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Down in the slumps: the role of credit in five decades of recessions

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Abstract

We investigate the role of private sector credit in shaping the severity of recessions. Using a sample of 130 downturns in 26 advanced economies since the 1970s, we assess whether the growth or level of credit is the better predictor of the severity of a recession. In addition to GDP we examine other metrics of severity, including unemployment and labour productivity. We find that a period of rapid credit growth in the immediate run-up to a recession predicts a deeper and longer downturn than when credit growth has been subdued, whether associated with a systemic banking crisis or not and whether that credit growth reflects borrowing by households or businesses. Credit growth is a more statistically and economically significant predictor of a recession's severity than the level of indebtedness, though there is some evidence that the effect of a credit boom is greater when leverage is high. A build-up in credit predicts worse recessions in terms of lower GDP per capita, higher unemployment and lost labour productivity.

Key words: Recessions, productivity, local projections.

JEL classification: G01, E51, N10.

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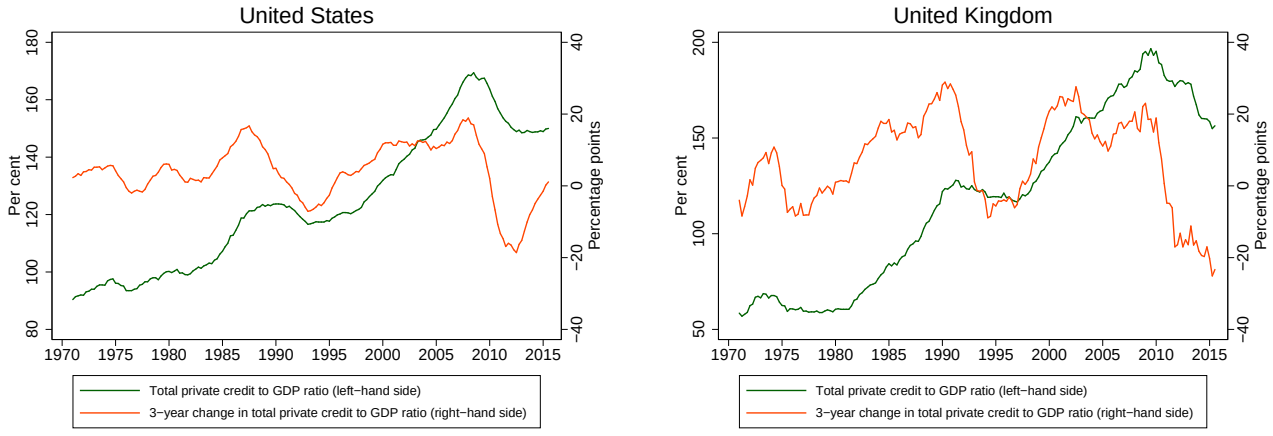
1 Introduction

In the wake of the financial crisis, a fundamental question is how to identify and mitigate building financial risks to the real economy. A flurry of empirical research since then has emphasised the importance of private sector credit as a reliable predictor of financial crises.[1] But credit may amplify or propogate shocks to the real economy, as well as cause them.

This paper investigates the role of private sector credit in shaping recessions by assessing whether the *growth* or *level* of credit is a more useful predictor of the severity of past downturns. While a number of studies have documented the empirical links between credit and the severity of recessions, there is not yet a consensus on whether it is a high level of debt heading into a recession or a period of rapid credit growth that is most concerning. Jordà, Schularick, and Taylor (2013), for instance, show that recessions in advanced economies since the 1870 were deeper and longer when preceded by a period of high credit growth, whether accompanied by a banking crisis or not. Others, however, have emphasised the role of high levels of indebtnedness in worsening slumps (Reinhart and Rogoff, 2009; Mian, Rao, and Sufi, 2013; Flodén, 2014). Studies that have compared the role of the level and growth of credit for the most recent financial crisis have found mixed results (Flodén, 2014; Bunn and Rostom, 2015). Understanding the different roles played by both the growth and level of credit is pertinent to many advanced economies following the recent financial crisis, where credit growth has remained subdued but, despite a phase of deleveraging, indebtedness remains elevated relative to the past (see Figure 1).

Figure 1: Level and change in credit to GDP ratios



Source: Bank for International Settlements.

[1] See, for example, Borio and Drehmann (2009), Drehmann, Borio, Gambacorta, Jiminez, and Trucharte (2010), Alessi and Detken (2014), Giese, Andersen, Bush, Castro, Farag, and Kapadia (2014) and Schularick and Taylor (2012).

There are a number of possible mechansims by which both high levels of indebtedness or periods of fast credit growth may propogate shocks and amplify the severity of a recession. High levels of debt can prolong macroeconomic slumps if accompanied by a tightening in credit conditions or fall in asset prices which forces credit-constrained households and businesses to deleverage. Its impact is amplified if monetary policy is unable to offset the loss in demand by inducing unconstrained agents to increase their spending due to the effective lower bound or because the high level of indebtedness makes the private sector reluctant to spend (Eggertsson and Krugman, 2012; Korinek and Simsek, 2016; Koo, 2011). Other models argue that periods of fast credit growth may be symptomatic of a relaxation in lending standards or 'excessive' borrowing based on over-optimistic expectations. This may amplify a recession if it leads to large asset price falls and banking sector losses during a recession (Dell'Ariccia and Marquez, 2006; Aikman, Haldane, and Nelson, 2015), or through borrowers' re-assessing their future income prospects. Credit booms may also be particularly associated with a misallocation of resources towards high collateral but low productivity sectors, which subsequently takes time to reverse during a recession, particularly if credit supply is impaired (Borio, Kharroubi, Upper, and Zampolli, 2016; Cecchetti and Kharroubi, 2015).

Our choice of question is also practical. While theory can find roles for both the growth and level of credit in amplifying shocks, one of these measures might be the more robust for policymakers to use when assessing the risks of the financial cycle. Assessing the risks associated with a given level of debt is complicated by structural changes in what level might be considered beneficial or sustainable in the long run, including those induced by changes in long-run interest rates and financial deepening (Cunliffe (2016)). These structural changes are, however, often difficult to identify in real time. As a result, focussing on the growth of credit may be a more robust and timely alternative. This is analogous to Orphanides and Williams (2002), who propose a robust monetary policy rule based on deviations of GDP growth from average, rather than a rule based on the level of the output gap, which is unobservable.

Using a dataset of 130 recessions spanning 26 advanced economies and five decades, we find that it is the rapid build-up in private sector credit just before a recession, rather than a high level of indebtedness, that is the more statistically and economically significant predictor of the length and depth of past recessions. A 10 percentage point increase in the 3-year change in the credit to GDP ratio before a recession is associated with around a 2 percent lower level of real GDP per capita three years after the peak in output. The ability of credit booms to predict more severe recessions holds for both downturns that were associated with systemic banking crisis and those that were not, and whether the increase in borrowing was done by households or businesses. While we do

not find that there is a particular threshold above which the level of debt itself starts to matter for severity, we find some evidence that high leverage can amplify the effects of credit booms. In other words, periods of fast credit growth predict an even worse outcome during a recession when leverage was high before the start of a recession than when leverage was low.

While the literature has typically focussed on the relationship between credit and output during recessions, we provide a richer picture by also examining the relationship with other metrics of the severity of a downturn, including unemployment and labour productivity. We find that credit booms predict worse outcomes for both unemployment and labour productivity during a recession over a three year horizon. These effects on the level of labour productivity are also persistent, suggesting that there may be a role for credit in amplifying the size of downturns through supply-side channels as well as a reduction in aggregate demand, either directly or indirectly.

These findings add to the fast-developing body of evidence that can facilitate improved risk assessment in the macroprudential realm. Not only do they indicate which financial variables might be the most informative for judging the build-up in risks associated with the financial cycle, but such empirical findings may also help to inform debates about which transmission mechanisms might be in play in amplifying shocks during recession. Although the application of our findings out of sample would rely on the assumption that next time will not be different, we argue that we would do well to learn from the empirical regularities of the past.

2 Recessions and our dataset

We are interested in the role of credit in *amplifying* the real economy implications of adverse shocks. We follow the approach of Jordà, Schularick, and Taylor (2013) in choosing recessions as our identification of such shocks.[2] Recessions, however, are reasonably rare events in macroeconomic history. We must therefore cast our net wide to capture sufficient episodes to make empirical analysis meaningful. As such, we have constructed a comprehensive cross-country panel dataset from a variety of sources, spanning 26 advanced economies since the 1970s. While including emerging economies in our dataset would increase the number of recessions, we restrict our sample to advanced economies to reduce the potential for more heterogeneous interaction across countries between financial and macroeconomic cycles. Although we include some countries that would have been categorised as newly-industrialised economies at the start of our sample, such

[2] An alternative approach is pursued by Mian, Sufi, and Verner (2015) who use their entire panel to make statements about the *average* effect of credit on GDP performance *through the cycle*.

as Hong Kong, Singapore and South Korea, the vast majority of recessions we identify in these countries occurred after the 1970s. The full sample of countries used is listed in Section A at the end of this paper.

We identify a recession as two consecutive quarters of negative real GDP growth, but to ensure that we do not identify small fluctuations within a more significant episode as a separate event, we also require there must be at least eight quarters between consecutive peaks or consecutive troughs (Bry and Boschan, 1971; Harding and Pagan, 2002).[3] Once the availability of data on control variables is taken into account, we identify 130 recessionary episodes. That sample size compares favourably with related cross-country empirical studies of recessions, such as Jordà, Schularick, and Taylor (2013), and is fairly evenly split both geographically and across decades (Table 1). In addition, we capture 31 recessions associated with systemic banking crises, as recorded by Valencia and Laeven (2012), the large majority of which are concentrated in the 2000s and 2010s.[4]

Table 1: Occurrence of recessions by region and decade

By region	Count	o/w financial	By decade	Count	o/w financial
Euro area core	31	10	1970s	26	1
Euro area periphery	33	11	1980s	23	1
Europe, excluding euro area	26	6	1990s	28	4
North America	7	1	2000s	38	15
Asia	17	3	2010s	15	10
Other	16	0			
Total	130	31		130	31

In addition to GDP, we have compiled data on unemployment, productivity, house and equity prices, a range of interest rates, inflation, the current account and a range of indicators of banking resilience. Our credit data come from the Bank for International Settlements' (BIS) "Long series on total credit and domestic bank credit to the private non-financial sector" database[5], and includes outstanding loans and debt securities to the private sector, households and non-financial corporations. The majority of our dataset is at a quarterly frequency, though some variables are at an annual frequency. Where possible, we have used well-known and comparable cross-country data sources, predominantly: the BIS; Datastream; the Global Financial Database; the OECD, the Total Economy Database and the World Bank. Data on measures of banking sector resilience are sourced from the banking sector dataset of Bush, Guimaraes, and Stremmel (forthcoming). A

[3]The decision to require at least eight quarters between the start of recessions is a more cautious approach than employed by Harding and Pagan (2002), who restrict the minimum length of a business cycle to be four to five quarters.

[4]We identify a recession as having been associated with a banking crisis if a crisis occurs in the same year as a recession or a year either side of it.

[5]http://www.bis.org/statistics/totcredit/credpriv_doc.pdf

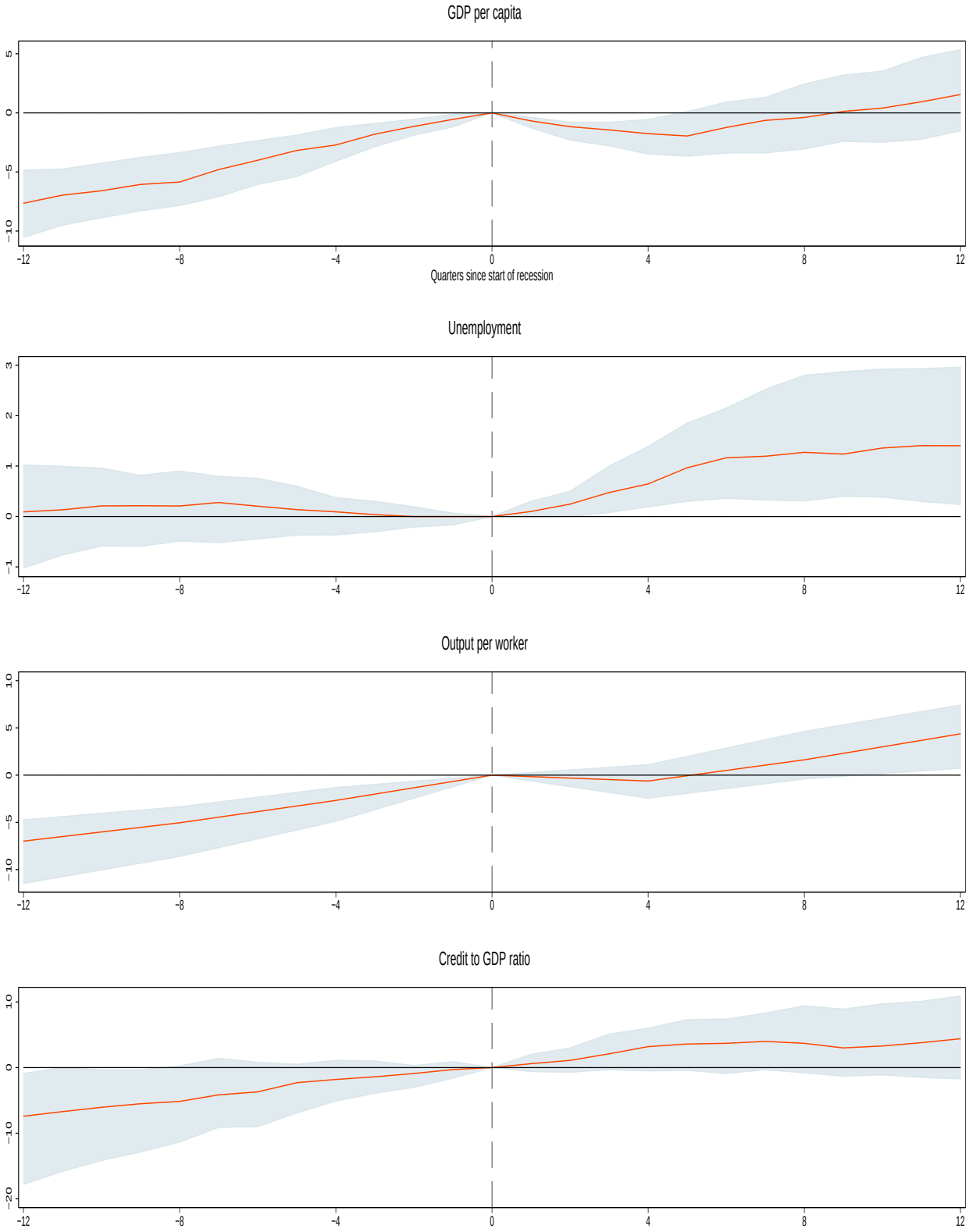
complete list of variables and associated data sources is available in Appendix A. Ongoing work aims to apply the full features of this dataset to other questions faced by policymakers; this paper is the first part of that research agenda.

There is no one definition of the severity of a recession. The maximum *amplitud*e of the fall in output from pre-recession peak is one obvious contender. But given that GDP represents a flow of goods and services, the *duration* of a recession is also important from a welfare perspective. We allow for both dimensions of severity by focussing on the full recession *path*. We consider the deviation in real GDP per capita from its peak before the start of the recession, through the following 12 quarters of downturn and recovery.[6] GDP measures the aggregate output of an economy, however, and losses during a recession might be unevenly distributed across the population. We therefore also measure severity by examining changes in measures of unemployment during recessions, as it captures these inequalities and welfare losses as well as changes in the activity of an economy (Krueger, Mitman, and Perri (2016)). Finally, while the literature has typically focussed on the relationship between credit and GDP during recessions, we provide a richer picture by examining whether any relationship between credit and severity is also reflected primarily in productivity.

What do these recession paths look like in practice? Figure 2 summarises the behaviour of our key variables of interest before and after the start of recessions. Economies in our sample have experienced a recession roughly once every ten years, losing 1.7% of real GDP per capita in the first year on average and take around two years for the level of output to recover. But within that there is substantial heterogeneity in the performance of economies. It is this variation in the severity of macroeconomic downturns that we seek to explain with credit conditions observable on the eve of the event. For example, the interquartile range of the change in GDP per capita a year into a recession is -3.5% to -0.6%. Recessions associated with banking crises tend to be more severe on average: the median level of real GDP per capita is around 1.8% lower and unemployment 0.3 percentage points higher a year into a financial recession than a normal one, and output takes more than a year longer to recover to its pre-recession peak.

[6]Note that we date our recessions using real GDP but measure the severity of a recession using real GDP per capita. This controls for any difference across time and countries in the extent to which trend growth rates are driven by underlying population growth.

Figure 2: Summary of key variables before and after recessions



The solid line shows the median observation of the per cent or percentage point change of each variable relative to their level at the quarter before the start of a recession, and the shaded area shows the upper and lower quartile.

3 Empirical Strategy

Our objective is to ascertain whether, in our sample, measures of credit in the run-up to a recession event help to predict the size and shape of the recession which follows. We do this employing the local projections methodology introduced by Jordà (2005) and applied to related research in Jordà, Schularick, and Taylor (2013) and Mian, Sufi, and Verner (2015).[7]

The key feature of this methodology is that impulse response functions are created by estimating separate regressions for each forecast horizon $t + h$, conditional on a given set of variables at time t. In other words, we estimate separately at each horizon how the starting conditions at the pre-recession peak affected the recession severity at that horizon. These estimates at the various horizons are then used to map out an impulse response function. Importantly for our research question, this methodology allows non-linear impulse response functions (such as interaction terms) to be estimated more flexibly than in a conventional VAR model, as well as being potentially more robust to mis-specification of the data generating process (Jordà (2005)). Such a framework does not, of course, necessarily imply causality between changes in our independent variables and severity, merely whether credit has been a useful predictor of the severity of past downturns.

As discussed in Section 2, we define our absolute severity metric $Y_{t(r)+h,j}$ as the percentage deviation in the level of real GDP per capita y from its pre-recession peak level $y_{t(r)}$, where $t(r)$ denotes the quarter before the onset of the r^{th} recession. We do this for each of our 130 recessions spanning our sample of 26 countries $j = \{1, ..., 26\}$ and for each quarterly impulse horizon h out to three years after the recession began $h = \{1, ..., 12\}$. That is [8]:

$$Y_{t(r)+h,j} = 100 * \left(y_{t(r)+h,j}/y_{t(r),j} - 1\right) \tag{1}$$

Our generic specification is then to estimate the following, at each horizon h, in order to construct a full impulse response:

[7] The local projections methodology has been applied beyond the severity of downturn literature in empirical studies seeking to identify the contingent impact of shocks in other fields. See for example, Auerbach and Gorodnichenko (2012, 2013); Ramey and Zubairy (2014) on the impact of fiscal shocks in good and bad times, Tenreyro and Thwaites (2013) for a similar enquiry into the impact of monetary policy and Bahaj, Bridges, Malherbe, and O'Neill (2016) for the state contingent response of banks to changes in their capital requirements.

[8] We consider the path of GDP per capita out to three years after the recession began (that is $H = 12$). This choice of horizon balances our interest in both the shape of recession and subsequent recovery with two drawbacks from ever-longer horizons. First, the longer the horizon, the greater the risk of overlapping observations, when one recession episode spills into another. Second, at longer horizons, impulse responses from local projections become increasingly imprecise, as noted by Ramey and Zubairy (2014).

$$Y_{t(r)+h,j} = \bar{\alpha_N}^h N + \bar{\alpha_F}^h F + \sum_{j=1}^{J-1} \alpha_j^h + \beta^h \left(X_{j,t} - \bar{X}\right) + \zeta^h trend_{j,t} + \theta controls_{j,t} + \epsilon_{j,t} \;\; \forall h = 1...12 \quad (2)$$

N and F are indicator variables for whether the recession was associated with a banking crisis or not. When the recession was accompanied by a banking crisis - defined as the recession being within one year of a systemic banking crisis classified by Valencia and Laeven (2012) - it is denoted "Financial" and the variable F equals one.[9] When there is no banking crisis, it is denoted "Normal" and instead N equals one. At its simplest, were we to exclude all terms except $\bar{\alpha}_N^h N$ and $\bar{\alpha}_F^h F$ we would simply recover the unconditional mean recession path across our crisis and non-crisis recession episodes.

To this, we add a vector of credit variables of interest $X_{j,t}$, containing measures of credit growth and the level of indebtedness at period t, the quarter before the onset of a recession. We remove the global mean across countries and time for each of our variables, such that - were all financial indicators at their average levels - the mean recession path would be recovered in $\bar{\alpha}_N^h N + \bar{\alpha}_F^h F$. Our focus is the coefficient vector β^h, which tells us - at each horizon h - the percentage point impact on the deviation of real GDP per capita from its peak level of a unit deviation of our financial variable of interest.

In our default specification, we include a number of controls:

- First, we control for fixed country effects, α_j^h. This controls for the possibility that, while our main variables of interest may explain some variation in the average recession path between countries, there may still be important time-invariant differences between countries that we do not capture with our main variables. The inclusion of country fixed effects is not costless. While including them controls for any bias in our estimates caused by unobserved time-invariant variables across countries, it means we lose degrees of freedom and hence lose precision in our estimates. That is particularly the case given that our panel is fairly wide, with a larger *N* and a smaller *T* than in some studies.

- Second, we include a time-varying and country-specific trend for real GDP per capita growth. Even though our sample is restricted to advanced economies and recent history, there remains significant variation in trend GDP growth in our sample across time and countries.

[9] Valencia and Laeven (2012) define a banking crisis as a situation in which "a country's corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time."

These differences in trend growth can have a significant effect on the the severity of a recession - countries that grew faster going into recessions have also tended to recover from recessions more quickly. We therefore control for this by including in the baseline specification country $j's$ average growth in real GDP per capita in the ten years running up the recession episode, as a measure of trend growth. Figure 10 in the Annex compares the average path of real GDP per capita during a recession against the de-trended path of output.

- Third, we include a vector of macroeconomic controls including the four-quarter averages of the ratio of the current account to GDP, inflation, the central bank policy rate and a proxy for the output gap.[10] We control for these macroeconomic variables since we are interested in the *incremental* information for downturn severity conveyed by financial variables, over and above the standard macroeconomic variables.

4 Credit and the severity of recessions

4.1 Is it credit growth or the level of credit that matters?

A growing body of empirical research suggests that credit matters for both the probability and subsequent severity of downturns and crises. But is it a high level of indebtedness or rapid credit growth that is most closely associated with severe recessions? The motivation for the question is partly practical – which indicators are the most reliable and robust signal of future risks and vulnerability of the economy? But it might also shed some light on the relative plausibility of different transmission channels through which credit can amplify shocks during a recession.

Simple scatter plots suggests that a build-up of credit ahead of recessions is associated with worse downturns. Figure 3 compares the performance in real GDP per capita three years after the start of a recession against the level of credit to GDP ahead of a recession in panel (a) and against the three-year change in that ratio in the run-up to a recession in panel (b). The choice of the three-year horizon for the change in the credit to GDP ratio is broadly in line with that used elsewhere in the literature (King (1994); Flodén (2014)).[11] Both scatter plots indicate that there is a negative unconditional relationship between credit and GDP performance – countries where the

[10] We use a simple measure of the output gap: the deviation of GDP from a one-sided Hodrick-Prescott filter with a smoothing filter of 1600 (the widely accepted parameter for business cycle frequencies).

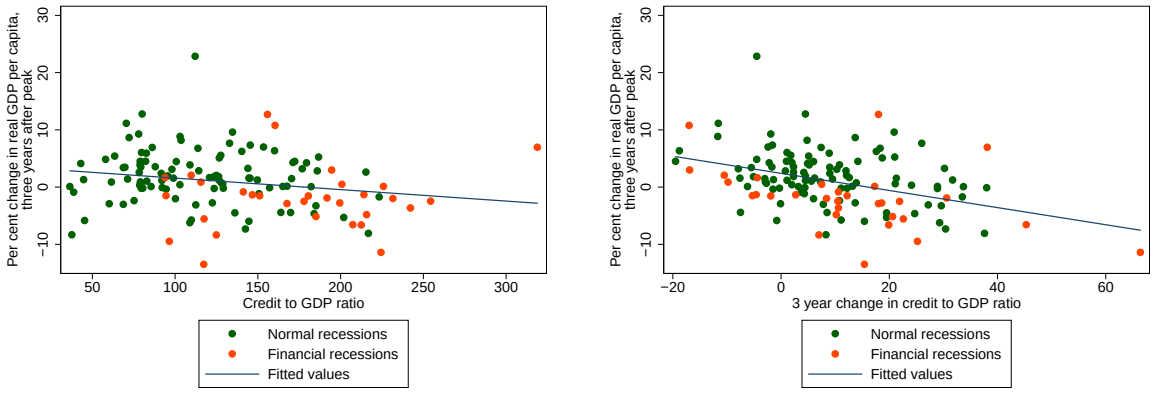
[11] Mian, Sufi, and Verner (2015) provide a more rigorous basis for this choice of horizon by using an autoregressive model to estimate the period over which the effect of a shock to debt on GDP persists.

level of private sector indebtedness was high or which had experienced significant credit growth experienced worse recessions.

Figure 3: Severity of a recession versus the level and growth of credit

(a) Total private credit to GDP ratio versus recession severity

(b) 3-year change in total private credit to GDP ratio versus recession severity



Sources: BIS, National Statistics, OECD, World Bank and authors' calculations.

Our econometric specification allows a robust assessment of this correlation, with appropriate controls. Table 2 shows the estimated relationship from the baseline specification in Section 3 between the change in the level of real GDP per capita three years after the start of a recession and either the credit to GDP ratio or the 3-year change in that ratio just before the recession began. It shows that, while both credit metrics have a negative relationship with output, only credit growth is a statistically and economically significant predictor of the loss in real GDP per capita.

This story remains once we include both measures in the same regression - does a higher level of indebtedness predict a more severe recession once we control for credit growth, and vice versa? Table 3 shows that in this horse race between the level and growth of credit, it is growth that wins. Indeed, the adjusted R-squared of this model is no higher than the model including only credit growth in Table 2, suggesting that the level of credit adds little extra information about future severity over and above credit growth.[12] The coefficient on the change in credit to GDP ratio is also economically significant, something which can be seen starkly in Figure 4 (a), which shows the marginal impact on the level of real GDP per capita of a 10pp higher increase in the credit to GDP ratio leading up to a recession. It shows that a 10pp increase in credit growth relative to GDP typically increases the severity of the recession in terms of lost GDP per capita by nearly 2

[12]The "credit gap" - the deviation in the credit to GDP ratio from a one-side Hodrick-Prescott filtered trend is another common indicator of a build-up in credit (Drehmann and Tsatsaronis (2014)). This variable has in practice been highly correlated with our 3-year change in credit to GDP variable over the bulk of our sample, hence adding it to our model adds little information above the recent change in the credit to GDP ratio.

Table 2: The level and growth of credit and severity of recession

	Change in real GDP per capita, three years after peak	
	Level of credit	Growth of credit
Credit to GDP ratio	-0.03	
	(-1.54)	
3 year change in credit to GDP ratio		-0.18***
		(-5.65)
Normal recession	1.70**	1.97***
	(2.68)	(4.75)
Financial recession	-0.44	-1.27
	(-0.29)	(-1.37)
Observations	130	130
Adjusted R-squared	0.27	0.43
RMSE	4.51	3.98
Fixed effects	Yes	Yes
Macro controls	Yes	Yes
GDP trend	Yes	Yes

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: The level and growth of credit and severity of recession

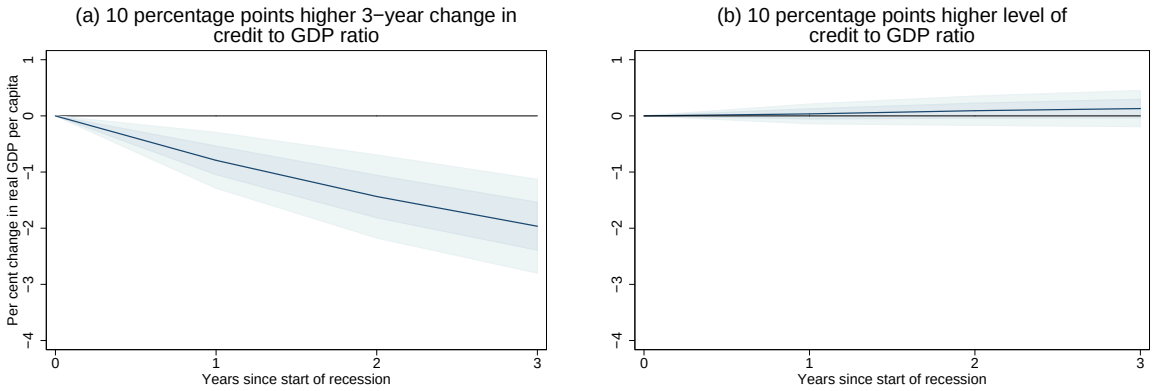
	Change in real GDP per capita		
	Year 1	Year 2	Year 3
Credit to GDP ratio	0.00	0.01	0.01
	(0.39)	(0.74)	(0.72)
3 year change in credit to GDP ratio	-0.08***	-0.14***	-0.19***
	(-2.85)	(-3.69)	(-4.51)
Normal recession	-2.36***	-0.06	2.09***
	(-11.85)	(-0.19)	(4.55)
Financial recession	-4.32***	-3.84***	-1.63
	(-8.63)	(-5.31)	(-1.58)
Observations	130	130	130
Adjusted R-squared	0.61	0.40	0.43
RMSE	2.26	3.01	3.99
Fixed effects	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes
GDP trend	Yes	Yes	Yes
P-value: Financial = Normal recession	0.01	0.00	0.02

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

percentage points after three years - a meaningful amount. By contrast, Figure 4 (b) shows that the effect of the level of credit being higher before a recession - for a given growth rate of credit - is negligible.

Figure 4: Marginal impact of credit on the level of real GDP per capita



Shaded areas represent the coefficient on credit +/- one and two standard deviations

Table 4: The role of credit in normal and financial recessions

	Change in real GDP per capita		
	Year 1	Year 2	Year 3
Normal recession * credit growth	-0.05*	-0.10***	-0.14***
	(-1.77)	(-2.92)	(-3.73)
Financial recession * credit growth	-0.12***	-0.21***	-0.27***
	(-4.55)	(-4.05)	(-4.01)
Normal recession * credit level	-0.00	0.01	-0.01
	(-0.16)	(0.44)	(-0.30)
Financial recession * credit level	0.01	0.02	0.04*
	(0.95)	(1.16)	(1.82)
Normal recession	-1.69	0.24	4.01*
	(-1.59)	(0.17)	(1.84)
Financial recession	-5.21**	-5.06*	-4.83*
	(-2.33)	(-1.85)	(-1.75)
Observations	130	130	130
Adjusted R-squared	0.62	0.42	0.46
RMSE	2.23	2.95	3.89
P-value: Financial = Normal recession	0.15	0.05	0.00
P-value: Financial = Normal recession (growth)	0.02	0.06	0.07
P-value: Financial = Normal recession (level)	0.33	0.35	0.03

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Consistent with the findings in Jordà, Schularick, and Taylor (2013), Table 3 indicates that reces-

sions associated with systemic banking crises are more severe than normal recessions.[13] However, it does not appear that the importance of credit growth in predicting more severe recessions is especially dependent on whether or not there was also a financial crisis. Table 4 interacts the level and growth of credit with an indicator variable for whether the recession was associated with a systemic banking crisis ("Financial") or not ("Normal"). The interaction terms indicate that higher credit growth predicts a more severe recession whether or not there is a banking crisis. Rapid credit growth before a recession may therefore lead to or amplify shocks to the real economy that are unrelated to sudden and systemic contractions in bank credit supply. The coefficients suggest that high credit growth predicts a larger loss in output for financial recessions than for normal ones, with the difference in the size of these effects statistically significant at the 5 or 10% level. By contrast, the coefficients on the level of credit remain small and generally statistically insignificant, with the positive coefficient on the level of credit in a financial recession in year three driven by one outlier.[14]

Further robustness checks are contained in Section 6, which show that the main findings are robust to a number of checks including the exclusion of particular time periods and countries from the sample (Figures 8 and 9), the exclusion of country fixed effects, macroeconomic controls and trend GDP growth (Table 9), and the inclusion of global average credit variables (Table 10).

One extension worth particular comment, however, is whether our results are sensitive to who is doing the borrowing. The existing literature has typically focussed on the role of household debt and mortgages in crises and severe recessions. Jordà, Schularick, and Taylor (2016), for instance, find that booms in lending used to finance property have been associated with particularly deep and prolonged recessions, while Mian, Sufi, and Verner (2015) show that increases in household and not corporate credit predict lower output growth over the medium term, unconditional on there being a recession. Table 5 shows, however, that rapid credit growth continues to be an important predictor of the severity of a recession whether we look at lending to non-financial companies (NFCs) or to households, suggesting that the role of lending to businesses should not be ignored. Our sample size is around two thirds of the size of that used in our baseline regressions with total credit, so some caution is warranted in drawing too much precision from these results.

[13] The difference between financial and normal recessions is smaller if we use the broader Reinhart and Rogoff definition of a banking crisis, which also includes non-systemic crises.

[14] That outlier is Ireland, which had a very high credit to GDP ratio before its recession in 2011 but whose level of GDP per capita was 7% higher three years after the start of the recession. This is the far right-most point in Figure 3(a).

Table 5: Sectoral credit and severity of recessions

	Change in real GDP per capita		
	Year 1	Year 2	Year 3
3 year change in household credit to GDP ratio	-0.09	-0.25***	-0.32***
	(-1.52)	(-3.39)	(-2.87)
Household credit to GDP ratio	-0.03	0.01	0.01
	(-0.90)	(0.30)	(0.28)
3 year change in NFC credit to GDP ratio	-0.14***	-0.17***	-0.21***
	(-3.56)	(-4.28)	(-3.68)
NFC credit to GDP ratio	0.05**	0.06**	0.09**
	(2.57)	(2.37)	(2.70)
Normal recession	-1.99***	0.22	2.18***
	(-8.36)	(0.49)	(3.54)
Financial recession	-4.81***	-4.71***	-2.58**
	(-10.44)	(-6.19)	(-2.41)
Observations	88	88	88
Adjusted R-squared	0.70	0.56	0.48
RMSE	2.15	2.59	3.50

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.2 Credit and productivity

The relationship between a build-up in credit before a recession and a more severe subsequent downturn is repeated for our range of other metrics of severity. Table 6 shows the relationship between credit and the change in output, unemployment and two different measures of labour productivity three years after the start of a recession.[15] Higher credit growth before a recession worsens outcomes for both unemployment and productivity during the downturn. A 10 percentage point increase in the credit to GDP ratio is associated with 0.5 percentage point higher unemployment rate and around a 1% lower level of labour productivity. As with GDP per capita, there is no statistically significant relationship between the level of credit and unemployment or labour productivity, once we control for credit growth.

Figure 5 also demonstrates that the dynamics of the relationship between credit and the severity of downturns differ, depending on what metric of severity we use. While we can explain much of the initial marginal impact of higher credit growth on output through changes in productivity in the first year or so of a recession, we do not see a significant relationship between pre-downturn

[15]We derived measures of labour productivity by dividing total real GDP by hours worked and by the number of employees. While the results for GDP and unemployment use quarterly data, we have used annual data on output per worker and hours due to more limited data availability. We have used the same recession dates in both sets of regressions.

credit growth and unemployment until later on in the recessionary period. Table 11 in Section 6 also demonstrates that this relationship between credit growth and unemployment is driven predominantly by financial recessions, while the relationship between between credit growth and the level of productivity is similar between normal and financial recessions.

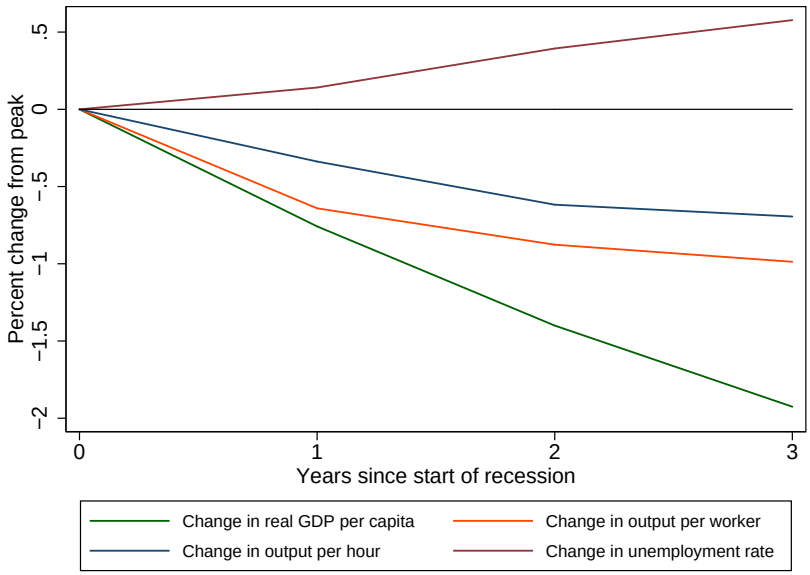
Table 6: The effect of credit growth on GDP, unemployment and productivity

	Change in level three years after start of recession			
	GDP	Unemployment	Output per worker	Output per hour
3 year change in credit to GDP ratio	-0.19***	0.06**	-0.10***	-0.07*
	(-4.51)	(2.41)	(-2.97)	(-2.01)
Credit to GDP ratio	0.01	-0.01	0.02	-0.01
	(0.72)	(-0.84)	(1.05)	(-0.35)
Normal recession	2.09***	1.50***	3.10***	4.02***
	(4.55)	(5.45)	(8.81)	(10.66)
Financial recession	-1.63	3.13***	1.55	3.71***
	(-1.58)	(4.20)	(1.56)	(3.35)
Observations	130	127	129	129
Adjusted R-squared	0.43	0.61	0.50	0.58
RMSE	3.99	1.98	3.65	3.93

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 5: Marginal impact of a 10 percentage points higher 3-year change in the credit to GDP ratio



This relationship between credit and low productivity during recessions could plausibly reflect the impact of credit booms on either the demand or supply-side of the economy. Models that emphasise the impact of debt deleveraging on demand during crises, such as Korinek and Simsek (2016)

and Eggertsson and Krugman (2012), may still affect *observed* productivity if labour hoarding mechanisms are also in play. Firms may employ more workers than they need during a recession, lowering observed productivity, because there are fixed costs in hiring and firing employees and firms expect demand to pick up in the future. However, in this instance, one would expect the relationship between credit and productivity to fade gradually over time as firms are unlikely to want to maintain an excessively large workforce in the medium term. In fact, high credit growth predicts a weaker level of productivity even three years after the start of a downturn.

The persistence of the effect of credit growth on the level of productivity suggests that it is plausible that there is some role for supply-side effects. That may reflect the fact that periods of low demand following credit booms are often associated with hysteresis effects, reducing an economy's long-run supply capacity - for instance, credit growth appears associated with persistent increases in unemployment during recessions, particularly those associated with a banking crisis. In other words, prolonged effects on demand may beget a reduction in supply. These hysteresis effects in the labour market may help to explain why the relationship between credit booms and unemployment is strongest for systemic banking crisis, which are typically accompanied by particularly deep recessions. Alternatively, credit booms may be associated with a more direct impact on potential productivity growth. One potential supply-side channel consistent with that is the disruption of the efficient pre- or post-crisis allocation of capital to the most productive sectors of the economy, as in Franklin, Rostom, and Thwaites (2015), Borio, Kharroubi, Upper, and Zampolli (2016) and Gorton and Ordoñez (2016).

4.3 Threshold and interaction effects

The results presented in the previous section assumed that the relationship between credit and the severity of a recession is linear. But the relationship may be particularly pronounced for very high levels or growth rates of credit. For instance, models such as Eggertsson and Krugman (2012) predict that high levels of debt would amplify a downturn if households and firms are credit constrained and so a shock to credit conditions necessitates a prolonged period of deleveraging - these credit constraints are potentially more likely to bind only when levels of debt are particularly high.

While the level of credit has no relationship with severity on average, we investigate whether there is a threshold above which higher leverage does become associated with more severe recessions.

While Cecchetti, Mohanty, and Zampolli (2011) have investigated such thresholds for the effect of the level of credit on GDP growth more generally, this has been less well explored in the literature on the severity of recessions. In addition, we examine whether there are interaction effects between leverage and credit growth - does fast credit growth predict a worse recession only when leverage is high, and vice versa?

Threshold effects

First, we examine whether there is a threshold for the credit to GDP ratio above which recessions become more severe. We do this by modifying our baseline specification in Section 3 to incorporate such a threshold:

$$Y_{t(r)+h,j} = \bar{\alpha_N}^h N + \bar{\alpha_F}^h F + \sum_{j=1}^{J-1} \alpha_j^h + \beta_{level-}^h \left(X_{j,t}^{level} - \bar{X}^{level}\right) I(X_{j,t}^{level} < \gamma) + \beta_{level+}^h \left(X_{j,t}^{level} - \bar{X}^{level}\right) I(X_{j,t}^{level} \geq \gamma) +$$

$$\beta_{growth}^h (X_{j,t}^{growth} - \bar{X}^{growth}) + \zeta^h trend_{j,t} + \theta controls_{j,t} + \epsilon_{j,t} \;\; \forall h = 1...12 \tag{3}$$

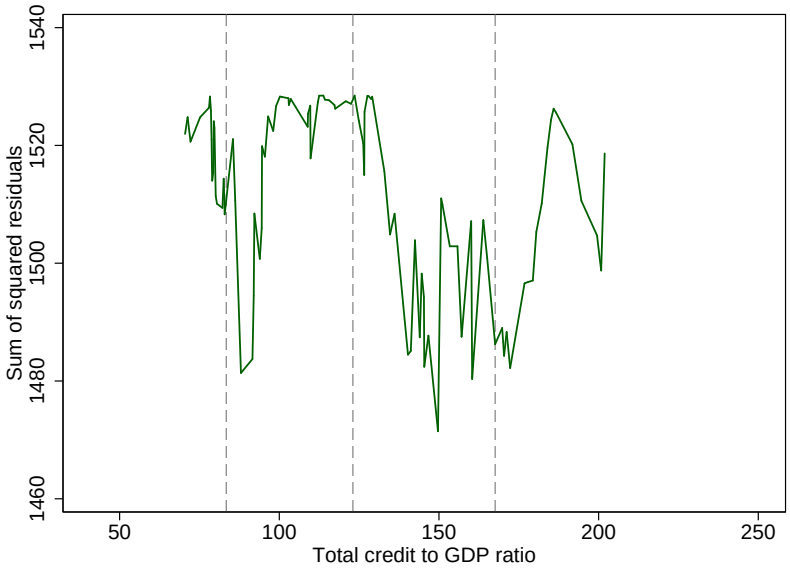
where $I(.)$ is an indicator function that equals one when the credit to GDP ratio is above γ and zero otherwise, and vice versa. In effect, this specification allows the relationship between indebtedness and the severity of a recession to vary depending on whether the level of debt is above or below a given threshold γ.

The threshold γ is unknown. Following Cecchetti, Mohanty, and Zampolli (2011) and Hansen (1999), we look for a suitable threshold by estimating equation (3) over different values of γ, the credit to GDP ratio, in our sample. Our choice of threshold is determined by the value of γ which minimises the sum of squared residuals (SSR). And the statistical significance of that choice of threshold over other variants - i.e. how confident can we be that that value of γ is the best one - is given with a likelihood test comparing the SSR of the chosen threshold against that of other potential choices of threshold.[16] To ensure that a sufficient number of recessions exist both above and below the threshold, we restrict the value of the threshold to lie above the 10th and below

[16]The likelihood ratio test statistic is calculated as $LR(\gamma) = \frac{SSR(\gamma) - SSR(\hat{\gamma})}{\hat{\sigma}}$. The confidence interval for γ for a confidence level $1-\alpha$ is the set of values of γ that satisfy $LR(\gamma) \leq c(\alpha) = -2log(1-\sqrt{1-\alpha})$, see Hansen (1999).

the 90th percentiles of the credit to GDP ratios observed ahead of recessions in our sample. For simplicity, we show only our results for the loss in real GDP per capita three years after the start of a recession, but the results are comparable at other horizons.

Figure 6: Sum of squared residuals



Notes: The dashed vertical lines show the 25th, 50th and 75th percentiles of the distribution of credit to GDP ratios observed ahead of the recessions in our sample.

Figure 6 shows the fit of this threshold model is minimised when the threshold takes the value of 149.7%. Table 7, however, shows that the coefficients on both the high and low level of credit to GDP ratio are similar and both statistically insignificant from zero. Moreover, we cannot be confident that this threshold value is the best-fitting choice of threshold - the difference between the fit of the model with this threshold is statistically insignificant from a model with any other threshold value. In other words, there is no one threshold for the level of the credit to GDP ratio that produces a model that fits significantly better than any other. These results therefore do not support the notion that higher levels of credit predict worse recessions once the level of debt is above a certain level.

Interaction effects

Next we consider whether there are any interaction effects between the growth and level of credit. For instance, is the relationship between credit growth and severity stronger for highly indebted economies than ones where leverage is low? We do this by interacting the coefficient on credit

Table 7: Threshold effects of the level of credit

	Change in real GDP per capita		
	Year 1	Year 2	Year 3
3 year change in credit to GDP ratio	-0.08***	-0.14***	-0.20***
	(-2.91)	(-3.70)	(-5.23)
Credit to GDP ratio (below 150)	0.02	0.02	0.03
	(1.32)	(1.01)	(1.48)
Credit to GDP ratio (above 150)	0.01	0.01	0.02
	(0.89)	(0.99)	(1.26)
Normal recession	-2.28***	-0.65	-0.06
	(-2.98)	(-0.46)	(-0.04)
Financial recession	-4.24***	-4.44***	-3.79***
	(-4.97)	(-3.60)	(-2.99)
Observations	130	130	130
Adjusted R-squared	0.62	0.40	0.44
RMSE	2.23	3.01	3.96

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

growth with an indicator variable for whether the level of credit is 'high' or 'low', as is shown in equation (4) below. And, vice versa, we examine whether the coefficient on the level of credit is any different if credit growth is high or low. We choose the threshold for the high and low level and growth of credit using the same procedure as in the previous section. Namely, we search for the value of the threshold in the data that maximises the fit of the model.

$$Y_{t(r)+h,j} = \bar{\alpha_N}^h N + \bar{\alpha_F}^h F + \sum_{j=1}^{J-1} \alpha_j^h + \beta_{level-}^h \left(X_{j,t}^{growth} - \bar{X}^{growth}\right) I(X_{j,t}^{level} < \gamma) + \beta_{level+}^h \left(X_{j,t}^{growth} - \bar{X}^{growth}\right) I(X_{j,t}^{level} \geq \gamma)$$

$$+ \beta_{growth}^h (X_{j,t}^{level} - \bar{X}^{level}) + \zeta^h trend_{j,t} + \theta controls_{j,t} + \epsilon_{j,t} \quad \forall h = 1...12 \tag{4}$$

First, is the relationship between credit growth and severity dependent on the leverage of the private sector? The choice of the value for the level of credit as a threshold that maximises the fit of the model is 163.9%. Table 8 shows the relationship between the pre-recessionary growth rate of credit and severity when the credit to GDP ratio is above and below this threshold. It shows that when private sector leverage is high, a period of rapid credit growth is associated with more severe recessions than when leverage is low. A 10 percentage point higher credit growth is associated with a 2.5% lower level of GDP per capita three years after the start of a recession when

the credit to GDP ratio is above the threshold, but with only a 1.5% lower level of GDP per capita when the level of credit is below the threshold (Figure 7). The two coefficients on credit growth are statistically significantly different from one another at the 10% level for the impact one year into a recession, but insignificantly different for horizons further out. There does not, however, appear to be a comparable relationship when we examine whether the effect of the level of credit depends on whether credit growth is above or below a certain threshold (see Table 12 in Section 6).

Table 8: Interaction of credit growth and the level of credit

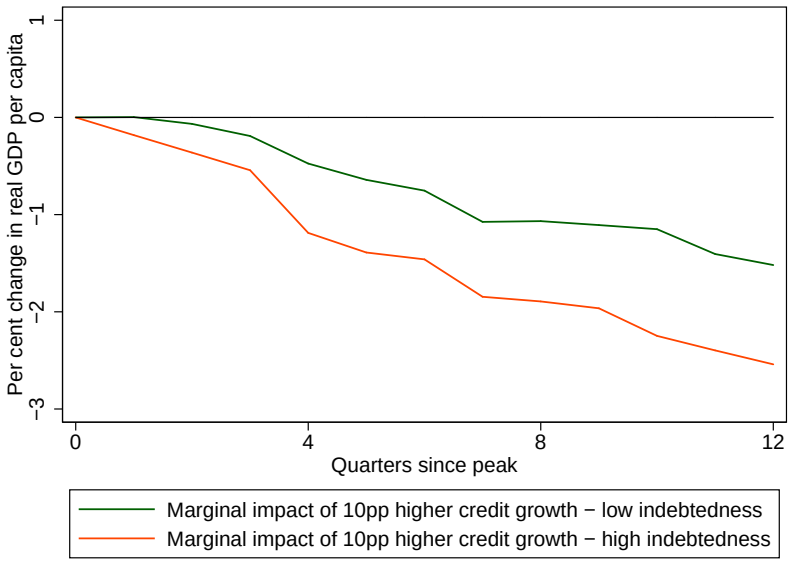
	Change in real GDP per capita		
	Year 1	Year 2	Year 3
3-year change in credit to GDP ratio (low indebtedness)	-0.05	-0.11**	-0.15***
	(-1.59)	(-2.44)	(-2.87)
3-year change in credit to GDP ratio (high indebtedness)	-0.12***	-0.19***	-0.25***
	(-3.33)	(-3.78)	(-4.43)
Total private credit to GDP ratio	0.01	0.02	0.02
	(1.14)	(1.29)	(1.21)
Normal recession	-2.38	-1.25	-1.21
	(-1.26)	(-0.45)	(-0.38)
Financial recession	-4.25*	-4.93	-4.79
	(-2.05)	(-1.56)	(-1.37)
Observations	130	130	130
Adjusted R-squared	0.63	0.42	0.44
RMSE	2.20	2.96	3.94
P-value: low indebtedness coefficient = high indebtnedness	0.07	0.15	0.18

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Therefore it appears that the level of credit before a recession matters for the severity of the downturn only when it is accompanied by a credit boom. This suggests that high levels of debt do not amplify the severity of recessions by themselves; rather, one requires a combination of high levels of leverage with some other shock in order to produce deep and prolonged recessions. Although this could reflect the fact that high levels of debt are associated with the occurrence of banking crisis, and - as shown earlier in Table 4 - credit growth has a larger effect for financial recessions, this interaction effect holds even if we drop financial crises from our sample (Table 13 in Section 6). By contrast, periods of fast credit growth appear to be associated with more severe recessions whether or not the level of credit is elevated. This suggests that debt deleveraging may not be the only mechanism through which credit can amplify downturns, and other mechanisms may be at play.

Figure 7: Marginal impact of 10pp higher credit growth on the level of real GDP per capita for high and low levels of credit



5 Conclusion

Across our sample of 130 recessions, it is the change in the total private credit to GDP ratio rather than the level that is the more robust and economically meaningful predictor of recession severity. That applies to 'normal' recessions as well as those associated with systemic banking crises. It also applies in terms of lost output but also changes in unemployment and productivity. The fact that recessions preceded by credit booms appear associated with persistent losses in the level productivity suggests that there may be some role for supply-side transmission channels from frothy credit to severe recessions, as well as debt deleveraging channels associated with a reduction in aggregate demand.

These results suggest - to the extent that the future mirrors the past - that rapid credit growth is a useful signal that the risks associated with the financial cycle amplifying real economy shocks have become elevated. Of course this does not mean that the level of credit should be ignored - and we find some support that credit booms in highly leveraged economies tend to predict worse recessions than when indebtedness is low. But given the difficulties in establishing what might be considered a 'sustainable' or 'equilibrium' level of credit, credit growth is found to be the more robust warning indicator and one that should not be ignored.

6 Annex

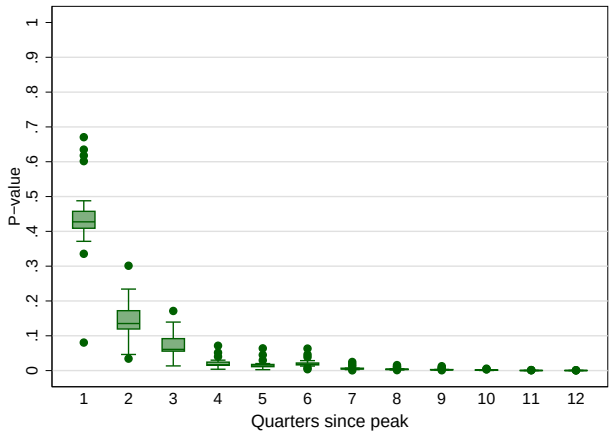
6.1 Sensitivity to countries and time periods

Using our baseline model, Figure 8 shows the sensitivity of the statistical significance of the coefficient on the 3-year change in the credit to GDP ratio to dropping from our sample of recessions individual countries or individual 5-year periods (e.g. 1960-64,1975-79...). The box plot at each horizon of a recession corresponds to the range of p-values for the coefficient on the change in credit obtained when either a country or time period is dropped, where a value of less than 0.05 indicates that the coefficient is statistically significant at at least the 5% level. The size of the box corresponds to the interquartile range (IQR) of p-values. The lines - or whiskers - correspond to p-values within 1.5 times the IQR above (below) the upper (lower) quartile, stopping at the largest (smallest) value. If a p-value falls outside of this range, it is represented by a dot.

Figure 8 (a) shows that the statistical significance of the correlation between credit growth and the loss in real GDP per capita is insensitive to the exclusion of particular countries, except for the first few quarters of a recession. Similarly, the statistical significance of credit growth is not sensitive to the omission of particular 5-year time periods in Figure 8 (b). The coefficient on credit growth also remains statistically significant if we omit the entire period associated with the financial crisis.

Figure 8: Sensitivity of p-values for coefficient on change in credit to GDP ratio to dropping individual countries or 5-year time periods

(a) Country exclusions



(b) 5-year periods exclusions

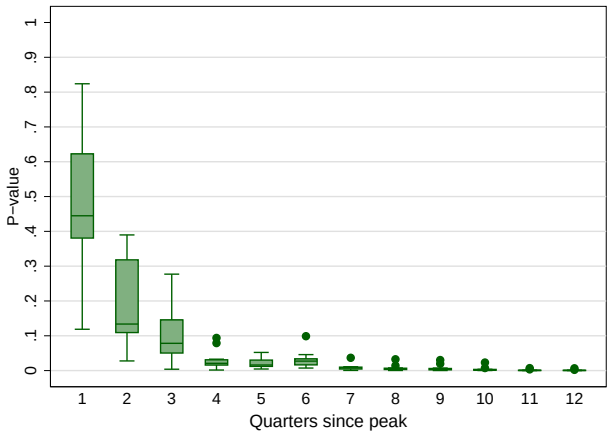
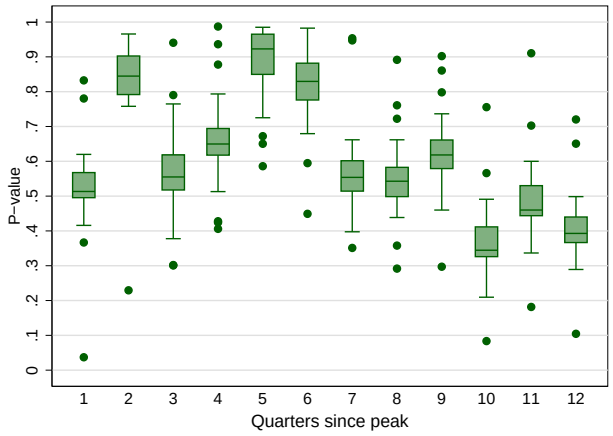


Figure 9 repeats this exercise but for the coefficients on the level of credit in our baseline specification. It shows that the statistical significance of the coefficient on the level of credit varies

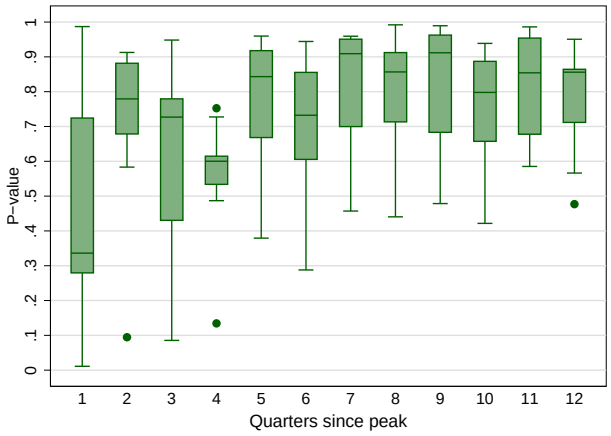
more than that on credit growth with the omission of particular countries or time periods, but in no instance is the level of credit consistently statistically significant. This reiterates our finding that it is the change rather than the level of the credit to GDP ratio that is the robust predictor of recession severity.

Figure 9: Sensitivity of p-values for coefficient on the level of the credit to GDP ratio to dropping individual countries or 5-year time periods

(a) Country exclusions



(b) 5-year period exclusions



6.2 Other robustness checks

Table 9: Excluding fixed effects, macro controls and trend growth

	Change in real GDP per capita three years after peak				
	(1)	(2)	(3)	(4)	(5)
Credit to GDP ratio	0.02**	0.02	0.02	0.01	-0.00
	(2.13)	(1.16)	(1.24)	(0.72)	(-0.01)
3 year change in credit to GDP ratio	-0.17***	-0.16***	-0.19***	-0.19***	-0.16***
	(-6.61)	(-5.10)	(-4.86)	(-4.51)	(-4.01)
Normal recession	1.85***	1.68***	2.20***	2.09***	2.27***
	(3.54)	(3.12)	(5.78)	(4.55)	(5.51)
Financial recession	-1.63*	-1.29	-1.67*	-1.63	-1.54
	(-1.83)	(-1.52)	(-1.80)	(-1.58)	(-1.31)
Observations	131	130	131	130	130
Adjusted R-squared	0.34	0.32	0.46	0.43	0.40
RMSE	4.34	4.33	3.94	3.99	4.09
Fixed effects	No	No	Yes	Yes	Yes
Macro controls	No	Yes	No	Yes	Yes
GDP trend	Yes	Yes	Yes	Yes	No

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Controlling for global credit

	Change in real GDP per capita		
	Year 1	Year 2	Year 3
Credit to GDP ratio	0.01	0.02	0.02
	(0.96)	(1.13)	(1.25)
3 year change in credit to GDP ratio	-0.05*	-0.13***	-0.19***
	(-1.88)	(-3.06)	(-4.30)
Normal recession	-2.49***	-0.14	2.11***
	(-12.14)	(-0.37)	(4.01)
Financial recession	-3.95***	-3.55***	-1.03
	(-7.14)	(-4.63)	(-0.89)
Level of global credit	-0.02	-0.03	-0.05
	(-1.07)	(-0.94)	(-1.41)
Global credit growth	-0.18***	-0.08	-0.03
	(-4.42)	(-0.90)	(-0.26)
Observations	124	124	124
Adjusted R-squared	0.69	0.41	0.43
RMSE	2.06	3.02	4.06

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11: The effect of credit growth on unemployment and productivity during financial and normal recessions

	Change in level three years after start of recession			
	GDP	Unemployment	Output per worker	Output per hour
Normal recession * credit growth	-0.14***	0.02	-0.09**	-0.07*
	(-3.73)	(1.53)	(-2.16)	(-1.84)
Financial recession * credit growth	-0.27***	0.12***	-0.11**	-0.08
	(-4.01)	(3.32)	(-2.29)	(-1.59)
Normal recession * credit level	-0.01	-0.00	0.01	-0.00
	(-0.30)	(-0.27)	(0.51)	(-0.06)
Financial recession * credit level	0.04*	-0.02	0.02	-0.01
	(1.82)	(-1.63)	(1.39)	(-0.57)
Normal recession	4.01*	1.58	2.24	4.98
	(1.84)	(1.60)	(0.79)	(1.69)
Financial recession	-4.83*	5.09**	-0.33	5.96*
	(-1.75)	(2.48)	(-0.13)	(2.03)
Observations	130	127	129	129
Adjusted R-squared	0.46	0.64	0.49	0.57
RMSE	3.89	1.89	3.68	3.97
P-value: F = N recession (growth)	0.07	0.02	0.61	0.80
P-value: F = N recession (level)	0.03	0.15	0.71	0.74

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Threshold effects

	Change in real GDP per capita		
	Year 1	Year 2	Year 3
Credit to GDP ratio (low credit growth)	0.00	0.00	0.00
	(0.02)	(0.25)	(0.21)
Credit to GDP ratio (high credit growth)	0.01	0.02	0.03
	(1.00)	(1.49)	(1.50)
3 year change in credit to GDP ratio	-0.11***	-0.21***	-0.29***
	(-3.66)	(-4.35)	(-4.59)
Normal recession	-0.84	1.37	2.19
	(-0.54)	(0.55)	(0.76)
Financial recession	-2.87	-2.54	-1.70
	(-1.68)	(-0.98)	(-0.62)
Observations	130	130	130
Adjusted R-squared	0.62	0.42	0.45
RMSE	2.24	2.94	3.90
P-value: low indebtedness coefficient = high indebtnedness	0.11	0.05	0.05

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Interaction effects - no financial crises

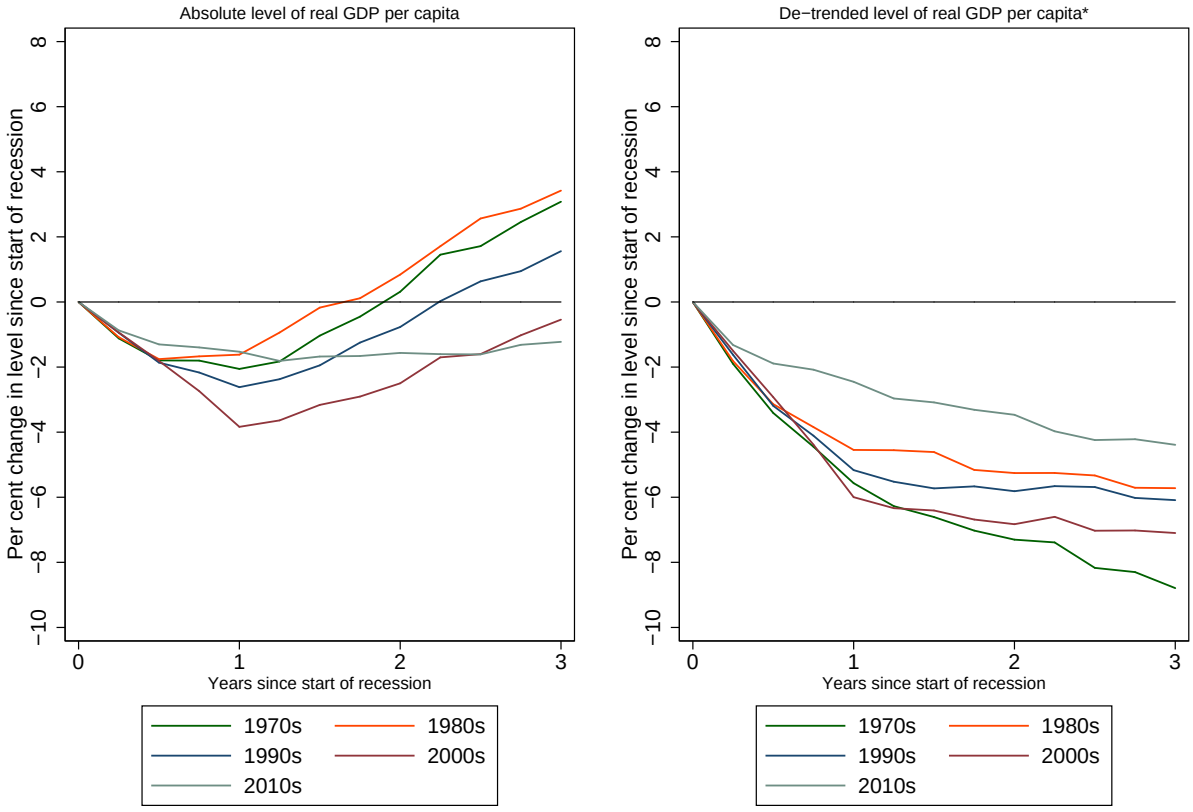
	Change in real GDP per capita		
	Year 1	Year 2	Year 3
3-year change in credit to GDP ratio (low indebtedness)	-0.02	-0.05	-0.09
	(-0.74)	(-1.38)	(-1.64)
3-year change in credit to GDP ratio (high indebtedness)	-0.11	-0.16**	-0.24***
	(-1.68)	(-2.70)	(-3.85)
Total private credit to GDP ratio	0.00	0.01	0.00
	(0.39)	(0.56)	(0.18)
Normal recession	-1.43	-0.20	1.20
	(-0.73)	(-0.06)	(0.28)
Financial recession			
Observations	99	99	99
Adjusted R-squared	0.55	0.23	0.39
RMSE	2.29	2.98	3.97
P-value: low indebtedness coefficient = high indebtnedness	0.13	0.04	0.06

Includes controls for country-fixed effects, macroeconomic variables and trend GDP growth.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6.3 Influence of trend on the severity of a recession

Figure 10: Average change in the absolute and de-trended level of real GDP per capita from the start of a recession



*Trend GDP growth is defined as the average growth rate over the past 10 years

A Data coverage

Table 14: Summary of countries in sample and averages of measures of credit at peak in real GDP

Country	Total private credit to GDP ratio	3-year change in credit to GDP ratio
Australia	83.2	6.6
Austria	91.6	9.0
Belgium	109.5	11.6
Canada	142.1	15.5
Czech Republic	77.8	0.0
Denmark	167.3	11.2
Finland	107.6	8.2
France	125.6	10.1
Germany	96.3	3.7
Greece	55.6	5.7
Hong Kong	148.3	11.5
Ireland	156.8	23.2
Israel	118.7	6.5
Italy	81.6	4.3
Japan	184.3	-4.2
Korea	106.7	11.9
Netherlands	125.6	12.7
Norway	166.7	10.5
New Zealand	95.0	10.7
Portugal	148.3	20.4
Singapore	106.1	5.7
Spain	133.6	10.1
Sweden	164.8	17.7
Switzerland	158.5	5.0
UK	98.8	14.3
USA	115.1	6.6
Total	122.5	9.4

Table 15: Summary of data sources

Variable	Data sources	Frequency	Notes
Real GDP	OECD and national statistics websites	Q	Older data for Germany, Greece and Hong Kong use the OECD's expenditure components.
Population	World Bank and National Statistics	A	Annual data are interpolated cubicly to generate quarterly data.
Unemployment	OECD and Global Financial Database (GFD)	Q	
Hours worked	Total Economy Database (TED)	A	
Output per hour	TED	A	
Private sector credit	Bank for International Settlements (BIS)	Q	
Central bank policy rates	GFD	Q	Market overnight interest rates are used where data on policy rates are unavailable for inappropriate
Long-term government bond yields	GFD, central bank database	Q	10-year government bond yields where available. Where there are no 10-year bonds in issue, the 5-year bond yield is used plus the history 10-5 year spread.
Mortgage rates	GFD	Q	Mortgage rates on new business
Equity prices	GFD and OECD	Q	
Current account	OECD, Datastream, World Bank and International Historical Statistics	Q/A	The latest data are drawn from the OECD and datastream. Where data become unavailable, annual data are sourced from the World Bank or, failing, that from International Historical Statistics. Quarterly data are generated by interpolating these annual data.
Inflation	GFD	Q	Consumer price indices
House prices	OECD, BIS and Dallas Federal Reserves	Q	
Banking crises	Laeven and Valencia (2012)	A	

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