

**BANK CAPITAL, LENDING BOOMS,  
AND BUSTS. EVIDENCE FROM SPAIN  
IN THE LAST 150 YEARS**

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## **Abstract**

In this paper we analyze the effect of bank capital on lending expansion and contraction for nearly 150 years in Spain. We first build up thoroughly a measure of bank leverage (i.e. the capital to assets ratio) for the Spanish banking sector starting in year 1880. Then, we run a proper econometric test to analyze the impact that bank capital levels have on lending cycles, controlling for other determinants of credit growth. We do find robust empirical evidence of an asymmetric relationship between bank capital and credit cycle. In particular, an increase in the bank capital before expansions reduces credit growth while it increases credit growth when the recession arrives. Conversely, a too depleted level of bank capital when entering in a recession has a severe impact on lending (i.e. may bring about a deep credit crunch) with quite negative and lasting effects in the economy and the wellbeing of the society as a whole. The paper is particularly useful to support macroprudential policies (dynamic provisions and the countercyclical capital buffer) that have been very recently put in place as they will help to smooth the credit cycle. The experience of Spain over more than a century, with very marked lending cycles, provides a fertile ground for analyzing and supporting them, not only based on the last lending cycle, but also on those occurred in the more distant past.

**Keywords:** lending cycles, bank crisis, capital ratio, leverage ratio, macroprudential tools.

**JEL classification:** G01, G21, N23, N24.

## Resumen

En este estudio analizamos el efecto del capital bancario en las expansiones y contracciones crediticias durante alrededor de 150 años en España. Primero construimos cuidadosamente una medida de apalancamiento bancario (*i. e.*, ratio de capital sobre activo) para el sector bancario español desde el año 1880. Después, llevamos a cabo un análisis econométrico sólido para analizar el impacto de los niveles de capital bancario sobre los ciclos crediticios, controlando por otros factores de crecimiento de crédito. Encontramos evidencia empírica robusta sobre la relación asimétrica entre el capital bancario y el ciclo crediticio. En particular, un aumento del capital bancario antes de una expansión reduce el crecimiento del crédito, mientras que lo aumenta cuando llega una recesión. Por el contrario, un nivel de capital demasiado menguado ante una recesión tiene un impacto severo sobre la actividad crediticia (*i. e.*, se puede incurrir en una escasez de crédito) con efectos negativos y duraderos en la economía y el bienestar de la sociedad en su conjunto. El artículo es particularmente útil para apoyar políticas macroprudenciales (provisiones dinámicas y colchones de capital anticíclico) que han sido implementados recientemente para alisar el ciclo crediticio. La experiencia de España durante más de un siglo con ciclos crediticios muy marcados permite analizarlos y respaldarlos, no solo basándonos en el último ciclo crediticio, sino también en los ocurridos en un pasado más lejano.

**Palabras clave:** ciclos crediticios, crisis bancaria, ratio de capital, ratio de apalancamiento, herramientas macroprudenciales.

**Códigos JEL:** G01, G21, N23, N24.

## 1. Introduction

The recent financial crisis has shown the impact that bank failures and/or bank recapitalizations may have on the economy and the society as a whole.<sup>2</sup> The international banking crisis that hit the United States, the United Kingdom, Spain and many other developed countries has had a long and lasting impact on the economy, the level of employment and the distribution of income, with some ripples reaching also the political arena.

Policy makers and regulators opened soon after the crisis's most acute phase a soul search process trying to understand and amend what went wrong at banks before the crisis. As a result, the G-20 mandated the newly renamed Financial Stability Board to look into the causes and remedies of the financial crisis. The Financial Stability Board in the subsequent years pushed for reforms in banking regulation and beyond (shadow banking, CCPs or central counterparties, derivatives, accounting paradigm, corporate governance, etc.).<sup>3</sup>

One of the main empirical conclusions of bank regulators and supervisors together with policy makers after the crisis was that banks entered into it with a too low level of capital. Capital had been expanded, or even worse, returned to shareholders via buy-backs or higher dividend streams,<sup>4</sup> at a lower path than risks in the previous lending expansion, partially based on the notion that credit risk was better measured and managed and less capital per unit of exposure was needed. The spread and strength of the banking crisis showed quite clearly the weaknesses in that approach that, at a regulatory level, underpinned the Basel 2 regulatory reforms, started in 1999 and concluded in 2004 (see BCBS (2004) and BCBS (2006) for a few additional changes before coming into force in 2008).

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<sup>2</sup> See, for instance, Chart 1 in Estrada and Saurina (2016).

<sup>3</sup> See, among others, FSF (2009) as well as G-20 press releases to see the sense of urgency and the direction of the reforms. In particular, the one after the meeting in London in April 2009 (see G-20 press release (2009)) asked for a significant increase in bank capital, as well as for countercyclical buffers and better provisioning requirements.

<sup>4</sup> See Acharya et al. (2011) and Acharya et al. (2017) for an estimate of the importance of those buy-backs and dividend payments for the US banks.



Moreover, the financial crisis underlined the need to move from a pure microprudential view of capital requirements (i.e. focused only on the level of capital at each individual bank) to a more comprehensive or so-called holistic view of capital, where the macroprudential approach is also a key ingredient.<sup>5</sup> That is, policy makers need to pay attention to how aggregate bank capital ratios evolve along the business cycle. Therefore, capital requirements need to have a countercyclical component, so that when the lending cycle is in full swing, banks need to reinforce the level of capital in order to help authorities to rein on the lending growth and the risk expansion, and even more importantly, build up a buffer to protect against future losses that may appear when the economy changes trend. The need for a higher level of capital at each bank, proportional to its risk, together with a countercyclical capital buffer (CCyB) for each bank, among other changes in capital, liquidity and systemic banks regulation, crystalized in the Basel 3 agreement (BCBS (2011)).

There is a solid and robust empirical evidence of both the need for countercyclical tools (Jiménez and Saurina (2006)) and its usefulness to reduce credit crunches during recessions (Jiménez et al. (2017)). In particular, the latter article shows that a countercyclical tool based on dynamic provisions, which behaves very similarly to the current countercyclical capital requirement in Basel 3, had an impact on reducing the speed of lending growth in Spain during the last lending boom and, more importantly, reduced the credit contraction when the economy turned sour. Those banks with a higher dynamic provision buffer just before the crisis reduced lending significantly less than the weakest banks in terms of capital levels. This is a crucial finding to support macroprudential policies.<sup>6</sup>

The aim of this paper is to expand quite significantly the perspective, so that we can learn not only from the last lending boom and bust in Spain but also from quite a long list of previous ones. In fact, we start our analysis in 1880, almost a century and a half ago, in order to see whether the role of bank capital has been similar or not in terms of fostering and/or smoothening the credit contraction. Our aim is to find even more robust empirical evidence,

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<sup>5</sup> To understand the content of the macroprudential approach see, among others, Crocket (2000), Borio (2003), Hanson et al. (2011), and more recently IMF (2014), IMF-FSB-BIS (2016), Mencia and Saurina (2016) and BIS (2017).

<sup>6</sup> A more thorough analysis of dynamic provisions can be found at Saurina and Trucharte (2017) with a summary of the mechanism for policy makers in Saurina (2009).



now from an aggregate point of view, to support macroprudential policies for a heterogeneous array of countries and banking systems. We base our analysis on a long period of Spanish history where different banking environments were present (i.e. very different levels of banking concentration and competition, different economic policy environments, different institutional arrangements, etc.).

We also follow here a long tradition of international analysis literature that has studied the potential role of bank capital in credit crunches (Bernanke and Lown (1991), Rajan (1994), Peek and Rosengren (1995), Berger and Bouwman (2013), Demirguc-Kunt et al. (2013) and Vazquez and Federico (2015)) or during the whole lending cycle (see for instance, Gambacorta and Mistrulli (2004) or Saurina and Shin (2012)). Our added value is that we do not only focus on one historical episode (such as the last lending boom and bust in Spain, the credit crunch in the US Eastern Coast States in the early 90's, Japan in its last credit boom and long lasting credit bust, or the last financial crisis, now a decade old), but rather on a large number of lending booms and busts in a country particularly prone to them as well as for banking crisis, both systemic and bank idiosyncratic.<sup>7</sup> An excellent narrative of banking crisis in Spain as well as their driving factors can be found in Martín-Aceña (2013).

Additionally, our approach contributes to the literature by complementing that of Elliot et al. (2013) and Elliot (2014) in the sense that instead of analyzing different past policy decisions as potential macroprudential tools, we focus on one regulatory or policy instrument (i.e. bank capital level) and assess its role along many different credit cycles.

Moreover, the paper has a second important contribution. To our knowledge, this is the first time that a long series of a bank capital ratio for the Spanish banking system is being elaborated. This allows us to compare the historical levels of capital ratios of the Spanish banking sector with, for instance, the ones for the US (Berger et al. (1995)) or the UK (Alessandri and Haldane (2009)), available for long time periods. The comparison is quite telling. As Martín-Aceña (2013) and others have convincingly insisted over time, the Spanish

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<sup>7</sup> Banks are usually more levered or indebted than non-financial companies. While capital over total assets may vary between half and one third in an industrial company, in a bank it can be as low as 10%, 5%, 3% or even less, as the financial crisis showed quite crudely. Therefore, a relatively small loss of value of their assets may wipe out completely their capital forcing them into bankruptcy. Historically, the capital over total assets ratio used to be much higher, as we show later in the paper.

banking developments and crisis, as well as many other developments in the economy and the political arena, are a reflection of international developments happening around the same time. Spain was not isolated from the world but rather connected to it more or less directly. Similarly, the level of bank capital along the last century and a half behaves quite in parallel with developments in the US and the UK.

We find for Spain a much higher level of bank capital in the late XIX century than in current times. In fact, until the Spanish Civil War, this ratio was also higher in Spain than in US and UK, but in all the three countries a steady decline was observed until the early sixties resulting in a marked convergence. Unfortunately, the long bank capital series for Spain has a serious breakdown during and right after the years of the Civil War, due to lack of available data. Notice that throughout the paper we will use indistinctly equity and capital, although conceptually the first includes the second.

During the last half a century, when Spain started to transform its economy from a quite significant agricultural country to, first, a more industrialized country and, finally, into a services oriented economy, the capital ratio was quite stable in a broader historical perspective, fluctuating roughly around 6% for most of the last 50 years, not far above the minimum level of the series the nearly last century and a half.

Turning to the methodology used, we apply the state of the art analysis for estimating the relationship between bank capital levels and lending cycles. Following Bernanke and Lown (1991) and Peek and Rosengren (1995), we model aggregated credit growth as a function of macroeconomic determinants, including the level and evolution of bank capital, using a non-linear model to endogenously distinguish between periods of high and low credit growth. During the years analyzed, there are a number of lending cycles, as well as banking crisis, that allow us to estimate the elasticity of credit to bank capital. The cycles identified concur quite well with the systemic financial crisis identified with narrative techniques in Martín-Aceña (2013).

Our findings show that the level of bank capital has an asymmetric effect in the credit cycle so that a high capital ratio in advance of a credit boom reduces credit growth; on the contrary, during the states of nature where credit growth is low or even negative, high capital ratios in

advance increase the average credit growth or cater for a lower contraction in credit. The former results are quite relevant from a policy point of view. They could be interpreted as if a countercyclical capital buffer would reduce the size of the expansion, and also the magnitude of the subsequent credit crunch. Banks need to deleverage less (i.e. to cut lending to the private sector) if they have accumulated a larger amount of capital during expansions. Conversely, a depletion of capital during the expansionary phases, leaves not only banks but also the economy to their own fate, as the recession hits borrowers and lenders and the latter do not have room of manoeuvre to react, buffering the impact of credit on the real economy.

Therefore, we find support for the usage of macroprudential tools (e.g. CCyB) in quite a different economic and banking environments along nearly a century and a half. Thus, in very different economic development stages and banking structures (with or without foreign banks, with more or less stringent regulation, with more or less oligopolistic structures), we do find support for countercyclical tools. This aggregated evidence complements the more granular-based evidence provided in Jiménez et al (2017), although only for the last boom and bust lending cycle.

Thus, we detail in the next section how we construct the capital ratio variable and also the other variables used in this research. In the third section we present the methodological approach used and, in the fourth, our main empirical results. In the final section, we extract some conclusions.

## **2. Databases and preview of the historical capital ratios**

It is somehow striking that there is not a long time series for an aggregate equity ratio in Spain; that is, there is no time series of bank capital over total assets that spans, say, several lending cycles. At least we have not been able to find it. Therefore, we have engaged into a building up process in order to elaborate the database. To fulfill that purpose, we had to combine information from several sources, not always initially compatible among them. Appendix 1 discusses the details more thoroughly. We are aware that these time-series will be substantially improved, but we consider that they could be, at least, a first good approximation as well as a good anchor for our empirical research. We do believe, therefore, this is an important contribution of this paper.

In the case of the banking system balance sheets, the departure point was the information available in Chapter 4 of the Banco de España *Statistical Bulletin*. From this source, the banking system's homogeneous balance sheets are available from 1962 onwards. These balance sheets show the sum of banks and savings banks.<sup>8</sup> We aggregate most of the assets and liabilities entries, as in previous years the available breakdown was much more reduced. In particular, we worked with three items from the asset side (credits, securities and other assets) and from the liability side (equity –capital plus reserves–, deposits and other liabilities). A breakdown of lending by industry or product (i.e. lending to households or firms) may be interesting but not needed for our research goals. The same happens with some capital components, as tier 1 and tier 2 instruments are quite recent.

The information from 1952 to 1962 was also obtained from former Banco de España Statistical Bulletins and additionally, we use several Bank Bulletins of the bankers association to obtain Spanish banks' balance sheet information from 1924 to 1935 and from 1941 to 1958. For the period 1915-1924, we used the series constructed by Martín-Aceña in the following book: "Estadísticas históricas de España volumen II, siglos XIX-XX", by Albert Carreras and Xavier Tafunell (2005). Finally, data up to 1914 were obtained from the book "La banca española en la Restauración II, datos para una historia económica" by Anes et al. (1974).

However, for the common years in different Statistical Bulletins, Bank Bulletins and books, the aggregated balance sheets do not exactly match. At this point, we adopted a statistical approach instead of an accountant one to make them comparable. We considered that the higher the aggregation, the higher the compatibility among different databases. Thus, we enlarged backwards the most recent database using the corresponding growth rates of the older databases, and afterwards we introduced an adjustment in the different assets and liabilities entries to guarantee that they added up. All in all, we build a continuous series of

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<sup>8</sup> Savings banks were not as prominent as they have been since early 1990s, when they could start to open branches nationwide and they expanded quite significantly. On the contrary, for most of the period analyzed, commercial banks dominated the banking landscape in Spain as they were the main providers of funding for non-financial industrial firms and, therefore, were the main source of funds for the economic development.

values for total assets, total credit and equity, by joining the four sources mentioned previously.<sup>9</sup>

Besides, in order to allow the scaling of all these variables and facilitate the empirical analysis that is presented below, it was necessary to backtrack two macroeconomic variables: nominal GDP and CPI (Consumer Price Index). Both variables were taken from the Spanish Statistical Bureau INE database and linked backwards using the growth rates contained in the book by Carreras and Tafunell (2005). Due to data constraints, we calculate the real GDP (and the rest of the real variables appearing in this paper) dividing nominal GDP over CPI. We acknowledge that using the GDP deflator would not modify significantly the results.

Figure 1 presents<sup>10</sup> the evolution of both total assets and equity of the Spanish banking system as a percentage over nominal GDP over the last 137 years. Besides, the shaded areas represent the systemic banking crisis identified in Martín-Aceña (2013). As it can be seen, total assets over GDP remained relatively stable since 1880 until 1915. Afterwards, they have shown a continued upward trend, only interrupted following systemic financial crisis happened. In fact, the maximum was reached just before the global financial crisis (around 2008, over 300%) and the current decline has been the highest observed in this sample period, allowing to recover the levels of the beginning of the new millennium.

Total banking assets as a percentage of GDP is a rough measure of the level of leverage or indebtedness of an economy, in particular for those economies, such the Spanish, where banks dominate the financial landscape and market funding is relatively low. Note then how different was the last lending boom and bust in Spain, with a substantial ramp up of households and firms leverage before the explosion, together with a quite impressive correction afterwards not yet finished. The increasing leverage of economic agents reflects a natural deepening of banking activities as the economy matures, but it could also be a source of financial fragility as the higher indebtedness of those agents reduces its resilience to economic and/or financial shocks.

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<sup>9</sup> In Appendix 1 we show the evolution of these variables from the different sources to assess the adequacy of the statistical approach adopted.

<sup>10</sup> All figures and tables are collected at the end of the main text.

The equity over GDP ratio has remained more stable. In fact, at the beginning of the sample period it represented around 5%, showing a downward trend until 1920 and recovering before the Civil War. Right after that period, it departed from a very low level (2.5%), recovering the previous century ceiling in 1970. Afterwards, a sustained increase has been observed. The visual inspection shows that this ratio has diminished during all the recorded systemic banking crisis apart from the last one, when it markedly increased.

From a different perspective, the green line of Figure 2 shows the equity ratio over total assets in Spain. After reaching values over 50% at the end of the XIX century, it showed a noticeable decline, reaching values around 15% before the Civil War. This downward trend continued afterwards, registering a floor of 4% by 1962. The trend changed and became positive until 1990 where it recorded a maximum value (7.6%) value since 1946. Then, it recorded a significant decline until the global financial crisis. During this last crisis, opposite to the previous ones, an important increase in this ratio has been recorded, reaching levels not observed since the early forties. The increase in equity over total assets during the last banking crisis is the result of different factors. First of all, the increase in capital brought about by more stringent new regulation (i.e. enforcement of Basel 3). Secondly, it reflects the recapitalization with public funds of failed savings banks. Last but not least, it may also reflect the significant deleverage process (e.g. reduction of private indebtedness) that came after the banking and economic crisis, the worse in magnitude since the Civil War.

Therefore, it seems that capital is being depleted during banking crisis as credit losses need to be absorbed. If those credit losses are large enough, given the low bank capital ratios already mentioned in the introductory section, they may end up causing the bankruptcy of the bank and, thus, forcing its exit of the market. This mechanism used to work in the distant past. Alternatively, banks can be recapitalized with public funds support, as the last three systemic banking crisis in Spain testify it, as well as in other developed countries. Note that the first two systemic banking crisis in our sample, those of the XIX century, implied a huge depletion of capital in relative terms, which never again was replenished.

This chart also includes the historical evolution of similar ratios in the cases of the US (orange line) and the UK (blue line). As it can be seen, Spain had the highest ratio until the Civil War, followed by US and UK, converging the three of them by the mid-fifties and remaining less

volatile, probably associated to the first international initiatives to cooperate in banking regulation. After the Civil War and from a quantitative perspective, the Spanish equity ratio has been more similar to that of the UK. However, the three of them share a common diminishing trend until the 1950s. Afterwards, a period of stabilization or slight increase was observed, being followed by a reduction from mid-nineties, and an important increase right after the global financial crisis, as mentioned before. Benink and Benston (2005) also present a graph of several countries' average capital ratio for a similar time span to ours. In common with our chart, they also display an almost constant evolution of the average capital ratio from the mid-fifties onwards, even if they consider a dissimilar basket of European countries. Further, Schularic and Taylor (2012) use a similar time span to ours as well about different countries (not exclusively European, as opposed to Benink and Benston (2005)), to reinforce the importance of credit cycles to determine the likelihood of financial crisis. They claim that credit booms gone wrong are very likely due to regulation deficiency.

Finally, a few words on the composition of equity in this wide time period. Figure 3 captures the weight of reserves in total equity. As it can be seen, there exists a marked trend to rely on retained profits to increase equity in the banking system. The value of the ratio ranges from around 8% to around 95% and by the end of 2017 it was 77%. This variable does not seem to show a common trend during systemic financial crisis; it has increased in some of them, decreased in others, and even remained stable in some other.

### **3. Methodological approach**

#### **3.1. The model**

As the final objective of this paper is to shed light on banks' equity's role on preventing or exacerbating systemic financial crisis, following the previous literature (Claessens et al. (2012) or Jordá et al. (2016)), we have opted for estimating a credit to the non-financial private sector equation. Other possibilities widely used could be modelling housing or stock market prices (see Dupery and Klaus (2017) for a recent discussion on several property market variables' effect on the probability of entering a financial stress regime).<sup>11</sup>

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<sup>11</sup> See Dembiermont et al. (2013) for a review of total and bank credit pattern for 40 countries since 1940.



This way, we will study the explanatory power of the equity ratio on credit, after controlling for the traditional determinants of credit (GDP, real interest rate, housing prices, deviations from the long-run equilibrium, among other). Bank capital should be included lagged, to avoid the possibility of endogeneity and more importantly, to simulate the conditions in which a policy maker operates (notice that, for example, when the CCyB is activated, banks have a period of one year to meet the new requirement).

If we introduce the equity ratio in the equation in a linear way and a negative and statistically significant sign is found, it could be concluded that the higher the bank capital, the lower the credit growth in any state of the nature. However, it could be interesting to check if that coefficient is different in stress periods (when credit declines) and in tranquil periods (when credit increases). For example, if the coefficient is negative when credit grows and positive when credit decline, it could be concluded that the higher the capital ratio the lower the volatility of the financial cycle.

The easy way to check this possible non-linearity consists on identifying, from external sources -for example using narrative techniques-, financially stressed and tranquil periods and estimate separate coefficients for the equity ratio in both subsamples. This approach may be criticized from different angles. First, in order to identify a financial crisis, a combination of qualitative and quantitative information is considered, which can be different from one paper to another (see, for example, Laeven and Valencia (2008) or Reinhart and Rogoff (2013)). Second, usually the number of positive outcomes of the dependent variable (the number of systemic crisis) is reduced. In our historic sample we have just 8 systemic crisis, but it needs to be acknowledged that in most used samples (luckily) there is no more than three episodes. The third possible critic is that this approach does not allow to analyze the depth and the duration of the crisis. More importantly, this methodology assumes as given the identified systemic crisis.

A way to solve these problems is to use a Markov-switching regime model (Hamilton, 1989). In this class of models the data itself identifies the periods where there is a high probability of being in a state of reduced or negative credit growth, that traditionally are linked to systemic banking crisis. In fact, a Markov-switching regime model allows the economy to be

at different states, where the probability of transition from one state to another is independent from the previous states the economy was at.

In any case, to double check that the real growth of credit is a promising variable for this analysis, we run an autorregresive Markov-switching model for this variable considering only one explanatory variable, a constant, which can be different in the two states of the nature.

$$\Delta cr_t = \beta_0(S_t) + \beta_2 \Delta cr_{t-1} + \varepsilon_t; \quad \varepsilon_t \sim N(0, \sigma_\varepsilon) \text{ and } Prob(S_t = 1/S_{t-1} = 2) = p_{12}$$

Where  $\Delta$  is the differences operator (that would take into account the integration order of the variable), lower case letters refer to the log of the variables and  $CR$  is real credit.

Therefore, the constant should capture the conditional average growth rate of real credit in every state. Then, we calculate the implicit probabilities of being in the state of the nature where credit grows the least, which should correspond to the periods associated with systemic banking crisis.

The time series credit to the non-financial private sector for Spain that we use in this paper are taken from the BIS database (1970-to date), which the original source is the country's financial accounts. We use two statistics: total and bank credit. The latter uniquely includes bank credit while the former adds all fixed income instruments issued by non-financial private companies. These time-series are backtracked until 1880 using the credit aggregate generated in the previous section from banks' balance sheets. We are aware that this is not the best way to proceed as these historical aggregate also include the credit to the public sector (i.e. it is not possible to disentangle both as we go back in time).

Figure 4 shows the growth rates of these two variables in real terms (that is, deflated by the CPI). The first remark to be done is the similarity between both. Before 1980, the similarity is due to the fact that there was very few information on bonds issuance by non-financial firms, but even afterwards the profile is very similar. In the second place, they show a notable volatility. Growth rates have fluctuated above 40% in absolute value. Third, in all the systemic banking crisis periods, a decline in the real growth of credit is observed. This suggest this variable is a promising one to capture this kind of events. Further, as it can be

seen in the table accompanying Figure 4, the descriptive statistics of both variables measured by their mean and standard deviation are very different before and after the Civil War; this is remarkable in the case of the volatility, which before the Civil War was almost double than afterwards. For this reason, in the empirical section we will check if the results are different in both sub-periods.

Figure 5 shows the main results of the estimation on the simple Markov-switching regime model. The result are quite satisfactory. In all the identified crisis using narrative techniques the probability of being in the low credit growth regime is 100%. However, the duration of the episodes is not always matched (especially in that of mid-seventies) and there is one period right after the Civil War where the results of the model are compatible with a stress episode which has not been identified as a systemic banking crisis with the narrative approach.<sup>12</sup>

Thus, the model to be estimated will have the following general form:

$$\Delta cr_t = \beta_0(S_t) + \beta_2 \Delta cr_{t-1} + \beta_3(S_t) \Delta EQR_{t-i} + \beta_4 \Delta y_t + \beta_5 \Delta RR_t + \beta_6 \Delta prv_t + \gamma ECM_{t-1} + \varepsilon_t \quad \varepsilon_t \sim N(0, \sigma_\varepsilon) \text{ and } Prob(S_t = 1/S_{t-1} = 2) = p_{12}$$

Where *EQR* is the equity ratio, *Y* is the income, *RR* the real cost of funds, *PRV* the collateral and *ECM* the error correction mechanism.<sup>13</sup>

Regarding the explanatory variables, it should be taken into account that sometimes it is difficult to build the most adequate determinants for this historical sample period. Thus, we use real GDP as the scale variable, to capture both income and part of the wealth effects. The relative cost of lending is measured with the real interest rate proxied by the nominal yield of public debt instruments minus the inflation rate measured by the CPI. Besides, we

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<sup>12</sup> Regarding the estimation results, of the autoregressive Markov-switching model of credit growth, the estimated constant implies that in the stress regimes, total credit declines 2.9% on average per year and 4.4% when uniquely bank credit is considered. This could be rationalized as if capital markets were partially compensating credit provided by banks during systemic financial crisis. Besides, the expected duration of that regime are 6.9 and 6 years, respectively. On the contrary, in the high credit growth regime, the corresponding constants are 9% in both cases.

<sup>13</sup> In this expression we only consider two states of the nature and we only allow two parameters to change with them. We have chosen this specification after several proofs, trying to retain the most parsimonious result.

construct a relative housing price, which is our proxy for the collateral (and part of the wealth) behavior.<sup>14</sup>

### 3.2. Estimation strategy

This model will be estimated in several steps. First, we check the time-series properties of all the variables. This will determine the differencing order of the variables to become stationary.<sup>15</sup> Second, we will check if there exist a cointegration relationship among the variables (or a subset of them). If that is the case, in order to obtain consistent estimates of the parameters in the stationary specification, it would be necessary to include an additional explanatory variable: the deviation of credit from its long run equilibrium (error correction term). This deviation captures the convergence to the long-run equilibrium; thus, the corresponding coefficient should be negative, statistically significant and smaller than one in absolute value. This cointegration relation will be obtained using the fully modified least squares estimator, which has proved to have very good properties with such a long time series as we have in this case.<sup>16</sup> We prefer this to the alternative of including the lagged levels of the relevant variables in the stationary specification and jointly estimate both the long and the short run parameters, as in this non-linear environment is preferable to estimating the most parsimonious specification possible.

As it can be seen in Appendix 2, both total and bank credit plus real GDP and the equity ratio conform a cointegrating vector. Nevertheless, results are not very robust, probably as a consequence of not being able to disaggregate credit to households and to non-financial firms. Hence, we do consider it given that the estimated coefficients seem reasonable and in line with previous research. The elasticity with respect to the GDP is positive and it is higher than the unity, reflecting how wealth effects implied a progressive increase of indebtedness already documented in Figure 1. The semielasticity of the equity ratio is negative, thus capturing both cost and balance sheet effects. The real interest rate and the housing price are not statistically significant, probably due, in the first case, to the fact that in most of the

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<sup>14</sup> In Appendix 1 we explain the details on how we construct these last two variables.

<sup>15</sup> The details of the time-series characteristics of these variables appear in Appendix 2, where the results of the unit-root tests are presented.

<sup>16</sup> In Appendix 2 we show the results of this analysis.

sample period nominal interest rates were regulated.<sup>17</sup> In the second case, the joint consideration of credit to households, for which there is evidence of being relevant, and to non-financial private companies, could be the most simple and straightforward explanation, although it should be also taken into account that until the Civil War, most of Spanish households were renting the houses they lived in.

An additional difficulty with the estimation process is that the explanatory variables can be considered endogenous, as they can be jointly determined with the own credit. In the case of the GDP, one of the motivations for this research is the important losses of GDP that usually happen during financially stressed episodes; there is evidence that part of those losses are due to the supply credit constrains that weak financial institutions apply to the real sector of the economy. In the case of the real housing prices, credit conditions also play a very important role in determining both the demand of housing services and the supply of new houses. Last but not least, the real interest rate is the equilibrium price of the supply and demand of credit, so it is clearly endogenous.

In these circumstances, to obtain consistent estimators for these two variables, it is necessary to instrument them or using an adequate lag. The two properties that the instruments should fulfill are they to be correlated with the variable to be instrumented and they not to be correlated with credit growth. Thus, in the case of GDP growth we have considered three instruments capturing demand shocks: world GDP growth, arrivals of tourists and the structural public balance. The first two instruments are determined abroad, so they will not be affected by Spanish credit conditions; the third one is determined by the public sector, which is the producer of the safe asset of the economy, so it should not be affected by domestic credit constrains. For the real housing price, we have added a supply side variable, the stock of houses per capita. As this variable is predetermined with respect to the prices, as most of the houses were built well in advance, it should be a valid instrument.<sup>18</sup> Finally, in the case of the real interest rates we decided to use its two-period lagged value to solve the problem.

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<sup>17</sup> In fact, this could help explain the sign and statistical significance of the capital ratio, as capital is the most costly source of funding for banks.

<sup>18</sup> Appendix 1 details how these instruments were constructed.

Thus, we can run regressions of GDP and real housing price growth on these instruments and obtain their adjusted values. These adjusted values will substitute the observed values in the model credit to obtain consistent estimators of the parameters of interest. As it can be seen in Appendix 2, the  $R^2$  of these auxiliary regressions is very high, so the instruments are well correlated with the instrumented variables.

### **3.3. Comparison with previous econometric approaches**

As it was said in the introduction, the main goal of this paper is to contribute to disentangle the role played by banks' equity in the periods of credit expansion and, more importantly, during systemic banking crisis. In that respect, several empirical papers have estimated different binary models of probability (logit, probit, etc.) where the variable to be explained was the occurrence of a financial crisis. However, contrary to this paper, their aim is to predict these events in advance. For instance, Demirgüç-Kunt and Detragiache (1998) and Hardy and Pazarbasioglu (1998) use multinomial logit models for the prediction of systemic banking crisis. More recently, Laina et al. (2015) use univariate signaling and multivariate logit models to study different systemic banking crises in the European Union. They show that the growth rates of loans-to-deposits and house prices are the best indicators to predict systemic banking crisis, followed by the growth rates of mortgages, household loans and private loans. In addition, Betz et al. (2014), focusing on the European banking market, state that joining both bank-specific and country-level macroeconomic and financial data such as house and stock prices, early-warning models' predictions of financial crises are greatly improved.

Besides, using the evolution of credit to identify financial stress periods we depart from the banking crises literature, which has focused on the role of the evolution of credit anticipate financial crises. For example, Kaminsky and Reinhart (1999) study the effect of credit among other variables on banking and currency crisis, concluding that credit to the private sector accelerates before a banking crisis emerges; Borio and Drehmann (2009) study the relationship between credit growth and asset prices to determine the likelihood of a future banking crises.

In any case, this is not the first time our methodology is used for our purpose at hand. For example, Kaufmann and Valderrama (2004) estimate equations of credit to households and firms with Markov-switching models and Anguren (2011) built a synthetic indicator of global credit stance using the same methodology. However, to our knowledge, this is the first time the role that bank equity plays in credit's evolution along time is studied, connecting with the bank capital and credit crunch traditional literature (Bernanke and Lown (1991), Rajan (1994), Peek and Rosengren (1995)). At the same time, we also analyze the role of bank equity (and debt) on credit from the supply side point of view (i.e. taking into account the solvency position of the banks), following a much more recent literature (Jiménez et al (2012, 2014, 2017) and Gambacorta and Shin (2016))<sup>19</sup> where panel data and very granular information at the bank or even at loan level is used. However, our historical perspective prevents us from engaging in this panel approach because of the lack of granular data. The elasticity of credit to bank capital is, of course, a key input for banking regulators as well as for policy makers in general.

#### 4. Results

Before presenting our estimated model, it is interesting to show the results that we obtain when we estimate a more traditional linear credit equation. Columns (1) and (3) of Table 1 present this exercise using both ordinary least squares (OLS) and instrumental variable techniques (2SLS). As it can be seen, there exists a certain inertia in the evolution of the stock of credit, that jointly with the GDP growth, the real housing price and the error correction term are the explanatory variables that come out statistically significant. The use of instrumental variable techniques does not change much the point estimates, although the statistical significance of both GDP growth and real housing prices growth declines. In all the cases, the parameter estimated for the ECM fulfills all the requirements to confirm the existence of a cointegration relationship, although it implies that the speed of adjustment to the long run equilibrium is relatively slow. The real interest rate has the expected sign but it is not statistically significant, as it happens with the equity ratio, which, as in the long-run estimation, has a negative effect on credit growth.

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<sup>19</sup> Adrian and Shin (2010, 2014) and Saurina and Shin (2012) stress the importance of analyzing bank leverage in order to understand bank behavior during expansions and recessions.



Columns 2 and 4 try to check in a simple way if the relationship between credit and its determinants differs in tranquil and stress times. We do that introducing a dummy that takes the value of one when there has been a systemic banking crisis in Spain according to the classification of Martín-Aceña (2013). Therefore, one minus that dummy captures tranquil times. Two observations are in order. First, the average growth rate of real credit is higher in tranquil times than during systemic banking crisis; however, the coefficients are only statistically significant when using instrumental variable technics. And second, when we interact the dummy with our variable of interest, the equity ratio, we obtain opposite signs, although the parameters are not statistically significant. On the one hand, in tranquil times the sign is negative, suggesting that if previously the bank increased its equity ratio, credit growth was moderated. On the other hand, the corresponding sign in crisis times is positive, so if previously the ratio had increased, credit would grow more (or diminish less). This result is very suggestive, as it would imply that the equity ratio could smooth the credit cycle.

In order to check more formally this asymmetry, we estimate the non-linear model presented before, that allows to identify endogenously the different states of the nature. The main results appear in Table 2. Columns (1) and (3) present the specification for total and bank credit respectively, where only the conditional mean changes with the state. In that specification, most of the coefficients are statistically significant and they have the expected sign. The growth of the credit stock shows a different mean in both states, presents a certain inertia, depends positively on GDP and real housing prices growth (the statistical significance of both variables diminishes when instrumented) and the error correction mechanism implies a relatively slow speed of adjustment. The real interest rate, as it happened in the linear specification, does not play any role. Again, the change in the equity ratio (our variable of interest) is negatively signed but it is not statistically significant.<sup>20</sup>

In the second specification (columns (2) and (4)) we allow the equity ratio (jointly with the constant) to have a non-linear effect on the credit growth. Indeed, this seems to be the case. According to our estimates, increasing the equity ratio in advance of a credit boom reduces the credit growth, while if it is done in advance of a credit crunch it moderates the expected

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<sup>20</sup> In the case of the equity ratio, we have considered another stationary transformation as a robustness check of the main results: its deviations from a Band-Pass filter trend. The results of this approach are presented in Appendix 3. The quantitative results are different, but qualitatively they imply similar conclusions.

decline in credit, although the former effect is estimated more imprecisely, mostly when instrumental variable techniques are considered. In any case, given the difference in the coefficients' absolute value and in its statistical significance in the short run, even taking into account that the equity ratio has a negative effect of credit in the long-run (error correction mechanism), it seems that this effect is more powerful during credit crunches. We interpret this result as if a countercyclical capital buffer would reduce the size of the expansion and, more importantly, the magnitude of the subsequent credit decline.<sup>21</sup> And this is exactly what a macroprudential tool should do: accumulate in the expansion to be freed in the recession.<sup>22</sup> All the other parameters show the expected sign, although neither the housing price nor the real interest rate are statistically significant. As it happened before, the main change in the IV estimation is the increase in the elasticity of credit to GDP.

From a quantitative perspective, the results are very significant. Notice that they imply that increasing by one percentage point the equity ratio before an expansionary period reduces the credit growth by 0.5 pp. On the contrary, if banks did that in advance of a contractionary period, it would reduce the decline rate by more than 10%. This last elasticity is very high. Nevertheless, if risk-weighted assets (RWA) are around half of total assets, which is the case for Spanish banks, not for other European banking sectors (Trucharte et al 2015), increasing by 1 percentage point (pp) the countercyclical capital buffer (CCyB) is akin to increasing 2 pp the capital in terms of RWA, as current capital requirements are being required. 2 pp increase in capital requirement is a very large demand for banks. Given the fact that Basel 3 has developed a CCyB requirement, with a maximum value at 2.5% of RWA, this is equivalent to 1.25% of total assets, if RWA density is 0.5 as stated before. Therefore, the impact of reaching a requirement at the maximum of the CCyB during the expansion, should allow for a reduction in lending decline, when the CCyB was freed in the recession, of around 15%, which is very significant, showing the potential impact of countercyclical tools. According to the dynamic multipliers (see Figure 6), the maximum effect is reached three years after the increase in the equity ratio is recorded, decreasing progressively in the

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<sup>21</sup> Note that this finding is in line with Jiménez et al. (2017) but considering eight systemic banking crisis and close to one and half century time span.

<sup>22</sup> Appendix 3 reproduces Table 2 but using the deviation of the equity ratio with respect to the Band-Pass filter trend. Although the results are quantitatively different, they are essentially the same from a qualitative point of view.

following periods until becoming negative and stabilizing at the estimated long-run elasticity. In any case, it is important to realize that the long period analyzed includes severe lending booms and busts and a significant volatility in credit growth rates, which may help to explain the high value of the elasticity in downturns.

The estimates also show that the duration of the states are highly asymmetrical. The expansionary periods as an average last sixteen years and the contractionary ones three years and a half. Therefore, on average in a lending cycle (boom and bust) the elasticity of credit to capital altogether would be much closer to other estimates in the literature (Gambacorta and Shin (2016)).

As the variables used in this paper go back more than one hundred years, full homogeneity is not guaranteed. Besides, the Spanish financial system has substantially changed and relevant regulation has been modified several times. Thus, in order to check results' robustness, we have repeated the estimations of the Markov-switching regime model using different sample periods to exclude some of the episodes of systemic banking crisis in order to increase homogeneity. In fact, after the loss of Cuba, a significant amount of capital returned to Spain from abroad and, partly, was invested in creating new bank houses that became large Spanish banks during the XX century (Banco Hispano Americano, Banco Español de Crédito and Banco de Vizcaya were created at the turning of the century).

Other robustness exercises performed consisted on estimating the model before and after the Spanish Civil war as we have a gap in the data in such a period. Moreover, this breakdown is of interest since, according to figure 4 and the accompanying table, real credit growth was much more volatile in the first period than in the second. However, considering that we have fully homogenous banking data from 1952 on, we conduct the post-Civil War test using the period 1952-2017, given that results are statistically and economically equivalent to those obtained when considering the period after the Civil War (1942-2017).

In Table 3 we show the results of the estimations shown in Table 2 but using different samples. That is, we re-estimate the non-linear model, excluding in the first/second and fifth/sixth columns the systemic banking crisis happened in the XIX century, whose nature may be quite different from those in the XX and XXI centuries. In columns third/fourth and

seventh/eighth we have excluded the period following the introduction of the euro currency, which represented a major structural change for the Spanish economy, in particular, in terms of monetary policy sovereignty; besides, this period includes also the credit boom of early 2000s and the global financial crisis.

We obtain similar and comparable results for the two subsamples. In the first case, we observe that the average duration of the credit booms is longer, as are the credit crunches; and, to some extent, the effect of the equity ratio in booms is higher and similar in busts. In the second case, the two relevant differences are that the average duration of credit booms is shorter, which seems to be reasonable taking into account that the credit boom that preceded the global financial crisis was one of the largest in history. Besides, the elasticity of the equity ratio in downturns is higher.

Table 4 shows other robustness checks considering the pre- and post-Spanish Civil war periods separately. The results in the period before the Civil War (columns (1/2) and (5/6)) are very similar to those obtained when the full sample is considered. Nevertheless, there are some differences worth mentioning. First, credit growth shows less inertia; and second, the elasticity to GDP is higher. Finally, in columns (3/4) and (7/8) we use the period for which fully homogeneous series for the equity ratio are available after the Civil war. The differences now are more relevant. Notice that in this sample we have a fewer number of systemic financial crisis (only three) and one of them is of a much higher order of magnitude; thus, it is not surprising that the results show more instabilities, being some of them difficult to reconcile with the theory or other empirical results .

We summarize in what follows the most relevant conclusions. First, the inertia is much higher, as a consequence of the higher maturity of the credit to the private non-financial sector; this is probably related to the expansion of mortgages that followed the access of Spanish households to their own house. Second, the sensitiveness of credit to GDP is higher. Third, and more importantly, although the equity ratio still has an asymmetric effect on credit growth, the parameters change importantly; they diminish considerably in stress periods; in fact, this estimated multiplier will imply that, for example, if a credit crunch comes with the CCyB full loaded at 2.5% of RWA, credit will diminish by 3% less than if that buffer were

not available. In fact, Figure 7 shows how the asymmetry in the dynamic multipliers of credit to the equity ratio diminish substantially, but it is still present.

In this last sample the weight of the so called Great Moderation period and the subsequent Great Recession could be very important, thus conditioning most of the results that we obtain. Notice that in such period, not only Spain became member of the European Monetary Union; further, from the perspective of the financial system, the Spanish banks started to operate in other countries and risk weights were introduced to calculate the solvency ratios; besides, when the crisis arose, the euro area as a whole was at stake. For these reasons, that crisis could have been different. We checked that by estimating the model only for this period (1995-2017), although results are not reported given that for that period one unique systemic financial crisis is included. However, it is interesting to remark that for this period the GDP growth becomes statistically non-significant (obviously, GDP continues being a long-run determinant of credit). Further and more importantly, the equity ratio seems to be non-relevant in the credit bust and bust phases; notice that in this period the Basel accords were implemented which implied a difference between the equity ratio and the regulatory capital ratio associated to the risk weighted assets.

## 5. Conclusions

One of the lessons learned from the global financial crisis is that we need additional policy tools to smooth the credit cycle and reduce the cost that the financial crisis has for taxpayers. For those reasons most of the countries have introduced in law code macroprudential tools to manage the financial cycle. Although these tools are micro in nature, they have a macro aim: to reduce systemic risk. This is a quite new job, and there is not much experience on how they work and what their efficiency is.

Spain, to some extent, is an exception in this respect, as the countercyclical provisions can be understood as a macroprudential tool similar to the countercyclical capital buffer.<sup>23</sup> Jiménez et al. (2017) show that these provisions were very effective in smoothing the credit crunch during the last crisis and slightly less in curving the credit boom. In this paper we try

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<sup>23</sup> See Saurina and Trucharte (2017) for a detailed discussion on the potential complement or substitution between dynamic provisions and countercyclical capital buffers.

to check whether these conclusions can be extended to other financial crisis suffered by the Spanish economy. In order to do that, we extend the aggregate information from the banking system back to 1880 in order to include eight episodes that, according to Martín-Aceña (2013), can be classified as systemic banking crisis.

The first conclusion from this exercise is that the equity ratio (capital plus reserves over total assets) has declined substantially, from figures around 40% at the end of the XIX century to almost 4% by 1962 and close to 9% in 2017. This behavior of the Spanish banking system has been very similar to that of US and UK, pointing once more towards Spain not being different to other countries; that is, in financial terms, Spain has been permeated along time by foreign developments.

Besides, using a non-linear framework, we show that after controlling for the traditional determinants of credit to the non-financial private sector, the changes in the equity ratio have an asymmetric effect on credit growth. In particular, in the periods when credit growth is negative, having increased the equity ratio in advance has an effect on reducing the credit decline. On the contrary, in periods when credit growth is positive, having increased the equity ratio some years before leads to a moderation of the credit expansion. And this effect is qualitatively quite robust in different sub-samples, using different definitions of credit and different transformations of the equity ratio.

We interpret these results as a support for the use of the new macroprudential tools and, specially, the countercyclical capital buffer to smooth the financial cycle. This is very much in line with the role assigned to bank capital in the traditional credit crunch literature (Bernanke and Lown (1991), Rajan (1994) and Peek and Rosengren (1995)). Moreover, our findings contribute to explain the determinants of systemic banking crisis as well as subsequent business cycle movements (i.e. recessions). It is important to stress the role of bank capital as a macroprudential tool to tame the lending cycle or, more realistically, to protect from the consequences of lending busts. Our findings complement the more recent ones of Gambacorta and Shin (2016), stressing the asymmetric role bank capital plays in lending booms and busts, in line also with Saurina and Shin (2012), Berger and Bouwman (2013) and Demirgüç-Kunt et al. (2013).

Finally, we have provided, apparently for the first time, a long time series of the aggregate capital ratio of the Spanish banking sector, spanning close to one century and a half. This time-series of the ratio of capital over total assets will certainly be improved along time by academic specialists. Our objective here is mainly to spur the debate on this data so that we can attract research interest on a crucial variable to understand past and future systemic banking crisis. The fact that there are no thorough analysis of this data strikes us. A serious effort should be devoted to improve historical banking sector databases, so that we can ask crucial questions such as how the implementation of a deposit guarantee scheme soon after the return of democracy to Spain may have changed the leverage and the behavior of banks and depositors; or the interplay between degree of competition in the banking market and incentives of banks to take risk, to protect its franchise with more capital and, in the end, to ask for the role bank competition plays in financial stability. These are only two questions of the myriad that could be addressed with much more confidence if we had proper databases on bank capital, at both aggregate and bank level.



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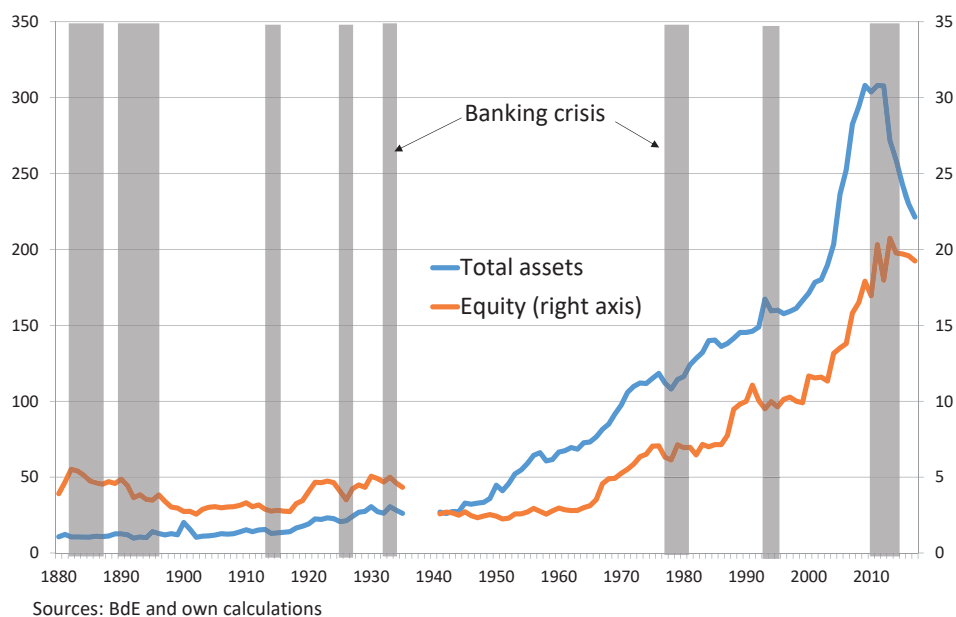
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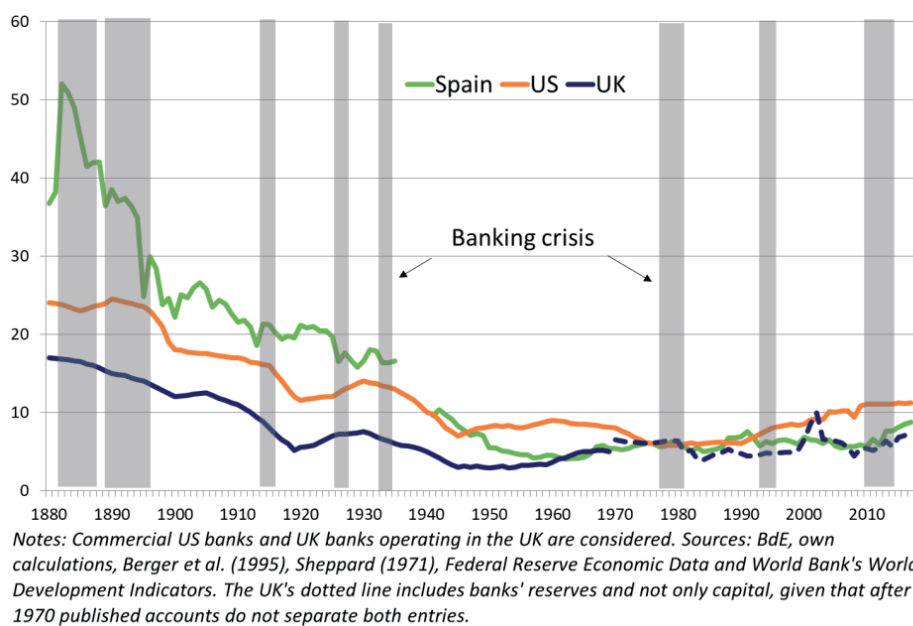
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## Tables and Figures

**Figure 1. Total Assets and Equity over GDP. 1880-2017**

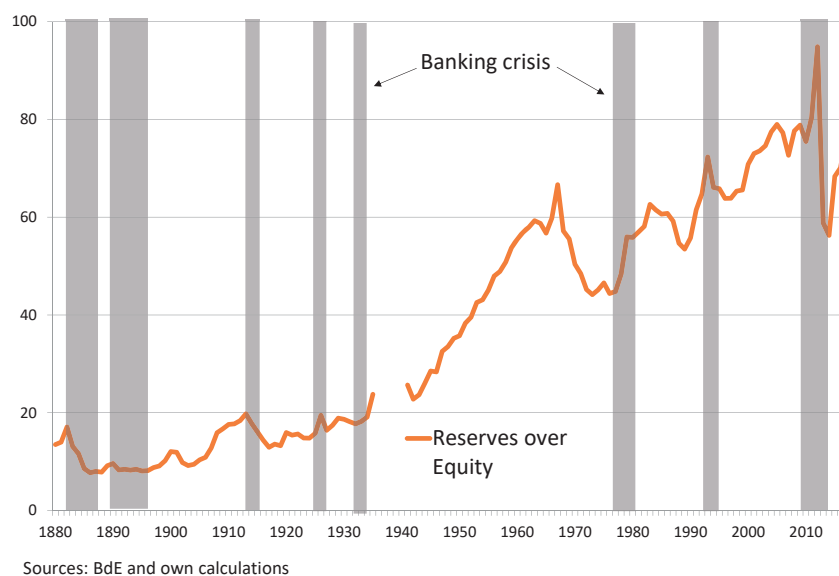


**Figure 2. Equity over total assets. 1880-2017**

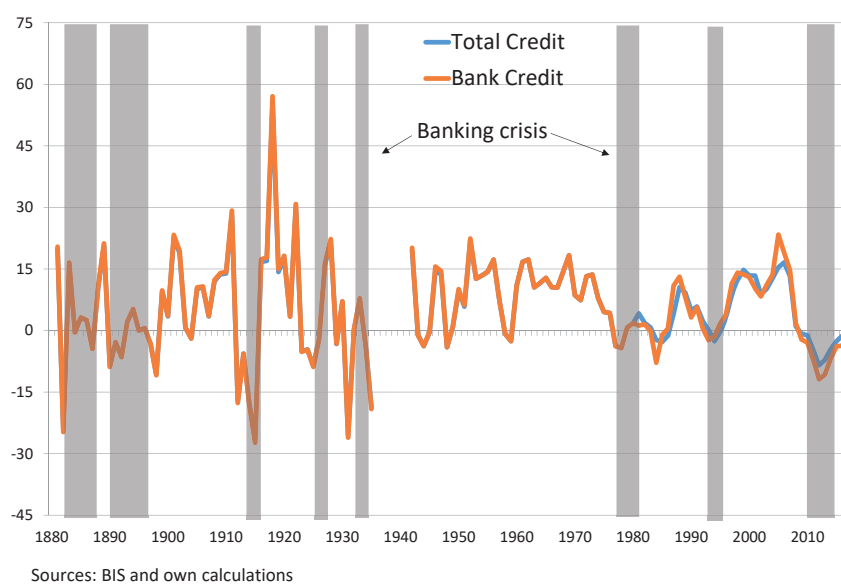




**Figure 3. Equity composition. 1880-2017**



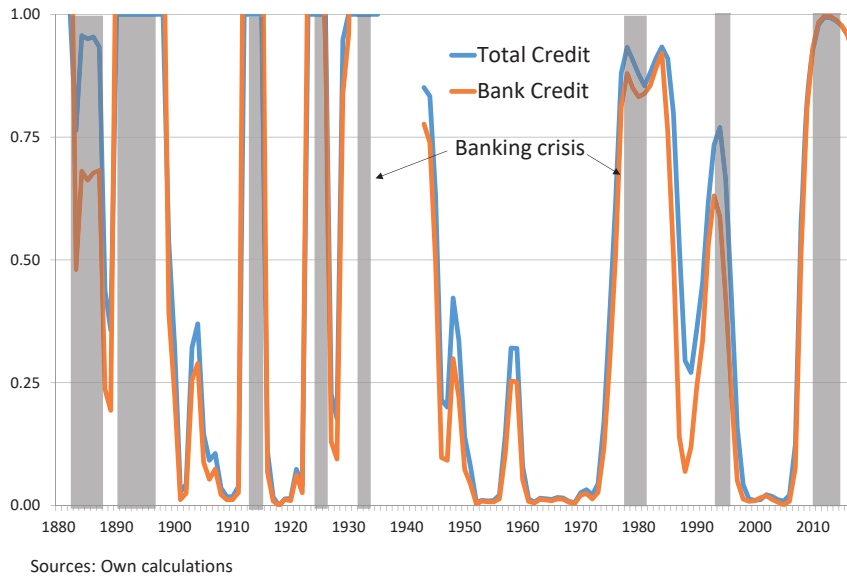
**Figure 4. Real growth of credit to the non-financial private sector. 1880-2017**



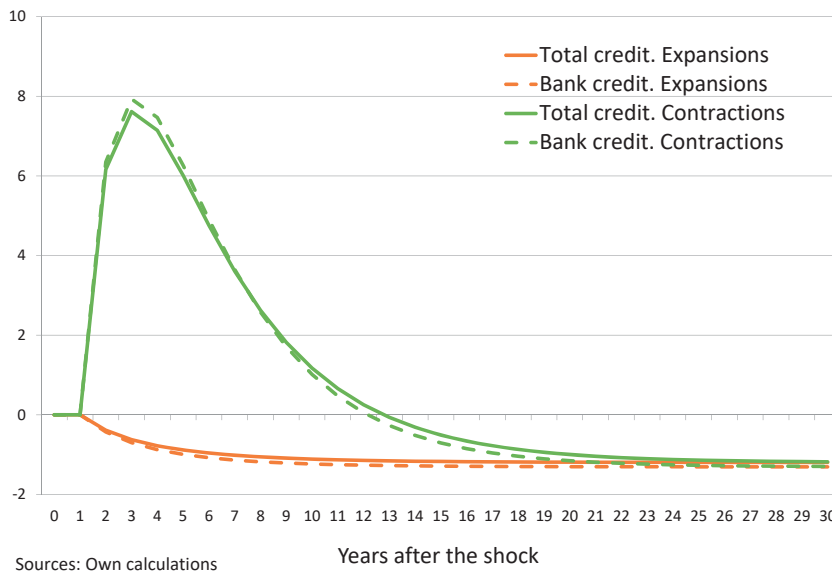
**Table accompanying Figure 4: Descriptive statistics of total and bank credit growth**

	Pre Civil War period 1880-1935		Post Civil War period 1942-2017		Full sample 1880-2017	
	Total credit	Bank credit	Total credit	Bank credit	Total credit	Bank credit
Mean	0.043	0.044	0.062	0.062	0.054	0.054
Std. Dev.	0.149	0.153	0.075	0.084	0.112	0.118

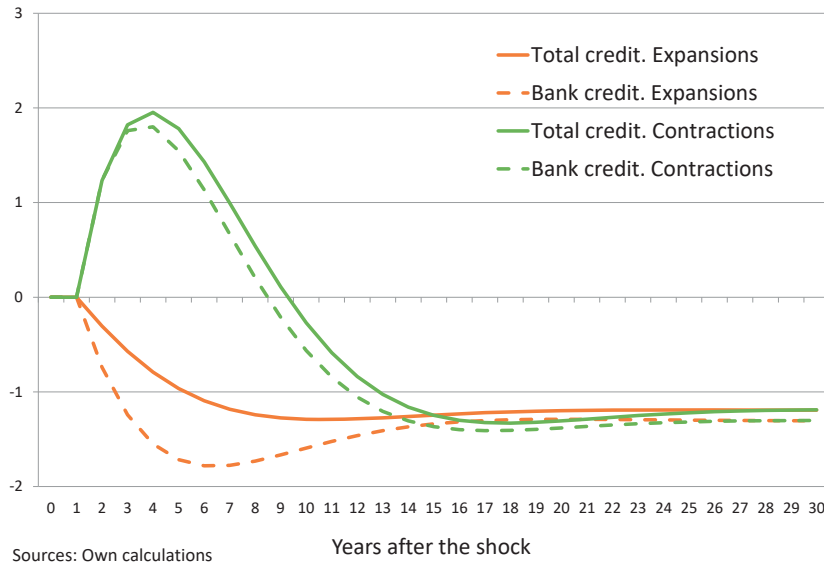
**Figure 5. Systemic banking crisis and probability of being in the low credit growth state. 1880-2017**



**Figure 6. Credit growth dynamic multipliers of the equity ratio. 1880-2017**



**Figure 7. Credit growth dynamic multipliers of the equity ratio. 1952-2017**



**Table 1. Linear credit equation. 1880-2017**

	Total credit				Bank credit			
	(1)		(2)		(3)		(4)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
<b>Constant</b>	0.014 (0.013)	0.017 (0.014)	-	-	0.013 (0.014)	0.016 (0.015)	-	-
<b>Crisis periods</b>	-	-	-0.013 (0.023)	-0.033 (0.023)	-	-	-0.014 (0.024)	-0.034 (0.024)
<b>Tranquil periods</b>	-	-	0.021 (0.017)	0.033* (0.018)	-	-	0.019 (0.018)	0.031* (0.018)
<b>Credit growth [-1]</b>	0.280*** (0.079)	0.277*** (0.086)	0.246*** (0.092)	0.208** (0.097)	0.289*** (0.079)	0.282*** (0.086)	0.257*** (0.091)	0.216** (0.097)
<b>GDP growth</b>	0.666*** (0.247)	0.610* (0.359)	0.634** (0.257)	0.545 (0.363)	0.708*** (0.257)	0.646* (0.375)	0.635** (0.267)	0.582 (0.378)
<b>Equity ratio change [-2]</b>	0.035 (0.399)	0.096 (0.419)	-	-	0.014 (0.416)	0.077 (0.436)	-	-
<b>Crisis periods* Equity ratio change [-2]</b>	-	-	0.250 (0.527)	0.18 (0.549)	-	-	0.234 (0.547)	0.304 (0.570)
<b>Tranquil periods* Equity ratio change [-2]</b>	-	-	-0.196 (0.625)	-0.066 (0.652)	-	-	-0.233 (0.648)	-0.109 (0.678)
<b>Real interest rate [-2]</b>	-0.103 (0.159)	-0.163 (0.167)	-0.101 (0.162)	-0.130 (0.169)	-0.109 (0.166)	-0.167 (0.175)	-0.101 (0.168)	-0.136 (0.176)
<b>Real housing price growth</b>	0.306*** (0.101)	0.310* (0.157)	0.291*** (0.106)	0.255 (0.164)	0.327*** (0.106)	0.354** (0.164)	0.313*** (0.111)	0.298* (0.171)
<b>Residuals of the cointegrating vector [-1]</b>	-0.144*** (0.040)	-0.155*** (0.042)	-0.137*** (0.041)	-0.138*** (0.044)	-0.137*** (0.039)	-0.151*** (0.041)	-0.130*** (0.040)	-0.135*** (0.043)
Adjusted R <sup>2</sup>	0.286	0.215	0.276	0.215	0.301	0.231	0.293	0.233
Standard deviation	0.088	0.092	0.089	0.093	0.092	0.096	0.092	0.096
Durbin-Watson	1.868	1.912	1.854	1.865	1.867	1.907	1.850	1.857

Notes: between parenthesis: standard deviation; between brackets: lags of the variable; \*, \*\*, \*\*\*, statistically significant at 10%, 5% and 1%, respectively. Both GDP and housing price growth were instrumented using their own lags and those of credit and interest rate plus contemporaneous world GDP growth.

**Table 2. Markov-switching model for credit growth. 1880-2017**

	Total Credit				Bank Credit			
	(1)		(2)		(3)		(4)	
	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.
<b>Constant</b>	-0.225*** (0.045)	-0.234*** (0.047)	-0.024 (0.024)	-0.029 (0.029)	-0.236*** (0.048)	-0.245*** (0.051)	-0.024 (0.022)	-0.028 (0.027)
	0.024** (0.011)	0.028** (0.013)	0.017 (0.011)	0.020 (0.012)	0.022* (0.012)	0.025* (0.014)	0.015 (0.011)	0.018 (0.012)
<b>Credit growth [-1]</b>	0.256*** (0.071)	0.249*** (0.080)	0.376*** (0.078)	0.373*** (0.085)	0.273*** (0.071)	0.262*** (0.080)	0.394*** (0.071)	0.390*** (0.078)
<b>GDP growth</b>	0.492** (0.240)	0.363 (0.334)	0.545*** (0.201)	0.483* (0.292)	0.517** (0.246)	0.382 (0.350)	0.582*** (0.199)	0.590* (0.291)
<b>Equity ratio change [-2]</b>	-0.051 (0.406)	-0.125 (0.386)	11.994*** (1.566)	12.597*** (1.653)	-0.106 (0.410)	-0.161 (0.399)	12.365*** (1.521)	13.005*** (1.626)
			-0.545 (0.334)	-0.497 (0.349)			-0.602* (0.328)	-0.551 (0.344)
<b>Real interest rate [-2]</b>	-0.013 (0.151)	-0.050 (0.160)	-0.030 (0.142)	-0.048 (0.154)	0.018 (0.154)	-0.063 (0.167)	-0.037 (0.139)	-0.062 (0.150)
<b>Real housing price growth</b>	0.308*** (0.098)	0.325** (0.150)	0.217** (0.085)	0.200 (0.130)	0.336*** (0.099)	0.376** (0.159)	0.235*** (0.086)	0.230* (0.130)
<b>Residuals of the cointegrating vector [-1]</b>	-0.128*** (0.036)	-0.132*** (0.038)	-0.111*** (0.035)	-0.115*** (0.037)	-0.123*** (0.035)	-0.131*** (0.037)	-0.109*** (0.032)	-0.117*** (0.034)
<b>Log(sigma)</b>	-2.626*** (0.075)	-2.578*** (0.075)	-2.711*** (0.069)	-2.665*** (0.070)	-	2.5579*** (0.072)	-2.530*** (0.075)	-2.673*** (0.066)
<i>Probability of remaining in state 1</i>	0.222	0.239	0.743	0.727	0.223	0.233	0.745	0.723
<i>Probability of remaining in state 2</i>	0.971	0.970	0.940	0.942	0.972	0.972	0.937	0.938
<i>Expected duration of state 1</i>	1.29	1.31	3.89	3.66	1.29	1.30	3.93	3.61
<i>Expected duration of state 2</i>	33.99	33.85	16.786	17.36	35.80	35.44	15.77	16.04
Standard deviation	0.089	0.094	0.142	0.146	0.093	0.098	0.147	0.151
Log-likelihood	137.521	131.442	147.287	141.313	132.073	126.022	142.269	136.112
Durbin-Watson stat.	1.922	1.941	2.347	2.312	1.924	1.940	2.356	2.323

Notes: See previous table. When there is a split of a variable in two rows, the values of the first row parameters pertain to the low credit growth episode (numbers in cursive) while the values of the second row pertain to the high credit growth episode.

**Table 3. Markov-switching model for credit growth. Robustness analysis (1)**

Sample Period	Total Credit				Bank Credit			
	1898-2017		1880-1998		1898-2017		1880-1998	
	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.
Constant	-0.047 (0.043)	-0.062 (0.045)	-0.011 (0.026)	-0.003 (0.032)	-0.038 (0.024)	-0.054* (0.032)	-0.012 (0.025)	-0.029 (0.035)
	0.011 (0.008)	0.013 (0.010)	0.023* (0.014)	0.030** (0.015)	0.010 (0.011)	0.011 (0.012)	0.024* (0.014)	0.029* (0.015)
Credit growth [-1]	0.384*** (0.084)	0.376*** (0.091)	0.297*** (0.080)	0.282*** (0.085)	0.404*** (0.068)	0.396*** (0.074)	0.290*** (0.075)	0.328*** (0.100)
GDP growth	0.678*** (0.221)	0.622* (0.321)	0.629*** (0.229)	0.487* (0.291)	0.737*** (0.216)	0.653** (0.307)	0.665*** (0.217)	0.455 (0.285)
Equity ratio change [-2]	11.585*** (1.363)	12.207*** (1.540)	13.588*** (2.265)	15.207*** (2.614)	11.793*** (1.429)	12.516*** (1.495)	13.991*** (2.154)	12.863*** (1.836)
	-1.568 (1.049)	-1.536 (1.094)	-0.347 (0.351)	-0.294 (0.365)	-1.796** (0.759)	-1.713** (0.780)	-0.356 (0.341)	-0.423 (0.382)
Real interest rate [-2]	0.121 (0.189)	0.150 (0.190)	-0.037 (0.153)	-0.089 (0.166)	0.077 (0.151)	0.110 (0.165)	-0.043 (0.149)	-0.074 (0.175)
Real housing price growth	0.150** (0.068)	0.134 (0.091)	0.251** (0.101)	0.258* (0.148)	0.169** (0.081)	0.166 (0.124)	0.263*** (0.099)	0.230 (0.148)
Residuals of the cointegrating vector [-1]	-0.104** (0.046)	-0.107** (0.044)	-0.160*** (0.045)	-0.161*** (0.049)	-0.109*** (0.032)	-0.115*** (0.035)	-0.157*** (0.041)	-0.114** (0.045)
Log(sigma)	-2.798*** (0.142)	-2.753*** (0.134)	-2.659*** (0.077)	-2.614*** (0.079)	-2.754*** (0.070)	-2.701*** (0.070)	-2.629*** (0.073)	-2.572*** (0.074)
Probability of remaining in state 1	0.763	0.766	0.679	0.552	0.752	0.750	0.684	0.723
Probability of remaining in state 2	0.950	0.958	0.922	0.904	0.935	0.950	0.921	0.933
Expected duration of state 1	4.22	4.27	3.12	2.23	4.03	4.00	3.17	3.62
Expected duration of state 2	20.20	23.68	12.84	10.41	15.47	19.90	12.60	14.96
Standard deviation	0.082	0.086	0.154	0.149	0.085	0.090	0.159	0.156
Log-likelihood	138.127	132.519	119.521	112.383	131.927	125.962	114.943	109.216
Durbin-Watson stat.	2.132	2.093	2.300	2.249	2.134	2.102	2.302	2.305

Notes: see previous table.

**Table 4. Markov-switching model for credit growth. Robustness analysis (2)**

Sample Period	Total Credit				Bank Credit			
	1880-1935		1952-2017		1880-1935		1952-2017	
	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.
Constant	-0.008 (0.066)	-0.038 (0.054)	-0.013 (0.015)	-0.012 (0.016)	-0.009 (0.067)	-0.039 (0.055)	-0.020* (0.011)	-0.016 (0.017)
	0.072** (0.044)	0.078** (0.040)	0.015 (0.023)	0.002 (0.014)	0.074 (0.046)	0.080** (0.041)	0.012 (0.010)	0.005 (0.016)
Credit growth [-1]	0.246* (0.149)	0.215 (0.132)	0.490*** (0.140)	0.637*** (0.127)	0.248* (0.150)	0.216* (0.131)	0.486*** (0.076)	0.607*** (0.137)
GDP growth	0.773 (0.497)	0.799 (0.512)	0.809*** (0.248)	0.814** (0.396)	0.801 (0.510)	0.830 (0.524)	0.972*** (0.209)	0.816* (0.448)
Equity ratio change [-2]	11.632** (5.903)	8.993*** (3.294)	1.481 (2.173)	2.660** (1.252)	11.893* (6.105)	9.275*** (3.351)	4.020 (3.796)	2.710* (1.313)
	-0.599 (0.505)	-0.416 (0.498)	0.393 (1.519)	-0.417 (1.517)	-0.516 (0.517)	-0.430 (0.510)	-0.289 (0.990)	-1.247 (2.555)
Real interest rate [-2]	-0.514 (0.427)	-0.461 (0.381)	-0.331** (0.163)	-0.168 (0.159)	-0.532 (0.440)	-0.479 (0.390)	-0.500*** (0.170)	-0.197 (0.189)
Real housing price growth	0.660* (0.339)	0.468 (0.343)	0.138** (0.068)	-0.006 (0.159)	0.672* (0.373)	0.473 (0.346)	0.175*** (0.058)	0.049 (0.192)
Residuals of the cointegrating vector [-1]	-0.224** (0.103)	-0.218** (0.087)	-0.092 (0.083)	-0.081** (0.041)	-0.223** (0.102)	-0.218** (0.086)	-0.086*** (0.030)	-0.090** (0.043)
Log(sigma)	-2.390*** (0.134)	-2.390*** (0.121)	-3.619*** (0.174)	-3.421*** (0.114)	-2.365*** (0.134)	-2.366*** (0.120)	-3.504*** (0.104)	-3.312*** (0.131)
Probability of remaining in state 1	0.565	0.813	0.924	0.887	0.569	0.814	0.976	0.854
Probability of remaining in state 2	0.918	0.947	0.967	0.924	0.918	0.948	0.909	0.958
Expected duration of state 1	2.30	5.35	13.07	8.62	2.32	5.39	41.89	6.66
Expected duration of state 2	12.14	19.22	29.87	12.68	12.14	19.26	11.02	23.72
Standard deviation	0.153	0.134	0.031	0.036	0.157	0.137	0.035	0.041
Log-likelihood	42.939	42.934	138.516	128.155	41.602	41.626	129.364	118.713
Durbin-Watson stat.	2.136	2.070	1.572	1.468	2.140	2.074	1.655	1.496

Notes: see previous tables.

## Appendix 1. Data Sources

Given the long period of time analyzed in the paper, we have had to use several databases. These databases are not always compatible among them and cover different time periods. In what follows we explain how we have handled the data and identify its sources.

We obtain Spanish macroeconomic information from a publicly available database owned and managed by Banco de España. We also obtain aggregated balance sheet information for the financial entities located and operating in Spain from a publicly accessible database of Banco de España, and we focus on commercial and savings banks. Data about banks' statistics is provided at a monthly basis since 1962. We uniquely employ the values regarding December of each year and the last year we consider for computational purposes is 2017.

Due to data constraints about banks' balance sheet information prior to 1962, data regarding that time period is not as disaggregated as the data available after 1962. Thus, we aggregate balance sheets' items from 1962 on in order to create a simplified or reduced balance sheet consistent with the balance sheets' entries prior to 1962. This way, as it is mentioned in the main text, the balance sheet entries we end up with using for the entire time period under consideration are the following: total assets and liabilities, total credit awarded to the private and public sector, deposits and capital and reserves. The last two items we group them for the purpose of the paper under the term equity.

Unfortunately, as we go back in time, it is not possible to disentangle credit to private and public sectors although, as we argue in the paper, that is not a significant drawback for the purposes of our research.

Banks' balance sheet information before 1962 is obtained from several Statistical Bulletins of Banco de España and from Bank Bulletins of the Spanish Banking Association, where the Spanish economy's aggregate financial information is provided up to 1925. This information is available uniquely in hard paper and it is manually digitalized by the authors.

Besides, in order to maximize the time length of available information, we use two books which provide Spanish banks' balance sheet information back until 1856. However, given that the Banco de España obtained the monopoly of currency issuance in 1874, we focus our



study from 1880 till 2017. That is, we exclude the relatively short period of time (e.g. less than a quarter of a century) where several banks had the privilege to issue currency, which may have a totally different impact in the incentives the banks had to raise equity and in the relationship between equity and credit provided to customers.

The first book, entitled "Estadísticas históricas de España volumen II, siglos XIX-XX" by Albert Carreras and Xavier Tafunell (2005), provides Spanish financial institutions' main balance sheet entries from the year 1856 until 2000, in an annual basis, excluding the information for the period concerning the Spanish Civil War (information not available from 1936 to 1941).

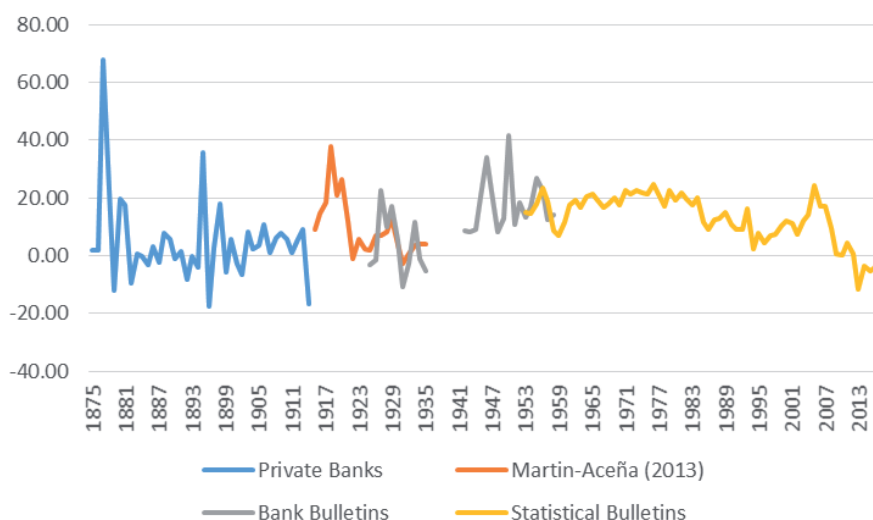
The second book we employ is entitled "La banca española en la Restauración II, datos para una historia económica", published by the research department of Banco de España in 1974, and it provides Spanish most important private banks' balance sheet information between 1874 and 1914. This source does not provide aggregated statistics about the Spanish overall banking system, but it does provide Spanish most important banks' balance sheet information, aggregated by regions. During the time covered by the book, the most important private commercial banks were headquartered in Madrid, Catalonia and the Basque Country, so the book provides the aggregated balance sheets of the entities located in those regions. We sum up all available banks' balance sheet entries' information to end up with all the Spanish most important private banks' balance sheet information.

As it is explained in the main text, the aggregate balance sheets of these different databases are not exactly the same, so we had to link them using a purely statistical approach. We assume that the higher the aggregation level of the balance sheet the higher the precision of the information. Thus we enlarged backwards total assets from the most recent database using the corresponding growth rates of the older databases. In the case of the different items on the balance sheet, we use the older databases growth rates but we introduced an adjustment in the different assets and liabilities entries to guarantee that they added up.

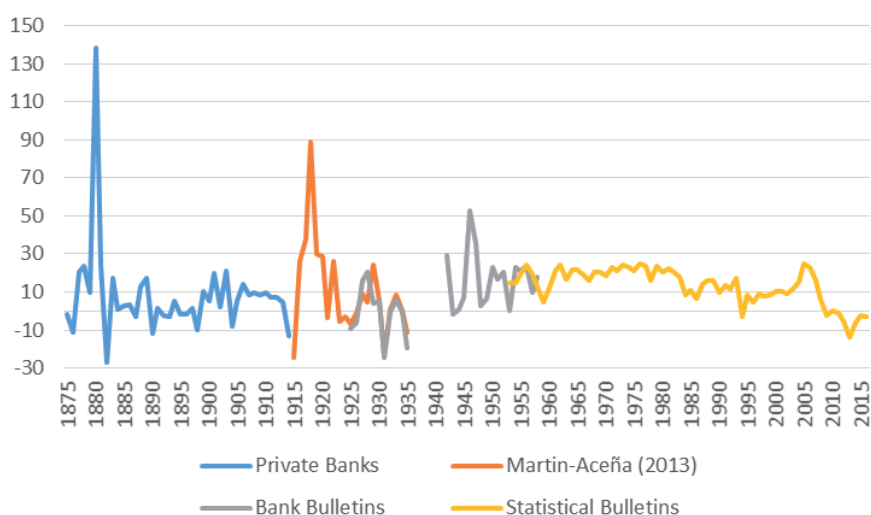
Therefore, to assess the validity of this approach, it is necessary to check if the growth rates of the different databases in the common years are similar. We do that for the most relevant items in Figures A.1.1 to A.1.3 (the rest are available upon request). Both in the case of total

assets and credit there seems to be a high coherence between the first three databases, not being possible to evaluate the fourth one due to the lack of a common sample. In the case of the equity ratio, the main discrepancy appears to be in the Martín-Aceña time series, although this is probably a consequence of not including the reserves in the equity.

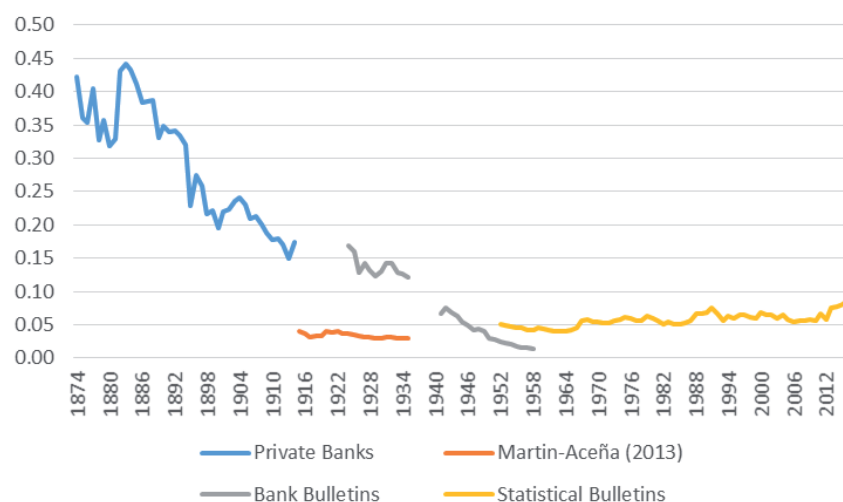
**Figure A.1.1. Annual variation rate of total assets, by source**



**Figure A.1.2. Annual variation rate of total credit, by source**



**Figure A.1.3. Evolution of the equity ratio, by source**



We also use the growth rates exposed in the book by Carreras and Tafunell (2005) to backtrack the Spanish GDP, inflation (CPI), the nominal interest rate (corresponding to public debt instruments), the housing price (using the evolution of prices implicit in the property register statistics), general government balance, number of houses built (this variable is crucial to construct an indicator of the stock of houses in Spain for the entire period we consider, combining it with Census data) and population. The most modern part of these statistics is obtained from the publicly available database at the Banco de España. Finally, the time series of total and bank credit to the non-financial sector is backtracked using the regression coefficients in the common period with our series of total credit described before (the  $R^2$  of these regressions was 0.94).

Even if the majority of the information is directly available in pesetas, we convert all values to euros according to the official exchange rate (1 euro = 166.386 pesetas) and work with values expressed in thousands of euros. The loss of precision for doing so is minimal and thus it is disregarded.

## Appendix 2. Unit roots, cointegration tests and instrument validity

The first part of this appendix presents the results obtained from the traditional unit root tests (Augmented Dickey-Fuller, ADF) applied to the seven variables considered in this paper. This is a crucial step to decide the number of differences that every variable requires in order to be considered stationary. As it can be seen in Table A.2.1, all the variables apart from the real interest rate seem to be integrated of first order. That is, it is the first difference transformation what makes them become stationary. The level of the real interest rate is stationary, provided that both nominal interest rate and inflation are integrated of first order and they conform a cointegration vector with a -1 coefficient.

**Table A.2.1. Unit root tests. 1880-2017**

	H0: First difference of the variable has an unit root			H0: The level of the variable has an unit root		
	ADF	Critical Value (1%)	P-value	ADF	Critical Value (1%)	P-value
<b>Equity ratio</b>	-12.416	-2.583	0.000	-1.948	-3.482	0.310
<b>Log of total credit to the private non-financial sector</b>	-8.351	-3.482	0.000	-2.749	-4.031	0.219
<b>Log of bank credit to the private non-financial sector</b>	-8.053	-3.482	0.000	-2.769	-4.031	0.212
<b>Log of GDP</b>	-8.811	-3.479	0.000	-1.970	-4.027	0.612
<b>Nominal interest rate</b>	-12.106	-2.583	0.000	-0.853	-2.583	0.345
<b>Inflation</b>	-13.715	-2.582	0.000	-2.437	-3.481	0.134
<b>Real interest rate</b>	-13.292	-2.583	0.000	-6.536	-3.481	0.000
<b>Log of real housing price</b>	-5.910	-3.480	0.000	-2.493	-4.027	0.331

ADF: Augmented Dickey-Fuller test

Therefore, we now check if there exists at least a cointegrating vector among each credit definition and GDP, real housing price and the equity ratio. As it can be seen in the first two columns of Table A.2.2, in the case of total credit, the GDP and the relative housing prices, they are not enough to conform a cointegrating vector (jointly with the real interest rate, which is a stationary variable). In fact, housing prices enter with an unexpected negative sign although they are not statistically significant, while the GDP is positively signed and very significant. Its elasticity is higher than the unity, which captures the how the progressive development of Spanish economy and its financial sector has implied an upward trend to higher indebtedness already pointed out in Figure 1. In column (3), when we also consider the equity ratio, its coefficient is negative and statistically significant, thus implying that, by

increasing this ratio, a moderation in indebtedness should be expected. In this specification neither the real interest rate nor the real housing price are statistically significant. In the case of the housing price, it should be taken into account that credit to households represents less than 50% of total credit in the period when we have that disaggregation. Previously, as banks were basically focused on lending to firms, funding their investments behind the economic development of the country, that percentage must have been much lower, not to mention the fact that income and wealth were much lower for ample segments of the population which prevented the development of household banking products, in particular of the asset side of the bank balance sheet (i.e. credit). In the case of the real interest rate, the reduction of the coefficient in absolute value means that the equity ratio, apart from balance sheet effects, is also capturing the cost of lending channel, as nominal interest rates were fixed by the authorities for most of the period considered.

Once we get rid of the non-significant variables in this regression by not including them in the regression shown in column (4), a kind of cointegration relation is found.

**Table A.2.2. Cointegration tests (FMLS). 1880-2017**

	Total credit				Bank credit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Constant</b>	8.085*** (0.263)	7.103*** (1.671)	8.071*** (1.231)	9.281*** (0.292)	7.552*** (0.284)	6.720*** (1.807)	7.769*** (1.331)	8.851*** (0.315)
<b>Log of GDP</b>	1.921*** (0.046)	2.068*** (0.248)	1.931*** (0.183)	1.751*** (0.047)	1.951*** (0.049)	2.076*** (0.269)	1.927*** (0.198)	1.766*** (0.052)
<b>Real interest rate</b>	-1.676* (0.983)	-1.640 (1.011)	-0.170 (0.761)	-	-1.870* (1.061)	-1.766 (1.093)	-0.171 (0.823)	-
<b>Log of real housing price</b>	-	-0.072 (0.123)	-0.087 (0.092)	-	-	-0.061 (0.133)	-0.076 (0.100)	-
<b>Equity ratio</b>	-	-	-2.333*** (0.430)	-2.390*** (0.423)	-	-	-2.535*** (0.465)	-2.611*** (0.455)
Adjusted R <sup>2</sup>	0.983	0.983	0.991	0.991	0.981	0.981	0.990	0.990
<b>E-G tau-statistic</b>	-2.673 [0.400]	-2.640 [0.609]	-3.568 [0.312]	-3.571 [0.086]	-2.532 [0.472]	-2.495 [0.680]	-3.500 [0.343]	-3.509 [0.098]
<b>E-G z-statistic</b>	-13.623 [0.375]	-12.979 [0.621]	-27.557 [0.165]	-27.424 [0.031]	-12.645 [0.429]	-11.864 [0.685]	-26.631 [0.189]	-26.698 [0.036]
t-ECM	-0.104 [0.009]	-0.0911 [0.009]	-0.167 [0.001]	-0.165 [0.001]	-0.0971 [0.013]	-0.091 [0.014]	-0.158 [0.001]	-0.158 [0.001]

Between parenthesis: standard deviation; between brackets: p-value; \*, \*\*, \*\*\*, statistically significant at 10%, 5% and 1%, respectively.

We have repeated this exercise for bank credit, and given the similarity between both definitions of credit, it is not surprising that the results are qualitatively and quantitatively very similar (columns 5 to 8). Again, it is necessary to add the equity ratio to the regression

of credit over GDP to obtain a cointegration relation and neither the real interest rate nor the relative housing price seem to be statistically significant.

Finally, we present in this section the econometric results that we obtain in the first stage of the two stage least squares (2SLS) procedure that we applied in some of the regressions. As we said in the main text, the two variables that can be considered endogenous are the contemporaneous growth of GDP and real housing prices. In the first case, it is well established both theoretically and empirically that credit conditions are very relevant to determine not only private consumption and investment but also external trade, influencing therefore private demand and GDP in the short term. In the second case, the interrelation run through housing investment and thus on prices for a given stock of houses that changes very slowly.

**Table A.2.3. First stage 2SLS procedure. 1880-2017**

	GDP growth	Real housing price growth
<b>Constant</b>	0.007** (0.003)	0.005 (0.008)
<b>World GDP growth</b>	0.477*** (0.0719)	.
<b>Tourist entrances growth [-1]</b>	0.036*** (0.011)	-
<b>Fiscal impulse</b>	-0.991*** (0.128)	-
<b>Housing stock (-1)</b>	-	-5.916** (2.291)
<b>Housing stock (-2)</b>	-	6.134*** (2.318)
<b>GDP growth [-1]</b>	-	0.347** (0.144)
<b>Real housing price growth [-1]</b>	0.117*** (0.023)	0.632*** (0.064)
<b>Inflation [-1]</b>	0.092* (0.048)	-
<b>Inflation [-2]</b>	-0.114** (0.048)	-
Adjusted R <sup>2</sup>	0.548	0.523
Standard deviation	0.023	0.064

Between parenthesis: standard deviation; \*, \*\*, \*\*\*, statistically significant at 10%, 5% and 1%, respectively.

Given the time span of this study, it is very difficult to get appropriate instruments for these two variables. However, we are able to construct several variables capturing exogenous demand pressures which are adequate to instrument GDP growth in a credit growth regression. In the external front we consider a world GDP by weighting the GDP growth of US, UK, France and Italy; and we also use tourist entrances. In the domestic front, the fiscal impulse is constructed from a structural public balance calculated by cleaning the public

balance from the effect of the output gap (obtained applying an HP filter on GDP); notice that a positive value implies a negative demand shock. These variables and its first lags plus the first and second lags of GDP growth, real housing prices growth and inflation constituted the instruments used in Table A.2.3 for GDP. As can be seen, retaining only the variables that were statistically significant, it seems that both the external and the domestic demand shocks are significant and have the expected sign; besides, lagged real housing prices growth, and inflation are also relevant. For the real housing price, we consider an additional instrument: the per capita housing stock, which should capture supply side effects in the residential market. In this case, the best predictors are lagged GDP growth, real housing price growth and two lags of the changes in the per capita housing stocks. Although in both regressions the  $R^2$  is quite high -taking into account the long period considered-, we always present the 2SLS results jointly with those of OLS to assess the impact of endogeneity.



### Appendix 3. The role of the equity ratio using other stationary transformation

An additional robustness check of the results consists on considering a different stationary transformation of the equity ratio and repeat the non-linear regressions presented in the main text. In particular, we eliminate the non-stationary part of the equity ratio by calculating its deviation from a Band-Pass filter. This filter is commonly used in economy to obtain the trend and, therefore, the non-stationary part of any variable. That trend is calculated by doing symmetric centered moving averages of the observed variable, with a length span of between 2 and 8 years. Obviously, the interpretation of the equity ratio parameter is different, as it reflects whether the equity ratio is above (positive) or below (negative) the trend level, instead of the increase/decrease of the equity ratio that we have included in the main text. Table A.3.1 shows that the results are qualitatively the same and our main result with respect to the asymmetry of the equity ratio during credit booms and busts is retained.

**Table A.3.1. Markov-switching model for credit growth. 1880-2017**

	Total Credit				Bank Credit			
	(1)		(2)		(3)		(4)	
	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.	Non-Instrum.	Instrum.
<b>Constant</b>	-0.252*** (0.041)	-0.241*** (0.043)	-0.051* (0.030)	-0.101** (0.048)	-0.265*** (0.043)	-0.250** (0.046)	-0.048 (0.031)	-0.096** (0.047)
	0.018* (0.011)	0.021* (0.012)	0.024 (0.013)	0.027** (0.013)	0.016 (0.012)	0.019 (0.012)	0.021 (0.013)	0.024* (0.013)
<b>Credit growth [-1]</b>	0.292*** (0.071)	0.314*** (0.078)	0.263*** (0.077)	0.256*** (0.077)	0.310*** (0.070)	0.330*** (0.078)	0.286*** (0.076)	0.273** (0.074)
<b>GDP growth</b>	0.457** (0.245)	0.307 (0.322)	0.541** (0.220)	0.379 (0.314)	0.475* (0.247)	0.324 (0.339)	0.575*** (0.218)	0.412 (0.311)
<b>Cyclical component of the equity ratio [-2]</b>	-0.447** (0.188)	-0.515*** (0.194)	10.204*** (2.021)	12.922*** (4.107)	-0.482** (0.196)	-0.552*** (0.203)	10.738*** (2.060)	13.816*** (4.011)
			-0.459** (0.192)	-0.493** (0.193)			-0.499*** (0.192)	-0.532*** (0.192)
<b>Real interest rate [-2]</b>	0.072 (0.138)	0.064 (0.142)	0.010 (0.141)	-0.034 (0.151)	0.071 (0.142)	0.061 (0.151)	0.003 (0.142)	-0.037 (0.148)
<b>Real housing price growth</b>	0.282*** (0.102)	0.262* (0.138)	0.304*** (0.094)	0.325** (0.140)	0.310*** (0.100)	0.304*** (0.147)	0.324*** (0.095)	0.367*** (0.140)
<b>Residuals of the cointegrating vector [-1]</b>	-0.132*** (0.035)	-0.137*** (0.037)	-0.147*** (0.043)	-0.140*** (0.037)	-0.128*** (0.034)	-0.136*** (0.036)	-0.138*** (0.037)	-0.141*** (0.034)
<b>Log(sigma)</b>	-2.647*** (0.072)	-2.611*** (0.072)	-2.629*** (0.071)	-2.616*** (0.072)	-2.600*** (0.070)	-2.564*** (0.072)	-2.584*** (0.068)	-2.571*** (0.068)
<i>Probability of remaining in state 1</i>	0.213	0.222	0.779	0.655	0.213	0.217	0.751	0.639
<i>Probability of remaining in state 2</i>	0.962	0.967	0.944	0.964	0.963	0.968	0.934	0.959
<i>Expected duration of state 1</i>	1.27	1.29	4.51	2.90	1.27	1.28	4.02	2.77
<i>Expected duration of state 2</i>	26.11	30.42	17.74	27.73	27.17	31.14	15.10	24.36
Standard deviation	0.094	0.093	0.325	0.102	0.097	0.097	0.331	0.109
Log-likelihood	138.360	135.124	141.978	138.891	132.958	129.712	136.681	133.514
Durbin-Watson stat.	1.911	2.018	2.175	1.803	1.923	2.023	2.177	1.765

Notes: see previous tables

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