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Abstract

Using data on 14 advanced countries between 1870 and 2008 we document two key facts of the modern business cycle: relative to typical recessions, financial crisis recessions are costlier, and more credit-intensive expansions tend to be followed by deeper recessions (in financial crises or otherwise) and slower recoveries. We use local projection methods to condition on a broad set of macro-economic controls to study how past credit accumulation impacts key macro-economic variables such as output, investment, lending, interest rates, and inflation. The facts that we uncover lend support to the idea that financial factors play an important role in the modern business cycle.

ALMOST ALL LANDMARK EVENTS in macro-economic history have been associated with a financial crisis. Students of such disasters have often identified excess credit as the "Achilles heel of capitalism," as James Tobin (1989) put it in his review of Hyman Minsky's book *Stabilizing an Unstable Economy*. Ironically, while the largest credit boom in history engulfed Western economies, the notion that financial factors influence the real economy faded out of macro-economic thinking. The warning signs of increased leverage in the run-up to the 2008 crisis were largely ignored.

This paper uses the lens of macro-economic history and builds on our earlier work to present a sharper picture of the role of credit in the business cycle. A primary challenge going forward is to redesign monetary and financial regimes to mitigate systemic crises (Turner 2009). Our results also add clarity at a time when it is still being argued that "[e]mpirically, the profession has not settled the question of how fast recovery occurs after financial recessions" (Brunnermeier and Sannikov 2012) and when, beyond academe, political debate rages over what the recovery "ought" to look like. We thus engage a broad new agenda in empirical macroeconomics and history that seeks to better understand the role of financial factors in macro-economic outcomes.[1]

We argue that credit plays an important role in shaping the business cycle, notably the intensity of recessions as well as the likelihood of financial crisis. This is consistent with the aftermath of the Great Recession: countries with larger credit booms in the run-up to the 2008 collapse (such as the United Kingdom, Spain, the United States, the Baltic States, and Ireland) saw more sluggish recoveries than economies that went in with smaller credit booms (like Germany, Switzerland, and the Emerging Markets).[2] The data support the idea that financial factors play an important role in the modern business cycle, as exemplified in the work of Fisher (1933), Minsky (1986), Bernanke and Gertler (1990)—or, more recently, Battacharya et al. (2011), Adrian and Shin (2012), Eggertsson and Krugman (2012), or Brunnermeier, Eisenbach, and Sannikov (2012), for example. Increased leverage raises the vulnerability of economies to shocks; procyclical prices can lead to debt-deflation pressures; rising leverage can lead to more pronounced confidence shocks and expectational swings; financial accelerator effects are also likely to be stronger when balance sheets are larger. Such effects could be more pronounced in a systemic crisis, due to banking failures, asset price declines, and expectational shifts that are bigger and more "coordinated." Disentangling all of these potential propagation mechanisms is beyond the scope of this paper.

Our focus is on the large-scale empirical regularities. We begin with descriptive statistics for 140 years of history across 14 countries. We date business cycle upswings and downswings consistently across countries, using the Bry and Boschan (1971) algorithm. We then look at real and financial aggregates across these episodes. To allow comparisons over different historical epochs, we differentiate between four eras of financial development, as in Schularick and Taylor (2012).

Next, we turn to the much-debated question: Are recessions following financial crises different? Cerra and Saxena (2008) find output losses in the range of 7.5% of GDP over 10 years after a crisis. Reinhart and Rogoff (2009a, Reinhart and Rogoff 2009b) calculate that the historical average of peak-to-trough output declines following crises are about 9%. Our results are similar. After 5 years, the financial-crisis recession path of real GDP per capita is about 5% lower than the normal-recession path.

But we can go further and show how a large build-up of credit makes matters worse, in normal as well as financial recessions. We construct a measure of “excess credit” build-up during the previous boom: the rate of change in the ratio of bank loans to GDP, in deviation from its mean, and calculated from the previous trough to the subsequent peak. Then we correlate this measure with output declines in the recession and recovery phase. We document, to our knowledge for the first time, that throughout a century or more of modern economic history in advanced countries, a close relationship has existed between the build-up of credit during an expansion and the severity of the subsequent recession, whether the recession is a normal or a financial-crisis recession. These findings of meaningful and systematic differences among “unconditional” output-path forecasts provide our first set of benchmark results.

Since it appears that the economic costs of financial crises can vary considerably depending on the credit built up during the previous expansion phase, these unconditional calculations raise a question: are the observed effects of credit on outcomes proxying for omitted information about the economy? As a more formal approach, using the local projection (LP) methods of Jordà (2005), we track the effects of excess credit on the path of seven key macro-economic variables for up to 5 years after the beginning of the recession. This richer dynamic specification shows how excess credit shapes the recovery path responses of other macro-economic variables. Indeed, we find large and systematic variations in outcomes such as investment, lending, interest rates, inflation, and the current account. These effects are somewhat stronger in recession episodes that coincide with financial crises, but remain clearly visible in garden-variety recessions. A variety of robustness checks lend support to these findings.

To put the results to use, we examine what our estimated models predict following the increase in credit that the U.S. economy saw in the expansion years after the 2001 recession until 2007. The subsequent predicted financial crisis recession path largely coincides with the actual observed path. Both are far below that of a normal recession, but consistent with the historical pattern of previous financial crises that followed similar credit build-ups.

Summarizing, the two important stylized facts about the modern business cycle that emerge are: first, financial-crisis recessions are more painful than normal recessions, and second, the credit intensity of the expansion phase is closely associated with the severity of the recession phase for both types of recessions. As the title of our paper suggests—credit bites back. Even though this relationship is strongest when the recession coincides with a systemic financial crisis, it can also be detected in "normal" business cycles, suggesting a deeper and more pervasive empirical regularity.

1. THE BUSINESS CYCLE IN HISTORICAL CONTEXT

The data set used in this paper covers 14 advanced economies over the years 1870–2008 at annual frequency. The countries included are the United States, Canada, Australia, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom, representing an overwhelming share of advanced economy GDP in the sample period.

For each country, we have assembled national accounts data on nominal GDP and real GDP per capita. We have also collated data on price levels and inflation, investment and the current account, as well as financial data on domestic bank loans, and short- and long-term interest rates on government securities (usually 3 months tenor at the short end, and 5 years at the long end). For most indicators, we relied on data from Schularick and Taylor (2012) and Jordà, Schularick, and Taylor (2011). The latter is also the source for the definition of "normal recessions" and recessions that coincided with financial crises, or "financial-crisis recessions." (For brevity, we often refer to these two cases as "normal" and "financial.") Our event classification for the 1870–1960 period follows the same definition of "systemic" banking crisis in Laeven and Valencia (2008) for the post-1960 period, maintaining consistency with contemporary approaches.

1.1 The Chronology of Turning Points in Economic Activity

Most countries do not have agencies that determine turning points in economic activity and even those that do have not kept records that reach back to the nineteenth century. Following Jordà, Schularick, and Taylor (2011), we use the Bry and Boschan (1971) algorithm, the closest algorithmic interpretation of the NBER's definition of recession.[3] Using *real GDP per capita* data in levels, a variable that generally trends upward over time, the algorithm looks for local minima. Each minimum is labeled as a trough and the preceding local maximum as a peak.[4]

In addition, we sorted recessions into two types, those that were associated with financial crises and those that were not, as described above. The resulting chronology of business cycle peaks is shown in Table 1, where "N" denotes a normal peak, and "F" denotes a peak associated with a systemic financial crisis. There are 298 peaks identified in this table over the years 1870–2008 in the 14-country sample. However, in later empirical analysis the usable sample size will be curtailed somewhat, in part because we exclude the two world wars, and still more on some occasions because of the limited available span for relevant covariates.

Table 1. Business Cycle Peaks

AUS	N	1875	1878	1881	1883	1885	1887	1889	1896	1898	1900	1904	1
		1913	1926	1938	1943	1951	1956	1961	1973	1976	1981		
	F	1891	1894	1989									
CAN	N	1871	1877	1882	1884	1888	1891	1894	1903	1913	1917	1928	1
		1947	1953	1956	1981	1989	2007						
	F	1874	1907										
CHE	N	1875	1880	1886	1890	1893	1899	1902	1906	1912	1916	1920	1
		1939	1947	1951	1957	1974	1981	1990	1994	2001			
	F	1871	1929	2008									
DEU	N	1879	1898	1905	1913	1922	1943	1966	1974	1980	1992	2001	
	F	1875	1890	1908	1928	2008							
DNK	N	1870	1880	1887	1911	1914	1916	1923	1939	1944	1950	1962	1
		1979	1987	1992									
	F	1872	1876	1883	1920	1931	2007						
ESP	N	1873	1877	1892	1894	1901	1909	1911	1916	1927	1932	1935	1
		1944	1947	1952	1958	1974	1980	1992					

Notes

"N" denotes a normal business cycle peak; "F" denotes a peak associated with a systemic financial crisis. AUS = Australia, CAN = Canada, CHE = Switzerland, DEU = Germany, DNK = Denmark, ESP = Spain, FRA = France, GBR = United Kingdom, ITA = Italy, JPN = Japan, NLD = The Netherlands, NOR = Norway, SWE = Sweden, USA = United States. We use crisis dates in Jordà, Schularick, and Taylor (2011) to classify nearby peaks in real GDP per capita identified with the Bry and Boschan (1971) algorithm as either normal or financial. This explains the differences between Table 1 in that paper and the dates reported in this table. See text.

1.2 Four Eras of Financial Development and the Business Cycle

To better understand the role of credit and its effects on the patterns of recessions, we examine the cyclical properties of the economies in our sample. We differentiate between four eras of financial development, as in Schularick and Taylor (2012).

The period before World War II was characterized by a relatively stable ratio of loans to GDP in the advanced countries, with credit and economic growth moving by and large in sync. Within that early period, it is worth separating out the interwar period since, in the aftermath of World War I, countries on both sides of the conflict temporarily suspended convertibility to gold. Despite the synchronicity of lending and economic activity before World War II, both the gold standard and the interwar era saw frequent financial crises, culminating in the Great Depression.[5]

The regulatory architecture of the Depression years, and the new international monetary order agreed at the 1944 Bretton Woods conference, buttressed financial stability. An oasis of calm appeared: no countries in our sample experienced a financial crisis until the 1970s. After the end of the Bretton Woods system, credit began to explode and crises returned. In 1975, the ratio of financial assets to GDP was 150% in the United States; by 2008 it was 350% (Economic Report of the President 2009). In the United Kingdom, the financial sector's balance sheet reached a nadir of 34% of GDP in 1964; by 2007 it had climbed to 500% (Turner 2010). In our sample, the ratio of bank loans to GDP almost doubled since the 1970s (Schularick and Taylor 2012). Perhaps not surprisingly, financial crises returned, culminating in the 2008 global financial crisis.

We begin by summarizing the salient properties of the economic cycle for the countries in these eras. We calculate several cyclical measures that we apply to the time series of real GDP per capita and to lending activity as measured by our (CPI-deflated) real loans per capita variable: (i) the peak-to-trough/trough-to-peak percent change, which we denominate as the *amplitude* of the recession/expansion cycle; (ii) the ratio of amplitude over duration, which delivers a per period rate of change and which we denominate *rate*; and, for real GDP per capita only, (iii) the *duration* of recession/expansion episodes in years. Table 2 summarizes these measures.

Table 2. Cyclical Properties of Output and Credit in Four Eras of Financial Development

	Real GDP per capita growth (per year)				Real Loans per capita growth (per year)			
	Pre-WWI	Interwar	BW	Post-BW	Pre-WWI	Interwar	BW	Post-BW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Amplitude								
Expansion	8.9	16.9	29.6	33.3	12.9	6.6	33.0	47.1
Recession	−2.4	−5.6	−1.3	−1.3	2.5	1.0	−0.2	0.6

	Real GDP per capita growth (per year)				Real Loans per capita growth (per year)			
	Pre-WWI	Interwar	BW	Post-BW	Pre-WWI	Interwar	BW	Post-BW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rate								
Expansion	3.7	4.8	4.2	2.6	4.4	1.5	6.2	4.9
Recession	–2.5	–4.6	–1.3	–1.3	2.9	2.0	0.1	1.1
Duration								
Expansion	2.7	3.7	6.2	10.3				
Recession	1.0	1.1	1.0	1.0				

Notes

See text. Amplitude is peak to trough change in real GDP per capita. Duration is peak to trough time in years. Rate is peak to trough growth rate per year of real GDP per capita. The full sample runs from 1870 to 2008 for 14 advanced countries. To cleanse the effects of the two world wars from the analysis, the war windows 1914–18 and 1939–45 are excluded. Pre-WWI period refers to 1870–1914; IW is the interwar period 1918–39; BW refers to the Bretton Woods period 1945–71; and Post-BW refers to the 1972–2008 period.

This analysis of real GDP per capita data in the left half of Table 2 reveals that the average expansion has become longer, going from a duration of 2.7 years before World War I (column (1)) to 10 years in the post–Bretton Woods period (column (4)). Because of the longer duration, the cumulative gain in real GDP per capita quadrupled from 9% to 33% (column (4)). However, the rate of growth in expansions has slowed down, from a maximum of almost 5% before World War II (column (2)) to 2.6% in recent times (column (4)). In contrast, recessions last about the same in all periods but output losses have been considerably more modest in recent times (before the Great Recession; our data set ends in 2008). Whereas the cumulative real GDP per capita loss in the interwar period peaked at 5.6% (column (2)), that loss is just 1.3% in recent times (column (4)). This is also evident if one looks at real GDP per capita growth rates (columns (2) and (4)).

Looking at loan activity in the right half of Table 2, the credit story takes form if one looks at the relative growth rates of real loans per capita versus real GDP per capita. Prior to World War II, real GDP per capita grew at yearly rates of 3.7% and 4.8% (before and after World War I, columns (1)–(2)) in expansions, and real loans per capita at rates of 4.4% and 1.5%, respectively (columns (5)–(6)); that is, per capita, real output growth in the interwar period was more than double the rate of loan growth. In the post–Bretton Woods era, a yearly rate of loan per capita growth of 4.9% in expansions (column (8)) was almost double the rate of real GDP per capita growth of 2.6% (column (4)), a dramatic reversal. Two other items merit note. Interestingly, the positive numbers for recessions indicate that on average, credit continues to grow even in recessions. And we must remember that for some countries, the recent explosion of shadow banking may obscure the true extent of credit-driven leverage in the economy. For example, Pozsar et al. (2010) calculate that the U.S. shadow banking system surpassed the size of the traditional banking system in 2008, and we consider such caveats later in an application to the U.S. experience in the Great Recession.

1.3 Credit Intensity of the Boom

The impact of credit on the severity of the recession and on the shape of the recovery is the primary object of interest in what is to come. But the analysis would be incomplete if we did not at least summarize the salient features of expansions when credit intensity varies.

Key to our subsequent analysis will be a measure of "excess credit" in the expansion preceding a recession. We construct an *excess credit variable* (denoted ξ) that measures the excess rate of change per year in the aggregate bank-loan-to-GDP ratio in the expansion, with units being percentage points per year (ppy). Table 3 provides a summary of the average amplitude, duration, and rate of expansions broken down by whether excess credit during those expansions was above or below its full-sample historical mean—the simplest way to divide the sample. Summary statistics are provided for the full sample (excluding both world wars) and also over two subsamples split by World War II. The split is motivated by the considerable differences in the behavior of credit highlighted by Schularick and Taylor (2012) before and after this juncture and described above.

Table 3. Real GDP per Capita in Expansions and "Excess Credit"

	Amplitude		Duration		Rate	
	Low excess credit (1)	High excess credit (2)	Low excess credit (3)	High excess credit (4)	Low excess credit (5)	High excess credit (6)
Full sample						
Mean	13.6%	21.2%	3.7	5.6	4.1%	3.5%
Standard deviation	(12.9)	(33.9)	(3.5)	(6.6)	(2.2)	(2.0)

	Amplitude		Duration		Rate	
	Low excess credit (1)	High excess credit (2)	Low excess credit (3)	High excess credit (4)	Low excess credit (5)	High excess credit (6)
Pre–World War II						

Notes

See text. Amplitude is peak to trough change in real GDP per capita. Duration is peak to trough time in years. Rate is peak to trough growth rate per year. High (low) "excess credit" means that this measure is above (below) its sample mean during expansions in the given period. The full sample runs from 1870 to 2008 for 14 advanced countries. To cleanse the effects of the two world wars from the analysis, the war windows 1914–18 and 1939–45 are excluded, as are data corresponding to peaks which are within 5 years of the wars looking forwards, or 2 years looking backward (since these leads and lags are used in the analysis below).

In some ways, Table 3 echoes some themes from the previous section. In the full sample, excess credit correlates with an extension of the expansion phase by about 2 years (5.6 years versus 3.7 years, columns (4) and (3), respectively) so that accumulated growth is about 7% higher (21% versus 14%, columns (2) and (1), respectively), although low excess-credit expansions display faster rates of real GDP per capita growth (4.1% versus 3.5% per year, columns (5) and (6)) on a per-period basis). However, there are marked differences between the pre– and post–World War II samples. As we noted earlier, expansions last quite a bit longer in the latter period—in Table 3 the ratio is about two to three times larger. Not surprisingly, the accumulated growth in the expansion is also about two to three times larger in the post–World War II sample. Even though excess credit is on average much higher in the post–World War II era, excess credit appears to be associated with longer periods of economic growth whichever way it is measured: cumulated growth from trough to peak between low and high excess-credit expansions is almost 25% larger (48% versus 23%, columns (4) and (3), respectively), and expansions last almost 5 years longer in periods of high excess credit (12 years versus 7 years, columns (4) and (3), respectively).

Naturally, the sample size is rather too short to validate the differences through a formal statistical lens, but at a minimum the data suggest that the explosion of credit after World War II had a small but measurable impact on growth rates in expansion phases. Whether these gains were enough to compensate for what was to happen during downturns is another matter. To answer that question in detail, we now focus on recessions and recoveries.

2. CREDIT IN THE BOOM AND THE SEVERITY OF THE RECESSION

We will make use of a data universe consisting of up to 223 business cycles in 14 advanced countries over 140 years. In all cases we exclude cycles that overlap the two world wars.[6] This forms our core sample for all the analysis in the rest of this paper. Most key regressions also exclude those cycles for which loan data are not available. By collating data on the entire universe of modern economic experience under finance capitalism in the advanced countries since 1870, we cannot be said to suffer from a lack of data: this is not a sample; it is very close to the entire population for the question at hand. If inferences are still unclear with this data set, we are unlikely to gain further empirical traction using aggregate macro-economic data until decades into the future.

Thus the real challenge is formulating hypotheses, and moving on to testing and inference using the historical data we already have. We want to address two key questions:

i. Are financial recessions significantly different, that is, more painful, than normal recessions?
ii. Is the intensity of credit creation, or leveraging, during the preceding expansion phase systematically related to the adversity of the subsequent recession/recovery phase?

We will follow various empirical strategies to attack these questions, beginning in this section with the simplest unconditional regression approach. For each peak date, a key predetermined independent "treatment" variable will be the yearly percentage point excess rate of change in aggregate bank loans relative to GDP in the preceding expansion phase (previous trough to peak, where excess is determined relative to the mean). We denote this measure ξ and think of it as the "excess credit" intensity of the boom. That is, we employ this proxy as a way of thinking about how fast the economy was increasing its overall financial leverage according to the loan/GDP ratio metric. (In the aggregate, domestic financial claims net out, and if the capital/output ratio is long-term stable, as per the stylized growth facts, then loan/GDP will reflect how far underlying real assets have been levered into debt.) The only other "treatment" variables will be indicators for whether the peak comes before a normal recession *N* or a financial recession *F*.

In what follows, the term treatment refers to a perturbation in the excess credit variable ξ that is predetermined relative to the recession. That the treatment is predetermined does not necessarily imply that the treatment is assigned as if it were random. Hence, the response to treatment may or may not reflect a causal link.

Summary statistics for the treatment variables can be found in Table 4 for the sample of 223 recessions. Of these, 173 are normal recessions, and the other 50 are financial crisis recessions, as described earlier. We also have information on the excess credit variable ξ for a subsample of these recessions, just 154 observations, due to missing data, and covering 119 normal recessions and 35 financial recessions. Averaged over all recessions, the excess credit variable has a mean of 0.47 ppy change in the loans-to-GDP ratio over prior expansions (s.d. = 2.17 ppy). The mean of excess credit for normal recessions is 0.24 ppy (s.d. = 2.01) and is, not surprisingly, quite a bit higher in financial recessions at 1.26 ppy (s.d. = 2.51 ppy). The latter finding meshes with the results in Schularick and Taylor (2012) who use the loan data to show that excess credit is an "early warning signal" that can help predict financial crisis events.

Table 4. Summary Statistics for the Treatment Variables

	All recessions	**Financial recessions**	**Normal recessions**
Financial recession indicator (*F*), mean	0.22	1	0
Observations	223	50	173
Normal recession indicator (*N*), mean	0.78	0	1
Observations	223	50	173
Excess credit measure (ξ), ppy, mean (s.d.)	0.47 (2.17)	1.26 (2.51)	0.24 (2.01)
Observations	154	35	119

Notes

See text. The annual sample runs from 1870 to 2008 for 14 advanced countries. To cleanse the effects of the two world wars from the analysis here and below, the war windows 1914–18 and 1939–45 are excluded, as are data corresponding to peaks that are within 5 years of the wars looking forward, or 2 years looking backward. "ppy" denotes rate of change in percentage points per year (of bank loans relative to GDP).

2.1 Unconditional Recession Paths

The dependent variables we first examine will be the key characteristic of the subsequent recession and recovery phases that follow the peak: the level in postpeak years 1 through 5 of log real GDP per capita (*y*) relative to its level in year 0 (the peak year). The data on *y* are from Barro and Ursúa (2008) and the peaks and troughs are derived from the Bry and Boschan (1971) algorithm discussed earlier.

We are first interested in characterizing the simple *unconditional path* of the cumulated response of the variable *y* to a treatment *x* at time $t(r)$:

$$CR(\Delta_h y_{it(r)+h}, \delta) = E_{it(r)}(\Delta_h y_{it(r)+h} | x_{it(r)} = \overline{x} + \delta) - E_{it(r)}(\Delta_h y_{it(r)+h} | x_{it(r)} = \overline{x}), \qquad h = 1, \ldots, H, \tag{1}$$

where $CR(\Delta_h y_{it(r)+h}, \delta)$ denotes the average cumulated response of *y* across countries and recessions, *h* periods in the future, given a size δ change in the treatment variable *x* (relative to its mean). In principle, *x* could be a discrete or continuous treatment. And in general *x* may be a vector, with perturbations δ permissible in each element. In what follows, we introduce at various times controls for both normal recessions and financial crisis (N, F) recessions into *x* as a discrete treatment, and we also introduce our "excess credit" variable (ξ) in both discrete and continuous forms.

2.2 Normal Bins versus Financial Bins

Our first results are shown in Table 5 for the simplest of specifications. Here the treatment variable *x* is a binary indicator for normal/financial recession.

Table 5. Unconditional Recession Paths, Normal versus Financial Bins

Log real GDP per capita (relative to year 0, × 100)	Year 1 (1)	Year 2 (2)	Year 3 (3)	Year 4 (4)	Year 5 (5)
Normal recession (*N*)	−2.0**	−0.0	2.0**	3.3**	4.5**
	(0.2)	(0.3)	(0.4)	(0.6)	(0.7)
Financial recession (*F*)	−2.7**	−3.1**	−2.5**	−0.9	1.0
	(0.3)	(0.6)	(0.8)	(1.1)	(1.2)
F-test equality of coefficients, normal = financial (*p*)	0.11	0.00	0.00	0.00	0.01
Observations, normal	173	173	173	173	173
Observations, financial	50	50	50	50	50
Observations	223	223	223	223	223

Note

Dependent variable: $\Delta_h y_{it(r)+h}$ = (change in log real GDP per capita from year 0 to year *h*)$\times 100$. Standard errors in parentheses.

**$p<0.05$.

Table 5 shows the unconditional path for the level of log real GDP per capita computed from a set of regressions corresponding to equation 1 at each horizon. The normalization implies that the peak year reference level of log real GDP per capita is set to zero, and deviations from that reference are measured in log points times 100. Hence, the intercept coefficients at horizon *h* (up to 5 years) represent the average path for a recession of each type. The sample is the largest possible given our data set and covers 223 recessions (173 normal, 50 financial), excluding windows that overlap the two world wars (and excluding the recessions starting in 2007–08 for which the windows do not yet have complete data).

The results reveal that in year 1 there is no significant difference between the two recession paths. The per capita output change is -2.0% in normal recessions and -2.7% in financial recessions, but an *F*-test cannot reject the null of equality of coefficients. However, at all other horizons out to year 5 the difference between the normal and financial-crisis recession paths is statistically significant (at the 1% level), and the paths accord very well with our intuition.

Along the recovery path, output relative to peak is more depressed in financial recessions. The difference is about -3% in year 2, -4.5% in year 3, -4.2% in year 4, and -3.5% in year 5. These losses are quantitatively significant, as well as being statistically significant.

2.3 Excess Credit as a Continuous Treatment

Earlier we found that excess credit is higher in financial recessions. A natural way to control for excess credit continuously is as follows. In addition to indicator variables for each type of recession (N, F) to capture an average treatment response in each bin, we also include interaction terms to capture marginal treatment responses due to deviations of excess credit from its specific recession-type mean. In normal recessions the variable is defined as ($N \times (\xi - \overline{\xi_N})$) and in financial recessions as ($F \times (\xi - \overline{\xi_F})$). As a result the sample is reduced further to 154 recessions for which the excess credit variable is available in all recessions, 119 of these being normal recessions and 35 being financial recessions.

Table 6 offers a concise look at our hypothesis that “credit bites back”: financial crisis recessions are on average more painful than normal recessions (row 2 effects are lower than row 1) and *within each type* a legacy of higher excess credit from the previous expansion creates an ever more painful postpeak trajectory (row 3 and 4 coefficients are negative, all bar one, which is zero).

Table 6. Normal versus Financial Bins with Excess Credit as a Continuous Treatment in Each Bin

	Year 1	Year 2	Year 3	Year 4	Year 5

Log real GDP per capita (relative to year 0, × 100)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Log real GDP per capita (relative to year 0, × 100)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	(0.2)	(0.4)	(0.5)	(0.7)	(0.9)
Financial recession (*F*)	−3.3**	−3.9**	−3.5**	−1.6	0.7
	(0.4)	(0.7)	(1.0)	(1.4)	(1.6)
Excess credit × normal recession ($N \times (\xi - \overline{\xi_N})$)	0.0	−0.2	−0.0	−0.2	−0.2
	(0.1)	(0.2)	(0.3)	(0.4)	(0.4)
Excess credit × financial recession ($F \times (\xi - \overline{\xi_F})$)	−0.1	−0.7**	−0.4	−0.9*	−1.0
	(0.2)	(0.3)	(0.4)	(0.6)	(0.6)
F-test equality of coefficients, normal = financial (*p*)	0.01	0.00	0.00	0.00	0.03
F-test equality of coefficients, interaction terms (*p*)	0.45	0.13	0.46	0.28	0.31
Observations, normal	119	119	119	119	119
Observations, financial	35	35	35	35	35
Observations	154	154	154	154	154

Notes

Dependent variable: $\Delta_h y_{it(r)+h}$ = (change in log real GDP per capita from year 0 to year *h*)× 100. Standard errors in parentheses.

p*<0.10*p*<0.05. In each bin, recession indicators (N, F) are interacted with demeaned excess credit, ($\xi - \overline{\xi_N}, \xi - \overline{\xi_F}$).

The average treatment responses show that with controls added, financial recession paths are below normal recession paths. The difference is shown by an *F*-test to be statistically significant out to 5 years. In a normal recession (with excess credit at its "normal" mean) GDP per capita is typically -1.9% in year 1 with a bounce back to zero in year 2, trending to about $+4.5\%$ in year 5. In a financial recession (with excess credit at its "financial" mean) GDP per capita drops -3.3% to -3.9% in years 1 and 2, and is not significantly different from zero in year 5.

As for the marginal treatments associated with excess credit, the coefficient for the normal bin ($N \times (\xi - \overline{\xi_N})$) ranges between 0 and –0.2 over the five horizons, but no single coefficient is statistically significant. But the coefficient for the financial bin ($F \times (\xi - \overline{\xi_F})$) ranges between

–0.1 and –1.0, which is to say much larger in quantitative terms, and it does breach statistical significance levels at some horizons (and also does so in a joint test).

Our main argument, to be explored below, is now clearly seen. On the one hand, we already know that financial-crisis events tend to be more likely after credit booms, a chain of association that has been noted before (Schularick and Taylor 2012). In addition, we now see that the subsequent recession is generally more severe when the expansion has been associated with high rates of change in the loans-to-GDP ratio, all else equal. Figure 1 summarizes the treatment responses derived from Table 6. The figure shows the average treatment response path (when excess credit is at the within-bin mean) along with the predicted paths when the excess credit treatment is perturbed +1, +2 or +3 ppy above its mean.[7]

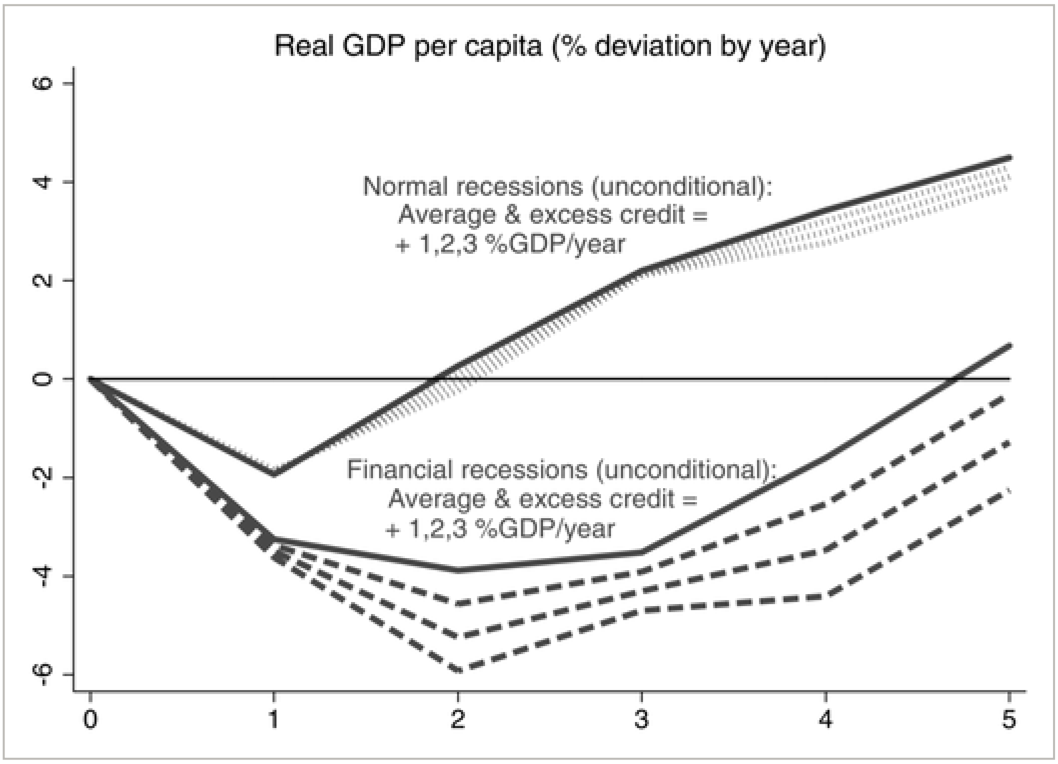

Figure 1

Open in figure viewer | PowerPoint

Unconditional Paths under Continuous Excess Credit Treatment.

Notes: See text. Solid lines show paths from Table 6, when excess credit ξ is at its mean in each bin. Dotted and dashed lines show paths when ξ is perturbed in three increments of +1 percentage points per year in each bin.

3. THE DYNAMICS OF EXCESS CREDIT: RECESSION AND RECOVERY

Using unconditional averaging, the prima facie evidence suggests that the evolution of economies from the onset of the recession greatly depends on whether the recession is associated with a financial crisis or not. In addition, the more excess credit formation in the preceding expansion, the worse the recession and the slower the subsequent recovery appear to be. These findings are based on a basic event-study approach à la Romer and Romer (1989) that treats every occurrence identically.

One concern might be that economies are complex and dynamic, with numerous feedback loops. Could the results in the previous section be explained by other macro-economic factors and a richer dynamic specification? In this section we explore these questions using more advanced econometric techniques. By enriching the analysis with more variables and more complex dynamics, we make it far less likely that excess credit survives as an independent driver of business cycle fluctuations. And yet this is precisely what we are going find.

The statistical toolkit that we favor builds on the LP approach introduced in Jordà (2005). Our treatment variable will still be excess credit ξ, defined as the percentage point per year change in the ratio of loans to GDP in the expansion. Recall that we use the term "treatment" as a predetermined perturbation to the historical norm. We ask: how different would the path of the economy be, conditional on a rich set of covariates and their lags, if excess credit in the expansion had deviated from its conditional mean? We do not assume that treatment assignment is random. However, if one were to assume that the set of controls included is sufficient to account for the selection mechanism, the effects could be interpreted causally. To draw the parallel with the VAR literature, it would be like achieving identification in a recursive system where the variable of interest is ordered last. Identification deserves a far more elaborate discussion than we have room to investigate here. For this reason, we proceed without making causal claims.

The mechanics of how this is done require a bit of notation. The dimensions of our panel are as follows. Let *N* denote the cross-sectional dimension of 14 countries. Let *T* denote the time dimension of approximately 140 years. Let *K* denote the dimension of the vector of macro-economic variables, to be described shortly. For any variable $k = 1, \ldots, K$, we want to characterize the change in that variable from the start of the recession to some distant horizon $h = 1, \ldots, H$, or from time $t(r)$ to time $t(r) + h$. Here, the time index *t* denotes calendar-time and $t(r)$ denotes the calendar-time period associated with the *r*th recession.

We will use the notation $\Delta_h y^k_{it(r)+h}$ to denote the relevant measure of change *h* periods ahead in y^k for country $i = 1, \ldots, N$ from the start of the *r*th recession where $r = 1, \ldots, R$. Sometimes the change measure might be the percentage point change, given by the difference in 100 times the logarithm of the variable, for example, for log of real GDP per capita. Other times it may refer to the simple time difference in the raw variable; for example, think of interest rates.

For notational convenience, we collect the *K* variables y_{it}^k into the vector Y_{it} as follows: $Y_{it} = [\, \Delta y_{it}^1 \ldots \Delta y_{it}^J \; y_{it}^{J+1} \ldots y_{it}^K \,]'$. That is, the first *J* out of the *K* variables enter in their first differences (appropriate for likely nonstationary variables). An example would be 100 times the logarithm of real GDP per capita so that Δy_{it}^{GDP} would refer to the yearly growth rate in percent. The latter $K - J$ variables enter in the levels (appropriate for likely stationary variables). An example would be an interest rate.

Finally, $x_{t(r)}$ will denote our treatment variable ξ when the treatment is excess credit formation in the expansion that preceded the rth recession. In terms of turning points, $t(r)$ refers to a *peak* of economic activity as defined in earlier sections. Therefore, $t(r) + h$ for $h = 1, \ldots, H$ refers to the subsequent *H* periods, some of which will be recessionary periods (those immediately following $t(r)$), some of which will be expansion periods linked to the recovery from the *r*th recession.

We are now interested in the following *conditional path* for the cumulated response of each variable in the *K*-variable system:

$$\begin{aligned} CR(\Delta_h y_{it(r)+h}^k, \delta) = {} & E_{it(r)}\big(\Delta_h y_{it(r)+h}^k \big| x_{it(r)} = \overline{x} + \delta; Y_{it(r)}, Y_{it(r)-1}, \ldots\big) \\ & - E_{it(r)}\big(\Delta_h y_{it(r)+h}^k \big| x_{it(r)} = \overline{x}; Y_{it(r)}, Y_{it(r)-1}, \ldots\big), \\ & k = 1, \ldots, K; h = 1, \ldots, H. \end{aligned} \tag{2}$$

Here $CR(\Delta_h y_{it(r)+h}^h, \delta)$ denotes the average cumulated response across countries and across recessions of the kth variable in the system, at a horizon *h* periods in the future, in response to a δ change in the treatment variable, *conditional* on the lagged history of all the variables y in the system at the path start time $t(r)$. Under linearity, the cumulated response in expression 2 is simply the sum of the 1 to *h* impulse responses.

In this paper we calculate the cumulated response in 2 with a fixed-effects panel specification, and at each horizon we allow a discrete treatment depending on whether the recession is financial or not (N, F), and a continuous treatment, based on the excess credit variable (ξ):

$$\begin{aligned} \Delta_h y_{it(r)+h}^k = {} & \alpha_i^k + \theta_N^k N + \theta_F^k F + \beta_{h,N}^k N(\xi_{t(r)} - \overline{\xi_N}) + \beta_{h,F}^k F(\xi_{t(r)} - \overline{\xi_F}) \\ & + \sum_{j=0}^{p} \Gamma_j^k Y_{it(r)-j} + u_{it(r)}^k; \quad k = 1, \ldots, K; \quad h = 1, \ldots, H, \end{aligned} \tag{3}$$

where α_i^k are country fixed effects, θ_N^k is the common constant associated with *normal* recession treatment ($N = 1$); θ_F^k is the constant associated with *financial* recession treatment ($F = 1$); a history of *p* lags of the control variables *Y* at time $t(r)$ are included, with coefficients Γ; and *u* is the error term. There are also two additional treatments admitted via the interaction terms. Notice that the continuous treatment variable ξ enters in deviation from its mean in *normal/financial* recessions, respectively. The reason is that these means can (and do) differ depending on the type of recession (see Table 4); hence, the above $\beta^k_{h,N}$ and $\beta^k_{h,F}$ will be homogeneous direct measures of the cumulated marginal effect of a unit treatment applied to ξ in each bin.

The treatment effects (θ, β) will be the chief coefficients of interest, and represent the *conditional path* for the cumulated response of each variable controlling for the history *Y*; this is in contrast to the *unconditional path* of the kind presented in the previous section. Clearly, for the case where the discrete (0–1) treatment is applied to the indicator variables, it will again be simple to test for the significance of the effects given the θ coefficients. And in the case where the treatment is applied to the excess credit variable ξ, the above panel estimator implies that the marginal effects are given by $\widehat{CR}_N(\Delta_h y^k_{it(r)+h}, \delta) = \widehat{\beta}^k_{h,N}\delta$ and $\widehat{CR}_F(\Delta_h y^k_{it(r)+h}, \delta) = \widehat{\beta}^k_{h,F}\delta$, and it is simple to test for the significance of these effects. In the special case where the two effects are of equal magnitude with $\beta^k_{h,N} = \beta^k_{h,F} = \beta^k_h$ we would find a common marginal treatment effect with $CR(\Delta_h y^k_{it(r)+h}, \delta) = \beta^k_h$. This hypothesis is also testable.

Fixed effects are a convenient way to allow cross-country variation in the typical path as well as in the average response to excess credit (as one might expect, say, when there is variation in the institutional framework in which financial markets and policies operate in each country), while at the same time allowing us to identify the common component of the response.

3.1 Conditional Paths from LPs for GDP

What remains is for us to specify the control variables *Y* in our system. Using the conditional LP methods just described, we use a seven-variable system that contains the following variables: (i) the growth rate of real GDP per capita; (ii) the growth rate of real loans per capita; (iii) the CPI inflation rate; (iv) short-term interest rates on government securities (usually 3 months or less in maturity); (v) long-term interest rates on government securities (usually 5 years or more in maturity); (vi) the investment to GDP ratio; and (vii) the current account to GDP ratio. Notice that including the growth rate of real loans per capita and its lags as controls will considerably stack the odds against finding that the credit build-up during the boom matters in explaining the path of the recession and subsequent recovery.

Table 7 presents the conditional paths estimated with the LP method using controls to compare findings with the earlier unconditional approach. The sample is now reduced to 132 recessions (101 normal, 31 financial) as we need data for all the controls. The controls are contemporaneous and 1-year lagged values of *Y* at horizon $h = 0$, and their coefficients are not shown; we focus on the coefficients of the four treatment responses.

Table 7. LP Conditional Paths—Seven-Variable System, Normal versus Financial Bins

Log real GDP per capita (relative to year 0, × 100)	Year 1 (1)	Year 2 (2)	Year 3 (3)	Year 4 (4)	Year 5 (5)
Normal recession (*N*)	−1.5**	0.0	2.6**	3.1**	4.0**
	(0.3)	(0.6)	(0.9)	(1.1)	(1.2)
Financial recession (*F*)	−3.0**	−4.6**	−3.9**	−3.4*	−2.0
	(0.5)	(1.0)	(1.4)	(1.8)	(1.9)
F-test equality of coefficients, normal = financial (*p*)	0.00	0.00	0.00	0.00	0.00
Observations, normal	101	101	101	101	101
Observations, financial	31	31	31	31	31
Observations	132	132	132	132	132

Notes

Dependent variable: $\Delta_h y_{i t(r)+h}$ = (change in log real GDP per capita from year 0 to year *h*)$\times 100$. Standard errors in parentheses.

*$p<0.10$, **$p<0.05$. Country fixed effects not shown. See text for a list of controls not shown here. LM test: normal and financial coefficients equal at each horizon: $F(10,640) = 9.208$; $p = 0.000$.

The results are consistent with the patterns seen earlier in the unconditional estimation. The path of real GDP per capita in normal recessions sits well above the path seen in financial recessions. In year 1 the levels are -1.5% versus -3.0%. By year 2 they are 0% versus -4.6%. The differences persist, and by year 5, the levels are $+4\%$ versus -2%. The normal and financial paths are different at each horizon, and an LM test confirms that the same is true in a joint test at all horizons. These conditional results with a full set of controls thus reveal starker differences between normal and financial recessions as compared to the unconditional results seen in Table 5. In the working paper version of this paper we also show that these results are robust when the Great Depression is excluded from the sample, so the findings are not being driven by the 1930s.

3.2 More Treatments Accounting for Excess Credit

Table 8 and Figure 2 now present our preferred conditional paths estimated with the continuous excess credit treatment added. The sample is now reduced to 121 recessions as we need data on not only the excess credit variable, but also for all the controls. The controls are contemporaneous and 1-year lagged values of *Y* at horizon $h = 0$, and their coefficients are not shown; we focus on the coefficients of the four treatment effects as before. The results are similar to Table 7, and compared to the unconditional results in Table 6, normal recessions display a slightly faster recovery path in these LP results; the average normal recession (row 1) suffers only -1.3% loss in output per capita in year 1 and recovers to +4.8% in year 5. The average financial recession (row 2) looks a bit more severe with losses at -2.8%,-4.1%, and -3.6% in years 1, 2 and 3, recovering to only -2.8% in year 4, and still stuck below the reference level at -1.4% in year 5.

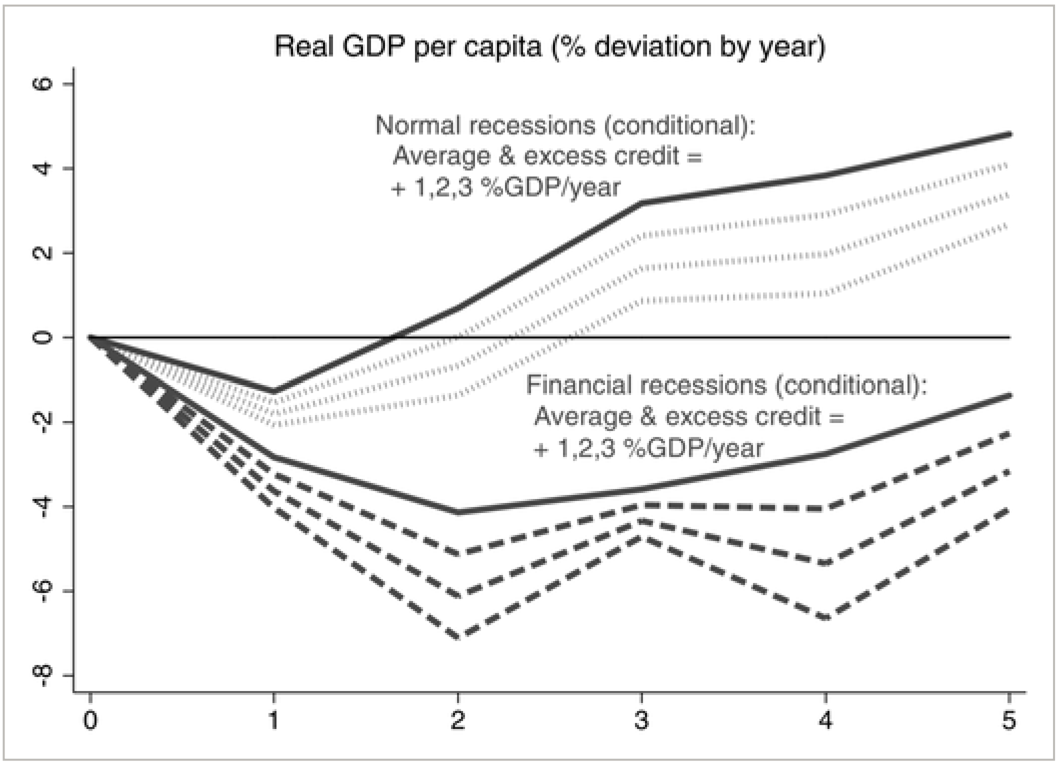

Figure 2

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Conditional Paths, Continuous Excess Credit Treatment.

NOTES: See text. Solid lines show paths from Table 8, when excess credit ξ is at its mean in each bin. Dotted and dashed lines show paths when ξ is perturbed in three increments of +1 percentage points per year in each bin. For each case all the controls are set to their historical mean values and the average country fixed effect is imposed.

Table 8. LP Conditional Paths—Seven-Variable System, Normal versus Financial Bins and Excess Credit

	Year 1	Year 2	Year 3	Year 4	Year 5
Log real GDP per capita (relative to year 0, × 100)	(1)	(2)	(3)	(4)	(5)

	Year 1	Year 2	Year 3	Year 4	Year 5
Log real GDP per capita (relative to year 0, × 100)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Normal recession (*N*)	−1.3**	0.7	3.2**	3.8**	4.8**
Financial recession (*F*)	−2.8**	−4.1**	−3.6**	−2.8	−1.4
	(0.6)	(1.0)	(1.4)	(1.8)	(1.9)
Excess credit × normal recession ($N \times (\xi - \overline{\xi_N})$)	−0.3	−0.7**	−0.8*	−0.9*	−0.7
	(0.2)	(0.3)	(0.4)	(0.5)	(0.6)
Excess credit × financial recession ($F \times (\xi - \overline{\xi_F})$)	−0.4*	−1.0**	−0.4	−1.3*	−0.9
	(0.2)	(0.4)	(0.5)	(0.7)	(0.7)
F-test equality of coefficients, normal = financial (*p*)	0.01	0.00	0.00	0.00	0.00
F-test equality of coefficients, interaction terms (*p*)	0.57	0.47	0.49	0.62	0.82
Observations, normal	92	92	92	92	92

Notes

Dependent variable: $\Delta_h y_{it(r)+h}$ = (change in log real GDP per capita from year 0 to year *h*)$\times 100$. Standard errors in parentheses. *p<0.10, **p<0.05. Country fixed effects not shown. See text for a list of controls not shown here. LM test: All excess credit coefficients equal zero: $F(10,585) = 3.026$; $p = 0.001$. In each bin, recession indicators (N, F) are interacted with demeaned excess credit, ($\xi - \overline{\xi_N}, \xi - \overline{\xi_F}$).

Moving on to the marginal treatments in Table 8 based on excess credit (ξ), both normal and financial recessions display negative and significant correlations between excess credit and the trajectory of output per capita. All 10 coefficients (rows 3 and 4) are negative and they pass a joint significance test ($F(10,585) = 2.186$; $p = 0.017$). Equality of these marginal effects across each recession type cannot be rejected at any horizon. To grasp the quantitative significance of these effects, the average coefficient for normal recessions across the five horizon years is -0.51%; in the case of financial recessions the average coefficient is half again as large, -0.76%.

Given that the s.d. of the excess credit variable is 2 ppy for normal recessions and 2.5 ppy in financial recessions (Table 4), these coefficients imply that a +1 s.d. change in excess credit in each bin would depress output in each bin by nontrivial amounts: the 5-year postpeak recovery path would be lower on average by about 1% in normal recessions and by 2% in financial recessions.

3.3 Conditional Paths for the Full System

An advantage of expression 3 is that it can furnish conditional forecast paths not only for output per capita, but for all variables of interest in Y. The conditional paths for the seven-variable system are shown in Figure 3. The path for normal recessions is shown with a 95% confidence interval (dark solid line, shaded area), and the path for financial recession is also depicted (light solid line, no shaded area). We also show perturbations to these paths when excess credit ξ is +1 s.d. above its mean level in each bin.[8] The results are striking but intuitive, and we discuss them in turn.

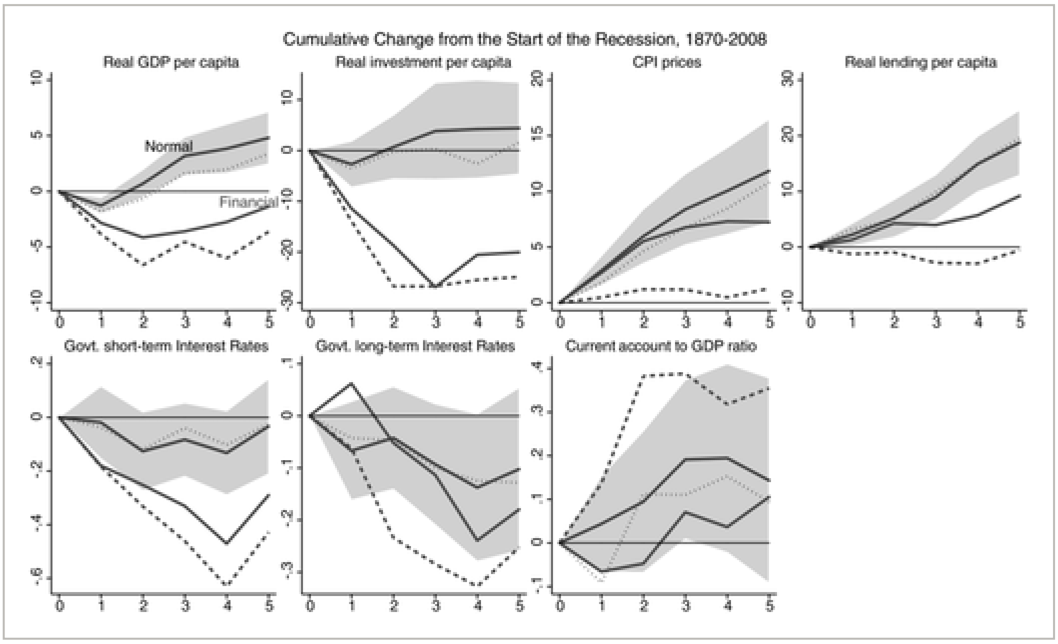

Figure 3

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All Conditional Paths: Financial versus Normal Recessions.

NOTES: See text. These responses correspond to estimates of regression equation (5) for four different treatments using the full sample. The solid dark lines with shaded 95% confidence interval show predicted values for the case of an average normal recession ($N=1, \xi=\overline{\xi_N}$). The solid light lines show predicted values for the case of an average financial recession ($F=1, \xi=\overline{\xi_F}$). The dotted and dashed lines show the predicted values for the cases of normal recession and financial recession, respectively, where ξ is set at 1 s.d. above the mean in each bin. For each case all the controls are set to their historical mean values and the average country fixed effect is imposed.

GDP per capita

Financial recessions are more painful, with recovery to previous peak taking 5 years, versus 2 in the normal case. The financial trough is 3% below peak; the normal trough 1.5%. Paths are worse when excess credit is raised by 1 s.d.; the normal path is dragged down by 1%, and the financial path by 2%. Highly levered recessions are more painful.

Real investment per capita

Investment falls 5% in normal recessions, and more than GDP, a standard procyclical pattern. It recovers starting in year 2. In financial recessions investment collapses by 20% and is depressed to year 5. The paths are much worse when excess credit is raised by 1 s.d.; the normal path is dragged down by about 3 or 4 percentage points, and the financial path by a similar amount. Highly levered recessions see sharply curtailed investment.

CPI prices

These rise in normal recessions, gaining 10% in 5 years, so inflation averages about 2% per year. In financial recessions, a slightly deflationary deviation appears, and prices rise only about 6% or 7% over 5 years, In the highly levered scenarios, the paths are significantly depressed in the financial recession case where inflation is held at a level close to zero. Highly levered financial crises appear to carry a lasting deflationary kick for several years, all else equal.

Real lending per capita

This follows an upward track on average in normal recessions, gaining 15–20% in 5 years. In financial recessions, the trend is muted, perhaps around 10% in 5 years. In the highly levered scenarios, the paths are significantly worse only in the financial recession case where the lending is flat for the entire 5-year window. Highly levered financial crises end with prolonged credit crunches.

Government short- and long-term rates

Both follow a downward trend in recessions, but given the scales as shown, the collapse in rates is more pronounced on the short end of the yield curve, as one would expect. Financial recessions are not so different on average, with a slightly steeper dip in short-term rates perhaps reflecting more aggressive policy. However, in the highly levered scenarios, the paths are significantly down only in the financial recession case where the rates drop further and for a more extended period. Highly levered financial crises presage unusually low interest rate environments.

Current account to GDP ratio

The external balances shift sharply toward surplus in normal recessions, and less dramatically after financial recessions, when the response appears delayed. However, the change is pronounced in a financial recession after a credit boom. Highly levered financial crises seem to lead to more acute external forces requiring large and fast current account adjustment.

4. HISTORY VERSUS REALITY: USA 2007–12

A practical interpretation of our results can be obtained by considering the U.S. experience in the recent crisis as an example, and using our empirical work to give an out-of-sample prediction to assess whether U.S. economic performance has been above or below what might have been reasonably expected.

This question has attracted much attention in current debates. Despite the seemingly broad agreement in the previous literature, and notably the widely cited work of Reinhart and Rogoff (2009b), as we noted above some uncertainty seems to remain as to whether financial recessions are really more painful, and if so, by how much and for whom. For example, in studies such as Howard, Martin, and Wilson (2011) and Bordo and Haubrich (2010), which focus on just the history of U.S. recessions, a clear picture may be hard to discern given the small sample size, and by focusing on the speed of the recovery (normalizing at the trough rather than, as is typical, at the peak), the goalposts are in a different place. Another issue arises because a majority of past studies have pooled advanced and emerging/developing countries in their sample. We share concerns that emerging market experience may not provide an entirely suitable parallel for most advanced countries, and we also worry that a focus on a single-country sample provides too few recession observations for meaningful, robust inference. We see such doubts as an argument for the type of analysis we have undertaken here, which focuses *only* on the experience of advanced countries.

To apply our model to the current situation, our treatment needs to be calibrated to actual U.S. data for the 2007 business cycle peak. The easy part is to set $F = 1$ for a financial crisis peak. What about excess credit? In the U.S. actual excess credit based on the change in bank loans was +1.74 percentage points of GDP over 2001–07. This corresponds to the 60th percentile of ξ in the *F* bin over our full historical sample. However, one major concern is that the U.S. credit boom is not fully captured by aggregate loans on banks' loan books. This might lead us understate the “excess credit” treatment in our out-of-sample prediction. In particular, and far more than any other episode in our historical sample, the U.S. boom was also fed by the shadow banking system (e.g., securitization). In our empirical work we have only looked at loans extended by the domestic banking sector to nonfinancial business and households. There are plausible arguments both for and against the inclusion of credit extension by nonbanks.[9]

These remain open questions. But to attempt to measure the importance of shadow system loans we use Federal Reserve Flow of Funds statistics and compute the change in total credit market liabilities (change in stock of all credit market liabilities of the nonfinancial sector minus corporate bonds) for the 2001–07 expansion. This broad excess credit measure rose by +5.0 percentage points of GDP per year, well above the +1.75 percentage points of GDP per year for just bank loans, and an excess of +3.75 percentage points per year relative to the historical mean of excess credit in the *F* bin ($\overline{\xi_F} = +1.26$). This broad measure would clearly put the U.S. boom at the higher end of the historical range, and definitively in the top tercile of the *F* bin.

In Figure 4, we use these measures of U.S. excess credit before the crisis to compare outcomes (IMF WEO actual data to 2011, to plus 2012 estimate) with the path that would have been predicted based on historical experience.[10] The United States is seen to have performed as could have been expected given the historical outturn for financial recessions. Allowing for the shadow system, it did rather well. Initially the United States did considerably better than could have been expected, although the favorable outcome in year 1 might have reflected the delay of the full-blown impact of the crisis until late 2008 after the Lehman collapse. By years 3, 4, and 5 (2010–11), however, we see that the U.S. economic recovery may have faced stronger headwinds in this later phase of the recovery period. It may be tempting for some readers to see these paths, by historical standards, as a partial or relative success story, and even as a reflection of unprecedented policy responses.

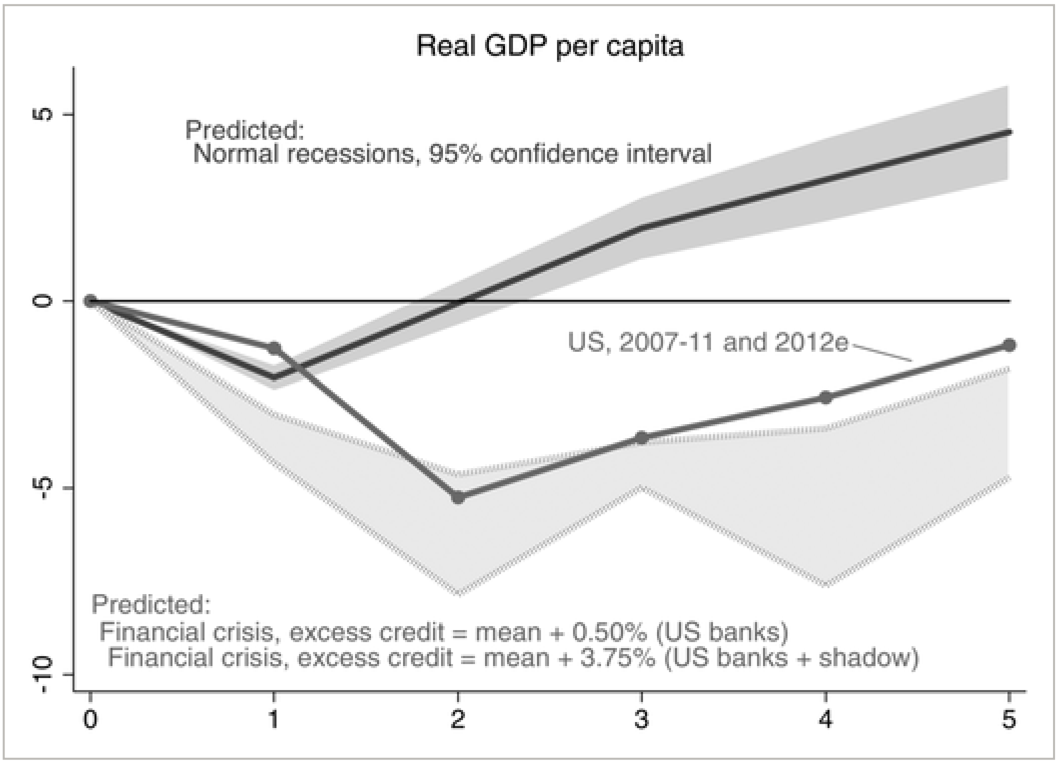

Figure 4

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The United States, 2007–12: Actual versus Predicted Paths.

Notes: See text. The output per capita forecast paths are based on Table 7. For the forecast paths, the excess credit variable must be chosen. The U.S. actual excess credit variable based on the change in bank loans was 1.74 percentage points of GDP for the prior expansion from 2001 to 2007. The value of 0.5 (upper boundary of predicted range) corresponds to the difference between the actual level (1.74) and the mean of excess credit in the *F* bin (1.26). The value of 3.75 (lower boundary of predicted range) corresponds to the difference between the estimated excess credit for both conventional and shadow systems (5.0) and the mean of excess credit in the *F* bin (1.26). In the predictions, all other control variables (*Y*) are set at the historical sample mean.

5. CONCLUSION

All else equal, the aftermath of leveraged booms is associated with slower growth, investment spending and credit growth than usual. If the recession coincides with a financial crisis, these effects are compounded and accompanied by pronounced deflationary pressures. Beyond confirming older results, our work shows how the costs of crises vary considerably depending on the run-up in leverage during the preceding boom.

For now, we content ourselves with documenting these new important facts about the role of credit in the modern business cycle without imposing a tight theoretical frame *a priori*, but in a variety of models a credit build-up in the boom can heighten the vulnerability of economies. Our results are compatible with the idea that financial factors play an important cyclical role. Potential explanations include the possibility that financial accelerator effects are larger with more leveraged balance sheets, that debt-overhang pressures are more acute after credit-intensive booms, or that expectational shifts have more serious effects when credit intensity has risen in a more extreme fashion. Investigating these different channels is an important task for future research.

1 See, for example, Bordo et al. (2001), Cerra and Saxena (2008), Mendoza and Terrones (2008), Reinhart and Rogoff (2009a, Reinhart and Rogoff 2009b), Bordo and Haubrich (2010), Reinhart and Reinhart (2010), Teulings and Zubanov (2010), Claessens, Kose, and Terrones (2011), and Schularick and Taylor (2012). Our paper also connects with previous research on stylized facts for the business cycle, for example, Romer (1986), Sheffrin (1988), Backus and Kehoe (1992), and Basu and Taylor (1999).

2 These differences in postcrisis economic performance mirror the findings by Mian and Sufi (2010) on the impact of precrisis household leveraging on postcrisis recovery at the county level within the United States. See also King (1994) on the 1980s housing debt overhangs and subsequent recessions in the early 1990s.

3 See www.nber.org/cycle/.

4 In Jordà, Schularick, and Taylor (2011) we drew a comparison of the dates obtained with this algorithm for the United States against those provided by the NBER. Each method produced similar dates, which is not surprising since the data used are only at a yearly frequency. See Harding and Pagan (2002) for suitable smoothing methods in higher frequency applications of the Bry and Boschan (1971) algorithm.

5 Major institutional innovations occurred, often in reaction to financial crises. In the United States, this period saw the birth of the Federal Reserve System in 1913, and the Glass-Steagall Act of 1933, which established the Federal Deposit Insurance Corporation (designed to provide a minimum level of deposit insurance and hence reduce the risk of bank runs) and introduced the critical separation of commercial and investment banking. This separation endured for over 60 years until the repeal of the Act in 1999. Similar ebbs and flows in the strictness of financial regulation and supervision were seen across the advanced economies.

6 See the note to Table 4 on how we cleanse the effects of the two world wars from the analysis.

7 The average paths for the normal/financial bins are solid lines, and perturbations are shown with dotted/dashed lines. Recall from Table 4 that the standard deviation of the excess credit variable is about 2 ppy in normal recessions and about 2.5 ppy in financial recessions. Thus, the fan chart reflects deviations in excess credit from average by amounts corresponding to 0.5, 1, and 1.5 standard deviations approximately.

8 As noted, this corresponds to about an extra +2 ppy change in the loans to GDP ratio per year in the normal case, and about +2.5 ppy in the financial crisis case.

9 On the one hand, to the extent that such shadow credit creates macroprudential/crisis shocks via overleveraged debits on borrowers' balance sheets (leading to deleveraging and subdued borrowing, that is, damage on the credit demand side), a loan is a loan, whether it ends up as a credit on a bank loan book or in a securitized product held elsewhere. It is a financial obligation for the borrower and the distinction whether the creditor is a bank or someone else may not matter. On the other hand, to the extent that it is the loans appearing on bank balance sheets that create macroprudential/crisis shocks via the banking channel (overlending followed by a crunch and limited bank intermediation, plus payments-system risk/panic, that is, damage on the credit supply side) then by dispersing risk, the nonwarehoused securitized loans held outside the banking system may—in theory—mitigate or cushion the impact of crises on banks themselves and help to shield the real economy.

10 The conditional forecast in Figure 4 is based on Table 6 and uses the actual measures of excess credit seen in the U.S. expansion from 2001 to 2007, either for strictly bank loans or for the whole system including shadow credit, and it sets all other control variables equal to their historical mean values. We do not show the case where conditioning variables are set equal to U.S. 2007 values. This would actually produce an even more adverse real GDP path, around 200–300 bps below that shown here, so the main conclusion (the United States has done better than expected) would not be changed, only amplified.

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