real GDP per capita. In this section we investigate a variety of other macro-financial variables. This should give us a better sense of the underlying channels.

Using a similar approach to Figure 3, in Figure 5 we display the responses of other key indicators, as follows. Panels (a) and (b) of Figure 5 show the responses of real consumption and real investment per capita, two important components of GDP. Panels (c) and (d) display the responses of the unemployment rate and inflation respectively, two key variables in any analysis of monetary policy. Panels (e) and (f) display the responses of real household and business credit to get a sense of frictions that may impede the recovery and hence justify the dynamics that we observe for GDP. Finally, panels (g) and (h) show the responses of asset prices.[11]

[11] All local projections underlying the figures are presented in tabular form in the appendix. They include

Figure 4: *Business and household credit, normal versus financial recessions, average and +2SD responses*



Notes: Local projections stratified by type of recession. Left panel displays average and two SD business credit growth paths, right panel displays the same figure but for household credit. All regressions include the full set of macro controls and country fixed effects. Standard errors clustered by country. Shaded areas denote the 95% confidence interval. See text.

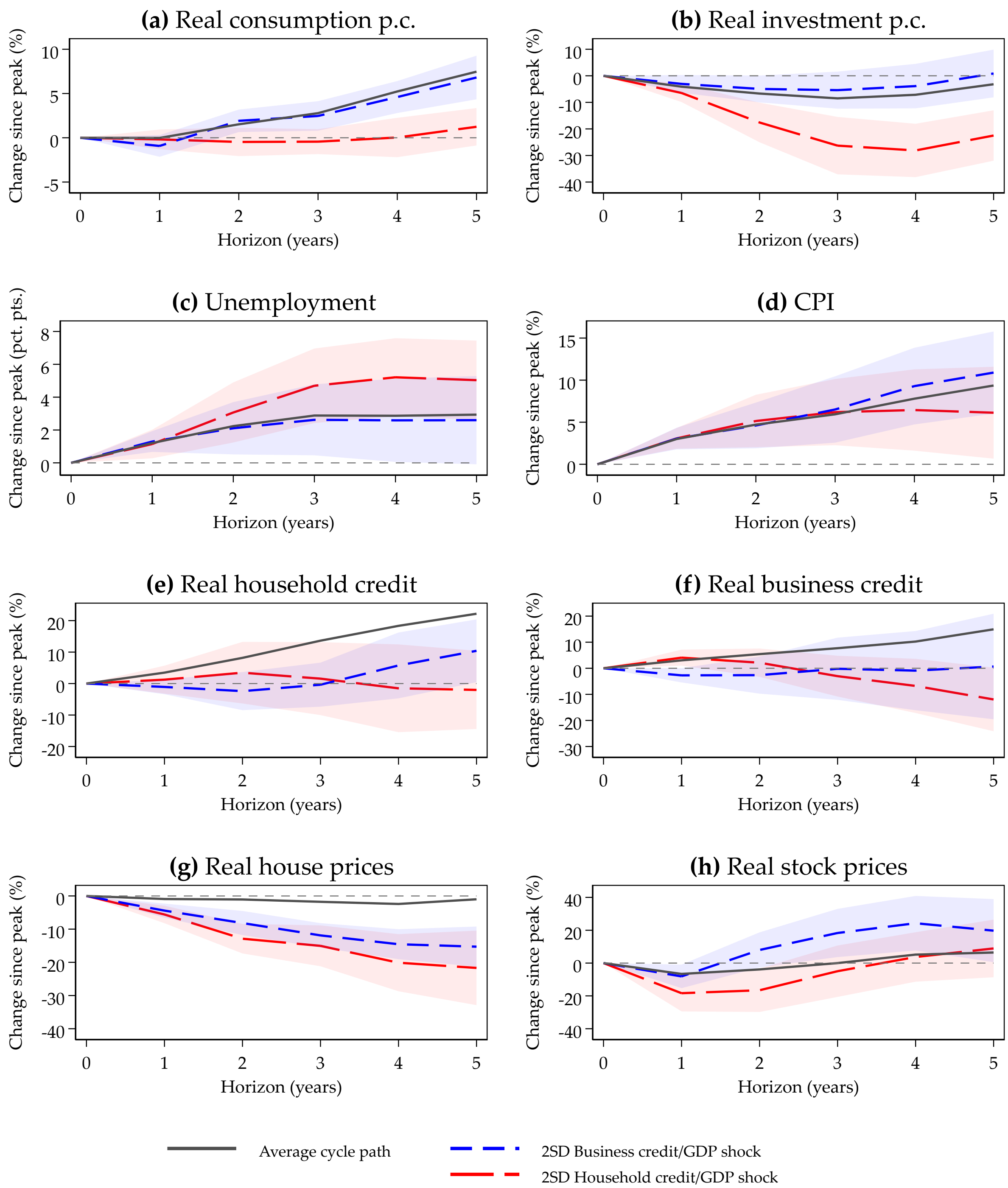
Generally speaking, corporate credit booms do not depress aggregate demand—whether consumption, or more interestingly, investment. This is in stark contrast to a household credit boom, whose effects are particularly visible in investment. A possible explanation as to why investment is relatively insensitive to a corporate boom is that firms may shift to other internal sources of financing, i.e., equity instead of debt. Covas and Den Haan (2011) document that for large firms, equity issuance is countercyclical while debt take-up is procyclical. Another alternative explanation is that, although business credit declines (as shown in panel (e)), lower business credit may simply reflect debt restructurings and haircuts since our data are aggregated.

The effects on the unemployment rate and inflation are consistent with the behavior of consumption and investment, though they are measured more imprecisely. Nevertheless, a household credit boom generally results in higher unemployment and lower inflation than in the average recession, though, of the two, the inflation response is less clear cut. Thus, a recession that follows a boom in household credit appears to require stronger monetary support. These same features are not apparent in corporate credit booms.

Panels (e) and (f) of Figure 5 show the aftermath in credit markets. Echoing Jordà,

the full set of macro economic controls. The left-hand side variable, as before, refers to the cumulative change since the cycle peak. All experiments refer to a credit boom 2 standard deviations above the historical mean.

Figure 5: *Business and household credit, responses of various macro-financial variables*



Notes: The figure shows responses to a two-SD credit expansion in the five years preceding the recession for business credit booms on the left and household credit booms on the right of each panel. The sample includes all business cycles in 17 advanced economies since 1870. Standard errors clustered at the country level. Shaded areas denote the 95% confidence interval. See text.

Schularick, and Taylor (2013), household credit booms are followed by a long period of household deleveraging, which in turn is consistent with depressed aggregate demand, as panels (a) to (d) indicate. Business credit also grows significantly slower after business credit booms, requiring a similar period of financial repair. And this is true even if the boom takes place in the household sector. The same cannot be said as strongly for household credit. A business credit boom has much less effect on it, and it recovers more rapidly.

Finally, we investigated asset price behavior, reported in panels (g) and (h). We find that both house and stock prices are more negatively affected after household credit booms as compared to business credit booms. Declining housing wealth and falling residential investment seem to have been an important catalyst for the toxic general equilibrium spiral of household credit reported by Mian and Sufi (2010) for the U.S. after 2008.

4. Tail risks: quantile local projections

Up to this point we have not been able to uncover evidence to suggest that corporate credit booms affect the recession path, our preferred measure of business cycle effects, given the constraints of our data. One possibility is that corporate debt has no visible mean effects, but it may bring considerable tail risk to the economy. Recent research by Adrian, Boyarchenko, and Giannone (2019) make a similar point for household debt, whereas and Jordà, Schularick, and Taylor (2020) suggest that the economy exhibits fat-tailed behavior, that is, the lower quantiles of the GDP growth distribution contain potentially extreme losses. Thus, to investigate whether corporate debt makes the worst recessions have very extreme declines, we estimate quantile local projections (see, e.g., Linnemann and Winkler, 2016; Adrian, Boyarchenko, and Giannone, 2019; Stolbov and Shchepeleva, 2020). Specifically, we examine how corporate debt affects the distribution of GDP per capita growth *conditional* on observables.

Denote $\Delta_h y_{it(p)+h} = y_{it(p)+h} - y_{it(p)}$, that is, the approximate cumulative growth rate of GDP per capita using the same notation of the previous section. Let $\boldsymbol{X}_{it(p)}$ collect the credit growth variables defined earlier ($\Delta_5 x^j_{it(p)}$, $j = B, H$), as well as the vector of macro controls, $\boldsymbol{w}_{it(p)}$, the constant, and the fixed effects. Given this setup, quantile local projections can be estimated based on

$$\begin{aligned}\hat{\boldsymbol{\theta}}_{h,\tau} \;=\; \underset{\boldsymbol{\theta}_{h,\tau}}{\operatorname{argmin}} \sum_{1}^{t(P)} \Big(& \tau\, \mathbb{1}(\Delta_h y_{it(p)+h} \geq \boldsymbol{X}_{it(p)}\boldsymbol{\theta}_{h,\tau}) |\Delta_h y_{it(p)+h} - \boldsymbol{X}_{it(p)}\boldsymbol{\theta}_{h,\tau}| \\ & + (1-\tau)\, \mathbb{1}(\Delta_h y_{it(p)+h} < \boldsymbol{X}_{it(p)}\boldsymbol{\theta}_{h,\tau}) |\Delta_h y_{it(p)+h} - \boldsymbol{X}_{it(p)}\boldsymbol{\theta}_{h,\tau}| \Big) , \end{aligned} \tag{2}$$

where $\mathbb{1}(\,.\,)$ denotes the indicator function and $\tau \in (0,1)$ indicates the τ^{th} quantile. The quantile of $\Delta_h y_{it(p)+h}$ conditional on $\boldsymbol{X}_{it(p)}$ is then given by

$$Q\left(\Delta_h y_{it(p)+h} | \boldsymbol{X}_{it(p)}\right) = \boldsymbol{X}_{it(p)} \boldsymbol{\theta}_{h,\tau} \equiv q^h_{\tau,t}\,. \tag{3}$$

The coefficients $\boldsymbol{\theta}_{h,\tau}$ measure the effect of the right-hand side variables on the τ quantile of the conditional distribution of $\Delta_h y_{it(p)+h}$. Specifically, using notation analogous to that in Equation 1, the coefficient $\beta^B_{h,\tau}$ will measure the effect of a corporate debt boom on the conditional distribution of $\Delta_h y_{it(p)+h}$, and similarly for household debt with the coefficient $\beta^H_{h,\tau}$. Hence, note that these coefficients will vary depending on the quantile τ selected.

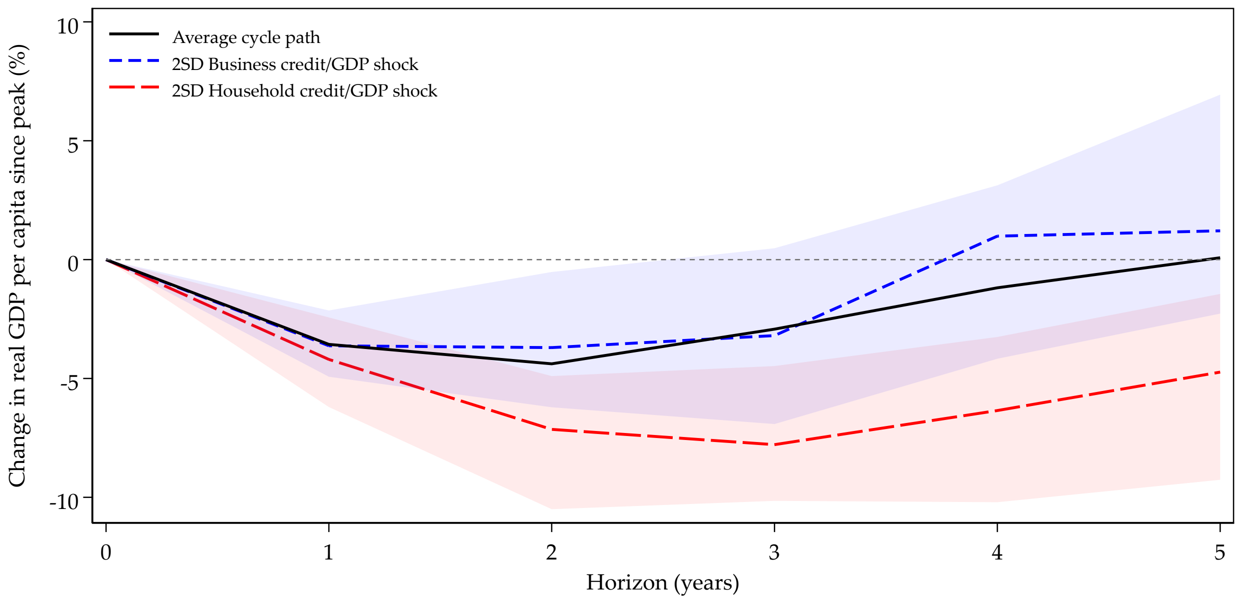
Our approach to calculating quantile local projections is completely parallel to the way one usually computes local projections at the mean, as we did in Equation 1. The only difference is that we are now dealing with a nonlinear model so the marginal effect of a change in corporate (household) debt has to be evaluated accordingly. However, this simple setup admits these nonlinear effects in an unspecified, flexible manner.

Figure 6 shows how we apply these methods to our data. In particular, we focus on the 20^{th} percentile of the conditional distribution of GDP per capita growth to investigate tail events. We did not choose a smaller quantile so as to have a reasonable data sample size for estimation. The figure displays quantile local projections alongside typical local projections evaluated at the mean. We display two cases, one for corporate debt, and one for household debt booms. These are defined as before, comparing the debt growth at the historical mean against growth at a rate two standard deviations above the historical mean. Consider first the figure associated with a corporate debt boom. The marginal effect of a corporate debt boom on the recovery path is the same whether considering the average growth path or the path of the 20^{th} percentile worst recessions. In contrast, a household debt boom of a similar magnitude affects the worst 20^{th} percentile recession paths very differently than the mean path: household debt booms increase the risk of experiencing a bad recession. These results therefore align well with Adrian, Boyarchenko, and Giannone (2019).

5. Inspecting the mechanism: the costs of debt restructuring

The analysis thus far highlights a striking dichotomy: household debt booms have much stronger cyclical implications than corporate debt booms. One possible explanation is the legal difference between the two types of debt: household debt is owed by individuals, business debt is owed by abstract legal entities, which makes for different incentive structures (Jensen and Meckling, 1976). The liabilities of businesses are limited by their assets,

Figure 6: *Business and household credit, responses at 20th percentile of real GDP per capita growth*



Notes: Figures show the predictive effects on growth of a two-SD business/household credit buildup in the five years preceding the recession based on a LP series of quantile regressions. Business credit booms shown in the left-hand side panel and household credit booms shown in the right-hand side panel. Shaded areas denote the 95% confidence interval based on bootstrap replications. See text.

shielding the private wealth of owners. When recessions obliterate business profits, they also reduce business liabilities by shrinking assets. In addition, a common desire to protect any "going concern" value of a business acts as a powerful incentive to restructure debt burdens, thereby minimizing collateral damage to the economy. Households face a very different environment. In a recession households see incomes decline yet their debts remain unchanged. Consumer debt exemptions and protections, if any, are hard-coded in the law—and tend to be flimsy (Niemi-Kiesiläinen, 1997; Mitman, 2016). While businesses can try to finance through issuing more equity, creditors cannot of course secure a claim to human capital, and recourse provisions can drive the pursuit of recoveries like wage garnishments. Such settlements can take a long time to work out and even longer to fulfill and escape. Here debt overhang can cast a longer, darker shadow. Agarwal, Amromin, Ben-David, Chomsisengphet, Piskorski, and Seru (2016) and Auclert, Dobbie, and Goldsmith-Pinkham (2019), among others, have highlighted the importance of debt relief for aggregate demand management.

An implication from this literature is that efficient debt resolution is crucial to prevent debt overhang and zombie firms following a corporate debt boom. A corollary is that variations in the efficiency of the institutions will modulate the costs of debt booms. The harder it is to restructure debt, the worse the corporate debt overhang is likely to be. Similarly, liquidation with high deadweight costs grow the population of zombie firms at the margin.

Andrews and Petroulakis (2019) find that legal frictions in insolvency frameworks stall the liquidation of zombie firms. Where legal efficiency is high, bank forbearance ends sooner, reducing capital misallocation and speeding up the recovery. While these are substantively firm-level questions, this section traces out their aggregate macroeconomic implications. We aim to get to a more granular empirical differentiation between a world of Myers (1977) and large-cost liquidation and the frictionless Modigliani and Miller (1958) benchmark view where debt overhang and zombie firms should not arise.

We put these ideas to work by assessing how measures of efficient debt restructuring and business liquidation modulate the responses that we calculated earlier. That is, for a recession preceded by corporate debt built-up, do frictions impeding restructuring and liquidation slow down the recovery? To measure the characteristics of these legal procedures we draw on the creditor rights indicator of La Porta, López-de-Silanes, Shleifer, and Vishny (1997) expanded by Djankov, McLiesh, and Shleifer (2007), spanning the years 1978–2003. This measure codes legal norms regarding creditors' ability to extract—and present owners from channeling off—assets in case of bankruptcy. Strong protection of creditor claims reduces the possibility that firm owners can withhold assets in bankruptcy, which would weaken owner's incentives to negotiate a restructuring. Moreover, strong creditor protection decreases liquidation costs for creditors, reducing their incentives to keep zombie firms afloat. We extend this series using World Bank survey data collected using the methodology of Djankov, Hart, McLiesh, and Shleifer (2008) for the later period 2004–2019.

In the survey, attorneys and judges practicing bankruptcy law are asked about national insolvency proceedings and to characterize the likely outcome of a stylized case based on standardized metrics. We use the *recovery rate*, measuring the share of debt paid to creditors in the event of default. A high recovery rate reflects low frictions in both renegotiations as well as liquidations.[12]

To maximize sample size, we seek to combine the two indicators into a single series. To do this, we transform each series by using the deciles of the distribution over each sample into a discretely-valued variable, L_{it}, that takes on values from 1 to 10 to refer to each decile.[13] Thus, when the indicator takes the value of one, this refers to a country-year pair that has among the highest frictions impeding restructuring and liquidation. With this new indicator, the data cover the full time span from 1978 to 2019, totaling 65 business cycles from all 17 countries in our sample.

[12] The results are very similar when using other indicators provided by the survey: insolvency procedure cost, insolvency procedure time, or two further summary measures—the resolution score and overall strength of the bankruptcy procedure.

[13] The results are virtually unchanged when varying the number of quantiles used to partition the indicators.

Using the new variable L_{it}, we can modulate the effect of business credit expansion $\Delta_5 x_{it}^B$ on the recession with an interaction term. To ease exposition, define $x_{it}^{BL} = \Delta_5 x_{it}^B \times L_{it}$. Using this new variable, we now specify the local projection in Equation 1 as

$$\Delta_h y_{it(p)+h} = \alpha_h + \alpha_{hi} + \beta_h^{BL} x_{it(p)}^{BL} + \beta_h^H \Delta_5 x_{it(p)}^H + \beta_h^B \Delta_5 x_{it(p)}^B + \gamma_h \boldsymbol{w}_{it(p)} + e_{it(p)} \,. \tag{4}$$

Impulse responses are estimated for the 1978–2019 period with OLS based on Equation 4 and are presented in Figure 7a. The figure shows the recession path as a function of corporate debt 2 standard deviations above the mean in the preceding 5-years modulated by whether bankruptcy procedures are "high-friction" (i.e., $L_{it} = 1$), or "low-friction" (i.e., $L_{it} = 10$).

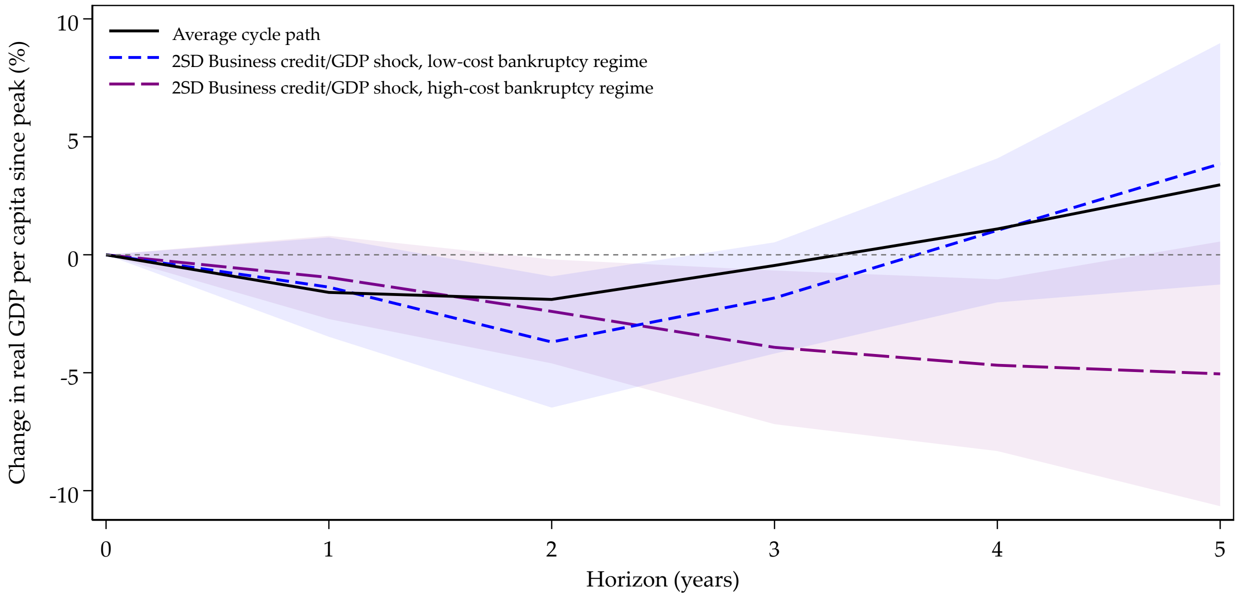
This figure makes the point quite strikingly. The harder it is to restructure or liquidate the more protracted and incomplete the recovery. In fact, for the least efficient cases, a preceding corporate debt boom has nearly the same effects on the recovery path as a preceding household debt boom. Institutional frictions can therefore have substantial macroeconomic effects and possibly explain why there is such a difference between household and corporate debt overhangs. In Appendix D we also ran a placebo experiment, interacting the legal indicator with household credit instead of business credit. Corporate bankruptcy regimes should not matter for the aftermath of household credit booms. Reassuringly they do not affect the path of the economy. Only business bankruptcy regimes shape the aftermath of business debt booms.

However, the institutions of insolvency respond, to some extent, to a country's economic experience as legal systems have evolved alongside society. Hence, a reason for concern is that unobserved factors, independently affecting legal and economic institutions, could create a spurious statistical link between insolvency frictions and recession trajectories. We try to address these concerns using instrumental variable local projections, or LP-IV. Specifically, we instrument the friction indicator using differences in the legal traditions across countries.

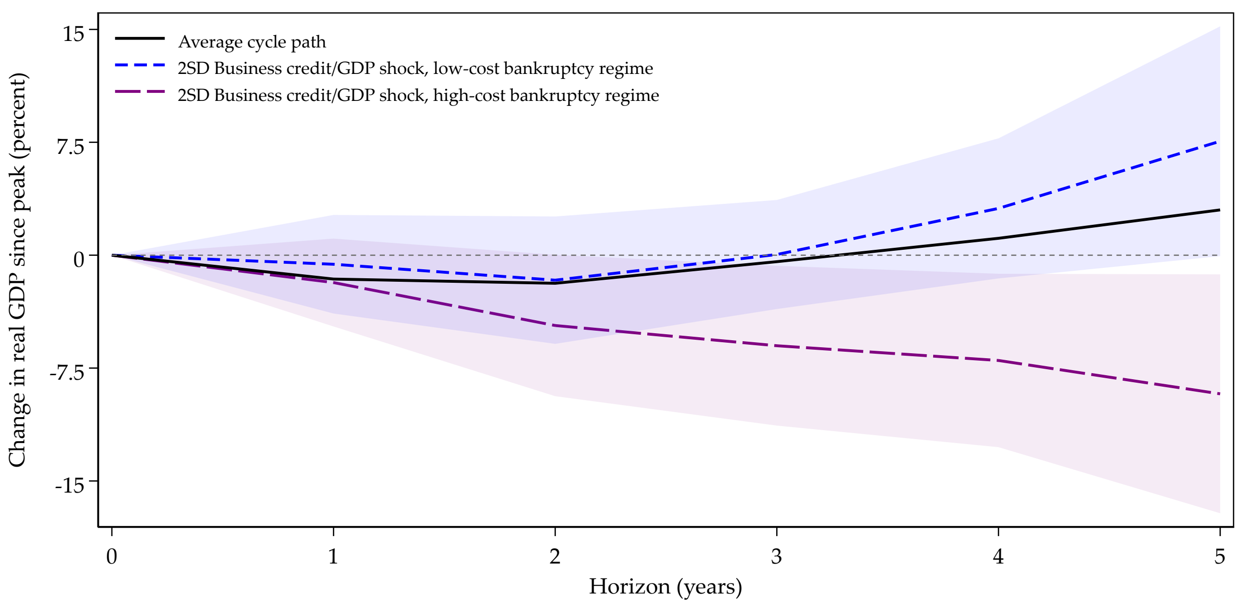
In particular, we follow an established literature and distinguish traditions of *civil law* and *common law*. The civil law traditions originate in Roman law, but they then morphed into different European varieties under the influence of gradual or drastic change such as the French Revolution. By contrast, the British common law tradition is associated with legal principles of private dispute resolution with less public control (La Porta, López-de-Silanes, Shleifer, and Vishny, 1998; Glaeser and Shleifer, 2002). The adoption of either civil or common law dates back to the 17$^{\text{th}}$ and 18$^{\text{th}}$ centuries, when revolution, colonization, and

Figure 7: *Frictions to restructuring and liquidation make the corporate debt overhang worse*

(a) *OLS estimates modulated by bankruptcy costs*



(b) *Friction indicators instrumented by the type of legal tradition*



Notes: Both panels show the responses of a 2-SD expansion in business credit/GDP in the five years preceding a recession. In the plot, "high-friction bankruptcy regime" refers to $L_{it} = 1$ whereas the "low-friction bankruptcy regime" refers to $L_{it} = 10$. All estimates are conditional on controls for contemporaneous and two lags of GDP per capita growth and inflation. Panel (a) is based on OLS estimation of Equation 4. Panel (b) instruments friction indicators with a dummy for legal tradition, civil or common law. Standard errors are clustered at the country level. Shaded areas denote the 95% confidence interval. See text.

Table 2: *Explaining bankruptcy regime quality by legal origin*

Dependent variable: Interaction term $x_{it(p)}^{BL}$

	(1)
Instrument $z_{it(p)}$	-2.87^{**}
	(0.85)
Business credit/GDP expansion $\Delta_5 x_{it(p)}^{B}$	3.30^{**}
	(0.59)
Household credit/GDP expansion $\Delta_5 x_{it(p)}^{H}$	0.26
	(0.86)
Macro controls	Yes
F-statistic	101.41
R^2	0.58
Cycles	65

Notes: First stage results for LP-IV estimation. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$. Credit expansion denotes past 5-year change in credit/GDP ratio. Macro controls include contemporaneous and two lags of GDP per capita growth and inflation.

Napoleonic conquest laid the foundations of legal principles across Europe and America. In Japan, a variety of German civil law was adopted during extensive reforms under Emperor Meiji at the end of the 19$^{\text{th}}$ century (Djankov, McLiesh, and Shleifer, 2007).

Most importantly for us, civil and common law traditions differ markedly in their handling of bankruptcy. Djankov, McLiesh, and Shleifer (2007) and Gamboa-Cavazos and Schneider. (2007) document that civil law systems rely on frequent interlocutory appeals, leading to bankruptcy procedures that are more intricate and costly than those under common law. Based on the coding of legal origins in Djankov, McLiesh, and Shleifer (2007), we instrument the variable x_{it}^{BL} with the interaction of the business credit buildup variable, $\Delta_5 x_{it}^{B}$ and the legal origin dummy, d_{it}^{LO}, that is $z_{it} = \Delta_5 x_{it}^{B} \times d_{it}^{LO}$ is the instrument for $x_{it}^{BL} = \Delta_5 x_{it}^{B} \times L_{it}$.

The first stage regression of $x_{it(p)}^{BL}$ on $z_{it(p)}$ and controls for our sample of business cycle peaks is shown in Table 2. Our instrument is strong, with an F-statistic above 100, and the sign of the coefficient is significant and consistent with our hypothesis. The result shows that ancient common law traditions have resulted in more efficient systems today for the resolution of corporate financial distress.

The results based on estimating Equation 4 with LP-IV are shown in Figure 7b. These confirm the findings from Figure 7a; although the estimates are slightly less precise, the path differences are even starker. As before, frictions impeding restructuring and liquidation aggravate the effects of corporate financial distress to the point of making the recession trajectory resemble that from a household debt boom. In contrast, efficient institutions are associated with recession trajectories that resemble normal recession trajectories, even when there is a preceding large buildup of corporate debt. The differences between the "high-friction" and "low-friction" trajectories are statistically significant at the 5% level.

Figure A.9 provides additional insights on the path of investment through the recession, The picture corresponds closely to the patterns in GDP growth. In low-frictions regimes, the path of investment after a corporate credit boom looks similar to the average path, and a previous debt build-up does not modulate the investment path over the subsequent years. However, when institutions are high-cost and inefficient, investment tanks and does not recover for many years after debt booms. This is the clearest evidence for the aggregate importance of debt overhang that we can find. Business investment is negatively affected by high debt when inefficient legal processes and institutions lead to high costs for restructuring and liquidation.

Summing up, we think that history has important lessons to offer. Institutional factors have a profound impact on how efficiently the financial aftermath from business debt booms can be resolved. In line with theory, debt overhang becomes costly when frictions impede a quick resolution and reallocation of resources. It makes one wonder if similarly frictionless debt resolution procedures were available to individuals, whether household debt booms would also then be associated with milder recessions.

6. Conclusion

Debt overhang can lead to under-investment by firms. Following Myers (1977), a large theoretical literature has explored the idea that investment shrinks for such indebted firms because the existing debt holders, not new investors, would be the main beneficiaries from new investment. In practice, the strength of these effects depends on departures from the canonical Modigliani and Miller (1958) theorem. How large these departures are in practice, and how strong the repercussions are from a macro perspective are largely an empirical question. Our results suggest that, at the aggregate level, corporate debt overhang does not play an economically or statistically significant role.

As a first macroeconomic approximation, for the most part we seem to live in a Modigliani-Miller world when it comes to corporate debt overhang in advanced economies. Unlike household credit, business debt can be restructured quickly. Damage from debt overhang is not common. However, the after-effects of business debt booms become more problematic when debt restructuring and liquidation become more costly. In this situation, zombie firms are more likely to emerge as high costs of liquidation increase incentive for banks "extend and pretend" instead of liquidating.

We used institutional proxies for the costs of balance sheet reorganization to delineate different institutional environments that make debt reorganization more or less efficient. In those places and times where reorganization and restructuring is inefficient and costly, corporate debt overhang is an important macroeconomic force that has measurably negative effects at business cycle frequency.

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ONLINE APPENDIX

A. Business cycle peaks

As described in the text, we date business cycle peaks using the algorithm of Bry and Boschan (1971). Moreover, we characterize the ensuing recession to be "financial" when the peak falls into a ±2-year window around a financial crisis dated by Jordà, Schularick, and Taylor (2017). Table A.1 shows business cycle peaks followed by normal recession and not falling into any war episode. Table A.2 shows business cycle peaks followed by normal recession and not falling into any war episode. Both types of peaks are also visualized in Figure A.1.

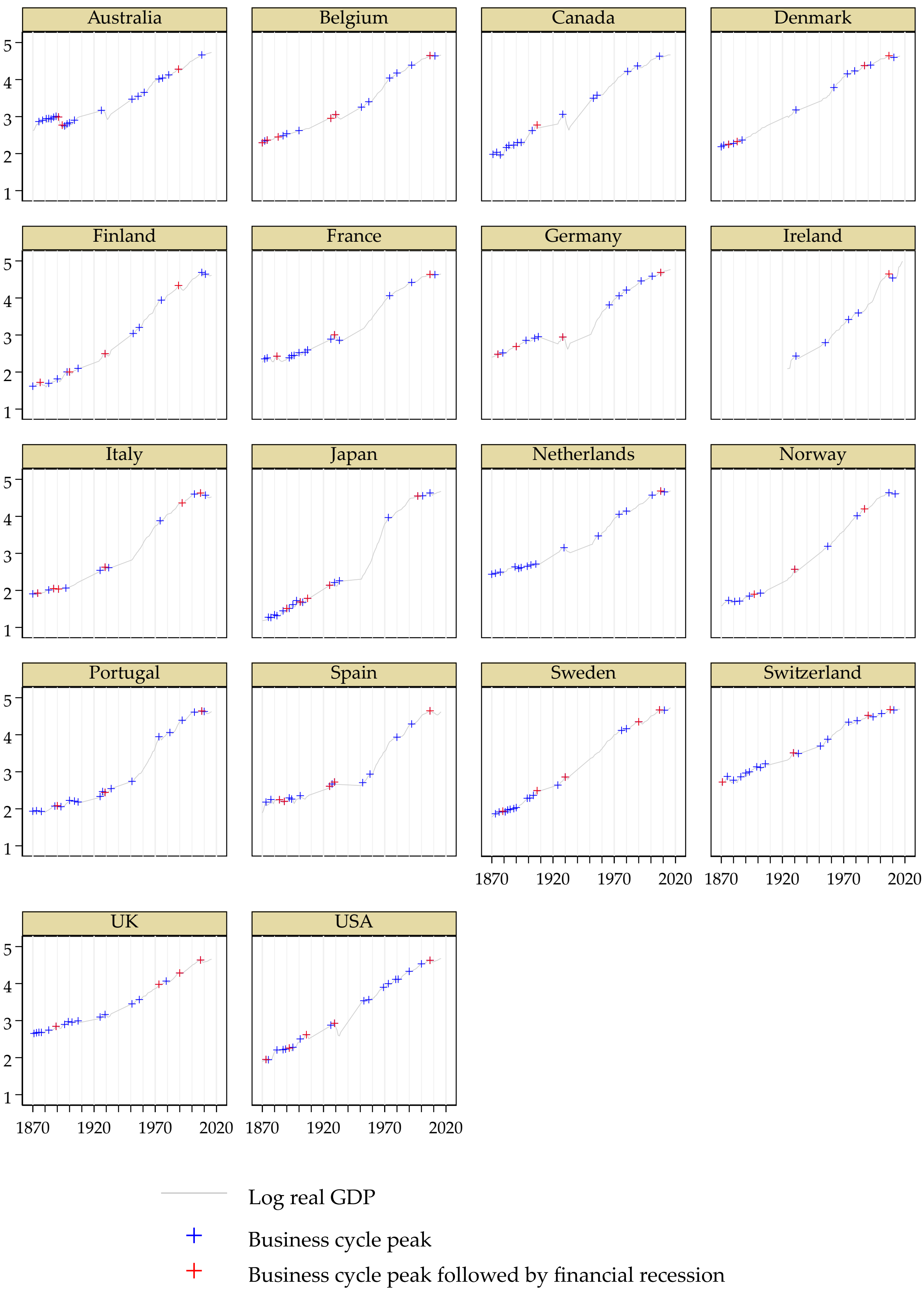
Table A.1: *List of business cycle peaks followed by normal recessions*

Australia	1961, 1973, 1976, 1981, 2008
Belgium	1957, 1974, 1980, 1992, 2011
Canada	1891, 1894, 1903, 1928, 1953, 1956, 1981, 1989, 2007
Denmark	1880, 1887, 1931, 1962, 1973, 1979, 1992, 2011
Finland	1957, 1975, 2008, 2011
France	1905, 1907, 1926, 1933, 1974, 1992, 2011
Germany	1898, 1905, 1908, 1966, 1974, 1980, 1992, 2001
Ireland	1955, 1974, 1982
Italy	1974, 2002, 2011
Japan	1973, 2001, 2007
Netherlands	1957, 1974, 1980, 2001, 2011
Norway	1876, 1881, 1885, 1893, 1902, 1957, 1981, 2007, 2012
Portugal	1973, 1982, 1992, 2002, 2010
Spain	1927, 1952, 1958, 1980, 1992
Sweden	1876, 1881, 1883, 1885, 1888, 1890, 1899, 1901, 1904, 1924, 1980, 2011
Switzerland	1875, 1880, 1886, 1890, 1893, 1899, 1902, 1906, 1933, 1951, 1957, 1974, 1981, 1994, 2001, 2011
UK	1896, 1899, 1902, 1907, 1925, 1929, 1951, 1957, 1979
USA	1926, 1953, 1957, 1969, 1973, 1979, 1981, 1990, 2000

Table A.2: *List of business cycle peaks followed by financial recessions*

Australia	1989
Belgium	2007
Canada	1907
Denmark	1883, 1987, 2007
Finland	1989
France	1929, 2007
Germany	1890, 2008
Ireland	2007, 2010
Italy	1992, 2007
Japan	1997
Netherlands	2008
Norway	1897, 1930, 1987
Portugal	2008
Spain	1925, 1929, 2007
Sweden	1879, 1907, 1930, 1990, 2007
Switzerland	1929, 1990, 2008
UK	1889, 1973, 1990, 2007
USA	1929, 2007

Figure A.1: *Business cycle peaks followed by financial and normal recessions*



B. Macroeconomic environment

We show regression tables for the plots in the main text and additional impulse responses (without tables), all conditional on the usual set of controls.

Table A.3: *Change in log real consumption*

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	-0.01	1.52**	2.78**	5.24**	7.47**
	(0.18)	(0.15)	(0.19)	(0.29)	(0.29)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	-2.79	1.22	-0.97	-1.94	-2.02
	(1.93)	(2.00)	(2.62)	(2.84)	(3.88)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	-1.14	-13.77*	-22.22**	-35.88**	-42.96**
	(3.93)	(5.64)	(4.95)	(7.81)	(7.43)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.725	0.024	0.001	0.002	0.000
R^2	0.23	0.29	0.42	0.38	0.36
Cycles	150	150	150	150	149

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.4: *Change in log real investment*

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	-4.09^{**}	-6.66^{**}	-8.45^{**}	-7.11^{**}	-3.15^{*}
	(0.36)	(0.71)	(1.08)	(1.24)	(1.48)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	3.24	5.36	9.59	10.12	12.46
	(5.28)	(7.97)	(11.02)	(13.21)	(14.14)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	-16.33	-75.14^{*}	-122.73^{**}	-144.57^{**}	-133.24^{**}
	(12.12)	(26.25)	(37.97)	(35.32)	(33.35)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.133	0.011	0.006	0.002	0.002
R^2	0.28	0.37	0.35	0.43	0.46
Cycles	150	150	150	150	149

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.5: *Change in unemployment rate*

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	1.21^{**}	2.23^{**}	2.88^{**}	2.87^{**}	2.94^{**}
	(0.28)	(0.41)	(0.51)	(0.69)	(0.88)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	0.28	-0.40	-0.80	-0.86	-1.04
	(0.99)	(2.50)	(3.40)	(3.98)	(4.22)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	-0.42	5.74	12.50	16.17	14.47
	(3.06)	(6.44)	(7.98)	(8.36)	(8.47)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.837	0.410	0.177	0.126	0.141
R^2	0.39	0.23	0.35	0.35	0.34
Cycles	112	113	113	113	112

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.6: *Change in log real household credit*

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	3.47**	8.19**	13.67**	18.41**	22.23**
	(0.23)	(0.45)	(0.52)	(0.69)	(0.97)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	-13.96**	-32.54**	-43.08**	-38.77*	-36.26*
	(3.68)	(9.53)	(11.00)	(16.44)	(15.67)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	-15.40	-32.50	-83.22	-137.02*	-166.99**
	(15.63)	(34.43)	(40.81)	(49.08)	(43.73)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.938	0.999	0.420	0.109	0.023
R^2	0.28	0.29	0.37	0.33	0.40
Cycles	149	149	149	149	146

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.7: *Change in log real business credit*

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	3.06**	5.47**	7.73**	10.30**	15.06**
	(0.28)	(0.46)	(0.58)	(0.78)	(1.04)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	-17.69**	-24.80*	-24.26	-34.27	-43.87
	(4.30)	(11.17)	(18.74)	(23.86)	(31.79)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	7.18	-22.71	-73.91*	-117.26**	-185.43**
	(10.81)	(19.12)	(27.49)	(36.57)	(42.91)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.055	0.930	0.173	0.093	0.026
R^2	0.39	0.35	0.27	0.28	0.31
Cycles	149	149	149	149	148

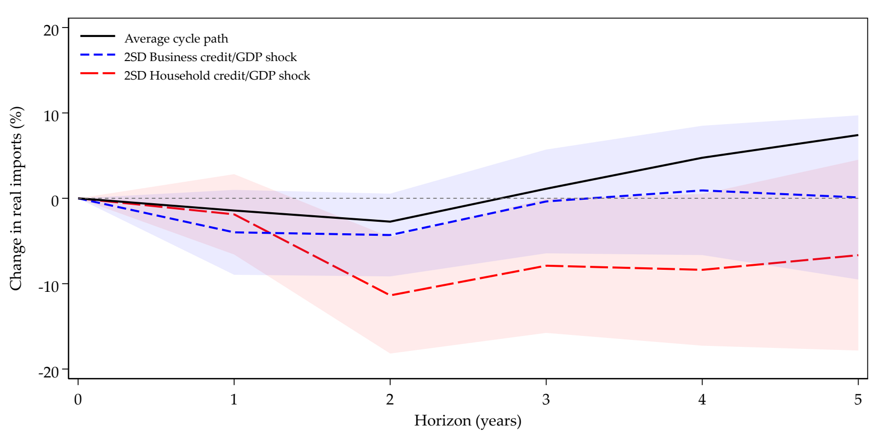
Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.8: *Change in log CPI*

	(1)	(2)	(3)	(4)	(5)
	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
Average cycle	3.00^{**}	4.70^{**}	5.92^{**}	7.77^{**}	9.33^{**}
	(0.10)	(0.22)	(0.31)	(0.39)	(0.50)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	0.15	-0.31	1.76	4.60	4.73
	(2.03)	(4.27)	(6.19)	(7.16)	(7.67)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	0.47	2.99	1.79	-9.30	-22.31
	(4.33)	(10.97)	(13.84)	(16.99)	(19.22)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.941	0.749	0.999	0.454	0.209
R^2	0.75	0.71	0.68	0.66	0.67
Cycles	150	150	150	150	150

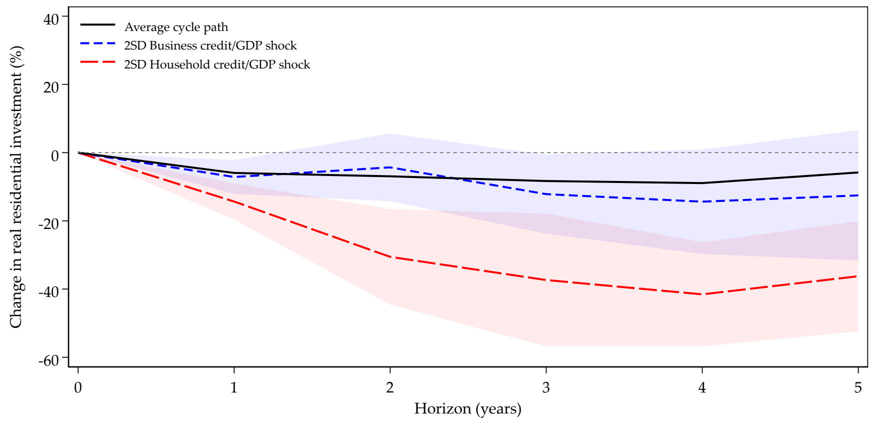
Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Figure A.2: *Conditional effect of 2 SD debt expansion on real imports*



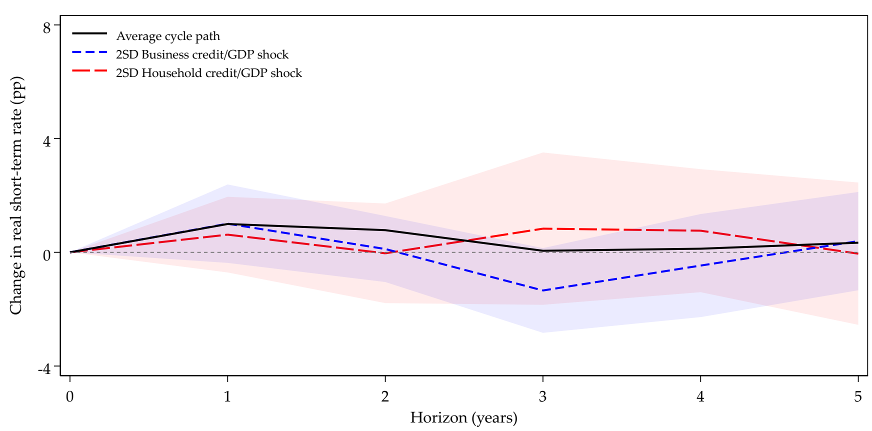
Notes: The figure shows the effects of a two-SD credit expansion in the five years preceding the recession for household credit booms (lhs) and business credit booms (rhs). The estimations rely on all business cycles in 17 advanced economies since WW2.

Figure A.3: *Conditional effect of 2 SD debt expansion real residential investment*



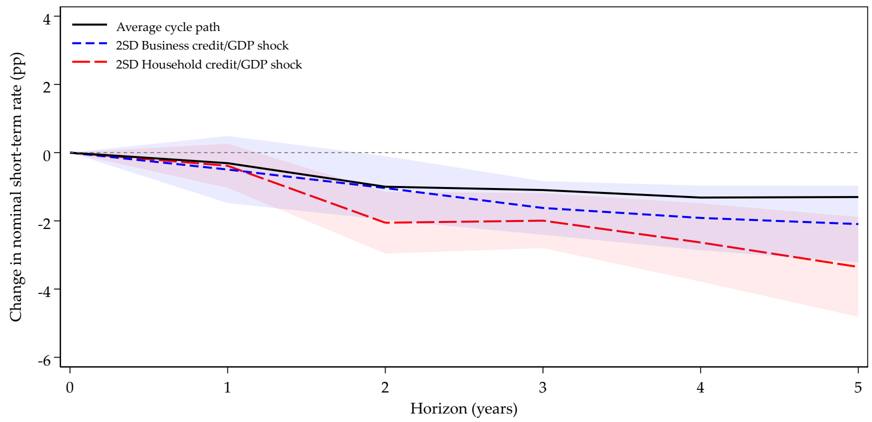
Notes: The figure shows the effects of a two-SD credit expansion in the five years preceding the recession for household credit booms (lhs) and business credit booms (rhs). The estimations rely on all business cycles in 17 advanced economies since WW2.

Figure A.4: *Conditional effect of 2 SD debt expansion on short-term real rates*



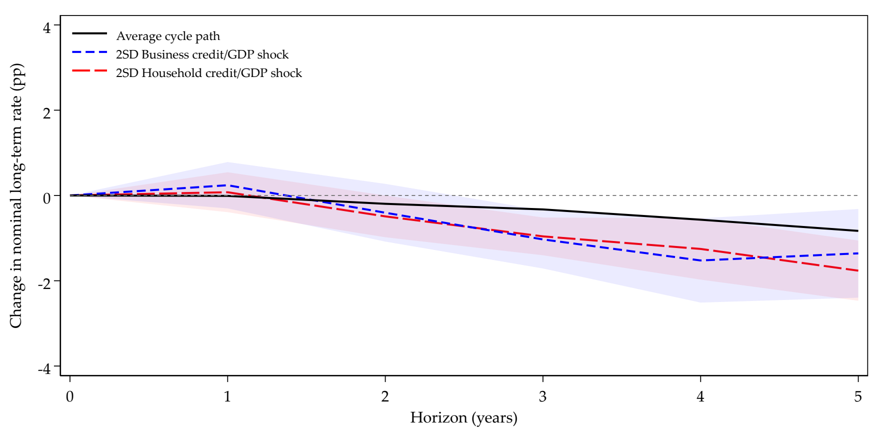
Notes: The figure shows the effects of a two-SD credit expansion in the five years preceding the recession for household credit booms (lhs) and business credit booms (rhs). The estimations rely on all business cycles in 17 advanced economies since WW2.

Figure A.5: *Conditional effects of 2-SD-expansion on nominal short-term interest*



Notes: The figure shows the effects of a two-SD credit expansion in the five years preceding the recession for household credit booms (lhs) and business credit booms (rhs). The estimations rely on all business cycles in 17 advanced economies since WW2.

Figure A.6: *Conditional effects of 2-SD-expansion on nominal long-term interest*



Notes: The figure shows the effects of a two-SD credit expansion in the five years preceding the recession for household credit booms (lhs) and business credit booms (rhs). The estimations rely on all business cycles in 17 advanced economies since WW2.

C. Robustness

We test different specifications for our main model and expose it to a battery of robustness checks. Results are documented below. Across all variants, we find no evidence of significant and quantitatively relevant debt overhang effects.

We introduce linear and quadratic time trends (Table A.9), exclude all recessions from 2007 onwards (Table A.10) and test alternative measures of debt overhang (Table A.11, Table A.12, Table A.13). We also report unconditional estimates in Table A.14. Finally, we test whether the effects of business credit expansions show up only at particularly high or low levels of business debt levels. We introduce an interaction term of 5-year changes in business credit/GDP with the level of business credit/GDP at peak and condition on the usual set of macro controls, country fixed effects and a linear and quadratic time trend. Figure A.7 plots the effects of credit expansion interacted with credit/GDP level.

Table A.9: *Introducing linear and quadratic time trends*

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	-1.60**	-0.78**	0.68	1.89**	3.58**
	(0.13)	(0.22)	(0.35)	(0.38)	(0.50)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	-0.04	2.47	0.42	0.22	2.65
	(1.38)	(1.90)	(1.93)	(4.13)	(4.57)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	-6.08	-16.66*	-25.07**	-34.89**	-34.14*
	(4.02)	(6.73)	(7.66)	(11.89)	(12.60)
Macro controls	Yes	Yes	Yes	Yes	Yes
Time trends	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.191	0.019	0.006	0.026	0.023
R^2	0.16	0.38	0.43	0.47	0.49
Cycles	150	150	150	150	149

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.10: *Omitting recessions post 2006*

	(1)	(2)	(3)	(4)	(5)
	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
Average cycle	-1.59**	-0.48**	1.12**	2.79**	4.86**
	(0.10)	(0.14)	(0.20)	(0.30)	(0.41)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	-0.27	2.12	-1.23	-1.34	0.55
	(1.15)	(1.77)	(2.65)	(3.77)	(4.79)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	-3.86	-12.23	-27.86*	-40.26*	-40.46*
	(3.98)	(6.56)	(10.12)	(14.15)	(14.23)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.412	0.054	0.007	0.013	0.010
R^2	0.21	0.32	0.39	0.42	0.41
Cycles	121	121	121	121	121

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.11: *Expansion measured by 3-year change in credit/GDP*

	(1)	(2)	(3)	(4)	(5)
	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
Average cycle	-1.53**	-0.36	1.60**	3.47**	6.29**
	(0.19)	(0.34)	(0.54)	(0.71)	(0.77)
Business credit/GDP expansion $\Delta_3 x^B_{it(p)}$	-2.33	1.34	-1.94	-2.60	-9.08
	(3.05)	(6.78)	(7.65)	(9.42)	(9.86)
Household credit/GDP expansion $\Delta_3 x^H_{it(p)}$	-0.92	-26.04**	-39.60**	-51.00**	-62.76**
	(4.57)	(8.58)	(10.99)	(17.27)	(18.72)
Macro controls	Yes	Yes	Yes	Yes	Yes
R^2	0.143	0.323	0.397	0.421	0.470
Cycles	155	155	155	155	154

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.12: *Expansion measured by 10-year change in credit/GDP*

	(1) $h=1$	(2) $h=2$	(3) $h=3$	(4) $h=4$	(5) $h=5$
Average cycle	-1.40**	0.17	2.03**	3.84**	6.09**
	(0.27)	(0.42)	(0.52)	(0.55)	(0.93)
Business credit/GDP expansion $\Delta_{10}x^B_{it(p)}$	0.21	0.63	0.02	-0.61	-0.45
	(1.30)	(1.44)	(1.86)	(1.76)	(2.73)
Household credit/GDP expansion $\Delta_{10}x^H_{it(p)}$	-3.12	-12.15**	-16.70**	-20.76**	-22.71**
	(1.74)	(2.67)	(3.50)	(4.91)	(5.36)
Macro controls	Yes	Yes	Yes	Yes	Yes
R^2	0.214	0.292	0.376	0.405	0.481
Cycles	132	132	132	132	131

Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.13: *Expansion measured by real credit growth*

	(1) $h=1$	(2) $h=2$	(3) $h=3$	(4) $h=4$	(5) $h=5$
Average cycle	-0.57	-1.68	0.29	2.27	3.75
	(0.69)	(1.11)	(1.73)	(2.35)	(2.01)
Business credit expansion $\Delta_5 log(credit^B_{it(p)})$	0.01	0.04**	0.03	0.05	0.07*
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Household credit expansion $\Delta_5 log(credit^H_{it(p)})$	-0.04*	-0.01	-0.02	-0.04	-0.04
	(0.02)	(0.03)	(0.05)	(0.06)	(0.06)
Macro controls	Yes	Yes	Yes	Yes	Yes
R^2	0.180	0.283	0.333	0.353	0.408
Cycles	150	150	150	150	149

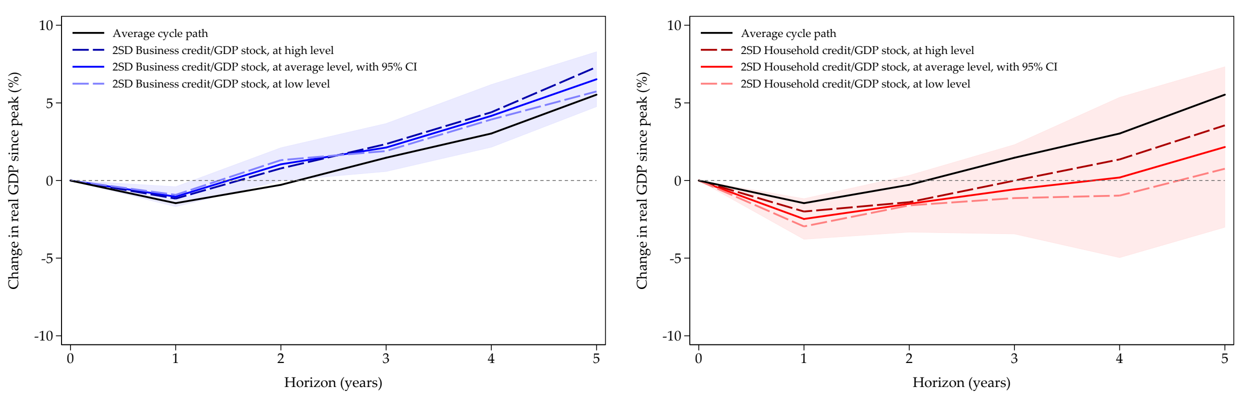
Within-estimator, standard errors clustered on countries in parentheses.
** $p < 0.01$, * $p < 0.05$.

Table A.14: *Unconditional*

	(1) $h=1$	(2) $h=2$	(3) $h=3$	(4) $h=4$	(5) $h=5$
Average cycle	-1.70^{**}	-0.95^{**}	0.76^{**}	2.52^{**}	4.39^{**}
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Business credit/GDP expansion $\Delta_5 x^B_{it(p)}$	0.19	−1.34	−4.60	−5.14	−5.86
	(1.45)	(1.80)	(2.92)	(2.97)	(3.32)
Household credit/GDP expansion $\Delta_5 x^H_{it(p)}$	0.62	-18.02^{**}	-24.49^{**}	-26.98^{**}	-31.79^{**}
	(2.62)	(3.80)	(4.87)	(7.40)	(8.20)
$\beta^B_h = \beta^H_h$ (p-value)	0.893	0.001	0.008	0.017	0.008
R^2	0.00	0.12	0.11	0.09	0.10
Cycles	157	157	157	157	156

Notes: Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$. Credit expansion denotes past 5-year change in credit/GDP ratio.

Figure A.7: *Interacting expansions and levels*



Notes: The figure visualizes the effects of credit expansions when interacted with credit-to-GDP levels. It plots predictive effects on growth of a two-SD credit expansion in the five years preceding the recession when at the business cycle peak credit-to-GDP levels stand at i) country-specific historical averages, ii) one standard deviation above country-specific averages or iii) one standard deviation below country-specific averages. The usual set of controls are included. To make sure that credit level trends do not spuriously drive estimates, we include a linear time trend for the pre-WW2 period and—to account for the structural break on credit-to-GDP series—a dummy and separate time trend for the post-WW2 period. Estimates based on all business cycles in 18 advanced economies since 1870. Standard errors are clustered at the country level.

D. Placebo tests

Frictions in business bankruptcy regimes shape the aftermath of corporate debt booms. But it is possible that the legal indicator picks up confounding recession drivers. Would we find the for business bankruptcy efficiency with pre-recession changes in household credit/GDP—instead of business credit/GDP—alongside both base terms, country fixed effects and the usual set of dynamic macro-financial controls. Using analogous short-hand notation $\Delta_5 x^{HL}_{it(p)} = \Delta_5 x^{H}_{it(p)} \times L_{it(p)}$, the estimation equation thus becomes:

$$\Delta_h y_{it(p)+h} \;=\; \alpha_h + \alpha_{hi} + \beta^{HL}_h \Delta_5 x^{HL}_{it(p)} + \beta^{H}_h x^{H}_{it(p)} + \beta^{B}_h \Delta_5 x^{B}_{it(p)} + \gamma_h w_{it(p)} + e_{it(p)} \,. \tag{5}$$

Coefficient estimates are visualized in Figure A.8. The upper panel plots the impulse response function of a 2-SD household credit/GDP boom under a low-friction business bankruptcy regime scoring in the top decile of the legal indicator (left panel) and high-friction regime scoring in the bottom decile (right panel). The lower panel re-draws those impulse responses for the IV pendant of Equation 5, where the legal indicator is instrumented by the binary variable of civil vs. common law legal origin.

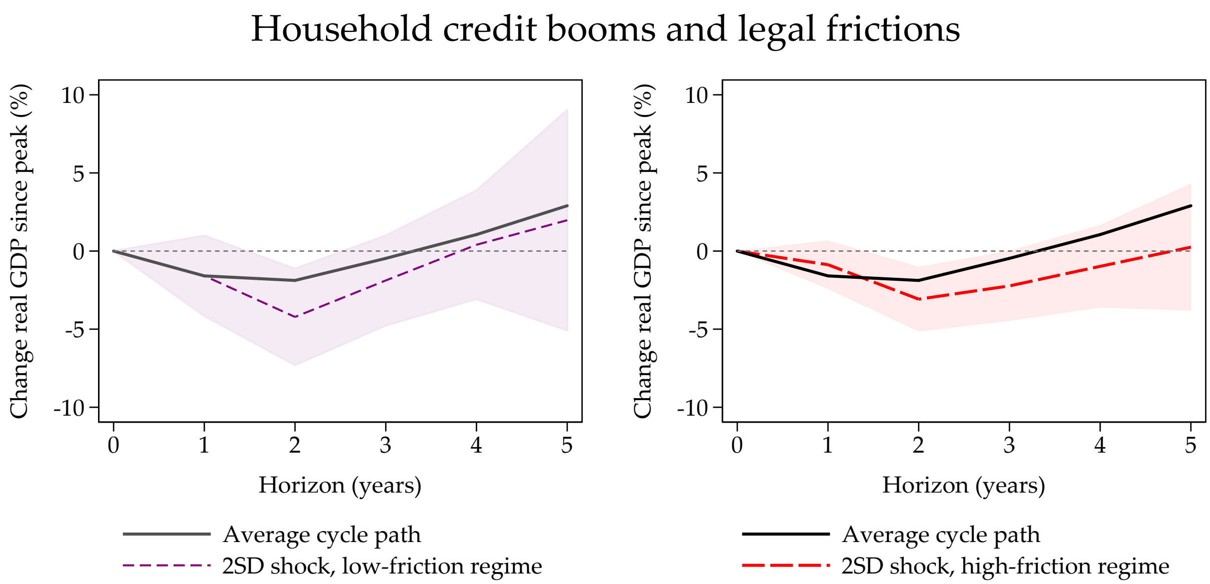
The estimates yield the following picture. Business bankruptcy regime quality does *not* mediate the effects of household credit/GDP booms in the same way it interacts with business credit. If anything, household credit booms seem to predict *milder* recessions under high-friction bankruptcy regimes. Overall, the placebo estimates are plagued by large standard errors, as one would expect from a poor model fit. Note that confidence intervals always include the baseline estimates as shown in Figure 3, where a 2-SD household credit/GDP boom predicts a fall in GDP by -4% under pre-recession levels.

E. Legal regimes and under-investment

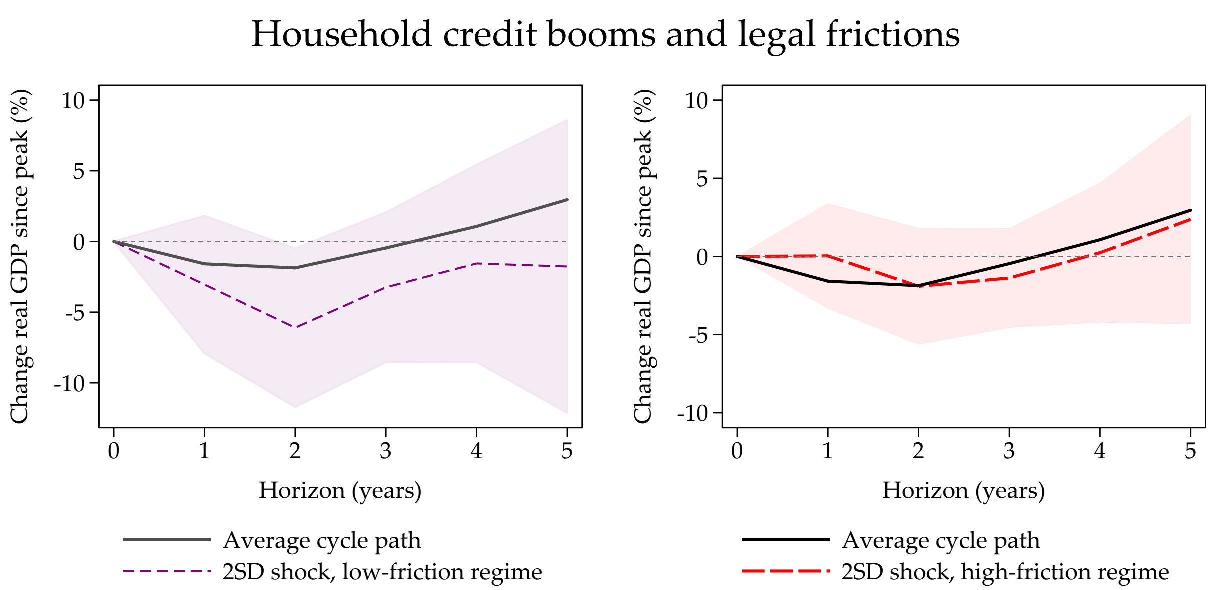
Debt overhang should cause under-investment. Similarly, a large population of corporate zombies could depress industry dynamism and technology adoption by deterring investments in more productive firms. If the moderating effect of legal regimes on GDP operates through preventing debt overhang and zombification, we should thus find direct evidence in macroeconomic investment behavior. We can use the legal interaction model of Equation 4 to directly test whether efficient legal regimes reduce under-investment problems after business debt booms. Simply replacing the dependent variable by cumulative changes in real investment yields estimates visualized in Figure A.9. In fact, we find that corporate debt booms significantly depresses investment below its average recession trajectory—if and only if they occur in legal environments with poor bankruptcy resolution procedures.

Figure A.8: *Placebo tests*

(a) *Interacting household credit booms with business bankruptcy regime*



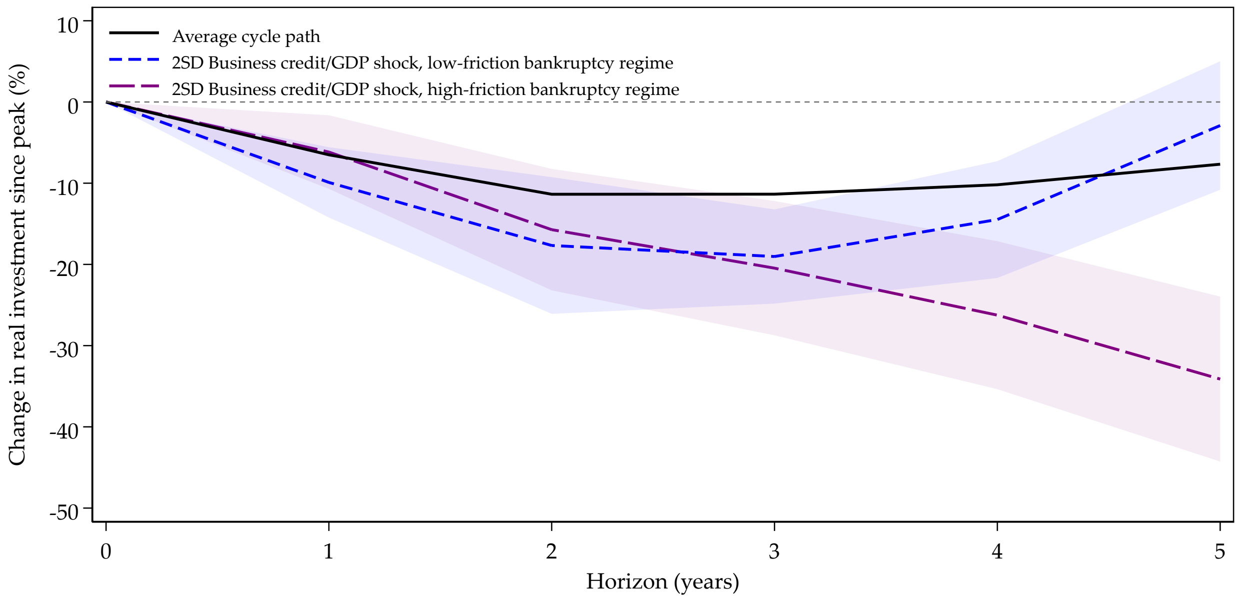
(b) *Instrumenting the interaction of household credit booms and business bankruptcy regimes*



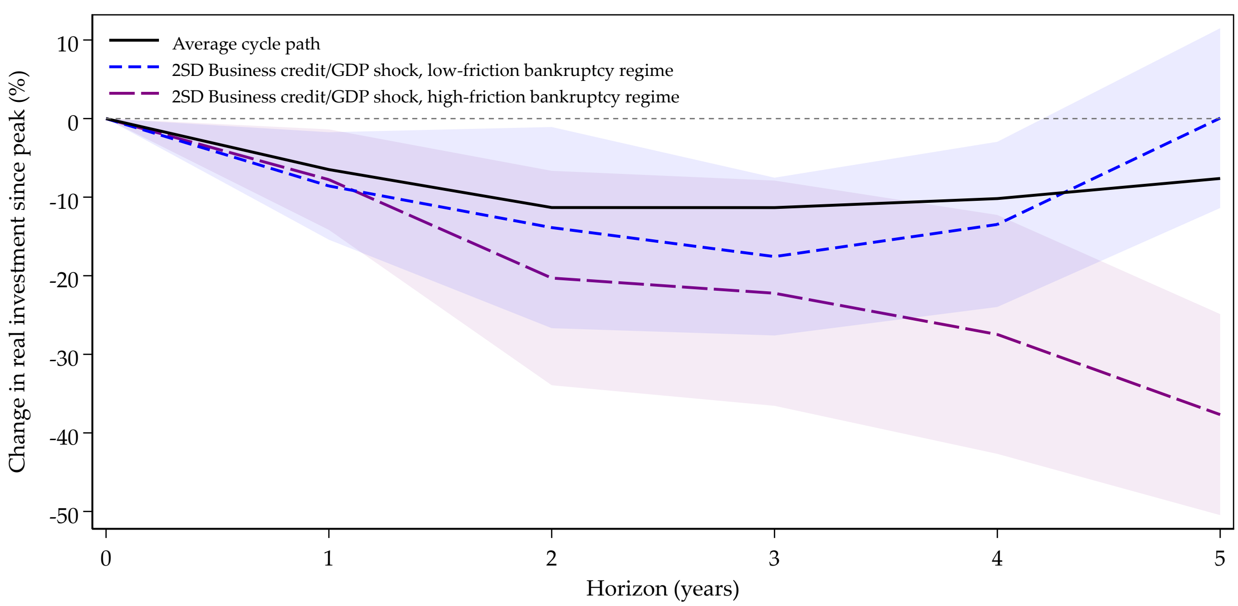
Notes: The figure shows the responses of a 2-SD expansion in household credit/GDP under different business bankruptcy regimes. Left panels show impulse responses under "low-friction bankruptcy regime", referring to $L_{it} = 10$, whereas panels on the right show the effects under "high-friction bankruptcy regime" refers to $L_{it} = 1$. All estimates are conditional on controls for contemporaneous and two lags of GDP per capita growth and inflation. Panel (a) is based on OLS estimation of Equation 5. Panel (b) instruments friction indicators with a dummy for legal tradition, civil or common law. Standard errors are clustered at the country level. Shaded areas denote the 95% confidence interval. See text.

Figure A.9: *Corporate debt booms, legal regimes and investment*

(a) *OLS estimates*



(b) *IV estimates*



Notes: Both panels show the recession trajectory for real aggregate investment following a 2-SD expansion in business credit/GDP in the five years preceding a recession. In the plot, "high-friction bankruptcy regime" refers to $L_{it} = 1$ whereas the "low-friction bankruptcy regime" refers to $L_{it} = 10$. All estimates are conditional on controls for contemporaneous and two lags of real business credit growth, real GDP per capita growth and inflation. Impulse responses are based on estimates of Equation 4 with real investment as dependent variable. Panel (a) shows OLS estimates. Panel (b) instruments friction indicators with a dummy for legal tradition, civil or common law. Standard errors are clustered at the country level. Shaded areas denote the 95% confidence interval. See text.

F. Business credit data

For parts of the post-WW2 sample, we can draw on financial accounts data of the OECD and Eurostat databases and individual publications such as Bonci and Coletta (2012) for Italy, Roe (1971) and Office for National Statistics (2016) for U.K. data, Deutsche Bundesbank (1983) and Deutsche Bundesbank (1994) for German data. All postwar U.S. data are from the Fed's Flow of Funds.

In addition, we rely on comprehensive measures of business credit provided by the "Total credit database" assembled by the Bank of International Settlements (BIS). These include secured and unsecured debt obligations of all maturities and from all types of lenders in addition to conventional bank lending contracts. For methodological details see Dembiermont, Drehmann, and Muksakunratana (2013).

For earlier years, we proxy credit growth using data on bank lending to the non-financial business sector. In addition, we extend the business lending series of Jordà, Schularick, and Taylor (2017) to obtain data for the 19$^{\text{th}}$ and the first half of the 20$^{\text{th}}$. We fill post-WW2 gaps with data kindly provided by Müller (2018).

For the pre-WW2 period, we calculate bank credit to the non-financial business sector based on the assets of specialized commercial banks, providing loans to business and other corporate financing. For example in the case of Germany, we sum credit extended to non-banks by joint-stock industrial banks as well as commercial credit unions. Where the banking sector is more diversified, we exploit that the bulk of pre-WW2 household loans were mortgages and obtain business credit as the residual to total private credit. Here, we can rely on Jordà, Schularick, and Taylor (2017) for necessary data on residential mortgages and total credit. We list all sources in detail below.

Table A.15 presents summary statistics of business credit and of household credit for comparison.

Table A.15: *Summary statistics for full sample of annual data*

	N	Mean	SD	SD resid.	Min	P10	P90	Max
Business debt/GDP, 5-year change	1286	0.04	0.16	0.15	-0.63	-0.15	0.22	0.62
Household credit/GDP, 5-year change	1218	0.04	0.08	0.07	-0.35	-0.03	0.13	0.44
Business debt/GDP	1373	0.86	0.37	0.19	0.12	0.44	1.40	2.14
Household credit/GDP	1313	0.35	0.26	0.11	0.00	0.03	0.72	1.21

Notes: SD resid denotes residual standard deviation after controlling for country fixed effects and country-specific linear time trends.

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