October 2013

Sovereigns versus Banks: Credit, Crises, and Consequences *

Abstract

Two separate narratives have emerged in the wake of the Global Financial Crisis. One speaks of private financial excess and the key role of the banking system in leveraging and deleveraging the economy. The other emphasizes the public sector balance sheet over the private and worries about the risks of lax fiscal policies. However, the two may interact in important and understudied ways. This paper studies the co-evolution of public and private sector debt in advanced countries since 1870. We find that in advanced economies financial stability risks have come from private sector credit booms and not from the expansion of public debt. However, we find evidence that high levels of public debt have tended to exacerbate the effects of private sector deleveraging after crises, leading to more prolonged periods of economic depression. Fiscal space appears to be a constraint in the aftermath of a crisis, then and now.

Keywords: leverage, booms, recessions, financial crises, business cycles, local projections.

JEL Codes: C14, C52, E51, F32, F42, N10, N20.

Òscar Jordà (Federal Reserve Bank of San Francisco and University of California, Davis)
e-mail: oscar.jorda@sf.frb.org; ojorda@ucdavis.edu

Moritz Schularick (University of Bonn)
e-mail: moritz.schularick@uni-bonn.de

Alan M. Taylor (University of California, Davis, NBER, and CEPR)
e-mail: amtaylor@ucdavis.edu

*The views expressed herein are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of San Francisco or the Board of Governors of the Federal Reserve System. The authors gratefully acknowledge financial support through a research grant from the Institute for New Economic Thinking (INET). For helpful comments we thank those who attended presentations at the NBER Summer Institute Sovereign Debt and Financial Crises Pre-Conference, Cambridge, Mass., July 2012; the first CEPR Economic History Programme Meeting, Perugia, Italy, April 2013; the Swiss National Bank, Zurich, Switzerland, June 2013; the NBER Summer Institute DAE Meeting, Cambridge, Mass., July 2013; and the San Francisco Fed and INET conference Finance and the Welfare of Nations, September 2013. We are particularly grateful to Early Elias and Niklas Flamang for outstanding research assistance. All errors are ours.

1 Introduction

From Beijing to Madrid to Washington, the risks of excessive borrowing feature prominently in the public debate. A seemingly simple lesson that many people drew from the financial crisis is that high debts harbor risks. However, it is much less evident which debts one should worry about. A priori, many economists would probably point to the public sector where incentive failures of politicians and the common-pool problem might lead to reckless debt financing. Private households and companies, by contrast, are assumed to be acting in their enlightened self-interested, have some "skin in the game" and can be taken for "consenting adults."

Whether private debts ultimately bankrupted sovereigns or excessive public debt undermined the banking sector is a question that is not easily answered. In some countries, the public sector was overwhelmed by the costs of cleaning up the banking system and forced to seek bail-outs (Ireland and Spain). The pattern in these cases aligns well with the link between financial crises and sovereign debt distress that has been documented in detail by Carmen Reinhart and Kenneth Rogoff (2009a; 2010). In other countries, the main source of vulnerability was indeed concentrated on the public sector balance sheet itself. When the economic outlook worsened after the crisis, the sustainability of high public debts was called into question. Doubts about the solvency of the sovereign quickly spread to banks with substantial holdings of government debt (such as in Italy and Portugal), setting in motion a "diabolic loop" (Brunnermeier et al. 2011).

What the crisis made abundantly clear is that private and public debts cannot be looked at only in isolation. Studying the interactions between the two from a long-run historical perspective is therefore the main purpose of this paper. While various studies have looked at private and public debt separately, a joint study of the evolution of public and private borrowing is missing. With our study, we aim to start to fill this gap.

We rely on a novel long-run annual panel dataset covering private bank credit and public debt and a wide swath of macroeconomic control variables for 17 advanced economies from 1870 to 2011. This is the near universe of advanced economies' experiences in the past 140 years. This long-run historical perspective allows us to work with a sufficiently large number of observations to achieve statistically meaningful results.

We first present a number of new facts. Section 2 reveals that total economy debt levels have risen strongly over time, but the bulk of the increase has come from the

private sector. Section 3 shows that private credit booms, not public debt booms, are the main precursors of financial instability. Section 4 documents the cyclical properties of private and public borrowing. Private borrowing is strongly pro-cyclical whereas public debt is usually counter-cyclical.

These facts then serve as a platform for the analysis in the remainder of the paper. By using local-projection methods to track how public debt and private credit levels influence business cycle dynamics, we discover that both varieties of debt overhang, public and private, matter, but in different ways. Whereas a credit boom and subsequent private debt overhang critically determine the depth of the recession and the speed of the recovery, it is the level of public debt and not its buildup that matter. Entering a financial crisis with high levels of public debt is associated with considerably more painful recessions and slower recoveries, potentially because high initial debt limits the fiscal space of the government.

Our results resonate with two active research areas in macroeconomics. One strand of work focuses on the role of private credit. Like Schularick and Taylor (2012), we find that financial crises are credit booms gone bust. Crises in turn tend to have long-lasting economic effects. A number of recent studies have demonstrated that recoveries from financial crises tend to be considerably slower and more protracted than normal as private credit booms or overhangs hold back the economy (see for example Cerra and Saxena 2008; Reinhart and Rogoff 2009; Jordà, Schularick, Taylor 2011, forthcoming; Mian and Sufi 2011).[1]

The second strand of recent research related to our work has focused on public debt. The surge of public debt in the wake of the crisis has not only led to doubts about the efficacy of deficit spending, but also triggered fears about the negative consequences of excessive levels of public debt. Reinhart and Rogoff (2010) and Reinhart et al. (2012) argued that a threshold of 90 percent of GDP exists, beyond which public debt levels may become a drag on the economy.[2] Irons and Bivens (2010) question these findings, while Minea and Parent (2012) argue that the threshold if it exists is somewhat higher, at around 115 percent of GDP. In a related part of the literature, Corsetti et al. (2012) argue

[1] Some authors continue to doubt that recoveries from financial crises are qualitatively different from standard recessions. See Howard, Martin, and Wilson (2011) as well as Bordo and Haubrich (2010).

[2] Checherita and Rother (2010) as well as Kumar and Woo (2010) have found supporting evidence of slower growth when public debts are high.

that if risk premia on public debt rise with higher levels of public debt, the multiplier effects of fiscal policy shrink.

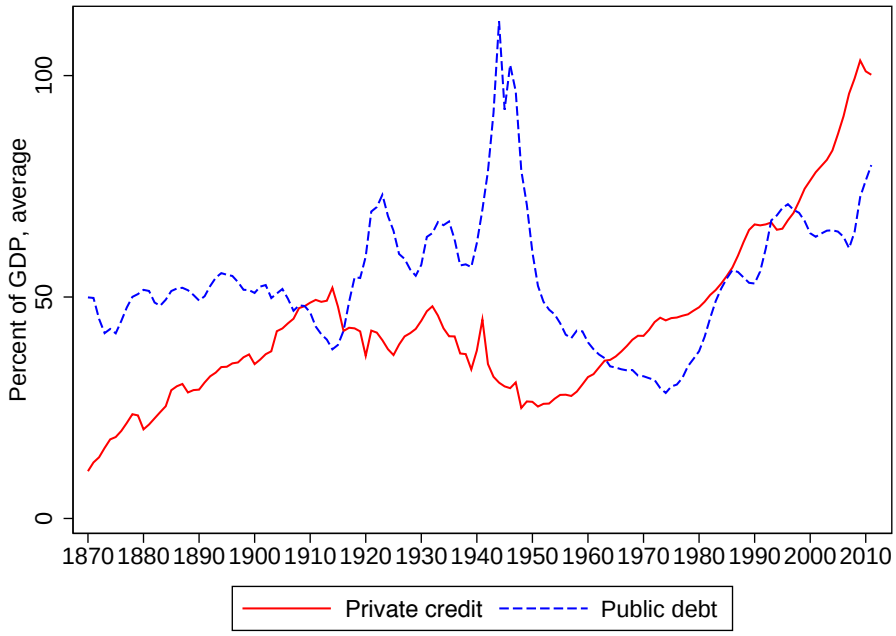
The key findings of this paper provide nuanced support for both strands of this literature. On the one hand, we reaffirm the central role played by private sector borrowing behavior for the build-up of financial fragility. The idea that financial crises typically have their roots in fiscal problems is not supported by history. On the other hand, our results also speak to the potential dangers of high public debt in some situations. While high levels of public debt make little difference in normal times, entering a financial crisis recession with an elevated level of public debt seems to exacerbate the effects of private sector deleveraging and typically accompanies a prolonged period of sub-par economic performance. That is, the long-run data suggest that without enough fiscal space, a country's capacity to perform macroeconomic stabilization and resume growth may be impaired.

2 The Evolution of Public Debt and Private Credit since 1870

The experience of the Euro Area periphery during the recent Global Financial Crisis exemplifies the connection that exists between private credit growth and financial crises on the one hand, and public debt and sovereign crises on the other. In 2007, Spain had a budget surplus of about 2 percent of GDP and its general government debt stood below 40 percent of GDP.[3] By 2012, Spain's government debt had doubled to reach about 90 percent of GDP. What began as a banking crisis driven by the collapse of the real estate bubble, quickly turned into a sovereign debt crisis. A similar, possibly even more dramatic, story could be told for Ireland. The lesson of these episodes seems to be that there was next to nothing in key indicators of public finances that indicated the imminent catastrophe. The build-up of financial risks mainly occurred on private balance sheets. In other words, public and private sector debt cannot be looked at in isolation. Yet the debate about mounting public debt levels in advanced economies has often focused on a narrower view of the historical experience, paying little attention to the development of private credit.

[3] Source: OECD, Country Statistical Profile.

Figure 1: Public debt and bank credit to private non-financial sector, 1870–2011



Notes: The sample period is 1870–2011 and the annual averages are shown for 17 advanced countries. Total private credit is proxied by total bank loans to the nonfinancial sector, excluding interbank lending and foreign currency lending based on Schularick and Taylor (2012) and updates thereto. Public debt is the face value of total general government debt outstanding.

This section provides an overview of the co-evolution of private and public sector debt over the last 140 years. The data in this paper update the novel dataset compiled in Schularick and Taylor (2012) with more recent observations, more countries, now including the experiences of Belgium, Finland and Portugal, and more variables, including data on the fiscal positions and public debt of individual countries. In particular, the sample includes observations from 1870 to 2011 at annual frequency for 17 advanced economies representing over 50% of world output more or less consistently throughout the period (see Maddison, 2005).[4] More details are provided in the data appendix.

Figure 1 displays the public-debt-to-GDP ratio and private-credit-to-GDP ratio for the 17 countries in the sample. Several features deserve comment. On the public debt side, the dominant event in the 20th century is clearly World War II. The war raised the level of public debt to unprecedented levels, often breaching the 100% debt to GDP level (and

[4] These countries are: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the U.K. and the U.S.

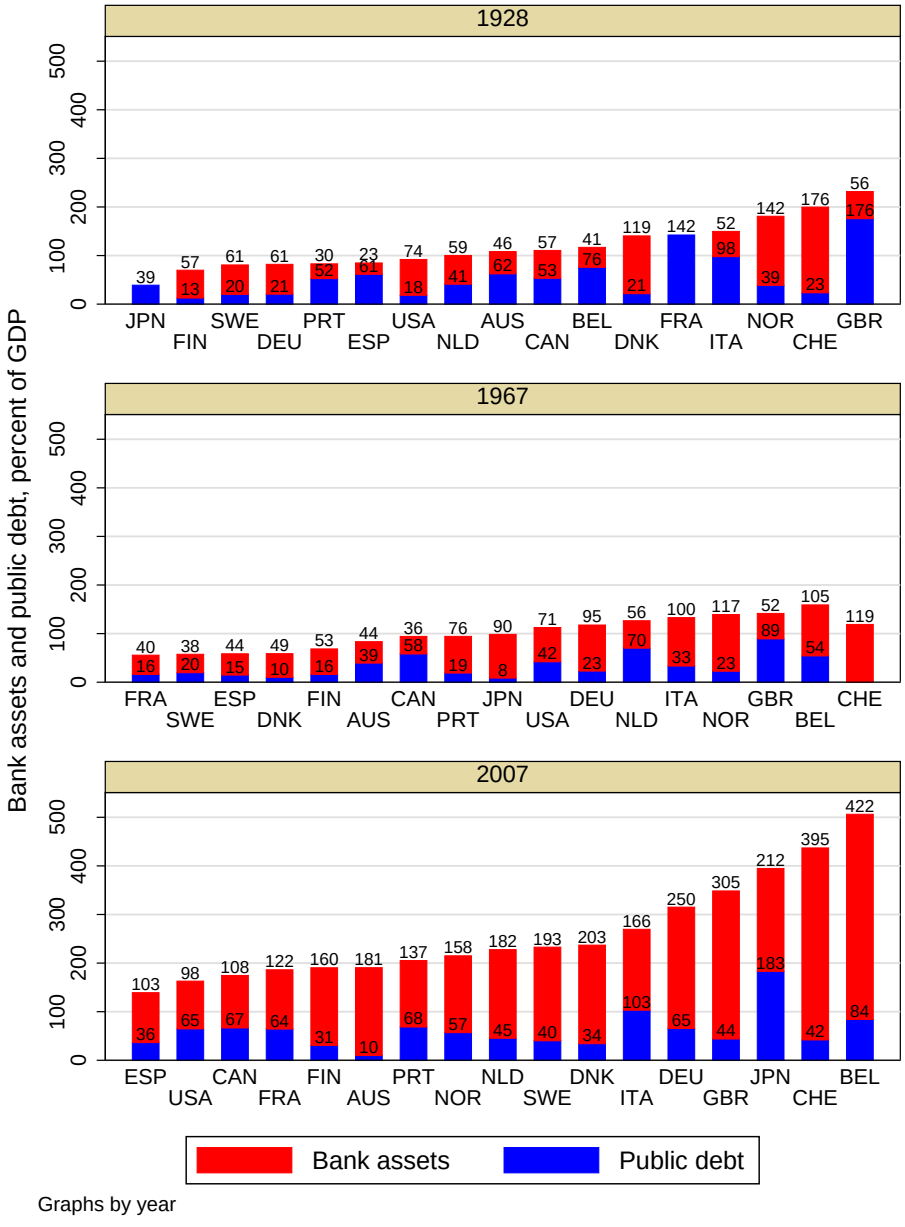
in the case of Germany, Japan, and the U.K. shooting past 200%). In the reconstruction boom of the Bretton Woods era, public debt levels gradually declined over the thirty years following the end of the war, reaching a nadir of about 30%–40% debt to GDP around the mid-1970s. Since the late 1970s, public debt levels steadily increased until the mid-1990s before improving somewhat in the decade before the crisis. The Global Financial Crisis put an end to this gradual improvement. Fiscal balances have worsened considerably and public debt has shot up to levels last seen in World War II.

However, these broad trends in public finance should be set against the startling trends in private credit discussed by Schularick and Taylor (2012). Leading up to World War II bank credit to the non-financial sector maintained a fairly stable relationship with GDP. The median of bank credit to GDP was in the 40%–50% range for most of the pre–World War II period. Private credit collapsed in the Depression and during World War II when public debt expanded rapidly. Bank credit recovered its prewar levels by the 1970s and surged to unprecedented levels in the following decades. The implications of this financialization of Western economies are profound and have become an active area of investigation.

Visualizing the development of the two kinds of debts (private and public) across the countries in our sample, Figure 2 presents stacked bar graphs of private sector debt (proxied by total outstanding bank loans to the private sector) and public debt for three different years separated by roughly 40 year intervals covering our sample. The top panel corresponds to 1928, the year before the Great Depression began in most countries. The middle panel corresponds to 1967, just before the rapid climb in private and public debt discussed earlier and visible in Figure 1. The bottom panel corresponds to 2007, the year before the start of the recent Global Financial Crisis.

This exercise yields some interesting insights. First, the average level of public debt to GDP in 1928 was about 60 percent, virtually identical to the average level in 2007. Put differently, there has been very little change in public debt levels from the 1920s until to the start of the Global Financial Crisis. Second, the average level of bank assets in 2007 has tripled relative to the level reached in 1928. Almost all of the increase in total (public and private) debt in the course of the 20th century was due to bank balance sheet expansion. Averaging across all 17 advanced countries, the ratio of public debt to bank assets went from roughly 3/4 in 1928, to 1/2 in 1967, and to 1/3 in 2008. Third, while

Figure 2: Private and public balance sheet sizes across countries: Three snapshots for 1928, 1967, and 2007



Notes: For each country, the bottom bar reflects the level of public debt to GDP. The top bar reflects the level of bank assets to GDP. Data on banking assets for France and Japan in 1928 are missing. Countries arranged by the size of the total liabilities to GDP.

public ratios have increased in most, albeit not all, Western economies in the second half of the twentieth century, public debt accounts for only about one third of the increase in total economy debt since the 1970s.

Summing up, aggregate debt (the sum of public debt and private credit) has grown to historically unprecedented levels in Western economies over the last century and a half. The break with the past is particularly evident since the 1970s. However, the increase in economy-wide debt levels has been dominated by the behavior of the private sector (bank lending) and not by the public sector: it is private sector borrowing from banks, not public sector debt, that reached historically unprecedented levels in Western economies in the early 2000s on the eve of the recent crisis.

3 Sources of Financial Instability: Banks vs. Sovereigns

Is private or public borrowing the greater risk to financial stability? This section builds on the basic classification framework in Jordà and Taylor (2011) and used in Schularick and Taylor (2012) using our expanded long-run 17 country dataset. We start from a probabilistic model that specifies the log-odds ratio of a financial crisis event occurring in country i, in year t, as a linear function of lagged controls, including changes in the private and public debt to GDP ratio, in year t,

$$\log \frac{P[S_{it} = 1|X_{it}]}{P[S_{it} = 0|X_{it}]} = b_{0i} + b_1(L)X_{it} + e_{it}, \tag{1}$$

where L is the lag operator and notice that the model allows for country fixed-effects.

Given the predicted odds from this model and denoted $\hat{p}$, we then evaluate whether the assignment rule $I(\hat{p} > c)$ can do better than the null (a coin toss) in sorting the binary crisis event data, given the threshold c. To proceed with formal inference, we use the techniques discussed by Jordà and Taylor (2011). We chart all combinations of true positives against true negatives in the unit box by varying the threshold c between $-\infty$ and $+\infty$, and create a Correct Classification Frontier (CCF). A classifier is informative if its CCF is above the null CFF of a coin toss, which lies on the diagonal. Formally, we can test if the area under the curve (AUC) exceeds 0.5 for the null to be rejected, and inference on families of AUCs turns out to be simple (they are asymptotically normal).

In specifying the log-odds ratio in expression (1), we allow the controls to enter as 5-year moving averages. This is a parsimonious way to summarize medium-term fluctuations and to facilitate the investigation of the interaction between public and private credit movements. We report estimates based on a variety of specifications detailed below. The error term e_{it} is assumed to be well behaved.

Information on the occurrence of systemic financial crises is taken from the study by Jordà, Schularick, and Taylor (2011, forthcoming) which in turn builds on the timing of crisis events pioneered by Bordo et al. (2001) and Reinhart and Rogoff (2009) for historical times. The Laeven and Valencia (2008, 2012) dataset of systemic banking crises is the main source for post-1970 crisis events. Following the definition of Laeven and Valencia (2012), a financial crisis is characterized as a situation in which there are significant signs of financial distress and losses in wide parts of the financial system that lead to widespread insolvencies or significant policy interventions.[5] Since 1870, there have occurred no less than 95 systemic financial crises in the sample of 17 countries used here. A list of years in which systemic financial crises occurred in the 17 countries under study here can be found in the data appendix.

The key results are shown in Table 1 based on 17 advanced countries for the period 1870 to 2011. Starting with the simple model based on credit used in Schularick and Taylor (2012), we run it against rival models with public debt added as an alternative, or in combination with the private credit measure. The question is, do any of these alternative variable sets add any information at all?

The answer is very clearly no. In columns (1) and (2), the AUC of the private credit model for the full sample is 0.61 with a standard error of 0.03; the AUC of the public debt model is 0.56 with a standard error 0.03. The private credit variable is statistically significant, the public debt variable is not, at the conventional 5% level. The joint model has an AUC that is virtually identical to the pure private sector credit model indicating that not much is gained by including the public debt information in the long-run. We also checked for the robustness of these results by including additional controls for the levels of credit and debt or an interaction between the two, but none of these specifica-

[5] The important distinction here is between isolated bank failures, such as the collapse of the Herstatt Bank in Germany in 1975 or the demise of Baring Brothers in the UK in 1995, and system-wide distress as it occurred, for instance, in the crises of the 1890s and the 1930s, in the Japanese banking crises in the 1990s, or during the Global Financial Crisis of 2008. It is clear that the lines are not always easy to draw, but the overall results appear robust to variations in the crisis definitions.

Table 1: Financial Crisis Predictive Ability: Private Credit v. Public Debt

Logit models. Dependent variable: d = Crisis dummy.
Regressors: X = lags and/or levels of private credit/GDP and public debt/GDP.

	(1)	(2)	(3)	(4)	(5)
Change in private credit/GDP (5 year m.a.)	17.01***		17.05***	28.74**	
	(4.707)		(4.723)	(11.58)	
Change in public debt/GDP (5 year m.a.)		-3.001*	-1.906		-2.972
		(1.677)	(2.376)		(3.119)
Lagged level of private credit/GDP				-0.112	
				(0.542)	
Lagged level of public debt/GDP					0.0199
					(0.265)
Interaction term				-12.65	-0.668
				(12.57)	(2.732)
Observations	2,111	2,228	2,018	2,035	2,041
AUC	0.609	0.564	0.617	0.612	0.561
s.e.	(0.033)	(0.030)	(0.034)	(0.033)	(0.031)

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Country fixed effects in all models, not reported. The null model with fixed effects only has AUC = 0.533 (0.03). Interaction term = (Lagged level of private credit/GDP) × (Lagged level of public debt/GDP).

tion changes impacted our key results and the additional controls were not statistically significant, as the table shows.

Summing up, the idea that financial cries have their roots in fiscal problems is not supported over the long sweep of history. Some cases may of course exist—like Greece today—but these have been the exception not the rule. In general, like Ireland and Spain today, financial crises can be traced back to developments in the financial sector itself. Over 140 years there has been no systematic correlation of financial crises with prior growth in public debt levels. Private credit has been the only useful and reliable predictive factor.

4 Private and Public Debt over the Business Cycle, 1870-2011

One explanation for the results of the previous section could be differences in the cyclicality of private credit and private debt. How do private credit and public borrowing evolve over the business cycle? Are they pro- or counter-cyclical? Have the dynamics of private credit and public debt changed in different eras and under different monetary regimes? And how does the behavior of private credit and public debt differ in normal cycles and those associated with financial crises? These are the questions we address in this section on the basis of our long-run data set.

4.1 Methods

There are no official data on business cycle turning points going back 140 years and covering all the countries in our sample. In order to investigate the business cycle features of the data, we find it convenient to generate two auxiliary dummy variables using the intuition in the Bry and Boschan (1971) algorithm. At a yearly frequency, this algorithm replicates the NBER's dating of U.S. business cycle peaks and troughs almost perfectly.

The algorithm consists of generating dates of peaks and troughs in economic activity for each country in our sample separately. Conveniently, this simple algorithm does not require any prior detrending of the data. Using real GDP per capita, a *peak* corresponds to a local maximum whereas a *trough* corresponds to a local minimum. Therefore, recessions refer to the period between a peak and the following trough, whereas expansions refer to the period between the trough and the subsequent peak. By definition, peaks and troughs perfectly alternate one another.

Using data for peaks and troughs, for any given variable of interest we can compute three cyclical statistics of interest: *amplitude, duration* and *rate. Amplitude* denotes the average change between turning points; *duration* refers to the average interval of time elapsed between turning points; and *rate* is simply the ratio of *amplitude* over *rate* so as to provide a per year rate of change.

4.2 Five Stylized Facts

Using this dating method, we can sketch the broad contours of output, debt and credit in the modern business cycle. Remember that our sample of 17 economies represents the near-universe of advanced economies for which long-run data exist. The following five facts about the modern business cycle and encapsulated in Figure 3 stand out.

First, as panel (a) shows, the typical expansion has become longer lasting. Expansions lasted 3 years before World War I, almost 4 years between the wars, 6 years in the Bretton-Woods era, and 10 years since. As expansions have become longer-lasting, output per capita amplitudes in expansions have risen gradually as well. It is striking that recessions have lasted 1 year on average, in all periods, but were deeper in the interwar era.

Second, the annual rate of real GDP growth in the expansion (amplitude divided by duration) has gradually declined. It averaged 3.5 percent per annum (p.p.a.) before World War I, peaked at 5.2 p.p.a. in the interwar period, declined to 4.3 p.p.a. in the Bretton Woods era, and currently averages about 2.7 p.p.a. In other words, business cycles last longer but growth rates have come down.

Third, private borrowing is pro-cyclical in the sense that it grows faster in expansions than in recessions, and increasingly so. In a typical cycle in the post Bretton Woods era, real private credit per capita increased by about 58%, about double the rate of growth of per capita GDP (see Figure 3(b), column 1).

Fourth, public debt tends to grow faster in recessions than in expansions, indicating some counter cyclical stance of pubic borrowing, but only mildly so. Moreover, the Bretton-Woods period stands out as the only period of public debt reduction both in expansions and recessions (Figure 3(b), column 2). In the immediate postwar decades, countries gradually reduced their World War II debt obligations, certainly aided by the reconstruction boom and tight controls over the financial system.

Fifth, the combined sum of public debt and private credit (Figure 3(b), column 3) has grown at an unprecedented pace in the past four decades, looking at the averages in expansions and recessions. It is evident from the chart that the 1970s mark a major break in the dynamics of aggregate debt. The combination of strong private credit growth and higher public borrowing put the annual growth of the economy's total liabilities at over 9 p.p.a. in expansions, and over 5 p.p.a in recessions, a rather remarkable development in the history of the last 140 years.

Figure 3: Real GDP, Private and Public Debt Over the Business Cycle

(a) Real GDP Over the Business Cycle: Amplitude, Duration and Rate

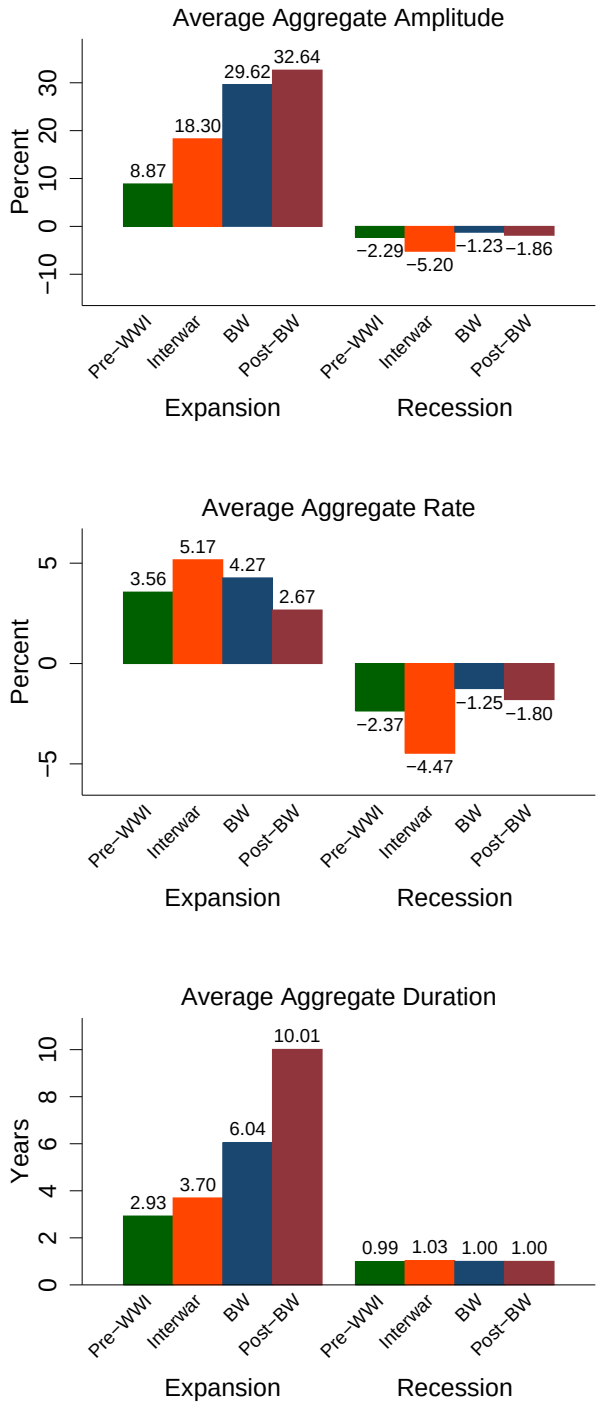
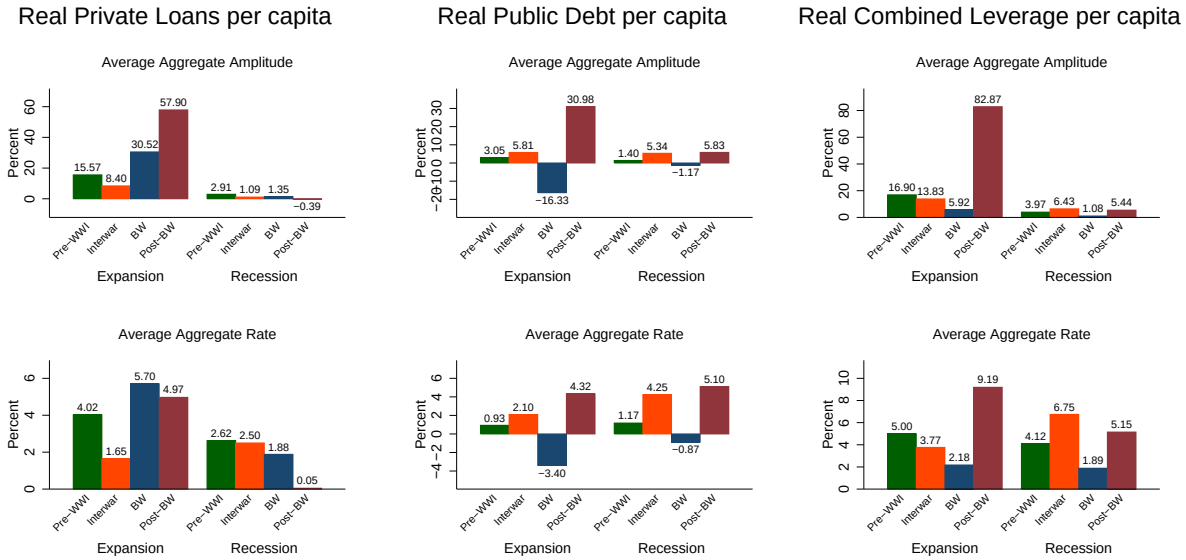


Figure 3 (ctd.) Real GDP, Private and Public Debt Over the Business Cycle
(b) Private and Public Debt Over the Business Cycle: Amplitude and Rate



Notes: Amplitude, duration and rate as defined in the text: amplitude is change in variable from start to end of the expansion or recession phase; rate is amplitude divided by the duration of the phase. Units are percent and percent per annum, respectively.

In sum, we find that business cycles have gradually become longer lasting and much more credit-intensive. Private borrowing tends to be strongly pro-cyclical while public borrowing display at least some counter cyclical elements in advanced economies. In modern economic history, the Bretton-Woods period stands out as the only period of sustained public debt reduction, both in expansions and recessions.

4.3 Booms, Busts, and Crises

Not all cycles are created equal. Some cycles end in financial crises and severe recessions, while others do not. The natural next step is to ask how the cyclical behavior of credit differs between normal cycles and those that end in severe financial crises. We therefore introduce a distinction between recessions that coincide with a major financial crisis—we call them *financial recessions*—and *normal recessions* without major financial disruptions. More precisely, we call a recession *financial* if and when a major financial crisis erupts within a two year window around the peak (the start of the recession). This classification is summarized in the data appendix and extends prior work in Jordà, Schularick and Taylor (2011, forthcoming) with the data for Belgium, Finland and Portugal and the

post-2008 years.

Table 2 summarizes the universe of recessions and their classification using this approach. The table is broken into three panels. Panel (a) corresponds to the full sample, panel (b) to the pre-World War II sample, and panel (c) to the post-World War II sample. The full sample contains 269 recession episodes of which 77 are classified as financial crisis recessions and 192 are classified as normal recessions. However, that proportion varies with each sub-sample. In the pre-World War II sample 1 in 3 recessions was a financial crisis whereas after World War II, the proportion decreases to about 1 in 5.

The table also includes information on changes in *private credit and public debt ratios*, measured as the percentage point change per annum in private credit and public debt over GDP in the business cycle expansion. With respect to private credit, the key result arising from the table is that private credit grows twice as rapidly before financial recessions than before normal recessions, regardless of the era. From a business cycle perspective, this clearly reinforces the earlier finding that financial crises tend to be preceded by a rapid accumulation of *private* liabilities. Crisis cycles are special in the sense that the preceding boom is much more credit-intensive than in normal times.

The public debt to GDP ratio, by contrast, tends to decline before normal and financial recessions. In the pre-World War II sample, public debt declines at a rate of about 0.88 p.p.a. before normal recessions and 0.66 p.p.a. before financial crises. After World War II, the difference between normal and financial cycles is starker. Whereas debt declines by a similar amount in normal recessions, about 0.93 p.p.a, it *increases* at a rate of about 0.24 p.p.a. before financial crises. However, this result is driven by the absence of financial crises under the Bretton Woods System and the parallel reduction in public debt in the postwar reconstruction boom.

Summing up, we find that business cycles associated with financial crises tend to exhibit much more credit-intensive expansions than normal. With regard to the behavior of public debt, however, the differences appear to be rather small. Across all countries and periods, public debt tends to decline in expansions that end in financial crises. The lesson seems to be that there is very little in key indicators of public debt that indicate the imminent danger. At least in advanced economies, the build-up of financial fragility typically occurs on private sector balance sheets.

Table 2: Summary Statistics

(a) Full sample	(1)		(2)		(3)	
Recession types in sample	All		Financial		Normal	
	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)
Financial recession indicator	0.29		1		0	
Observations	269		77		192	
Normal recession indicator	0.71		0		1	
Observations	269		77		192	
Change in private credit/GDP	0.58	(1.92)	0.85	(2.22)	0.48	(1.80)
Observations	199		55		144	
Change in public debt/GDP	-0.77	(6.03)	-0.47	(3.55)	-0.90	(6.80)
Observations	220		64		156	
(b) Pre-World War II sample	(1)		(2)		(3)	
Recession types in sample	All		Financial		Normal	
	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)
Financial recession indicator	0.34		1.00		0.00	
Observations	186		63		123	
Normal recession indicator	0.66		0.00		1.00	
Observations	186		63		123	
Change in private credit/GDP	0.36	(1.97)	0.51	(1.92)	0.28	(2.00)
Observations	127		41		86	
Change in public debt/GDP	-0.81	(6.75)	-0.66	(3.80)	-0.88	(7.85)
Observations	149		50		99	
(c) Post-World War II sample	(1)		(2)		(3)	
Recession types in sample	All		Financial		Normal	
	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)
Financial recession indicator	0.17		1		0	
Observations	83		14		69	
Normal recession indicator	0.83		0		1	
Observations	83		14		69	
Change in private credit/GDP	0.98	(1.78)	1.84	(2.76)	0.77	(1.41)
Observations	72		14		58	
Change in public debt/GDP	-0.70	(4.20)	0.24	(2.48)	-0.93	(4.51)
Observations	71		14		57	

Notes: See text. Changes in private credit and public debt refer to the prior expansion.

5 Debt Booms and Overhangs: Private and Public

What does the long-run historical evidence say about the prevalence and effects of private and public debt booms and overhangs? Do high levels of public debt impact on business cycle dynamics, as the public debt overhang literature argues? Are the effects of either variety of debt overhang more pronounced after financial crises? These are some of the questions that we explore in the next few sections. First, some background on the existing tensions in the literature.

The empirical observation that recoveries from financial crises seem to be special (see e.g. Cerra and Saxena, 2008; and Claessens, Kose and Terrones, 2011) has prompted researchers to look deeper into the causes of slow recoveries. One key theme is that high and/or newly-elevated levels of private indebtedness—a "debt overhang"—may hold back economic recovery after financial crises. In the crisis, agents in the economy suddenly realize that asset values were too high and leverage limits too lax. After this "Minsky moment" households (or companies) repair their balance sheets and adjust their debt levels. This deleveraging process in turn may weigh on aggregate demand and be responsible for the sluggish recovery (Koo 2008; Mian, Rao, Sufi 2011; Mian and Sufi 2012). Krugman and Eggertsson (2012) present a model with heterogeneous households: some households are patient creditors, others are impatient debtors. When credit conditions tighten in a crisis, indebted households have to cut back on consumption to adjust to the new borrowing constraint. The real interest rate needs to fall to induce higher spending by patient households, but the zero lower bound may prevent full adjustment in the short run. Hall (2011), Guerrieri and Lorenzoni (2011) as well as Philippon and Midrigan (2011) develop similar ideas. Using long-run historical data since 1870, Jordà, Schularick and Taylor (2011, forthcoming) demonstrate in related empirical work that debt overhang effects after credit booms are a regular feature of the business cycle.

Yet another strand of the literature warns of the effects of the overhang from public, not private, borrowing. Reinhart et al. (2012) studied 26 episodes where public debt to GDP accounted for more than 90% of GDP on a sustained basis and found evidence that these public debt overhang episodes were associated with a substantial slowdown of GDP growth relative to low-debt years. These results mesh with those of a much-debated earlier contribution by Reinhart and Rogoff (2009) that presented evidence that above a certain public debt to GDP threshold the overhang of public debt goes hand in

hand with a substantial slowdown in economic growth.

The empirical approach that we will follow to address these issues is multifaceted. After a short presentation of our key statistical methods (5.1), we will first revisit the historical evidence on private credit booms (5.2). More precisely, we will study if and how private credit booms influence the depth of recession and the speed of the recovery. We shall see that *private credit* build-up during the expansion tends to make the recession deeper and longer lasting. This is the essence of the well-known private sector debt overhang story that we can confirm with our larger and longer macro-historical dataset, extending results in Jordà, Schularick and Taylor (2011, forthcoming).

In a next step (section 5.3), we will take a closer look at the effects of public debt booms, thus addressing one of the most hotly debated topics in macroeconomics in recent years. Importantly, we will improve upon previous studies of public debt boom episodes in so far as we move beyond a simple unconditional analysis and include a number of additional macroeconomic controls that could account for the previously diagnosed growth slowdown in times of high public debt. Upgrading from an *unconditional* to a *conditional* analysis will show that high public debt levels have little impact on the business cycle dynamics in normal times, but that high levels of public debt, a public debt overhang, slows down the economy after financial crises.

In a last step (5.4), we will look at the interaction of private credit buildups and the level of public debt. We will see that high levels of public debt exacerbate the effects of private sector deleveraging. The combination of private sector credit booms and high levels of public sector debt typically leads to considerably deeper recessions and slower recoveries. Our results therefore lend support to precautionary fiscal policy regimes intended to keep public sector debt at low levels—not because these debts necessarily endanger growth at all times, but for a more narrow, specific reason: to avoid the need for a parallel rentrenchment of private and public sector borrowing in times of crisis and in the associated and typically prolonged recession.

5.1 Statistical Design

The statistical toolkit we will use to address these questions relies on the *local projection* (LP) approach introduced in Jordà (2005). Several reasons justify the choice. The sample of data available may appear abundant for most statistical analyses. However,

we are interested in characterizing a number of dynamic multipliers from a multivariate perspective. Standard models are too parametrically intensive for the available sample. Moreover, some of the multipliers that we calculate allow for asymmetries and nonlinearities in the form of modulation through the level of debt at the start of the recession. These features are difficult to model with assumptions about the underlying global data generating process. And in any case, this would impose numerical burdens that our sample cannot easily bear. Instead, direct local analysis of the multipliers of interest using the LP method is straightforward.

Let K denote the dimension of the vector of macroeconomic aggregates of interest, M denote the cross-section dimension of countries, and T denote the time dimension of the sample. For any variable $k = 1, ..., K$ we want to characterize the change of the variable from the start of the recession to some distant horizon $h = 1, ..., H$, or the change from time $t(p)$ to time $t(p) + h$ where p refers to *peak*. That is, $t(p)$ denotes the time period that corresponds to the p^{th} peak or recession. We focus on the change from the start of the recession to some distant period so that the results can be directly compared with the results presented in earlier sections and results available in the literature for unconditional responses.

Let $y^k_{it(p)+h}$ denote a given macroeconomic aggregate observed for country $i = 1, ..., M$ at time $t(p) + h$, the h period ahead change is denoted $\Delta_h y^k_{it(p)+h}$. Sometimes $\Delta_h y^k_{it(p)+h}$ will refer to the percentage point change, given by the h-step difference in 100 times the logarithm of the variable. An example is when y^k_{it} refers to 100 times the logarithm of real GDP per capita. Other times it may refer to the simple h-step difference, such as when y^k_{it} refers to an interest rate. These differences are easily understood from the context and we abstain from introducing further notation to indicate the distinction. The macroeconomic aggregates y^k_{it} are consolidated into the vector $Y_{it} = [\Delta y^1_{it} \; ... \; \Delta y^J_{it} \; y^{J+1}_{it} \; ... \; y^K_{it}]'$. The first J elements of this vector refer to variables expressed in first differences, such as 100 times the logarithm of real GDP per capita, and the remaining $K - J$ variables refer to variables in the levels, such as an interest rate.

Lastly, denote $x_{it(p)}$ the accumulated change of the variable x in the expansion that ended at time $t(p)$ for country i. Perturbations of this variable from its long-run mean, e.g., accelerations of borrowing, will define the experiments whose effects on other macroeconomic variables we wish to evaluate. The value of this variable remains fixed

for any value of h over which $\Delta_h y^k_{it(p)+h}$ is considered.

Consequently, the path of the recession and the recovery, conditional on information up to time $t(p)$—and denoted $Y_{it(p)}, Y_{it(p)-1}, ...$—will vary depending on $x_{it(p)}$ and we will be interested in characterizing how these recovery paths change as $x_{it(p)}$ changes from a given baseline level that here we take as the long-run mean, $\overline{x}_i$, with respect to an experimental level $\overline{x}_i + \delta$.

That is, the average cumulated response for each variable in the K-dimensional vector of macroeconomic aggregates is defined as:

$$\begin{aligned} CR\left(\Delta_h y^k_{it(p)+h}, \delta\right) &= E_{it(p)}\left(\Delta_h y^k_{it(p)+h} | x_{it(p)} = \overline{x}_i + \delta; Y_{it(p)}, Y_{it(p)-1}, ...\right) \\ -E_{it(p)}&\left(\Delta_h y^k_{it(p)+h} | x_{it(p)} = \overline{x}_i; Y_{it(p)}, Y_{it(p)-1}, ...\right), \quad k = 1, ..., K; h = 1, ..., H \end{aligned} \tag{2}$$

As an aside, note that, under an assumption of linearity, this cumulated response is simply the sum of the 1 to h impulse responses:

$$\begin{aligned} IR\left(\Delta y^k_{it(p)+h}, \delta\right) &= E_{it(p)}\left(\Delta y^k_{it(p)+h} | x_{it(p)} = \overline{x}_i + \delta; Y_{it(p)}, Y_{it(p)-1}, ...\right) \\ -E_{it(p)}&\left(\Delta y^k_{it(p)+h} | x_{it(p)} = \overline{x}_i; Y_{it(p)}, Y_{it(p)-1}, ...\right), \quad k = 1, ..., K; h = 1, ..., H, \end{aligned} \tag{3}$$

that is

$$CR\left(\Delta_h y^k_{it(p)+h}, \delta\right) = \sum_{j=1}^{h} IR\left(\Delta y^k_{it(p)+h}, \delta\right). \tag{4}$$

Expression (3) can be recognized as the definition of an impulse response in Jordà (2005). Of course, the reason to work with expression (2) rather than with expressions (3) and (4) is to provide a direct measure of the cumulated responses that do not rely on the probably quite implausible assumption of linearity. To proceed, we need a way to estimate expression (2).

In practice we estimate $CR\left(\Delta_h y^k_{it(p)+h}, \delta\right)$ by assuming that the expectation can be approximated by a local projection. In particular, this approximation can be obtained by

estimating the following fixed-effects panel regression:

$$\Delta_h y^k_{it(p)+h} = \alpha^k_i + \theta^k_N d^N_{it(p)} + \theta^k_F d^F_{it(p)} + \beta^k_{h,N} d^N_{it(p)} \left(x_{it(p)} - \overline{x}_i \right) + \beta^k_{h,F} d^F_{it(p)} \left(x_{it(p)} - \overline{x}_i \right) + \sum_{l=0}^{L} \Gamma^k_{h,l} Y_{it(p)-l} + u^k_{h,it(p)}; \quad k = 1, ..., K; h = 1, ..., H, \tag{5}$$

where α^k_i are country fixed effects, θ^k_N is the common constant associated with *normal* recessions $d^N_{it(p)} = 1$ (o otherwise); θ^k_F is the common constant associated with financial recessions $d^F_{it(p)} = 1$ (o otherwise); a history of l lags for the control variables $Y_{it(p)-l}$ with coefficient matrices $\Gamma^k_{h,l}$. When $x_{it(p)} = \overline{x}_i$ then θ^k_N and θ^k_F measure the average cumulated response in normal versus financial recessions. As we determined earlier, these unconditional means appear to differ in the sample and allowing for this distinction is consistent with our earlier findings. When $x_{it(p)} = \overline{x}_i + \delta$, the marginal effect of the experiment δ is given by the coefficients $\beta^k_{h,N}$ and $\beta^k_{h,F}$ depending on whether the recession is *normal* (N) or *financial* (F). Here we could have assumed that $\beta^k_{h,N} = \beta^k_{h,F}$ but we prefer to allow the data to speak for themselves.

Our decision to use a panel estimator with fixed effects allows cross-country variation in the typical path computed and in the average response to δ. This is a convenient formulation and accounts for variation across countries in their degree of financialization and other macroeconomic differences while still being able to identify the common component of the response.

If δ were exogenously determined, then expression (2) would provide the causal effect of an increase x on the outcome y at time h. Formally, we cannot claim this to be the case. However, we note that the amount of private credit or public debt is a given quantity at the start of the recession. Naturally, there is no direct feedback mechanism except for any possible anticipation during the expansion on the severity of an impending recession. In addition, we use an extensive set of controls and their lags to soak up variation in economic outcomes that can be explained by conditions experienced during the expansion.

The Y variables that we will include as controls are: (1) the growth rate of real GDP per capita; (2) the growth rate of real loans per capita; (3) the consumer price index (CPI) inflation rate; (4) the growth rate of real investment per capita; (5) the growth rate of real public debt per capita; (6) short-term interest rates on government securities (usually 3

months or less in maturity); (7) long-term interest rates on government securities (usually 5 years or more in maturity); and (8) the current account to GDP ratio. Note that our set of controls Y will include data on lending and public debt, which will tend to attenuate any effects that we measure through x. That is, we stack the odds against finding that credit or debt have any independent effects on the shape of the recession and recovery.

These variables will be the controls included in the vector Y defined earlier. Starting with private credit, we will use a two standard deviation of private credit growth from its long-run average as our "experimental" x variable. In other words, we will track how credit booms in the expansion change the conditional forecasts of the behavior of other macroeconomic variables in the subsequent recession and recovery. Expression (5) will serve as the platform from which we develop a more ambitious exploration of the effects of high public debt levels and study the interaction of private and public debt overhangs. These extensions will require modifications to our main estimating equation in expression (5) that we discuss when each experiment is introduced below.

5.2 Private Credit Booms

We start by determining how strong growth of private credit to GDP in the expansion (we use a two standard deviation from the long run average) alters the expected course of an economy through recession and recovery. This experiment builds on the analysis in Jordà, Schularick and Taylor (forthcoming), but relies on a larger and longer sample. The core results from that study remain intact.

Figure 4 reports the cumulated responses calculated using expressions (2) and (5) for output, investment, inflation, lending and debt. The top row refers to the full sample analysis whereas the bottom row refers to the post-WWII sample. In a normal recession output declines in year one about 1%–2%, by year two it has recovered it original pre-recession level and then continues to grow in years three to five. However, financial recessions are considerably more painful. On average, they only reach bottom (–5%) around year two or three and output does not quite recover its pre-recession level by year five. Overhang from a previous credit boom makes matters considerably worse. The recession can be about two to three percentage points deeper at and the recovery is even slower. The effects are even more dramatic when considering real investment, with

drops on the order of 20–30 percent in crisis recessions. Regarding inflation, whereas prices continue to grow during normal recessions, they remain more repressed in financial crises, and more so after credit booms. Similarly, lending activity continues during a normal recession, it stands still in the average financial crisis and it contracts in a financial crisis after a credit boom. Public debt accelerates faster in financial crisis recessions, and even more so after a credit boom. All results are quite intuitive, and echo recent real-world experiences.

As a robustness check, we consider a sub-sample analysis based on post-World War II data. Although we have excluded the two World War periods from the analysis, the interwar period was unusually turbulent and marked by the Great Depression. The bottom row of Figure 4 replicates the analysis in the top row using the shorter and more contemporary sample from 1946 to 2011. Broadly speaking, the results hold up surprisingly well, not just qualitatively but also quantitatively.

Overall, the responses confirm that financial crises are more painful and take longer to recover from than normal recessions, even after conditioning on macroeconomic aggregates and their lags. Moreover, a large accumulation of private sector debts during the preceding expansion—a private sector credit boom—tends to make recessions and recoveries worse.[6]

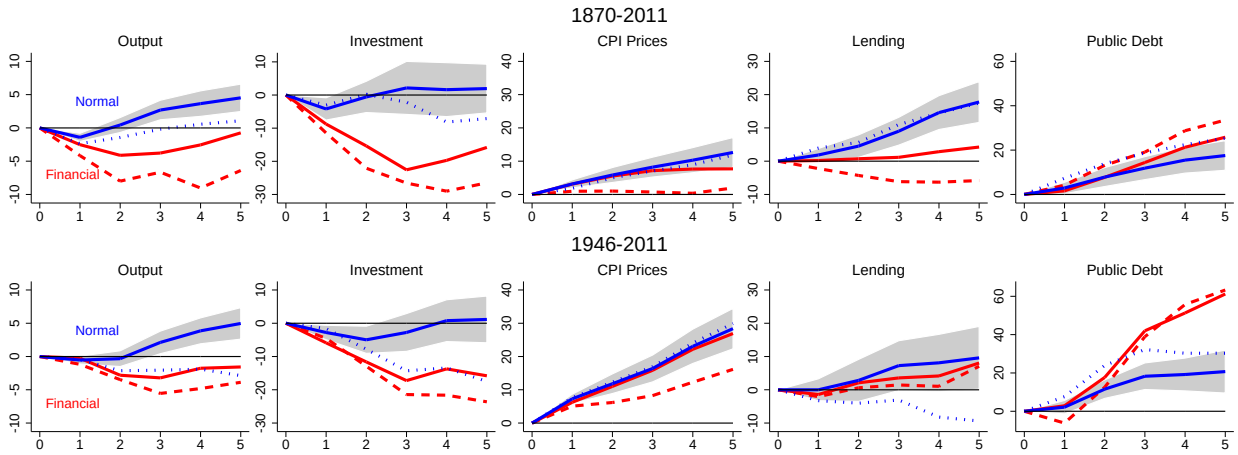
5.3 Public Debt Overhangs

Using historical data for developed economies starting in the early 1800s, Reinhart and Rogoff (2012) find that when the ratio of public debt to GDP exceeds 90% over five years, growth slows down by about 1 percentage point per year. In this section we take off from the main premise in Reinhart and Rogoff (2012) and ask if the *level* of public debt relative to GDP has an effect on the expected path of the economy through recession and recovery. Put differently, does high public debt make recessions worse and recoveries slower?

To estimate these effects, we can modify expression (5) above to measure how the *level* of debt to GDP modulates the average response in the recession conditional on

[6] We ran similar experiments for the accumulation of public debt in the expansion, as opposed to the level which we study in the next section, but did not find strong effects.

Figure 4: Conditional cumulative paths of selected macroeconomic aggregates in the recession as a function of private credit growth in the expansion and the type of recession. Samples: 1870–2011 and 1946–2011. Scales matched by row but allowed to vary across variables.



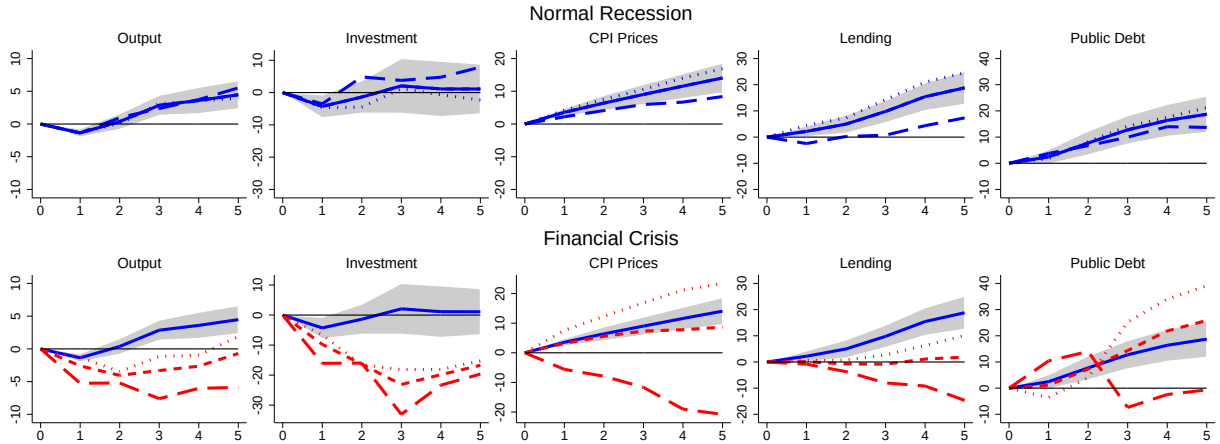
Notes: Top row refers to an excess credit experiment; the cumulative change in the variable since the start of the recession is displayed. The solid line with shaded region refers to the average path in normal recessions. The shaded region is a 95% confidence interval. The dotted line refers to the path in a normal recession when liabilities accumulated during the expansion grew at the mean plus two standard deviations. The solid line without shaded region refers to the average path in financial crises. The dashed line refers to the path in financial crises when liabilities accumulated during the expansion grew at the mean plus two standard deviations. Output measured as real GDP per capita; Investment in real terms and per capita; CPI measure the change in the index; lending measured as real bank lending in per capita terms; and public debt measured in percent of GDP. These results are conditional on macroeconomic aggregates and their lags as explained in the text.

controls. Specifically:

$$\Delta_h y^k_{it(p)+h} = \alpha^k_i + \theta^k_N d^N_{it(p)} + \theta^k_F d^F_{it(p)} + \phi^k_{h,N} d^N_{it(p)} \left(g_{it(p)} - \overline{g}_i \right) + \phi^k_{h,F} d^F_{it(p)} \left(g_{it(p)} - \overline{g}_i \right) + \sum_{l=0}^{L} \Gamma^k_{h,l} Y_{it(p)-l} + u^k_{h,it(p)}; \quad k = 1, ..., K; h = 1, ..., H \tag{6}$$

where $g_{it(p)}$ denotes the level of debt to GDP for country i at the start to the recession at time $t(p)$. Using expression (6), we then consider three experiments: the debt level is at zero, the debt level is at the mean, or the debt level is at twice the mean. Over the sample, the average debt level is 51% of GDP. Thus twice the mean indicates a situation where debt is running slightly above 100% of GDP. Notice that like before, we allow the

Figure 5: Conditional cumulative paths of selected macroeconomic aggregates in the recession as a function of the level of public debt and the type of recession. Sample: 1870–2011. Scales matched by row but allowed to vary across variables.



Notes: Top row refers to normal recessions. Solid line with 95% confidence region refers to debt at the historical mean and hence replicates the average response reported in earlier figures. The dotted line corresponds to debt at zero and dashed line to debt at twice the mean. The bottom row refers to financial crises. The solid line with confidence region replicates the trajectory displayed in the first row. Dotted line corresponds to debt at 0, dashed is debt at historical mean, and long dash with debt at twice the historical mean.

mean to be country-specific to allow for variation in addition to the fixed effect. The results of these experiments are reported in figure 6 for financial and normal recessions, using the full sample.

Figure 5 displays the trajectory of output, investment, inflation, bank lending and public debt in a normal recession and in a financial crisis. The top row displays typical trajectories in a normal recession. The solid line is the trajectory when the debt level at the start of the recession is at its long-run average (along with a 95% confidence region); the dotted line when debt is at zero; and the dashed line when debt is at twice the per country average or about 100% of GDP for most countries. The bottom row maintains the solid line as the trajectory in a normal recession with the debt level at the start of the recession at is long-run average (with a 95% confidence region) and then contains three additional trajectories, all corresponding to a financial crisis under different assumptions on the level of debt. Specifically, the dotted line corresponds to debt at zero; the short-dashed line refers to debt at the long-run average (about 51 percent of GDP); and the long-dashed line corresponds to debt at twice its long-run average.

Consider the trajectories for output first. Within the confines of our sample and our methods, one can detect that the level of public debt at the start of the recession does not meaningfully alter the path of the economy in normal times. The trajectory of output when debt is at zero, at its long-run mean or at 100% of GDP is virtually the same. However, in a financial recession, the level of public debt going into the recession seems to become more important. The higher the debt level at the start of the recession, the worse the recession and the slower the recovery. At average levels of debt, recovery from a financial crisis is achieved in year 5. But at high levels of debt, the recovery continues to sputter even in year five.

These results would be consistent with a scenario in which economies fare badly if the government is unable to do much to support the economy in a crisis through active fiscal policy, or else is somehow punished by credit markets with higher spreads, in scenarios where initial debt levels are elevated. It is telling that public debt (column 5) tends to grow in the first two years in a financial crisis at high initials levels of debt. Yet after two years, the trajectory reverses and public debt begins to contract, possibly because financial markets force austerity on the government.

Summing up, we find rather strong evidence that high levels of public debt matter for the path of economies out of recessions, confirming the results of Reinhart et al. (2012). However, our more granular conditional estimations suggests that the negative effects of high public debt on economic growth arise specifically after financial crises, and not so much in normal times. This may reflect either the economy's stronger powers of self-healing in normal recessions, meaning less need for stabilization policy, and/or smaller fiscal strains, meaning greater scope to act.

5.4 Private Credit Booms with Overhang of High Public Debt Levels

So far we have established that private credit booms can be a real drag on the economy, and that the same is true of high levels of public debt, at least in times of financial crises. What if both come together? Are the after-effects of private sector credit booms compounded when the public sector is constrained by already high levels of public debt? The goal of this section is to look at the effects of private credit booms and the effects of public debt overhangs discussed in Reinhart et al. (2012) jointly. We will see that, broadly speaking, the interaction matters. Both in normal and financial recessions, the

drag from a private credit boom is made worse by high levels of public debt.

Looking at private and public debt jointly can be easily accomplished within the statistical design presented in expressions (2), (5) and (6). Specifically, consider extending this last expression as follows:

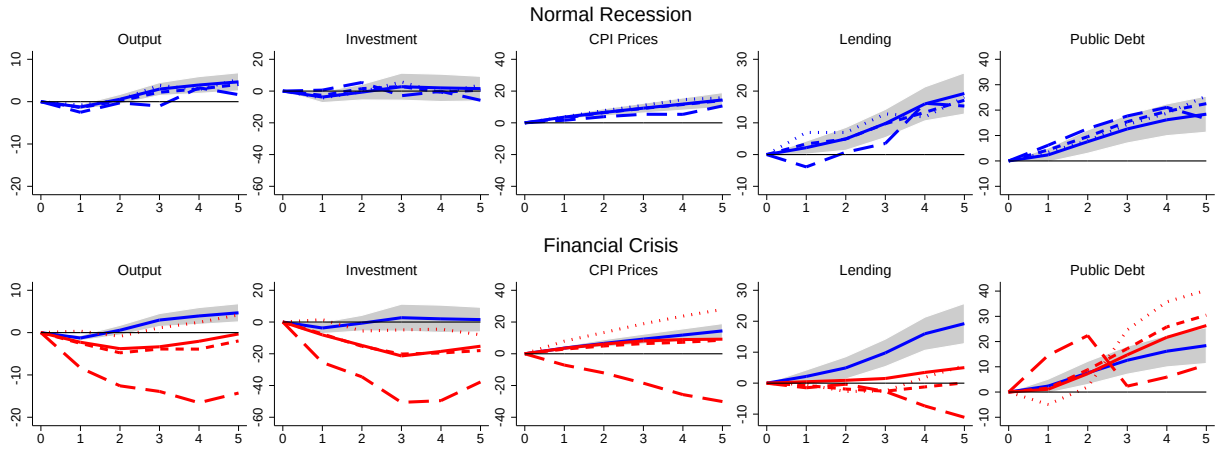
$$\begin{aligned}\Delta_h y^k_{it(p)+h} = \alpha^k_i + \theta^k_N d^N_{it(p)} + \theta^k_F d^F_{it(p)} + \beta^k_{h,N} d^N_{it(p)} \left(x_{it(p)} - \overline{x}_i\right) + \beta^k_{h,F} d^F_{it(p)} \left(x_{it(p)} - \overline{x}_i\right) \\ + \phi^k_{h,N} d^N_{it(p)} \left(g_{it(p)} - \overline{g}_i\right) + \phi^k_{h,F} d^F_{it(p)} \left(g_{it(p)} - \overline{g}_i\right) \\ + \delta^k_{h,N} d^N_{it(p)} \left(g_{it(p)} - \overline{g}_i\right) \left(x_{it(p)} - \overline{x}_i\right) + \delta^k_{h,F} d^F_{it(p)} \left(g_{it(p)} - \overline{g}_i\right) \left(x_{it(p)} - \overline{x}_i\right) \\ + \sum_{l=0}^{L} \Gamma^k_{h,l} Y_{it(p)-l} + u^k_{h,it(p)}; \quad k = 1, ..., K; h = 1, ..., H. \end{aligned} \tag{7}$$

This is a complicated expression with numerous interaction effects that requires some explanation. The coefficients $\beta^k_{h,N}$ and $\beta^k_{h,F}$ capture the effect of accumulation of private sector liabilities during the expansion. The coefficients have a similar interpretation to the coefficients in expression (5). Next, the coefficients $\phi^k_{h,N}$ and $\phi^k_{h,F}$ capture the effect of the level of debt at the start of the recession as discussed in the previous section. Notice that the debt levels g enter in deviation from country specific means to allow for cross-variation. Finally, the coefficients $\delta^k_{h,N}$ and $\delta^k_{h,F}$ correspond to the interaction of the public debt level with the private credit overhang term. Their purpose is to allow for a modulated effect on x. That is, these coefficients allow us to consider whether the effects of a private credit binge during the expansion aggravate a financial crisis even more when public debt levels are high to begin with.

Figure 6 displays as concise a summary of the numerous experiments as is possible.

The figure is organized in two rows. The top row corresponds to experiments with normal recessions and the bottom row to experiments with financial recessions. Both rows display experiments in which private credit grew at the average level plus one standard deviation in the previous expansion, but the effect of the private credit overhang is modulated by the level of public debt to GDP at the start of the recession. The various dashed lines indicate how the path of the economy differs with public debt at zero, at the long-run average (about 51% of GDP), or at twice the long-run average (slightly above 100% of GDP). Each of these debt levels is represented with a dotted line when debt is at zero, a short-dashed line when debt is at the mean, and a long-dashed

Figure 6: Conditional cumulative paths of selected macroeconomic aggregates in the recession as a function of the interaction between the level of public debt at the start of the recession and the preceding private credit boom. Sample: 1870–2011. Scales matched by row but allowed to vary across variables.



Notes: Top row refers to normal recessions, bottom row refers to financial crisis recessions. The solid lines depict the average response in each type of recession with all variables at their mean, and in the normal case with a 95 percent confidence region. The various non-solid lines indicate how the path of the economy differs with two simultaneous perturbations: when private credit grows at the average level plus one standard deviation in the previous expansion; and, in addition, when public debt is set at zero, at 51 percent of GDP (the mean), or at twice the mean (slightly above 100 percent of GDP). Each of these debt levels is represented with a dotted line when debt is at zero, a short-dashed line when debt is at the mean, and a long-dashed line when debt is at twice the mean.

line when debt is at twice the mean. Finally, in all figures the average path of normal recessions is displayed as a solid line along with a 95 percent confidence region.

Let's start with the top row. Broadly speaking, these five charts convey a very similar message to the one discovered in the previous section. On average, the trajectories are very similar. When the experiment focuses on public debt levels at twice the historical average, the economy tends to suffer from somewhat deeper and more prolonged recessions. One could also say that the negative effects of a private sector debt overhang can mostly be undone by entering the recession with low levels of public debt to GDP.

However, the real story appears in the second row, i.e., in financial crisis recessions. Here it becomes clear that high initial levels of public debt to GDP can be an enormous drag on the recovery if they coincide with a sizeable private credit overhang. When an above average private sector credit boom is unwound, high levels (about 100% of GDP) of public debt turn out to be highly problematic. Output remains severely depressed for

many years, being far off the previous peak even in year 5.

Both the behavior of investment and prices reinforce this message of a potentially dangerous cocktail of private and public sector debt overhang: after private sector credit booms, high levels of public debt are associated with substantial shortfalls in investment and prolonged deflationary pressures. The behavior of public debt itself may contain part of the explanation. Whereas public debt rises relative to GDP throughout the recession when initial debt levels are low and thereby potentially cushions the effects of private sector retrenchement, the fiscal space of the government may be more limited when initial debt is high. The initial increase in public debt is reversed after two years, coinciding with additional slack in output, investment and private borrowing.

In sum, high levels of public debt can be dangerous and our findings argue in support of the idea of keeping public debt low for precautionary reasons. In particular, in financial crisis recessions, high initial levels of public debt are associated with prolonged spells of weak growth, potentially because high debt undercuts the government's ability to counteract the drag from private sector balance sheet repair.

6 Conclusion

We have looked at over 100 years of the history of inter-relationships of private credit and sovereign debt, and we end with five main conclusions.

First, while public debt has grown in most countries in recent decades, the extraordinary growth of private sector debt (bank loans) is chiefly responsible for the strong increase of total liabilities in Western economies. Shadow bank liabilities, important in some cases like the U.S. and U.K. amplify this conclusion. About two thirds of the increase in total economy debt originated in the private sector. Sovereign and bank debts have generally been inversely correlated over the long run, but have increased jointly since the 1970s. In modern times, the Bretton-Woods period stands out as the only period of sustained public debt reduction, both in expansions and recessions.

Second, in advanced economies financial stability risks originate in the private sector, not in the public sector. To understand the driving forces of financial crises, one has to study private borrowing and its problems. In the very long run, if we run a horse race between the impact of changes or run-ups in private credit (bank loans) and

sovereign debt as a predictor of financial crisis, and its associated distress, there is no doubt that private credit is the more significant predictor; sovereign debt adds virtually no predictive information. This fits with the events of 2008: with the exception of fiscal malfeasance in Greece, most other advanced countries did not have obvious public debt problems *ex ante* (though, of course, *ex post*, the fierce financial crisis recession would wreak havoc on public finances via crashing revenues and rising cyclical expenditures).

Third, with a broader and longer sample we confirm that private credit booms are a regular feature of the modern business cycle. We find that once a country does enter a recession, whether it is an ordinary type or a financial-crisis type of recession, if it carries the legacy of a large private credit boom, then the post-recession output path of the economy is typically adversely affected, with slower growth.

Fourth, the new data also allow us to see the distinct contribution of public debt overhang more clearly. We find evidence that high levels of public debt matter for the path of economies out of recessions, confirming the results of Reinhart et al. (2012). But the negative effects of high public debt on the performance of the economy arise specifically after financial crises. While high levels of public debt make little difference in normal times, entering a financial crisis recession with an elevated level of public debt exacerbates the effects of private sector deleveraging and typically leads to a prolonged period of sub-par economic performance.

Fifth, and following from the above, from a macroeconomic policy standpoint, these observations could inform ongoing efforts to devise better guides to monetary, fiscal and financial policies going forward, at a time when policymakers are searching for lessons from the Great Recession. On the private credit side, many countries and international bodies are considering or implementing rules or guides for macro prudential policies that incorporate private credit indicators. On the fiscal side, sovereign stresses in advanced countries have also brought to the fore questions of fiscal space and what limits on average or over the cycle may be usefully employed, whether, for example, in the form of fiscal rules or in better planning the timing of austerity.

References

Bordo, Michael D., and Joseph G. Haubrich. 2010. Credit Crises, Money, and Contractions: An

Historical View. *Journal of Monetary Economics* 57: 1–18.
Bry, Gerhard, and Charlotte Boschan. 1971. *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*. New York: NBER.
Claessens, Stijn, M. Ayhan Kose, and Marco E. Terrones. 2011. Financial Cycles: What? How? When? in *NBER International Seminar on Macroeconomics 2010* edited by Richard Clarida and Francesco Giavazzi. Chicago: University of Chicago Press, pp. 303–43.
Cerra, Valerie, and Sweta C. Saxena. 2008. Growth Dynamics: The Myth of Economic Recovery. *American Economic Review* 98(1): 439–457.
Bordo, Michael D., and Joseph G. Haubrich. 2010. Credit Crises, Money and Contractions: An Historical View. *Journal of Monetary Economics* 57: 1–18.
Brunnermeier, Markus K., Luis Garicano, Philip R. Lane, Marco Pagano, Ricardo Reis, Tano Santos, Stijn Van Nieuwerburgh, and Dimitri Vayanos. 2011. European Safe Bonds: ESBies. euro-nomics.com.
Checherita, Cristina, and Philipp Rother. 2010. The impact of high and growing government debt on economic growth—an empirical investigation for the euro area. ECB Working Paper No. 1237. Forthcoming in *European Economic Review*.
Corsetti, Giancarlo, Keith Kuester, André Meier, and Gernot Müller. 2012. Sovereign Risk, Fiscal Policy, and Macroeconomic Stability. CEPR Discussion Paper 8779.
Eggertsson, Gauti B., and Paul Krugman. 2012. Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach. *Quarterly Journal of Economics* 127 (3): 1469–1513.
Guerrieri, Veronica, and Guido Lorenzoni. 2011. Credit Crises, Precautionary Savings, and the Liquidity Trap. NBER Working Paper 17583.
Hall, Robert E. 2011. The Long Slump. *American Economic Review* 101(2): 431–69.
Jordà, Òscar. 2005. Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review* 95(1): 161–182.
Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2011a. Financial Crises, Credit Booms and External Imbalances: 140 Years of Lessons. *IMF Economic Review* 59(2): 340–78.
Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2011b. When Credit Bites Back: Leverage, Business Cycles, and Crises. NBER Working Papers 17621. Forthcoming in *Journal of Money, Credit, and Banking*.
Howard, Greg, Robert Martin, and Beth Anne Wilson. 2011. Are Recoveries from Banking and Financial Crises Really So Different? Board of Governors of the Federal Reserve System, International Finance Discussion Paper 1037.
Jordà, Òscar, and Alan M. Taylor. 2011. Performance Evaluation of Zero Net-Investment Strategies. NBER Working Paper 17150.
Koo, Richard. 2008. *The Holy Grail of Macroeconomics: Lessons from Japan's Great Recession.* New York: Wiley.
Maddison, Angus. 2005. Measuring and Interpreting World Economic Performance, 1500–2001. *The Review of Income and Wealth* 51(1): 1–35.
Mian, Atif, and Amir Sufi. 2010. Household Leverage and the Recession of 2007 to 2009. *IMF Economic Review* 58(1): 74–117.
Mian, Atif, Kamalesh Rao, and Amir Sufi. 2011. Household Balance Sheets, Consumption, and the Economic Slump. Unpublished. Chicago Booth School of Business.
Minea, Alexandru, and Antoine Parent. 2012. Is High Public Debt Always Harmful to Economic Growth? Reinhart and Rogoff and Some Complex Nonlinearities. Association Franaise de

Cliomtrie (AFC) Working Paper 12-08.
Philippon, Thomas, and Virgiliu Midrigan. 2011. Household Leverage and the Recession. NBER Working Paper 16965.
Pozsar, Zoltan, Tobias Adrian, Adam Ashcraft and Hayley Boesky. 2010. Shadow Banking. Federal Reserve Bank of New York Staff Report 458.
Reinhart, Carmen M., Vincent R. Reinhart, and Kenneth S. Rogoff. 2011. Debt Overhangs: Past and Present. NBER Working Paper 18015.
Reinhart, Carmen M., and Kennth S. Rogoff. 2009a. The Aftermath of Financial Crises. *American Economic Review* 99(2): 466–72.
Reinhart, Carmen M., and Kenneth S. Rogoff. 2009b. *This Time is Different: Eight Centuries of Financial Folly*. Princeton, N.J.: Princeton University Press.
Reinhart, Carmen M., and Kenneth S. Rogoff. 2010. Growth in a Time of Debt. NBER Working Paper 15639.
Schularick, Moritz, and Alan M. Taylor. 2012. Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008. *American Economic Review* 102(2): 1029–61.