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### Introduction

The current crisis has clearly shown the need to deepen our understanding of the linkages between macroeconomic and financial variables. Indeed, the science of economics has been accused of being incapable of predicting the crisis, even though apparently unsustainable imbalances were building up during the preceding expansionary phase. In particular, there have been many references to rapid credit growth and how it has caused upward pressure on assets, particularly real estate. As a result of this experience, mechanisms to predict the economic cycle are currently being proposed that are based on using credit as a “leading variable” for the cycle, in other words, as an indicator containing information predicting the likelihood of a recession. It is also increasingly common for macroeconomic supervision by international institutions to use credit growth as a signal of macroeconomic imbalances or as a warning sign of future recessions.

However, the statistical basis for this type of inference draws on studies carried out since the start of the current crisis. This work by both academics and analysts examines the behaviour of the economy drawing on the information available at each point in time, which is used to attempt to describe the past. It is a different question whether the information available at each point in time can predict the future, or, other words, what variables in real-time economic prediction models contain predictive information allowing turning points in the economic cycle to be detected.

In this paper we present a summary of recent work addressing this issue. Specifically, our study aimed to determine whether, with the information available at a given moment in the expansionary phase prior to the crisis, it would have been possible to make a clear diagnosis of the economy’s situation at that time. And, above all, it asks whether changes in any of the financial variables (credit, in particular) would have been a useful predictor of the onset of recession.<sup>1</sup> This paper starts by describing the combined evolution of credit and the economic cycle in several countries over the last few decades, and highlighting a number of empirical studies that have sought to base economic predictions on this information. It then discusses the origin of the difficulties involved in using credit as a leading indicator of the cycle, and puts forward an alternative methodological approach for the use of financial variables in models predicting the economic cycle.

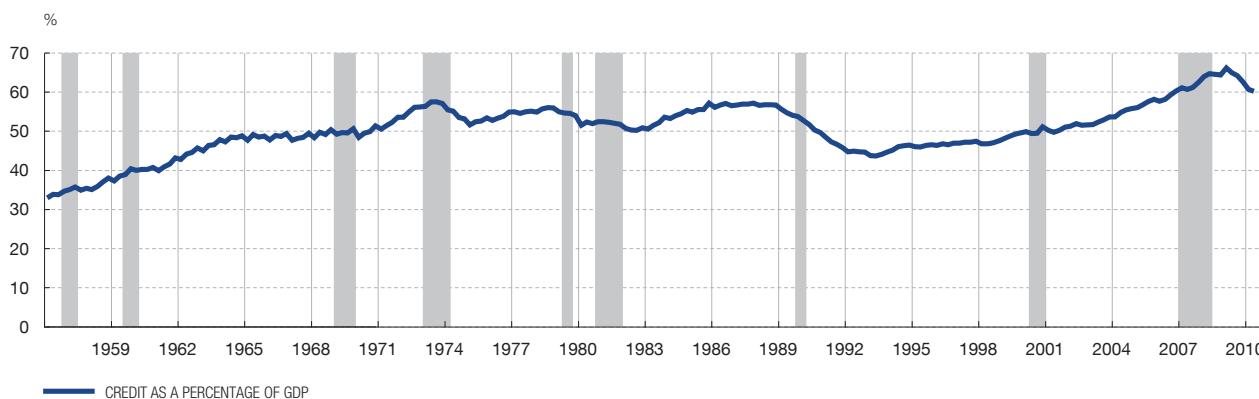
### Credit and the economic cycle

Chart 1, plotting the ratio of bank credit<sup>2</sup> to GDP in the United States, clearly shows the association between the economic cycle and changes in the amount of credit. In the U.S. case, since 1960 an expansion of credit can be observed just prior to each recession.<sup>3</sup> Moreover this regularity is not limited to the United States. Using a sample of 39 OECD countries, Gadea and Pérez Quirós (2012) have shown that, over the period between the first quarter of 1950 and the second quarter of 2011, credit performed in this way during expansions in all the developed economies. What is more, many theoretical models indicate that it is an intrinsic feature of the cycle that credit should grow endogenously with

<sup>1</sup> See Gadea and Pérez Quirós (2012).

<sup>2</sup> We refer in particular to the “Claims on private sector of depository corporations” series in the IMF’s International Financial Statistics.

<sup>3</sup> The recessions on the chart have been dated using the NBER methodology.



SOURCES: IMF and NBER.

expansions.<sup>4</sup> This regularity underlies recent empirical work seeking to identify a causal relationship between credit growth and the likelihood of a recession.<sup>5</sup>

All these studies have concluded that the change in the credit-to-GDP ratio is a particularly robust variable with which to predict future recessions. Nevertheless, the studies backing this conclusion do not always agree on which comparison of credit and GDP contains most information about the cycle. Thus, some studies [e. g., Gourinchas and Obstfeld (2011)] have used the level of the credit to GDP ratio [e. g., Jordá et al. (2011a) and IMF (2011)] have opted for the change in the credit-to-GDP ratio, while others have used what they have called a “credit intensity” indicator, which represents the cumulative value of the difference between the credit and GDP growth rates since the last recession [e. g., Jordá et al. (2011b)]. These are all variables that grow systematically during periods of expansion.

Where these studies agree is on the methodological approach used. Basically, the aim is to characterise the statistical relationship between one variable (i.e. “recession”) which takes a value 1 in period “t” if there is a recession (exogenously defined) between periods  $t + 1$  and  $t + 3$ , and 0 in all other periods, and the variable chosen to characterise credit performance, while controlling for the possible effects of a set of other variables that, like the credit variable, are dated at the current time, “t.”<sup>6</sup> In all the studies cited, a positive and statistically significant relationship is obtained between credit and the variable representing the occurrence of a recession, and given this result, the economic policy implication is that credit growth has to be controlled in order to reduce the likelihood of a recession.

#### A few words of caution

Although the foregoing results may seem clear cut, before basing economic policy on them the following points – at least – should be taken into account:

- a) Descriptive analysis should not be confused with statistical inference. Taking recessions as an “exogenous” event and analysing how certain macroeconomic and financial variables behave around the time of their occurrence is not the same thing as establishing a causal relationship. For example, there

<sup>4</sup> See Gertler and Karadi (2011), Gertler and Kiyotaki (2010), Christiano, Motto and Rostagno (2010), and Nuño and Thomas (2012), among others.

<sup>5</sup> See, for example, IMF (2011), Schularick and Taylor (2009), Jordá et al. (2011a and b), Gourinchas and Obstfeld (2011) and Claessens et al. (2011a and b).

<sup>6</sup> Formally, this is a logit model.

have been episodes of rapid credit growth that have not ended in a recession, such as in the nineteen eighties and nineties, and again in the early 2000s.<sup>7</sup>

- b) Including a variable with a trend, such as credit levels or the ratio of credit to GDP, in an econometric model can throw up spurious statistical associations.
- c) Given that variables relating to credit are used to define periods of recession, when the recession variable is regressed against credit, the latter is not exogenous. The results of the estimate are therefore skewed upwards and the relationship between credit and future recessions is not captured correctly.
- d) Finally, the findings regarding the association between credit growth and the occurrence of recessions are skewed by the latest recession, which has financial origins. Before this episode, very rarely did any country in the OECD show such a close relationship. Therefore, it would not have been possible to establish a stable relationship between the financial sector and the real economy prior to 2007. Accordingly, most macroeconomic models did not include these financial variables because this strong relationship between the real and financial worlds did not exist in the data.

To illustrate this point, it is worth looking at some merely descriptive findings from the sample of OECD countries studied by Gadea and Pérez Quirós (2012). In this sample 149 recessions can be identified, of which only 45 coincide with one of the financial crises documented by Gourinchas and Obstfeld (2011). For their part, Gourinchas and Obstfeld (2011) identify 143 financial crises, of which only 45 coincide with recessions dated as such. What is more, of these 45 recessions that do coincide with financial crises, 31 are observed after 2007, with only 14 occurring before 2007. Thus, if the question as to the relationship between financial crises and recessions had been asked in 2007, there would only have been evidence of a coincidence in 14 cases in the sample of 230 occurrences of recessions ( $230 = 149 - 31$  real world crises +  $143 - 31$  financial crises). In other words, a coincidence between recession and financial crisis would have been detected in just 6% of cases. This is an association that is obviously too weak for any statistical analysis to have detected it as significant.

In short, it may be concluded that prior to the outbreak of the latest crisis there was no clear evidence of a connection between financial crises and recessions. And even now, after all that has happened, the techniques of econometric analysis are unable to reveal a clear causal relationship between these two variables such as would allow us to infer information about the probability of a future recession from one of them (credit).

### Is it possible to use credit as a leading indicator of the economic cycle?

For the purposes of economic prediction and the design of macroeconomic stabilisation policies, the relevant question is not whether there is a statistical association between credit and the occurrence of recessions, but whether, given the way credit is evolving at any moment in time, it is possible to infer anything about the future probability of a recession in the subsequent period and about the characteristics of that recession. To answer this question we need a real-time predictive model which shows credit's predictive capacity.

<sup>7</sup> To use a medical analogy, considering only the recessions observed is like conducting a pathological examination of recessions rather than a clinical medical analysis: the fact that a particular feature has been identified in a patient prior to his or her death does not mean that this feature was the cause of death or that all patients sharing this feature will die.

We use one of the most standard models in the literature – Hamilton’s Markov Chain model (1989) – to describe recessions and expansions in real time. This model considers the GDP growth rate to fluctuate around two different values according to whether the economy is in expansion or recession. To capture the momentum of recessions and expansions, their dynamics are also considered to follow a Markov Chain process, such that there is a constant probability ( $p$ ) that an expansion will be followed by another expansion and a constant probability ( $q$ ) that a recession will be followed by another recession. In this context, if credit is really able to predict the occurrence and nature of recessions, a statistically significant relationship should be found between the GDP growth rate and credit, or between the probabilities just described ( $p$ ,  $q$ ) and credit, i.e. that credit should affect either the expected growth rate in recessions and expansions (or the amplitude of recessions and expansions, which amounts to the same thing) or the probability of exiting these periods (or, in other words, the expected duration of recessionary and expansionary periods).<sup>8</sup>

Given that the number of recessions observed in each country is small (eight, for example, in the United States), the foregoing model’s estimate for each country in isolation is insufficiently powerful to enable confirmation of the hypothesis of credit’s predictive capacity, in particular, as regards its ability to predict the probability of entering into recession. It is therefore necessary to mix recessions and use the relationship between credit and the cycle at each point in time in all the economies in the sample. To do so, various statistical procedures have been designed that use information from other countries in order to infer the occurrence of a recession in the country in question.<sup>9</sup> With these procedures, in the case of certain countries the description of the turning points improves substantially with respect to the univariate per-country model, and in others they coincide almost precisely. In the case of the United States the probability of recession on the two methods – that using only data on the United States and that which uses aggregate data – offer a similar profile, basically describing recessions reported by the NBER. In the cases of France and Spain, the one-country model explains the recessions obtained by the standard cyclically dated descriptive methods very poorly, whereas the predictive power of the model combining countries, by contrast, is such that it yields much better descriptions of the crises (see Chart 2). Using the aggregate data from all the economies, the method combining information explains each country’s future recessions better, and this improvement is statistically significant.<sup>10</sup>

The best model being that which combines information from various countries, it was in this model that credit was introduced into the estimate of the GDP growth rate and the probabilities of a transition between expansion and recession. The results suggest that credit affects both the scale of growth in the expansions and recessions, as well as the probability of remaining in a particular state (see Table 1). Nevertheless, this result has to be treated with caution. Firstly, using the data for the period up to 2007 these coefficients are not significant, which indicates that it is a phenomenon associated only with this latest recession. Secondly, trying to use this model to predict future recessions and expansions – or the characteristics

8 Formally the model would be:  $\gamma_t = \mu_t \delta_t + e_t$  where  $\gamma_t$  is the GDP growth rate, and

$E(\gamma_t / CR_{t-1}) = \mu_1 + \alpha_1 CR_{t-1}$ . If the economy is expanding

$E(\gamma_t / CR_{t-1}) = \mu_0 + \alpha_0 CR_{t-1}$ . If the economy is in recession

$p_t = p + d_1 CR_{t-1}$

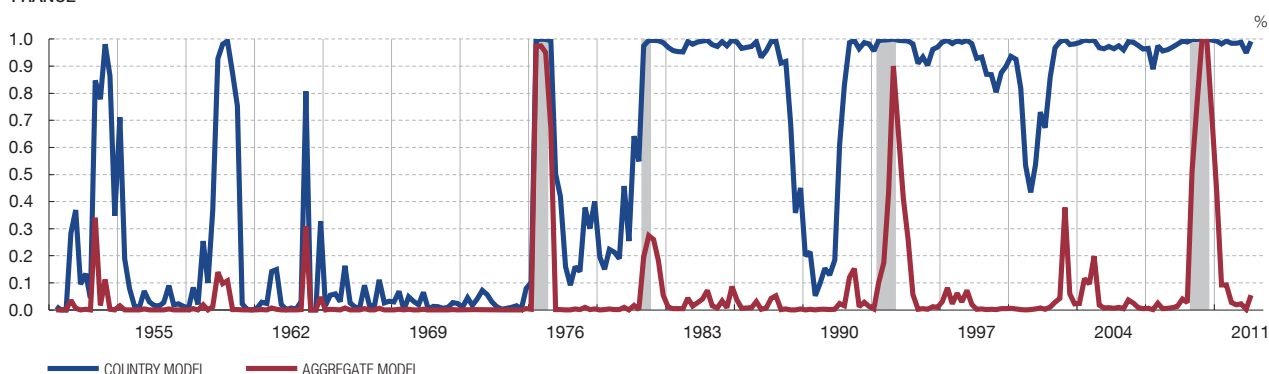
$q_t = q + d_0 CR_{t-1}$

where  $CR_{t-1}$  is the level of credit in period  $t-1$ . Credit will have information value if the alpha or delta parameters are significant.

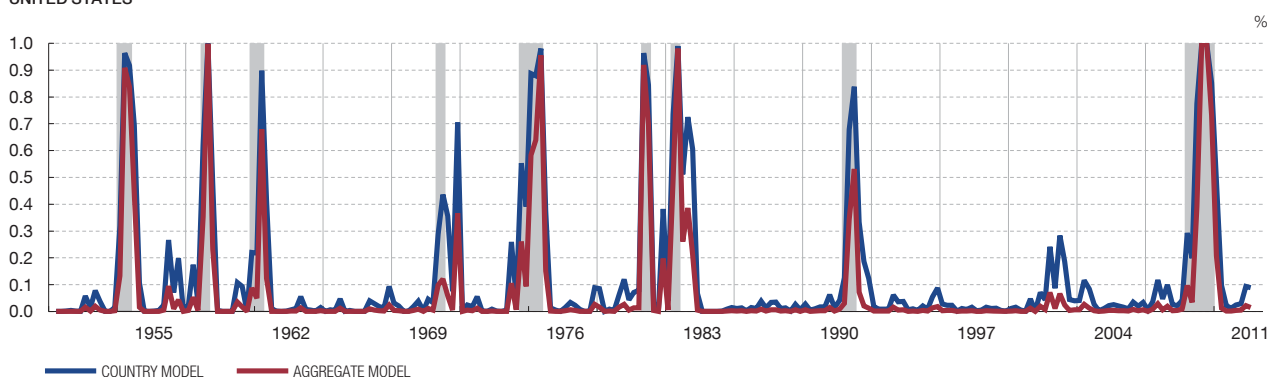
9 For more details, see Gadea and Pérez Quirós (2012). A Bayesian interpretation of this approach is that a univariate model is estimated for each period for country by imposing a set of priors associated with the average behaviour of these coefficients in the rest of the economies, in order to reduce the standard deviations and so be able to make an inference using a more powerful test.

10 The p-value of the Diebold and Mariano test (1996) is 0.00.

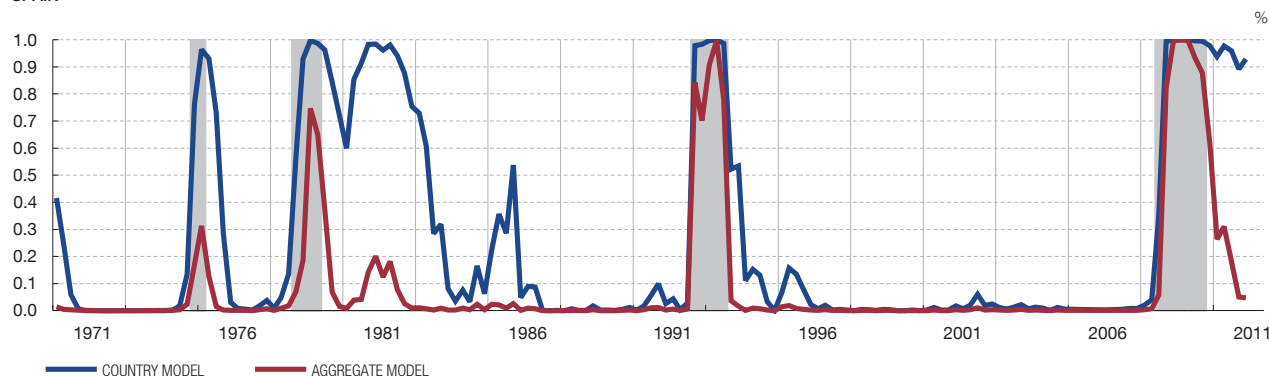
FRANCE



UNITED STATES



SPAIN



SOURCES: IMF and NBER.

of the economic cycle – yields no improvement on predictions in years outside the sample. Lastly, the estimated coefficients are not robust when the duration of the recession or expansion (a standard variable in this type of model) is introduced as an explanatory variable.

**Conclusion**

One consequence of the recent financial crisis and its considerable negative impacts on the real economy has been the call for more attention to be paid to financial variables in economic forecasts and when macroeconomic stabilisation policies are contemplated. Specifically, credit growth has been singled out as a harbinger of future recession and

$\mu_1$	$\mu_2$	$\sigma^2$	$\rho$	$\eta$	$d_1$	$d_2$	$a_1$	$a_2$
Model with fixed mean and transition probabilities								
0.87 (0.019)	-1.84 (0.112)	1.01 (0.026)	0.97 (0.010)	0.60 (0.3804)				
Model with variable mean and fixed transition probabilities								
1.15 (0.037)	-1.41 (0.194)	0.99 (0.026)	0.97 (0.010)	0.60 (0.037)			-0.37 (0.043)	-0.50 (0.215)
Model with fixed mean and variable transition probabilities								
0.87 (0.019)	-1.84 (0.12)	1.01 (0.027)	0.97 (0.00)	0.50 (0.068)	-0.04 (0.003)	0.11 (0.057)		

SOURCES: IMF and NBER.

numerous recent studies have tried to identify an underlying causal relationship between credit growth and the occurrence of a recession. In the macroeconomic supervision exercises undertaken by international institutions, more and more attention is being paid to how credit is evolving and early-warning mechanisms are being considered in which this variable plays an important role.

Nevertheless, the foundations on which the causal relationship between credit and the occurrence of recessions is based are somewhat weak. This paper has set out a number of points concerning the interpretation of the statistical association between credit and recession, and has put forward an alternative approach which, by overcoming some of the technical limitations of earlier studies, yields results suggesting that the relationship between credit and the occurrence of recessions, if it exists, is very weak, although it has materialised in the latest recession. This raises doubts about its possible use in the design of economic policy, and at the very least, suggests that there are no grounds for introducing credit as an explanatory variable in models predicting turning points in the economic cycle. In short, the empirical evidence – particularly that existing in 2007 – offers only limited support for the idea that economists' ignorance of the consequences of credit on the economic cycle might have had an important role their failure to anticipate the current crisis.

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