The Aftermath of Credit Booms: Evidence from Credit Ceiling Removals

Matthew Baron and Isaac Green

November 3, 2021

Abstract

In the years after WWII, many countries adopted "credit ceilings" – annual restrictions on the quantity of aggregate credit banks could extend – as a means of monetary control. We identify a group of 13 countries that enacted and subsequently removed credit ceilings and study the aftermath of these deregulatory events, with an eye towards understanding the formation of credit booms and the events that follow them. We find that a removal of credit ceilings predicts sharp, sudden increases in credit-to-GDP ratios, which, almost universally, are followed by increases in investment, real estate construction, and asset prices over the short-term, and then by reversals and banking crises in the medium-run. These credit booms are driven by the types of banks and loans most affected by deregulation, and the timing is most consistent with credit ceiling removals relative to other types of financial deregulations that happened in the same era. We uncover several new phenomena related by credit booms: the asynchronous nature of GDP and credit growth and "calm before the storm" phenomenon described in theory by Greenwood, Hanson, and Jin (2019); "successive bubbles," as asset price booms inflate and reverse in succession; and the "irreversibility" of credit booms: once started, they are resistant to regulatory efforts to reimpose control. Our results have implications today for macroprudential policy and for credit control policies in countries such as China.

Do credit booms sow the seeds of their own demise, as Minsky (1974) hypothesized? Several recent papers have presented evidence in support of Minsky's hypothesis (Borio and Lowe, 2003; Schularick and Taylor, 2012; Greenwood and Hanson, 2013; Mian, Sufi, and Verner, 2017; Lopez-Salido, Stein, and Zakrajsek, 2017;). Underlying this hypothesis is the idea that extended stretches of financial calm can help inflate credit booms and booms in real estate and other assets classes. These booms eventually collapse, leading to banking crises and deep recessions. Moreira and Savov (2017), and Greenwood, Hanson, and Jin (2019) model these boom-bust dynamics with time-varying "credit market sentiment" arising from over-extrapolation of default rates in the recent past.

This paper analyzes these theories by studying the removal of "credit ceilings" in an international panel of countries from 1950 to 2016. "Credit ceilings," as we refer to them throughout the paper, were systems of rigid direct controls on bank credit, enacted in several countries in the post-World War II period. These policies imposed maximum permissible growth rates of bank loans each year, at a time when corporate bond markets or nonbank lending were, by law, either highly circumscribed or nonexistent. As the global financial system modernized, and as international sentiment trended toward financial deregulation in the 1970s and 1980s, these countries gradually dismantled their credit ceilings, allowing bank credit to expand freely. We find that removals of these credit ceilings were followed by sharp and immediate accelerations in the granting of bank credit, as previously suppressed lending became unshackled. Furthermore, we show these credit ceiling removals were distinct in time from other types of deregulatory policy (e.g., deregulations of interest rates, capital controls, foreign bank entry), and tended to affect just certain institutions (e.g., large banks) and types of loans (e.g. real estate loans), helping us to isolate the consequences of these credit ceiling removals.

To study the effects of credit ceiling removals, we assemble macroeconomic panel data on 39 economies over the period 1950 to 2018, and identify 13 countries which remove credit ceilings. To systematically analyze credit ceiling removals, we implement a local projections-instrumental variable (LPIV) framework of Jorda, Schularick and Taylor (2020) to control for the normal feedback between credit cycles and the real economy, while also using credit ceilings removals to instrument for the growth of credit relative to GDP. In the first stage of our analysis, we find that credit ceiling removals are followed by a large and sudden increase in domestic bank-credit-to-GDP in 12 out of 13 cases, with credit-to-GDP increasing by an average of about 8 percentage points and reaching an average peak after three years. The increases are mainly found among institutions and credit types most affected by deregulation. In the second stage, we find that in the short run, the credit boom coincides with increases in GDP growth, investment, asset prices, and real estate construction (the boom), followed in the medium run by reversals and often a banking crisis (the bust). These effects are not observed following other types of deregulation. Specifically, we find that if quantities are measured relative to the credit boom peak that is at $t = 3$ years after the credit ceiling removal, real GDP declines by 1%, bank stocks decline by 10%, house prices decline by 2%, and residential investment declines by 3%, on average, over the subsequent five years. In 11 out of 13 credit ceiling removals, a banking crisis occurs within five years after the initial credit boom.

We then document three phenomena associated with the aftermath of credit booms. The first phenomenon is the "calm before the storm" described in theory by Greenwood, Hanson, and Jin (2019), that the business cycle starts to turn before the credit cycle does, as banks continue to expand their lending even after GDP has started to decline. Specifically, we find that after credit ceilings are removed, GDP hits its cyclical peak on average 1-2 years prior to the subsequent peak of the credit cycle. This pattern, whereby GDP ebbs before credit growth falters, occur in 9 of the 11 cases where there is a clear downturn in real GDP within the ten years following credit ceiling removals. The second phenomenon we call "successive bubbles", as several different types of asset price booms (residential real estate, commercial real estate, and stock prices) inflate and peak in succession. We argue that bankers and investors often chase other lending opportunities and asset classes, in the final stages of a boom after one asset class starts to deflate. The third phenomenon is the "irreversibility" of credit booms, as credit booms "take on a life of their own" and are resistant to regulatory efforts to reimpose control. Indeed, we document that in the six countries in which credit controls are reimposed within five years of removal, credit continues to rapidly expand in three and is only partially moderated in the other three. Moreover, all six countries still experience banking crises within five years of the new restrictions.

In addition to uncovering these three phenomena after credit booms, our paper expands the existing literature in two important ways. First, while a large body of work provides historical evidence that credit booms tend to precede banking crises, economic downturns, and asset price crashes (Schularick and Taylor, 2012; Greenwood and Hanson, 2013; Baron and Xiong, 2017; Mian, Sufi, Verner, 2017; Lopez-Salido, Stein, and Zakrajsek, 2017)—the evidence in these papers is mainly correlational, with the notable exception of Mian, Sufi, and Verner (2019), discussed below. As a result, this has led some to question to what extent these patterns are causal (Santos and Veronesi, 2018; Gomes, Grotteria, and Wachter, 2018a,b)[1]. In contrast, our paper takes an instrumental variables approach using credit ceiling removals, and we discuss our identification strategy, along with potential limitations, below and also in Section III.

Second, it is unclear from this prior literature which types of deregulations are associated with subsequent credit booms and busts. While Mian, Sufi, Verner (2019) study bank branching deregulation, which is unique to the U.S., their paper leaves open a broader question of why credit booms inflate in other countries. An earlier literature on international financial crises shows that financial crises tend be preceded by deregulations (e.g., Kaminsky and Reinhart, 1999). Our paper goes further by building a new database of other types of financial deregulations and showing the key role of credit ceiling removals across a variety of developing and advanced economies. Lastly, Mian, Sufi, Verner (2019) leave open the question of whether their state-level deregulation helped initiate the credit boom or simply amplified an already-present national boom-bust cycle in U.S. states with more deregulations. In contrast, our study suggests that credit ceiling removals can themselves lead to credit booms that subsequent go bust.

Second, it is unclear from this prior literature which types of deregulations are associated with subsequent credit booms and busts. While Mian, Sufi, Verner (2019) study bank branching deregulation, which is unique to the U.S., their paper leaves open a broader question of why credit booms inflate in other countries. An earlier literature on international financial crises shows that financial crises tend be preceded by deregulations (e.g., Kaminsky and Reinhart, 1999). Our paper goes further by building a new database of other types of financial deregulations and showing the key role of credit ceiling removals across a variety of developing and advanced economies. Lastly, Mian, Sufi, Verner (2019) leave open the question of whether their state-level deregulation helped

[1]Santos and Veronesi (2018) show that a number of the stylized facts on high leverage and subsequent downturns can be obtained in a purely frictionless model in which investors have heterogeneous endowments and risk-preferences.

initiate the credit boom or simply amplified an already-present national boom-bust cycle in U.S. states with more deregulations. In contrast, our study suggests that credit ceiling removals can themselves lead to credit booms that subsequent go bust.

Our identification strategy rests on the assumption that credit ceiling removals are generally exogenous events uncorrelated with the business cycle or other policy shifts that may have also affected lending and financial stability. Our arguments in support of this assumption are as follows. First, as we further describe in Section I, credit ceilings were mainly removed for ideological reasons, usually a desire to modernize monetary regimes (to use interest rates and open market operations rather than quantitative controls) and a desire to enhance economic competition in the banking sector; they were generally not implemented due to macroprudential or business cycle considerations. Their particular timing usually coincided with a political shift: for example, the removal credit controls in the U.K. in 1971 coincided with the election of Edward Heath's Conservative government, which implemented a broader deregulatory agenda.

Second, as we show, credit ceiling removals coincide exactly in time with sharp inflection points in bank credit, as these events are nearly all followed by rapid accelerations in lending. Thus, part of our identification argument comes from the sharpness in the timing. In addition to the institutional arguments on their motivation discussed above, the timing does not suggest that credit ceiling removals were implemented either in response to a downturn (to stimulate the economy) or after a boom had already started (to cater to banks seeking to take advantage of lending opportunities in a strong economy). Rather, we argue the credit ceiling removals themselves were a trigger that allowed the sudden unleashing of new lending that had previously been suppressed. In addition to showing that financial and real variables fail to exhibit any clear systematic pattern across countries in the years preceding credit ceiling removals, our local projection methodology likewise helps control for the normal endogeneity between the business cycle and credit cycle. In the context of our model, the rapid rise in bank credit coincident with credit ceiling removals appears as a break in prior trends.

Third, we show that these credit ceiling removals were distinct in time from other types of deregulatory policy (e.g., deregulations of interest rates, capital controls, foreign bank entry) and that the rapid rise in credit corresponds most closely in time with credit ceiling removals versus other types of deregulatory policy. This analysis helps isolate the effect of credit ceiling removals from other types of deregulations, which generally occurred in the same decade, though several years apart, as we document.

Lastly, we show these credit ceiling removals tended to more substantially affect certain institutions (e.g., large banks) and types of loans (e.g. real estate loans), helping us to isolate the consequences of these credit ceiling removals. Although this analysis is limited to a few countries where the policies were known to affect only some institutions or loan types—and where disaggregated data is available on these classes of institutions and loan types—this evidence is consistent with the rapid credit increase being driven by the credit ceiling removal.

Our study is related to Farhi and Werning (2016), Korinek and Simsek (2016), and Schmitt-Grohé and Uribe (2016) who construct macroeconomic models in which credit booms can boost the macroeconomy in the short-run but lead to financial instability in the medium-run. Our study is also related to Aikman, Bush, and Taylor (2016) who study the business cycle consequences of quantitative credit controls (a broader class of policies, of which credit ceilings is an important one) in the U.K. in the postwar period and find that, while quantitative credit controls reduced bank lending, there is mixed evidence on whether they affected output and inflation. Monnet (2014) studies the role of quantitative credit controls in postwar France as a key policy lever of the Bank of France in managing inflation and employment. Other studies analyzing the effects of quantitative credit controls in various other countries include Romer and Romer (1993) for the U.S., Glocker and Towbin (2015), Sonoda and Sudo (2016), and Monnet (2016).

Our analysis proceeds as follows. In section I we describe the credit ceiling policies and the broader regulatory system in 13 countries that enacted these policies after WWII. We outline why we believe credit ceiling removals were not systematically related to broader events in the macroeconomy or financial system. Section II discusses our data. In section III we use an LPIV approach to study the link between credit growth, asset prices, and the macroeconomy. Section IV discusses three new phenomena that we relate to credit booms. In section V we discuss other financial reforms in the countries we study and show that credit ceiling removals appear to coincide more closely in time with inflection points in credit growth than any other type of policy reform. Section VI links our results to recent discussion of macroprudential policy, and we also briefly discuss how China has prominently used quantitative credit controls, with varying degrees of success, to manage their macroeconomy in the aftermath of the 2007-8 global financial crisis.

I. Institutional Setting

In this paper, we study the imposition and the subsequent removal of a set of policies referred to here as "credit ceilings." Credit ceilings were implemented in a number of countries (hereafter referred to as "credit ceiling countries") in the decade immediately following the World War II and took the form of tight restrictions on the quantity of loans and other forms of credit that could be extended by financial institutions over a particular time period.

Our appendix contains extensive documentation of how credit ceilings were implemented in each individual country in our sample, citing from a variety of both primary sources, written by policymakers implementing credit controls, and contemporaneous scholars analyzing such policies while they were in place. We use this section to summarize some general insights and to highlight common themes that unite the financial reform processes undertaken by a number of these countries.

Across the countries we study, credit ceilings were generally implemented by central banks via a mixture of formal decrees and informal guidance with restrictions that varied across institutions and loan types. In Sweden, for example, "Bank actions were continuously scrutinized by the Riksbank and views on proper bank behavior were communicated in weekly meetings between the governor and representatives of the major banks. As one result of these meetings, the banks would commit to keep their lending within certain limits. It was only in 1974, however, that a law was passed giving the Riksbank the right to impose legally binding regulations" (Englund, 2015). Hodgman (1976) writes, "The Riksbank imposed a ceiling on the rate of expansion of bank loans for purposes other than house building... In 1974 the ceiling rate on loan expansion over a 12 month period was 18 per cent for commercial banks, 10 per cent for savings banks and 13 per cent for cooperative banks."

What was the motivation behind these policies? Credit ceilings were implemented not as macroprudential policies (that is, for financial stability, a purpose which is almost never mentioned in contemporaneous accounts) but to keep inflation in check by directly controlling the growth of monetary aggregates. For example, French monetary authorities formalized and tightened their credit ceiling policies in 1972, in the midst of a bout of inflation. A French Banking regulator, the National Credit Council, noted in its 1974 annual report that "[t]he policy of restrictive credit, put in place at the end of 1972, has, to a large extent, contributed to limiting the growth of the money supply to 15% over the course of 1973... the main objective of the monetary policy that followed in 1974 was to slow down the rise in prices appreciably, without causing too marked a fall in economic activity." In the UK, Hodgman (1976) notes that "use of selective credit controls... was motivated partly by efforts to influence credit allocation and partly by the belief of the authorities that credit control techniques permitted more efficient control over interest rates, total credit, and aggregate demand than would have a monetary policy that relied upon market forces and control over monetary aggregates." A general barrier faced by a number of countries that used credit ceilings was that money markets had not sufficiently developed for central banks to use open market operations to fine tune the money supply over the short-term.

In addition to being a tool to control inflation, credit ceilings and other quantitative controls of lending were also related to government efforts in many countries to use credit policy in furtherance of national priorities, such as ensuring governments' access to cheap sources of funding, and channeling funds to priority sectors, such as agriculture and exports.

While the countries that implemented credit ceilings after WWII all had the same primary motivation for adopting them, there are also a number of idiosyncratic historical factors that led these countries to adopt credit ceilings. Thus, it is does not appear that the set of countries that adopted credit ceilings did so for a set of systematic reasons which would set them apart from the other countries in our study, which did not use ceilings. For example, the Bank of Japan used quantitative restrictions on lending in part because it did not have the independent authority to set most interest rates.[2] The heavily controlled interest rate regime was largely the purview of the Ministry of Finance, rather than the Bank of Japan, and so the BOJ did not have the ability to control inflation via interest rates and open market operations (see Rhodes and Yoshino, 2007).[3] Similarly, in Italy, the conduct of monetary policy through the purchase of

[2]It was able to adjust the rate at which banks could borrow from its discount window, but these would to transmit to other rates in the economy that were controlled by the MOF.

[3]The Ministry of Finance, in turn, set rates with an eye toward channeling cheap credit to industry, and was thus not principally

government bonds was beyond the reach of monetary authorities. The reason is that the "Bank of Italy was bound to purchase all debt papers issued by the Treasury and not sold to the public. This formal relationship lasted till 1982 and ended with the so-called divorce between the Bank of Italy and the Treasury" (Kaufman, 1992). It is important to note that many other countries—even many in Western Europe (e.g., Germany, Switzerland, and Spain) that implemented other credit restrictions (such as directed lending to prioritized sectors or financial repression)—did not adopt any form of credit ceilings.

Just as idiosyncratic factors influenced countries' decisions to adopt credit ceilings in the first place, the exact form that these ceilings took varied from country to country. We exploit some of these differences in our analysis. In many of the countries that adopted credit ceilings, there were some types of credit and certain institutions that were exempt from the ceilings. In Australia, for example, all of the national banks, including the major trading banks and savings banks, had to comply with credit ceilings, but the state-chartered banks were exempt; so too were mortgage associations and other non-bank financial institutions. In the UK and Japan, credit ceilings initially targeted only the largest banks (i.e. the London clearing banks and the so-called "city banks" in Japan) though they were later expanded to cover some of the smaller banks. In most of these countries certain priority classes of loans were also exempt. France had a dizzying array of different types of favored credit, such as agriculture loans, medium- and long-term mortgage loans, and export loans (see Melitz, 1987). Sweden exempted loans that funded homebuilding while Norway had a number of special purpose banks to fund priority sectors such as education, agriculture, and fisheries, with these banks subject to a different set of credit restrictions.

Though there were notable differences across countries in how credit ceilings operated, we nonetheless strive to maintain a fairly narrow set of criteria for the policies we label as credit ceilings. We categorize policies as credit ceilings only if they feature an explicit limit on the rate at which a broad class of intermediaries can expand the asset sides of their balance sheets. We maintain this narrow definition in order to isolate the set of credit policies most likely to place a binding constraint on the aggregate supply of credit, and which operate in a straightforward way through a credit supply channel. We ignore other forms of quantitative controls, like statutory

concerned with inflation. See Suzuki (1987) for further discussion.

reserve requirements, which implicitly place limits on the aggregate credit supply, but which were not actively used to curtail credit growth and which often did not bind in practice.[4][5]

Over the course of two decades, from 1971 to the early 1990s, these credit ceilings were removed in all the countries we study. The complete list of credit ceiling countries, and the dates that these ceilings were removed, is shown in Table 1. To do this, we analyze a number of primary and secondary source documents, including official central bank releases, government budget documents, and academic papers and books on the evolution of banking and financial regulations in various countries, which we document in the appendix. For each country, we also note major central bank tools for the conduct of monetary policy and dates of major financial reforms. The resulting database on the implementation and removal (and, in some cases, re-implementations and removals) of credit ceilings are documented in the appendix. As can be seen from Table 1, although we identify only 13 countries with credit ceilings, the set of countries represents a fairly diverse swath of large economies during the postwar period and there is thus little evidence to suggest that the sample is biased in favor of countries with particular traits.[6] Our sample of credit ceiling countries includes mostly advanced economies, but also includes some emerging markets; it contains countries from every continent with the exception of North America; and it contains countries with highly regulated financial sectors as well as those with more market-oriented policies.[7]

INSERT TABLE 1 HERE

For all the credit ceiling countries, we can identify formal credit ceilings in place for several years, and in most cases, more than a decade prior to their repeal. These policies were not

[4] One caveat is some of the policies that we label as credit ceilings were technically labelled as supplementary reserve requirements. That is, a country might maintain a primary reserve requirement, which is rarely if ever changed. At the same time, they might set a maximum rate of loan expansion (i.e. a credit ceiling) accompanied by an additional reserve requirement. This additional requirement would serve as a penalty for exceeding the credit ceiling. Banks exceeding the ceiling would then be required to maintain an additional quantity of non-interest-bearing reserves at the central bank which would vary as a function of the amount by which it exceeded the ceiling. This supplementary reserve requirement would often be so high (particularly against the backdrop of moderate to high inflation) that it effectively maintained a hard credit ceiling, even if banks were technically allowed exceed it.

[5] Portfolio requirements, and other forms of directed credit that primarily target the composition of bank asset holdings, rather than the quantity, similarly do not qualify as credit ceilings for our purposes.

[6] Our empirical approach of using country fixed effects means that we generally focus within-country variation in our outcome variables, mitigating concerns about underlying differences between countries.

[7] We do not list the dates that these policies were established. The reason for this is that several of the countries that enacted credit ceilings initially did so in an informal manner, where central bankers conveyed lending preferences privately to banks, even before statutory authority was given to set binding credit ceilings (as in the case of Sweden, discussed above).

completely static during the time they existed, and there were periods in which these restrictions were made more and less binding.[8] Nonetheless, for most of the countries we study, we view the dates of their removal as being sharply defined.[9]

There is also some evidence that policymakers, perhaps mistakenly, assumed that credit ceilings were rendered ineffective by financial modernization, and no longer served a purpose. For example, in Japan, according to Shigehara (1991), "given a significant progress in the de-regulation of financial transactions both domestic and international, Japanese non-bank borrowers' access to alternative sources of finance and innovations in financial engineering could negate the effect of compulsory control on the volume of domestic bank lending." Similarly, in Norway, according to Thorvald et al. (2004), "the growth of the Eurokrone market, financial innovations and increasing flexibility of the shadow credit market made it much more difficult for the government to constrain the underlying market forces by credit regulations... This problem appears to be the main reason why the government decided to move away from credit regulations." It should be noted that strong credit growth in the wake of credit ceiling removals in these countries cast doubt on the notion that financial innovations had rendered ceilings to be completely ineffective.

During the financial regulatory regimes that preceded credit ceiling removals, one consequence of credit rationing was that banks generally extended loans only to the most fiscally sound borrowers. Often these borrowers were large firms that had explicit or implicit government backing. As a result, large losses by banks were rare. For example, in Norway, Solheim, Thorvald, and Vale (2004) note that "[b]anks had been exposed to little credit risk during the regulatory regime that had more or less been in place between 1945 and 1984, partly because of relatively stable macroeconomic developments and partly because the regulatory regime did not allow any bank to expand its lending rapidly. Furthermore, the regime implied a rationing of credit that allowed banks to pick mainly the best credit risk among the queue of unsatisfied credit demand. Thus, when the quantitative regulation was lifted, banks had hardly any experience in how to

[8] In a small number of cases, we were able to identify sources suggesting that a country had quantitative credit guidelines for some stretch of time, but where there were insufficient details on the specifics of these policies to determine whether they would constitute credit ceilings for our purposes. Our sample is thus not necessarily exhaustive of the set of countries globally that had some form of credit ceilings.

[9] In a few countries, the exact deregulation dates can be slightly ambiguous. For example, in France, the central bank dismantled credit ceilings by first announcing, in 1984, its long-term intention to remove credit ceilings, then lowering the penalty for exceeding the ceilings, in 1985, before finally removing the ceilings altogether in 1987. In this case, we choose 1987 as the date of deregulation. In Japan, credit ceilings ("window guidance") were legally abolished in the 1990s but were effectively discontinued in the 1980s, with some debate among scholars about the exact year they stopped being enforced. In most cases other than these, however, credit ceilings were removed all at once, and there is little ambiguity surrounding the relevant dates.

operate in this new much more competitive environment." If bankers used their credit loss history during the years in which credit was heavily regulated to form their expectations of market outcomes post-liberalization, it is likely that deregulation would be accompanied by insufficient credit monitoring, fueling high levels and poor quality of credit provision.

Lastly, we should note that credit ceiling removals were separate in time from other types of financial deregulation. For example, in Sweden, interest rate restrictions were liberalized in 1978; restrictions on capital flows, issuance for private sector bonds, and foreign ownership of Swedish equity shares were removed in 1980; foreign banks were allowed to enter in 1986; restrictions on foreign exchange controls and foreign asset holdings were removed in 1989, and bank branching deregulations occurred in 1990. Figure 2 in the appendix is a chart of the various types of deregulations in each of the countries, showing as in Sweden that credit ceiling removals were separate in time from other types of financial deregulation. In Section 5, we formally analyze the timing of these other types of deregulation and show that the specific credit booms we study correspond most closely in time with credit ceiling removals versus other types of deregulatory policy.

II. Data and Summary Statistics

Our main analysis focuses on country-level data from an unbalanced panel consisting of 39 countries. Our dataset contains macroeconomic and financial variables measured at an annual frequency over the years 1950-2016. The full list of countries that appears in the sample is available in the appendix alongside further details on variable construction.

Our main data source is Baron, Verner, and Xiong (2020), from which we obtain country-level data on bank credit, GDP, inflation, returns on bank equity indices, and their list of banking crises. We also make use of an alternative set of banking crisis dates from Reinhart and Rogoff (2009) for robustness. We add data on house prices and real residential fixed investment. Data on house prices come from Schularick and Taylor (2017), Global Financial Data, and central bank websites. Data on real residential investment is constructed using data from the OECD and from CEIC. In our analysis, all variables are expressed in real terms and are deflated using data on CPI inflation from Baron, Verner, and Xiong (2020). For our analysis, bank stock prices, GDP, house prices, and residential investment are normalized relative to their 1980 values, so that their 1980 levels assume a value of 100. When data for a particular variable and country begins after 1980, that country's observations are normalized relative to the first year that data for the variable-country pair appears in the dataset. Such normalization ensures a relatively equal weighting of observations across countries. In a small number of cases, observations in the early part of the sample were generated via linear interpolation of the surrounding years. Such interpolations were made when there were no more than two consecutive missing years, and it was ensured that no data were interpolated in years surrounding credit ceiling removals.

Our key independent variable is the bank credit to GDP ratio. Our aggregate credit variable comprises all credit extended by domestic banks to residents (i.e. consumers and non-financial firms) with the exception of foreign currency loans. Aggregate credit data come from Baron, Verner and Xiong (2020), who in turn gather data from Jorda, Schularick, and Taylor (2017), the BIS long credit series, and a various of newly transcribed historical sources. Following the literature on credit booms we scale the aggregate credit variable by domestic GDP in order to focus on credit growth in excess of GDP growth.

Summary statistics on the variables are presented in Table 2. Table 2 shows an upward trend in all variables, including the bank credit to GDP ratio. Most of the secular growth in this variable has occurred since 1970, as noted by Schularick and Taylor (2012), with growth rates picking up even more substantially in much of the world after 1990.

INSERT TABLE 2 HERE

We compile information on the existence and removal dates of government-imposed credit ceilings in a number of countries in our sample, as described in Section I. The full list of sources from which we compile our data on credit ceiling policies and deregulation dates is available in the appendix. After gathering our sources, we are able to identify a list of 13 countries that implemented and subsequently removed credit ceilings over the years 1971-1990. After identifying the list of countries with credit ceilings and finding the dates of their removal, we also construct a larger database with timelines of various types of significant financial deregulations in these countries.

Finally, we collect some additional data which we use for robustness checks and for analysis of the three phenomena we study related to the aftermath of credit booms. We collect data on commercial real estate prices and on the level of corporate investment in real estate. Commercial real estate data comes from the BIS commercial property database[10], from central banks and other government sources such as Statistics Sweden, as well as from a number of academic papers written at the time that credit ceiling policies were in effect. Corporate investment in real estate is similarly drawn from a variety of sources including OECD, CEIC, and central bank sources. Both of these data series give us limited data coverage, and as such we do not include them in main LPIV analysis, given the more limited sample. However, we analyze this data around credit ceiling removals in the relevant parts of our analysis.

III. Credit Ceiling Removals and Subsequent Credit Booms and Busts

Credit ceiling removals could, in theory, have a number of effects. They could, for example, increase inflation, consistent with the original motivation behind their enactment, if central banks do not have alternate mechanisms in place to sufficiently restrain money and price growth. They could also foster economic growth by allowing financial institutions to fund a larger portion of the available positive-NPV projects. The latter might move the economy towards a more efficient outcome, if removals of credit ceilings allow an economy to move toward its optimal levels of investment and consumption. Our evidence does not appear to be consistent with either of these possibilities, as we see unchanged inflation, lower GDP, lower bank stock prices, and a high probability of a banking crisis in the near future.

The alternative hypothesis, consistent with our evidence, is that the removal of credit ceilings fosters instability. If bankers used their credit loss history during the years in which credit was heavily regulated to form their expectations of market outcomes post-liberalization, it is

[10] For more information on the construction of these series, see https://www.bis.org/statistics/pp_commercial.htm, and Eurostat (2017): “Commercial property price indicators: sources methods and issues,” Publications Office of the European Union.

likely that deregulation would be accompanied by insufficient credit monitoring and inefficient overextension of credit. Such reckless credit expansion may lead to future defaults, bank failures, and poor macroeconomic performance.[11]

In this section, having identified a set of 13 countries that implemented and then removed credit ceilings, we introduce and estimate the LPIV specification of Jorda et al. (2020). Our approach uses credit ceiling removals to instrument for credit growth while using several auto-regressive terms to control for the broader state of the macroeconomy. We first show that our instrument is highly relevant: in part A of this section we show that credit ceiling removals predict sharp and immediate increases in credit to GDP ratios. In the second stage of our analysis, we show how events unfold after this initial surge in credit growth. We highlight the behavior of several real variables (e.g. GDP growth and residential fixed investment) and depict the evolution of financial conditions (e.g. bank stock prices and real estate prices) in the wake of credit booms, showing how these booms eventually go bust. These results are robust to a variety of specifications, including reduced form estimates and event studies.

Our key identification assumption is that credit ceiling removals were uncorrelated with other factors that might simultaneously forecast credit growth and induce financial instability. At the moment, our primary justifications for the validity of this assumption are that the architects of credit ceiling policies weren't motivated by financial stability considerations, and that these financial reforms were conceptually unrelated to events unfolding in the broader economy. In section V we will more thoroughly explore potential objections to our identification assumption, including the notion that there were other financial reforms adopted at a similar time to credit ceiling removals that served as the source of ensuing financial instability, and the possibility that the credit ceiling removals themselves were not binding, so that the credit growth we observe in the wake of their abolition stemmed from strong household credit demand, a surge in foreign investment, or other unobserved factors that may also be correlated with economic downturns.

[11] A more nuanced version of this hypothesis is that the initial credit provision subsequent to deregulation might be efficient, but that the credit boom might be self-propelling—as low initial rates of default and high bank profitability lead banks to increase their lending even more—so that the lending is no longer efficient in the credit boom's later stages. This possibility would be consistent with theory by Moreira and Savov (2017) and Greenwood, Hanson, and Jin (2019), in which lenders form their expectations of future outcomes in part by extrapolating recent default rates, and, in so doing, underestimate true default probabilities during prolonged stretches with low default rates.

A. Credit growth and Macroeconomic Variables Around Credit Ceiling Removals

We first examine the behavior of country-level credit to GDP ratios in periods surrounding credit ceiling removals. We find evidence consistent with the notion that credit ceiling removals led to credit booms in the short- to medium-term.

Before beginning our formal econometric analysis using an LPIV framework, we first plot credit-to-GDP in each country with credit ceiling removals, which provides a preliminary visual presentation of our results. Appendix Figure 1 plots the behavior of these ratios over ±5-year windows surrounding credit ceiling removals for each of the 13 credit ceiling countries. Appendix Table 1 similarly shows country-level data for the credit ceiling countries, showing changes in credit to GDP ratios in the three years after credit ceiling removals as compared to the country-level averages for all three-year windows outside of the post-liberalization periods. In 12 of the 13 countries, credit grows faster in the three years after credit ceilings are removed than it does during the average of all other three-year windows in that country's credit history.[12] Table 3 quantifies these initial findings on credit growth. On average, credit to GDP ratios increase by 10.9% in the three-year period that follows credit ceiling removals. The average rate of credit expansion during all other periods is only 3.7%.

INSERT TABLE 3 HERE

There does not seem to be a systematic relationship between credit ceiling removals and macroeconomic conditions at the time these removals took effect. As illustrated by the individual country plots in Appendix Figure 1, in many countries, such as Australia, Italy, South Africa, and Portugal, credit was decreasing in the leadup to credit ceiling removals. In other countries, such as Japan, Sweden, Chile, and France, credit was relatively flat or increasing moderately. There is thus little evidence that countries were in the midst of a boom prior to ceiling removal. There are also no instances in which a country removed ceilings in the middle of a financial crisis or a major recession. There is thus little to suggest that the financial problems experienced by

[12] The lone exception is Austria, which is the only country in which we do not see a sharp rise in credit in the years after credit ceilings are removed. It is also one of only two countries that does not experience a financial crisis in the ten-year period after ceiling removal.

countries after deregulation were already underway prior to liberalization. After liberalization however, credit grows rapidly in almost every country in the sample. In some countries (e.g. Argentina, Norway, France) credit growth begins in the very year that ceilings are removed, while others (Sweden, Portugal, the UK, New Zealand, and Italy) see credit growth take off in the year after liberalization. As we will show in section 5, no other set of policy reform in these countries sees this kind of rapid credit growth within a short window of their enactment.

In order to summarize the progression of credit and other macroeconomic variables, across all the countries in our sample, we estimate local projections of Jorda (2005) to trace out the impulse responses of various outcomes to removals of credit ceilings. Specifically, we consider regressions of the following form:

$$y_{i,t+h} = \alpha + \beta^h * Liberalize_{i,t} + \sum_{k=1}^{4} \gamma_k^h * y_{i,t-k} + \sum_{k=1}^{4} \delta_k^h * X_{i,t-k} + \varepsilon_{i,t+h}^h \tag{1}$$

For h = 0, 1, ... 12.

Here, y is one of the response variables of interest, which we describe below; the subscript i represents one of the 39 countries in our sample (i.e. the 13 credit ceiling countries, and the 26 other "control" countries) while the t subscript represents the year. *Liberalize* is an indicator variable which takes a value of one for country i, and year t, if country i removes its existing credit ceilings in year t. The *Liberalize* variable takes a value of zero in all other country-year pairs. Thus, for the 26 countries in the sample which never enact credit ceilings of the form described in section I, the *Liberalize* variable will assume a value of zero in all years.

The response variables y that we consider in this initial specification are real GDP, bank stock prices, real house prices, and real residential fixed investment. We also initially choose to estimate our regressions in levels, as recommended by Hamilton (2018). Each of these variables, with the exception of credit to GDP ratios, are expressed in log form in the estimating equations. For control variables X, we include up to three separate macroeconomic controls, including three lags of GDP, inflation, and credit to GDP ratios.[13] We include lagged values of the response

[13] We include inflation in our set of controls because the primary purpose of instituting credit ceilings was to establish control over inflation. Thus, it is perhaps plausible that these ceilings were removed only when inflation was deemed to be dormant. The reasons for including lagged GDP and lagged credit to GDP ratios are somewhat more obvious. We ultimately seek to determine the effect of credit growth on the broader economy. If credit ceilings are removed in a way that coincides with the underlying state of the macroeconomy (for instance if credit ceilings are removed in the midst of broader economic booms, or if they are removed when growth is low with the intention of spurring credit and GDP growth) it will be important to control for these factors.

variable y on the right-hand side of the equation, as we want to ensure that the coefficient on our *Liberalize* variable captures only innovations to the country-level time-series of a given variable that occur after ceilings are removed. If credit ceiling removals tend to coincide with periods of strong economic growth, we do not want to incorrectly attribute strong growth after ceiling removals to effects that result solely due to variables' persistent character.

INSERT FIGURE 1 HERE

Figure 1 shows the dynamic response of credit to GDP ratios to credit ceiling removals by plotting the sequence β^h in the set of equations above for h = 1, 2, ... 12. We adopt the convention of normalizing the estimated impulse response by subtracting from each coefficient the estimated coefficient from the time zero regression. Red lines in each picture trace out our point estimates for the effects of credit ceiling removals on each of the response variables, while dashed blue lines depict 95% confidence intervals. The standard errors used to compute confidence intervals are robust to clustering at the country level.

Figure 1 shows a rise in credit growth in the years after credit ceilings are removed. We estimate that removal of credit ceilings raises credit to GDP ratios by more than 7% in the three years after ceiling removal, relative to the counterfactual case where ceilings remain in place.[14] Credit to GDP ratios remain substantially elevated up to five years after ceilings are removed but begin to contract thereafter. In total, we see a contraction by roughly 5% from years 5-12, though we do not see an aggregate reversal.

The same cannot be said of the other variables. Real GDP remains relatively unchanged in the first two years after ceiling removal but begins to drop at a relatively steady rate thereafter. After 12 years, we find that GDP levels are roughly 20% lower as a result of credit ceiling removals. In this plot, we notice that the upper bound of the 95% confidence interval crosses below zero, indicating significantly lower GDP growth in the years after ceilings are removed than we would expect in similar periods without ceiling removals. Similar patterns are observable in the other variables as well, although these variables, if anything, present stronger evidence of boom-and-bust cycles. In general, these variables exhibit similar timing, with respect to their peak values, as

[14]This is a very similar result to our earlier "non-parametric" analysis.

credit to GDP. Bank stock prices, residential investment, and house prices, all see initial increases in the three years after ceilings are removed and then experience declines thereafter. Of these, house prices have perhaps the most dramatic collapses. After their peak, real estate prices decline by roughly 20% over the ensuing nine years. The general pattern of real estate price boom and bust cycles is visible across a number of individual countries, including the UK, Norway, Sweden, France, and Australia. As we will show later, these aggregated results perhaps understate or obscure the disaggregated episodes, since some credit cycles turned more quickly than others. Bank stock prices and residential real estate prices exhibit similar patterns to house prices; of these variables, bank stocks have the most precipitous single-year drop (7 years after ceilings are removed) but rebound in the years thereafter.

B. Estimating the Effects of Credit Ceiling Removals in a LPIV Approach

We now turn to our more formal econometric analysis, in which we explore the dynamic relationship between credit ceiling removals, credit growth, and macroeconomic outcome variables using a local projections-instrumental variables (LPIV) approach of Schularick and Taylor (2014). For our analysis, we formalize our conception of credit cycles, modeling them as a combination of an initial three-year "boom" phase, and a "bust" phase from years 4-12. In a first stage, we use credit ceiling removals to instrument for credit growth during the initial boom phase and then trace out the effect of fitted credit growth on macroeconomic outcomes during the bust.[15]

Specifically, in the first stage we instrument for credit growth using the *Liberalize* variable:

$$\Delta_3 Credit{-}to{-}GDP_{i,t} = \alpha^{s1} + \beta^{s1} * Liberalize_{i,t} + \sum_{k=1}^{4} \gamma_k^{s1} * \Delta_1 Credit{-}to{-}GDP_{i,t-k} + \sum_{k=1}^{4} \delta_k^{s1} * \Delta_1 X_{i,t-k} + \varepsilon_{i,t}^{s1} \tag{2}$$

where the *s1*, superscripts attached to the coefficients and error term in the above equation indicated that these are "stage 1" coefficients. We then use the predicted values of *Credit-to-GDP* generated from equation (2) to estimate

[15] We noted previously that high levels of credit growth are apparent up to t=5. Our results are not substantially different if we use year five as the peak of the credit boom rather than year three.

$$\Delta_h y_{i,t+3} = \alpha^{s2} + \beta^{s2,h} * \Delta_3 Credit \hat{-} to - GDP_{i,t} + \sum_{k=1}^{4} \gamma_k^{s2,h} * \Delta_1 y_{i,t-k} + \sum_{k=1}^{4} \delta_k^{s2,h} * \Delta_1 X_{i,t-k} + \varepsilon_{i,t+3+h}^{s2,h} \tag{3}$$

where the *s2* superscript above each coefficient and the error term indicates that these are our "stage 2" estimates. The "hat" marker over the *Credit-to-GDP* variable indicates that these are predicted values of the credit to GDP ratio generated from estimating (2). We adopt the same set of control variables that we used for our analysis in the previous section. Our dependent variables are now expressed as differences, so that we can assess how their values progress relative to their levels at the height of the credit boom. We adopt the notational convention that for any variable y, $\Delta_h y_{i,t} = y_{i,t+h} - y_{i,t}$; thus, *Credit-to-GDP* is constructed by subtracting the time zero value of a country's credit to GDP ratio from its value at time three.[16] It should be noted that the X vector above includes lagged values of a country's credit to GDP ratio as well as lagged GDP and inflation.

INSERT FIGURE 2 HERE

Figure 2 plots the impulse responses, $\beta^{s2,h}$ obtained from equation (3), for each of the variables of interest in the period after a credit boom. The impulse responses are defined as the responses to a one hundred basis point increase in a country's credit to GDP ratio. We leave horizontal space on the left-hand side of each plot, with a solid vertical bar at t=3 as a reminder that the impulse responses show the behavior of each variable after a credit shock, which is assumed to take place during the previous three years. The vertical axes are expressed in decimal form, so that a value of .01, for example, would indicate that a 1% increase in a country's credit to GDP ratio over the preceding three years would generate a 1% increase in the dependent variable.

Figure 2 panel A shows how credit evolves in the years after the initial boom. We can see that after a three-year credit supply shock, credit to GDP ratios are gradually mean reverting.

[16] We do not difference the control variable inflation, since inflation is already expressed as a first difference of consecutive years' CPI levels.

While credit remains relatively flat for the first few years after the initial boom, in years 4-9 after the initial credit boom (or 7-12 years after the beginning of the boom) credit recedes and total growth over the period is negative, suggesting that credit booms eventually reverse.

These results, and those below, are also shown in tabular form in Table 4, which reports the estimates β^h of the coefficients on the *Credit-to-GDP* variable in equations (3) and (4). For the sake of brevity, the table presents coefficients beginning four years after the credit boom (h=4 in the equations above, or seven years after the *beginning* of the credit boom). Standard errors, in parentheses beneath each coefficient, are again robust to clustering.

INSERT TABLE 4 HERE

Turning back to Figure 2, Panel B illustrates the dynamics of aggregate output after a credit boom. The impulse response suggests that GDP growth turns negative immediately after the peak of the credit boom, declining at a relatively stable rate across the nine years after the shock. By year four after the credit boom, the response is statistically significant at the 5% level. By the ninth year after the credit boom, the coefficient on Credit-to-GDP reaches a level of -1.673, suggesting a 1% shock to Credit-to-GDP over a three-year window leads to a 1.67% reduction in GDP in the subsequent nine years.[17]

Panels C-E of Figure 2 show some of the phenomena that accompany the fall in output that we observe in the aftermath of credit booms. Panel C shows a large decline in bank stock prices that occurs four years after the credit boom. Baron and Xiong (2017) present similar evidence across an international panel and a long time-series showing an association between credit expansion and subsequent bank stock price declines. Theoretical work by Tirole (1987) and He and Krishnamurthy (2018) suggest that shocks to the net-worth of financial intermediaries can be an important channel in propagating economic distress. The β^h coefficient for h=4 in the bank

[17]To put this figure into perspective, consider that the removal of credit ceilings led to roughly 7% growth to a country's credit to GDP ratio. Suppose that a country, in the absence of a credit boom, would be expected to grow at an annual rate of 4%. After nine years, we would then normally expect this country's total output to be 42.3% higher than it was at the beginning of this period. If, instead, this country experienced a credit boom in the years preceding this period, of the same size as the average credit boom generated by credit ceiling removals, then we would expect total economic growth over the nine years after the credit boom to be only 30.6% (or 42.3 – 7*(-1.673)). Thus, this average-sized credit boom would wipe out roughly 28% of the growth that this country would have otherwise expected over a nine-year period.

stock price regressions is -7.445, suggesting that bank stock prices fall more than 7% for every 1% increase in credit to GDP ratios occurring during the initial credit boom. Again, considering that credit ceiling removals were associated with roughly 7% credit growth on average, this suggests that bank stock prices would decline by roughly 52% in reaction to an average sized credit boom generated by ceiling removals. Our results here suggest that credit booms damage the economy, in part, by facilitating bank losses that deplete the equity capitalization of the financial sector.

Panels D and E show the dynamics of real estate prices and residential fixed investment following a credit boom. Recent work by Schularick and Taylor (2014) and Mian, Sufi, and Verner (2017) suggests that housing booms and busts can be an important driver of financial crises, either because banks hold substantial quantities of real estate loans on their balance sheets or because housing wealth is an important part of the household balance sheet. Panel D shows that house prices exhibit a relatively steady decline in the years after a credit boom, with the largest single-year price drops coming five and seven years after the initial credit boom. The cumulative negative effects of the credit boom on house prices attain statistical significance, at the 5% level, by year eight after the boom. The results of estimating the effects of credit growth on residential real estate investment echo the results that we find in house prices, with large drops in residential investment levels in years five and six after the credit boom, followed by relatively flat growth in the ensuing years.

The results we present in Table 4 show that credit booms also have the ability to forecast banking crises. Using lists of banking crises assembled by Baron, Verner, and Xiong (2020) and Reinhart and Rogoff (2009), we define a new variable that captures the total number of banking crises that occur in a country over a particular period of time, with crisis dates defined according to one of these lists. The time windows for which we construct these variables are the same windows that we look at when constructing our impulse responses. Thus, our crisis variables are defined as the total number of banking crises that occur in a country in expanding time windows of length 4-9 years, and the regression coefficients on these variables should be interpreted as the marginal contribution of a 100-basis point credit supply shock to a country's expected number of financial crises over a given window. As shown in Table 4 panel E, which uses the Reinhart and Rogoff (2009) crisis list to construct the expected crisis variable, the coefficient for the h=4 regression is 4.97, which suggests that an increase in a country's credit to GDP ratio of 1% increases the expected number of financial crises that the country will experience in the four years after the credit boom by .0497. The β^h coefficient in the Reinhart and Rogoff crisis regressions peaks at a value of 7.55 for the year h=6. Based on this coefficient, a credit supply shock of 7% over a three-year credit boom would increase the number of crises that the country could expect to suffer in the six years after the credit boom by 7*.0755=.528.[18]

The analogous results in Table 4 panel F suggests a strong association between credit booms and future banking crises. For both the Baron, Verner, and Xiong (2020) crisis list and the Reinhart and Rogoff (2009) crisis list, we observe large coefficient values on the Credit-to-GDP variable, suggesting that credit booms predict large increases in the expected number of crises a country will experience. For both sets of variables, we obtain coefficients that are statistically significant at the 5% level over the entire time horizon that we study. In total, 11 of the 13 countries that dismantle credit ceilings in our sample experience a financial crisis in the 10 years after ceilings are removed. The only countries that do not experience financial crises are Austria, which also does not experience any kind of credit boom, and Portugal. In the 11 countries that do experience crises, we observe a total of 14 distinct financial crises, with three countries (Argentina, Chile, and South Africa) experiencing two crises in the years after liberalization. The occurrence of such a large number of crises is striking since banking crises are relatively rare events in the larger sample.

IV. Newly Uncovered Phenomena Associated with Credit Booms

In this section we look more closely at the periods surrounding credit ceiling removals. We newly document three empirical patterns on the behavior of key variables over the boom-and-bust phases of the credit cycle. The first is the "calm before the storm" phenomenon described in theory by Greenwood, Hanson, and Jin (2019), that the business cycle starts to turn before the credit cycle does, as banks continue to expand their lending even after GDP has started to decline. The second is the emergence of "successive bubbles," in which we find that sharp

[18]Note that an increase of .52 in the expected number of crises a country will experience does not necessarily suggest a 52% increase in the probability of a single crisis. It could, for example, correspond to a 26% increase in the probability that a country will suffer two crises and a 0% change that the country will suffer from a single crisis.

boom and bust cycles in prices of different classes of assets often occur one after the other. We argue that bankers and investors often chase other lending opportunities and asset classes in the final stages of a boom, after prices and investment in one asset class start to deflate. The third concerns the "irreversibility" of credit booms. When regulators re-impose credit restrictions after an initial removal of ceilings, aimed at stanching the growth of credit, these restrictions seemingly have little effect, as credit booms appear to take on a life of their own once they are underway. Avoiding the negative effects of large credit booms seems to require more than simply reversing the incentives that generated them in the first place, as all six countries that reimposed controls still experience banking crises within five years of the new restrictions.

A. The Asynchronous Nature of Business and Credit Cycles: The Calm Before the Storm

The first of the phenomena that we present is the calm before the storm phenomenon of Greenwood, Hanson, and Jin (2019). While their paper is mainly theoretical, the authors highlight stylized facts from the U.S. in 2007-8 case, in which credit tended to grow strongly well into mid-2008, even as GDP had already started to decline. In the model of Greenwood, Hanson, and Jin (2019), investors form beliefs, in part, by extrapolating past market outcomes (i.e. the occurrence of defaults) in addition to looking at firm fundamentals (i.e. cash flows). In such a setting, credit markets can become detached from fundamentals in the late part of the credit cycle, when cash flows recede but do not yet trigger defaults.

We seek to investigate whether the calm before the storm phenomenon is visible across the credit booms of our study. Plots for each country of real GDP and real credit growth, in windows surrounding credit ceiling removals, are plotted in Appendix Figure 2. Black vertical bars mark the years of credit ceilings removals, while vertical gray bars mark banking crises.

To systematically analyze turning points of business cycles and credit cycles, we use the following procedure of Hamilton (2018) to effectively detrend variables and then identify peaks. We begin by regressing GDP and credit on their four most recent lagged values, in separate regressions for each variable and credit ceiling country. We then compute forecast errors from these regressions and label as the start of downturns the first year in a sequence of years where we observe either two consecutive negative forecast errors, or one large negative forecast error, defined as observations belonging to the bottom 10th percentile for that country.[19] We define business cycle or credit cycle peaks as the last year before the beginning of a downturn in GDP or credit, respectively.

We use two approaches to analyzing the timing relationship between business cycle and credit cycle peaks. The first is simply measuring the average number of years between the peaks of these cycles. We assign a positive value to the difference in the number of years between cyclical peaks if the business cycle peaks before the credit cycle, and we assign this difference a negative value if the credit cycle peaks first. The results of this exercise are reported in the first column of Table 5 panel A. On average, business cycles tend to hit their peak 1.30 years before credit cycles. Some examples in which the calm before the storm phenomenon is easily visible in country-level data include Argentina, where the business cycle hits its peak three years before the credit cycle (1980 vs. 1983), Norway, where GDP hits its peak in 1986, four years before credit recedes, and France, where GDP peaks a year before credit. A notable exception is Japan, where credit begins to ebb in 1987, despite strong GDP growth that persists until 1991.

Our second approach involves looking at windows around financial crises occurring after the initial credit boom. Since 11 of the 13 credit ceiling countries experienced banking crises in the 10 years after ceiling removal, we use the dates of these banking crises, as given by the Baron, Verner, and Xiong (2020) crisis list to anchor our analysis. We choose the business cycle and credit cycle turning points that most closely coincide with these dates as the relevant cyclical turning points for evaluating the calm before the storm phenomenon. We consider this second approach for evaluating the distances between turning points, even if less algorithmic, to be the more natural of the two approaches. It allows for the removal of two countries, Austria and Portugal, where there was no clear boom and bust cycle following deregulation, and it allows us to focus on the largest (and most obvious) economic shocks emerging in the wake of credit ceiling removals. When we apply this new approach to measuring distances between peaks, the average distance between credit cycle and business cycle turning points increases slightly. The

[19] We can define the beginning of a business cycle or credit cycle upturn (i.e. the transition from a contraction to an expansion) analogously, by looking for the first of two consecutive positive forecast error, or a single large positive forecast error. However, our analysis focuses more heavily on identifying downturns.

average distance between peaks is 1.86 years, closely matching the historical experience of the 2008 financial crisis in the United States where these two cycles peaked two years apart. More notably, it lowers the volatility in the distances between peaks, mainly by removing the two countries which didn't have clear downturns. The upshot of this refinement is that the average distance between peaks of business and credit cycles attains strong statistical significance. Of the 11 countries, only one of these countries (Japan) saw the credit cycle turn before the business cycle; there were two cases in which the cycles were perfectly synchronized, while the remaining eight countries saw business cycles which hit their peaks between 1-4 years before credit showed signs of a downturn.

B. Successive Bubbles

Can investor sentiment spill over from one asset market to another? Do bankers and investors often chase other lending opportunities and asset classes, in the final stages of a boom after one asset class starts to deflate? In this section we present evidence that appears to suggest the affirmative to both these questions. Specifically, we study markets for both residential and commercial real estate and find that rapid price appreciation in one of these two asset classes tends to be followed by a price boom in the other. Then, as the credit cycle turns, prices frequently plummet in both of these markets, with the asset that experiences a larger and earlier price boom tending to face more precipitous price declines. We also find similar evidence of successive booms not just in prices but also in the quantities of investment in residential and commercial real estate.[20][21]

Appendix Figure 3 presents plots of prices in residential and commercial real estate markets for each individual country, while Appendix Figure 4 presents analogous plots for investment quantities. In France, for example, the residential real estate boom begins in 1988, one year after ceilings are removed, and several years after commercial real estate prices begin their rapid ascent. In Australia, Norway, Italy, and Sweden, we similarly see these smaller price booms in residential

[20] Our analysis sometimes suffers from limitations with respect to the availability of data. In many of the countries in our sample, long time-series on commercial real estate prices are simply unavailable.

[21] It should be noted that the data on real estate prices and real estate investment do not necessarily reflect prices and investment on directly comparable structures. For example, commercial real estate price data often reflects office prices in a country's largest cities, while corporate real estate investment data covers investment in a broader range of structures that includes office buildings, factories, airplane hangars, and certain types of infrastructure.

real estate prices, emerging after credit ceiling removals, and following closely behind the earlier spike in commercial real estate markets. After the credit cycle begins to enter its contractionary phase, both residential and commercial real estate markets experience price collapses. However, in a number of cases, we observe price growth in residential real estate markets remaining strong even after commercial real estate begins its steep descent.

To examine the timing of these peaks, for each country where we have residential and commercial real estate data, we define peaks as the highest value that these series obtain at any point during the sixteen-year period beginning five years before ceiling removals and ending ten years after.[22] When we define peaks in this way, we find that the two series tend, on average, to peak 0.75 years apart. The dispersion between peak dates is much lower than the dispersion between the inflection points that mark the starts of these price booms. In all cases that we observe, the two series peak within two years of each other before plummeting. In total, we observe five countries in which peak dates differ. While the differences in peak dates is not large, it is notable in a number of these cases that prices continue to rise in the late-developing market, even in the midst of price collapses in the earlier-developing market. Italy, Norway, and France, all see residential real estate prices continue to grow, even after commercial real estate prices see contractions of more than 10%.

The evidence that we collect from the price data is reinforced by the data in investment quantities. The investment data are somewhat more volatile than the price data, with cycles that are less clear in illustrating stark booms and busts in many cases. In a similar structure to our investigation of the calm before the storm phenomenon, we use banking crisis dates to anchor our investigations of cyclical turning points and look for large price declines that occur within a short window surrounding financial crises in each country.[23] We then define investment peaks as the last year prior to the largest price decline that occurs in the years surrounding the financial crisis. When applying this approach, we again find data suggesting asynchronous peaks in the residential and commercial real estate markets. We find that the beginnings of investment booms, in the buildup to financial crises, tend to occur 0.66 years apart and that peak investment

[22]One could make the case that New Zealand is tougher to identify. The paths of residential and commercial real estate prices do not entirely align with the patterns we observe more generally, as both assets see strong growth in the years prior to credit ceiling removals, while residential real estate prices see a smaller price contraction a year before the financial crisis in 1987.

[23]We thus exclude Austria from our analysis, though we nonetheless plot its data in the appendix.

in these markets tends to occur roughly a year apart.

Taken together, we interpret our findings on real estate prices and quantities as consistent with the notion that, as markets in that asset class begin to overheat, and lending standards become increasingly loose, lenders may shift to a new asset. Such an account is anecdotally consistent with the experience of bankers in the lead-up to the 2008 financial crisis, when residential real estate price growth drove the credit cycle, but began to subside as early as 2006, with stock prices and commercial real estate prices maintaining robust growth until 2007 and 2008, respectively.

C. "Irreversibility" of Credit Booms

We next present evidence suggesting that once credit ceilings are removed, the ensuing credit boom can "take on a life of its own" and be difficult to contain. Given the length of time it takes for a credit boom to inflate and then reverse, one tempting conclusion would be that if policymakers were to take early steps aimed at gradually bringing credit back down, that they could avoid the perilous after-effects of credit cycle downturns. Unfortunately, there appears to be little evidence that reimposing credit restrictions is effective in reversing the underlying forces that contribute to financial instability.

Of the 13 countries that remove credit ceilings in our sample, six of these countries reimpose new restrictions in the years after removal. Table 5 panel C shows the list of countries that instituted new restrictions in the years after credit ceilings were removed and displays the number of years of credit growth that these countries experienced in the years after new controls were put in place.

It should be noted that none of these countries fully restored the regulatory regimes that were in place prior to ceiling removal. We also do not know, in all cases, what specific factors regulators were responding to when they reimposed these partial controls. However, in a number of cases, narrative evidence suggests that regulators were responding to greater than anticipated credit growth and potentially overheating financial markets. In the UK for example, after robust credit growth in the two years after ceiling removal, the Bank of England imposed new rules requiring banks to post additional reserves at the central bank if deposit growth exceeded a certain threshold. In Italy, after robust credit growth in the two years after deregulation, authorities partially reinstated credit ceilings in 1986, with the understanding that such restrictions would be temporary, rather than a permanent fixture of the regulatory regime. These restrictions were subsequently removed after a year. Norway announced new supplementary reserve requirements in 1986, two years after deregulation, and Japan re-issued lending guidance for the largest "city banks" in 1989.

The evidence appears mixed on whether these new restrictions were narrowly successful in dampening credit growth. When assessing the likely effects of these policies more broadly, however, it appears clear that they did little to stem the tide of the broader credit cycle or to prevent crises. While the ratio of credit to GDP decreased in Italy, in 1986, when temporary ceilings were put in place, this did not appear to stop credit growth in its tracks or to reverse the broader trend toward higher credit and greater financial instability. After temporary credit controls were removed, credit grew even more rapidly, and the banking system experienced a crisis in 1990 followed by weak growth and poor credit conditions in the subsequent years. After the UK installed new regulations in 1973, credit growth remained relatively flat in the following year, either measured in real terms, or relative to GDP. However, the financial system suffered a crisis in 1974 and credit contracted in the following year. After Japan instituted credit restrictions in 1989, credit subsequently receded relative to GDP (though growth continued in real terms) but the economy went into a recession shortly thereafter and there was a devastating financial crisis in 1991. Finally, credit growth in Norway continued to surge after supplementary restrictions were mandated in 1986. Finance companies and other non-bank institutions began to fail in 1987 and there was a wave of commercial bank failures in 1990.

The other two countries that imposed controls after removing credit ceilings did so in the midst of crises. Argentina reinstalled some restrictions on credit growth, while South Africa placed new restrictions on capital flows, with the assumption that one of the problems leading to their crisis in 1985 was unchecked growth of credit from abroad. Since these policies were installed during or after banking crises, disentangling their effects from the banking crises that were already underway is impossible. Nonetheless, it is noteworthy that both of these countries slid into crisis for a second time, shortly after their first crisis episodes.

The historical experience of countries that install new restrictions after initial periods of financial deregulation suggests that it is difficult for regulators to fine tune the financial system using selective credit controls. There are a number of reasons this may be the case. It may be that regulators simply overestimate their ability to contain bank credit and are insufficiently aggressive with policies meant to reverse the tide of credit booms. In Italy, and the UK, credit barely budged when new controls on banks were put into place, and credit surged in Norway in spite of new controls. This suggests that there may be some momentum to credit growth once a boom is underway. Moreover, if deregulation in these instances worked primarily by unleashing buoyant sentiment on markets, then containing downturns may not be as simple as restraining credit, even if new policies are effective in doing so. If bankers extend credit in part by irrationally extrapolating prior credit market outcomes, as in Greenwood, Hanson, and Jin (2019), then the strong growth and low default rates that emerge shortly after deregulation may further boost sentiment, making it even harder to control markets as time goes on.

V. Additional Analyses Linking Credit Ceiling Removals to Subsequent Credit Booms

In this section we look to solidify our key argument that credit ceiling removals were the true cause of credit growth that we subsequently observe, and that this explosion of credit generated the ensuing economic declines. We address two possible sources of concern with our identification. The first potential concern is that credit ceiling removals may not have been the true driver of credit growth during the period we study, and that other structural changes, such as increased financial globalization or strong household credit demand, caused credit growth and also generated financial instability. If, for example, rapid credit growth during the 1970s and 1980s stemmed from consumer credit demand shocks rather than supply factors, one could argue that credit growth was a cause of later downturns, but only because increased household leverage made consumers more vulnerable to economic shocks, as proposed by Mian, Sufi, and Verner (2017), and not because credit market sentiment prompted intermediaries to fund negative-NPV projects. In part A of this section, we will argue further that credit ceiling removals were the underlying cause of ensuing credit growth by showing that the types of credit and institutions that were most severely constrained under the credit ceilings were the institutions that most rapidly expanded credit in the wake of deregulation. In part B of this section, we will address a second concern, namely that some other set of government policies, adopted alongside credit ceiling removals, generated the correlations we observe. We address this possibility by systematically studying other financial policies adopted in credit ceiling countries.

A. Analyzing Types of Loans and Financial Institutions Most Affected by Credit Ceilings

In this section we attempt to make the causal interpretation of our empirical evidence more convincing by showing that in some of the credit ceiling countries, we can identify institutions that were differentially affected by credit ceiling policies. We use the knowledge of how policies were geared toward specific institutions to improve our identification of policy-created credit booms. We show that those institutions identified ex-ante as more constrained by credit ceilings were the institutions that drove credit growth after liberalization. In another instance, we show that institutions that remained constrained to a larger degree after deregulation did not expand credit as freely after ceilings were removed. Since the finer details regarding how credit ceilings were operated and enforced varied across the different countries in our study, we proceed with our analysis on a country-by-country basis. The main results of our analysis are presented in Figure 3. Vertical lines in these figures mark the dates credit ceilings are removed.

We begin with a further discussion of credit policies in Norway. Our analysis centers on a comparison of private commercial banks with government-controlled state banks ("Statsbankene"). While the system of credit controls on the private banks was removed in 1984, the state-banks, regulated via a different mechanism, were still subject to government control.[24]

We plot the credit supplied by state banks and the private commercial banks in Norway from 1977-1991 in panels A and B of Figure 3. Figure 3 panels A and B show that prior to the removal of credit ceilings state-bank and private bank credit largely grew in tandem with one another: the annual credit supplied by the two types of institutions hovered within a narrow band, until 1984, when credit ceilings were removed. However, after 1984, credit rapidly accelerates among private banks but remains steady at state-banks, as can be seen in Figure 3, consistent with the

[24]The state-banks were a central part of the financial system beginning in the years after WWII. The state-banks were instrumental in carrying out the government's lending policies, helping to ensure that credit was channeled to sectors of the economy that the government deemed to be high priority, or which were believed to be inadequately served by private credit markets. While lending by the state-banks was geared toward particular sectors of the economy, taken as a whole, state-bank lending appeared to cover a relatively broad and diverse swath of the economy, from small-business loans to consumer lending.

notion that deregulation generated credit growth only among the private banks.[25]

Another country where we can observe differential effects of credit ceilings is Australia. Among the credit ceiling countries we study, Australia appeared to have one of the more advanced financial systems, with non-bank financial institutions that included merchant banks (investment banks and securities firms), finance companies, and permanent building societies (which financed home loans).[26] Credit ceilings only affected the trading banks (the largest commercial banks) and the savings banks but not the non-bank financial institutions mentioned above.

Panel C of Figure 3 plots the total outstanding credit supplied by banks and non-bank financial institutions (NBFIs), both deflated by real GDP, between 1975 and 1995.[27] Credit ceilings were removed in 1982.[28] The values depicted in the plot are normalized, so that the outstanding credit of both banks and NBFIs assumes a value of 100 in 1982. While this normalization facilitates easy comparisons between banks and NBFIs in the years following deregulation, the picture would not be substantially different if we instead plotted the raw dollar values of credit of these institutions.

Panel C shows that, in the decade prior to the removal of credit ceilings, the NBFIs gradually but steadily gained market share.[29] The years after liberalization saw a stark reversal of this trend. In the five years after credit ceilings were removed, credit supplied by banks, relative to GDP, increased by 64.0% relative to its 1982 value, with the NBFI credit to GDP ratio increasing by only 17.4%. A glance at the plot of Australian credit in Figure 1 in the appendix shows that in the aggregate, Australia experienced a large credit boom after ceilings were removed in 1982. From 1982 to 1990, credit to GDP increased from around 23% to 50% of GDP. Meanwhile,

[25]It is also unlikely that the explosion in credit by private banks merely reflected a compositional shift in institutions supplying credit to the economy. That is, it is likely that private banks didn't merely reclaim a share of the lending that would have otherwise been supplied by other institutions. Although the share of credit supplied by institutions regulated outside of the system of credit ceilings, such as finance companies and insurance companies, had been increasing prior to the removal of credit ceilings, likely at the expense of private banks, in 1980 these firms combined to make up only 11.4% of total outstanding credit. By 1985, after deregulation, their share had actually increased to 12.4%. Since credit expansion at private banks was quite large, and since the non-bank sector was quite small, it is unlikely that the expansion of bank credit only reflected a compositional shift in the supply of credit rather than a real expansion of the aggregate credit supply.

[26]While banks remained central to the financial system, there was opportunity for non-bank entities, particularly the specialty mortgage companies to expand at the expense of banks whenever credit controls on banks were particularly rigid. According to Hall (1987): "largely as a result of regulatory 'straightjackets', savings banks' share of total financing declined markedly between 1953 and 1982 from 20 per cent of total assets of all financial institutions to 13 per cent. This performance contrasts sharply with that of their major competitors, the permanent building societies and credit unions."

[27]Normalizing by real GDP "compresses" the graph somewhat, but does not change the overall pattern, relative to displaying total real credit without deflating by GDP, since both the bank credit and NBFI credit series are divided by the same GDP number.

[28]Identification of the entities subject and not subject to ceilings may not be perfect here. Among the banks, were institutions, like the state banks, which were not regulated by the federal government and thus not subject to credit ceilings. Thus, the outstanding bank credit numbers depicted in Figure 3 panel C likely included credit of institutions that were not covered by credit ceilings.

[29]In September of 1976, the NBFIs had 15.4 billion Australian dollars (AUDs) of credit outstanding, compared to 18.6 billion supplied by the banks. By the time credit ceilings were removed in 1982, the NBFIs had narrowly surpassed the banks, holding 41.1 billion AUDs of outstanding credit, compared to 39.1 AUDs for banks.

the share of credit provided by the institutions most constrained under the regulatory regime that preceded the reforms of the 1980's increased rapidly at the same time. If increased credit provision after 1982 was solely the result of a positive shock to credit demand, there would be little reason why the total credit provided by banks and by NBFIs, which had moved in lockstep during the eight years before deregulation, would diverge so sharply after 1982. Similarly, it is unlikely that deregulation changed only the allocation of credit across institutions, without changing the aggregate amount of credit provided, since total credit boomed after 1982.[30]

In the final piece of this analysis, we turn to the case of Sweden, for which we compare credit expansion by the largest commercial banks to credit extended by smaller regional and savings banks. In Sweden, for reasons described below, credit ceilings made it even more difficult for mid-sized and smaller banks to lend than the larger institutions. Thus, after the credit ceiling removals, the increase in credit growth is mainly driven by these previously constrained banks.

In the 1970s and 1980s credit markets were largely dominated by the three largest commercial banks: Handelsbanken, Skandinaviska Enskilda Banken (SEB), and Post-och Kreditbanken (PK-Banken). National policy favored these larger banks. For example, Englund (2015) notes that PK-Banken was state-owned and that its growth was a priority of the Social Democrat regime that gained control of the government in 1982. Additionally, the credit ceilings put in place by the Riksbank seemed to favor credit expansion by larger banks. For example, according to Hodgman (1976), when the credit ceilings in were formalized in 1974, the maximum rate of credit expansion for commercial banks was 18% over a 12-month period, while the smaller savings and cooperative banks were limited to 10% and 13% credit expansion, respectively. Moreover, while the credit ceilings remained in place in Sweden until 1985, certain other restrictions, which had been more rigid for the larger banks than for small banks, had already been lifted earlier in the 1980s.[31] Thus, by 1985, deregulation was somewhat further along for the larger banks than for smaller ones.

[30] Also, because the primary non-bank competitors of the trading banks were building societies and other specialized institutions that were constrained in the types of credit they were permitted to offer, it is unlikely that non-bank institutions could have absorbed all of the surplus credit demand that the banks were unable to fulfill prior to 1982. It is thus likely that credit ceiling removals allowed some entities to receive credit would have otherwise been unserved during the previous regulatory regime.

[31] For example, according to Hodgman (1976), liquidity ratio requirements, which were lifted in 1983, were set at higher rates for the largest commercial banks than for the smaller commercial banks. The savings banks and agricultural credit associations tended to face even lower liquidity ratio requirements. Hodgman puts the liquidity ratios in 1974 at 30% for larger commercial banks, 24% for smaller commercial banks, 27% for the post office bank, and 20% for savings banks and agricultural credit associations.

Panel D of Figure 3 shows outstanding loans of the three largest Swedish banks mentioned above (shown in red) as compared to loan provision by a collection of smaller regional and savings banks (shown in blue). While the aggregate real supply of outstanding credit in Sweden increased by over 15% from 1985-1986, outstanding loans of the three largest banks actually decreased slightly. In contrast, loans supplied by the smaller banks increased dramatically in 1986, expanding by more than 30%. Ultimately, both the larger and smaller banks played a large role in the credit boom, as large-bank credit expanded by roughly 70% from 1985-1989. Anecdotal evidence suggests that the results are even more stark when comparing banks, which were all subject to ceilings to some degree, to the finance companies and other "gray market" providers of credit, which were not.[32]

B. Relationship of Credit Ceiling Removals to Other Financial Deregulation Policies

In previous sections, we have made note of the fact that credit ceiling removals were often a part of a broader set of financial deregulations, though the process of financial deregulation often spanned more than a decade and major financial reforms, other than credit ceiling removals, generally occurred at separate times. In this section, we conduct a more thorough analysis of the other policy changes in financial markets that occurred during the period we study.

There are two factors that motivate this analysis. The first is related to identification concerns. A potential concern is that that the credit booms we observed were precipitated by policies other than credit ceilings, of which credit ceiling removals were merely a part. (In some sense, such a confounding variable might not matter to the ultimate conclusions of our study. Suppose, for example, that credit ceiling removals coincided nearly perfectly with removals of interest rates restrictions, which were the true cause of the credit booms we observe in the data. If removals of these interest rate restrictions also generated exogenous credit supply shocks, it would not change our conclusions on the aftermath of credit booms, even if we misattributed the ultimate source of these credit shocks.)

The second reason is to gain an understanding of why credit booms emerge in the first place,

[32] While we do not have reliable data on the extent of the gray market provision of credit in Sweden, Englund (2015) suggests that "the institutions that had been most directly hit by the regulations now expanded most rapidly, banks by 174 per cent and mortgage institutions by 167 per cent between 1985 and 1990."

which types of policies may give rise to them, and which types of macroprudential policies could be used to prevent them. Thus, it is useful to contrast the effects of credit ceiling removals with the effects of other types of financial deregulations.

In this analysis, we narrow the set of countries in our ensuing analysis to the set of 13 credit ceiling countries, in order to focus on compiling detailed accounts of the regulatory environments in this subset of countries. We then construct detailed timelines of financial reforms across our 13 credit ceiling countries focusing on several broad classes of policies that could plausibly affect credit growth or financial stability. Our major policy categories are: interest rate restrictions, branching restrictions, barriers to entry of new banks, specialization requirements (e.g. rules prohibiting banks from underwriting or trading securities), international capital controls, and controls in non-bank credit markets (e.g. bond or commercial paper markets). In some cases, there are slight disagreements between different sources regarding the years in which policy changes are enacted, while in a few other cases the distinctions between different types of financial reforms are blurry. Nonetheless, it does not appear that these sources of uncertainty are sufficient to meaningfully change our results. We describe the set of specific financial reforms and the set of sources from which we determine the dates these reforms were enacted in the appendix.

As a preliminary visual indicator of our results, Appendix Figure 6 plots the deregulatory timelines associated with each country by overlaying these reforms on the progression of credit to GDP ratios in each country. The timing of credit ceiling removals does not follow any immediately obvious pattern relative to the removals of other types of restrictions. In general, most of these countries begin a gradual process of financial market deregulation beginning in the 1970s, and extending through the 1980s and into the early 1990s, in some cases. Credit ceiling removals often appear to be roughly in the middle of a country's broader history of reforms, though perhaps somewhat closer to the end than the beginning. In a number of cases, it appears that credit ceiling removals come right at the beginning of an inflection point in the progression of credit. For example, in Sweden and Australia, credit ceilings come at the end of long periods of relatively static credit to GDP ratios, and at the beginning of steep and sustained increases.

After compiling our regulatory timelines, we create a series of indicator variables, with one variable for each of the six policy varieties mentioned above, that take a value of one in year t

and in country i, if country i *removes* a restrictive policy of that type in year t.

Appendix Table 2 reports correlations between these policy indicator variables for each pair of policies, which are close to zero in all cases, indicating that these policy reforms rarely coincided in time. The type of reform with which credit ceiling removals coincide most closely is the removal of interest rate restrictions, as the two indicator variables corresponding to these policies have a correlation coefficient close to .2, corresponding to three instances (in New Zealand, Sweden, and the UK) in which credit ceilings and interest rate controls are removed at the same time.

To compare credit ceiling removals to other types of financial deregulations, we first ask how well each type of policy predicts credit growth. In particular, we ask whether the estimated effects of credit ceiling removals survive controlling for other types of deregulatory policies. We thus estimate regressions of the following form:

$$\Delta_h Credit-to-GDP_{i,t} = \alpha^h + \beta^h * Policy_{i,t} + \gamma^h * \Delta_1 X_{i,t-1} + \varepsilon_{i,t+h} \tag{4}$$

For h=3 and 5.

The *Policy* variable can be a vector in some specifications (that is, we will look at specifications with a single policy variable as well as those with multiple policy variables). The vector X contains the control variables which consist of lagged GDP growth, and the lagged investment to GDP ratio.

Table 6 panels A and B display results when three-year credit to GDP growth is used as the dependent variable, while panels C and D display the results for five-year future credit growth.

Panel A shows results from specifications where we look at each policy-variable individually, for the sake of comparing the raw predictive power of each of the types of regulatory reforms (indicated in the first column of the table), without considering the collinearity between different types of policies. These results indicate that credit ceilings are the only variable that strongly predicts credit growth over a three-year period, in settings with a single policy-variable. Credit ceilings, though assessed in a simpler regression format than our earlier analyses, nonetheless appear to predict three-year credit growth of 7.6%, which is similar in magnitude to our earlier estimates. Among the other policy variables, none predicts credit growth over a three-year period anywhere close to as large as credit ceiling removals, and none of the others are statistically significant. In magnitude, the closest competitor to credit ceiling removals is the removal of barriers to entry of foreign banks, which forecast 3.3% growth to a country's credit to GDP ratio over the three years that follow removal.

Panel B of Table 6 displays results for regression specifications that include multiple policy variables at the same time. The first six specification pair credit ceiling removals with each individual other deregulation to ask whether any of the policy variables other than credit ceilings can significantly diminish the estimated effect that credit ceilings have on credit to GDP growth. In the final column of panel B we show the results of the "horse race" regression where we include all policy variables together. The results in panel B suggest that the additions of multiple policy variables do little to affect the ability of credit ceiling removals to predict credit growth. The magnitude of the coefficient on the credit ceiling policy-variable is remarkably stable across the seven specifications, ranging from a value of roughly 7.4% to a maximum of 7.7%. The only other policy variable with a coefficient that attains a marginal level of statistical significance is the "Fin. Reform" variable, which corresponds to removals of restrictions in the bond market (and other non-bank credit markets). All these results are broadly similar in specifications in which five-year credit growth is used as the dependent variable.

In a final piece of the analysis on alternate policies, we look to assess which types of financial reforms best forecasts the *beginnings* of credit booms in terms of timing.

For any of the policies we analyze, it may be that their removals simply coincide with credit booms that were already underway at the time they were removed and that they forecast credit growth associated with the tail-end of a boom that began earlier. Given these considerations, we estimate the ability of each type of policy reform to predict a credit boom in the context of a probability model. Specifically, we estimate logistic regressions, where we assume that the probability of observing the beginning of a credit boom, in any country i, and any year t, takes the form:

$$Log\left(\frac{p_t^{boom}}{1-p_t^{boom}}\right) = \alpha + \beta * Policy_t + \Delta_1 X_{t-1} \tag{5}$$

Where the variable p_t^{boom} represents the probability that a credit boom will begin in year t. The policy variables and the set of controls take the same form as our linear regression specifications in equation (5). In particular, we will estimate versions of the model of equation (6) that include a single policy variable, as well as versions that include multiple policy variables. We estimate model (6) using maximum likelihood methods. In order to estimate (6), we need to define a binary variable equal to one in the event that a credit boom begins at time t, and zero otherwise. To this end, we use two different algorithms for defining credit booms, which we believe capture our intuitive notion of what credit booms are. We then refer to the set of credit booms that we can identify in the underlying data using these two approaches as "Type I" credit booms and "Type II" credit booms, which are described in the appendix. We believe that as compared to estimating models such as equation (5) or the Jorda (2005) projections that preceded them, the logit estimation in (6) is less sensitive to the specific parametric assumptions of a linear regression model, such as the correct lag structure for auto-regressive terms, the assumption that lagged values of credit growth affect credit linearly and with a constant relationship over time, and so on.

Table 7 displays the results of our logit estimation. Panels A and B display results for Type I credit booms while panels C and D display results for Type II credit booms. In a similar fashion to Table 6, each column of Table 7 (for any of the panels) represents a separate regression specification and each row corresponds to a coefficient representing one of the types of policy reforms. In panels A and C, we display the results of regressions that include only a single policy variable among the set of right-hand side variables. Panels C and D display averages for all other possible specifications. That is, we estimate models with every possible permutation of two or more policy variables on the right-hand side and collect the results.

The results in panel A show a coefficient of 2.638 for the credit ceiling removal variable, when estimating (6) on Type I credit booms in a single policy-variable setting. This suggests that removal of credit ceilings, in an arbitrary year, is estimated to increase the log odds ratio corresponding to the probability of a credit boom, by 2.638. Straightforward calculations show that this translates to a credit ceiling removal being associated with an increase the probability that a credit boom will begin in that year from 10% to 60.8%.[33]

[33]The proportion of years covered by the beginnings of Type I credit booms is roughly 10% in our sample. Suppose then that in an arbitrary year, we expect that the probability that a credit boom will begin is 10%. The associated log odds ratio, is then log(.1/(1-.1)). = -2.197. If we were to be told, in addition, that credit ceiling policies would be removed in that same year, we would revise our log odds ratio upwards by 2.638, to 0.440. This odds ratio corresponds to a credit boom probability of exp(.440)/(1+exp(.44)) = 0.608.

Among the other policies, in single policy-variable specifications, removals of interest rate controls and removals of capital flow restrictions both also forecast the beginnings of credit booms. Interestingly, in our estimation of equation (6) (i.e. the three-year and five-year credit growth regressions), removals of capital flow restrictions had little predictive power in forecasting credit growth. Our results suggest that removals of capital flow restrictions forecast "small" credit booms that look like inflection points in credit growth, as compared to prior years, but which do not turn into large shocks to the quantity of credit. None of the other policy variables forecasts the beginning of Type I credit booms.

In panel B, we present coefficient averages from multivariate specifications. Coefficients on the credit ceiling variable range from a minimum of 2.437 to a maximum of 2.773 and associated p-values range from a high of .025 to a low of .010, so that credit ceiling removals strongly predict credit booms, and maintain statistical significance (at the 5% level) across specifications with all possible combinations of policy variables. The interest rate liberalization policy variable attains a maximum coefficient of 1.267, which it achieves in the specification where it is accompanied by branching restriction removals and no other policy variables. However, the predictive power of interest rate reforms become weaker once we include credit ceiling removals as a policy variable. In most cases, when credit ceiling removals, capital flow liberalization, or non-bank credit deregulation enters a specification, interest rate reforms lose their predictive power. Capital flow liberalizations, on the other hand, maintain statistically significant coefficients, at the 10% level or better, in all specifications. Capital flow liberalizations have predictive power of a similar magnitude to interest rate liberalization. They attain a maximum coefficient of 1.267, which is the same (up to three decimal places) as the maximum interest rate coefficient.[34] In contrast to interest rate restrictions, capital flow liberalization appears complementary to credit ceilings. When the two variables appear in the same regression, both strongly predict credit booms, and their individual forecasting power increases when they are both added to the same regression.[35]

[34]None of our variable combinations generate perfect collinearity, but since all policy variables are binary (0 or 1) and many have similar numbers of observed deregulations across the sample, there are many instances where variables attain very similar coefficient values.

[35]A measure of the informativeness of the models we estimate is given by the Akaike Information Criterion (AIC), for which smaller values suggest models that are more informative relative to the number of parameters used in the estimation. Among the versions of model (7) that we estimate, 49 of the 50 lowest AIC specifications include credit ceiling removals as one of the policy variables, while 33 of the 50 include capital flow liberalizations, suggesting that these are the two most informative variables. Interest rate deregulation, the third most informative variable, appears in 28 of the 50.

Among all the policy variables, credit ceiling removals, interest rate reforms, and capital flow liberalizations, are the only policy variables that ever attain statistically significant coefficients at the 10% level or better. Interestingly, while our earlier methodology, using linear regression specifications on five-year credit growth, showed that removals of bank specialization restrictions and removals of restrictions in non-bank credit markets forecast credit growth, in our logit estimation of equation (7), these variables never appear to forecast credit booms very strongly. This result confirms the notion that although these policies forecast credit growth, they do so with a significant lag and are not able to pick up true inflection points, where credit growth takes off rapidly relative to the recent past.

Panels C and D display similar results for Type II credit booms. These results are discussed in more detail in the appendix. This definition of credit booms is geared even more strongly toward identifying inflection points that signal the start of long-lived credit booms.

VI. Conclusions

Recent research has documented a strong link between credit growth and subsequent economic and financial turmoil. Mian, Sufi, and Verner (2019) showed that credit growth can substantially amplify business cycle downturns; their strong identification procedure suggested that credit growth was is not merely associated with negative outcomes, but appeared to be a driver of those outcomes. We have performed a similar analysis in an international context and have attained results suggesting that credit expansion may not merely amplify economic downturns, but may generate them on their own. While financial crises are relatively rare episodes, we found that 11 of 13 countries that removed credit ceilings experienced crises in the 10 years that followed these reforms. Credit booms were also associated with booms and busts in real estate markets and precipitous drops in bank stocks, suggesting that the banking sector was at the epicenter of the downturns that followed deregulation.

Our results do not identify exactly why these credit booms had such negative impacts on the broader economy. We take our findings as being consistent with the view of Minsky (1977) that periods of strong growth in credit markets can generate recklessness among investors, who become accustomed to strong performance, and thus vulnerable to excessive optimism. However, we cannot rule out the interpretation of credit booms by Krishnamurthy and Muir (2018) and others who argue that high credit growth and leverage serve to make the financial sector more vulnerable to shocks that emanate elsewhere in the economy. We were not able to observe, with the data on hand, whether banks actually made riskier loans to less credit-worthy borrowers after ceilings were removed, or whether defaults and bank failures resulted from the combination of economic downturns and bank fragility. We nonetheless have sympathy for the market sentiment view of credit booms. Our empirical setting identifies a number of countries that go through a regulatory regime change, transitioning away from a period in which banks were prevented, via a number of mechanisms, from taking high levels of risk and losing money. Such events, following periods of low credit losses and financial market tranquility appear ripe for episodes of excessive optimism and over-extrapolation. We also find evidence of the calm before the storm phenomenon of Greenwood, Hanson, and Jin (2019), a phenomenon which is hard to square with most rational models where business cycles and credit cycles are one in the same. Moreover, our evidence on the irreversibility of credit booms suggests that even when policymakers have put measures in place to control credit after the onset of the boom, such measures do not appear to prevent financial collapse. This result held even in situations in which levels of credit to GDP began to go back down after an initial boom, suggesting that the level of credit to GDP may not be as important as the initial surge in credit.

Our results may also speak, to some degree, to the potential usefulness of various forms of macroprudential policy. Our results certainly do not suggest that credit booms are the only factor that can precipitate financial crises, and thus we cannot say that policies unrelated to the supply of credit do not have some bearing on financial stability nonetheless. However, we can say that a wide variety of financial reforms, other than credit ceilings, appear to have little effect on the quantity of credit when they are removed. Thus, if we believe that a central goal of macroprudential policymakers should be to constrain uncontrolled growth in credit, our analysis suggests that the reinstitution of Glass-Steagall era specialization restrictions, or the reinstatement of branching restrictions may be of little use. In contrast, while draconian controls on bank lending may be impractical in the current regulatory environment, our analysis suggests that the adoption of policies meant to restrain rapid credit growth may prove useful as part of the regulatory toolkit.

Figure 1

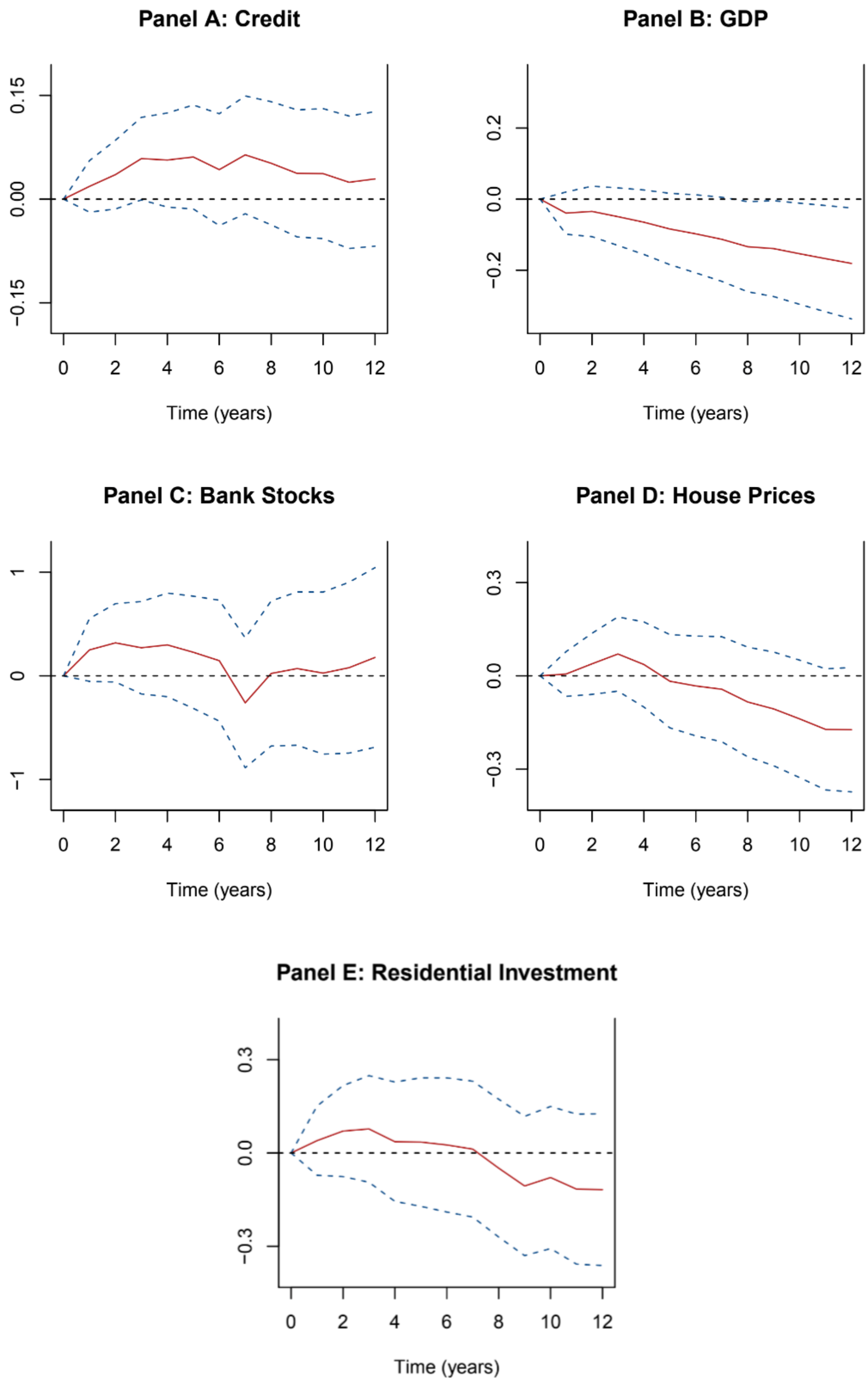

Panel A: Credit
0.15
0.00
−0.15
0
2
4
6
8
10
12
Time (years)
Panel B: GDP
0.2
0.0
−0.2
0
2
4
6
8
10
12
Time (years)
Panel C: Bank Stocks
1
0
−1
0
2
4
6
8
10
12
Time (years)
Panel D: House Prices
0.3
0.0
−0.3
0
2
4
6
8
10
12
Time (years)
Panel E: Residential Investment
0.3
0.0
−0.3
0
2
4
6
8
10
12
Time (years)

Figure 2

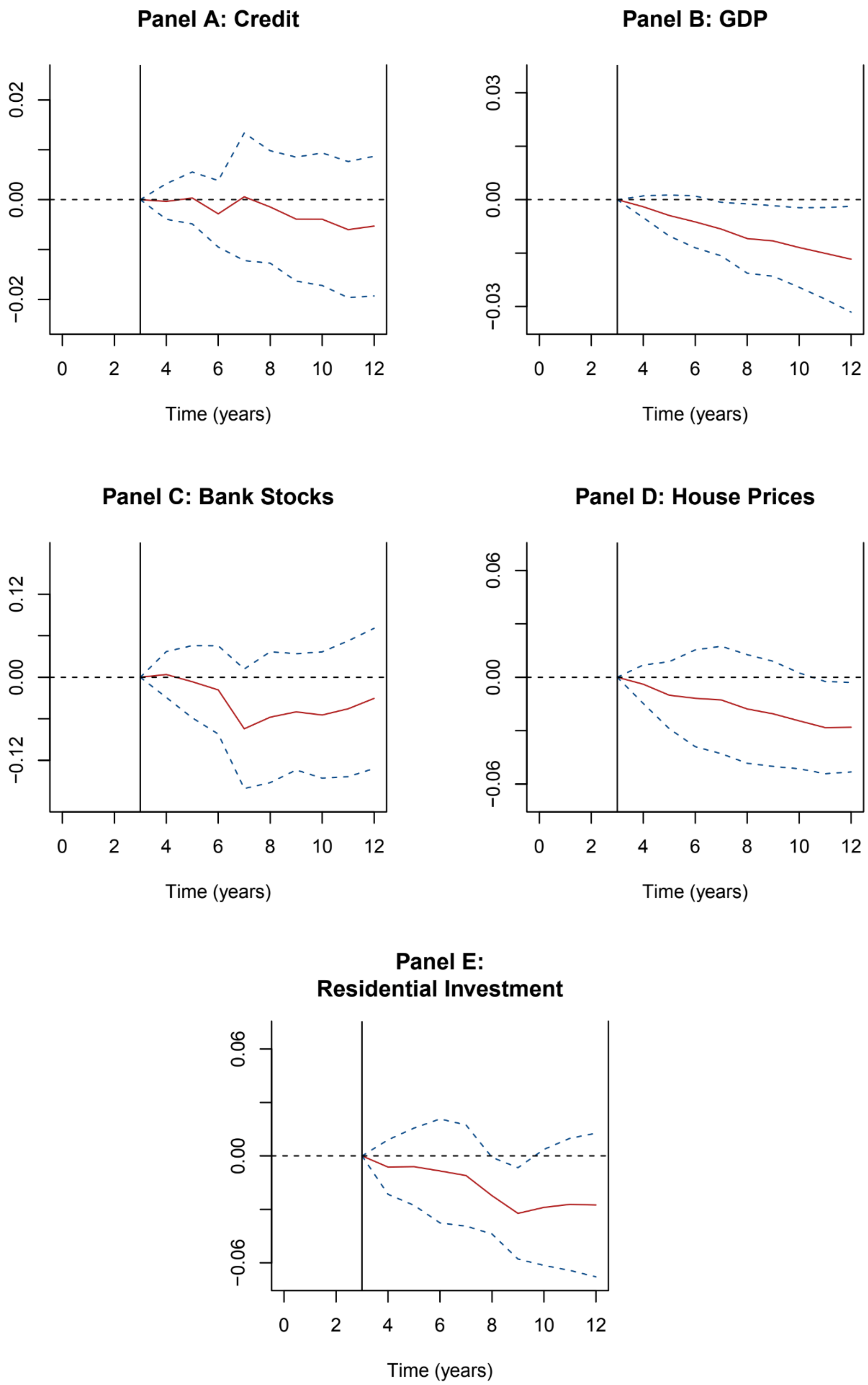
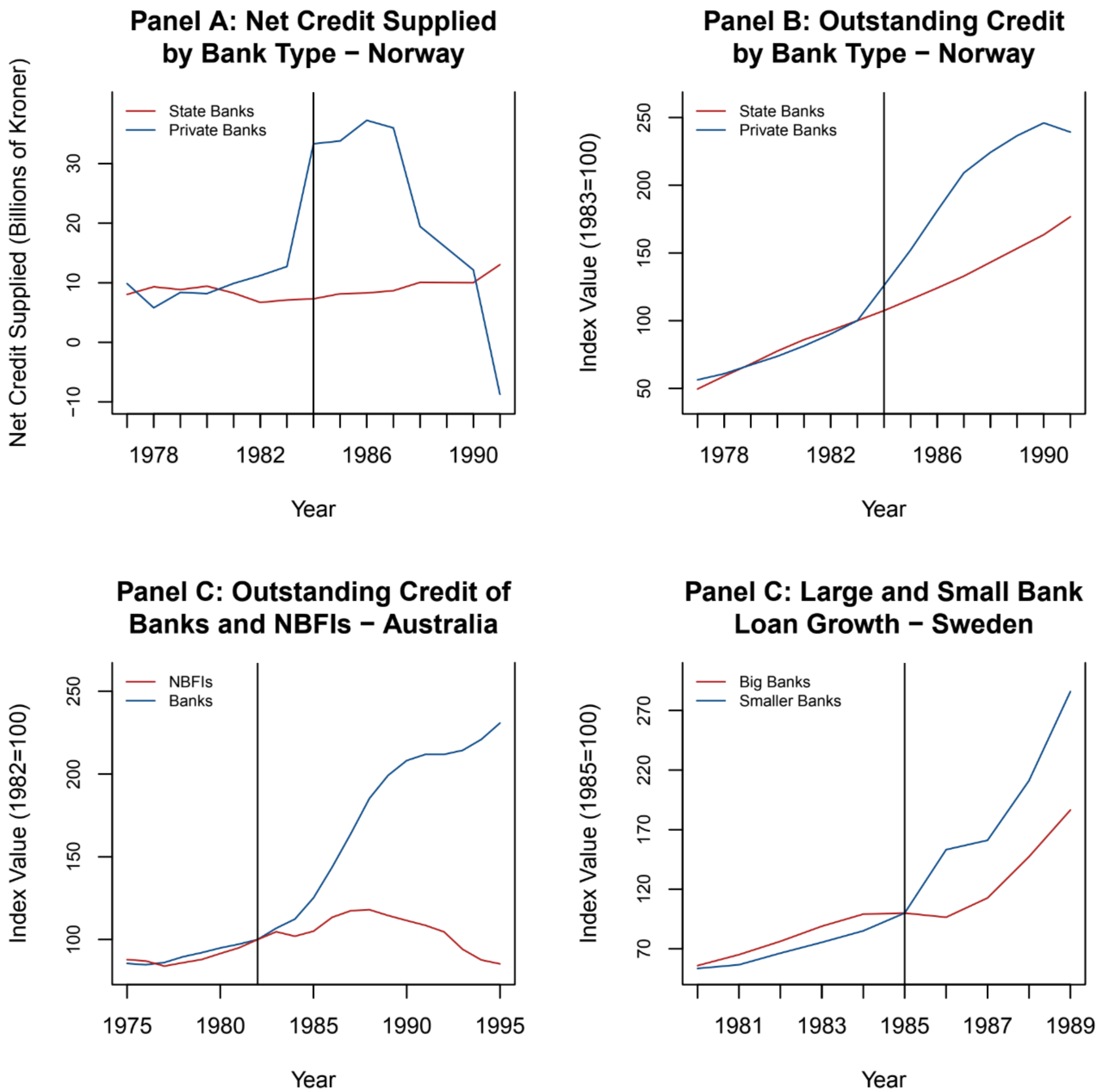

Panel A: Credit
0.02
0.00
−0.02
0 2 4 6 8 10 12
Time (years)
Panel B: GDP
0.03
0.00
−0.03
0 2 4 6 8 10 12
Time (years)
Panel C: Bank Stocks
0.12
0.00
−0.12
0 2 4 6 8 10 12
Time (years)
Panel D: House Prices
0.06
0.00
−0.06
0 2 4 6 8 10 12
Time (years)
Panel E:
Residential Investment
0.06
0.00
−0.06
0 2 4 6 8 10 12
Time (years)

Figure 3



Panel A: Net Credit Supplied by Bank Type − Norway
State Banks
Private Banks
Net Credit Supplied (Billions of Kroner)
−10
0
10
20
30
1978
1982
1986
1990
Year
Panel B: Outstanding Credit by Bank Type − Norway
State Banks
Private Banks
Index Value (1983=100)
50
100
150
200
250
1978
1982
1986
1990
Year
Panel C: Outstanding Credit of Banks and NBFIs − Australia
NBFIs
Banks
Index Value (1982=100)
100
150
200
250
1975
1980
1985
1990
1995
Year
Panel C: Large and Small Bank Loan Growth − Sweden
Big Banks
Smaller Banks
Index Value (1985=100)
70
120
170
220
270
1981
1983
1985
1987
1989
Year

Table 1

This table displays each of the 13 credit ceiling countries and the year in which each of these countries removed their credit ceilings. The credit ceiling countries appear in the order in which ceilings were removed.

Country	Year of Liberalization
United Kingdom	1971
Chile	1975
Argentina	1977
South Africa	1980
Austria	1981
Australia	1982
Italy	1983
Japan	1983
Norway	1984
New Zealand	1984
Sweden	1985
France	1987
Portugal	1990

Table 2

This table shows summary statistics for the main variables of interest in the study. The first five rows of the table express summary statistics for the annual growth rates of each of the variables. Real GDP, bank stock prices, real house prices, and real residential investment are expressed in year-over-year percent changes while credit-to-GDP is expressed as a simple year-over-year difference. CPI inflation is a year-over-year percent change in the consumer price index. The final row of the table expresses summary statistics in levels for credit-to-GDP. The first column in the table displays the number of unique countries for which we have data for a given variable. The second column displays the number of non-missing observations available for each variable, prior to taking differences. Observations are expressed at the country-year level. The remaining columns depict the mean, median, inter-quartile range, and standard deviation for each variable.

Variable	No. Countries	Observations	Mean	Median	25th Pct.	75th Pct.	St. Dev
Real GDP	39	3394	0.0362	0.0357	0.0162	0.0577	0.0444
Credit-to-GDP	39	3394	0.0088	0.0081	-0.0075	0.0269	0.0485
Bank Stock Index	39	2899	0.0902	0.0562	-0.0810	0.1942	0.3821
Real House Price	18	1049	0.0272	0.0236	-0.0202	0.0647	0.0824
Real Residential Investment	26	962	0.0279	0.0270	-0.0263	0.0884	0.1235
CPI Inflation	39	3394	0.0691	0.0319	0.0108	0.0760	0.1424
Credit-to-GDP Level	39	3394	0.5460	0.4603	0.2520	0.7667	0.3759

Table 3

Table 3 compares growth rates of credit to GDP ratios in the years following credit ceiling removals to credit growth during "normal times." For each of the 13 credit ceiling countries, we divide the sample into three-year windows and find the total growth of a country's credit to GDP ratio during each of those windows. For each of the credit ceiling countries, we find the three year growth corresponding to the credit ceiling year. If a credit ceiling is removed in year t, we define the three-year credit growth following the credit ceiling removal as being the difference between that country's credit to GDP ratio in year t+3 and the credit to GDP ratio in year t. We then take the average of credit growth in credit ceiling years across all 13 of the credit ceiling countries and we compare that to average credit growth across all three-year windows excluding credit ceiling years. The first two columns show average credit growth in credit ceiling years and other years, respectively. The third column shows the difference between these figures and shows the t-statistic and p-value that arise from a test of the null hypothesis that the difference in growth in liberalization years equal to growth during non-liberalization years. The final column displays the proportion of countries for which we observe credit growth in credit ceiling years which exceeds its average in non-liberalization years. Under the null hypothesis that 3-year credit growth is equally likely to be above or below its mean in any 3-year window, we assess the probability that we would observe a proportion of liberalization years with credit growth exceeding their non-liberalization year average equal or greater to what we observe in the data. We assume that liberalization-year credit growth is independent across countries.

Comparing 3-year Credit Growth in Liberalization and Non-Liberalization Years				
	Liberalization Years	Non-Liberalization Years	Difference	Proportion Positive
Average 3-yr. Credit Growth	0.109	0.037	0.072***	.923***
t-Statistic			3.370	
p-Value			.005	.002

Table 4

Panel A: GDP						
	Dependent Var: y_{it+3+k}, $k = 4, 5, ...9$					
	(k=4)	(k=5)	(k=6)	(k=7)	(k=8)	(k=9)
β_{t+3}^{Cred}	-0.827**	-1.093**	-1.160 **	-1.345**	-1.508**	-1.673**
	(0.345)	(0.447)	(0.455)	(0.514)	(0.591)	(0.683)
Observations	2066	2027	1988	1949	1910	1871

Panel B: Real Bank Stock Prices						
	Dependent Var: y_{it+3+k}, $k = 4, 5, ...9$					
	(k=4)	(k=5)	(k=6)	(k=7)	(k=8)	(k=9)
β_{t+3}^{Cred}	-7.445*	-5.767	-4.996	-5.455	-4.554	-3.052
	(3.887)	(4.194)	(3.727)	(4.048)	(4.353)	(4.494)
Observations	1676	1631	1587	1544	1501	1459

Panel C: Real House Prices						
	Dependent Var: y_{it+3+k}, $k = 4, 5, ...9$					
	(k=4)	(k=5)	(k=6)	(k=7)	(k=8)	(k=9)
β_{t+3}^{Cred}	-1.274	-1.780	-2.055	-2.449*	-2.828**	-2.807**
	(1.314)	(1.329)	(1.285)	(1.172)	(1.128)	(1.095)
Observations	868	850	832	814	796	778

Panel D: Real Residential Investment						
	Dependent Var: y_{it+3+k}, $k = 4, 5, ...9$					
	(k=4)	(k=5)	(k=6)	(k=7)	(k=8)	(k=9)
β_{t+3}^{Cred}	-1.101	-2.232**	-3.226**	-2.890*	-2.720	-2.757
	(1.260)	(0.955)	(1.138)	(1.446)	(1.616)	(1.757)
Observations	701	675	649	623	597	571

Panel E: Reinhart and Rogoff Crises						
	Dependent Var: y_{it+3+k}, $k = 4, 5, ...9$					
	(k=4)	(k=5)	(k=6)	(k=7)	(k=8)	(k=9)
β_{t+3}^{Cred}	4.971**	5.312**	7.550***	6.835***	6.095***	6.320**
	(1.851)	(2.009)	(2.162)	(2.022)	(1.886)	(2.162)
Observations	2066	2027	1988	1949	1910	1871

Panel F: Baron, Verner, and Xiong Crises						
	Dependent Var: y_{it+3+k}, $k = 4, 5, ...9$					
	(k=4)	(k=5)	(k=6)	(k=7)	(k=8)	(k=9)
β_{t+3}^{Cred}	5.845**	7.163**	8.365***	7.620**	6.835**	7.039**
	(2.062)	(1.971)	(2.715)	(2.576)	(2.438)	(2.625)
Observations	2066	2027	1988	1949	1910	1871

Table 5 - Three Phenomena Associated with Credit Booms

The following figures illustrate three prominent phenomena associated with credit booms. In panel A we illustrate the "calm before the storm" phenomenon, by which the business cycle (as measured by real GDP) begins to weaken prior to the collapse of credit. We investigate this using two approaches. First, we identify the cyclical component of GDP as the forecast errors generated by regressing GDP on its four most recent values. We define a business cycle downturn as any period with two or more consecutive years of negative forecast errors, and the first of these years is labelled as the beginning of the downturn. The credit cycle is defined analogously. In the first column we use this method to find the average amount of time, in years, between the first business cycle and credit cycle peaks that occur after credit ceilings are lifted. This difference is assigned a positive value whenever a business cycle peaks before a credit cycle, and a negative value when the credit cycle peak precedes the business cycle peak. In the fourth row we give the proportion of observations for which this signed difference is positive (observations where the time difference is zero are discarded for this portion of the analysis). We present p-values for this proportion under the null hypothesis that the sign of the time difference between business cycle and credit cycle peaks are independently distributed Bernouilli random variables with Bernouilli parameter equal to .5. In the second column we make two adjustments to our approach for calculating distances between business cycle peaks. First, we remove the two observations (Austria and Portugal) in which ceiling removals are not followed by a major financial crisis (as defined by the crisis dates compiled by Baron, Verner, and Xiong (2017)). Next, we consider the business and credit cycles that coincide most closely to the financial crisis date (i.e we discard downturns that occur immediately following liberalization).

In panel B, we document the phenomenon of successive bubbles in the real estate market, whereby an asset price boom in one sector of the real estate market (either residential or commercial) is often followed by a smaller price boom in the other sector. The first column shows the time between the first year of each price boom, while the second column documents the average time between peaks (i.e. the last year before prices begin to fall). The last two columns give the proportion of observations in which the earlier price boom is larger than the later one and in which the price collapse in the earlier bubble is larger than that of the later one.

In panel C, we document the irreversibility of credit booms. Six of the 13 countries that removed credit ceilings during our sample reinstated partial credit controls in the years after liberalization. The first column shows the number of years that credit continued to grow between the enactment of the new restrictions and the subsequent downturn of the credit cycle. The second column suggests that the regulations were insufficient to deter financial crises, as all six countries experienced large financial crises in the five years that followed the enactment of new regulations.

Panel A: The Calm Before the Storm – Business Cycle Peaks Before Credit Cycle		
	Residuals-based Method	Crisis-window Method
Average time between peaks (years)	1.30	1.82***
t-Statistic	1.109	3.390
Observations	13	11
Pos/(Pos+Neg)	.636	.888**
Bernouilli p-value	.274	.020

Panel B: Successive Bubbles – Large Asset Price Boom is Followed by a Smaller One				
	Time between start dates	Time between peaks	Initial bubble has Higher Peak	Initial bubble has larger drop
Average Time Difference (years)	2.75**	.75***		
Observations	8	8	5	5
t-Statistic	2.433	3.00		
Proportion			1.0**	1.0**
Bernouilli p-value (1-sided)			.0313	.0313
Panel C: Similar Results for Real Estate Investment				
Average Time Difference (years)	.667*	1.0***		
Observations	9	9	4	9
t-Statistic	2.309	3.0		
Proportion			.75	.667
Bernouilli p-value			.3125	.254

Panel D: Irreversibility of Credit Booms			
Country	Year of New Restriction	Years of Credit Growth After Policy	Crisis within 5-years?
Argentina	1982	0	yes
Italy	1986	7	yes
Japan	1989	1	yes
Norway	1986	4	yes
South Africa	1985	0	yes
UK	1973	1	yes

Table 6

Table 4 depicts the ability of credit ceiling removals and removals of other financial policy restrictions to forecast credit growth. To investigate the forecasting ability of various policy reforms, credit growth, over 3-year and 5-year windows was regressed on policy liberalization indicator variables (taking a value of one in a year in which a restrictive policy was removed) and controls, which consisted of a one-year lag of GDP growth and a one-year lag of the investment-to-GDP ratio. Panel A shows coefficients on the various policy liberalization variables in specifications where 3-year credit growth is regressed on a single policy variable and controls (i.e. credit growth is regressed on the policy variables one-by-one). Panel B shows policy variable coefficients in specifications with two or more policy variables. First, credit ceilings are faced off against each of the other alternate policy variables, while the final column in panel B shows the results of the horse race regression that includes each of the different policy variables side by side. Panels C and D show analogous results for credit growth over 5-year windows. In the tables below, the abbreviation "Int. Rates" stands for any removal of restrictions on the rates banks are allowed to pay out on deposits or on the rates banks (or occasionally non-bank institutions) are able to charge on loans, credit lines, or other credit products. "Barriers" refers to the removal of barriers to entry of new banks in the domestic market (generally taking the form of restrictions on the entry of foreign banks). "Branching" refers to removal of restrictions on the ability of banks to open new branches. "Specialization" refers to removal of restrictions on the types of services banks are allowed to offer or the activities they may engage in. Examples of such policies include restrictions on the types of liabilities banks may offer (e.g. restrictions on the ability of banks to raise longer term debt or fixed-maturity time deposits) or laws forbidding banks from trading securities. "Cap. Flows" refers to the liberalization of restrictions on the movement of capital flows (e.g. rules against foreigners acquiring domestic securities or limits on foreign currency holdings by domestic residents). "Fin. Reform" refers to financial reform in the bond market or money markets (e.g. removal of restrictions that allow only state-owned firms or favored industries to raise capital in bond markets). For each regression, R-squared values and the number of observations are reported in the final two rows. It should be noted that the sample includes only the set of 13 countries that removed credit ceilings at some point during the study, and thus includes fewer observations than previous parts of the analysis. Standard errors are listed in parentheses beneath each coefficient and *, **, and *** labels denote statistical significance at the 10%, 5%, and 1% levels respectively.

Panel A: Association Between Deregulation and 3-yr. Credit Growth							
	Single Policy-Variable Specifications						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	7.638***						
	(2.329)						
Int. Rates		1.890					
		(1.641)					
Barriers			3.336				
			(2.498)				
Branching				-0.025			
				(3.525)			
Specialization					2.862		
					(2.496)		
Cap. Flows						1.600	
						(1.532)	
Fin. Reform							2.667
							(1.955)
Controls?	✓	✓	✓	✓	✓	✓	✓
R^2	.045	.024	.025	.021	.024	.023	.025
Observations	423	423	423	423	423	423	423

Panel B: Association Between Deregulation and 3-yr. Credit Growth							
	Two Policy-Variable Specifications						All Vars
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	7.392***	7.396***	7.639***	7.695***	7.553***	7.695***	7.524***
	(2.382)	(2.341)	(2.332)	(2.328)	(2.331)	(2.327)	(2.294)
Int. Rates	0.832						-0.092
	(1.660)						(1.724)
Barriers		2.546					2.545
		(2.485)					(2.507)
Branching			0.131				0.202
			(3.485)				(3.500)
Specialization				3.027			2.415
				(2.467)			(2.533)
Cap. Flows					1.409		0.834
					(1.516)		(1.599)
Fin. Reform						2.778	3.990*
						(1.933)	(2.162)
Controls?	✓	✓	✓	✓	✓	✓	✓
R^2	.046	.048	.045	.049	.047	.050	.060
Observations	423	423	423	423	423	423	423

Panel C: Association Between Deregulation and 5-yr. Credit Growth							
	Single Policy-Variable Specifications						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	7.638**						
	(3.323)						
Int. Rates		3.356					
		(2.326)					
Barriers			5.752				
			(3.538)				
Branching				-5.119			
				(4.991)			
Specialization					7.167**		
					(3.526)		
Cap. Flows						1.184	
						(2.175)	
Fin. Reform							5.343*
							(2.766)
Controls?	✓	✓	✓	✓	✓	✓	✓
R^2	0.018	0.010	0.011	0.007	0.015	0.005	0.014
Observations	405	405	405	405	405	405	405

Panel D: Association Between Deregulation and 5-yr. Credit Growth							
	Two Policy-Variable Specifications						All Vars
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	6.945**	7.169**	7.591**	7.785**	7.581**	7.758**	7.141**
	(3.395)	(3.336)	(3.323)	(3.310)	(3.329)	(3.312)	(3.386)
Int. Rates	2.367						1.027
	(2.367)						(2.438)
Barriers		4.992					5.316
		(3.540)					(3.546)
Branching			-4.956				-4.294
			(4.966)				(4.950)
Specialization				7.341**			6.773*
				(3.507)			(3.581)
Cap. Flows					0.999		-0.412
					(2.166)		(2.262)
Fin. Reform						5.460**	6.912**
						(2.751)	(3.058)
Controls?	✓	✓	✓	✓	✓	✓	✓
R^2	.020	.022	.020	.028	.018	.020	.036
Observations	405	405	405	405	405	405	405

Table 7

In Table 4, we examined the ability of loosening of banking and financial market restrictions of various types to predict credit growth. While we would like to establish evidence in support of the notion that removal of credit ceilings *causes* credit growth, the evidence in Table 4 cannot rule out two other possibilities: that credit ceilings are removed because of their ineffectiveness or because of strong macroeconomic conditions (i.e. there is reverse causality) or, that credit ceilings accelerate credit booms that are already underway, but do not themselves generate credit booms. To more directly investigate which of these hypotheses the data are most consistent with, we look at whether various policies can forecast the start of credit booms. To do this, we generate two different approaches for defining the beginning of a credit boom and then assess the ability of policy variables to predict 1-year ahead credit booms in the context of a logit model. Credit booms of type I begin whenever there are two or more consecutive years of credit growth above the median level of growth credit growth in the previous five years, or there is a single year of greater than 1% growth (a round number we have chosen because it lies within the top 5% of credit growth years). Credit booms of type II begin in the same way, however they preclude a second credit boom from emerging when a boom is already underway. A type two credit boom ends when there are two consecutive years of negative credit growth or a single year with a credit contraction of 1% or more.

Table 5 reports the coefficients on policy variables from logit models where binary credit booms of type I and type II are regressed on controls and policy variables. We control for GDP growth and the investment GDP ratio. Panel A shows policy variable coefficients in specifications where the dependent variable is a type I credit boom indicator variable and a single policy variable on the right-hand side of the estimating equation. Panel B shows results from multivariate logit specifications. We regress type I policy booms on the controls and all combinations of subsets of the policy variables. Panel B shows the coefficient averages across all multivariate specifications. Panels C and D display analogous results for specifications in which type II credit boom indicator variables are used as the dependent variable. The tables also report the Akaike Information Criterion (labeled AIC at the bottom of each table) for each of the regressions. Standard errors are listed in parentheses below each coefficient and statistical significance at the 10%, 5%, and 1% levels are denoted by *, **, and ***, respectively.

Panel A: Predicting 1-year Ahead Credit Booms (of Type I) with Policy Variables							
	Single Policy Variable Logit Specifications						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	2.638**						
	(1.076)						
Int. Rates		1.256**					
		(0.536)					
Barriers			0.981				
			(0.777)				
Branching				0.666			
				(1.010)			
Specialization					0.655		
					0.718		
Cap. Flows						1.190**	
						(0.481)	
Fin. Reform							0.656
							(0.646)
Controls?	✓	✓	✓	✓	✓	✓	✓
AIC	422.427	426.565	430.690	431.873	431.480	426.013	431.288
Observations	328	328	328	328	328	328	328

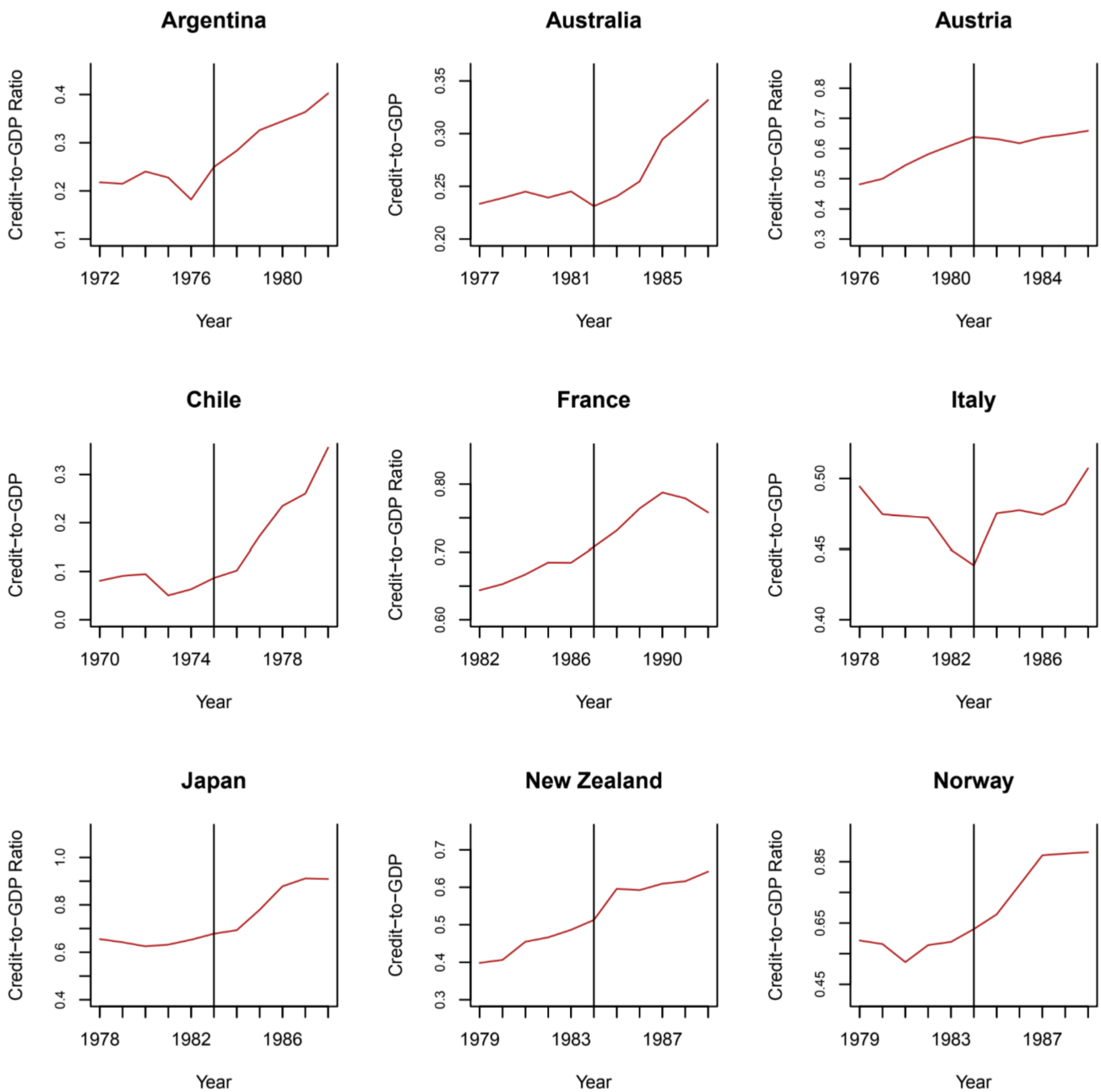
Panel B: Predicting 1-year Ahead Credit Booms (of Type I) with Policy Variables							
	Multiple Policy Variable Logit Specifications (Coefficient Averages)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	2.614 **						
	(1.084)						
Int. Rates		1.056*					
		(0.557)					
Barriers			0.852				
			(0.814)				
Branching				0.676			
				(1.028)			
Specialization					0.470		
					(0.746)		
Cap. Flows						1.126**	
						(0.495)	
Fin. Reform							0.611
							(0.665)
Controls?	✓	✓	✓	✓	✓	✓	✓
AIC	422.326	425.198	426.339	426.207	426.694	423.806	426.006
Observations	328	328	328	328	328	328	328

Panel C: Predicting 1-year Ahead Credit Booms (of Type II) with Policy Variables							
	Single Policy Variable Logit Specifications						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	2.041***						
	(0.747)						
Int. Rates		-0.011					
		(0.661)					
Barriers			-15.128				
			(905.661)				
Branching				-14.090			
				(727.532)			
Specialization					0.342		
					(0.830)		
Cap. Flows						0.425	
						(0.545)	
Fin. Reform							0.082
							(0.807)
Controls?	✓	✓	✓	✓	✓	✓	✓
AIC	323.380	330.941	327.998	329.310	330.780	330.368	330.931
Observations	328	328	328	328	328	328	328

Panel D: Predicting 1-year Ahead Credit Booms (of Type II) with Policy Variables							
Multiple Policy Variable Logit Specifications (Coefficient Averages)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ceilings	2.330***						
	(0.817)						
Int. Rates		-0.266					
		(0.713)					
Barriers			-15.543				
			(858.63)				
Branching				-14.69			
				(963.777)			
Specialization					0.277		
					(0.848)		
Cap. Flows						0.533	
						(0.565)	
Fin. Reform							0.104
							(0.816)
Controls?	✓	✓	✓	✓	✓	✓	✓
AIC	325.499	329.719	327.887	329.778	329.415	329.518	330.355
Observations	328	328	328	328	328	328	328

Appendix

Figure 1 - The Evolution of Credit-to-GDP Ratios Across Countries



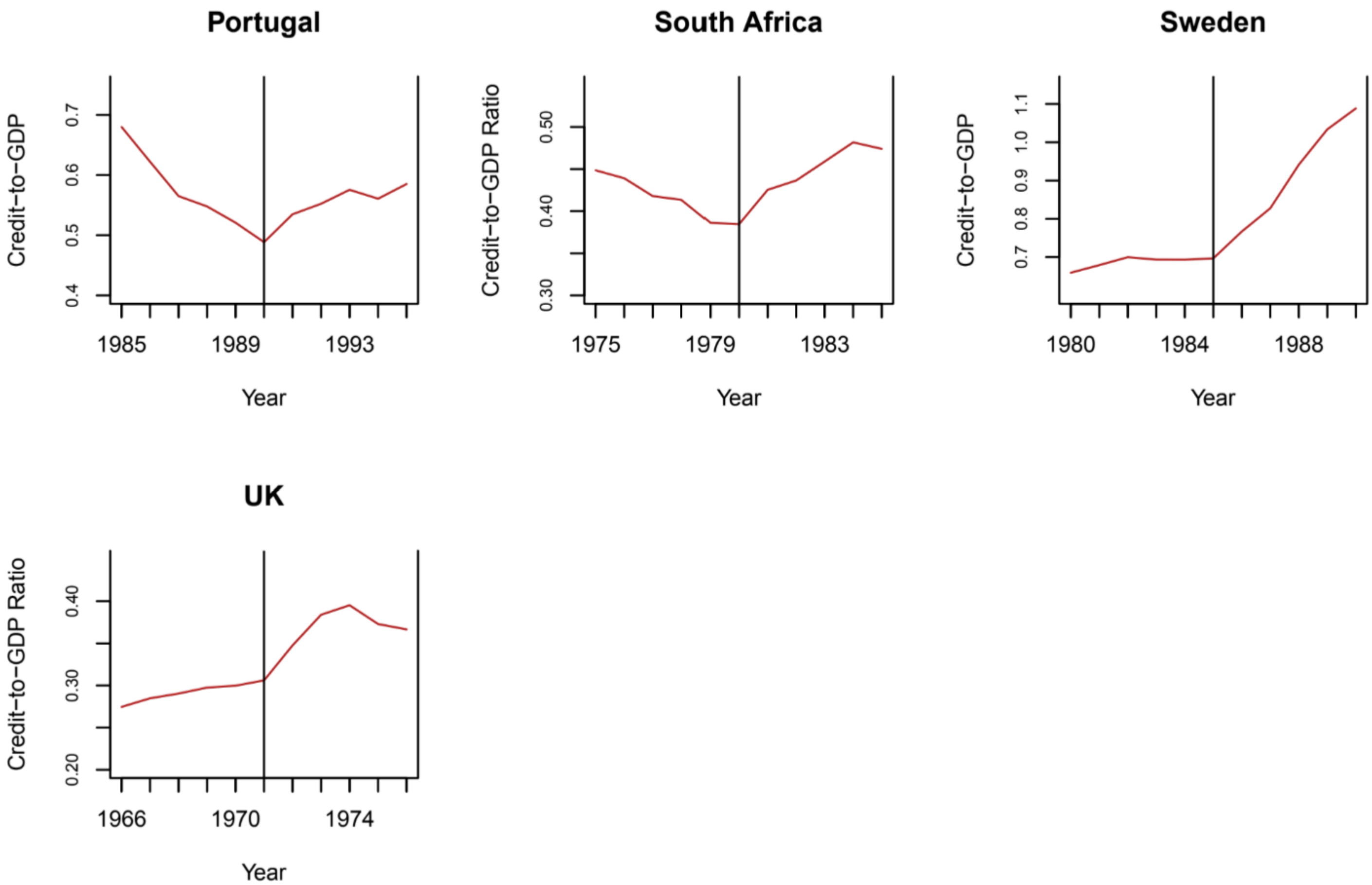
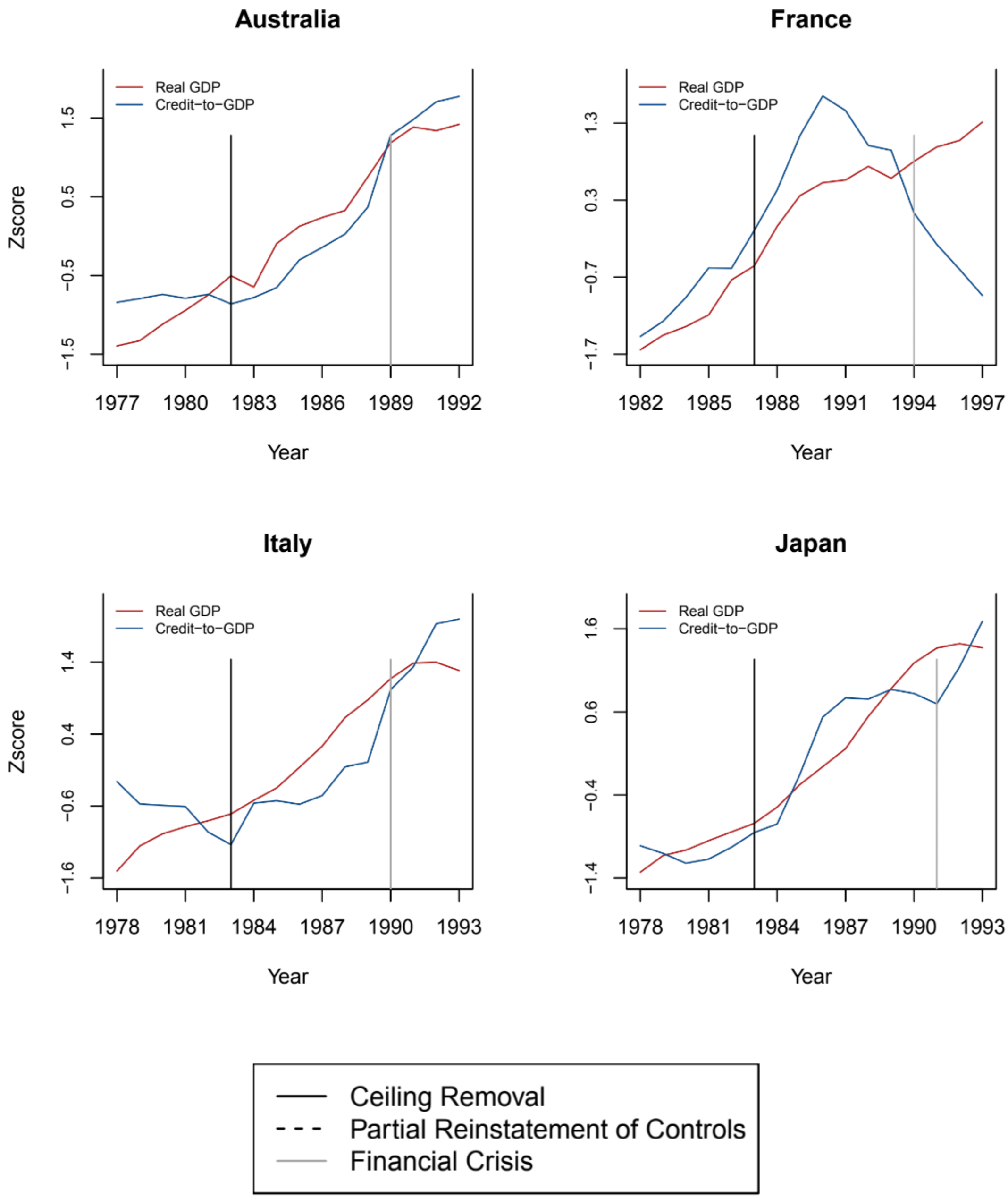
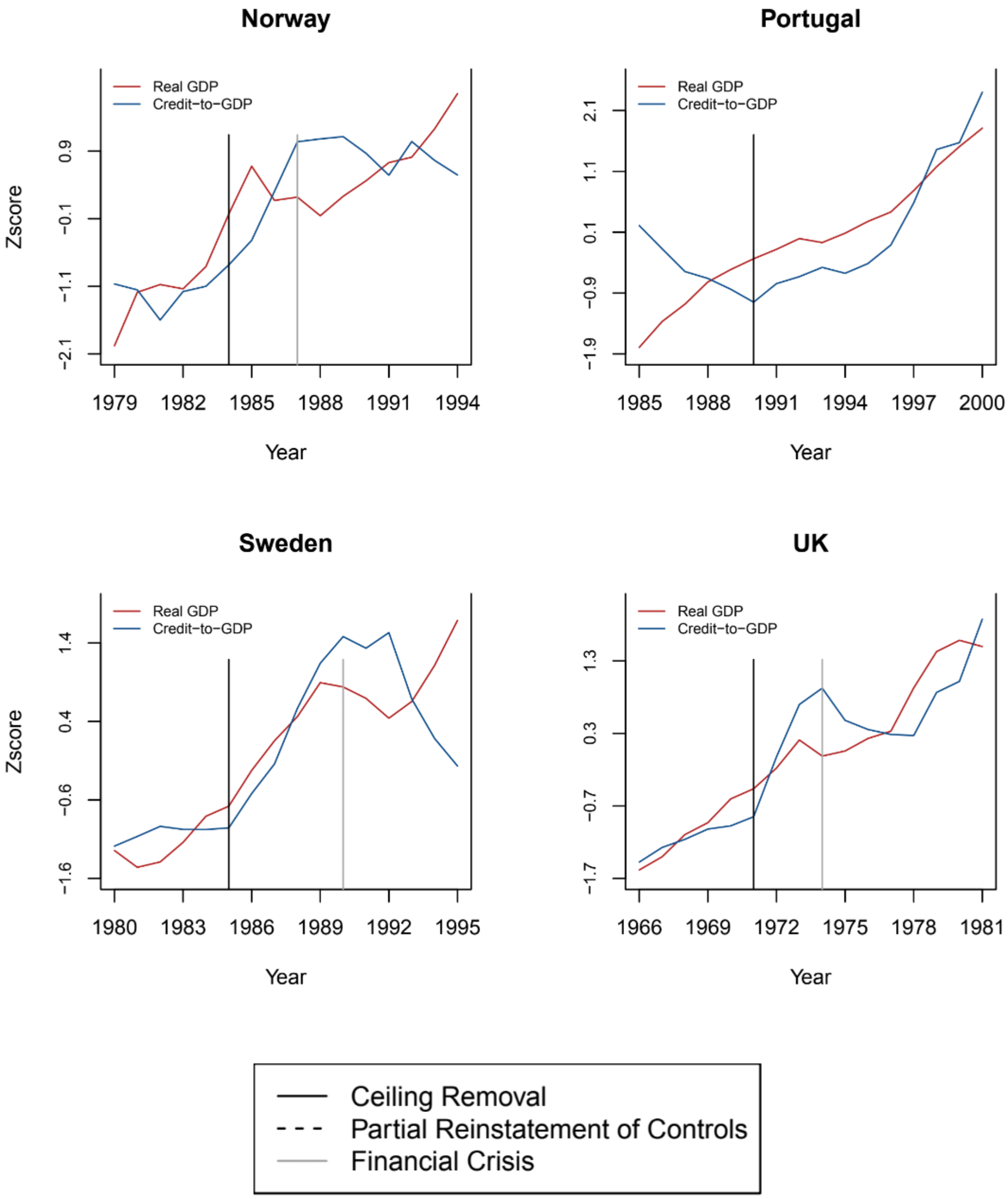

Portugal
Credit-to-GDP
0.4
0.5
0.6
0.7
1985
1989
1993
Year
South Africa
Credit-to-GDP Ratio
0.30
0.40
0.50
1975
1979
1983
Year
Sweden
Credit-to-GDP
0.7
0.8
0.9
1.0
1.1
1980
1984
1988
Year
UK
Credit-to-GDP Ratio
0.20
0.30
0.40
1966
1970
1974
Year

Figure 2 - Calm Before the Storm





Norway
Portugal
Sweden
UK
Real GDP
Credit−to−GDP
Zscore
Year
0.9
−0.1
−1.1
−2.1
1979 1982 1985 1988 1991 1994
2.1
1.1
0.1
−0.9
−1.9
1985 1988 1991 1994 1997 2000
1.4
0.4
−0.6
−1.6
1980 1983 1986 1989 1992 1995
1.3
0.3
−0.7
−1.7
1966 1969 1972 1975 1978 1981
Ceiling Removal
Partial Reinstatement of Controls
Financial Crisis

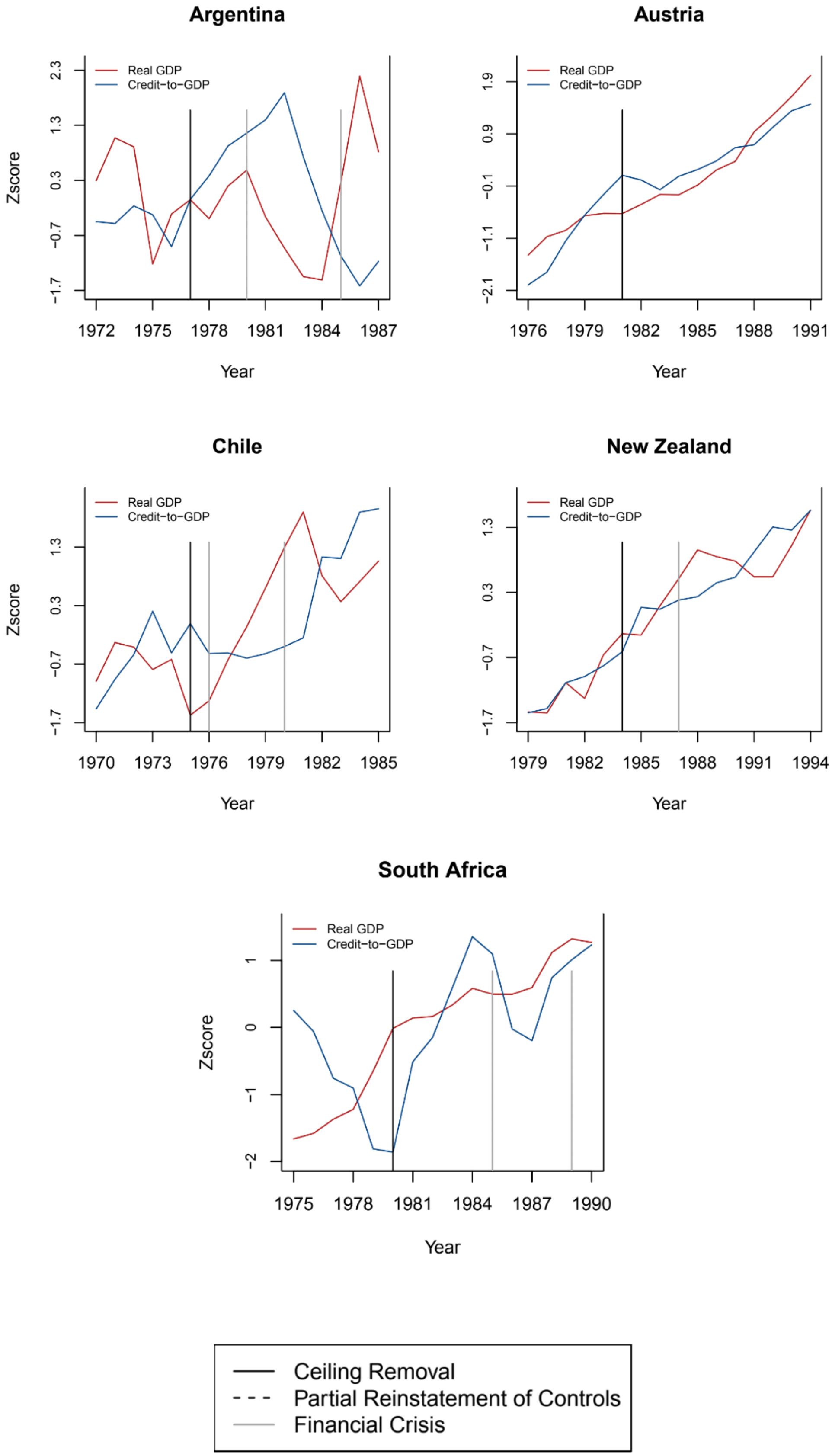
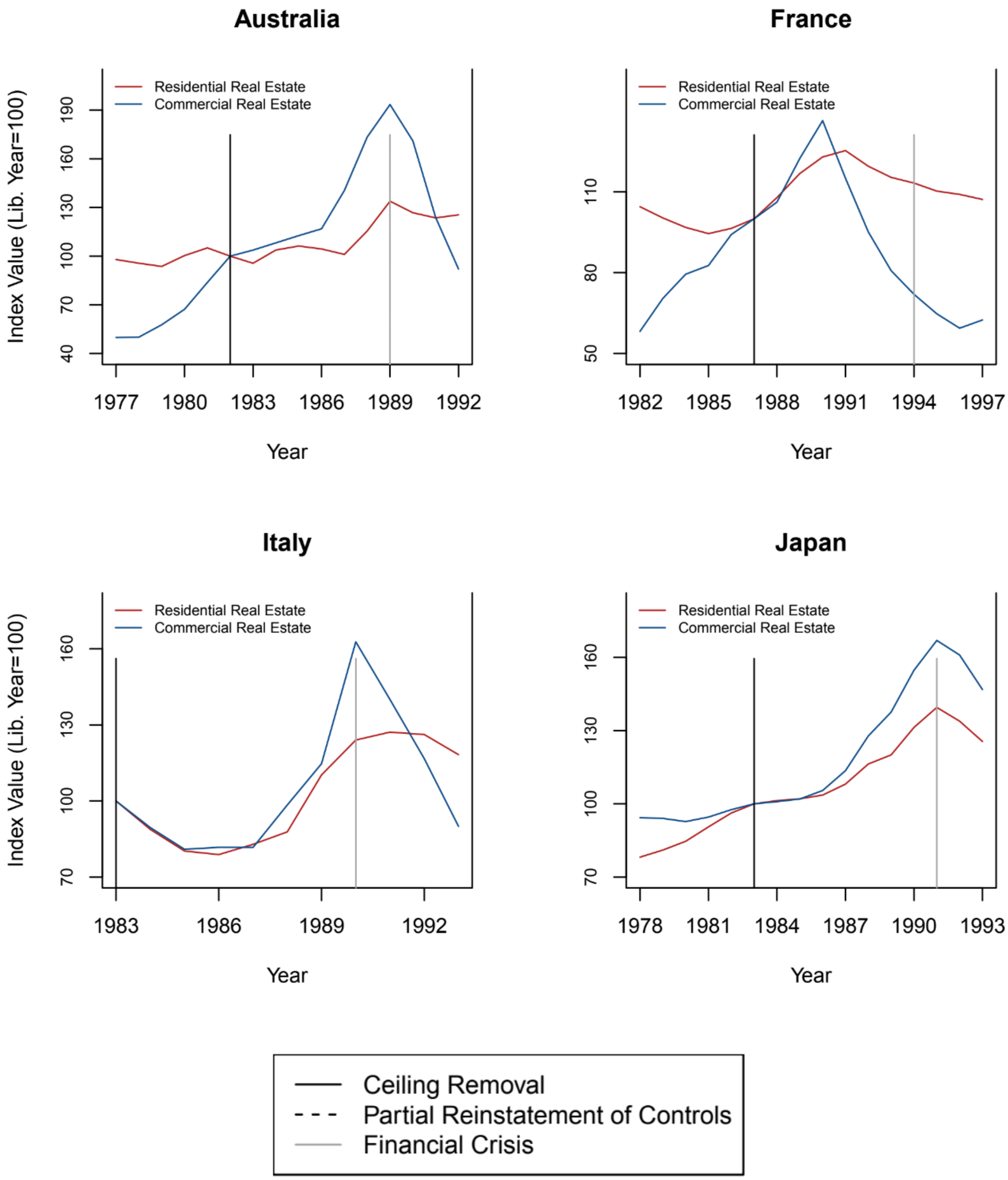

Argentina
Real GDP
Credit−to−GDP
Zscore
−1.7
−0.7
0.3
1.3
2.3
1972
1975
1978
1981
1984
1987
Year
Austria
Real GDP
Credit−to−GDP
−2.1
−1.1
−0.1
0.9
1.9
1976
1979
1982
1985
1988
1991
Year
Chile
Real GDP
Credit−to−GDP
Zscore
−1.7
−0.7
0.3
1.3
1970
1973
1976
1979
1982
1985
Year
New Zealand
Real GDP
Credit−to−GDP
−1.7
−0.7
0.3
1.3
1979
1982
1985
1988
1991
1994
Year
South Africa
Real GDP
Credit−to−GDP
Zscore
−2
−1
0
1
1975
1978
1981
1984
1987
1990
Year
Ceiling Removal
Partial Reinstatement of Controls
Financial Crisis

Figure 3 - Successive Bubbles in Real Estate Prices



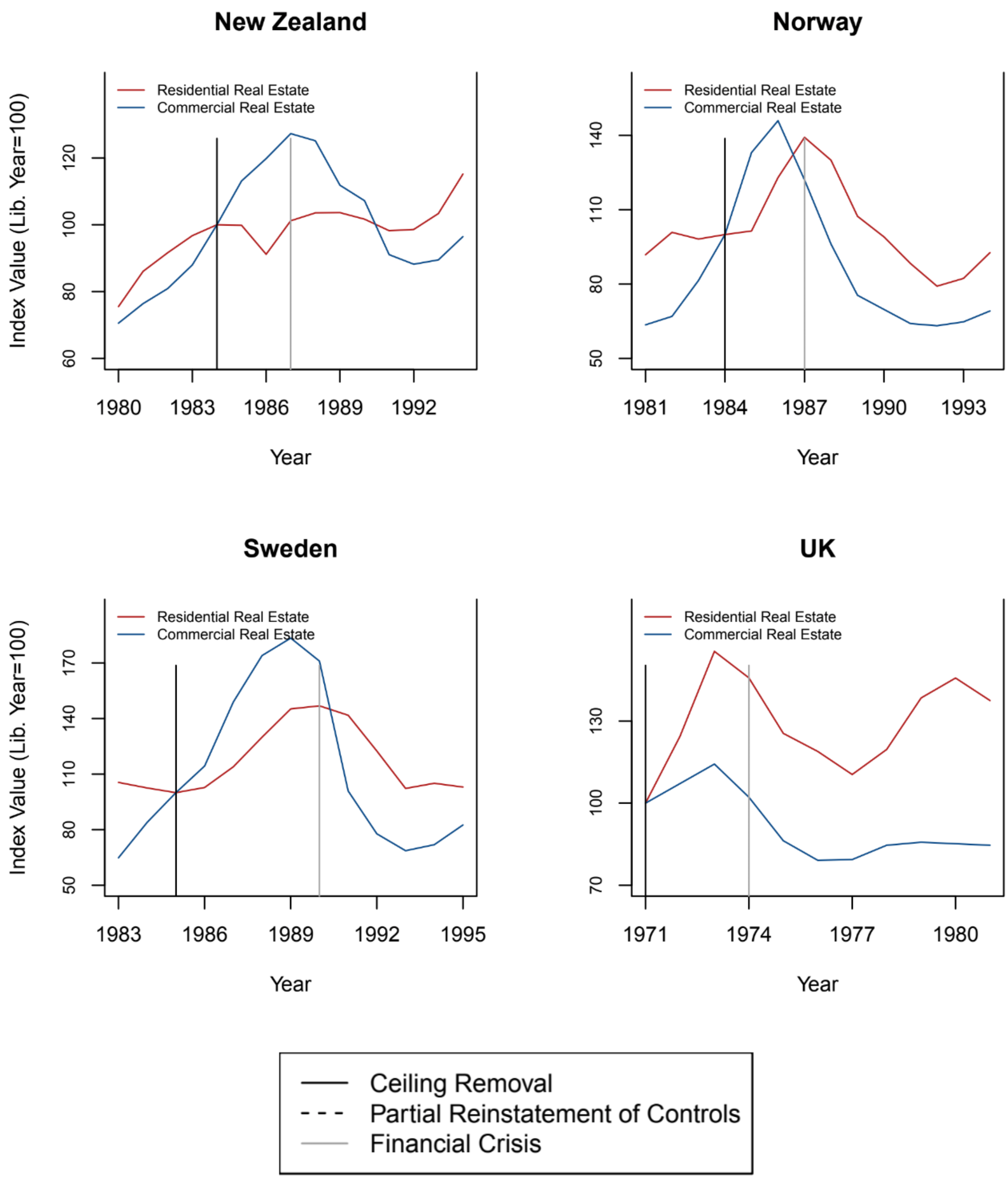
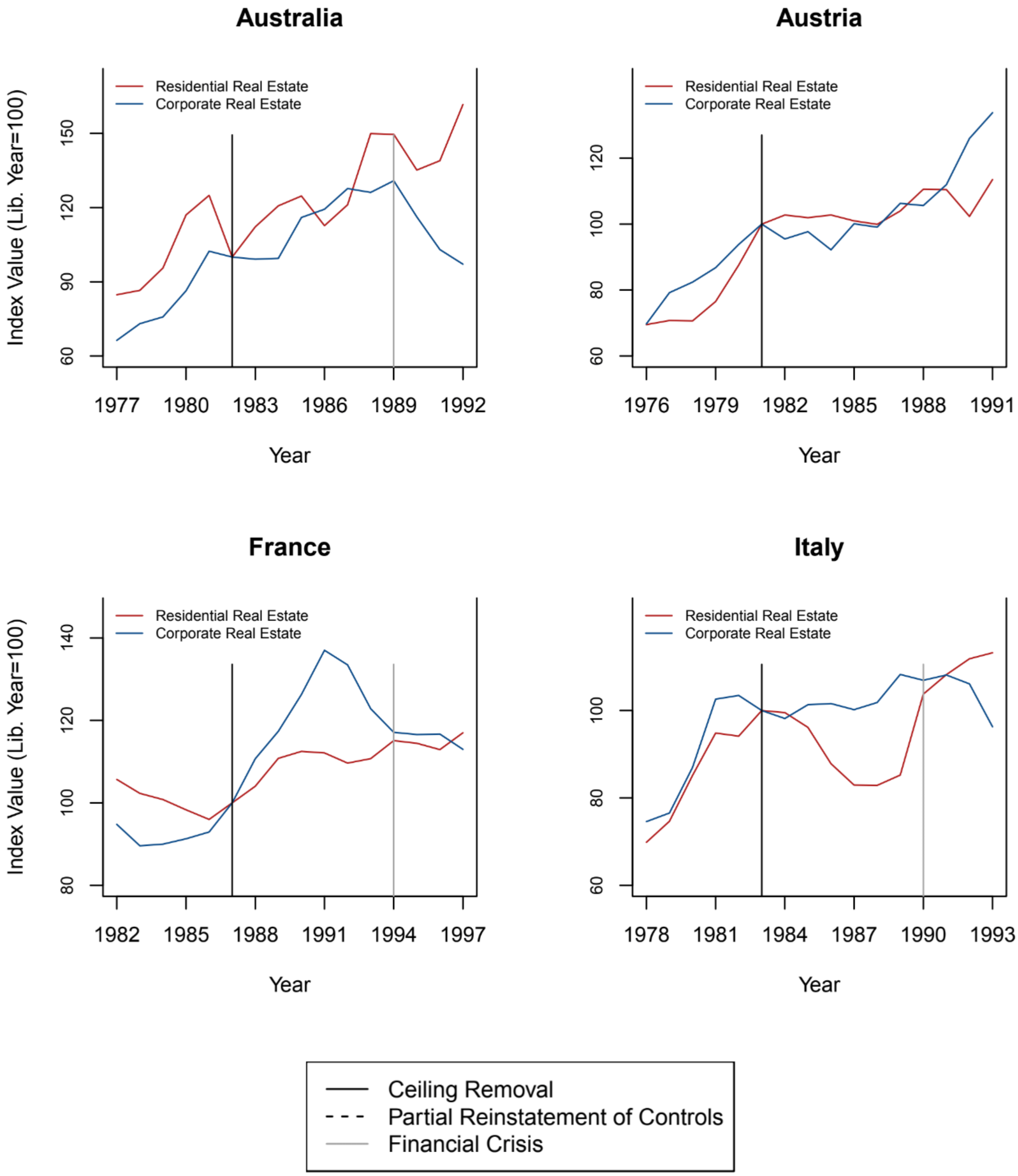
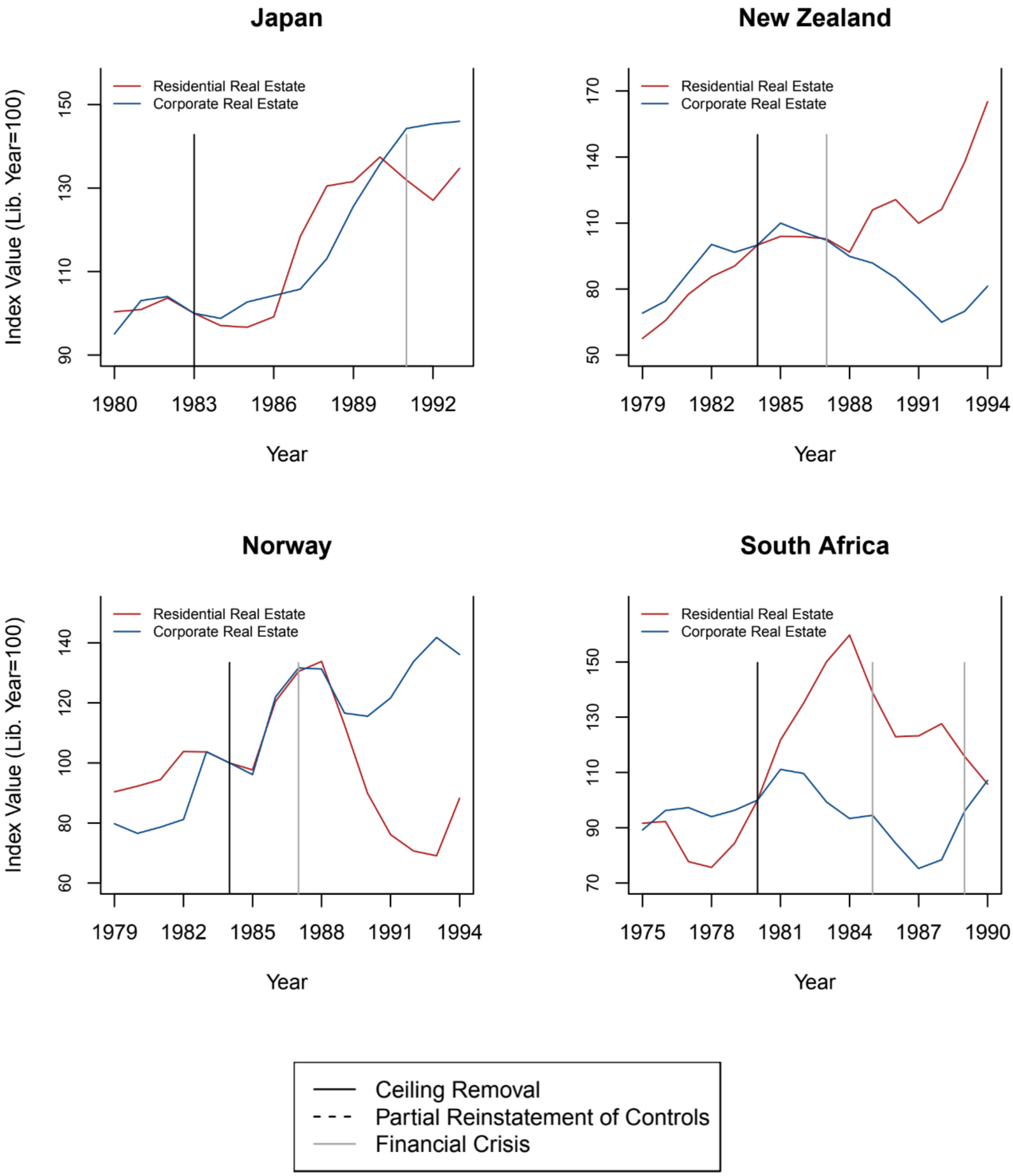

New Zealand
Norway
Sweden
UK
Residential Real Estate
Commercial Real Estate
Index Value (Lib. Year=100)
Year
1980
1983
1986
1989
1992
1981
1984
1987
1990
1993
1995
1971
1974
1977
1980
Ceiling Removal
Partial Reinstatement of Controls
Financial Crisis

Figure 4 - Successive Bubbles in Real Estate Investment




Japan
New Zealand
Norway
South Africa
Residential Real Estate
Corporate Real Estate
Index Value (Lib. Year=100)
Year
Ceiling Removal
Partial Reinstatement of Controls
Financial Crisis

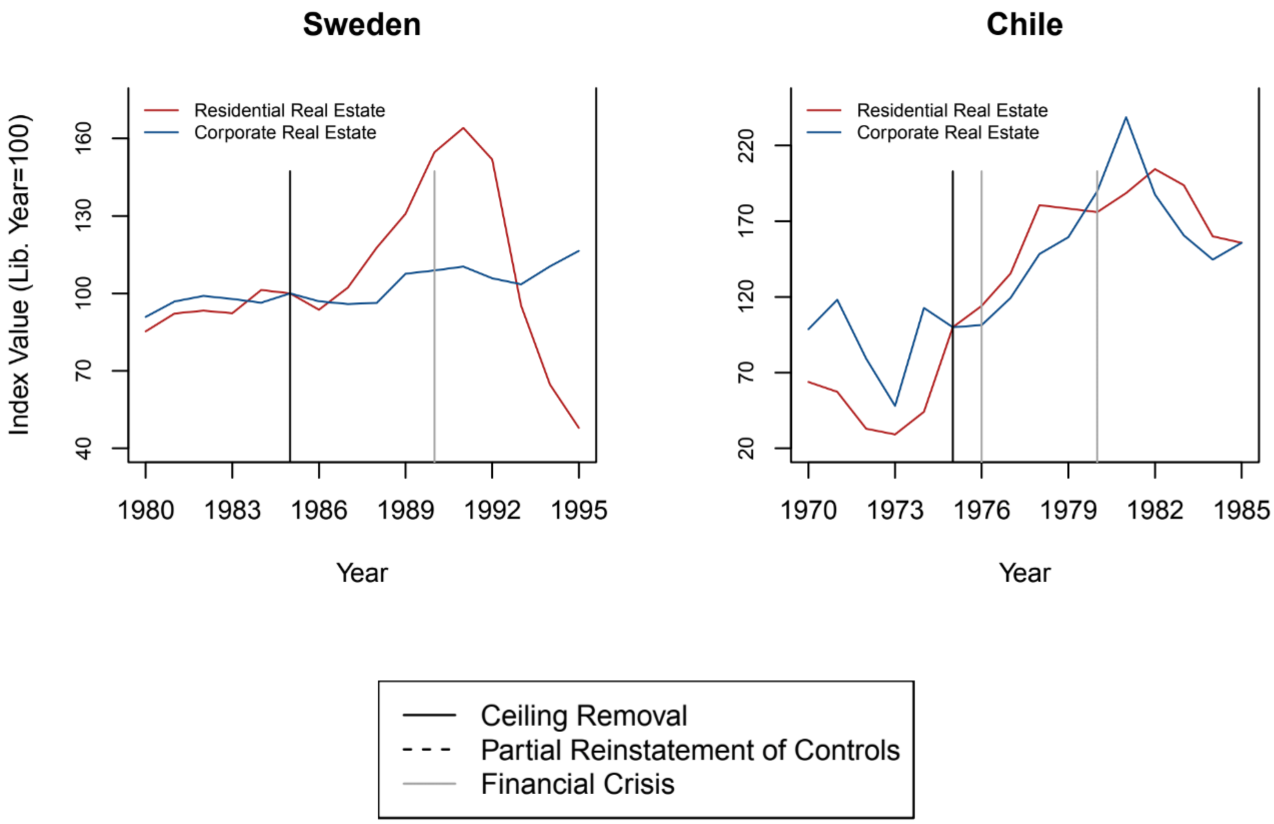
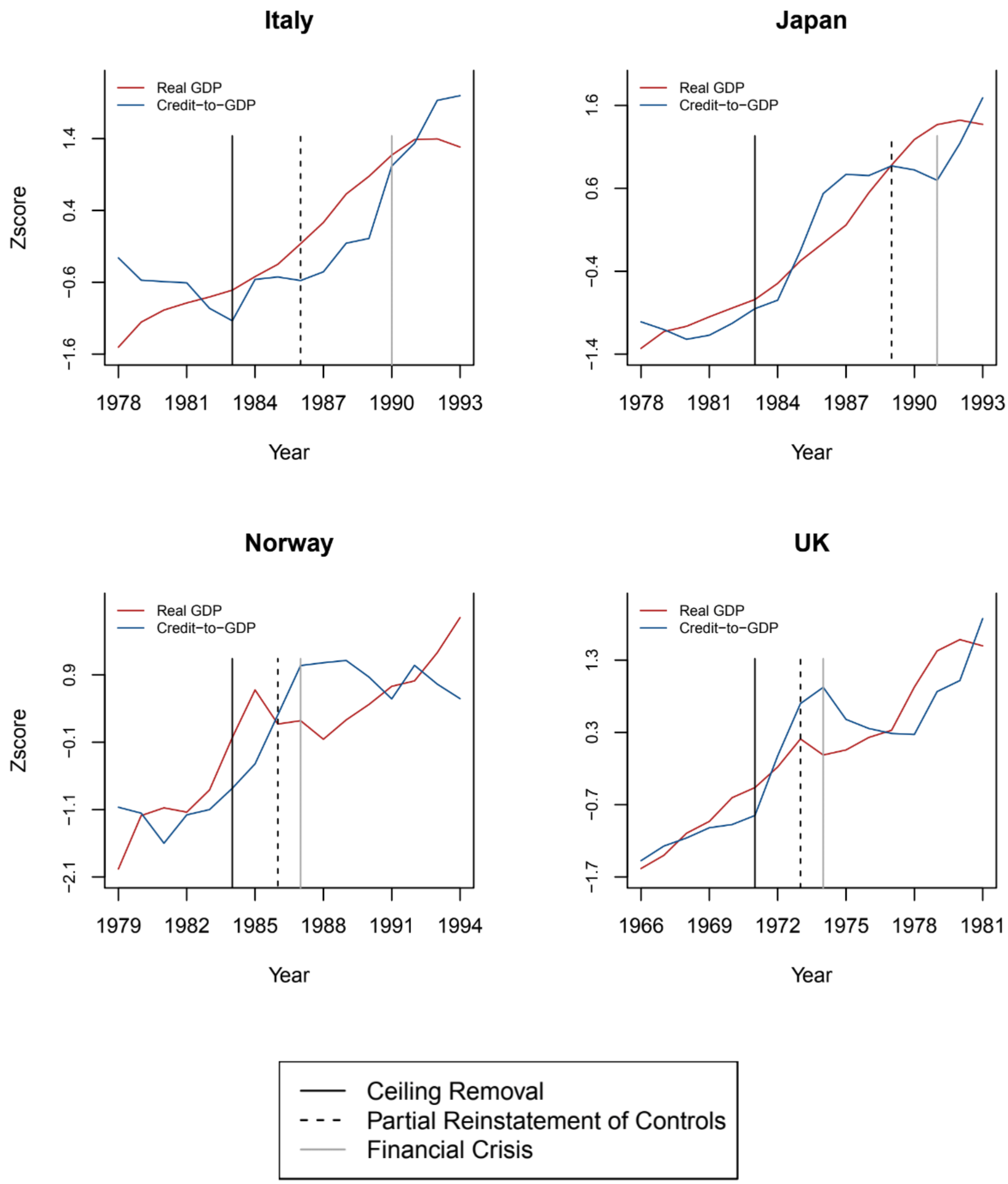

Sweden
Residential Real Estate
Corporate Real Estate
Index Value (Lib. Year=100)
40
70
100
130
160
1980
1983
1986
1989
1992
1995
Year
Chile
Residential Real Estate
Corporate Real Estate
20
70
120
170
220
1970
1973
1976
1979
1982
1985
Year
Ceiling Removal
Partial Reinstatement of Controls
Financial Crisis

Figure 5 - Irreversibility of the Credit Boom



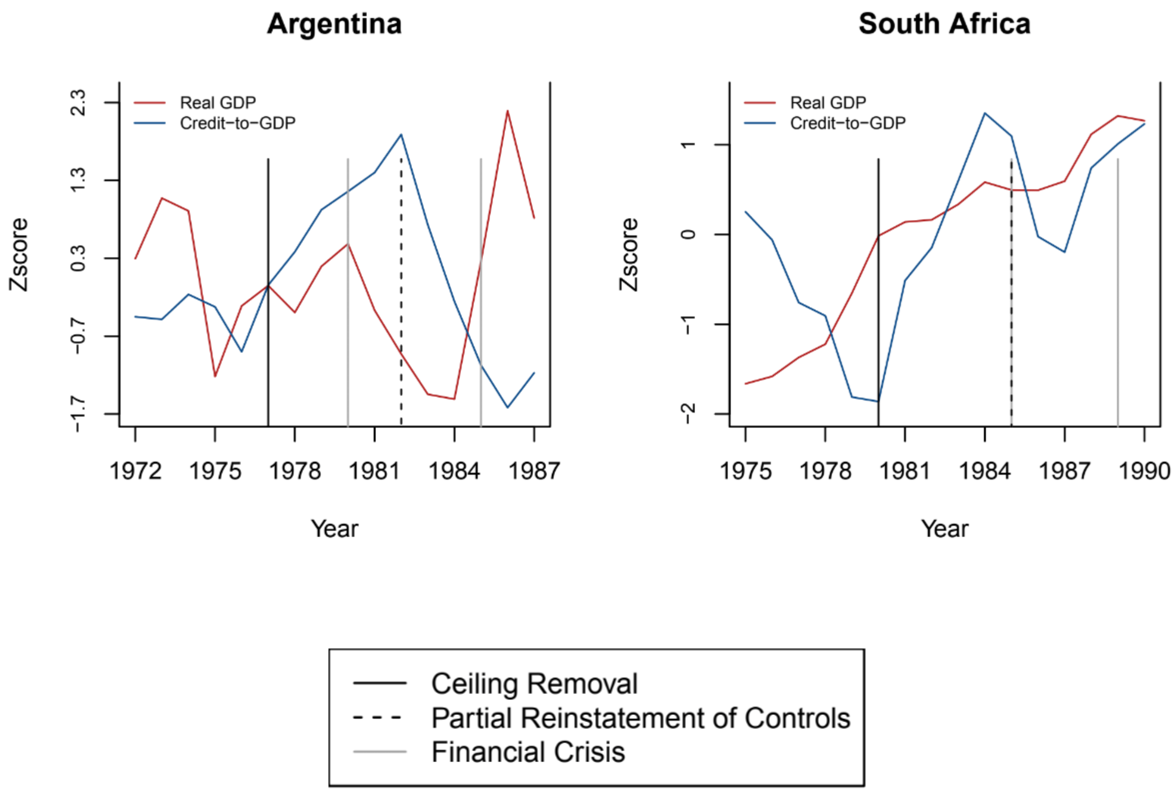

Argentina
Real GDP
Credit−to−GDP
Zscore
2.3
1.3
0.3
−0.7
−1.7
1972
1975
1978
1981
1984
1987
Year
South Africa
Real GDP
Credit−to−GDP
Zscore
1
0
−1
−2
1975
1978
1981
1984
1987
1990
Year
Ceiling Removal
Partial Reinstatement of Controls
Financial Crisis

Table 1 - Country by Country Credit Growth

This table compares credit growth in the three years following credit ceiling removal, to credit growth in across all other three-year windows. To calculate credit growth in the years after liberalization, we subtract a country's credit to gdp ratio in year t from its credit to GDP ratio in year t+3, where year t denotes the year credit ceilings were removed. We perform this comparison country-by-country and show the difference between credit growth after liberalization and average credit growth during other three-year windows. This difference is shown in the final column.

	3-Year Avg. Credit Growth		
	Non-liberalization Years	Liberalization Years	Difference
Argentina	-0.013	0.095	0.108
Australia	0.063	0.063	0.000
Austria	0.045	-0.001	-0.047
Chile	0.031	0.148	0.117
France	0.029	0.047	0.017
Italy	0.035	0.036	0.001
Japan	0.023	0.200	0.176
New Zealand	0.069	0.097	0.028
Norway	0.034	0.241	0.207
Portugal	0.060	0.087	0.027
South Africa	0.023	0.074	0.051
Sweden	0.035	0.245	0.210
UK	0.057	0.089	0.032
Total Avg.	0.037	0.109	0.072

Table 2

This table shows the correlation coefficients associated with each pair of policy variables. Policy indicator variables are constructed by finding the dates of policy reform or removal for each type of policy, across the 13 credit ceiling countries. For each country, an indicator variable for a particular policy assumes a value of one in any year in which there was a meaningful liberalization of a policy of that particular type. The variable takes a value of zero in all other years. Some countries never removed a particular type of policy while others never had restrictions of a given type to begin with (though all obviously had credit ceilings at some point in the sample). In these cases, the relevant country would have that policy variable set to equal zero in all years. In the columns and rows below, "Ceilings" refers to removals of credit ceiling restrictions; "Int. Rates" refers to removals of interest rate restrictions; "Barriers" refers to removals of barriers to entry by foreign banks; "Branching" refers to removals of branching restrictions; "Specialization" refers to removals of bank specialization requirements; "Cap. Flows" refers to removals of restrictions on international capital flows; "Fin. reform" refers to financial reforms in non-bank credit markets.

Correlations Between Binary Policy Variables							
	Ceilings	Int. Rates	Barriers	Branching	Specialization	Cap. Flows	Fin. Reform
Ceilings	1						
Int. Rates	0.205	1					
Barriers	0.100	0.054	1				
Branching	-0.014	-0.021	-0.014	1			
Specialization	-0.020	0.054	-0.019	-0.014	1		
Cap. Flows	0.039	0.206	0.124	0.087	0.202	1	
Fin. Reform	-0.018	0.170	-0.017	-0.012	0.083	0.033	1