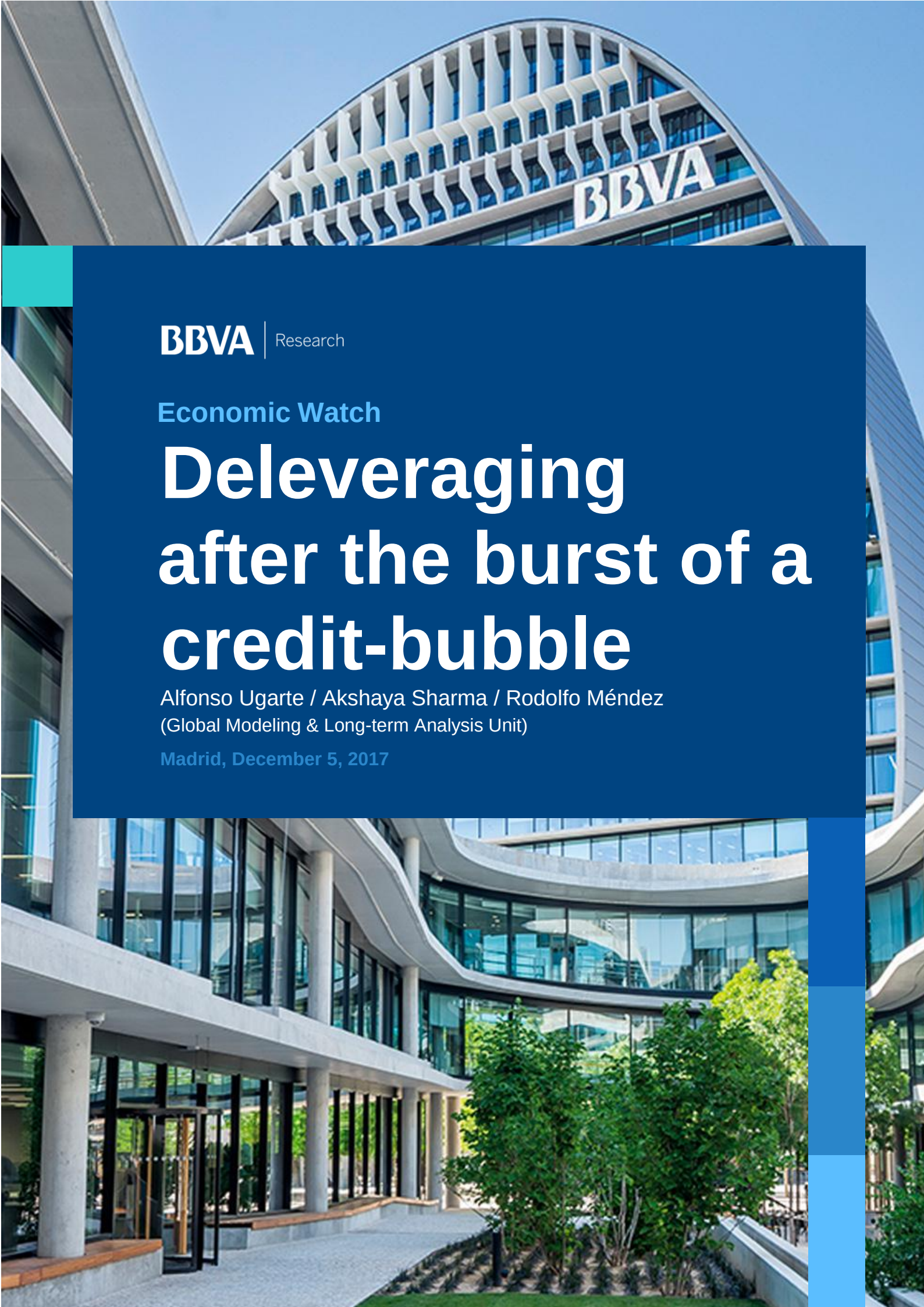

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Economic Watch

Deleveraging after the burst of a credit-bubble

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1. Introduction and Motivation

What happens to private leverage after the bursting of a banking-crisis-inducing credit-bubble? The obvious answer would be simply that it falls. But the international experience shows that the process and consequences of a systemic banking crisis (including those preceded or accompanied by credit bubbles) are actually quite heterogeneous across different countries and even across different crises within the same country. Some recent literature has concentrated on the effects of a banking crisis on economic activity, but few studies have explored the deleveraging process itself.

How hard private leverage falls, how fast and what factors determine how severe is such a deleveraging process? In this study we explore some tentative answers to these questions. In order to do this **we assemblage a rich database on the macro-financial dynamic preceding and following events of simultaneous occurrence of credit-bubbles and systemic banking crises**, and used it in the estimation of a simultaneous equation econometric model able to explain and forecast the deleveraging dynamic conditioned to kind of events.

According to our results, the main determinants of the severity and speed of a deleveraging process after the burst of a credit-bubble (following a banking crisis) are the growth rate of the credit ratio during the boom period and the fiscal position of the country at the peak of the credit boom, while the external position plays a more limited role.

The contributions of this note are illustrated by analyzing the consequences of a hypothetical burst of the current credit bubbles experienced by two economies, Canada and Thailand, in the case that they were suffering a systemic banking crisis. We chose these two countries as examples since our Early Warning System of systemic banking crises indicate that the probability of an event of this type in these countries is significant[1].

[1] Ortiz & Ugarte (2015), BBVA Research Country Risk Report 3Q-2017

2. Database Description

Credit/GDP (Banking to private sector, total debt) Series

In order to investigate the determinants of a deleveraging process due to the burst of a credit bubble we first need to have a sufficiently large dataset on credit bubbles and bursts around different banking crises episodes. However, the existing databases on banking credit-to-GDP ratios present several shortcomings. On the one hand, the International Monetary Fund's International Financial Statistics database (IMF-IFS) includes a large number of countries and a long time span. However, the IFS series suffer from several breaks and jumps in the data that severely limit their reliability. On the other hand, the Bank for International Settlements (BIS) credit series data is much more restricted in terms of the number of countries and is thus quite limited in the number of banking crisis' episodes that can be analyzed.

Therefore, the first step in our investigation was to **build a database of credit/GDP series (banking credit to private sector, and total debt) extending from the year 1960 onwards in 88 countries, taking as primary source the IMF-IFS banking credit to private sector** (code 32.d) series and complementing or adjusting it by using BIS series on domestic banking credit to the private non-financial sector. Observed on a case-by-case basis, changes in BIS credit series were applied to the data from IMF IFS, or vice-versa. Significant effort has been undertaken in order to correct for any jumps or irregularities in either data source.

Banking Crises Characteristics Database

Making further use of the credit-to-GDP database, a second, new database was constructed containing the **timing and other characteristics of 113 banking credit-bubbles associated to a systemic banking crisis that has occurred in 71 of the 88 countries**. The timing of these crises refers to the dates at which a credit boom starts, the date at which it peaks, and the date at which the burst ends, as well as the timing of the banking crisis itself. Based on these moments, we were able to account for several other characteristics of each crisis, such as the variation of the credit ratio during boom and bust cycles of a bubble, along with the duration, speed and severities of said cycles.

The first point that needs to be clarified about the methodology of related to the **definition and occurrence of a systemic banking crisis.** We primarily follow the definition of Laeven & Valencia (2012), which states it as a period during which *a "country's corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time"*[2]. This definition is further cross-checked with the occurrence of deposit runs, freezes, liquidity support and non-performing loan (NPL) rates. However, in the construction of our database, two additional sources of literature that also define the timing of banking crises are used as a consensus[3]. This allowed us to place more robust dummies for crisis outbreaks and durations in our database.

To determine the specific dates that define the characteristics of a credit cycle can be problematic and highly subjective, especially when attempting to define the starting year of a credit boom. Nevertheless, the peak year

[2] Laeven & Valencia (2012)
[3] Lund & Jensen (2012), Asli Demirgüç-Kunt & Enrica Detragiache (2005)

of the bubble is usually fairly evident, and in most cases, the end-of-deleveraging year is also clear. Therefore, our main criterion to select the date at which the boom starts and the date at which the burst ends (trough), when the latter was not evident, was based on the estimation of a long-term trend of our credit series through a Hodrick-Prescott filter. The gap between the long-term trend and the actual credit-to-GDP series determined the starting dates of credit booms, and the end of deleveraging periods. In a few select cases, other criteria such as a clear change in slope were considered more appropriate. In any case, the credit cycles considered are only those around a systemic banking crisis, taking as reference those crises identified by the literature and defined in the first step.

Other similar efforts have been undertaken in previous studies by the BIS , but have not been able to include as many systemic crisis bubbles (39 financial crises were documented by Upper and Takats, and 66 systemic crises by Gertler and Hofmann). Also, several crises in 2008 which were not previously included in studies due to being classified as "ongoing", are now also included in our sample.

Out of our 113 systemic banking crises in the database, 104 were identified as having a boom-bust pattern in the evolution of credit. This was identified in order to be able to carry out predictive analysis on the severity of credit bursts. The remaining 9 crises were observed to be in a constant deleveraging process or boom cycle during their crisis periods. These 9 events were classified by us as "borderline" crises. However, this is not to be confused with the definition of "borderline events" as defined by Laeven & Valencia (2012). These were crises that did not fully comply with their requirements of contagion and policy response of systemic crises.

Finally, we extended the database to include several other characteristics of each country's GDP and evolution of several macroeconomic indicators, during their financial bubbles. (Macroeconomic variables include fiscal balance, current account, foreign reserves, inflation, interest rate, and indicators of economic freedom).

Descriptive Statistics

In Table 1 we can observe descriptive statistics of some characteristics of 113 crises analyzed. In the first three columns we can see the mean, median and standard deviation of all 113 crises, meanwhile in columns four to six we can see the same statistics, but only for 104 crises that have a clear boom & bust pattern. It is clear from the numbers that there is a large variability in those characteristics and we can also claim from the raw data that the presence of large outliers makes that the mean and median values differ significantly.

From these descriptive statistics we can see that crises last around 8 to 9 years in total (from boom to trough), although with a large variability (5 years std.dev.). We also can see that the boom period is about one year longer than the bust one. Despite the bust period, from boom to trough most countries' leverage still grows a few points of GDP (about 7%) divided on 29 points grown during the boom and -22 points during the bust one.

From the group of variables analyzed in Table 1 we are clearly more interested in the values taken by two variables:

i) The ratio between the credit-to-GDP ratio at the trough and the ratio at the peak of the crisis

ii) The speed rate at which the credit-to-GDP ratio drops during the years of the credit burst.

The first variable measures the **severity of the deleveraging process**. It is close to one if the deleveraging process is very mild and it is close to zero if it is quite severe. The second variable simply measures the number of points of GDP per year that the credit ratio drops during the deleveraging process, i.e. **the speed at which the deleveraging process occurs**.

Taking into account only those 104 crises with a clear boom and bust pattern the mean fall in the credit-to-GDP ratio represents about 31% of what the ratio grows during the boom period (or the ratio at the trough is 69% of the ratio at the peak). Given that the bust cycle in these crises lasts about 4 years, the leverage ratio falls about 6 points per year on average.

It is important to mention that **these two variables display a very high variability in the sample**. The ratio of credit-to-GDP ratios at the trough vs. the peak shows a standard deviation of 0.22 points of GDP and the speed rate of the fall in the credit-to-GDP ratio has a standard deviation of almost 12 years. Such **large observed variability in these two variables clearly motivates the need for a more formal examination of their economic determinants**, which is what we intend to do in the next section.

Table 1 Summary of Deleveraging Process' Characteristics around Banking Crises

		Mean	Median	Standard Deviation	Mean (no "borderline")	Median (no "borderline")	Std.Dev. (no "borderline")
Duration in years	Total	9.0	8.0	4.8	9.3	9.0	4.9
	From Boom to Peak	4.8	4.0	3.1	5.0	4.5	3.1
	From Peak to Trough	4.2	3.0	3.0	4.3	3.5	3.1
Credit-to-GDP (C/Y) (% of GDP)	At Boom	44	32	34	45	33	35
	At Peak	70	57	56	73	58	57
	At Trough	50	36	43	52	41	44
C/Y Change (% of GDP)	Total	7	4	19	7	2	19
	From Boom to Peak	27	25	35	29	18	36
	From Peak to Trough	-20	-21	31	-22	-13	32
(C/Y at Trough)/(C/Y at Peak)		0.71	0.62	0.27	0.69	0.75	0.23
Speed Rate of Drop in C/Y (points per year)		-4.9	-7.2	10.4	-6.0	-3.2	10.6

Source: BBVA Research

3. Regression Analysis

Our main goal is to estimate a model able to predict the path of the Credit-to-GDP that follows the bursting of a credit bubble linked to a systemic banking crisis, given the macroeconomic and financial conditions prevalent in a country at the onset of the deleveraging process or at the peak of the bubble. Therefore, we perform a SUR regression analysis to estimate the effect of a group of explanatory variables on the two (dependent) variables mentioned before:

i) The ratio between the credit-to-GDP ratio at the trough and the ratio at the peak of the crisis

ii) The speed rate at which the credit-to-GDP ratio drops during the years of the credit burst.

We perform a SUR regression since we assume that the severity and the speed of the deleveraging process are related to each other and thus their error terms are assumed to be correlated. We have analyzed the effect of several possible economic determinants including the following:

- **Fiscal position**: Fiscal balance, public debt and public expenditure all expressed as percentage of GDP.
- **External position**: Current account as percentage of GDP, reserves-to-imports ratio, reserves-to-M2 ratio.
- **Financial variables**: Short-term interest rate and pre-crisis characteristics of the leverage process.
- **Macroeconomic variables**: GDP growth and inflation rate.
- **Institutional background**: An index of public interventionism in the economy.

In order to find the best possible specification we have evaluated different transformations of these variables: variables in levels, variables in changes, variables in deviations from historical means and changes in deviations from historical mean. Moreover, we have assessed and compared the effect of these variables at different moments in time: i) the value at the start of the boom, ii) the value at the peak, and iii) the value at the onset of the banking crisis.

The explanatory variables that are included in the final specification of both dependent variables are the following (as shown in Table 2):

- Speed Rate of Boom in the credit-to-GDP ratio
- Credit-to-GDP (at Peak)
- Public Expenditure (at Peak)
- Change in Reserves-to-Imports (from Boom to Peak)
- Fiscal Balance-to-GDP (at Peak)
- Current Account-to-GDP (at Peak)

Table 2 SUR Regression Analysis Results

	C/Y Ratio (at Trough)/(at Peak)	Speed Rate of Drop in C/Y
Speed Rate of Boom in C/Y	-0.0260***	0.5220***
Credit-to-GDP (at Peak)	0.0007	0.0215*
Public Expenditure (at Peak)	0.0047**	-0.1257***
Change in Reserves-to-Imports (Boom to Peak)	0.0175*	0.1367
Fiscal Balance-to-GDP (at Peak)	0.0130**	-0.4482***
Current Account-to-GDP (at Peak)	0.0063	-0.1870**
R-squared	**0.46**	**0.60**
Number of Observations	**51**	**51**

Note: ***, **, * denote statistical significance at 1%, 5% and 10% levels, respectively.
Source: BBVA Research

According to our results, the main determinants of the severity and speed of a deleveraging process are the growth rate of the credit ratio during the boom (speed) and the fiscal position of the country at the peak of the credit boom, measured by the public expenditure level and the fiscal balance.

The first result is quite intuitive, **the faster the credit boom the stronger and faster the burst**, i.e. the lower the ratio at the end of the deleveraging process (at trough), and the faster the drop in leverage.

Importantly, we find that **those countries with larger public sectors (public expenditure) tend to suffer milder deleveraging processes**, i.e. less severe and slower drop in leverage. Similarly, those countries with **healthier public finances at the peak of the credit boom also suffer milder busts afterwards**.

Additionally, other variables such as the leverage ratio level and the external position also play a role. First, we find that he higher the credit ratio at the peak the higher the speed of deleveraging. However, it does not seem to have an effect on its severity. Secondly, the international reserves accumulated during the boom reduce the severity of the crisis, but it does significantly impact its speed. Finally, we find that having a higher current account ratio at the peak reduces the speed of deleveraging and its severity (although its latter effect is not significant at the traditional 10% level).

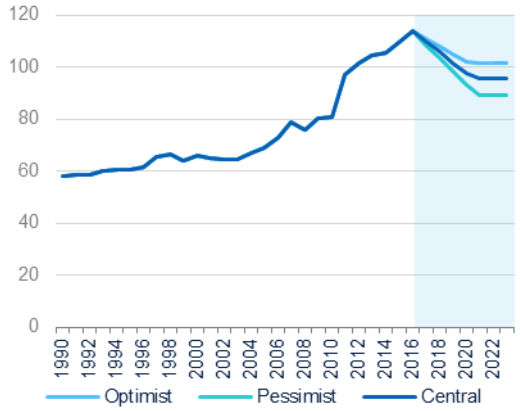
4. What if a systemic banking crisis had occurred in Canada or in Thailand in 2017?

We use the results of the regression to estimate the expected amount and speed of the fall in the credit-to-GDP ratio after a hypothetical and banking-crisis-inducing burst of the credit-bubbles experienced by Canada and Thailand in the past years, assuming the respective bursts had started in in 2015 in Thailand and 2016 in Canada. With our estimates we can also calculate the duration in years of the deleveraging.

Towards the end of 2016 the banking credit-to-GDP ratio of Canada reached about 114 points of GDP, having grown about 38 points since 2008. The speed of growth during the bubble has been thus about 5.4 points per year. Given these values and the other values of the explanatory variables at the end of 2016, which is the year we assume to be the "peak" in the credit ratio, the model predicts that the future "trough" in the credit-to-GDP ratio will be around 95 points of GDP in the case that a banking crisis had arisen (a fall of 18 points). Given that the speed of fall in the ratio predicted by the model is about 5 points per year, the duration of the slump will be around 5 years. The results are shown in Figure 1.

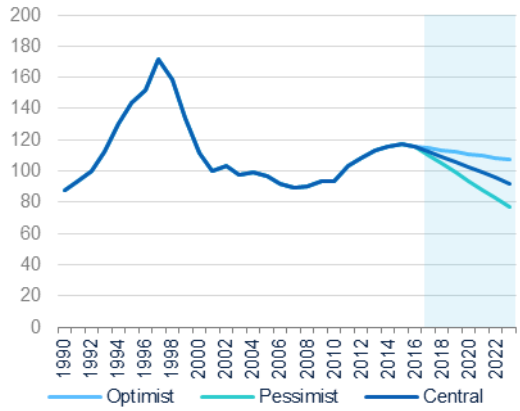
After estimating confidence intervals for our two dependent variables we use them to construct different scenarios. For instance the more pessimistic scenario is estimated using the lower value of the Peak-to-Trough ratio (stronger drop) and the upper value of the "speed rate of drop" (faster drop). Similarly, the most optimist scenario is estimated using the opposite values.

Figure 1 Canada: Predicted behavior of banking credit-to-GDP in the case a systemic banking crisis had burst in 2017



Source: BBVA Research

Figure 2 Thailand: Predicted behavior of banking credit-to-GDP in the case a systemic banking crisis had burst in 2017



Source: BBVA Research

Similarly, in the case of Thailand the banking credit-to-GDP ratio reached about 117 points of GDP in 2015, having grown about 24 points since 2011. The speed of growth during the bubble has been thus about 6 points per year, somewhat faster than the Canada's case. Given the value of the explanatory variables at the end of 2015, the model predicts that the "trough" in the credit-to-GDP ratio will be around 92 points of GDP with a drop speed of about 3.5 points per year and duration of the bust period of around 7 years The results are shown in Figure 2.

The comparison between the predictions for the two countries analyzed show a smaller contraction in the case of Canada, but with a higher speed. These results reflect basically a slightly lower speed of the boom period, a higher public expenditure and a better accumulation of international reserves during the boom period in Canada than in Thailand, but a much worse external position (current account) in Canada, which has only a significant impact in the speed of the fall.

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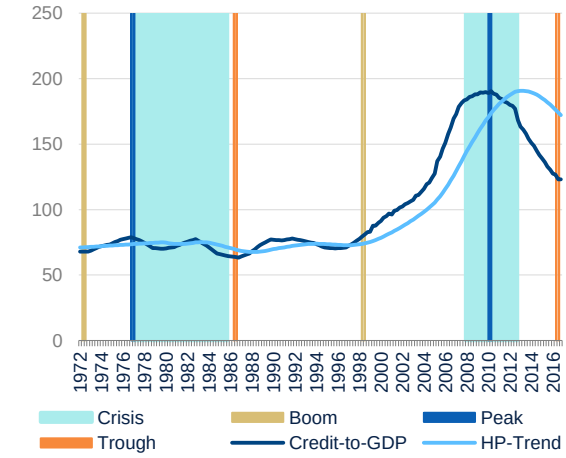
Annex: Example of the definition of the timing of Booms, Peaks and Troughs

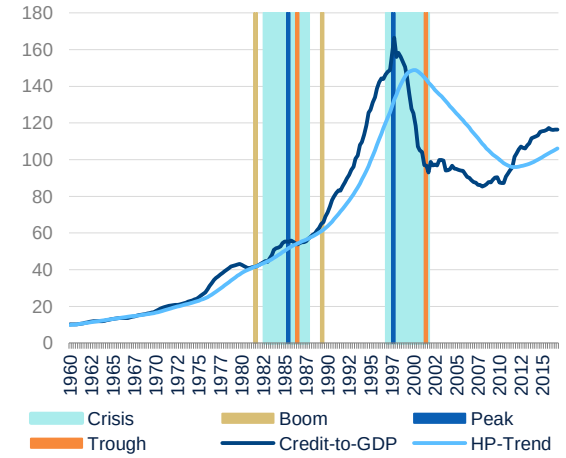
In Figures A1 and A2 we show a couple of examples of how the timing of the credit boom, peak and trough were determined around systemic banking crises episodes. According to the different sources defining the occurrence of systemic banking crises, there were two banking crisis in Spain, the first one between 1977 and 1985, and the second one between 2008 and 2012. In the case of Thailand there were also two banking crises, the first one between 1983 and 1987. It is quite evident that the characteristics of these crises were very different in all accounts in every case.

Figure A1 Spain



Source: BBVA Research

Figure A2 Thailand



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