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Credit and business cycles' relationship: evidence from Spain

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Abstract

This study provides evidence on the interaction between business and credit cycles in Spain during the period 1970–2014. The paper works on three analyses: the cycle turning points are identified; the main features of credit and business cycles are documented; and in both cycles the causal relationship is assessed. We find differences in the features of the business and credit cycle phases, which lead to a scant degree of synchronization over time. The lack of synchronization might be a sign that the cyclic interaction could be non-contemporaneous. Our results reveal that there is causation. A significant lagged relationship between business and credit cycles is found; specifically, fluctuations of the business cycle lead fluctuations of the credit to non-financial corporations and a lag exists with respect to the fluctuations of the credit to households. We also examine episodes of credit boom and credit crunch. In the period 1970–2014, Spanish credit booms did not involve deeper business cycle contractions and credit crunches were not associated with deeper and longer business cycle contractions. These differences are related with the great importance of the real estate sector in Spain.

Key word: credit cycle, business cycle, credit, expansion, contraction, synchronization, Granger-causality.

JEL: G01, E32, O52

1. Introduction

The crisis of 2008 has reignited the interest in understanding financial fluctuations and the role that they could play in the generation and propagation of shocks to economic activity. The extent to which financial fluctuations affect the real economy has become an interesting question. In this sense, it is evident that the role of credit in the economy has changed over time.¹ Since the Second World War, credit has been growing strongly in relation to GDP as well as in relation to broad money, becoming the centre of the

¹ Schularick and Taylor (2012) summarise the historical context of business and credit cycles.

discussion.² The current crisis reaffirms the importance of credit in the output fluctuations and in the relationship between the two variables.

The purpose of this paper is to provide an empirical overview of the relationship between business and credit cycles in Spain during the period 1970–2014. The study focuses on three main goals. First, we identify the credit and business cycle phases by means of their turning points. Second, we document the main features of credit and business cycles. Finally, we examine how these characteristics of the cycles affect their interactions. A well-established methodology is used to analyse the extent of the cycles' synchronisation. As the results indicate a low degree of synchronisation, we wonder whether fluctuations of the cycles hide lags (leads) that guide their relationship. To answer this question and to study the causality in the transmission of the cycles, a cross-correlation analysis and a Granger causality test are carried out.

In studies that are closely related to ours, Claessens et al. (2009, 2011, 2012) provide an empirical overview of the linkage between business and financial cycles for a large number of OECD countries, included Spain. In our investigation, we adopt a similar methodology, but it is complemented and amplified in different ways. First, we carry out a specific study centred on Spain in which, besides the interaction between credit and business cycles, we analyse the causality in the transmission of the cycles. Second, and in relation to the database, Claessens et al. (2009, 2011, 2012) define credit as claims on the private sector by deposit money banks. As the authors recognise, it could be useful to consider alternative and broader measures of credit. Our data set gathers all the sources of lenders and, furthermore, the financial instruments include loans and debt securities. Although debt securities account for a smaller share in Spain than in market-based system economies, like the US, their importance has been increasing sufficiently to include them in the study.³ In the case of borrowers, we move beyond a credit aggregate measure because we differentiate between credit to non-financial corporations and credit to households. This approach is important in a country like Spain, where the housing bubble has been so important in the household debt.

² Schularick and Taylor (2012) show that Spain reached a state of financial catch-up in the 1870–1939 period relative to the main developed countries and achieved subsequent rapid credit growth in the pre-Second World War period. In the post-war period, both ratios increased, as in the rest of the developed countries.

³ In 1985, debt securities accounted for almost 10% of the Spanish financial assets, in 2005 they had reached 35% and with the crisis they decreased to about 19%.

We seek to contribute to the debate from an empirical perspective in the following ways. First, given that no work has been undertaken to analyse the credit–GDP links in Spain, this paper aims to fill this gap. Second, any future line of enquiry that seeks to model the interactions between financial and economic factors in Spain will require an adequate understanding of credit cycle features, which can be provided by the results presented in this paper. Third, it is also necessary to determine the link between credit and business cycles to redirect or avoid future unwanted fluctuations. With respect to the data and methodology, we want to stress different aspects. On the one hand, we work with three different credit series, namely, total credit to the non-financial private sector, credit to non-financial corporations and credit to households. This allows us to achieve more specific and disaggregated outcomes of the relationship between business and credit cycles. On the other hand, quarterly data, rather than annual data, are used. Annual data are less suitable than quarterly data to analyse the business cycle because annual data mask short-term economic developments. Also, quarterly data supply four times as many observations, which is very helpful when techniques such as a regression analysis are used. Both disaggregations enable drawing more robust and accurate conclusions.

The overall conclusions are that there is a non-contemporaneous cyclic interaction between business and credit cycles. A significant lagged relationship between business and credit cycles is found; specifically, fluctuations of the business cycle lead to fluctuations of the credit to non-financial corporations and a lag exists with respect to the fluctuations of the credit to households. We also examine episodes of credit boom and credit crunch and find that in the period 1970–2014, Spanish credit booms did not involve deeper business cycle contractions and credit crunches were not associated with deeper and longer business cycle contractions. These differences are linked with the great importance of the real estate sector in Spain.

Our work is related to the extensive literature on the relationship between the financial sector and the real economy. We do not intend to undertake an exhaustive review, but we can mention some interesting papers in different fields. Borio et al. (1994), Detken and Smets (2004) and Goodhart and Hoffman (2008) analyse the relationships among credit, asset prices and economic activity. Jiménez et al. (2012) shed light on the effects

of monetary conditions and economic activity on the granting of loans. Borio and Lowe (2002), Alessi and Detken (2009) and Gerdesmeier et al. (2010) identify the most important indicators of financial distress. Bernanke and Gertler (1989), Kiyotaki and Moore (1997), Bernanke et al. (1999) and Hammersland and Bolstad (2011) show that, when market frictions are present, the interactions between financial variables and the real economy can be amplified through the ‘financial accelerator’. Other works forecast economic activity using financial indicators, for example Borio and Lowe (2004), English et al. (2005), Levine (2005), Hatzius et al. (2010), Ng (2011), Schularick and Taylor (2012) and Xu (2012). Whereas Jordà et al. (2011) and Reinhart and Rogoff (2011) focus on the determinants of financial crises, Laeven and Valencia (2012) show the cost of banking crises. Kalemli-Ozcan et al. (2013) identify a negative effect of banking integration on output synchronisation.⁴ The financial cycle and its relationship with the business cycle are analysed by Claessens et al. (2009, 2011, 2012), Helbling et al. (2011), Drehmann et al. (2012), Gómez-González et al. (2013), Karfakis (2013), Jordà et al. (2014), Aikman et al. (2015) and Barbone et al. (2015), among others.

The paper is organised as follows. Section 2 describes the database and explains our selection of variables. Section 3 presents the turning point and the characteristics of the business and credit cycles. We analyse the synchronisation and the causality relationship in Section 4. We conclude in Section 5 with a brief summary of the main results and a reflection on future lines of research.

2. Database

The data set used in this paper covers 44 years with a quarterly frequency. We analyse the interactions between the Spanish credit and business cycles during the period 1970-1Q/2014-4Q. We use the data from Dembiermont et al. (2013) for the credit cycle and the Instituto Nacional de Estadística (INE) for the business cycle.

With respect to the credit cycle, three characteristics define credit series: the lender, the financial instruments and the borrower (Dembiermont et al., 2013). The lending sector capture all the sources of lenders, independent of the country of origin or the type of lender: non-financial corporations, financial corporations (central banks, other domestic

⁴ As the authors acknowledge, their findings contrast with those of other studies on this subject. In this sense, the study provides an accurate review of the related literature.

depository corporations, other financial institutions), general government, households, non-profit institutions serving households, internationally active banks and other sectors around the world. The instruments are debt securities (bonds and short-term papers) and loans. The borrowers include non-financial corporations and households;⁵ we refer to the whole as the non-financial private sector. As we stated in the introduction, we analyse the cycle of both non-financial corporations and households. Therefore, the credit variables characterising the cycle are: total credit to the non-financial private sector (CT), credit to non-financial corporations (CnFC) and credit to households (CH).

GDP is the business cycle indicator. We use the GDP series 1995-1Q/2014-4Q with the base year 2008 and the GDP series 1970-1Q/1997-4Q with the base year 1986. To have a long-run quarterly series encompassing the period 1970-1Q to 2014-4Q with the base year 2008, we rescale the GDP series with the base year 1986, using the linked series from De La Fuente (2012)⁶ and the annual GDP series from the INE (1970–1997) with the base year 1986. The period 1996-1Q/1997-4Q presents data in both series (1986 and 2008 base year), so the correlation index between the rescaled quarterly series and the INE quarterly series with the base year 2008 is calculated. The correlation index reaches a value of 0.9968 and is an indicator of the goodness of the rescaled series.

All the variables are at a quarterly frequency, in real terms (deflated by the GDP deflator), in log-levels, and seasonally adjusted. The series has been detrended using the Hodrick–Prescott filter (HP). Therefore, throughout the study, the variables CT, CnFC, CH and GDP are the log-levels of the cyclical components of the samples in real terms.

3. Turning points and main features of cycles

3.1. Turning points

The pioneering work of Burns and Mitchell (1946) defines business cycles as ‘a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions,

⁵ The series data of the households include non-profit institutions serving households (NPISHs).

⁶ De la Fuente (2012) draws up a linked series of Spanish employment and GDP for the period 1955–2010.

contractions, and revivals which merge into the expansion phase of the next cycle' (p. 3); this approach is called the 'classical business cycle'.

Based on the work by Burns and Mitchell (1946), different methodologies have been proposed to characterise the business cycle. Our study is based on the 'growth cycle' definition, specifically on the 'deviation cycle'. This methodology regards the business cycle as fluctuations around a trend (Lucas 1977).⁷ The 'deviation cycle' makes the extraction of the cyclical component necessary for obtaining peaks (P) and troughs (T). As already stated, we compute the cyclical components of the variables using the HP filter.

Different methodologies are available to identify turning points. Our study is based on one of the most widely used, namely Bry and Boschan's (1971) algorithm. We work with the adaptation of Harding and Pagan (2002) for quarterly data. The authors point out that the algorithm gathers the requirements enforceable to ensure correct identification of cyclical phases. First, it makes it possible to determine a potential set of turning points. Second, the algorithm ensures that the peaks and troughs alternate. Finally, it establishes a set of rules that satisfy the previously determined criteria related to the duration and amplitude of the phases and cycles.

The software employed is known as BUSY and was developed by the European Commission (Fiorentini and Planas 2003). The procedure entails certain censoring rules:

1. A peak is defined as the highest point within the two preceding and following quarters: $y_t = \text{peak}$ if, at time t , it is the maximum between $(y_{t-2} \dots y_{t+2})$.
2. A trough is defined as the lowest point within the two preceding and following quarters: $y_t = \text{trough}$ if, at time t , it is the minimum between $(y_{t-2} \dots y_{t+2})$.
3. A peak must be followed by a trough; therefore, only completed cycles will be set.

⁷ The 'classical business cycle', on the basis of the National Bureau of Economic Research (NBER), focuses on changes in the levels of economic activity. An alternative methodology to the 'classical business cycle' is the 'growth cycle', which can be approximated by analysing the 'growth rates' or the 'deviation cycle'. Many authors recommend studying cycles by means of the 'growth cycle' and demonstrate its advantages; see for example Niemira and Klein (1994) or Diebold and Rudebusch (1999).

4. The minimum cycle length is 5 quarters. Bry and Boschan (1971) established a minimum duration of 15 months. However, as we used quarterly data, 15 months can be associated with 4 or 5 quarters, depending on the month in which a turning point occurs and the relative figures of the months in a quarter. We have calculated the turning point using 4 and 5 quarters and we have found the same results, so we will present the results based on 5 quarters.

By applying the turning-point algorithm, we obtain a set of peaks and troughs for the variables analysed. The results are presented in Table 1 and plotted in Figures 1 to 4. The GDP presents seven complete peak-to-peak cycles, CT and CnFC six and CH five.⁸

TABLE 1. Turning points

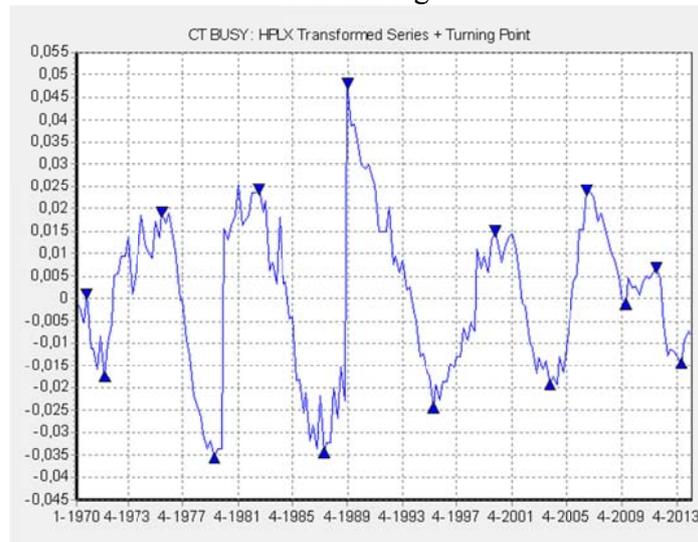
GDP		CT		CnFC		CH	
P	T	P	T	P	T	P	T
	1971-1Q	1970-4Q	1972-1Q	1970-4Q	1972-1Q	1970-4Q	1972-1Q
1973-4Q	1977-4Q	1976-2Q	1980-1Q	1976-2Q	1980-1Q	1976-2Q	1980-1Q
1980-1Q	1986-2Q	1983-2Q	1988-1Q	1983-2Q	1988-3Q	1982-4Q	1986-1Q
1991-3Q	1993-3Q	1989-4Q	1996-1Q	1989-4Q	1996-1Q	1989-4Q	1997-1Q
1995-1Q	1996-1Q	2000-3Q	2004-3Q	2001-4Q	2005-1Q	2000-2Q	2003-1Q
1997-4Q	1999-1Q	2007-2Q	2010-1Q	2007-3Q	2009-4Q	2007-2Q	2014-1Q
2001-3Q	2005-1Q	2012-2Q	2014-1Q	2012-1Q	2014-1Q		
2008-2Q	2010-2Q						
2011-4Q	2013-2Q						

Note: P = peak; T = trough

Source: BUSY

⁸ The turning points identified are robust to changes in the censoring rules. A robustness analysis can be found in the Appendix.

FIGURE 1
Peaks and Troughs CT

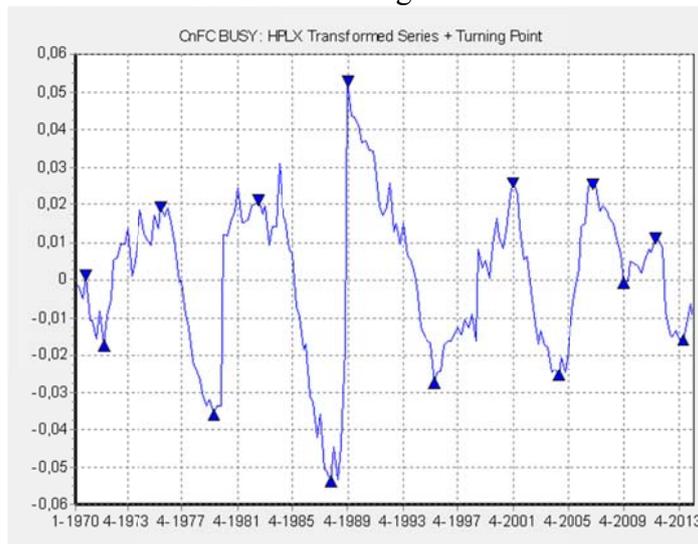


∇ Peak: the maximum (yt-2...yt+2)

Δ Trough: minimum (yt-2...yt+2)

Source: BUSY

FIGURE 2
Peaks and Troughs CnFC

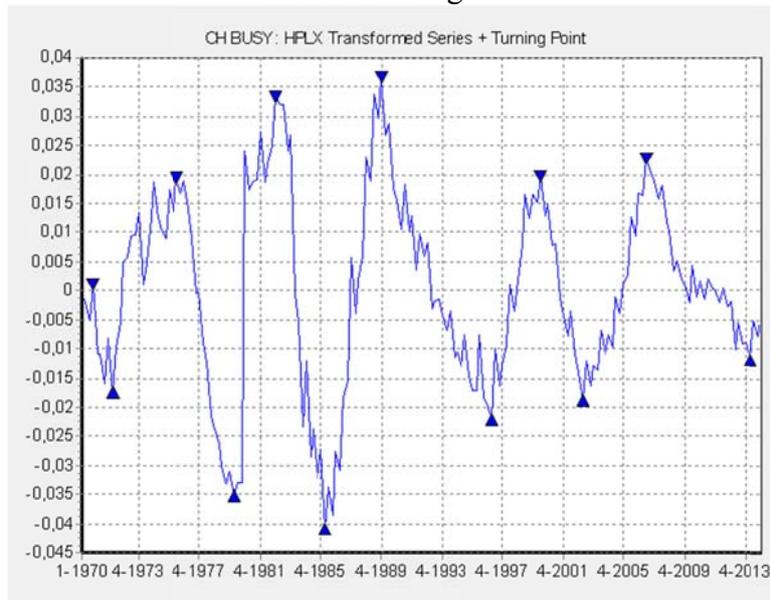


∇ Peak: the maximum (yt-2...yt+2)

Δ Trough: minimum (yt-2...yt+2)

Source: BUSY

FIGURE 3
Peaks and Troughs CH

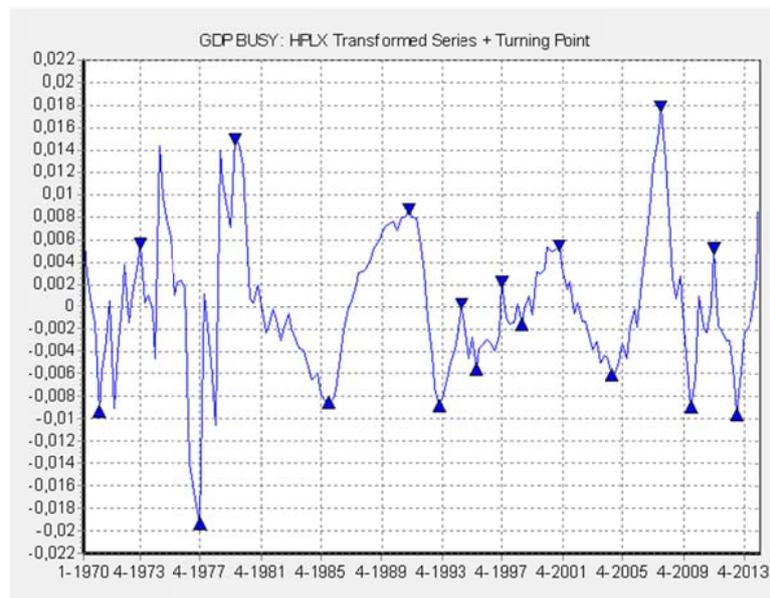


▽ Peak: the maximum (yt-2....yt+2)

△ Trough: minimum (yt-2....yt+2)

Source: BUSY

FIGURE 4
Peaks and Troughs GDP



▽ Peak: the maximum (yt-2....yt+2)

△ Trough: minimum (yt-2....yt+2)

Source: BUSY

Analysing the turning points, we can observe that the GDP turning points capture the Spanish recessions well. The energy crisis, the downturn at the beginning of the 1980s, the crisis in the 1990s and the one in 2007 are identified. Meanwhile, CT also displays

the Spanish banking crises, namely those in 1977–1985, 1993 and 2007.⁹ The crisis that took place in 1977 was the most important in the twentieth century. More than half of the banks existing in the country were affected, representing around 27% of all bank workers and 24% of bank branches (Ontiveiros and Valero 2013). In our data set, a peak was reached in 1976-2Q, which reflects the association between the CT and the 1977 financial crisis.

The 1993 financial crisis is associated with the crisis of BANESTO, one of the most important Spanish banks. The relationship between the CT phases and the financial crisis is not as clear as in the other case. However, if we consider that although the crisis emerged in 1993, it had been brewing for quite some time; we can assume that the peak detected in 1989-4Q was an exponent of the Spanish bank problems.

The CT contraction phase initiated in the second quarter of 2007 is perfectly correlated with the financial crisis. The peak was reached in 2007-2Q and shows the plight of the Spanish financial system, exacerbated by the punishment of the markets for Spanish sovereign debt.¹⁰

3.2. Main features of cycles

We analyse the cycle in terms of duration, amplitude, deepness and steepness using the analytical indicators defined below. Their choice is based on two main criteria. Firstly, they are easy to calculate and interpret, and secondly, they are the most commonly used in this field.

The number of the quarters separating peak and peak (trough and trough) is defined as the duration of the cycle. Meanwhile, the number of quarters separating the peak and the next trough (trough and peak) is defined as the contraction (expansion) duration. In terms of business cycle, the amplitude of the expansion (contraction) cycle phases approaches the gains (losses) of the production and it is calculated as the percentage change between the value of the cyclical component in the peak (trough) and the value

⁹ A review of the banking crisis in Spain during the period 1977–2012 is available in Ontiveiros and Valero (2013).

¹⁰ Peydró (2013) identifies several factors that explain the excessive credit boom and lending standards' deterioration in the Spanish real estate market before this crisis.

in the previous trough (peak). In this paper we calculate the amplitude of the GDP, CT, CnFC and CH and we focus on the average of the duration and amplitude.

The presence of asymmetries in the cycles is analysed through deepness and steepness indicators. On the one hand, if troughs (peaks) are deeper than the peaks (troughs), the distribution of the series will be asymmetrical. On the other hand, if contraction (expansion) phases have steeper slopes than the expansions (contractions), there will be asymmetry in the distribution of the first differences. To evaluate the presence of these kinds of asymmetries we follow Sichel (1993). The deepness is contrasted using the indicator $D(c)$:

$$D(c) = \left[T^{-1} \left(\sum_t (c_t - \bar{c}) \right)^3 \right] / \sigma(c)^3$$

With c_t being the cyclical component (CT, CnFC, CH and GDP in this study), \bar{c} the cyclical component average, $\sigma(c)$ the standard deviation and T the size of the sample.

As the c_t values observed are autocorrelated, we estimate $D(c)$ using the procedure suggested by Newey and West (1987) (HAC) with Bartlett weights. The variable z_t , defined below, is regressed on a constant of which the estimation is the same as that for $D(c)$. As the quotient between the constant and its standard error is asymptotically normal, the significance of $D(c)$ can be analysed using the values of the t-ratio.

$$z_t = \frac{(c_t - \bar{c})^3}{\sigma(c)^3}$$

The deepness asymmetry has to be analysed in the following way:

- The (c_t) series does not show deepness asymmetry if it does not show bias: $E(c_t - \bar{c})^3 = 0$.
- The (c_t) series shows deepness asymmetry in the contraction phases if it presents a negative bias: $E(c_t - \bar{c})^3 < 0$. So, if the contractions are deeper than the expansions, the (c_t) series will have a negative value in this asymmetry.

- The (c_t) series shows deepness asymmetry in the expansion phases if it presents a positive bias $E(c_t - \bar{c})^3 > 0$. So, if the expansion phases are deeper than the contractions, the (c_t) series will have a positive value in this asymmetry.

In the steepness asymmetry, we analyse if the contractions show greater steepness than the expansions; this is the reason why we must work with the first difference of the series. The asymmetry coefficient that approximates steepness, $ST(\Delta c)$, follows the same logic as that used for deepness but in this case on the series in first differences (Δc_t).

$$ST(\Delta c) = \left[T^{-1} \left(\sum_t (\Delta c_t - \bar{c}_{\Delta c_t}) \right)^3 \right] / \sigma(\Delta c)^3$$

where $\bar{c}_{\Delta c_t}$ and $\sigma(\Delta c)$ are the average and the standard deviation of Δc_t . The asymptotic standard error for contrasting steepness is calculated in the same way as for contrasting deepness. The significance of $ST(\Delta c)$ will be evaluated using the values of the t-ratio.

The steepness asymmetry must be analysed in the following way:

- The (Δc_t) series does not show steepness asymmetry if it does not show bias: $E(\Delta c_t - \bar{c}_{\Delta c_t})^3 = 0$.
- The (Δc_t) series shows steepness asymmetry in the contraction phases if it presents a negative bias: $E(\Delta c_t - \bar{c}_{\Delta c_t})^3 < 0$. So, if the contractions show greater steepness than the expansions, the (Δc_t) series will have a negative value in this asymmetry.
- The (Δc_t) series shows steepness asymmetry in the expansion phases if it presents a positive bias: $E(\Delta c_t - \bar{c}_{\Delta c_t})^3 > 0$. So, if the expansion phases show greater steepness than the contractions, the (Δc_t) series will have a positive value in this asymmetry.

Table 2 presents the main features related to the duration and amplitude. The average duration of the cycle, peak to peak, of the credit variables is roughly 27 quarters; the expansion phases last around 13 quarters and the contraction phases around 14 quarters. Credit cycles tend to be longer than business cycles, due to both expansion and

contraction phases.¹¹ In addition, our results suggest that in the expansion phases, the amplitude of the credit cycles is greater than the GDP, and in contraction phases, it is smaller. In expansion phases, the credit gains are greater than the gains in economic activity, and in contraction phases, the credit losses are smaller than those of economic activity, with the only exception being the expansion of credit to households, which shows the smallest amplitude.

TABLE 2. Duration and amplitude (average)

	Average duration ^a (quarters)				Average amplitude ^b (% change)	
	Expansion	Contraction	Cycle (P-P)	Cycle (T-T)	Expansion	Contraction
GDP	10.38	10.75	20.86	20.25	230.96	-538.99
CT	12.50	14.00	26.83	27.17	296.76	-446.69
CnFC	12.83	13.71	26.67	27.17	394.00	-448.04
CH	14.60	16.67	28.40	32.80	201.22	-472.74

^a Number of quarters that elapse between a trough and the next peak (expansion) or a peak and the next trough (contraction)

^b Average percentage change from trough to peak (expansion) or peak to trough (contraction)

Table 3 reports the deepness and steepness asymmetry tests. The sign of the deepness is what we expected in light of the data in Table 2. By and large, a greater amplitude in contraction phases translates into a negative sign in the deepness estimation. However, the deepness asymmetry is not statistically significant. The asymmetry in steepness has positive values, which indicate that the steepness is greater in expansion phases than in contraction phases. This asymmetry is also not statistically significant.

TABLE 3. t-ratio deepness and steepness asymmetry

	t-deepness ^a	t-steepness ^b
GDP	-0.304762	1.267142
CT	-0.121626	1.269491
CnFC	-0.121615	1.087128
CH	-0.264548	0.915282

^a t-student of the estimate of D(c)

^b t-student of the estimate of ST(Δc)

¹¹ The average business cycle contraction lasts about 11 quarters, which might suggest that Spanish contractions are very long. However, this result fits with other studies which provide a chronology of business cycle turning points for Spain. See, for instance, Bengochea et al. (2002), Camacho et al. (2008), Álvarez and Cabrero (2010b) or Bergé and Jordà (2013).

We sum up the main features of the cycles. First, the cycles identified can be defined as short-term cycles, with a duration between 5 and 32 quarters (Comin and Gertler 2006). Second, credit cycles are, on average, longer than GDP cycles, due to both expansions and contractions. Third, by and large, the amplitude is greater for financial variables than for GDP. Finally, in all cases, the amplitude is greater in contractions than in expansions and the slope is greater in expansions than in contractions. The results are consistent with a large number of empirical studies (see, e.g., Busch 2012; Claessens et al. 2012; Drehmann et al. 2012; Gómez-González et al. 2013; Arias et al. 2014; Jordà et al. 2014; Aikman et al. 2015).

3.3. What about contractions associated with credit booms and crunches?

We would like to highlight some empirical findings to answer two important questions. First, our analysis of the amplitude underlined that in expansion phases the credit gains are larger than the gains in economic activity and in contraction phases the losses are smaller (Table 2). In addition, the steepness and deepness asymmetries are not statistically significant, although, according to the t-student statistic, the business cycle contraction phases are deeper (Table 3). Given these results, we pose two questions. Can they imply that credit booms tend to be followed by deeper business cycle contractions (Jordà et al. 2014; Aikman et al. 2015) and can they imply that business cycle contractions associated with credit crunches tend to be deeper and longer than other contractions (Claessens et al. 2009, 2012; Drehmann et al. 2012)? We define credit boom years as those during which the cumulative growth rate of CT over a consecutive 20-quarter period (5 years)¹² exceeds the seventy-fifth percentile for the whole sample (Aikman et al. 2015)¹³, and we associate the credit crunch years with those in which the cumulative growth rate of CT over a consecutive 20-quarter period does not exceed the twenty-fifth percentile for the whole sample.

Table 4 plots the amplitude of those business cycle contractions that follow credit boom periods. The amplitudes in Table 4 are lower than the average amplitude of the whole

¹² By including five lags of the growth in the CT, we follow Schularick and Taylor (2012) and Aikman et al. (2015). As Schularick and Taylor suggest, credit booms last for many years, so they must be considered a medium-term phenomenon.

¹³ There are other possibilities to define a credit boom. For instance, Dell’Ariccia et al. (2012) and Laeven and Valencia (2012) define credit boom years as those during which the deviation of the credit-to-GDP ratio relative to its trend is greater than 1.5 times its historical standard deviation and its annual growth rate exceeds 10 per cent or years during which the annual growth rate of the credit-to-GDP ratio exceeds 20 per cent.

sample (−538.99, see Table 2). Therefore, answering the first question, Spanish credit booms do not tend to be followed by deeper GDP contractions. Regarding the second question, Table 5 plots the business cycle contractions associated with credit crunches. In two of three cases, the amplitude and duration of GDP contractions associated with credit crunches are lower than the average of the GDP sample (−538.99 and 10.75, respectively, Table 2). This result indicates that business cycle contractions do not tend to be deeper and longer than other contractions. Thus, we can conclude that, based on Tables 4 and 5, our results differ from those found in the literature, namely that the Spanish credit booms do not imply deeper GDP contractions and the credit crunches are not associated with deeper and longer GDP contractions.

TABLE 4. Credit boom and business cycle contractions

Credit boom (initial and final quarter)	Amplitude of business cycle contraction^a (% change)
1975-1Q/1976-2Q	− 446.32
1983-1Q/1985-2Q	−157.25
1987-4Q/1989-3Q	−201.93
1998-4Q/2008-2Q	−150.28

^a Percentage change of the business cycle contraction (from peak to trough) that follows a credit boom

TABLE 5. Credit crunch and business cycle contractions

Credit crunch (initial and final quarter)	Amplitude of business cycle contraction^a (% change)	Duration of business cycle contraction^b (quarters)
1978-4Q/1980-1Q	− 157.25	25
1986-1Q/1988-1Q	−201.93	8
2102-2Q/2014-1Q	−281.54	6

^a Percentage change of the business cycle contraction (from peak to trough) associated with a credit crunch

^b Number of quarters that elapse between a peak and the next trough (contraction) associated with a credit crunch

To understand these differences, we proceed in two steps. In the first step, we present two pieces of empirical evidence about the housing market and credit market that affect business cycles both in Spain and in other countries. In the second step, we seek a Spanish differential trait that allows us to conclude why such empirical evidence works differently in the Spanish GDP contractions.

Empirical evidence:

1. The literature reveals that in some countries, such as Germany, France, Spain or the USA, the residential investment leads to GDP fluctuations, which means that new construction of housing also leads to GDP fluctuations (see, e.g., Leamer 2007; Álvarez and Cabrero 2010a, 2010b; BBVA 2014).
2. Stylised facts from the Euro area conclude that credit to households, especially those for house purchases, may increase before credit to firms, as the banks tend to think that their collateral has higher quality (ECB 2013).

The Spanish differential trait:

The real estate sector represents around 9% of the Spanish GDP and the residential investment around 8% – percentages that place Spain at the top of the ranking of the OECD countries. These high percentages increase the sensitivity of the Spanish business cycle with respect to the real estate sector and more specifically with respect to the housing sector and its prices. We have calculated that, in the Spanish business cycle contraction phases, the growth rate of the housing price decreases on average during 5 quarters. This means that the house prices tend to recover relatively quickly pushing forward the housing sector. While in other countries this improvement may not be enough to break the GDP contraction, in Spain it may be. The effect of the credit boom or the credit crunch on the Spanish contraction is not as strong as it is in other countries.

Having achieved these results, it is important to examine the interaction between credit and GDP. In the next section, we will focus on the synchronisation and causality indicators.

4. Synchronisation and causality

The presence or absence of differences and asymmetries in the features of the phases affects the synchronisation of cycles. Synchronisation is defined as the amount of time for which two series (i,j) are in the same phase. We carry out the synchronisation analysis using two different methodologies. The first one follows Harding and Pagan (2002), who proposed the following concordance index (I):

$$I_{ij} = T^{-1} \left[\sum_{t=1}^T (S_{it} S_{jt}) + \sum_{t=1}^T (1 - S_{it})(1 - S_{jt}) \right]$$

where S_{it} (S_{jt}) is a binary variable that takes the value one when the cycle i (j) is in expansion and zero when it is in contraction and T is the number of observations. The index varies between one, perfect concordance, and zero, total absence of concordance.

There are mainly two advantages for the concordance index. The first is that it is very easy to interpret. The second is that it makes it possible to know if the two cycles are pro- or counter-cyclical. However, its most important disadvantage is that it does not provide information on whether the co-movements are statistically significant. For this reason, another synchronisation methodology has to be applied. We follow Harding and Pagan (2006) who propose a robust test of the hypothesis that cycles are either unsynchronised or perfectly synchronised. By concentrating upon the relationship between two cycles, S_{it} and S_{jt} , the authors demonstrate that the estimation of the correlation coefficient ($\hat{\rho}_s$) is a natural measure of the degree of synchronisation. To estimate (ρ_s), the authors recommend using the GMM method because it produces a robust standard error. Then, the moment condition can be written as:

$$E \left[\left(\sigma_{s_i}^{-1} (S_{it} - \mu_{s_i}) \sigma_{s_j}^{-1} (S_{jt} - \mu_{s_j}) \right) - \rho_s \right] = 0$$

where μ_s is the mean and σ_s the standard deviation of the series S_{it} and S_{jt} . The estimator can be written as:

$$\frac{1}{T} \sum_{t=1}^T \left[\left(\hat{\sigma}_{s_i}^{-1} (S_{it} - \hat{\mu}_{s_i}) \hat{\sigma}_{s_j}^{-1} (S_{jt} - \hat{\mu}_{s_j}) \right) - \hat{\rho}_s \right] = 0$$

In order to assess the statistical significance using the t-ratio, Newey and West's (1987) heteroskedastic and autocorrelation estimation procedure (HAC) with Bartlett weights is used.

Table 6 summarises the synchronisation information. The two indicators fall into the same range; a low degree of synchronisation is observed. The phases are not well aligned (the concordance index is around 55%) and the t-ratio is not statistically significant. The features of the phases lead to a scant degree of synchronisation of

cycles, although the t-student sign does not allow us to define counter-cyclical behaviour.

The fluctuations of cycles could hide lags (leads) that guide their relationship. We consider an alternative specification that includes a non-contemporaneous link between cycles. We take a widely used measure, cross-correlation, to analyse the relationship between credit and business cyclical components in different lags and leads.

TABLE 6. Synchronization indicators

	Concordance index (I)	t-student^a
GDP-CT	0.559	0.803300
GDP-CnFC	0.572	1.127778
GDP-CH	0.525	0.259615

^a t-student of the estimated correlation coefficient ($\hat{\rho}_s$) between S_{it} and S_{jt}

The cross-correlations are presented in Table 7; the reference series is the business cycle (GDP). The columns display the cross-correlation coefficient between GDP and the credit variables, that is, CT, CnFc and CH. The (t-k) columns report the correlation between the fluctuations of GDP in period t and the fluctuations of the credit variables in period (t-k). The (t+k) columns report the correlation between GDP fluctuations in period t and the fluctuations of the credit variables in period (t+k). According to the correlation indexes, there is a high and significant correlation between the Spanish business cycle and the lags of total credit to the non-financial private sector and credit to non-financial corporations. Conversely, we find a leading nature of the fluctuations of credit to households with respect to the business cycle. Complementarily, Table 8 plots the average lag (lead) of the credit turning points with respect to GDP. The results confirm those of the previous cross-correlation analysis: credit to non-financial corporations lags with respect to the GDP, in both peaks and troughs (4.40 and 2.33 quarters, respectively), while credit to households tends to lead it, in both peaks and troughs (-4.75 and -0.80 quarters, respectively). From the data in Tables 7 and 8, we cannot draw any inference about causality; nevertheless, we can suspect that the fluctuations of the business cycle might lead the fluctuations of credit to non-financial corporations and might lag with respect to the fluctuations of credit to households.

TABLE 7. Cross-correlations^a

K^b	GDP/CT		GDP/CnFC		GDP/CH	
	T-k	T+k	T-k	T+k	T-k	T+k
0	0.2164*	0.2164*	0.1599**	0.1599**	0.4223*	0.2884*
1	0.1458	0.2855*	0.0889	0.2322*	0.4306*	0.2445*
2	0.0823	0.3567*	0.0185	0.3069*	0.4538*	0.2188*
3	0.0085	0.4148*	-0.0568	0.3699*	0.4452*	0.1731**
4	-0.0649	0.4379*	-0.1324	0.3991*	0.4054*	0.1278
5	-0.1254	0.4556*	-0.1932**	0.4236*	0.3366*	0.0863
6	-0.1814**	0.4687*	-0.2530*	0.4444*	0.2699*	0.0552
7	-0.2287*	0.4790*	-0.2984*	0.4610*	0.2274*	0.0170
8	-0.2759*	0.4232*	-0.3435*	0.4208*	0.1811**	-0.0238

^a GDP reference series

^b +k (-k) denotes a lag (lead) with respect to the reference series (GDP)

* Significant at the 1% level

** Significant at the 5% level

TABLE 8. Turning points. Average lag (lead) with respect to the reference series^a

Average lag/lead (quarters)^b		
	Peaks	Troughs
CT w.r.t. GDP	+1.67	+2.86
CnFC w.r.t. GDP	+4.40	+2.33
CH w.r.t. GDP	-4.75	-0.80

^a GDP reference series

^b + (-) denotes a lag (lead) with respect to the reference series (w.r.t. GDP)

Source: BUSY

4.1. Granger causality analysis

To give robustness to the results of the cross-correlations, we analyse the causality (lagging/leading) between cycles using the Granger causality test. Granger causality directs us to consider the topic of VAR models, which are the usual technique to analyse the transmission of the cycles. The following VAR model is used:

$$y_t = \alpha + \phi y_{t-1} + \phi y_{t-2} + \dots + \phi y_{t-k} + \varepsilon_t$$

where y_t are (2×1) vectors of the GDP and CT (CnFC or CH), ϕ are (2×2) coefficient matrices, α is a (2×1) vector of constants and ε_t is a 2-dimensional white noise process: $E(\varepsilon_t) = 0$; $E(\varepsilon_s \varepsilon_t') = \Omega$ if $s = t$ or 0 otherwise.

Given that we use cyclical components, it is normal to suppose that the series do not have unit roots. To specify the order of the lags in the equations, we use the AIC and SIC information criteria. According to the AIC, the order of the VAR to CT and CnFC is set at 2, and according to the SIC it is set at 1. In contrast, both criteria set the order of the VAR to CH at 1. In the CT and CnFC models, we choose the lag with uncorrelated residuals; we check this non-correlation by applying the Ljung–Box test. If the order of the lags is 2, we cannot reject the null hypothesis that the residuals are uncorrelated, so the order 2 is appropriate for the VAR lag length. Thus, the VAR(2) model is used for CT and CnFC and the VAR(1) for CH.

We estimate the VAR by means of ordinary least squares. A Granger causality F-test is then conducted to test the causal relationship between GDP and the credit variables. Tables 9, 10 and 11 present the results. Looking at the p-value for the null hypothesis (5% significant level), it is possible to conclude that the business cycle Granger-causes the total credit to the non-financial private sector (CT) and the credit to non-financial corporations (CnFC). However, the credit variables do not Granger-cause the business cycle. Thus, the causality is uni-directional: GDP affects CT and CnFC but not vice versa (Tables 9 and 10). This pattern could not be found for credit to households (CH) (Table 11). Credit to households Granger-causes GDP but not vice versa. These findings confirm that the fluctuations of the business cycle lead the fluctuations of credit to non-financial corporations and lag with respect to the fluctuations of credit to households.

In summary, our outcomes demonstrate a temporary lag in the relationship between the CT cycle and GDP, which is due to the CnFC, since the behaviour of the CH is different and shows a temporary lead with respect to GDP.

TABLE 9. Granger causality test VAR. Results for the GDP and CT

GDP/CT	
Null hypothesis:	P-value ^{**}
No Granger causality from CT to GDP cycle	0.78813
No Granger causality from GDP to CT cycle	0.00412

^{**} Significant at the 5% level

TABLE 10. Granger causality test VAR. Results for the GDP and CnFCT

GDP/CnFC	
Null hypothesis:	P-value**
No Granger causality from CnFC to GDP cycle	0.53925
No Granger causality from GDP to CnFC cycle	0.00104

** Significant at the 5% level

TABLE 11. Granger causality test VAR. Results for the GDP and CH

GDP/CH	
Null hypothesis:	P-value**
No Granger causality from CH to GDP cycle	0.00453
No Granger causality from GDP to CH cycle	0.09123

** Significant at the 5% level

4.2. Under the gaze of the literature: interpretation of the lagging (leading) relationship

Basic economic theory based on the ‘financial accelerator’ literature claims that the direction of the relationship between financing indicators and economic growth is not unidirectional but works both ways.¹⁴ Consequently, on the one hand, the evolution of economic activity affects credit. A downturn of the credit may occur because an external shock slows economic activity or because business prospects worsen. On the other hand, financial activity affects the real variables. As Peydró (2013) and Brunnermeier and Sannikov (2014) indicate, the main channel through which financial shocks affect economic activity is a credit crunch. The reduction of credit might decrease the capacity for investment and consumption and might result in economic deceleration; the opposite might also be true (‘bank lending channel’, Gordon and Winton 2003). These feedback loops are emphasised by the models of the ‘financial accelerator’ theory. Briefly, credit market frictions, such as asymmetry of information, agency costs or collateral constraints, act as a financial accelerator that spreads and amplifies the effects of real and financial shocks (Bernanke et al. 1999).¹⁵

¹⁴ We can highlight, among others, Bernanke and Gertler (1989), Kiyotaki and Moore (1997), Bernanke et al. (1999) and Hammersland and Bolstad (2011).

¹⁵ In Xu (2012), we can find a review of the literature on financial frictions and their impact on the real economy.

The one-way lag/lead found in the Spanish relationship seems to contradict the feedback mechanism suggested by the literature and thus deserves an economic interpretation. We would like to point out firstly that increasing research suggests that bidirectional causality has to be re-examined and nuanced. While it is well known that credit correlates with economic activity, the pattern of such co-movement has not yet been explored in all its depth.¹⁶ The unidirectional lagging/leading relationship is defended by several papers, showing robust empirical and economic reasons.

Analysing the Euro area's stylised facts of money and credit over the business cycle, the ECB (2009, 2013) concludes that credit to non-financial corporations tends to lag the business cycle. Busch (2012) finds, for credit to non-financial corporations, a strong lag of three quarters against the German GDP, while for credit to households the correlation is weak and no significant lead or lag can be identified. Giannone et al. (2012) present a lag of three quarters in the relationship between the Euro area credit to non-financial corporations and GDP, whereas credit to households tends to lead GDP. As we can see, our findings are in accord with the Euro area's stylised facts.

What kinds of arguments lie behind these stylised facts? We deal first with the relationship between CnFC and GDP. The lag may have several explanations.¹⁷ The credit granted is the result of supply and demand. The credit supply is largely led by the general economic climate expected. Becker and Ivashina (2014) present evidence that in an uncertain economic environment, banks are cautious about granting new credit. Generally, banks' balance sheet, which results from their risk perception based mostly on their economic forecasting, determines the credit supply. Expansion phases and financial innovations encourage greater risk taking in the future (Minsky 1982). The level of price competitiveness can be very high and the conditions of credit are relaxed. Monetary policy can also have an effect because a lower overnight interest rate may increase the credit supply and the risk-taking incentives of the bank (Borio and Zhu

¹⁶ The two-way relationship is one of the most important outcomes; however, we can find papers that provide different empirical evidence. For instance, Gordon and He (2008) argue that there is no relationship between the financial cycle and the business cycle. Arcand et al. (2012) find a threshold above which financial development has a negative effect on output growth. Samargandi et al. (2014) conclude that financial development and economic growth are not linearly related (inverted U-shape relationship). Furthermore, Hook and Singh (2014) provide an excellent summary of papers that defend such a non-monotonic relationship between finance and growth.

¹⁷ Doménech et al. (2014) describe the role played by the reasons that we highlight below in the evolution of bank financing to Spanish corporations before, during and at the end of the 2007 crisis.

2012). In contrast, downturns generate a borrower quality loss, leading the lenders to adopt more conservative positions. The risk is overrated and credit tends to be reduced ('credit risk channel', Anguren 2012).¹⁸

On the demand side, the lagging pattern of credit to non-financial corporations over the business cycle can also be explained in several ways. For example, in the market descendant phases, if the asset prices fall, companies' net worth declines and their capacity to borrow, invest and consume decreases. In addition, the fall of the domestic investment and consumption discourage their investment plans, hence companies need less external funding. After a while, the credit demand falls. The reverse process can occur in the market ascendant phases. We could add that corporations postpone new borrowing in the expansive phases in favour of utilising internal funding until the external finance premiums and the credit market frictions have decreased (ECB 2009, 2013; Covas and den Haan 2011; Busch 2012). Moreover, the ECB (2013) brings out special, though modest, behaviour detected especially in large firms, which consists of companies using corporate bonds when the capital market shows favourable conditions rather than bank borrowing to finance themselves. On aggregate, the processes described need some time to unfold. Hence, a time lag seems natural.

In the case of credit to households, its advancement mostly comes from its main component: credit for house purchases. The correlation between house prices and their demand is usually positive. Prices tend to lead demand and, at the same time, as we have seen in subsection 3.3, demand tends to lead the business cycle (Leamer 2007; Álvarez and Cabrero 2010a, b; BBVA 2014). In expansion phases, house prices increase and may involve a future sales increase because of the expectations of revalorisation, which increase the willingness of buyers to pay a higher price (Díaz and Jérez 2010). However, during contractions, the decline in both house prices and interest rates encourages households to resume their demand for housing loans when the expectations for a recovery strengthen. Furthermore, the household credit demand depends on families' income outlooks, which run in line with economic growth (Busch 2012). Hence, credit to households may begin to increase or decrease without a lag or

¹⁸ Jiménez and Saurina (2006) find this behaviour in the granting of credit in Spain since the 1980s, when the Spanish financial liberalisation process began to strengthen. Banks have tended to expand credit without looking at the risk hedging.

with some lead, depending on families' optimism or pessimism. On the supply side, as we have also pointed out in subsection 3.3, the study by the ECB (2013) concludes that credit to households, especially those for house purchases, may increase before credit to firms, as banks tend to think that their collateral has higher quality. Our results are definitely supported by the literature and by the empirical evidence.

5. Conclusion

Our paper contributes to the literature that seeks to characterise the credit cycle. This study provides evidence on the interaction between Spanish business and credit cycles using data over the period 1970–2014. The paper explores the following: the cycle turning points are identified; the main features of financial and business cycles are documented; and the causal relationship is assessed.

The turning points reveal that credit cycles tend to be longer and have a higher amplitude than business cycles, although neither credit nor business cycles reach a significant level of asymmetry in deepness and steepness. The differences in the features of the cycles lead to a scant degree of synchronisation over time, although counter-cyclical behaviour is not detected. The lack of synchronisation may be due to a non-contemporaneous cyclic interaction. We calculated the cross-correlations and the analysis confirmed the existence of a non-contemporaneous correlation between business and credit cycles.

We carried out a robust causality check using the VAR methodology. Our findings demonstrate that there is a causality interaction. Namely, the business cycle Granger-causes the total credit to the non-financial private sector and credit to non-financial corporations, while credit to households shows a temporary lead with respect to the business cycle. The analysis confirms that the fluctuations of the business cycle lead the fluctuations of credit to non-financial corporations and lag with respect to the fluctuations of credit to households. The results for Spain's credit and business fluctuations broadly fit the Euro area's stylised facts, with a comparable pattern of time-lagged dependence.

We also examined episodes of credit boom and credit crunch to confirm the literature regularities about their link with the amplitude and duration of business cycle phases.

Our results do not agree with the empirical literature's results. In this sense, our findings contrast with those of Jordà et al. (2014), who conclude that credit booms imply deeper contractions, and Claessens et al. (2009, 2012), who argue that credit crunches are associated with deeper and longer contractions. We provide evidence that in the period 1970–2014, Spanish credit booms do not involve deeper business cycle contractions and credit crunches are not associated with deeper and longer business cycle contractions. These differences are associated with the great importance of the real estate sector in Spain, and more specifically with respect to the housing sector and its prices. During business cycle contractions, the housing prices show a quite quick recovery which pushes the housing sector forward. This behaviour and the great importance of the real estate sector mean the contractions may be broken, although it also makes Spain very sensitive to the dangerous housing bubbles. This occurs independently of whether the contractions are or are not related with a credit crunch or credit boom episodes.

We would like to share our thoughts on where the future lines of research in this field could be directed. In the first place, analysing the impulse response function may be one possible future line of enquiry. This would allow us to determine how credit reacts over time to output shocks. Moreover, co-integration could be an appropriate way to amplify our results and investigate the long-run persistence of the relationship and the speed at which the system converges to its equilibrium position. Second, we want to explore more thoroughly the nature of the interaction between credit and economic activity. In our opinion, it is important to discern the explanatory variables of this interaction. The last section of our study has highlighted the main findings of the specialised literature in this field. Based on these results we will carry out an in-depth analysis of that nature in the Spanish economy. For instance, future studies should examine in greater depth the role of the credit risk channel in shaping the interaction between credit and business cycles and confirm the theory of whether there is a threshold in the credit and growth relationship.

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Appendix. Turning points robustness check

One might wonder about the extent to which the cycles identified are sensitive to the methodology used and, in particular, to the censoring rules established in relation to the duration of the phases and cycles. We carry out a robustness check to examine this sensitivity of the results. We calculate the turning points, softening the constraints to the fullest extent allowed by the BUSY programme. In particular, we calculate the turning points according to the censoring rules reported in Table A.1:

TABLE A.1. Softened rules to implement BUSY

Options	Phase length	Cycle length
1	y_t is a peak at time t if y_t is the max. ($y_{t-1} \dots y_{t+1}$) and it is a trough if y_t is the min. ($y_{t-1} \dots y_{t+1}$).	4
2 ^a	y_t is a peak at time t if y_t is the max. ($y_{t-2} \dots y_{t+2}$) and it is a trough if y_t is the min. ($y_{t-2} \dots y_{t+2}$).	4
3	y_t is a peak at time t if y_t is the max. ($y_{t-2} \dots y_{t+2}$) and it is a trough if y_t is the min. ($y_{t-2} \dots y_{t+2}$).	3

Note: Each row describes the constraints imposed in the BUSY programme to find the turning points

^a This rule was already tested in the text when we presented the methodology used; we found that there were no changes in the turning points between 4 and 5 quarters of cycle length.

The turning points calculated under the constraints of each row of Table A.1 are identical to those reported in Table 1. The censoring rules imposed by the methodology do not affect the results; thus, we conclude that the nature of the results is robust.