NBER WORKING PAPER SERIES

CREDIT BOOMS GONE BUST: MONETARY POLICY, LEVERAGE CYCLES AND FINANCIAL CRISES, 1870–2008

Moritz Schularick
Alan M. Taylor

Working Paper 15512
http://www.nber.org/papers/w15512

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 2009

This paper is forthcoming in the American Economic Review. Some research was undertaken while Taylor was a visitor at the London School of Economics and a Houblon-Norman/George Fellow at the Bank of England. The generous support of both institutions is gratefully acknowledged. We thank Roland Beck, Warren Coats, Steven Davis, Charles Goodhart, Pierre-Cyrille Hautcoeur, Carl-Ludwig Holtfrerich, Gerhard Illing, Christopher Meissner, Kris Mitchener, Eric Monnet, Andreas Pick, Hyun Shin, Solomos Solomou, Richard Sylla, and two anonymous referees for helpful comments. We also benefitted from helpful comments by conference and workshop participants at the Bank of England, the Federal Reserve Bank of San Francisco, the 2010 EHA meetings, the ECB, the NBER DAE Program Meeting, the 16th Dubrovnik Economic Conference, New York University, Fordham University, Columbia University, the Free University of Berlin, and the Universities of Munich, Mannheim, Muenster and Kiel. Farina Casselmann, Stephanie Feser, and Felix Mihram provided valuable research assistance. All remaining errors are our own. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870–2008
Moritz Schularick and Alan M. Taylor
NBER Working Paper No. 15512
November 2009, Revised July 2011
JEL No. E44,E51,E58,G01,G20,N10,N20

ABSTRACT

The crisis of the advanced economies in 2008–09 has focused new attention on money and credit fluctuations, financial crises, and policy responses. We study the behavior of money, credit, and macroeconomic indicators over the long run based on a new historical dataset for 14 countries over the years 1870–2008, using the data to study rare events associated with financial crisis episodes. We present new evidence that leverage in the financial sector has increased strongly in the second half of the twentieth century as shown by a decoupling of money and credit aggregates. We show for the first time how monetary policy responses to financial crises have been more aggressive post-1945, but how despite these policies the output costs of crises have remained large. Importantly, we demonstrate that credit growth is a powerful predictor of financial crises, suggesting that such crises are "credit booms gone wrong" and that policymakers ignore credit at their peril. It is only with the long-run comparative data assembled for this paper that these patterns can be seen clearly.

Moritz Schularick
John-F.-Kennedy-Institute,
Free University of Berlin,
Berlin,
Germany
moritz.schularick@fu-berlin.de

Alan M. Taylor
Department of Economics
University of Virginia
Monroe Hall
Charlottesville, VA 22903
and NBER
alan.m.taylor@virginia.edu

In the brief history of macroeconomics, the subject of money and banking has witnessed wide fluctuations in both its internal consensus and external influence. The crisis of 2008–09 has reignited a new interest in understanding money and credit fluctuations in the macroeconomy and the crucial roles they could play in the amplification, propagation, and generation of shocks both in normal times and, even more so, in times of financial distress. This may reopen a number of fundamental fault lines in modern macroeconomic thinking—between theories that treat the financial system as irrelevant, or, at least, not central to the understanding of economic outcomes, and those that reserve a central role for financial intermediation. Economic history has an important role to play in this debate. The failures revealed by the present crisis demand that we humbly return to macroeconomic and financial history, in the hope that better empirical evidence may provide safer guidance than introspection alone.

Still, for other more pragmatic reasons a return to the past is inevitable, because "rare events" thrust comparative economic history to the fore. If regular business cycles are roughly once per decade events, then we already have very few observations in the postwar data for any given country. More disruptive events like depressions and financial crises are rarer still, at least in developed economies. When sample sizes are this small, providing a detailed quantitative rendition, or even just a sketch of the basic stylized facts, requires that we work on a larger canvas, expanding our dataset across both time and space. Hence, scholars have reached back to make careful comparisons not just with past decades, but past centuries, using formal statistical analysis to examine the nature of financial crises and other rare events with new panel datasets, as in recent work by Carmen M. Reinhart and Kenneth S. Rogoff (2009), Robert J. Barro (2009), and Miguel Almunia et al. (2010). In the same spirit, the purpose of this paper is to step back and ask such questions about money, credit, and the macroeconomy in the long run. As a key part of this effort, we present a new long-run historical dataset for 14 developed countries over almost 140 years which will provide not just the empirical backbone for our research agenda but also serve as a valuable resource for future investigations by other scholars interested in this subject.

Economic thinking about the role of money and credit in the macroeconomy has changed substantially over time (Xavier Freixas and Jean-Charles Rochet 1997, chap. 6). The experience of the late nineteenth and early twentieth century, including the disruptions of the 1930s, formed the foundation of the "money view" which is indelibly associated with the seminal contributions of Milton Friedman and Anna J. Schwartz (1963).[1] In the late twentieth century the "irrelevance view" gained influence, associated with the ideas of Franco Modigliani and Merton Miller (1958) among others, where real economic decisions became independent of financial structure altogether. Starting in the 1980s, the "credit view" gradually attracted attention and adherents. In this view, starting with the works of Frederic S. Mishkin (1978), Ben S. Bernanke (1983), and Mark Gertler (1988), and drawing on ideas dating back to Irving Fisher (1933) and John G. Gurley and E. S. Shaw (1955), the mechanisms and quantities of bank credit matter, above and beyond the level of bank money.[2] Still, one strand of criticism notes that in most financial-accelerator models credit is largely passive—a propagator of shocks, not an independent source of shocks (Claudio Borio 2008; Michael Hume and Andrew Sentance 2009).[3] By contrast, in other classes of models, multi-

[1]In this account, the central bank can and must exert proper indirect control of aggregate bank liabilities, but beyond that, the actual functions of the banks, and their role in credit creation via bank loans, are of no great importance.

[2]The entire bank balance sheet, the asset side, leverage, and composition, may have macroeconomic implications. One consequence may be an amplification of the monetary transmission mechanism, that is, a financial accelerator effect (Bernanke and Alan S. Blinder 1988). Another issue might be financial fragility induced by collateral constraints (Bernanke, Gertler, and Simon Gilchrist 1999 or BGG). This important turn in the literature in the 1980s was guided by more inductive empirical work, where warnings about the role of credit included Otto Eckstein and Allen Sinai (1986) and Henry Kaufman (1986).

[3]This limitation was well understood: for example, Bernanke and Gertler (1995, p. 28) stated that "[t]he credit channel is an enhancement mechanism, not a truly independent or parallel channel." A step forward is to introduce disturbances to credit constraints in a BGG-style model (Charles Nolan and Christoph Thoenissen 2009; Urban Jermann and Vincenzo Quadrini 2009),

ple equilibria or feedback effects are possible (Bernanke and Gertler 1995; Nobuhiro Kiyotaki and John Moore 1997); work by John Geanakoplos (2009) on leverage cycles meshes with this view.[4]

Given these disparate views, we ask: what are the facts? To our knowledge, the dynamics of money, credit, and output have not been studied across a broad sample of countries over the long run. There are, however, a few recent studies that are comparable to ours in spirit, in that they lift the veil of finance to re-examine the link between financial structure and real activity in the past or present. Tobias Adrian and Hyun Song Shin (2008, 2009), Enrique G. Mendoza and Marco E. Terrones (2008), as well as Hume and Sentance (2009) have analysed the structural changes in the financial system in recent years and the consequences for financial stability and monetary policy. Previously, Peter L. Rousseau and Paul Wachtel (1998) had investigated the link between economic performance and financial intermediation between 1870 and 1929 for five industrial countries, while Barry Eichengreen and Kris Mitchener (2003), among others, have studied the credit boom preceding the Great Depression.[5]

1 Money, Credit, and Crises in The Long Run

As quantitative historians we want to know whether the structures and dynamics of money, credit and the macroeconomy have shifted in the long run—and, how, and with what effects. The contribution of this paper is to make a start on the broader, systematic, cross-country quantitative history of money and credit, by focussing on three main questions: (*i*) which key stylized facts can we derive from the long-run trends in money and credit aggregates?; (*ii*) how have the monetary policy responses to financial crises changed over time?; and (*iii*) what role do credit and money play as a cause of financial crises? Our empirical analysis proceeds as follows.

We first document and discuss our newly assembled dataset on money and credit, aligned with various macroeconomic indicators, covering 14 developed countries from 1870 to 2008. We establish a number of important stylized facts about what we shall refer to as the "two eras of finance capitalism". The first era runs from 1870 to 1939. In this era, money and credit were volatile but over the long run they maintained a roughly stable relationship to each other, and to the size of the economy measured by GDP. The only exception was the Great Depression period: in the 1930s money and credit aggregates collapsed. In this first era, the one studied by Friedman and Schwartz, the "money view" of the world looks entirely plausible.

However, the second financial era, starting in 1945, looks very different. First, money and credit began a long postwar recovery, trending up rapidly and then surpassing their pre-1940 levels compared to GDP by about 1970. That trend continued to the present and, in addition, credit itself then started to decouple from broad money and grew rapidly, via a combination of increased leverage and augmented funding via the nonmonetary liabilities of banks. With the banking sector progressively more leveraged in the second financial era, particularly in the last decade or so, the divergence between credit supply and money supply offers *prima facie* support for the credit view as against a pure money view; we have entered an age of unprecedented financial risk and leverage, a new global stylized fact that is not fully

though we still need to know precisely what drives the processes or beliefs that create such disturbances.

[4]More radical departures are possible in an older tradition; in the work of scholars such as Hyman P. Minsky (1977), the financial system itself is prone to generate economic instability through endogenous credit bubbles with waves of euphoria and anxiety. And indeed, economic historians such as Charles P. Kindleberger (1978) have generally been sympathetic to such ideas pointing to recurrent episodes of credit-driven instability throughout financial history.

[5]A great number of postwar studies have focussed on the role of financial structure in comparative development and long-run economic growth, a question that is related but distinct from our analysis (Raymond W. Goldsmith 1969; E. S. Shaw 1973; Ronald I. McKinnon 1973; Woo S. Jung 1986; Robert G. King and Ross Levine 1993).

appreciated.

In a second empirical investigation we look at money, credit and the consequences of crises. We use an event-analysis approach to study the co-evolution of money and credit aggregates and real economic activity in the five-year window following a financial crisis. We also pursue this analysis in two periods, 1870–1939 and 1945–2008. This approach is motivated by our identification of two distinct eras of finance, as above; but it also reflects the very different monetary and regulatory framework after WW2, namely the shift away from gold to fiat money, the greater role of activist macroeconomic policies, the greater emphasis on bank supervision and deposit insurance, and the expanded role of the Lender of Last Resort. Our results show dramatically different crisis dynamics in the two eras, or "now" versus "then." In postwar crises, central banks have strongly supported money base growth, and crises have not been accompanied by a collapse of broad money, although credit does still contract. On the real side, a striking result is that the economic impact of financial crises is no more muted in the postwar era than in the prewar era. However, given the much larger financial systems we have today (the first stylized fact above) the real effects of the postwar regime could take the form of preventing potentially *even larger* real output losses that could be realized in today's more heavily financialized economies without such policies. With regard to prices, inflation has tended to rise after crises in the post-WW2 era, with economies avoiding the strong Fisherian debt-deflation mechanism that tended to operate in pre-WW2 crises, and this could be another factor preventing larger output losses. The bottom line is that the lessons of the Great Depression, once learned, were put into practice. After 1945 financial crises were fought with more aggressive monetary policy responses, banking systems imploded neither so frequently nor as dramatically, and deflation was avoided—although crises still had real costs. However, in tandem with our previous findings, it is natural to ask to what extent the implicit and explicit insurance of financial systems by governments encouraged the massive expansion of leverage that emerged after the war.

In a final empirical exercise we ask what we can learn about the fragility of financial systems using our credit data. Specifically, we test one element of the credit view argument—associated with Minsky, Kindleberger, and others—that financial crises can be seen as "credit booms gone wrong." This approach also echoes Joseph Schumpeter's diagnosis that "reckless lending" and financial speculation are closely linked to credit creation as the "monetary complement of innvoation" over the business cycle (Schumpeter 1939). We follow the early-warning approach and construct a typical macroeconomic lagged information set at any date T for all countries in our sample. Lagged credit growth turns out to be highly significant as a predictor of financial crises, but the addition of other variables adds very little explanatory power. Introducing interaction terms, we also find some support for the notion that financial stability risks increase with the size of the financial sector and that boom-and-bust episodes in stock markets become more problematic in more financialized economies.

These new results from long-run data inform current controversies over macroeconomic policy in developed countries. Specifically, the pre-2008 consensus argued that monetary policy should follow a "rule" based only on output gaps and inflation, but a few dissenters thought that credit deserved to be watched carefully and incorporated into a broader central bank policy framework. The influence of the credit view has certainly advanced after the 2008–09 crash, just as respect has waned for the glib assertion that central banks could ignore potential bubbles and easily clean up after they burst.

2 The Data

To study the long-run dynamics of money, credit and output we assembled a new annual dataset covering 14 countries over the years 1870–2008. The countries covered are the United States, Canada, Australia, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, and the United Kingdom. At the core of our dataset are yearly data for aggregate bank loans and total balance sheet size of the banking sector. We complemented these credit series with narrow (M0 or M1) and broad (typically M2 or M3) monetary aggregates as well as data on nominal and real output, inflation and investment. To investigate the potential inter-relationship between crises, credit, and asset prices, we have also collected long-run stock market indices from a number of (partly new) sources as discussed in a later section below.

The two core definitions we work with are as follows. Total lending or *bank loans* is defined as the end-of-year amount of outstanding domestic currency lending by domestic banks to domestic households and non-financial corporations (excluding lending within the financial system). Banks are defined broadly as monetary financial institutions and include savings banks, postal banks, credit unions, mortgage associations, and building societies whenever the data are available. We excluded brokerage houses, finance companies, insurance firms, and other financial institutions. Total *bank assets* is then defined as the year-end sum of all balance sheet assets of banks with national residency (excluding foreign currency assets).

It is important to point out that the definitions of credit, money, and banking institutions vary profoundly across countries, which makes cross-country comparisons difficult. In addition, in some cases, such as the Netherlands or Spain, historical data cover only commercial banks, not savings banks or credit co-operatives. In this paper, we therefore focus predominantly on the time-series dimension of the data and for the most part avoid outright comparisons in levels (e.g., we employ country fixed effects). However, the definitions of money and credit aggregates have also changed within countries over time in response to institutional or financial innovation. Building a consistent and comparable dataset was therefore no easy task and we often had to combine data from various sources to arrive at reasonably consistent long-run time series.[6] Further details on our dataset can be found in the web appendix, but Table 1 summarizes the key variables at our disposal.

Several features of the data are already apparent in Table 1. In the upper panel, the major ratios of assets and loans to money and GDP both climbed after the war, but the averages disguise some important trends. The trend breaks are more apparent as we study the growth rates in the lower panel where it is clear that annual growth rates of broad money (3.65%), loans (4.16%), and assets (4.33%) were fairly similar in the pre-WW2 period; in contrast, after WW2 average broad money growth (8.57%) was much smaller than loan growth (10.94%) and asset growth (10.48%). The loan-money ratios grew at just 0.17% per year before WW2 but 2.22% per year after, a 20-fold increase in the growth rate of this key leverage measure. Similarly asset-money growth rates jumped from 0.43% to 1.82% per year, a quadrupling. Thus even at the level of simple summary statistics we can grasp that the behavior of money and credit aggregates changed markedly in the middle of the twentieth century. However, a more detailed analysis of these and other data brings the differences between the two eras into sharper relief.

[6]Our key sources were official statistical publications such as the U.S. Federal Reserve's *All Bank Statistics* or the Bundesbank's *Geld- und Kreditwesenstatistik*. We also draw on the work of individual economic historians such as David Sheppard's statistics for the British financial system or Malcolm Urquhart's work on Canadian financial statistics. And we are indebted to our many colleagues who provided advice and assistance to us in all these tasks. We wish to acknowledge the support we received from Joost Jonker and Corry van Renselaar (Netherlands); Gianni Toniolo and Claire Giordano (Italy); Kevin O'Rourke (Denmark); Eric Monnet and Pierre-Cyrille Hautcoeur (France); Carl-Ludwig Holtfrerich (Germany); Rodney Edvinsson (Sweden); Youssef Cassis (Switzerland); Pablo Martin Aceña (Spain); Ryland Thomas (Britain). In addition, we would like to thank Michael Bordo and Solomos Solomou for sharing monetary and real data from their data collections with us. Kris Mitchener directed us to the sources for Japan; Magdalena Korb and Nikolai Baumeister helped with translation.

Table 1: Annual Summary Statistics by Period

	Pre-World War 2			Post-World War 2		
	N	mean	s.d.	N	mean	s.d.
Loans/Money	665	0.4217	0.3582	831	0.5470	0.4239
Assets/Money	617	0.7132	0.4453	828	1.0135	0.6688
Broad Money/GDP	742	0.5343	0.2070	834	0.6458	0.2405
Loans/Money	642	0.7581	0.4382	833	0.8380	0.4942
Assets/Money	586	1.2790	0.5642	831	1.5758	0.7525
Δ log Real GDP	868	0.0148	0.0448	854	0.0270	0.0253
Δ log CPI	826	−0.0002	0.0568	852	0.0452	0.0396
Δ log Narrow Money	787	0.0278	0.0789	825	0.0780	0.0717
Δ log Money	741	0.0365	0.0569	833	0.0857	0.0552
Δ log Loans	652	0.0416	0.0898	833	0.1094	0.0749
Δ log Assets	607	0.0433	0.0691	825	0.1048	0.0678
Δ log Loans/Money	626	0.0017	0.0729	825	0.0222	0.0643
Δ log Assets/Money	573	0.0043	0.0452	820	0.0182	0.0595

Notes: Money denotes broad money. Loans denote total bank loans. Assets denote total bank assets. The sample runs from 1870 to 2008. War and aftermath periods are excluded (1914–19 and 1939–47), as is the post-WW1 German crisis (1920–25). The 14 countries in the sample are the United States, Canada, Australia, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, and the United Kingdom.

3 Money and Credit in Two Eras of Finance Capitalism

In a first step, we analyse the new dataset with an eye on deriving a number stylized facts about credit and monetary aggregates from the gold standard era until today.

The first important fact that emerges from the data is the presence of two distinct "eras of finance capitalism" as shown in Figures 1 and 2. Figure 1 displays the trend in credit and money aggregates relative GDP, while Figure 2 displays the long–run trends in the credit to money ratios, where in each case we show the average trend for the 14 countries in our dataset. To construct these average global trends, both here and in some other figures that follow, we show the mean of the predicted time effects from fixed country-and-year effects regressions for the dependent variable of interest. That is for any variable x_{it} we estimate the fixed effects regression $x_{it} = a_i + b_t + e_{it}$ and then plot the estimated year effects b_t to show the average global level of x in year t.

From these figures we see that the first financial era lasted from 1870 to WW2. In this era, money and credit were volatile but over the long run they maintained a roughly stable relationship to each other and relative to the size of the economy as measured by GDP. Money and credit grew just a little faster than GDP in the first few decades of the classical gold standard era from 1870 to about 1890, but then remained more or less stable relative to GDP until the credit boom of the 1920s and the Great Depression. In the 1930s, both money and credit aggregates collapsed. Figure 2 shows that the relationship between the loan or asset measures and broad money remained almost perfectly stable throughout the first era up to WW2, save for the 1930s global credit crunch. In that epoch, money growth and credit growth were essentially two sides of the same coin. The same was not true in the second era after WW2, when loans and assets both embarked on a long, strong secular uptrend relative to broad money, and here both graphs reveal profound structural shifts in the relationship between credit, money, and output.

Thus, during the first era of finance capitalism, up to 1939, the era studied by canonical monetarists like Friedman and Schwartz, the "money view" of the world looks entirely reasonable. Banks' liabilities were first and foremost monetary, and exhibited a fairly stable relationship to total credit. In that envi-

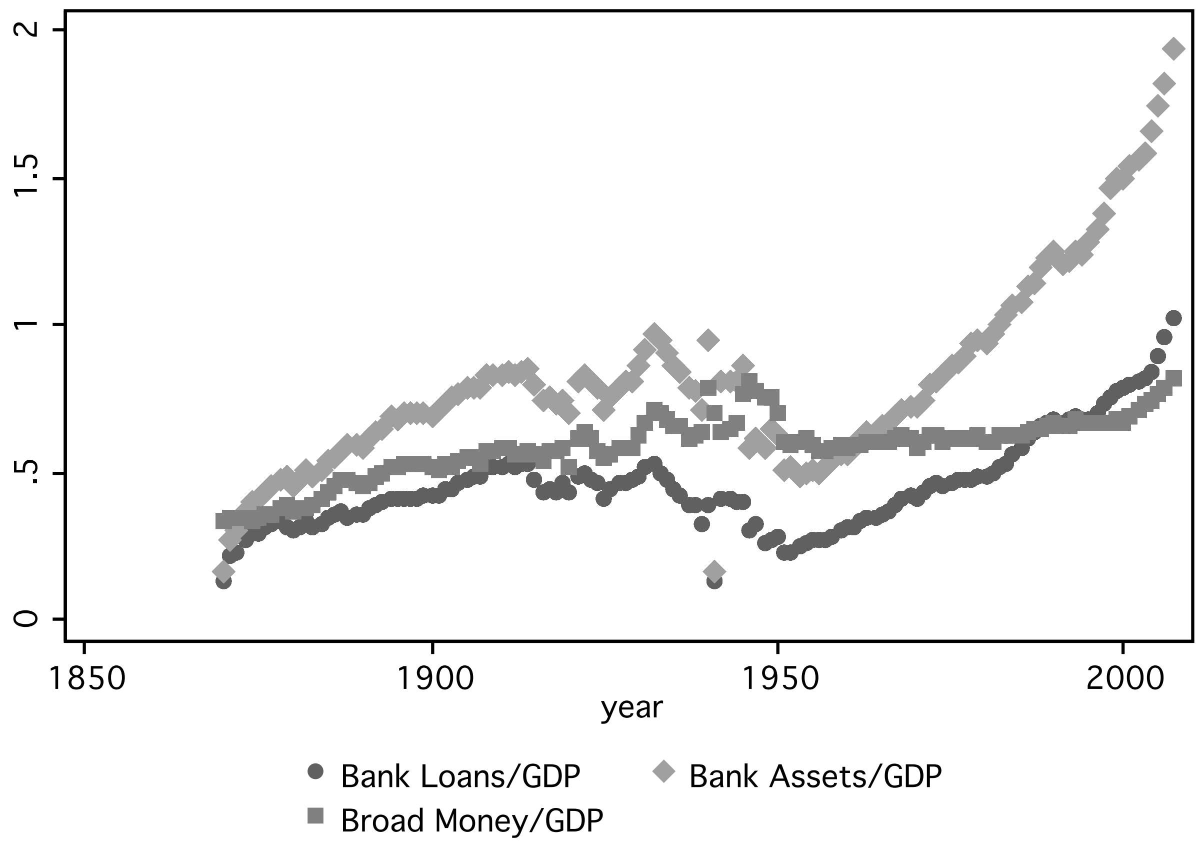

Figure 1: Aggregates Relative to GDP (Year Effects)

ronment, by steering aggregate liabilities of the banking sector, the central bank could hope to exert a smooth and steady influence over aggregate lending.

The relationships changed dramatically in the post-1945 period. First, credit began a long recovery after the dual shocks to the financial sector from the Great Depression and the war. Loans and bank assets took off on a very rapid upward trend in the Bretton Woods era as seen in Figure 1, and they managed to surpass their pre-1940 ratios, compared to GDP, by about 1970. Second, credit not only grew strongly relative to GDP, but also relative to broad money after WW2, via a combination of higher leverage and (after the 1970s) through the use of new sources of funding, mainly debt securities, creating more and more non-monetary bank liabilities.[7] Again, the pre-WW2 ratios of credit and assets to money were surpassed circa 1970, as seen in Figure 2. Loan-money and asset-money ratios, shown here in logs, continued ever higher, attaining levels $+0.750$ log points higher than their prewar average by around 2000 (i.e., about $\times 2$ in levels).

We also note that this increase in the credit to money ratio does not only apply to a few individual countries, e.g., the usual Anglo-Saxon suspects, but has been a common phenomenon in many countries. Figure 3 shows the log loan-money and log asset-money ratios for all countries at decadal dates. Country

[7]It is even likely that our numbers underestimate the process of credit creation in the past decades as a growing portion of lending, at least in some countries, was securitized and is no longer carried on banks' balance sheets.

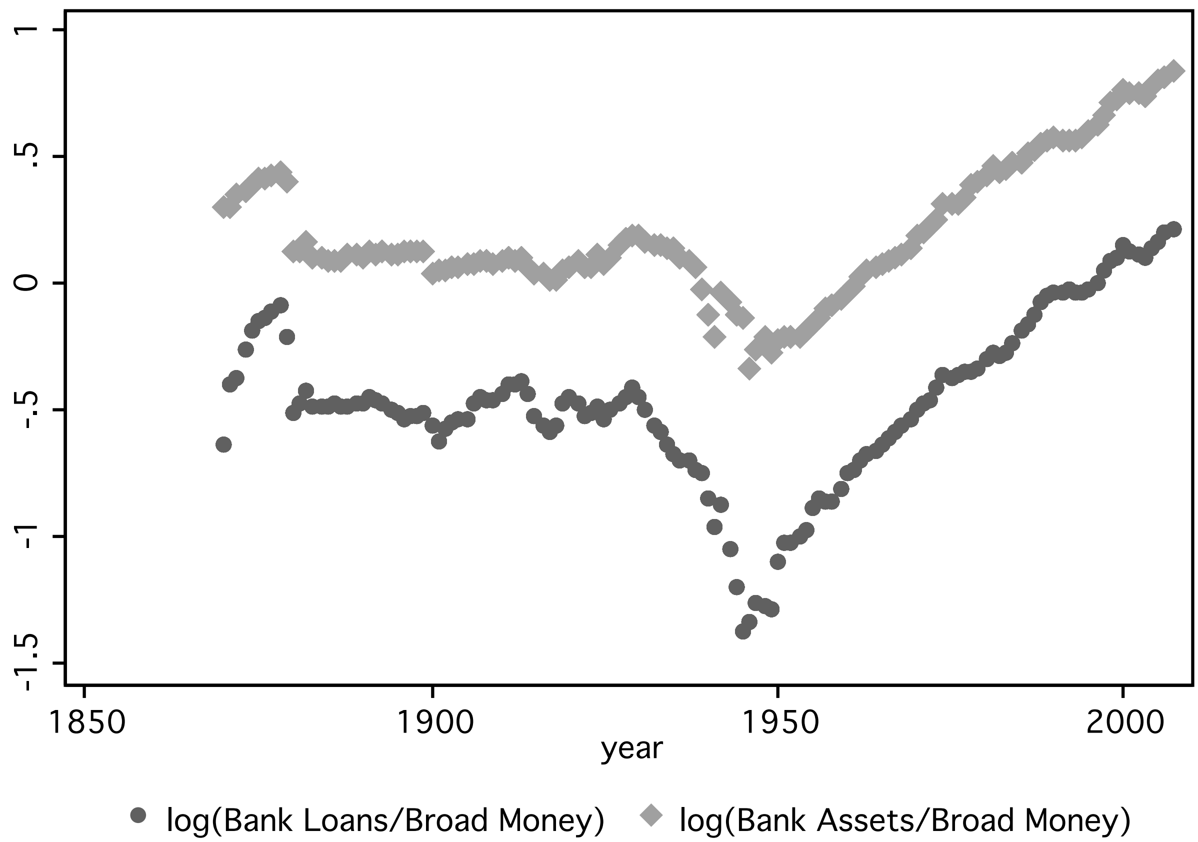

Figure 2: Aggregates Relative to Broad Money (Year Effects)

experiences varied somewhat before WW2, but in a way consistent with accepted historical narratives. For example, the countries of the late nineteenth century periphery in our sample—Italy and Spain—saw rapid financial catch-up relative to the core in the 1870–1939 period, and this explains their rapid leverage growth in the pre-WW2 period, when most other countries exhibit a flat trend. But after WW2, for all countries in the sample, the experience is strikingly similar—a trend increase in both ratios from the 1950s to the present. These new insights expose a *global* story of decades of slowly encroaching risk on bank balance sheets, not one confined to a few profligate nations.

To sum up, the ratio of credit to money remained broadly stable between 1870 and 1930. The Great Depression then saw a marked deleveraging of the banking system. In the postwar period, banks first grew their loan books relative to available deposits, before sustaining high credit growth through increasing reliance on non-monetary liabilities. The dynamics are basically comparable between the European countries in the sample and the United States, but the pace of the balance sheet growth has been even higher in Europe than in the United States, as, in the latter, non-bank financial intermediaries like broker dealers have played a large role and exhibited even stronger balance sheet expansion than the commercial banks (Adrian and Shin 2008).

What does this structural change mean for the questions about money, credit, and output raised before? First, in the latest phase, in which banks fund loan growth through non-monetary liabilities, the

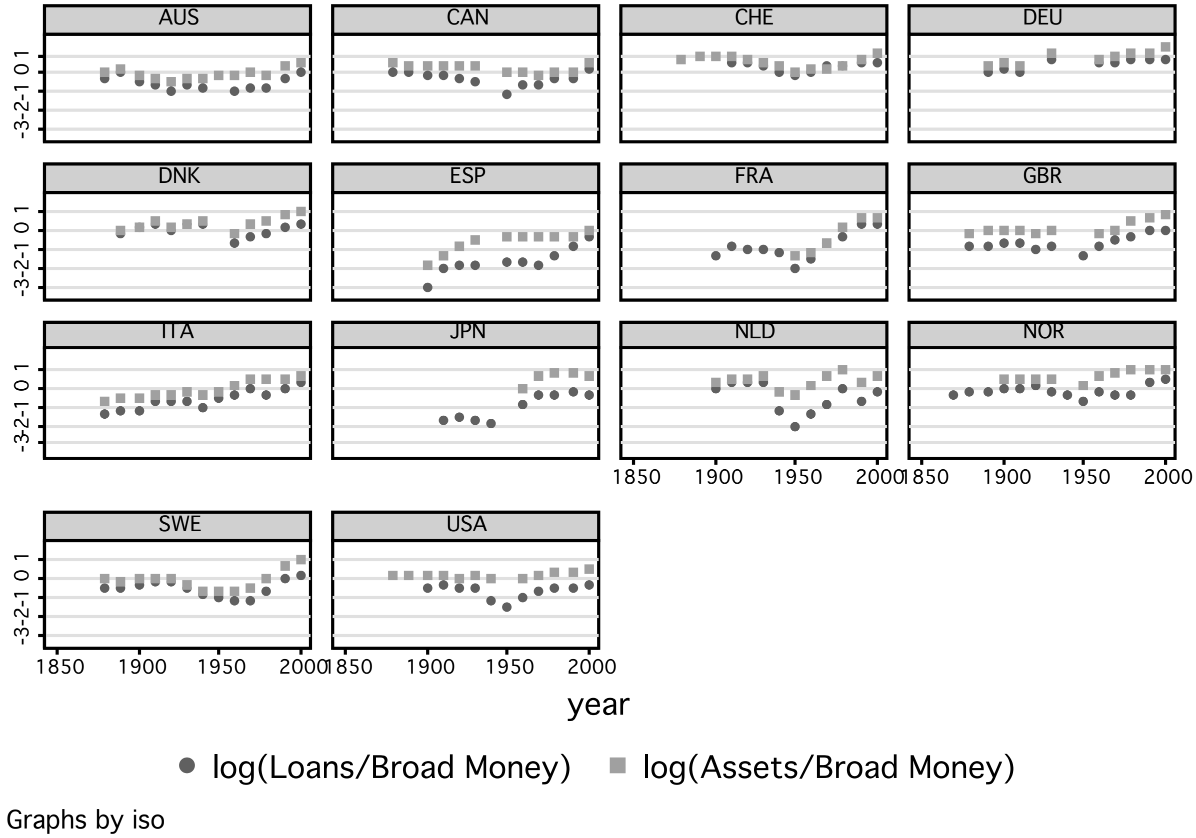

Figure 3: Aggregates Relative to Broad Money (By Country)

traditional monetarist view could potentially become more problematic. While central banks might still be able to steer aggregate credit through the monetary aggregates, it is also possible that the link between money and credit becomes looser than in a situation where banks' liabilities are predominantly or even exclusively monetary. This is exactly what many of the world's central banks found out in the 1980s, as Benjamin M. Friedman and Kenneth N. Kuttner (1992) have documented.

Second, if we look at the ratio of bank credit to non-monetary liabilities on banks' balance sheets, it is easy to see how funding structures have changed in a historically unprecedented way. Banks' access to nonmonetary sources of finance has become an important factor for aggregate credit provision. Thus, what happens in financial markets—borrowing conditions, liquidity, market confidence—starts to matter more than ever for credit creation and financial stability, possibly amplifying the cyclicality of financing in a major way (Adrian and Shin 2008). While these links still need to be explored in greater detail, the consequences for macroeconomic stability could be powerful, since the conventional transmission mechanisms can now be buffeted by large financial shocks. Last but not least, the increasing dependence of the banking system on access to funding from financial markets could also mean that central banks are forced to underwrite the entire funding market in times of distress in order to avoid the collapse of the banking system as witnessed in 2008–09. This "mission creep" follows from the fact that banking stability can no longer rest on the foundations of deposit insurance alone, with the Lender of Last Resort now having to confront wholesale (i.e., non-deposit) bank runs.

This hitherto unknown historical backdrop buttresses the argument that without stronger forms of capital and/or liquidity requirements, banking systems will be prone to skate on the thinnest of ice (Anil K. Kashyap et al. 2008; Emmanuel Farhi and Jean Tirole 2009). Indeed, these developments correlate with the frequency of financial crises. The frequency of crises in the 1945–71 period was virtually zero, when liquidity hoards were ample and leverage was low; but since 1971, as these hoards evaporated and banks levered up, crises became more frequent, occurring with a 4% annual probability.[8]

4 Money, Credit, and Output after Financial Crises: An Event Analysis

In this section we look at financial crises in more depth. We are able to demonstrate the existence of dramatically different crisis dynamics in the two eras of finance capitalism, or now versus then. We exploit our long-run dataset with an eye on improving our understanding of the behavior of money and credit aggregates as well as the responses of the real economy and prices in financial crisis windows before and after WW2. We were concerned that our results might be strongly influenced by the Great Depression, so we also re-ran our analysis excluding data for the 1930s Depression window, but we obtained similar results as documented below. We find substantially different dynamics in the pre- and post-WW2 periods which we think reflect different monetary and regulatory frameworks: the shift away from gold to fiat money, the greater role of activist macroeconomic policies, and greater emphasis on bank supervision and deposit insurance.

For our event-analysis we adopt an annual coding of financial crisis episodes based on documentary descriptions in Bordo et al. (2001) and Reinhart and Rogoff (2009), two widely-used historical data sets that we compared and merged for a consistent definition of event windows (a table showing the crisis events can be found in the web appendix). In line with the previous studies we define financial crises as events during which a country's banking sector experiences bank runs, sharp increases in default rates accompanied by large losses of capital that result in public intervention, bankruptcy, or forced merger of financial institutions. We have corroborated the crisis histories from Bordo et al. (2001) and Reinhart and Rogoff (2009) with alternative codings found in the databases compiled by Luc Laeven and Fabian Valencia (2008), as well the evidence described in Stephen G. Cecchetti et al. (2009). In a last step, we have sent the crisis dates to colleagues who are country specialists and asked them to confirm the dates that we have listed. A table showing the crisis events by country-year can be found in the web appendix. In total, we identify 79 major banking crises in the 14 countries we study. We are hopeful that the crisis dates will prove useful in future research.[9]

Figure 4 opens the discussion with a look at the behaviour of money and credit in the aftermath of financial crises. We see that there are clear differences between the two eras of finance capitalism. Before WW2, credit and money growth dipped significantly below normal levels after crisis events and did not recover to pre-crisis growth rates until fully five years after the crisis. In contrast, after WW2 a dip in the growth rate of the monetary and credit aggregates is hardly discernible in the aftermath of a crisis.[10]

[8] Data on the frequency of financial crises are taken from Michael Bordo et al. (2001, Figure 1, banking crises).

[9] We wish to thank, without implicating, Daniel Waldenstroem (Stockholm), Pierre-Cyrille Hautcoeur and Angelo Riva (Paris), Jan Klovland (Oslo), Carl-Ludwig Holtfrerich (Berlin), Reinhard Spree (Munich), Margrit Grabas (Saarbrucken), Charles Tilly (Munster), Mari Oonuki (Tokyo), Tobias Straumann (Zurich), Joost Jonker (Utrecht), Michael Bordo (Rutgers), Pablo Martin-Acenã (Alcalà). We asked these scholars whether they agreed that systemic banking crises took place in the given years and if any events were missing. In a few cases the question was not whether a significant crisis had occurred, but whether it should be called systemic. In such cases, we used some discretion to ensure comparability between countries. We generally coded crises if a significant part of the banking system was affected as measured by the number or the size of affected institutions.

[10] It is sometimes claimed that negative credit growth would be a signal of a credit crisis (e.g., V. V. Chari et al. 2008). In our data, before WW2 crises were associated with slightly negative average loan growth in the year after the crisis began. However, this result is driven by the Great Depression. In general it is the second derivative of loan growth that changes sign during a

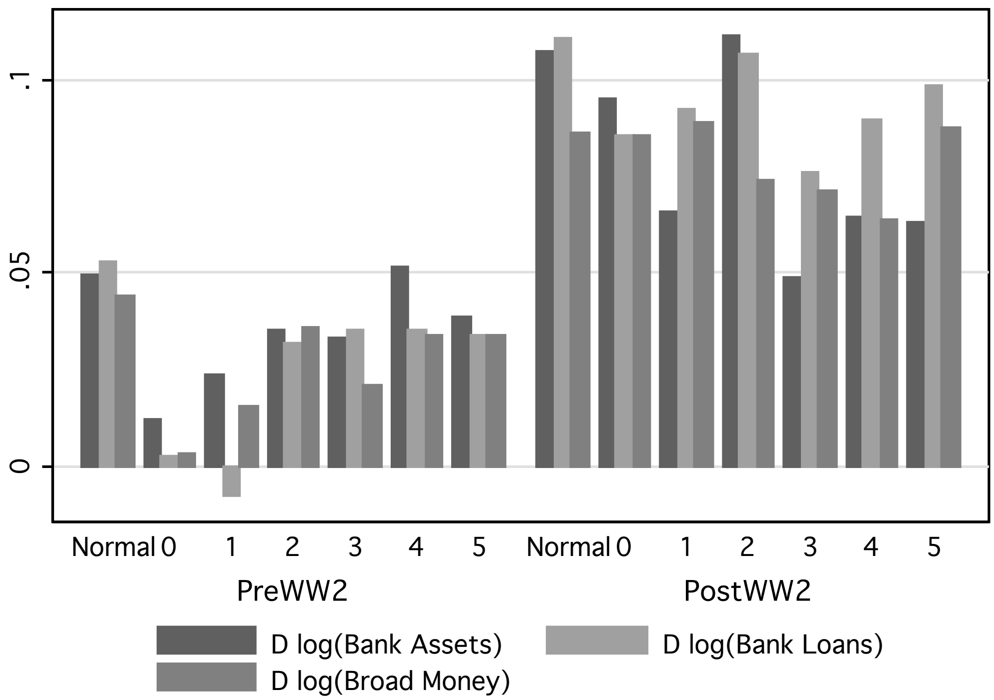

Figure 4: Aggregates (Post Crisis Periods Relative to Normal)

We infer that in the later period, central banks have supported growth of the monetary base, prevented collapse of broad money, and thus kept bank lending at comparatively high levels. Only total bank assets now behave in a meaningfully different way after financial crises, as we will discuss in further detail below.

Turning to real economic effects shown in Figure 5, it becomes clear that the impact of financial crises was more muted in the postwar era in absolute numbers, but of comparable magnitude relative to trend. As mentioned before, this result holds up even when the Great Depression is excluded from the prewar event analysis. Measured by output declines, financial crises remain severe in the post-1945 period. The maximum decline in real investment activity was somewhat more pronounced before WW2, albeit with a sharp bounce back after 4 to 5 years.

Turning to Figure 6, we see that it is with regard to price developments that a major difference between the two eras appears, which is again not driven by the Great Depression. Financial crises in the prewar era were associated with pronounced deflation (for three years), and a stagnation of narrow and broad money growth. Financial crises in the postwar era were if anything accompanied by some upwards pressure on inflation relative to normal, potentially due to the much more active monetary policy response, as shown by the expansion of narrow money. Our data suggest that through more activist policies the strong Fisherian debt-deflation mechanism that typically operated in prewar crises was avoided in the postwar period. The internal reallocation of real debt burdens was therefore likely to have been dramatically different in the two periods.

The bottom line of our event analysis is the following. Policymakers learned lessons from the Great Depression. After this watershed, financial crises were fought with a more aggressive monetary policy

crisis, not the first. See Michael Biggs et al. (2009) for an explanation and related evidence.

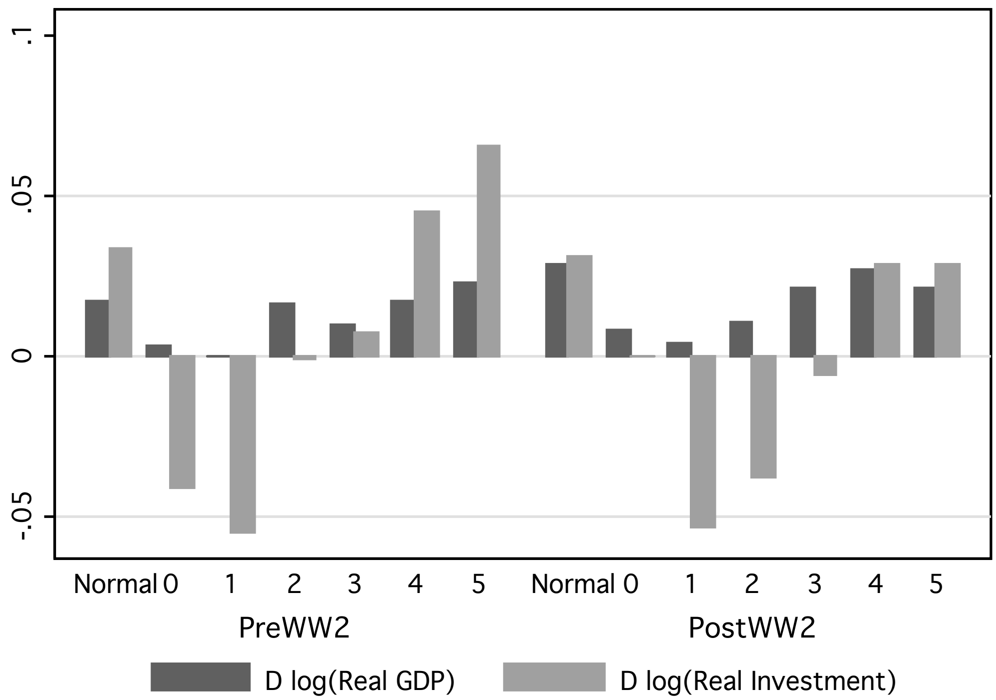

Figure 5: Real Variables (Post Crisis Periods Relative to Normal)

response and quick support for the financial sector. Also institutional responses to the Great Depression such as deposit insurance are likely to have contributed to greater stability of the monetary aggregates in postwar crises. As a consequence, irregular deleveraging of the financial sector was avoided and aggregate asset and loan growth remained relatively high.

Table 2 summarises the key lessons of our event study by showing the cumulative level effects (relative to trend growth in non-crisis years five years after the event) of financial crises in the two eras of finance capitalism. What stands out clearly is positive inflation, higher narrow money growth and a smaller deleveraging (on the loan side) that has taken place in crisis episodes in the second half of the twentieth century (compare columns 1 and 3). Recalling the important proviso that all deviations are measured relative to the noncrisis trend, we see that before WW2, five years after a crisis year the level of broad money was 14 percent below trend, and bank loans 25 percent below trend. In the postwar period, however, narrow money growth did not slow down relative to trend, and the declines were a mere 8 percent (not statistically significant) for broad money and 14 percent for bank loans.

Of course, a key institutional difference between the pre- and post-war environment is the introduction of deposit insurance in many countries in response to the banking panics during the Great Depression. The effects are visible in our long-run data which show the greater stability of narrow and broad monetary aggregates in financial crises in the postwar era. By contrast, total bank assets, which rely on uninsured sources of funding to a greater extent, have actually become *more* volatile in the postwar era. Turning next to the effect on the securities side of banks' balance sheets, the signs of a changing response to crises are even stronger, with bank assets falling 26 percent below trend in the postwar period, versus 16 percent prewar. This confirms the modern findings by Adrian and Shin (2008) who show that the

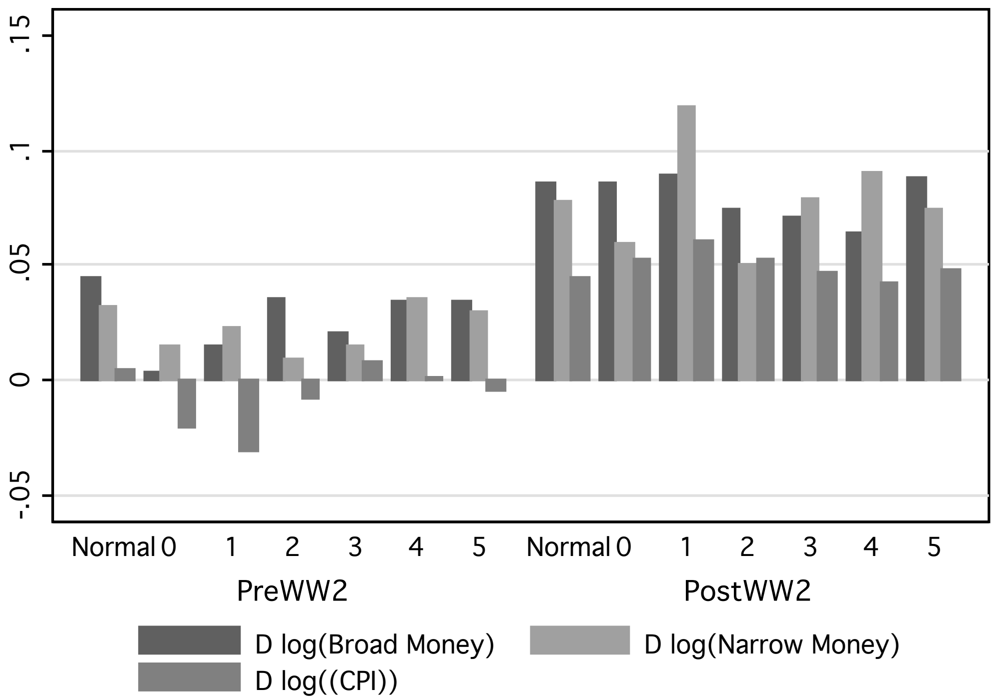

Figure 6: Money and Inflation (Post Crisis Periods Relative to Normal)

behaviour of nonloan items on the balance sheets of financial institutions is particularly procyclical.

Turning to real effects, it is interesting to observe that despite the much more aggressive policy response, the cumulative real effects have been even somewhat stronger in the postwar period. In the aftermath of postwar financial crises output dropped a cumulative 7.9 percent relative to trend, and real investment by more than 25 percent. The prewar output decline effect, however, is largely an artefact of the massive financial implosions of the 1930s. Excluding the 1930s (see column 2), the cumulative real output and investment declines after crises were substantially smaller and not statistically significant. The finding of limited losses prior to the 1930s would be consistent with the idea that in the earlier decades of our sample the financial sectors played a less central role in the economy and financial crises were hence less costly. It is also consistent with the view that economies suffered less from nominal rigidity, especially before 1913, as compared to the 1930s, and hence were better able to adjust to nominal shocks like crisis-induced debt-deflation (Natalia Chernyshoff et al. 2009).

The finding that the real effects of financial crises have not been less pronounced despite stronger policy responses and institutional safeguards such as deposit insurance is surprising. However, it meshes with research on historical business cycles that has shown that recessions after WW2 have become less frequent, but not less severe (Christina D. Romer 1999), a result that is most clearly true when the Great Depression is treated as a special case. These findings are mirrored in our data. Moreover, since we focus on postcrisis dynamics, our data do not yet reflect the real effects of the Great Recession of 2008–09 because events are still unfolding and this datapoint is not in our sample. But given the severity of the recent recession this would certainly strengthen our overall result that the real effects of financial crises have not become less severe.

Table 2: Cumulative Effects After Financial Crises

Cumulative log level effect, after years 0–5 of crisis, versus noncrisis trend, for:	Pre-World War 2	Pre-World War 2, excluding 1930s	Post-World War 2
Log broad money	−0.139***	−0.103***	−0.077*
	(0.027)	(0.029)	(0.040)
Log narrow money	−0.083**	−0.098***	0.009
	(0.037)	(0.036)	(0.053)
Log bank loans	−0.248***	−0.220***	−0.144***
	(0.044)	(0.047)	(0.055)
Log bank assets	−0.156***	−0.144***	−0.258***
	(0.035)	(0.038)	(0.050)
Log real GDP	−0.041**	−0.018	−0.079***
	(0.020)	(0.020)	(0.018)
Log real investment	−0.190**	−0.115	−0.257***
	(0.091)	(0.089)	(0.049)
Log price level	−0.089***	−0.055***	0.007
	(0.025)	(0.026)	(0.029)

Notes: Standard errors in parentheses. Significance levels denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

But this result begs a new question: why are output losses so large today despite more activist policies and the presence of deposit insurance? Some other forces might be at work here. Governments have made more efforts since the 1930s to prevent negative feedback loops in the economy and have sought to cushion the real and nominal impact of financial crises through policy activism. But at the same time the financial sector has grown and increased leverage, expanding the size of the threat even as the policy defences have been strengthened. As a result the shocks hitting the financial sector might now have a potentially larger impact on the real economy, absent the policy response. Still, a complete diagnosis has to recognize the potential reverse causality too: it is an open question to what extent implicit government insurance and the prospect of rescue operations have in turn contributed to the spectacular growth of finance and leverage within the system, creating more of the very hazards they were intending to solve.

5 Credit Booms and Financial Crises

In the previous sections we have documented the rise of credit and discussed how activist monetary policy responses to crises could have been a factor behind the uninterrupted growth of leverage in the postwar financial system. We now look at the sources of recurrent financial instability in modern economies. More specifically, we want to know whether the financial system itself can create economic instability through endogenous lending booms. In other words, are financial crises "credit booms gone wrong"?

By looking at the role of the credit system as a potential source of financial instability—and not merely as an amplifier of shocks as the financial accelerator theory has it—we implicitly also ask a different question about the importance of credit in the conduct of monetary policy. The pre-crisis New Keynesian consensus held that money and credit have essentially no constructive role to play in monetary policy. Hence, central bankers were to set interest rates in response to inflation and the output gap, with no meaningful additional information coming from credit or monetary aggregates. Yet even before the crisis of 2008–09 this view did not go unchallenged. A number of dissenters argued that money and credit aggregates provided valuable information for policymakers aiming for financial and economic stability.[11]

[11] Some argued that excessive credit created "imbalances" and a risk of financial instability (e.g., Borio and Philip Lowe 2002,

On this point, one could also detect echoes of other recent research pointing to a tentative relationship between credit booms and financial fragility in studies of emerging market crises.[12]

The idea that financial crises are credit booms gone wrong is not new. The story underlies the oft-cited works of Minsky (1977) and Kindleberger (1978), and it has been put forward as a factor in the current cycle (Hume and Sentance 2009; Reinhart and Rogoff 2009) as well as in the Great Depression (Eichengreen and Mitchener 2003). Yet statistical evidence is still relatively scant. A number of previous studies has established that systemic financial crises tend to be preceded by rapid expansion of credit (McKinnon and Huw Pill 1997; Kaminsky and Reinhart 1999; Gourinchas et al. 2001). This explanation appears as a somewhat robust element in descriptions of *emerging-market* crises; but evidence that the same problem afflicts advanced countries has not yet attained a consensus position, partly due to the small sample sizes provided by recent history, an inconclusive situation which we can hope to rectify.

Our contribution to this literature is twofold. First, our sample consist of long-run data for 14 developed economies, in contrast to the focus of much of the recent literature on the experience of developing countries where financial crises are often linked to currency instability or sovereign debt problems. A pure developed-country sample is also arguably less affected by the institutional weaknesses and credibility questions that emerging markets tend to face. Second, our focus is clearly on the long-run. Our cross-country dataset spans 140 years of economic history. Moving beyond explorations of selected events and the experience of the past 30 or 40 years, our interest is in whether there is systematic evidence for credit-growth induced financial instability in history. If we can find such a link, then the argument for the credit boom-and-bust story will be strengthened. In this respect, our work follows in the footsteps of recent long-run comparative work by Reinhart and Rogoff (2009) and others. However, a key innovation here is that our new dataset enables us to work with detailed financial and other macroeconomic data on an annual basis, including data (e.g., bank loans and assets) that have never been collected or explored in previous research. As a consequence, we can study the determinants and temporal dynamics of financial crises in considerably greater detail than before. In this respect, our work is more closely related to the analyses of lending booms focusing on recent decades (e.g., Gourinchas et al. 2001).

To test for this link we propose to use a basic forecasting framework to ask a simple question: does a country's recent history of credit growth help predict a financial crisis, and is this robust to different specifications, samples, and control variables? Formally, we use our long-run annual data for 12 countries, and estimate a probabilistic model of a financial crisis event in country i, in year t, as a function of a lagged information at year t, in one of two forms,

$$\begin{array}{ll} \text{OLS Linear Probability:} & p_{it} = b_{0i} + b_1(L)D\log CREDIT_{it} + b_2(L)\mathbf{X}_{it} + e_{it}, \\ \text{Logit:} & \text{logit}(p_{it}) = b_{0i} + b_1(L)D\log CREDIT_{it} + b_2(L)\mathbf{X}_{it} + e_{it}, \end{array}$$

where $\text{logit}(p) = ln(p/(1-p)$ is the log of the odds ratio and L is the lag operator. The *CREDIT* variable will usually be defined as our total bank loans variable deflated by the CPI. The lag polynominal $b_1(L)$, which contains only lag orders greater than or equal to 1, will be the main object of study and the goal will be to investigate whether the lags of credit growth are informative. The lag polynominal $b_2(L)$ will,

2003; Borio and William R. White 2003; White 2006; Charles A. E. Goodhart 2007). Recent theories show how a credit signal might dampen suboptimal business-cycle volatility (Lawrence J. Christiano et al. 2007).

[12] On the whole, the early-warning literature on banking crises focuses mainly on (*i*) emerging markets and (*ii*) factors other than lending booms (for a survey see Eichengreen and Carlos Arteta, 2002 Table 3.1). Exceptions, which use data from recent decades only, include Asli Demirgüç-Kunt and Enrica Detragiache (1998); Graciela L. Kaminsky and Reinhart (1999); Pierre-Olivier Gourinchas et al. (2001). Particularly relevant works are those by Borio and Lowe (2002, 2003), who like us focus on cumulative effects and place a high weight on the lagged credit growth signal.

Table 3: Financial Crisis Prediction—OLS and Logit Estimates

Specificaton	(1)	(2)	(3)	(4)	(5)
					Baseline
Estimation method	OLS	OLS	OLS	Logit	Logit
Fixed effects	None	Country	Country+year	None	Country
L.Δ log (loans/P)	-0.0281	-0.0273	-0.0489	-0.257	-0.398
	(0.0812)	(0.0815)	(0.0801)	(2.077)	(2.110)
L2.Δ log (loans/P)	0.301***	0.302***	0.320***	6.956***	7.138***
	(0.0869)	(0.0872)	(0.0833)	(2.308)	(2.631)
L3.Δ log (loans/P)	0.0486	0.0478	0.00134	1.079	0.888
	(0.0850)	(0.0853)	(0.0819)	(2.826)	(2.948)
L4.Δ log (loans/P)	0.00494	0.00213	0.0346	0.290	0.203
	(0.0811)	(0.0814)	(0.0782)	(1.282)	(1.378)
L5.Δ log (loans/P)	0.0979	0.0928	0.136*	2.035	1.867
	(0.0746)	(0.0752)	(0.0729)	(1.607)	(1.640)
Observations	1,272	1,272	1,272	1,272	1,272
Groups	14	14	14	14	14
Sum of lag coefficients	0.425***	0.417***	0.443***	10.10***	9.697***
s.e.	0.123	0.126	0.136	2.590	2.920
Test for all lags $= 0^{\dagger}$	4.061***	3.871***	4.328***	24.95***	17.23***
p value	0.00116	0.00174	0.000661	0.000143	0.00408
Test for country effects $= 0^{\dagger}$	—	0.71	0.84	—	7.67
p value	—	0.754	0.617	—	0.864
Test for year effects $= 0^{\dagger}$	—	—	4.15***	—	—
p value	—	—	0.0001	—	—
$R^{2\dagger\dagger}$	0.016	0.023	0.290	0.0434	0.0659
Pseudolikelihood	—	—	—	-210.8	-205.8
Overall test statistics†	4.061***	1.638*	4.184***	24.95***	36.21***
p value	0.0012	0.0445	0.00001	0.000143	0.00663
AUROC	0.673***	0.720***	0.952***	0.673***	0.717***
s.e.	0.0357	0.0341	0.00865	0.0360	0.0349

Note: † Reported statistic is F for OLS, χ^2 for logit. †† Reported statistic is Pseudo R^2 for Logit. Standard errors in parentheses. Logit standard errors are robust. Significance levels denoted by *** p<0.01, ** p<0.05, * p<0.10.

if present, allow us to control for other possible causal factors in the form of additional variables in the vector **X**. The error term e_{it} is assumed to be well behaved.

We first present some simple variants of these models in Table 3. These results take the form of an estimate of the above equations with no additional controls, so that the term **X** is omitted. In this long and narrow panel there are 1,272 observations over 14 countries, with an average of about 91 observations per country. The dependent variable is a dummy equal to one when there is a financial crisis according to our definitions, and otherwise zero. Our crisis definitions are the same as detailed above.

To keep the lag structure reasonable, we consider up to five annual lags of any regressor.[13] Model specification 1 presents an OLS Linear Probability model with simple pooled data. Model specification 2 adds country fixed effects to the OLS model, but these are not statistically significant ($p = 0.75$). Keeping country effects, model specification 3 then adds year effects to OLS, and these are highly statistically sig-

[13] Formal lag selection procedures (AIC, BIC, and likelihood ratio tests) suggest we could in most cases use just two lags of *CREDIT*; however higher order lags are sometimes significant, as can be seen in Table 2, and credit booms are typically considered phenomena that last for many years, so we maintain 5 lags as our initial specification.

nificant. What does this say? It implies that there is a common global time component driving financial crises—and, if you happen to know ex ante this effect, you can use it to dramatically enhance your ability to predict crises. This is not too surprising given the consensus view that financial crises have tended to happen in waves and often afflict multiple countries, but is also not of very much practical import for out-of-sample forecasting, since such time effects are not known ex ante. Thus, from now on, given our focus on prediction, we study only models without time effects.

In all of the OLS models the sum of the lag coefficients is about 0.40, which is easy to interpret. Average real loan growth over 5 years in this sample has a standard deviation of about 0.07, so a one standard deviation change in real loan growth increases the probability of a crisis by about 0.0280, or 2.8 percentage points. Since the sample frequency of crises is just under 4 percent, this shows a high sensitivity of crises to plausible shocks within the empirical range of observed loan growth disturbances.

Still, there are well known problems with the Linear Probability model, notably the fact that the domain of its fitted values is not constrained to the unit interval relevant for a probability outcome. Thus in columns 4 and 5 we switch to a Logit model. Model specification 4 displays pooled Logit, and specification 5 adds country fixed effects by including dummies in the regression, though again these are not statistically significant. Unfortunately, we cannot implement a Logit model with year effects. In our setting, the problem is small N and large T, the opposite of typical microeconometric applications. This means that the incidental parameters problem afflicts the T dimension, and we have consistency in N. Conditional fixed effects can only be estimated using years in the panel where there is actual variation in the outcome variable. In our case, this collapses the number of observations from 1,272 to just 140, so that model parameters could not be precisely estimated. We accordingly adopt Column 5, the Logit model with country effects but without time-effects, as our preferred *baseline* specification henceforth.

Our key finding is that all forms of the model show that a credit boom over the previous five years is indicative of a heightened risk of a financial crisis. The diagnostic tests reported show that the five lags are jointly statistically significant at the 1% level; the regression χ^2 is also significant. The difference between the first and second lag coefficients is also suggestive; the former is negative and the latter large and positive, confirming that when the *second* derivative of credit changes sign we can see that trouble is likely to follow (Biggs et al. 2009). The sum of the lag coefficients is about 10, and also statistically significant. To interpret this we need to convert to marginal effects, where in Column 5, at the means of all variables, the sum of the marginal effects over all lags is 0.301, similar, albeit a little smaller, than the 0.40 estimate given by the OLS Linear Probability model noted above.

Finally we note that in all its forms the model has predictive power, as judged by a standard tool used to evaluate binary classification ability, the Receiver Operating Characteristic (ROC) curve. This is shown in Figure 7 for our preferred baseline model. The curve plots the true positive rate $TP(c)$ against the false positive rate $FP(c)$, for all thresholds c on the real line, where the binary classifier is $I(\hat{p}-c>0)$, $I(.)$ is the indicator function, and $\hat{p}$ is the linear prediction of the model which forms a continuous signal. When the threshold c gets large and negative, the classifier is very aggressive in making crisis calls, almost all signals are above the threshold, and TP and FP converge to 1; conversely, when c gets large and positive, the classifier is very conservative in making crisis calls, almost all signals are below the threshold, and TP and FP converge to 0. In between, an informative classifier should deliver $TP > FP$ so the ROC curve should be above the 45-degree line of the null, uninformative (or "coin toss") classifier.

At this point we would prefer not to take a stand on where the policy maker would place the cutoff value of the threshold. The utility computation depends on costs of different outcomes and the frequency of crises. For example, the cutoff should be more aggressive if the cost of an undiagnosed crisis is high, but less so if the cost of a false alarm is higher. If crises are rare, the threshold bar should also be raised to deflect too-frequent false alarms (see Margaret S. Pepe 2003). Fortunately, a test of predictive ability

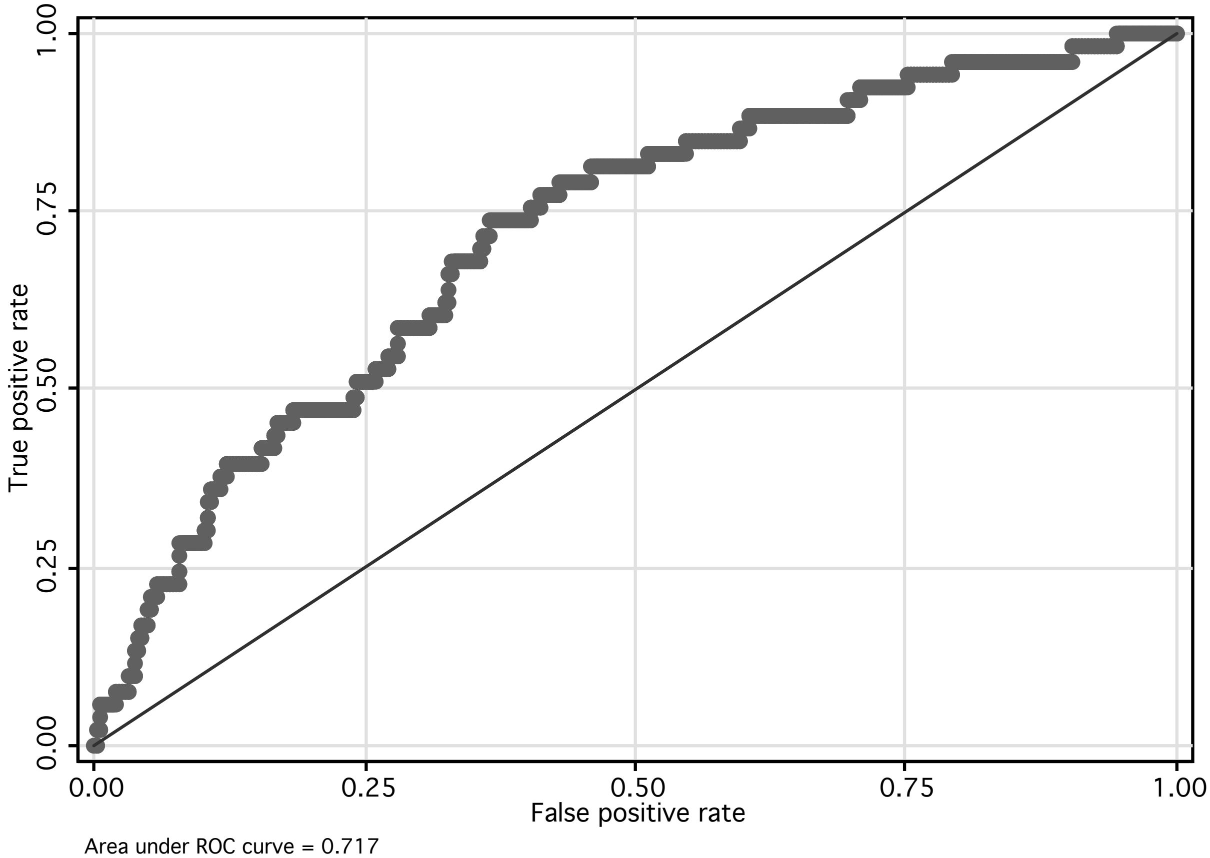

Figure 7: Receiver Operating Characteristic Curve (Baseline Model)

exists that is independent of the policymaker's cutoff. This is the area under the ROC curve (AUROC). It is essentially a test of whether the distribution of the model's signals are significantly different under crisis and noncrisis states, thus allowing them to use a basis for meaningfully classifying these outcomes. The AUROC provides a simple test against the null value of 0.5 with an asymptotic normal distribution, and for our baseline model AUROC $= 0.717$ with a standard error of just 0.0349. The model can therefore be judged to have predictive power versus a coin toss, although it is far from a perfect classifier which would have AUROC $= 1$.[14]

All the above forecasts suffer from in-sample look-ahead bias, even though they use lagged data. To put our model to a sterner test, we limited the forecast sample to the post-1983 period only (350 country-year observations) and compared in-sample and out-of-sample forecasts (the former based on full sample predictions, with look-ahead bias; the latter based on rolling regressions, using lagged data only). The in-sample forecast produced an even higher AUROC $= 0.763$ (s.e. $= 0.0635$), but the out-of-sample also proved informative, with an AUROC $= 0.646$ (s.e. $= 0.0695$), the latter having statistical significance at better than the 5% level. We think any predictive power is impressive at this stage given the general skepticism evinced by the "early warning" literature, and our out-of-sample results add some reassurance.

[14] Is 0.7 a "high" AUROC? For comparison, in the medical field where ROCs are widely used for binary classification, an informal survey of newly published prostate cancer diagnostic tests finds AUROCs of about 0.75.

We now ask some questions about the value added of our results and their robustness. The first claim we make is that the use of credit aggregates, rather than monetary aggregates, is of crucial importance. This would have broad implications, first for economic history, since monetary aggregates have been widely collected and may be easily put to use. But it also has policy implications. Indeed, after the crisis of 2008–09 the argument has often been heard that greater attention to such aggregates, in contrast to a narrow focus on the Taylor rule indicators of output and inflation, might have averted the crisis. But when we look at the long run data systematically, monetary aggregates are *not* that useful as predictive tools in forecasting crises, in contrast to the correct measure, total credit. We find the success of the credit measure appealing, and not just because it vindicates the drudgery of our laborious data collection efforts: we think credit is a superior predictor, because it better captures important, time-varying features of bank balance sheets such as leverage and non-monetary liabilities. The basis for these claims is the collection of results reported in Tables 4 and 5.

In Table 4 we start with the baseline model, reproduced in specification 6. All through this table we continue to estimate the model over the entire sample, using a Logit model with country fixed effects. Having settled on this model, we now also report, for completeness, the marginal effects on the predicted probability evaluated at the means for the lags of credit. We then take several perturbations of the baseline that take the form of replacing the five lags of credit with alternative measures of money and credit.

Specification 7 replaces real loans with real broad money, still deflated by CPI. The fit is still statistically significant, although slightly weaker judging from lower R2, and predictive power – the AUROC is also marginally lower. However, the basic message at this point is that broad money could potentially proxy for credit. Both the liability and the asset side of banks' balance sheets seem to do a good job at predicting financial trouble ahead over the whole sample—though we shall qualify this result in a moment. Specification 8 replaces loans with narrow money and the model falls apart, which is not unexpected; given the instability in the money multiplier, the disconnect between base money and credit conditions is too great to expect this model to succeed. Specifications 9 and 10 replace real loans with the loans-to-GDP ratio and the loans-to-broad-money ratio, respectively. Both of these variants of the model also meet with some success, and specification 9 outperforms slightly in terms of measures of fit and predictive ability as measured by AUROC.

So far the main results might tempt us to conjecture, first, that various scalings of credit volume could have similar power to predict financial crises; and, second, that broad money could also proxy for credit adequately well. The former idea may be true, but Table 5 quickly dispels the latter. The robustness checks here take the form of splitting the sample into pre-WW2 and post-WW2 samples, where we are guided to conduct this test by the summary findings above showing very different trends in the behavior of money and credit in these two epochs.

Specifications 11 and 12 show that using our credit measure, real loans, the baseline model performs quite well in terms of both fit and predictive power both before and after WW2. Column 12 is particularly interesting, since the significant and alternating signs of the first and second lag coefficients in the postwar period highlight the sign of the second derivative (not the first) in raising the risk of a crisis. In contrast, specifications 13 and 14 expose some unsatisfactory performance when broad money is used. Before WW2 the weaknesses are not evident, with the lags of broad money still significant, and similar predictive power. But after WW2 the model based on broad money is a failure: the fit is much poorer, and from a predictive standpoint the model has a much lower AUROC.

To explore the predictive ability differences more closely, we examined the ROC curves for specifications 11–14 as shown in Figure 8, this time computed on common samples within each period (thus the statistics differ slightly from those in Table 5). We used AUROC comparison tests along with Kolmogorov-Smirnov tests (of the difference in the signal distributions under each outcome) to see whether one

Table 4: Baseline Model and Alternative Measures of Money and Credit

Specification (Logit country effects)	(6) Baseline	(7) Replace loans with broad money	(8) Replace loans with narrow money	(9) Replace real loans with loans/ GDP	(10) Replace real loans with loans/ broad money
L.Δ log (loans/P)	−0.398	−1.051	−2.504	2.091	0.601
	−2.11	−2.771	−1.806	−2.235	−2.383
L2.Δ log (loans/P)	7.138***	5.773***	2.303	7.627***	5.842**
	−2.631	−2.181	−1.781	−2.135	−2.327
L3.Δ log (loans/P)	0.888	3.515	1.768	3.569	2.092
	−2.948	−2.329	−1.664	−2.386	−2.048
L4.Δ log (loans/P)	0.203	−1.535	−2.880*	2.333*	1.613
	−1.378	−2.287	−1.51	−1.405	−1.766
L5.Δ log (loans/P)	1.867	3.077	1.373	3.164**	0.497
	−1.64	−2.256	−1.63	−1.583	−2.37
Marginal effects	-0.0124	-0.0350	-0.0888	0.0598	0.0196
at each lag	0.222	0.192	0.0817	0.218	0.190
evaluated at the means	0.0276	0.117	0.0627	0.102	0.0681
	0.00629	-0.0511	-0.102	0.0668	0.0525
	0.0580	0.102	0.0487	0.0905	0.0162
Sum	0.301	0.326	0.00211	0.538	0.346
Observations	1,272	1,348	1,381	1,245	1,224
Groups	14	14	14	14	14
Sum of lag coefficients	9.697***	9.779***	0.0596	18.78***	10.65***
s.e.	2.920	3.400	3.240	3.651	4.053
Test for all lags = 0, χ^2	17.23***	17.77***	6.557	29.85***	10.62*
p value	0.00408	0.00324	0.256	0.000016	0.0594
Test for country effects = 0, χ^2	7.674	8.755	8.834	8.012	9.140
p value	0.864	0.791	0.785	0.843	0.762
Pseudo R^2	0.0659	0.0487	0.0381	0.0923	0.0497
Pseudolikelihood	-205.8	-224.6	-237.4	-198.9	-201.5
Overall test statistic, χ^2	36.21***	36.81***	17.37	47.77***	19.82
p value	0.00663	0.00555	0.498	0.000163	0.343
Predictive ability, AUROC	0.717***	0.681***	0.631***	0.743***	0.680***
s.e.	0.0349	0.0294	0.0339	0.0337	0.0378

Note: Robust standard errors in parentheses. Significance levels denoted by *** p<0.01, ** p<0.05, * p<0.10.

model or the other was to be preferred in each period for its binary classification ability. Before WW2 (for $N = 486$ common observations) a test of equality in AUROCs between the credit and money models passed easily ($p = 0.37$); the ROC curves are very close to each other and almost overlapping; and both models attain a maximum height above the diagonal that is significantly different from zero. After WW2 (for $N = 700$ common observations) the money model ROC curve is below the credit model ROC curve at almost all points, except at a few points close to the (0,0) and (1,1) points, where operation is unlikely to be optimal for the policymaker; the two AUROCs are different, with a p-value of 0.237. We also find that of the four ROCs in Figure 8, only the Post-WW2 money model fails the Kolmogorov-Smirnov test, so its maximal height above the diagonal (*TP* minus *FP*) is not statistically different from zero at conventional levels, which is also highly discouraging.

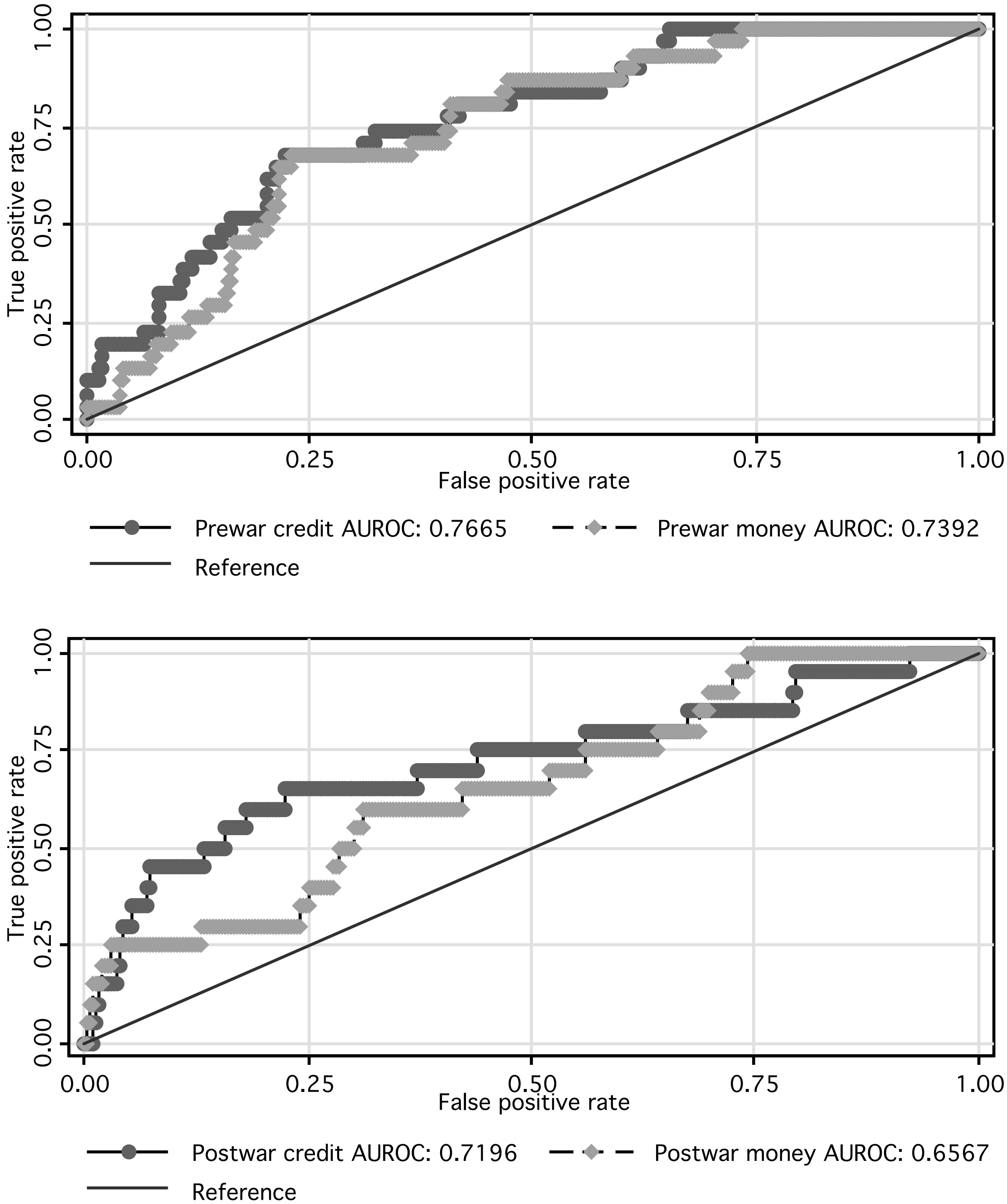

Figure 8: ROC Comparisons of Money and Credit as Predictors: Prewar versus Postwar

Table 5: Baseline Model with Pre-WW2 and Post-WW2 Samples

Specification (Logit country effects)	(11) Baseline pre-WW2 sample using loans	(12) Baseline post-WW2 sample using loans	(13) Pre-WW2 sample replace loans with broad money	(14) Post-WW2 sample replace loans with broad money
L.Δ log (loans/P)	2.249	-0.316	-0.227	2.705
	(2.362)	(3.005)	(3.014)	(4.438)
L2.Δ log (loans/P)	7.697**	8.307***	7.393**	4.719**
	(3.221)	(2.497)	(3.004)	(2.375)
L3.Δ log (loans/P)	2.890	2.946	4.077	4.060*
	(3.056)	(2.687)	(2.915)	(2.170)
L4.Δ log (loans/P)	2.486	0.755	-0.249	-0.838
	(1.587)	(2.623)	(1.982)	(5.359)
L5.Δ log (loans/P)	4.260**	-1.749	4.844*	0.808
	(1.735)	(3.204)	(2.647)	(4.016)
Observations	510	706	585	708
Groups	13	14	13	14
Marginal effects	0.0873	-0.00642	-0.0102	0.0617
at each lag	0.299	0.169	0.332	0.108
evaluated at the means	0.112	0.0598	0.183	0.0926
	0.0965	0.0153	-0.0112	-0.0191
	0.165	-0.0355	0.218	0.0184
Sum	0.760	0.202	0.711	0.261
Sum of lag coefficients	19.58***	9.943	15.84***	11.45*
s.e.	4.921	6.056	5.119	6.022
Test for all lags = 0, χ^2	19.20***	12.44**	13.53**	12.13**
p value	0.00176	0.0292	0.0189	0.0330
Test for country effects = 0, χ^2	6.369	5.348	11.74	5.917
p value	0.932	0.945	0.549	0.920
Pseudo R^2	0.130	0.0771	0.0855	0.0476
Pseudolikelihood	-106.4	-83.97	-126.2	-86.71
Overall test statistic, χ^2	40.21***	36.44***	35.95***	19.89
p value	0.00195	0.00401	0.00716	0.280
AUROC	0.763***	0.718***	0.728***	0.659***
s.e.	0.0391	0.0691	0.0361	0.0600

Note: Robust standard errors in parentheses. Significance levels denoted by *** p<0.01, ** p<0.05, * p<0.10. Robust standard errors in parentheses. In the prewar sample NLD is dropped from the logit regression because there are no crises in the sample (with five lags of credit or money in non-war years), so $N = 13$ for these cases.

How do we interpret these results? The findings mesh well with our overall understanding of the dramatic changes in money and credit dynamics after the Great Depression. In the summary data for the pre-WW2 sample, we saw how broad money and credit moved hand in hand, so that a Friedman "money view" of the financial system, focusing on the liability side of banks' balance sheets, was an adequate simplification. After WW2 this was no longer the case, and credit was delinked from broad money aggregates, which would beg the question as to which was the more important aggregate in driving macroeconomic outcomes. At least with respect to crises, the results of our analysis are clear: credit matters, not money.

These findings have potentially important policy implications, especially for central banks that still embrace the oft-forgotten idea of using quantitative indicators as a "pillar" of monetary policymaking. If this pillar is there as to support price stability goals, then indeed a monetary aggregate may be the right tool for the job; but if financial stability is a goal, then our results suggest that a better pillar might make use of credit aggregates instead and their superior power in predicting incipient crises.

6 Robustness Tests

To underscore the value of our model based on the "credit view" and to guard against omitted variable bias, in Table 6 we subject our baseline specification to several perturbations that take the form of including additional control variables X as described above. Specification 15 adds 5 lags of real GDP growth. Specification 16 adds 5 lags of the inflation rate, since inflation has been found to contribute to crises in some studies (e.g., Demirgüç-Kunt and Detragiache 1998). Neither set of controls can raise the fit and predictive performance of the model substantially. The inclusion of these terms has little effect on the coefficients on the lags of credit growth, their quantitative or statistical significance, and their substantive contribution to the model's predictive ability. Specifications 17 and 18 add 5 lags of the nominal short–term interest rate or its real counterpart, since some studies find that high interest rates, e.g., to defend a peg, can help trigger crises (e.g., Kaminsky and Reinhart 1999). While some of the lags are significant at the 5% level, they do not alter the baseline story and the credit effects remain strong.

In specification 19 we add 5 lags of the change in the investment-to-GDP ratio, to explore the possibility that the nature of the credit boom might affect the probability that it ends in a crisis. For example, according to arguments heard from time to time, if credit is funding "productive investments" then the chances that something can go wrong are reduced—as compared to credit booms that fuel consumption binges or feed speculative excess by households, firms, and/or banks.[15] Our results caution against this rosy view. Over the long run, in our developed country sample, most of the lags of investment are not statistically significant at the conventional level, and the only one that actually has a "wrong" positive sign, suggesting that crises are slightly more likely when they have been funding investment booms as opposed to other activity.[16] As an additional check, we also tested the interaction of the 5-year moving average of credit growth with real investment growth. The interaction term was found to be statistically insignificant. Interacting the two variables also had virtually no impact on the fit or the predictive power of the model.[17] In brief, when it comes to investment finance versus consumption finance, we could not find any conclusive evidence that the nature of the credit boom made any difference. If this is the case, then the suspicion arises that when banks originate lending, they may be almost equally incapable of assessing repayment capacity in all cases, with investment loans having no special virtues.

Summing up the results from Table 6, we conjecture that, although some of the auxiliary control variables may matter in some contexts—perhaps in other samples that include emerging markets—for the developed economies these other factors are not the main signal of financial instability problems. Rather the key indicator of a problem is an excessive credit boom. Indeed, the sum of the lag loan coefficients (or their marginal effects) is even higher in Table 6 columns (15)–(19) than in the baseline specification (6), so credit effects are amplified here, rather than being diminished by the added controls; and the pseudo-R^2 values range between 0.0765 and 0.123, compared to the 0.0659 value in the baseline case, showing that the greater fraction of the model's fit is always due to the credit terms.

[15] The argument has often been applied to foreign capital flows manifest in current account deficits. The argument that capital flowing into investment booms does not matter has been variously stated as the "Lawson doctrine," "Pitchford critique," or "consenting adults view." See Sebastian Edwards (2002) for a survey of this area.

[16] The sum of the lags on investment is positive, so crises are marginally more likely in an investment boom, controlling for credit growth.

[17] The results are not reported due to space constraints but are available from the authors on request.

Table 6: Robustness Checks

Specification (Logit country effects)	(15) Baseline plus 5 lags of real GDP growth	(16) Baseline plus 5 lags of inflation	(17) Baseline plus 5 lags of nominal short-term int. rate	(18) Baseline plus 5 lags of real short-term int. rate	(19) Baseline plus 5 lags of change in I/Y
L.Δ log (loans/P)	1.544	-0.771	0.113	-1.458	-0.152
	(2.081)	(2.362)	(2.072)	(2.442)	(2.250)
L2.Δ log (loans/P)	8.571***	10.22***	8.491***	10.99***	7.131**
	(2.403)	(2.690)	(2.982)	(2.689)	(2.845)
L3.Δ log (loans/P)	3.114	-1.590	1.054	-1.258	0.546
	(2.347)	(2.856)	(3.443)	(3.239)	(3.213)
L4.Δ log (loans/P)	2.555*	1.503	0.241	2.686	1.124
	(1.441)	(1.461)	(1.697)	(1.673)	(1.366)
L5.Δ log (loans/P)	3.539**	1.128	1.996	0.821	3.004
	(1.555)	(1.842)	(2.058)	(1.820)	(1.943)
Observations	1,272	1,272	969	961	1,218
Groups	14	14	14	14	14
Sum of lag coefficients	19.32***	10.49***	11.89***	11.78***	11.65***
s.e.	4.329	3.121	3.275	3.385	3.404
Test for all lags = 0, χ^2	28.99***	24.45***	19.45****	26.54	16.59
p value	0.00002	0.000178	0.00159	0.00007	0.00536
Test lags of added vbl. = 0, χ^2	34.43	19.55	3.888	14.98	4.895
p value	0.000002	0.00152	0.566	0.0105	0.429
Test for country effects = 0, χ^2	10.41	8.031	7.727	5.888	8.538
p value	0.660	0.842	0.806	0.922	0.807
Pseudo R^2	0.123	0.104	0.0765	0.110	0.0870
Pseudolikelihood	-193.3	-197.4	-181.8	-174.9	-196.2
Overall test statistic, χ^2	61.47***	52.23***	36.40**	47.46***	52.38***
p value	0.00023	0.000466	0.0275	0.00128	0.000445
AUROC	0.751***	0.770***	0.725***	0.750***	0.737***
s.e.	0.0432	0.0422	0.0448	0.0454	0.0419

Note: Robust standard errors in parentheses. Significance levels denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Marginal effects not reported.

In the final part of our robustness analysis, we ask whether the inclusion of asset prices and controls for the level of financial development affect our results regarding the role of credit growth in generating financial instability. Asset price boom and bust cycles have a long history that is well documented (Kindleberger 1978). Also the financial crisis of 2008–09 was closely linked to the boom and bust of housing prices in the United States and elsewhere raising the possibility that asset prices play a central role in the emergence of systemic financial crises. Yet one can also think of other asset price booms (the run-up in the prices of technology stocks before 2001 comes to mind) that have not triggered large-scale financial instability.

From a monetary policy point of view, recurring asset price booms have led to considerable debate about their role in setting monetary policy. Until recently, the consensus has been that asset price developments should only influence the formulation of monetary policy to the degree that they affect the central banks' inflation forecast (Bernanke and Gertler 2001). However, in the light of recent events, a more granular assessment of asset bubbles has been suggested (Mishkin 2008). The key distinction here is that asset price bubbles that are not accompanied by increased leverage against higher asset values might not pose particular stability risks for the financial system. However, if booming asset prices relax collateral constraints which in turn feed more lending and higher prices, financial stability risks could be elevated. As the positive feedback loop between asset values and lending reverses, the balance sheets of financial intermediaries and households can come under severe strain.

As a first step to disentangle these issues empirically, we include stock price data into our regressions and test if they increase the predictive power of the model. In the context of our long-run cross-country sample stock market indices are the only available indicator for asset market developments. Data availability and comparability problems make the use of house price data impossible. If the inclusion of stock prices into our regression yields strong predictive signals, this would be evidence that stock price booms *per se* pose financial stability risks. Later on, we will also use interaction terms to test whether the financial risks emanating from stock price booms depend on credit levels or the pace of credit creation. To create the database of long-run stock prices in the 14 countries in our sample we started with standard sources (e.g., Global Financial Data), and then, thanks to the help of a number of colleagues, we were able to extend our dataset and include extended time series of historical equity market indices for France, Italy, the Netherlands, and Sweden that have become available in recent years.[18]

The results are shown in Table 7. In specification 20 we add five lags of changes in nominal stock prices to our baseline, in regression 21 we add changes in real (CPI-deflated) stock prices. The overall results of these additive models are mixed. The lags of nominal stock prices are insignificant, but reach significance at the 5% level in the case of real prices. The predictive ability of the model as measured by the AUROC rises slightly from 0.717 to 0.731. The pseudo-R^2 remains in 0.09 range, demonstrating that the greatest fraction of the fit of the model still comes from the credit terms which remain highly significant in all specifications. While asset prices contain some additional information about the likelihood of future crises, their overall contribution is relatively small. From a policy perspective, the key variable to watch is credit.

Before we turn to possible interaction effects, we address a related set of issues in specifications 22 and 23 in Table 7. We ask whether there is evidence that crises are more likely in larger financial systems (as proxied by the credit to GDP ratio) as compared to times when the level of financial intermediation is lower. As we employ country fixed effects throughout, we are effectively asking whether the crisis probability is greater in times when the credit to GDP ratio is high relative to the country average. One could hypothesize that such a positive relationship might stem from the fact that more complex financial systems and more highly leveraged economies have a greater propensity for disruptions in the face of shocks. But also a political economy explanation is possible. Excessive risk taking and moral hazard problems could become more endemic if the financial sector grows relative to the size of the economy.

Looking at these issues from a purely empirical point of view, some evidence emerges that crisis probabilities grow with financial depth. In specification 22 we include the credit to GDP ratio. This leads to an immediate increase of the AUROC by about 2 points relative to the baseline. The level of credit to GDP is also significant if both stock prices and credit levels are included in specification 23. Also the pseudo-R^2 of the regression increases by some margin indicating a slightly better fit. While the importance and significance of the credit growth remains unaffected, our long-run sample data suggest that the risk of financial crises grows with a higher credit to GDP level. This analysis therefore provides some quantitative evidence to back up the claim that larger, more complex financial systems may be inherently more risky,

[18] While the coverage is generally good for the twentieth century, nineteenth century price data are harder to come by. We are indebted to Pierre-Cyrille Hautcoeur (France), Peter Koudijs (Netherlands), Angelo Riva (Italy) and Daniel Waldenström (Sweden) for sharing their data with us. Jan Tore Klovland, Kevin O'Rourke, and Hans-Joachim Voth directed us to other sources.

Table 7: Credit, Asset Prices, and Financial Development

Specification (Logit country effects)	(20) Baseline plus 5 lags of nominal stock price change	(21) Baseline plus 5 lags of real stock price change	(22) Baseline plus Loans over GDP	(23) Baseline plus 5 lags of real stock prices plus loans/GDP
L.Δ log (loans/P)	-2.491	-2.540	-0.755	-3.392
	(2.324)	(2.312)	(2.293)	(2.470)
L2.Δ log (loans/P)	7.316**	7.165**	7.599***	7.848**
	(2.910)	(2.915)	(2.871)	(3.215)
L3.Δ log (loans/P)	3.405	3.185	0.720	3.297
	(2.899)	(2.864)	(3.307)	(3.171)
L4.Δ log (loans/P)	-1.352	-1.684	0.0933	-1.747
	(1.521)	(1.539)	(1.497)	(1.669)
L5.Δ log (loans/P)	1.678	1.771	2.326	2.460
	(1.835)	(1.784)	(1.784)	(1.994)
L1.Δ log (stock prices)	-1.046**	-0.865**		-0.768*
	(0.464)	(0.434)		(0.455)
L2.Δ log (stock prices)	0.535	0.563		0.550
	(0.644)	(0.673)		(0.666)
L3.Δ log (stock prices)	0.272	0.715		0.691
	(0.651)	(0.692)		(0.690)
L4.Δ log (stock prices)	0.954	1.098		1.024
	(0.822)	(0.811)		(0.814)
L5.Δ log (stock prices)	0.0844	0.467		0.438
	(0.631)	(0.703)		(0.627)
Loans/GDP (log)			1.100*	1.601**
			(0.624)	(0.703)
Observations	1,061	1,062	1,271	1,061
Groups	14	14	14	14
Sum of lag coefficients	8.557**	7.898**	9.984***	8.466**
s.e.	3.468	3.443	2.918	3.460
Test for all lags = 0, χ^2	22.04***	20.65***	17.45***	21.19***
p value	0.000515	0.000944	0.00371	0.000747
Test lags of added vbl. = 0, χ^2	8.664	13.28**		11.89**
p value	0.123	0.0209		0.0363
Test for country effects = 0, χ^2	5.499	5.433	11.43	10.33
p value	0.939	0.942	0.575	0.587
Pseudo R^2	0.0882	0.0901	0.0749	0.108
Pseudolikelihood	-169.8	-169.5	-203.8	-166.2
Overall test statistic, χ^2	39.65**	46.84***	41.48***	47.20***
p value	0.0119	0.00154	0.00208	0.00212
AUROC	0.727***	0.731***	0.731***	0.764***
s.e.	0.0399	0.0383	0.0379	0.0358

Note: Robust standard errors in parentheses. Significance levels denoted by *** p<0.01, ** p<0.05, * p<0.10. Marginal effects not reported.

e.g., as argued in the prescient paper by Raghuram G. Rajan (2005).

What about interaction effects? Are asset price booms more dangerous when they occur at high credit to GDP levels or when they coincide with elevated rates of credit growth in the economy? Do these interactions force us to modify our core finding about the role of accelerations in credit creation as the prime suspect in causing financial instability? In order to keep the number of interaction terms manageable, we now use 5-year moving averages (the window excludes the current observation) and their interactions to explain the occurrence of a financial crisis. We start in Table 8, in specification 24, with a simple replication of our baseline model, relating the likelihood of a financial crisis to the rate of real credit growth in the five preceding. This 5-year moving average model matches our previous findings. Credit growth clearly helps predict financial crises. While the predictive ability of the model is (unsurprisingly) a little lower than in the fully specified model with five lags, the AUROC reaches a still respectable 0.663 (still significantly different from 0.5). In specification 26, we test for the impact of asset price booms conditional on credit growth. Including real stock prices plus the interaction of stock prices and credit growth does not meaningfully improve the predictive ability. The AUROC rises slightly to 0.669 and the fit does not rise meaningfully either. The interaction of credit growth and asset prices yields a statistically insignificant negative coefficient estimate on the interaction term. We are working with 5-year moving averages, so that this result could be partly due to the lags involved. When credit growth is strong and stock prices are rising during the boom phase, the risk of a crisis is low. Once the interaction term turns negative, i.e., when stock prices start falling or credit growth reverses, the odds increase. This accords with the view of Mishkin (2008) and others that it is the unwinding of *leverage-driven* asset bubbles that puts financial stability most at risk, posing a serious challenge for central banks.

In specification 28 we add credit to GDP and the interaction of credit growth and credit to GDP ratios. Predictive ability rises, but the interaction term is clearly insignificant. The impact of credit growth on financial crisis risks is not conditional on the size of the financial sector. Yet we find again that financial stability risks seem to increase independently with larger financial systems. This is shown in a higher predictive ability of the model which stems from adding information about the size of the financial sector, not from interaction effects with credit growth (27). When we run the identical model without the interaction term we find that fit, predictive ability and the coefficients on credit growth and levels are virtually unchanged. In light of 140 years of data, larger financial sectors (relative to long-run country means) appear to make for more crisis-prone economies. Further research is clearly needed to explore the causal relationships.

Yet while the effect of credit booms does not seem to be conditional on high credit to GDP ratios, there are reasons to think that stock price booms and busts are more dangerous if they occur in highly financialized economies. In specification 29, we therefore introduce an interaction term of stock price changes and credit to GDP levels, in addition to controls for credit growth, stock price trends and the size of the financial system. In other words, we are asking whether asset booms are more problematic in highly developed financial systems. The answer from a 140 years of historical data is affirmative. Both predictive ability and fit improve considerably, while the coefficient on the stock price increase falls strongly. Conditional on low credit to GDP levels, stock price booms are inconsequential. But the risks grow with the size of the financial sector. It is also worth adding that across these regressions credit growth remains highly significant, confirming our key result that accelerations of credit growth are a key variable to watch from a policy perspective.

To conclude, a predictive analysis of our large long-term, cross-country dataset lends support to the idea that, for the most part, financial crises throughout modern history can be viewed as credit booms gone wrong. From our regressions, past growth of credit emerges as the single best predictor of future financial instability, a result which is robust to the inclusion of various other nominal and real variables.

Table 8: Credit, Asset Prices and Financial Development—Interactions

Specification	(24)	(25)	(26)	(27)	(28)	(29)
(Logit country effects)	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
5-year moving average of:		plus	plus	plus	plus	plus
Δ log (loans/P)	5.340***	5.012**	7.526***	6.752***	6.632***	7.370***
	(2.069)	(2.288)	(2.464)	(2.012)	(2.243)	(2.368)
Δ log (stocks/P)		0.524	2.704			0.236
		(1.391)	(2.103)			(1.464)
Δ log (loans/P) x Δ log (stocks/P)			-22.77			
			(14.19)			
Loans/GDP (log)				1.432***	1.515**	1.704***
				(0.530)	(0.751)	(0.615)
Δ log (loans/P) x loans/GDP (log)					-1.243	
					(8.516)	
Δ log (stocks/P) x loans/GDP (log)						4.661
						(3.401)
Observations	1,278	1,278	1,278	1,437	1,437	1,278
Groups	14	14	14	14	14	14
Test for country effects = 0, χ^2	7.447	7.528	7.980	15.58	14.58	16.21
p value	0.878	0.873	0.845	0.272	0.334	0.238
Pseudo R^2	0.0348	0.0351	0.0407	0.0456	0.0457	0.0652
Pseudolikelihood	-203.7	-203.7	-202.5	-246.8	-246.8	-197.3
Overall test statistic, χ^2	17.58	18.47	22.95	35.78***	35.71***	30.92**
p value	0.227	0.239	0.115	0.00190	0.00317	0.0205
AUROC	0.663***	0.662***	0.669***	0.689***	0.689***	0.714***
s.e.	0.0392	0.0385	0.0369	0.0368	0.0367	0.0371

Note: Robust standard errors in parentheses. Significance levels denoted by *** p<0.01, ** p<0.05, * p<0.10. Marginal effects not reported.

Moreover, credit growth seems a better indicator than its nearest rival measure, broad money growth, especially in the postwar period. In light of the structural changes of the financial system that we documented above, this comes as no surprise. As credit growth has increasingly decoupled from money growth, credit and money aggregates are no longer two sides of the same coin. This brings us back to the crucial questions raised at the beginning of this section—should central banks pay attention to credit aggregates or confine themselves to following inflation targeting rules? Historical evidence suggests that credit has a constructive role to play in central bank policy. Valuable information about macroeconomic and financial stability would be missed if policymakers chose to ignore the behavior of credit aggregates, although how this information is included in the overall policy and regulatory regime, and via which instruments, is an open and much debated question.

Yet two other potentially important insights emerged from our long-run perspective on the determinants of financial crises. First, with regard to the effects of asset price booms and busts, our empirical analysis demonstrated that stock market booms become more problematic with larger financial sectors. At early stages of financial development, run-ups in equity markets are much less dangerous. Second, in the light of 140 years of financial crises the evidence suggests that larger financial sectors are more crisis prone. While the underlying causes remain in the dark—possibly fragility effects of growing complexity, increased moral hazard in more financialized economies, or lax regulation as a reason of both a larger financial system and frequent financial crises—this empirical finding deserves further dedicated research.

Our results also strengthen the idea that credit could matter, above and beyond its role as propagator of shocks hitting the economy. The credit system may not be merely an amplifier of economic shocks as in the financial accelerator model. At the very least, the importance of past credit growth as a predictor for financial crises and the robustness of the results to the inclusion of other key macro variables, raises the possibility that the financial sector is quite capable of creating its very own shocks. While different identification strategies are clearly needed, our historical data lend some support the ideas of scholars such as Minsky (1977) and Kindleberger (1978) who have argued that the financial system itself is prone to generate economic instability through endogenous credit booms.

7 Conclusions

Our ancestors lived in an Age of Money, where credit was closely tied to money, and formal analysis could use the latter as a proxy for the former. Today, we live in a different world, an Age of Credit, where financial innovation and regulatory ease broke that link, setting in train an unprecedented expansion in the role of credit in the macroeconomy. Without an historical perspective, these profound changes are difficult to appreciate, and one task of this paper has been to document this evolution and its ramifications.

We saw how the stable relationship between money and credit broke down after the Great Depression and WW2, as a new secular trend took hold that carried on until today's crisis. We conjecture that these changes conditioned, and were conditioned by, the broader environment of macroeconomic and financial policies: after the 1930s the ascent of fiat money plus Lenders of Last Resort—and a slow shift back toward financial *laissez faire*—encouraged the expansion of credit to occur. The policy backstop also, to some degree, insulated the real economy from a scaling up of the damaging effects that prior crises had wrought in days when the financial system played a less pivotal role. However, implicit government insurance and the prospect of rescue operations might also have contributed to the spectacular growth of finance and leverage within the system, creating more of the very hazards they were intending to solve. The important structural changes that have taken place in the financial system over the past decades have led to a greater role of credit in the macroeconomy. It is a mishap of history that just at the time when credit mattered more than ever before, the reigning doctrine had sentenced it to playing no constructive role in monetary policy.

In terms of lessons for policymakers and researchers, history demonstrates that they ignore credit at their peril. Credit aggregates contain valuable information about the likelihood of future financial crises. It is not, of course, a perfect predictor, and there may be fundamental reasons why, in some periods, especially in eras of financial development and innovation, credit expands to support real economic gains. At the same time, the record shows that recurrent episodes of financial instability have more often than not been the result of credit booms gone wrong, most likely due to failures in the operation and/or regulation of the financial system. For economists, adherence to the money view, not to mention the irrelevance view, has been called into question by the crisis. For policymakers, a complacent attitude towards the growth in the scale and riskiness of the credit system now looks like a misguided choice that ignored history.[19] Financial historians have long warned that more attention should be paid to recurrent episodes of financial sector instability in modern economies. We are hopeful that some of the firmer evidence we have assembled here will inform new avenues of research into the role of credit in the macroeconomy.

[19] Notable examples being the critical reaction and laissez faire response to precrisis warnings sounded at the Jackson Hole conferences by Borio and White (2003) and Rajan (2005). However, policymakers are now taking a harder look at how to regulate credit and the procylicality of the financial system (e.g., Adair Turner 2009).

REFERENCES

Almunia, Miguel, Agustín S. Bénétrix, Barry Eichengreen, Kevin H. O'Rourke, and Gisela Rua. 2010. From Great Depression to Great Credit Crisis: Similarities, Differences and Lessons. *Economic Policy* 25: 219–265.

Adrian, Tobias, and Hyun Song Shin. 2008. Liquidity and Financial Cycles. BIS Working Papers No. 256, July 2008.

Adrian, Tobias, and Hyun Song Shin. 2009. Money, Liquidity, and Monetary Policy. FRBNY Staff Report 360, January.

Barro, Robert J. 2009. Rare Disasters, Asset Prices, and Welfare Costs. *American Economic Review* 99(1): 243–64.

Bernanke, Ben S. 1983. Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression. *American Economic Review* 73(3): 257–76.

Bernanke, Ben S. 1993. Credit in the Macroeconomy. *Quarterly Review*, Federal Reserve Bank of New York, Spring, pp. 50–70.

Bernanke, Ben S., and Alan S. Blinder. 1992. The Federal Funds Rate and the Channels of Monetary Transmission. *American Economic Review* 82(4): 901–21.

Bernanke, Ben S., and Mark Gertler. 1995. Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *Journal of Economic Perspectives* 9(4): 27–48.

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist. 1999. The financial accelerator in a quantitative business cycle framework. In *Handbook of Macroeconomics*, vol. 1, edited by J. B. Taylor and M. Woodford. Amsterdam: Elsevier, pp. 1341–93.

Bernanke, Ben S., Mark Gertler. 2001. Should Central Banks Respond to Movements in Asset Prices? *American Economic Review Papers and Procedings* 91(2): 253–257.

Biggs, Michael, Thomas Mayer, and Andreas Pick. 2009. Credit and economic recovery. DNB Working Papers 218, Netherlands Central Bank, Research Department.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel, and Maria Soledad Martinez-Peria. 2001. Is the crisis problem growing more severe? *Economic Policy* 16(32): 51–82.

Borio, Claudio. 2008. The financial turmoil of 2007–?: a preliminary assessment and some policy considerations. BIS Working Papers no. 251. Bank for International Settlements.

Borio, Claudio, and Philip Lowe. 2002. Asset Prices, Financial and Monetary Stability: Exploring the Nexus. BIS Working Papers 114. Bank for International Settlements.

Borio, Claudio, and Philip Lowe. 2003. Imbalance or "Bubbles" Implications for Monetary and financial Stability. In *Asset Price Bubbles: The Implications for Monetary, Regulatory, and International Policies*, edited by W. C. Hunter, G. C. Kaufman, and M. Pomerleano. Cambridge, Mass.: MIT Press, pp. 247–70.

Borio, Claudio, and William R. White. 2003. Whither Monetary and Financial Stability? The Implications of Evolving Policy Regimes. *Proceedings*, Federal Reserve Bank of Kansas City, pp. 131–211.

Cecchetti, Stephen G., Marion Kohler, and Christian Upper. 2009. Financial Crises and Economic Activity. NBER Working Papers 15379.

Chari, V. V., Lawrence J. Christiano, and Patrick J. Kehoe. 2008. Facts and Myths About the Financial Crisis of 2008.Working Paper no. 666, Federal Reserve Bank of Minneapolis.

Chernyshoff, Natalia, David S. Jacks, and Alan M. Taylor. 2009. Stuck on Gold: Real Exchange Rate Volatility and the Rise and Fall of the Gold Standard, 1875–1939. *Journal of International Economics* 77(April): 195–205.

Christiano, Lawrence J., Roberto Motto, Massimo Rostagno. 2007. Two Reasons Why Money and Credit May be Useful in Monetary Policy. NBER Working Paper No. 13502.

Demirgüç-Kunt, Asli, and Enrica Detragiache. 1998. The Determinants of Banking Crises in Developing and Developed Countries. *IMF Staff Papers* 45(1): 81–109.

Eckstein, Otto, and Allen Sinai. 1986. The mechanisms of the business cycle in the postwar era. In *The American Business Cycle in the Postwar Era: Continuity and Change*, edited by Robert J. Gordon. Chicago: University of Chicago Press, pp. 39–122.

Edwards, Sebastian. 2002. Does the Current Account Matter? In *Preventing Currency Crises in Emerging Markets*, edited by Sebastian Edwards and Jeffrey Frankel. Chicago: University of Chicago Press, pp. 21–75.

Eichengreen, Barry. 2009. The Last Temptation of Risk. *The National Interest* (May/ June): 8–14.

Eichengreen, Barry, and Mitchener, Kris J. 2003. The Great Depression as a Credit Boom Gone Wrong. BIS Working Paper No. 137. Bank for International Settlements

Eichengreen, Barry, and Carlos Arteta. 2002. Banking Crises in Emerging Markets: Presumptions and Evidence. In *Financial Policies in Emerging Markets* edited by Mario Blejer and Marko Škreb. Cambridge, Mass.: MIT Press, pp. 47–94.

Farhi, Emmanuel, and Jean Tirole. 2009. Collective Moral Hazard, Maturity Mismatch and Systemic Bailouts. NBER Working Papers 15138.

Fisher, Irving. 1933. The Debt-Deflation Theory of Great Depressions. *Econometrica* 1(4): 337–57.

Freixas, Xavier, and Jean-Charles Rochet. 1997. *Microeconomics of Banking.* Cambridge, Mass.: MIT Press.

Friedman, Benjamin M., and Kenneth N. Kuttner. 1992. Money, Income, Prices, and Interest Rates. *American Economic Review* 82: 472–92.

Friedman, Milton, and Anna J. Schwartz. 1963. *A Monetary History of the United States: 1867–1960.* Princeton, N.J.: Princeton University Press.

Geanakoplos, John. 2009. The Leverage Cycle. Cowles Foundation Discussion Papers 1715, Cowles Foundation, Yale University.

Gertler, Mark. 1988. Financial Structure and Aggregate Economic Activity: An Overview. *Journal of Money, Credit and Banking* 20(3): 559–88.

Goldsmith, Raymond W. 1969. *Financial Structure and Development.* New Haven, Conn.: Yale University Press.

Goodhart, Charles A. E. 2007. Whatever Became of the Monetary Aggregates? Peston Lecture, delivered at Queen Mary College, London, on February 28, 2007

Gourinchas, Pierre-Olivier, Rodrigo O. Valdes, and Oscar Landerretche. 2001. Lending Booms: Latin America and the World. *Economía* 1 (2): 47–99.

Gurley, John G., and E. S. Shaw. 1955. Financial Aspects of Economic Development. *American Economic Review* 45(September): 515–38.

Hume, Michael, and Andrew Sentance. 2009. The Global Credit Boom: Challenges for Macroeconomics and Policy. External MPC Unit Discussion Paper No. 27, Bank of England, June.

Jermann, Urban, and Vincenzo Quadrini. 2009. Macroeconomic Effects of Financial Shocks. NBER Working Papers 15338, September.

Jung, Woo S. 1986. Financial Development and Economic Growth: International Evidence. *Economic Development and Cultural Change* 34(2): 333–46.

Kaminsky, Graciela L., and Carmen M. Reinhart. 1999. The Twin Crises: The Causes of Banking and Balance-of-Payments Problems. *American Economic Review* 89(3): 473–500.

Kashyap, Anil K., Raghuram G. Rajan, and Jeremy C. Stein. 2008. Rethinking Capital Regulation. *Proceedings*, Federal Reserve Bank of Kansas City, pp. 431–471.

Kaufman, Henry. 1986. Debt: the threat to economic and financial stability. *Economic Review*, Federal Reserve Bank of Kansas City, December, pp. 3–11.

Kindleberger, Charles P. 1978. *Manias, Panics, and Crashes: A History of Financial Crises.* New York: Basic Books.

King, Robert G., and Ross Levine. 1993. Finance and Growth: Schumpeter Might Be Right. *Quarterly Journal of Economics* 108: 717–27.

Kiyotaki, Nobuhiro, and John Moore. 1997. Credit Cycles. *Journal of Political Economy* 105(2): 211–48.

Laeven, Luc, and Fabian Valencia. 2008. Systemic Banking Crises: A New Database. IMF Working Paper 08/224, November.

McKinnon, Ronald I. 1973. *Money and Capital in Economic Development.* Washington, D.C.: Brookings Institution.

McKinnon, Ronald I.,and Huw Pill. 1997. Credible Economic Liberalizations and Overborrowing. *American Economic Review* 87(2): 189–93.

Mendoza, Enrique G., and Marco E. Terrones. 2008. An Anatomy Of Credit Booms: Evidence From Macro Aggregates And Micro Data. NBER Working Papers 14049.

Minsky, Hyman P. 1977. The Financial Instability Hypothesis: an Interpretation of Keynes and Alternative to Standard Theory. *Challenge* (March–April): 20–27.

Mishkin, Frederic S. 1978. The Household Balance Sheet and the Great Depression. *Journal of Economic History* 38: 918–37.

Mishkin, Frederic S. 2008. How should we respond to asset price bubbles? *Financial Stability Report* No.12, Banque de France, October, pp. 65–74.

Modigliani, Franco, and Merton Miller. 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. *American Economic Review* 48(3): 261–97.

Nolan, Charles, and Christoph Thoenissen. 2009.Financial Shocks and the U.S. Business Cycle. *Journal of Monetary Economics* 56(4): 596–604.

Pepe, Margaret S. 2003. *The Statistical Evaluation of Medical Tests for Classification and Prediction.* Oxford: Oxford University Press.

Rajan, Raghuram G. 2005. Has financial development made the world riskier? *Proceedings*, Federal Reserve Bank of Kansas City, pp. 313–369.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2009. *This Time is Different: Eight Centuries of Financial Folly.* Princeton, N.J.: Princeton University Press.

Romer, Christina D. 1999. Changes in Business Cycles: Evidence and Explanations. *Journal of Economic Perspectives* 13(2): 23–44.

Rousseau, Peter L., and Paul Wachtel. 1998. Financial Intermediation and Economic Performance: Historical Evidence from Five Industrialized Countries. *Journal of Money, Credit and Banking* 30(4): 657–78.

Schumpeter, Joseph Alois. 1939. *Business Cycles. A Theoretical, Historical, and Statistical Analysis of the Capitalist Process.* New York and London: McGraw-Hill.

Shaw, E. S. 1973. *Financial Deepening in Economic Development.* Oxford: Oxford University Press.

Turner, Adair. 2009. *The Turner Review: A Regulatory Response to the Global Banking Crisis.* London: Financial Services Authority.

Woodford, Michael. 2003. *Interest and Prices: Foundations of a Theory of Monetary Policy.* Princeton, N.J.: Princeton University Press.

White, William R. 2006. Is Price Stability Enough? BIS Working Papers, no. 205. Bank for International Settlements

APPENDIX

Appendix Table A1 gives our list of financial crisis dates. The sources for our other data were as follows. The raw data are shown in Appendix Figure A1.

RGDP: Real GDP per capita from Angus Maddison, Statistics on World Population, GDP and Per Capita GDP, 1–2006 AD. http://www.ggdc.net/maddison/. CPI: unless stated otherwise all data from Taylor, Alan M. (2002), A Century of Purchasing-Power Parity, Review of Economics and Statistics, vol. 84(1): 139–150; data for 2000–2008 from International Financial Statistics (IFS); GDP and I/Y: unless stated otherwise below pre-1945 data come from Brian R. Mitchell, 1993, International Historical Statistics: The Americas 1750–1988, Second Edition, New York, Macmillan; Brian R. Mitchell, 1992, International Historical Statistics: Europe 1750–1988. London, Macmillan; complemented by investment data from Jones, Matthew T., and Maurice Obstfeld, 1997, "Saving, Investment, and Gold: A Reassessment of Historical Current Account Data," NBER Working Paper no. 6103. Dataset: http://www.nber.org/databases/jones-obstfeld/; post-1945 data from IFS. STIR: short-term interest rate — unless otherwise stated the pre-WW2 data come from the dataset of Obstfeld, M., J. C.Shambaugh, and A. M. Taylor, 2005, "The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies, and Capital Mobility," Review of Economics and Statistics 87:423–38, and from the League of Nations Statistical Yearbook, various issues; data for the postwar period are taken from IFS. L: total domestic currency loans of banks and banking institutions to resident companies and households (excluding other financial institutions). C: total domestic currency assets of banks and banking institutions; of which: claims on government and the public sector for 1950–2008 were taken from IFS. NM: narrow money (M1); M: broad money (M2 or M3); E: equity market index; from the Global Financial Database unless noted otherwise.

Australia

L/C: 1870–1945 - table 1, total assets within Australia and total advances in Australia. S.J. Butlin, A.R. Hall, R.C. White, Australian Banking and Monetary Statistics, 1817–1945, Sydney 1971; 1953–2008— total loans and bank assets from Reserve Bank of Australia, Australian Economic Statistics 1949–50 to 1996–97, http://www.rba.gov.au/statistics/op8_index.html; 1997–2008 - Reserve Bank of Australia, Assets of Financial Institutions, table D02 and B01. NM/M: 1870–1983 — PF 57–71 from David Pope, Australian Money and Banking Statistics, Canberra, Australian National University, 1986; 1984–2008 — IFS.

Canada

L/C: 1870–1953 - M.C. Urquhart, Historical Statistics of Canada, Toronto 1965, Cambridge UP. Total loans and total assets of banks: series H55-H160. 1953–2008 StatCan, Table 176-0015: Chartered banks, assets and liabilities. NM: 1870–1929 — Rousseau and Wachtel; 1930–1940— League of Nations, Statistical Yearbook; 1953–2008— IFS. M: 1870–1938 — Based on unpublished datasets from Michael Bordo (henceforth Bordo); 1948–2008 — IFS.

Denmark

L: 1885–1938 — table 6.6, loans of commercial banks 1885–1938, Hans Chr. Johansen, Dansk Historisk Statistik 1814–1980; 1951–2008: total lending (excl. MFI's) of commercial banks and savings banks: Kim Abildgren, Financial Liberalization and Credit Dynamics in Denmark in the Post-World War II Period, Danmarks Nationalbank, Working Papers 47/2007. C: table 6.6 - assets of commercial banks, Hans Chr. Johansen, Dansk Historisk Statistik; 1981–2008 — series L plus holdings of securities and other assets from OECD (2009). NM/M: 1870–1940 — table 6.2, 6.6, 6.8 in Hans Chr. Johansen, Dansk Historisk Statistik; 1950–2008 — IFS.

Table A1: Crisis Dates by Country, 1870–2008

Australia	1893	1989							
Canada	1873	1907	1923						
Switzerland	1870	1910	1931	2008					
Germany	1873	1891	1901	1907	1931	2008			
Denmark	1877	1885	1902	1907	1921	1931	1987		
Spain	1883	1890	1913	1920	1924	1931	1978	2008	
France	1882	1889	1907	1930	2008				
U.K.	1873	1890	1974	1984	1991	2007			
Italy	1873	1887	1891	1907	1921	1930	1935	1990	2008
Japan	1882	1900	1904	1907	1913	1927	1992		
Netherlands	1893	1907	1921	1939	2008				
Norway	1899	1922	1931	1988					
Sweden	1878	1907	1922	1931	1991	2008			
USA	1873	1884	1893	1907	1929	1984	2007		

Sources: Bordo et al. (2001); Reinhart and Rogoff (2009); Laeven and Valencia (2008); Cecchetti et al. (2009). See text.

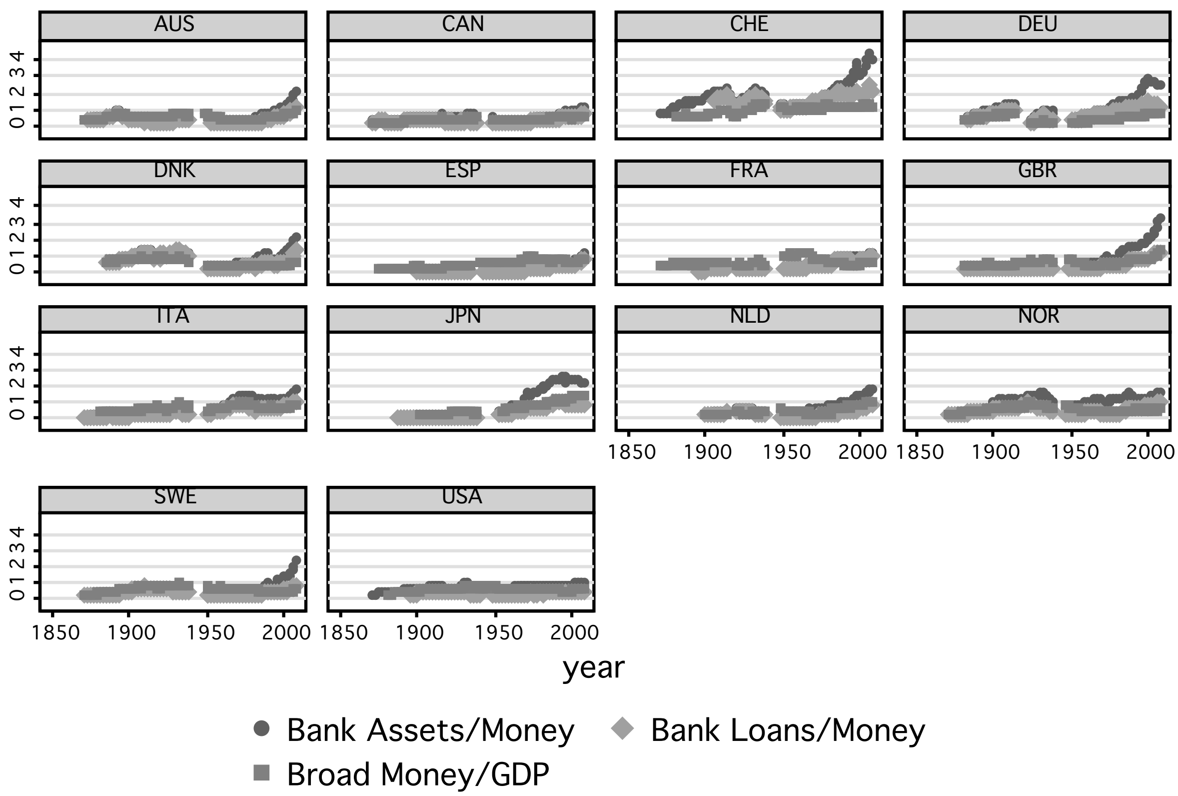

Figure A1: Raw Data

France

L: 1870–1940 from Saint Marc, Michelle, Histoire monétaire de la France, 1800–1980, Paris, 1983, who used credit data for Crédit Lyonnais, Société général, Comptoir national d'escompte and Crédit industriel et commercial. She assumed that total loans in the French economy averaged about twice that amount before 1940; 1945–2008: data for 1945–1969 from Conseil National du Credit (data kindly shared by Eric Monnet, Paris); 1970–1984 from INSEE ("Crédit à l'économie de caractère bancaire"); 1985–2008 from Banque de France (MFI loans to private sector residents, A20.A.1.U6.2200.Z01). The pre-1895 loan data are subject to very crude rounding errors and are not used. NM: 1870–1940 from Saint Marc (1983); 1949–2008 from IFS (M1). M: 1920–1940 from Patat, Jean-Pierre and Michel Lutfalla, Histoire monétaire de la France au XXe siècle, Paris 1986; 1949–2008 from INSEE and Banque de France (M2). E: Hautcoeur, Pierre-Cyrille and D. Le Bris, "A Challenge to Triumphant Optimists? A New Blue Chips Index for the Paris Stock-Exchange (1854–2007)," Financial History Review, 17 (2), 2010, pp. 141–83.

Germany

L: 1880–1940 - table B1 1.05, total loans of Aktienbanken, Sparkassen, Hypothekenbanken and Genossenschaftsbanken; Deutsche Bundesbank, Deutsches Geld- und Bankwesen in Zahlen, 1876–1975, Fritz Knapp: Frankfurt am Main, 1976. 1948–2008 - Bundesbank, Lending to domestic non-banks (All categories of banks, OU01115). C: 1880–1940 - table A 1.01, total assets of Aktienbanken, Sparkassen, Hypothekenbanken and Genossenschaftsbanken; Deutsche Bundesbank, Deutsches Geld- und Bankwesen in Zahlen, 1876–1975, Fritz Knapp: Frankfurt am Main, 1976. 1950–2008 — Bundesbank: Balance sheet total (All categories of banks, OU0308). NM: 1876–1940 —Bundesbank (1976); 1950–2008 from IFS (M1). M: 1880–1940 from Bordo; 1950–2008 from IFS (M2).

Italy

L/C: 1870–1940 — unpublished workfile: Alfredo Gigliobianco, Claire Giordano and Gianni Toniolo, "Regulators and Innovators Play Tag: The Italian Historical Experience", forthcoming. The datasources are De Mattia, R. (1967), I bilanci degli istituti di emissione italiani 1845–1936, Vol. 1, Banca d'Italia: Rome, for the period 1870–1889; Cotula F. et al (1996), I bilanci delle aziende di credito 1890–1936, Editori Laterza: Rome-Bari, for the period 1890–1935; Unpublished data, Bank of Italy, for the period 1936–1973. 1950–1994— Bank of Italy, total bank loans (S858159), extended 1995–2008 using growth rates from IFS and Bank of Italy (S515363M andS640592M, "lending to domestic non-financial enterprise and households"); assets 1950–2008 - Bank of Italy, series S049387, extended 1997–2008 using growth rates of banking sector assets from Bank of Italy (S463168M). NM/M: 1870–1939 M0 — Fratianni, M. and F. Spinelli, A Monetary History of Italy, Cambridge 1997; 1880–1945 M3 from Bordo; 1948–2008 - Bank of Italy, M1 and M2 Plus; after 1998 Italian contribution to Eurozone M1 and M3 from the Bank of Italy. E: Da Pozzo M. and Felloni G., La Borsa Valori di Genova nel secolo XIX, Torino, ILTE, 1963, Tab. LXVII, p. 499; and Parodi S., Il mercato finanziario genovese dal 1895 al 1914, unpublished thesis (tesi di laurea), University of Genoa, 1966, Tab XLV, p. 238. Data made available by Angelo Riva (Paris).

Japan

L/C: 1870–1940 — Bank of Japan, Hundred-year Statistics of the Japanese Economy, Tokyo 1966 (Meiji-Iko Hompo Shuyo Keizaitokei); 1953–1982 — Tamaki, Norio, Japanese banking: a history, 1859–1959, Cambridge 1995, and IFS, 1983–2008— Bank of Japan (series FA'FAABK-FAAB2DBEA40, Loans of domestically licensed banks less loans to other financial institutions); total domestic credit 1953–2008 from IFS. CPI: 1885–1940 — Obstfeld and Taylor (2003); 1950–2008— IFS. NM: 1880–1940 — Bordo and Eichengreen (2001); 1955–2008— IFS (M1). M: 1901–1918 — Bordo; 1919–1940 — Mitchell; 1955–2008 — IFS (M2). STIR: 1870–1940 from Bank of Japan, Nihon Ginko Hyakunen-shi Shiryo-hen (Bank of Japan: The First Hundred Years-Materials), Tokyo 1986 - http://www.boj.or.jp/type/pub/hyakunen/ hyakus.htm; 1950–2008 from IFS.

Netherlands

L: 1900–1982 sum of “Korte vorderingen op privatesector”, “Onderhandseleningen”, “Hypothecaireleningen”, “Diverse binnenlandactive,” table 3.1 - De Nederlandsche Bank,Nederlandse financile instellingen in de twintigste eeuw: balansreeksenen naamlijst van handelsbanken, DNB Statistische Cahiers Nr. 3, 2000;1982–2008 DNB, Banking statistics, table 5.6ek. C: 1900–1945 Bilans total (excl. foreign assets) of commercial banks, table 3.1 - De Nederlandsche Bank, Nederlandse financile instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken,D NB Statistische Cahiers Nr. 3, 2000; 1948–2008 IFS. NM: 1900–1992 — Bordo and League of Nations; 1993–2008— DNB, Table 5.4, Contribution of the Netherlands to euro area monetary aggregates, Guilder M1; 1945–1998 — IFS; 1999–2008 — DNB, Table 5.4, Contribution of the Netherlands to euro area monetary aggregates, Guilder M3. GDP and I/Y: 1880–1913 — van Zanden et al., National Accounts of the Netherlands, 1880–1913; http://national accounts.niwi.knaw.nl/start.htm; 1918–1940 —Mitchell; 1948–2008 — IFS. E: Tweehonderd jaar statistiek in tijdreeksen, 1800–1999, University of Groningen and Centraal Bureau voor de Statistiek, Voorburg/Heerlrn 2001, Table 10. Data made available by Peter Koujdis (Barcelona).

Norway

L/C: table A2 and A4, Eitrheim, Klovland, and Qvigstad (eds.), Historical Monetary Statistics for Norway, chapter 10: Credit, banking and monetary developments in Norway, Norges Banks Occasional Papers nr. 35, Oslo 2004, http://www.norges-bank.no/templates/article____42927.aspxNM/M: table 2a, Jan T. Klovland, Monetary Aggregates in Norway, 1819–2003, chapter 5, in: Eitrheim et al. (eds.), http://www.norges-bank.no/templates/article____42935.aspx; GDP, I/Y: Ola H. Grytten, The gross domestic product for Norway, 1830–2003, chapter 6, in: Eitrheim et al. (eds.), http://www. norges-bank.no/templates/ article____42937.aspx.

Spain

L/C: 1900–2000 — Entitades de credito, table 9.12 from A. Carreras and X. Tafunell (eds.), Estadísticas Históricas de España, Madrid 2005. 2000–2008 — growth rates of loans and assets for MFI’s from Bank of Spain - Residentes en España, total prestamos (BE060106) and total activos (BE060102). NM/M: 1870–1998: A. Carreras and X. Tafunell (eds.), Estadísticas Históricas de España, Madrid 2005, table 9.16; 1998–2008 IFS. GDP/IY: 1870–2000 Prados de la Escosura, Leandro, El progreso economico de Espana, 1850–2000, Madrid 2003, Appendix M.

Sweden

L: Table 2, Bank lending, monthly figures 1871–1938, Riksbank, Historical monetary statistics for Sweden, 1668–2008, Swedish Monetary History Project. C: table 8 — Income Statement items of the Swedish commercial banks 1870–2005, total assets of commercial banks (minus foreign assets), Riksbank, Historical monetary statistics for Sweden, 1668–2008, Swedish Monetary History Project. NM/M: 1871–2008 — Historical monetary statistics for Sweden. GDP, I/Y: Rodney Edvinsson, Historical national accounts for Sweden 1800–2000 (Historiska nationalräkenskaper för Sverige 1800–2000) Version 1.0. E: Waldenström, Daniel, Swedish stock prices and returns and bond yields, 1856–2006, forthcoming in R. Edvinsson, T. Jacobsson and D.Waldenström, Historical Monetary and Financial Statistics for Sweden, Volume 2, Sveriges Riksbank.

Switzerland

L: 1906–1992 - total loans, Swiss Economic and Social History Online Database (http://www.fsw.uch.ch/ mboxhiststat/); 1993–2008 — Swiss National Bank, Banks in Switzerland 2008, (http://www.snb.ch/en/iabout/ stat/statpub/ bchpub/stats/ bankench). C: 1870–1945 - Franz Ritzmann, Die Schweizer Banken, Bern und Stuttgart 1973; 1948–2008 - Swiss National Bank, Banks in Switzerland (2008): total balance sheet assets (less foreign assets).NM: 1880–2008 - Swiss National Bank, Historical time series: the monetary base and the M1, M2 and M3 monetary aggregate (http://www.snb.ch/en/iabout/ stat/statpub/histz); M: 1880–1914 — Bordo; 1914–1950 — M3, Swiss Economic and Social History Online Database (http://www.fsw.uch.ch/histstat/); 1950–2008 - M3, Swiss National Bank, Historical time series: the monetary base and the M1, M2 and M3 monetary aggregate (http://www.snb.ch/en/iabout/stat/statpub/histz).

United Kingdom

L/C: 1870–1939 - consolidated total assets of all financial institutions and consolidated bank loans and advances from table 3.4, David K. Sheppard, The Growth and Role of UK Financial Institutions, 1880–1962, Methuen & Co., London 1971; 1945–2008 Sterling loans (excl. loans to other financial institutions) from Bank of England; total domestic credit (32) from IFS. NM/M: 1880–1945 - Sheppard (1962); 1947–2008 - Bank of England.

United States

L: 1896–1941: Total loans and leases of commercial banks from Board of Governors of the Federal Reserve, US All Bank Statistics 1896–1955, Washington D.C., 1959; 1947–2008 - total loans and leases and security investments of commercial banks from the Board of Governors of the Federal Reserve H.8 release. C: Total bank assets are defined as the sum of loans and leases and security investments. Total assets of banks from Rousseau and Wachtel (1998), series BANKA, taken from: US historical statistics, Bureau of Census (1973); 1929–1940 - Board of Governors of the Federal Reserve, US All Bank Statistics 1896–1955, Washington D.C., 1959; 1950–2008 total domestic credit — IFS. NM/M: 1870–2008 — monetary base from the Federal Reserve Bank of St. Louis, Adjusted Monetary Base (available at http://research.stlouisfed.org/fred2/data/AMBSL.txt); money stock 1880–1918 from Rousseau and Wachtel (1998), 1919–1940 - Bordo; 1945–2008 — data for M2 are from IFS. E: Robert Shiller (2000), Irrational Exuberance, Princeton University Press, 2009, updates from http://www.econ.yale. edu/~shiller/data.htm.