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Assessing the Sustainability of Credit Growth: The case of Central and Eastern European Countries

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Abstract

Credit growth rates as high as 30% or 50% a year were observed in some Central Eastern European countries (CEECs) in 2006-2007, such as the Baltic States, Bulgaria or Romania. This strong credit growth could have been due to the catching-up process but could also have been excessive, paving the way to the credit crunch that followed the crisis in 2008-2009. We try to assess the excessiveness of credit by applying a number of methods. First, we consider the gap between current credit and its long-term trend and we find some signs of credit booms, in several CEECs in 2005-2007. Second, we assess the "normal" growth of credit with regard to fundamentals through econometric estimations. Credit growth is also shown to have been excessive in several countries just before the 2008-2009 financial crisis.

JEL codes: E30, E51, G21

Key words: credit boom, transition, financial development

1. Introduction

Credit booms are generally identified as a key factor behind financial crises, in particular in the emerging countries, as they tend to fuel excessive demand, inflationary pressures and speculative asset price bubbles. In this view, the severe financial crisis that hit some of the central and eastern European countries (CEECs) in 2009 could be attributed to previous excesses. Although the crisis was clearly triggered from abroad by the global financial turmoil, its severity is likely to have overwhelmed the mere contagion effects, especially in the Baltic States. In those latter countries, credit was soaring by 40% to 70% a year in 2006-2007, and has subsequently dried up in 2009. Most other CEECs have followed the same pattern, although with less extreme variations.

An important question is therefore whether the credit growth had been in excess in the CEECs in the years preceding the 2008-2009 financial crisis. This question is justified since credit growth has been shown to often precede credit crunches and financial crises. (Kaminsky and Reinhart, 1999). The theoretical literature on bubbles gives rationales for that, as leverage amplifies speculative behaviour as shown for example by Allen and Gale (2000). However, assessing the excessiveness of credit is tricky, especially in the case of the CEECS, because of their particular economic situation. As they are meant to catch up rapidly with the previous EU members, their levels of capital, productivity and income are converging towards those of advanced countries. Against this backdrop, it is not surprising that credit growth had been

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particularly strong, exacerbating external deficits and debt (Duenwald et al., 2005, Coricelli et al., 2006, Diev and Pouvelle, 2008).

Hence, the strong credit growth that was observed in the CEECs can be interpreted in two ways. First, it may have been part of a normal catching-up process. At the start of transition, between 1991 and 1993, the existing credit stock was eliminated by hyperinflation in some countries (in particular Poland and the Baltic States). Then, during the stabilisation phase, the pace of financial liberalisation and financial deepening steadily picked up. For instance, in 1997, the level of credit stock of these economies was still very low in percentage of GDP: less than 20% in the Baltic States, Poland and Romania (compared with, for example, 82% in France and 106% in Germany in the same period). Second, credit growth may also have been excessive, resulting in an overheating of the economy and inflationary pressures. This could be a concern for some of these countries that are expected to adopt the euro in the future and must therefore comply with the Maastricht convergence criteria, in particular the price stability criterion.

Two types of approach are used in economic literature to identify credit booms. The first is a purely statistical approach, based on deviations of credit series from their long-term trend, such as in Gourinchas et al. (2001), Tornell and Westermann (2002), IMF (2004) and Sa (2006). The second is econometric and seeks to explain the level of credit or credit growth as a function of economic fundamentals (Cotarelli et al. (2005), Boissay et al. (2005), Egert et al. (2006), Kiss et al. (2006)).

This article applies both types of approach using a large sample of emerging and developed countries, with a view to identifying a behaviour pattern that may be specific to countries of eastern and central Europe. The goal we pursue by using alternative calculations is to determine which one seems to be the better indicator of excessive credit growth. In the statistical approach, we test possible thresholds and indicators to define credit boom periods. In the econometric approach, we use an error-correction model. We first determine the equilibrium level of the credit/GDP ratio corresponding to the fundamentals in the sample as a whole. If the credit/GDP ratio has not yet reached its estimated equilibrium level in CEECs, the rapid credit growth may stem from the catching-up process. Credit growth is then explained as a function of deviations of the credit/GDP ratio from its equilibrium level, estimated in the previous stage, and other macroeconomic variables such as the growth of GDP per capita. An error-correction model had already been used by Boissay et al. (2005). Here, we use a large reference sample including both developed, emerging and transition countries in order to take account of the interactions between the initial level of credit and the speed of convergence towards the new long-term equilibrium.

The rest of the paper is organized as follows. Section 2 compares the credit/GDP ratio and real credit growth with their long-term trend; beyond a certain threshold, positive deviations are classified as credit booms. In Section 3, we provide econometric estimates of the credit/GDP ratio relative to macroeconomic variables and estimate the credit growth rates; we then compare the estimated values with the observed figures in the CEECs in 2007 and 2008.

2. Deviations from the long-term trend

2. 1 The principle

Comparing time series with their long-term trend is a straight way to identify outstanding observations. The time series is decomposed into its long-run and short-run components by a filtering method, the most popular being the two-sided linear Hodrick-Prescott (1980) filter. In the case of credit, if a credit indicator significantly exceeds its long-term trend at a certain date, this can be considered as signalling a credit boom. In the following, we present this methodology by generalising the method adopted by Gourinchas, Valdès and Landerretche (2001), IMF (2004) and Sa (2007). These different studies vary according to the credit indicators used, the way in which deviations from trend are calculated and thresholds defined.

2.1.1 The credit indicator used

Credit boom periods are generally estimated by using panel data, since too few of these events occur in a single country. The sample covers a set of countries, denoted $i = 1,.., n$, over a period $t = 1,.., T$.

The first relevant indicator is the credit/GDP ratio, as a percentage, denoted $c_{1,i,t}$:

$$c_{1,i,t} = 100 * C_{i,t} / Y_{i,t} \quad (1)$$

where C_{it} denotes the outstanding stock of loans of country i at date t, and Y_{it} its GDP. This is the indicator used by Gourinchas, Valdès and Landerretche (2001).

The second possible indicator is the real credit growth rate:

$$c_{2,i,t} = 100\left[\frac{C_{i,t}/C_{i,t-1}}{1+\pi_{i,t}} - 1\right] \quad (2)$$

where $\pi_{i,t}$ denotes the inflation rate of country i in time t. Tornell and Westermann (2002), IMF (2004) and Sa (2007) use this indicator.

2.1.2 Calculating the deviation from the trend

The long-term trend, denoted $\breve{c}_{k,i,t}$ for $,k = 1,2$ is generally estimated by a Hodrick-Prescott (HP) filter. In this paper, we also use a fixed-length symmetric band-

pass Baxter-King (1999) filter (BK). The deviation from the long-run trend is equal to the difference between the indicator and its trend.[3]

$$e_{k,i,t} = c_{k,i,t} - \breve{c}_{k,i,t} \tag{3}$$

It is therefore expressed as a percentage, corresponding to GDP percentage points, for $c_{1,i,t}$ and real growth points for $c_{2,i,t}$.

By definition, we consider that a credit boom is identified at period *t* in country *i* if and only if the deviation $e_{k,i,t}$ exceeds a certain threshold $S_{k,i}$.

$$e_{k,i,t} > S_{k,i} \tag{4}$$

The thresholds $S_{k,i}$ are set either separately for each of the countries or are the same across the sample, depending on the method used. We construct a dummy variable, denoted $I_{k,i,t}$, that indicates the credit boom being equal to 1 when the country experiences a credit boom, and to 0 otherwise.

$$I_{k,i,t} = 1, \text{ if } e_{k,i,t} > S_{k,i}$$
$$I_{k,i,t} = 0, \text{ otherwise.} \tag{5}$$

2.1.3 The two methods for defining the thresholds

By varying the threshold $S_{k,i}$, the definition of the credit boom is more or less restrictive: the higher the threshold, the rarer the cases of credit booms. The thresholds can be defined in two ways.

The first method defines them for each country individually as a multiple of the standard deviation of credit fluctuation around the trend:

$$S_{k,i} = a\sigma_{k,i} \tag{6}$$

[3] For the credit/GDP ratio, the deviation may also be defined in relative terms: $\tilde{e}_{kit} = (c_{kit} - c^{P}{}_{kit})/c^{P}{}_{kit}$. The results are not presented here for the sake of brevity but are very close to those displayed thereafter.

where σ_{ki} denotes the standard deviation of the credit fluctuation around the trend for country i, *a* is an arbitrarily chosen coefficient. The IMF (2004) uses this approach by setting the coefficient *a* at 1.75. A credit boom is thus defined as credit growth that exceeds its long-term trend by 1.75 times the standard deviation of the fluctuation around the trend. With this figure, assuming a normal distribution there would be a 5% probability that the gaps would lie above the threshold, which yields 5% of credit booms in the sample.

The second method consists in calibrating thresholds to obtain a given proportion *p* (0<p<1) of boom episodes in the sample.

$$S_k \text{ such that } \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=1}^{T} I_{kit} = p \qquad (7)$$

In this case, the threshold is set as a single value for all countries. Note that for each given proportion of crises *p*, Equations (5) and (7) implicitly defines a unique value of the threshold S_k. This is the method used by Gourinchas, Valdès and Landerretche (2001), who take a sample of 91 countries over the 1960-1996 period and set different thresholds in order to obtain a given number of booms.

Another more expeditious technique consists in choosing arbitrary thresholds for the credit growth in all countries (Tornell and Westerman, 2002). These authors take three different definitions of a boom: period of cumulative real credit growth over the two previous years of more than 20%, 30% and 40%, based on a sample of 39 countries, over the 1980-1999 period.

2. 2 Estimates

For each country, we consider two indicators: the credit/GDP ratio and real credit growth.[4] We estimate their long-run trend using a Hodrick-Prescott filter and a Baxter-King filter successively.[5] Then we calculate the deviations from trend. We identify credit boom periods by setting the thresholds using the two methods described above. The results being very similar with the two filters, we only report the results obtained with the HP filter in the following tables and graphs.

2. 2.1 The sample

The sample includes 52 countries: 21 developed countries, 17 emerging countries outside Europe and 14 emerging countries in within Europe. This latter group of 14 countries that covers central, eastern and south-eastern Europe is referred to as the

[4] Real credit growth is calculated in year-on-year terms to eliminate seasonality problems and because it is less volatile than quarter-on-quarter evolutions.

5 We apply the usual parameters for quarterly series, a smoothing parameter of λ = 1600 for HP and the values recommended by Baxter-King (1999) for BK.

CEECs in the following. The list of all countries as well as data sources are given in Appendix 1. Data are quarterly. For most countries, they span over 1980:q1 to 2008:q2 or 2008:q3, depending on data availability; for the CEECs, they start in 1993:q1. Given the lags required to calculate the year-on-year data and the long-term trend, the estimate only starts four years after the date of data availability. The series used for credit is the stock of domestic bank loans to private sector residents.

2.2.2 Thresholds that depend on the variability of credit in each country

In the first approach, we construct an interval proportional to the standard deviation around the trend in order to define the threshold (as in Equation (6)).[6] We identify 5% of credit booms for the credit/GDP ratio in the overall sample and 4.3% for real credit growth (Table 1).

Table 1: Percentage of booms identified with method 1 (*)

Country Groupings	Number of observations	Credit/GDP	Real credit growth
Total sample	4,096	5.0%	4.3%
Developed countries	2,067	5.0%	4.8%
Emerging countries	2,029	5.0%	3.8%

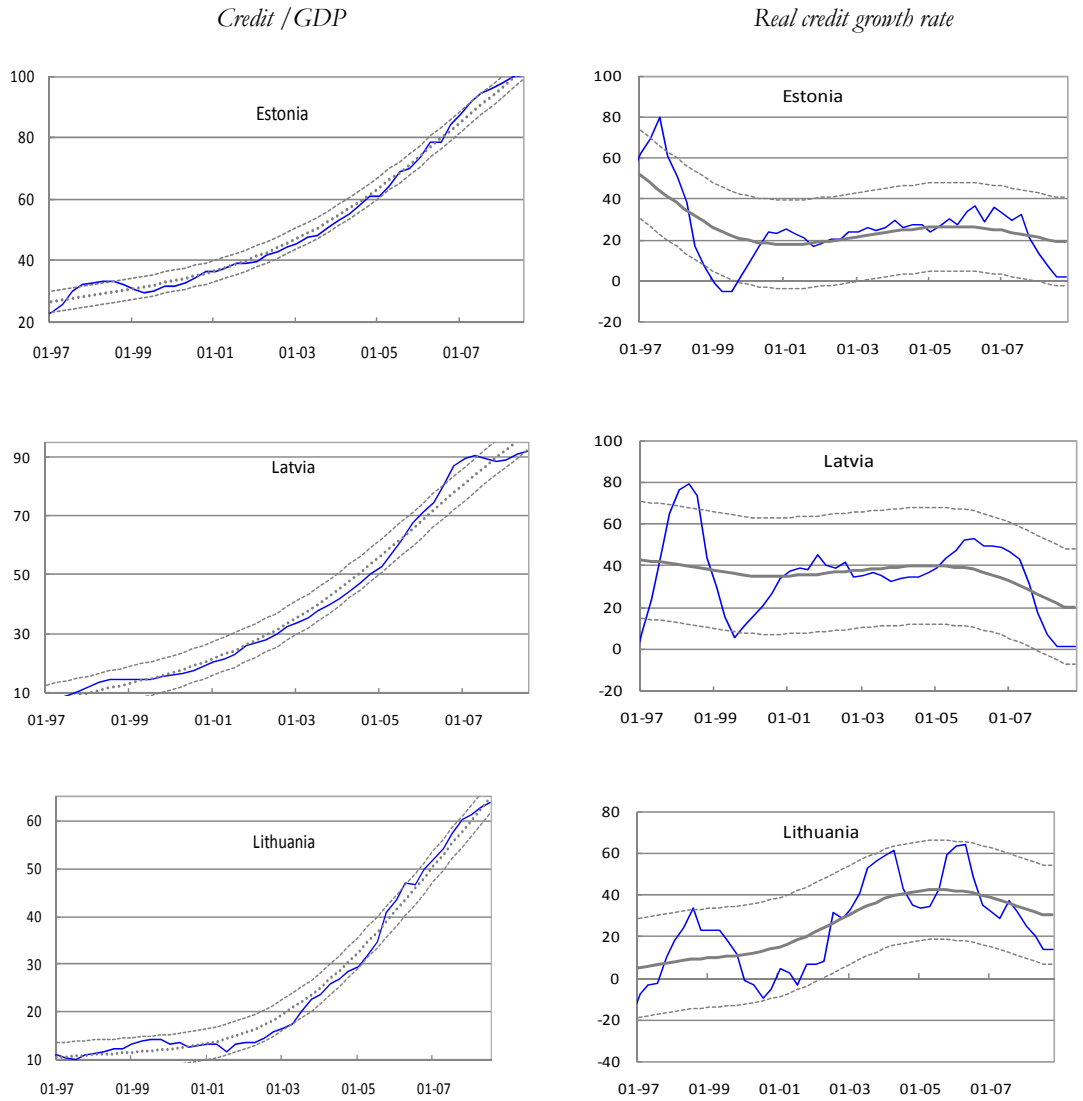
Note: (*) Booms are defined as observations exceeding their trend by more than 1.75 times their standard deviation.

Source: Authors' calculations, based on IMF data.

If, for one of the countries, an indicator is above the interval, this period corresponds to a credit boom. This is indeed the case in the Baltic countries by the end of the period for the credit/GDP indicator, as shown by Charts 1, left-hand column. Appendix 1 presents the results for all countries and shows that this situation also occurs in a number of other CEECs.

6 We use a parameter of 1.75 as the IMF (2004).

Chart 1: Credit/GDP and real credit growth for the Baltic countries, observed value, long-term trend and interval of 1.75 times the standard deviation around the trend, in %.



Source: IMF's International Financial Statistics and authors' calculations.

The dates of credit boom episodes in the CEECs according to the two indicators are listed on Table 2. The credit/GDP ratio shows booms in several CEECS at the end of the period (from 2006 on). This is the case for the three Baltic States (see also Charts 1, left-hand column), Hungary, Poland, Romania, Slovenia, Albania and Macedonia. The results obtained by the BK filter confirm this list of countries and also add the Czech Republic as experiencing a credit boom in early 2008. These assessments are in line with those made by observers of these markets (in particular Boissay et al. (2005), Egert et al. (2006), and Kiss et al. (2006)).

Table 2: Dates of credit booms identified in CEECs with method 1 (*)

	Credit/GDP	Real credit growth
Baltic states		
Estonia	1997:4-98:2; **2007:2 -3**	1997:3
Latvia	**2006:4- 2007:2**	1998:1-3
Lithuania	2006: 2	-
Central Europe		
Czech Rep.	2001 :2	-
Hungary	**2006:2-3** ;**2008:1**	2000:3-4
Poland	**2008:2-3**	**2007:3**
Slovakia	2000:3-4	1997:1-2; 2002:3
South-Eastern Europe		
Bulgaria	-	1998:4-1999:2
Romania	**2007:4-2008:3**	-
Balkans		
Albania	**2007:4-2008:2**	2005:3-4; 2005:3
Croatia	1998:2-4	1997:4-1998:1
Macedonia	1997:4-1998:1; **2008:3**	1999:3-4
Serbia	2000:3-2001:1	2000:2-4
Slovenia	**2006:3-4**	1998:4-1999:2

Note: (*) Booms are the observations exceeding their trend by 1.75 times the standard deviation, 1997:1-2008:3. In bold, the booms identified during the period 2006-2008.

Source: Authors' calculations, based on IMF data.

The conclusions would be different if we considered real credit growth. There would be hardly any credit booms in the CEECs in the recent period, as shown in Table 2, but also on Charts 1, right-hand column for the Baltic countries, and on the Charts A1 in Appendix 1 for the other CEECs. Table 2 shows that credit booms obtained by this indicator are mainly concentrated at the start of the period (1997 or 1998) (Albania, Bulgaria, Croatia, Estonia, Romania, Slovakia and Slovenia), except Poland. The gap between the results found with the two indicators may seem strange; however it can be explained simply because credit growth was particularly strong at the start of the period in transition countries, owing to the very low initial credit stocks. In this context, real credit growth appears "excessive" at the start of the period.

For this reason, credit growth is probably not a good indicator. Another drawback of credit growth rates is their high sensitivity to the business cycle; this is particularly the case for deviations from trend as well. Economic slowdowns and episodes of credit

rationing may result in a negative bias, which would lead to credit booms being incorrectly identified as soon as a recovery starts. Very low growth rates may thus appear to be credit booms if they are preceded by a period in which the growth rate was negative.[7] Use of the growth rate indicator therefore generates biases, which could be avoided by using the credit/GDP ratio. This is why the latter variable seems more relevant for signalling possible credit market booms.

2.2.3 Calibrated thresholds to identify a given percentage of booms

In the second approach, instead of using standard deviations, we identify a threshold beyond which the deviation of credit from its long-term trend gives a certain percentage of booms in the sample. We calculate for different given frequency of booms the corresponding thresholds that we have to apply (Table 3). For instance, suppose that we wish to obtain 5% of booms in the sample, as previously, which corresponds to a boom per country every 20 years. In this case, we find that the credit/GDP indicator must exceed its trend by at least 5% and the corresponding threshold is at 12.7% for the real credit growth (Table 3).

The results of the two methods may therefore be made equivalent in terms of the number of credit booms identified. Setting the threshold at 1.75 times the standard deviation or an interval of 5 percentage points for the credit/GDP ratio, or 12.7% for real credit growth gives the same proportion of 5% of booms in the sample. The two methods nevertheless give different results in terms of individual observations, for the thresholds are calculated individually for each country in the first method, while they are the same across all the countries, in the second one.

Table 3: Thresholds for defining credit booms with method 2 (*)

% of credit booms in the sample	credit/GDP	real credit growth
1%	13.0%	28.4%
2%	9.2%	22.1%
3%	6.9%	18.2%
4%	5.6%	14.5%
5%	5.0%	12.7%
10%	3.2%	7.9%

Note: (*) Booms are defined as the observations exceeding their trend by the threshold indicated in the 2nd and 3rd columns. For example, the first line indicates that there are 1% of credit booms in the sample if a boom is defined each time the credit ratio exceeds its trend by 13% (of GDP), and real credit growth by 28.4%.

Source: Authors' calculations, based on IMF data.

7 This is the case in Bulgaria, 1998:04-1999:02, Slovakia 1997:01-02 and 2002:03, Macedonia 1999:03-04 and Serbia 2000:04.

In fact, the results are different from those obtained previously (Table 4). Over the most recent years of the period, only Latvia, Bulgaria and Romania are identified as experiencing a credit boom using the credit/GDP indicator. There are much fewer CEECs showing credit booms than in the previous approach. Conversely, the credit growth indicator detects a credit boom in Latvia, Lithuania, Slovakia, Bulgaria, Albania and Serbia in the recent period, while this was not the case before. This means that real credit growth exceeds its long-term trend by more than 12.7% in these countries. In comparison, we can therefore conclude that the threshold previously calculated on a country-by-country basis (1.75 times the standard deviation) was greater than 12.7%, due to the high credit volatility in these three countries. The first method that sets the thresholds by country seems therefore to be more relevant for identifying credit booms.

Table 4: Dates of credit booms identified in CEECs with method 2 (*)

	Credit/GDP	**Real credit growth**
Baltic states		
Estonia	-	1997:3-1998:1
Latvia	**2006:3-2007:2**	1997:4-1998:4; **2006:1-07:2**
Lithuania	-	1998:3-1999:4; 2003:4-2004:3; **2006:1-3**
Central Europe		
Czech Rep.	-	-
Hungary	-	2000:4-2001:1
Poland	-	-
Slovakia	1999:4; 2000:2-4	1997:2-1998:1; 2002:4-2003:1; **2006:1**
South-Eastern Europe		
Bulgaria	2005:1; **2008:2**	2003:2; 2005:3-**2006:2; 2007:2**
Romania	**2008:2**	1998:3-1999:2; 2002:1-4; 2003:4-2004:2
Balkans		
Albania	-	2000:4; 2002:1; 2005:3-**2006:2**
Croatia	-	1998:1-3; 2003:1-2
Macedonia	-	1999:4-2001:1
Serbia	2000:1-2001:4	2000:2-4; 2003:2-4; 2005:2; **2006:1**
Slovenia	-	-

Note: (*) Booms are defined as observations exceeding their long-term trend by 5 % for the credit/GDP indicator and 12.7% for the real credit growth over the period 1997:1-2008:3. In bold, the booms identified during the period 2006-2008.

Source: Authors' calculations, based on IMF data.

2.3 Credit booms and busts

Episodes of booms and busts, which are typical in financial markets, are also observed in credit distribution. Phases of investor euphoria are followed by sudden surges in risk aversion, as the loans taken out turn out to be less profitable than expected. The 2007 subprime crisis in the US is a typical case in point, as it basically stems from an excess credit distribution in 2005-2006 to insolvent lenders. The same pattern was reproduced in many countries at the same time, or with some lag. In the CEECs, credit soared in 2006-2007, and then collapsed in late 2008 and 2009.

Empirical literature shows that banking crises are typically preceded by lending booms, but the reverse is less true as few lending booms end in a banking crisis (Gourinchas et al. (2001), Tornell and Westermann (2002), Bordo and Jeanne (2002), Borio and Lowe (2002), and IMF (2004)). Rapid credit growth therefore generally appears to be a necessary but not a sufficient condition for a credit crisis.

In order to be in line with this observation, a good credit boom indicator should therefore detect fewer boom periods followed by contractions than contraction periods preceded by a boom. We verify this for our preferred indicators constructed in 2.2.2 by taking a definition for credit busts symmetrical to that of credit booms. We consider that there is a credit bust when credit contraction exceeds 1.75 times the standard deviation of the fluctuation below the trend. Episodes of credit contraction may therefore be seen in Chart 1 when the indicator exceeds the interval below the trend.

Overall, for the credit/GDP ratio, the percentage of credit booms followed within two years by a bust is 19% (Table 5). This percentage can be interpreted as an empirical probability that a credit boom is followed by a bust. The probability that a bust is preceded by a boom is higher, i.e. 30%. This is in line with expected results. For the real credit growth indicator, however, both probabilities are more or less the same, i.e. 24%. These results confirm our preference for the indicator based on the credit/GDP ratio.

Table 5: Probability of a credit bust in the two years following a boom and vice versa (*)

% of booms followed by a bust	
Credit/GDP	Real credit growth
18.6	24.1
% of busts preceded by a boom	
Credit/GDP	Real credit growth
30.0	23.6

Note: (*) Booms (busts) are the observations corresponding to deviations from (below) the trend that exceed 1.75 times the standard deviation; the sample includes 52 countries. Source: authors' calculations, based on IMF data.

2.4 Limitations of the method

The main criticism that can be made of the calculations based on credit growth rates is that they do not take account of the initial level of credit. Logically, when defining a threshold for the credit growth rate, it is important to consider whether the initial level of credit is high or low. In particular, it is normal that the financial deepening, which accompanies the catching-up of emerging countries, causes a temporary acceleration in credit growth, as they generally start from a very low level.

In this respect, the credit/GDP ratio may be a more reliable indicator. However, the calculations are not without flaws, since estimating long-term trends using filtering methods may lack robustness for short series. This problem is particularly acute for the transition countries. All in all, credit boom indicators based on a purely statistical approach can give useful warnings but should be cross-checked with other methods.

3. Credit indicators as a function of fundamentals

3. 1 Rationales for the approach

The credit/GDP ratio tends to increase along with financial and economic development. Therefore, it is likely to increase in the CEECs in line with real convergence. This is why we adopt a two-stage approach. In the first stage, we estimate the credit/GDP ratio as a function of a number of fundamental variables, in particular the level of economic development. The fitted value of this ratio is considered to be the "normal" value or the equilibrium level relative to fundamentals. If the observed ratio is below this fitted value, the country should "catch up" with the normal level through a higher credit growth rate. If not, a high growth rate in credit cannot be justified by a catching up effect. In the second stage, the change in the GDP ratio is explained by several economic fundamentals and by the deviation of the credit/GDP ratio from its "normal" value. We therefore use an error-correction model.

A number of studies have already adopted this type of approach. Some have attempted to define credit/GDP ratios that are compatible with economic fundamentals (Cottarelli, Dell'Ariccia and Vladkova-Hollar, 2005; Egert, Backé and Zumer, 2006). To do so, the ratio is regressed on a set of explanatory variables generally including: per capita GDP in PPP, public debt, inflation, interest rates, etc. Qualitative variables are sometimes added, such as financial deregulation, countries' legal systems, etc. However, these studies do not estimate the credit growth rates. Two recent studies use an error-correction model to estimate a long-run relationship between the variables in levels and explain the credit growth rates themselves. Kiss et al. (2006) estimate long-term growth in credit/GDP ratios, but do not display their simulations. Boissay et al. (2005) attempt to directly model the credit growth rate using fundamentals; they use both a linear and a quadratic trend and find an overshooting in this way. Table 6 summarises the methods used in the main studies.

Table 6: Characteristics of studies using an econometric approach (*)

	Sample of countries	**Methodology**	**Dependent variable**	**Explanatory variables**
Cottarelli, Dell'Ariccia and Vladkova-Hollar (2005)	24 developed and emerging, excluding transition countries	panel estimation and cointegration	Credit/GDP	Public debt/GDP, PPP-GDP pc, INF threshold, financial liberalisation, entry restrictions to the banking sector, accounting standards and legal origin
Egert, Backé and Zumer (2006)	Small open OECD, Asian and Latin-American emerging countries	fixed effects OLS, DOLS, mean group estimator	Credit/GDP	PPP-GDP pc, credit to public sector/GDP, short and long IR, INF, house price, financial liberalisation, credit registries
Coricelli et al. (2006)	10 CEECs	Fixed effects GMM / panel EGLS	Real consumption growth Real credit growth rate	- IR on household credits, real GDP growth, interaction term / - lagged credit growth, lagged IR
Duenwald et al. (2005)	21 developed countries, EU New Member States	Panel estimation with fixed effects GLS	Trade balance/GDP	trade balance, lagged public balance, lagged credit flows, GDP growth
Diev and Pouvelle (2008)	11 CEECs	GMM	Current account /GDP	Nominal credit flows/GDP, public balance/GDP, net FDI/GDP.
Kiss et al. (2006)	Euro area countries	ECM PMG	Credit/GDP ratio	PPP-GDP pc, RIR, INFL
Boissay, Calvo-Gonzales and Kozluk (2005)	11 developed / 8 transition countries	ECM for individual countries and panel estimation	Credit/GDP Credit growth rate	- RIR, deterministic trend - GDP growth rate, real interest rate, gap between observed and estimated credit/GDP ratio
This paper	52 countries: 21 developed, 17 emerging + 14 CEECs.	ECM	Credit/GDP Credit/GDP growth rate	- PPP-GDP pc, RIR, net capital inflows/GDP, stock capitalisation/GDP, exchange rate regime, legal origin

Note: ***(*)*** *IR stands for the interest rate, RIR for the real interest rate, INFL for inflation, pc for per capita.*

3.2 Estimate of the credit/GDP ratios

We now try to assess the "normal values" of the credit/GDP ratio as a function of the fundamental variables of each country. As we aim at finding a common framework for all countries, the coefficients of the model will be common to a whole set of countries, which implies a panel estimation.

3.2.1 The explanatory variables

The model is derived from a credit supply and a credit demand equation. The explanatory variables are those that are the most frequently used in the economic literature. The model is expressed as:

$$\log(c_{i,t}) = \alpha_{0,i} + \sum_{m=1}^{M} \alpha_{m,i} X_{m,i,t} + \varepsilon_{i,t} \tag{8}$$

where $c_{i,t}$ is country *i*'s credit/GDP ratio for time *t*[8], $\alpha_{0,i}$ denotes a constant that possibly depends on the country *i,* $\alpha_{m,k}$ m=*1,…M,* denote the M coefficients common to all countries, $X_{m,i,t}$ represent the economic fundamental variables, and the $\varepsilon_{i,t}$, the residuals of the equation.

The supply variables are as follows:

- net capital inflows, provided by the financial account of the balance of payments, relative to GDP, $n_{i,t}$, which should stimulate the supply of credit; a positive relation is therefore expected;
- the origin of the legal system, LS_i, taken from La Porta et al. (1998), extended to transition countries by Djankov et al. (2005). La Porta et al. suggest that Anglo-Saxon legal systems, grounded in jurisprudence, promote financial development, followed by German and Scandinavian systems, since they better protect the creditors' rights. Conversely, those based on the French legal system result in weaker financial institutions. We set the value of this variable at 2 for countries with an Anglo-Saxon legal system, at 1 for those with a German or Scandinavian system and at 0 for the French legal system. Thus, we expect a positive sign for this variable. Note that, as this variable is fixed across time, it is redundant with fixed effects.

The demand variables are as follows:

- GDP per capita in PPP, $\tilde{y}_{i,t}$, which represents the level of development of the country, taken in log. A positive coefficient is expected for this

[8] From now on, we remove the index k=1 present in equation (2), to simplify notations, as we only focus on the credit/GDP ratio.

variable, since the level of credit in an economy depends on the level of financial intermediation, which is in turn linked to the level of development;

- stock market capitalisation/GDP ratio, $cap_{i,t}$, which represents financial development and alternative sources of corporate finance. The sign is theoretically ambiguous since bank lending and market financing may appear either substitutional or complementary[9] . However, the relationship is less obvious in countries where credits to households are predominant

- an exchange rate regime variable $ERR_{i,t}$. We use the de facto classification of Levy-Yeyati and Sturznegger (2005), updated by the IMF classification. The variable increases in line with the rigidity of the exchange rate, i.e. 2 for countries with fixed exchanges rate, 1 for countries with intermediate exchange rate regimes and 0 for countries with floating exchange rates. On the one hand, we can expect a positive relationship between fixed exchange rates and credit growth, as domestic bank loans to private sector residents include foreign currency-denominated loans. Indeed, in emerging countries, if agents expect the nominal exchange rate to remain stable, they may borrow in foreign currency to take advantage of foreign interest rates that are often lower. In this case, domestic and foreign loans are not perfect substitutes: the lower interest rates on the foreign currency-denominated loans result in an overall increase in lending. On the other hand, fixed exchange rates constraint monetary policy, and may result in lower domestic credit. The sign of the coefficient on this variable is thus ambiguous.

Two other variables may pertain either to a demand or to a supply regime:

- the real interest rate, $r_{i,t}$, for which a negative sign is expected under a standard assumption of a demand-driven credit. However, a positive sign could be found if the monetary authorities react to a rise in credit by raising the interest rate. In this case, it will be the supply (or the endogenous reaction of the central bank) that determines the relation between credit and interest rate. The sign of the estimated coefficient will enable us to check which regime applies;

- a transition country dummy variable, $TRANSI_i$, added in order to observe any specific features of these countries relative to the rest of the sample, resulting from either demand conditions (boom in domestic demand), or supply conditions. In particular, in these countries, the strong presence of foreign banks, notably from the European Union, marked by an asset share in total bank assets frequently exceeding 80%, may be a factor

9 Depending on the estimation method used, the sign may be different: a more financially developed country will tend to record a larger credit stock and stock market capitalisation relative to GDP. However, if we control for the level of financial development, a country that chooses a market-based financing model should record a lower credit/GDP ratio than that of a country choosing a financial intermediation model.

influencing rapid credit growth owing to these banks' strategy to gain market share. A positive sign is therefore expected.

Assuming credit market equilibrium, the model to be estimated over a panel of countries is expressed as follows:

$$\log(c_{i,t}) = \alpha_{0,i} + \alpha_1 \log(\tilde{y}_{i,t}) + \alpha_2 r_{i,t} + \alpha_3 n_{i,t} + \alpha_4 cap_{i,t} + \alpha_5 EER_{i,t} + \alpha_6 LS_i + \alpha_7 TRANSI_i + \varepsilon_{it} \quad (9)$$

3.2.2 The sample

The sample covers the same 52 countries as in the previous section. It spans over the 1980:1-2007:2 period for the developed countries, and the 1993:1-2007:2 period for the emerging and transition countries. In this way, our estimation period ends just before the outburst of the world financial crisis originated in the US subprime market. Due to its deepness and its worldwide extension, this crisis cannot be considered as a "normal" event. Therefore, we did not deem it to be suitable to include in our reference period for the estimation of equilibrium relationships. The explanatory variables and their source are described in greater detail in Appendix 1.

An estimate based on a broad sample of countries seems appropriate for it enables us to resituate the CEECs countries vis-à-vis the rest of the world. A sample limited to the CEECs would only allow for a comparison within this area and would be less appropriate for detecting a possible credit bubble if it were common to the whole area. A broad sample of countries also compensates for the shortness of the time series of transition countries and provides a large number of observations. It allows the calculation of a worldwide standard, under the assumption that all countries in the world more or less share the same long-term equilibrium path.

It can be argued that the presence of the CEECs may bias the parameters downwards as they form a significant share of the sample and their credit ratio is particularly low. If so, it would be preferable to remove them from the sample. Therefore, we have made two successive sets of estimations: one over the whole sample, the other one over a reduced sample including all countries except CEECs.

3.2.3 Linear regressions on pooled data

We estimate equation (9) by an OLS linear regression on pooled data, successively without and with fixed effects. The results are presented in the first columns of Table 7. Several variables have significant coefficients: GDP per capita in PPP, the real interest rate, the exchange rate regime and net capital inflows (though not in the reduced sample). The origin of the legal system and the transition country dummy variable are also highly significant in the pooled regression, though they could not be included in the fixed effect estimations. All the coefficients have the expected sign. The variables for which we expected an ambiguous sign (interest rate and exchange rate regime) do not have the same sign in the two estimations, with and without fixed effects. Except for the coefficient on the exchange rate regime, the results are similar over the two samples.

3.2.4 Panel cointegration

There may be a caveat in these first estimates, as they are likely to be spurious if the series have a unit root and are not cointegrated. Firstly, we test the hypothesis of a unit-root by using several panel unit root tests: Levin, Lin and Chu (2002); Breitung (2000); Im, Pesaran and Shin (2003) as well as augmented Dickey-Fuller and Phillips-Perron tests (Table A3-1 in the Appendix). The results show that credit/GDP, PPP GDP per capita, and stock market capitalisation/GDP do have unit roots. The other significant variables, net capital inflows and real interest rates, are stationary. Therefore, only GDP per capita in PPP and stock market capitalisation/GDP may be retained as explanatory variables in a long-term relationship with the credit/GDP ratio. Secondly, we test the hypothesis of cointegration by using Pedroni (2004) tests (Table A3-2 in the Appendix). Both series are found cointegrated with the credit/GDP ratio.

The cointegration model is our preferred specification. We use the Fully Modified OLS for heterogeneous panels proposed by Pedroni (2001) to find the cointegration vector. It indicates a positive relationship between credit/GDP and PPP GDP per capita (second columns of Table 7). The cointegration vector between the series of credit/GDP and stock market capitalisation/GDP appears very unstable, since a closer look at the detailed results of the test shows that its sign changes across countries. We therefore prefer not to include it.

Here again, the estimated coefficients are quite close over the whole sample and the reduced sample. The coefficient on the GDP per capita is somewhat smaller in the reduced sample, but this is compensated by the greater intercept (see last column of Table 7). As a consequence, fitted values of credit levels are not so different, using one sample or the other. Therefore, we prefer to use the whole sample, as it is more informative, and also more consistent with the idea of a "world norm" including all countries.[10]

[10] Likewise, in our subsequent error-correction model for the estimation of credit growth, we carried out our regressions on two samples: the whole sample of 52 countries and a sample without transition countries. Overall, the level of significance of the estimated coefficients appeared to be higher in the whole sample, especially for the error-correction term (results can be provided on request). This finding confirms our preference for an estimation on the whole sample of 52 countries.

Table 7: Estimations of the credit/GDP ratio

Explanatory variables	Pooled OLS		Pooled OLS with fixed effects		Panel cointegration	
	Whole sample	Reduced sample	Whole sample	Reduced sample	Whole sample	Reduced sample
Constant	0.078 (0.6)	0.211 (1.4)	-	-	-0.164	1.90
PPP-GDP per capita (log)	0.385 *** (25.8)	0.369*** (23.5)	0.536 *** (36.8)	0.495*** (27.3)	0.44 *** (48.9)	0.24 *** (35.5)
Real interest rate	-0.003 *** (-2.3)	-0.002* (-1.8)	0.004 *** (7.0)	0.006*** (6.5)	-	-
Net capital inflows	0.003*** (2.4)	0.002 (1.1)	0.005 *** (7.2)	0.004 *** (6.2)	-	-
Market capitalisation/GDP	0.002 *** (9.6)	0.002*** (9.0)	0.000 (0.0)	0.000 (0.0)	-	-
Exchange rate regime	0.101 *** (10.0)	0.113*** (10.3)	-0.021 *** (-2.4)	0.041*** (5.1)	-	-
Legal origin	0.256 *** (21.2)	0.260*** (20.5)	-	-	-	-
Transition country	-0.567 *** (-20.3)	-	-	-	-	-
Adjusted R^2	0.50	0.452	0.89	0.91	-	-
SEE	0.46	0.47	0.24	0.19	-	-
Number of observations	2,785	2,397	3,178	2,397	3,959	3,222

*Notes: The whole sample contains 52 countries, the reduced sample leaves out the 14 CEECs. *** significant at the threshold of 1 %, ** 5% ; * 10 %. t-statistics in brackets. The intercept in the cointegration model is set so as to fit the mean of the sample. Source: Authors' calculations, based on IMF data.*

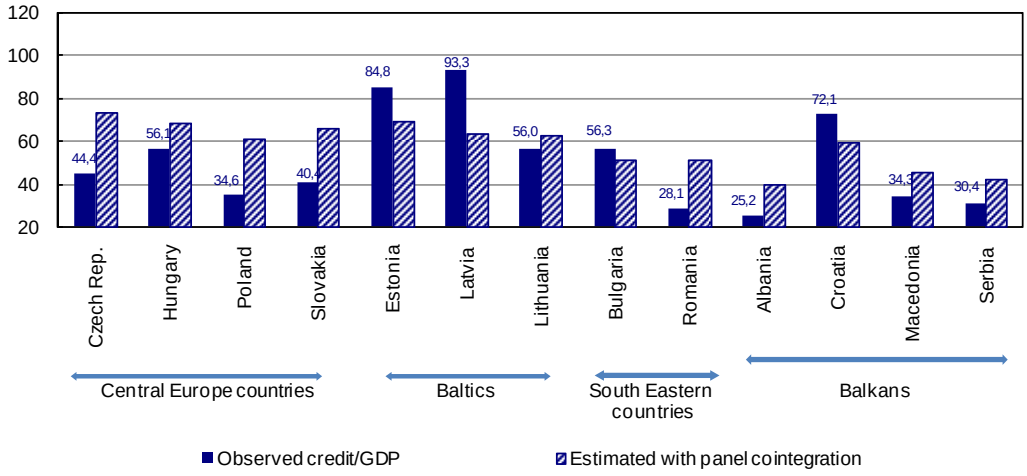
3.2.5 Estimates of credit/GDP ratios for the CEECs

We now consider that the fitted values of credit/GDP ratios obtained by panel cointegration are in line with long-run economic fundamentals and thus can be assimilated to "equilibrium levels". In this view, we compare the observed credit ratios in the CEECs in early 2007 with these fitted values (Charts 2 and 3). [11] If observed ratios are below fitted values, we conclude that credit level is still below its equilibrium, which justifies a greater credit growth for catching-up.

Following this approach, we find that credit ratios were still far below their equilibrium levels in most transition countries in early 2007. For example, Poland and the Czech Republic, in particular, had especially low levels of credit (34% and 44% of GDP respectively), which are nearly 30 percentage points of GDP below the values estimated by the model. Slovakia and Romania also had a low credit ratio relative to their level of development, i.e. 25 percentage points of GDP below the estimated values. To a lesser extent, this is also the case for Hungary, Albania, Macedonia and Serbia, which had credit ratios of 10 to 20 percentage points below the fitted values of the model. These results are in line with a number of studies on the subject (Cotarelli et al. 2005, and Egert et al. 2006), showing that the level of credit in the CEECs still appears to be in a catching-up phase.

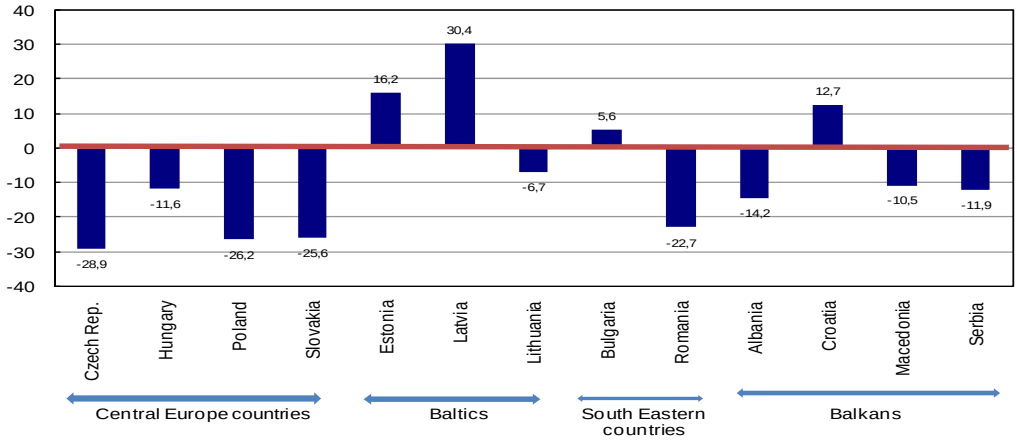
However, the very rapid credit growth observed in the mid 2000s changed the situation for Latvia, Estonia, Croatia, and even Bulgaria. These countries had credit ratios above the estimated values in 2007, which suggests that their credit growth was faster than what was justifiable by a catching-up process. This was particularly the case for Latvia, where the outstanding stock of credit (93% of GDP) exceeded the model's estimates by 30 percentage points.

Chart 2: Credit/GDP ratios, observed and estimated values in 2007:02, in %.



11 We leave out Slovenia in the following, for its credit data have a time series break in 2006:4 (see Appendix 2).

Chart 3: Credit/GDP ratios in 2007:02, gaps between observed and estimated values, as a % of GDP.



Source: Authors' calculations based on IMF IFS data.

3.3 Estimate of the credit growth as a function of fundamentals

We now estimate changes in the credit/GDP ratio as a function of gaps between observed and previously estimated levels, as well as economic fundamentals. We use an error-correction model.

3.3.1 The error-correction model

The dependent variable is the quarterly growth rate of the credit/GDP ratio, denoted:

$$\Delta c_{i,t} = \log(c_{i,t}) - \log(c_{i,t-1}).$$

The explanatory variables are as follows:

- the gap between the credit/GDP ratio observed level and the level estimated by the cointegration vector for the preceding period. This variable, called the error-correction term and denoted $\varepsilon_{i,t-1}$, is equal by definition to the lagged residuals of the cointegration model considered in the previous section. The expected sign is negative. The lower the credit/GDP ratio in relation to the estimated level, ($\varepsilon_{i,t-1} < 0$), the higher the growth rate must be during the following period for the catching-up process to continue;
- the dependent variable lagged by 1 to 4 quarters : $\Delta c_{i,t-1},...,\Delta c_{i,t-4}$;
- the quarter-on-quarter growth rate of GDP per capita in PPP, $\Delta \tilde{y}_{i,t} = \log(\tilde{y}_{i,t}) - \log(\tilde{y}_{i,t-1})$, lagged by 1 to 4 quarters;

- the transition country dummy, $TRANSI_i$.

The estimated equation is therefore expressed as:

$$\Delta c_{i,t} = \beta_0 - \lambda \varepsilon_{i,t-1} + \sum_{j=1}^{4} \beta_{1,j} \Delta c_{i,t-j} + \sum_{j=1}^{4} \beta_{2,j} \Delta \tilde{y}_{i,t-j} + \beta_3 TRANSI_i + u_{i,t} \quad (10)$$

The transition country dummy is not significant, indicating that these countries' credit growth is not systematically faster or slower, given their economic fundamentals. After eliminating this variable, we display the results in Table 8. The error-correction term is significant and negative, which confirms the cointegration relationship.

Table 8: Estimation of the credit/GDP growth rate by a panel error-correction (ECM) model.

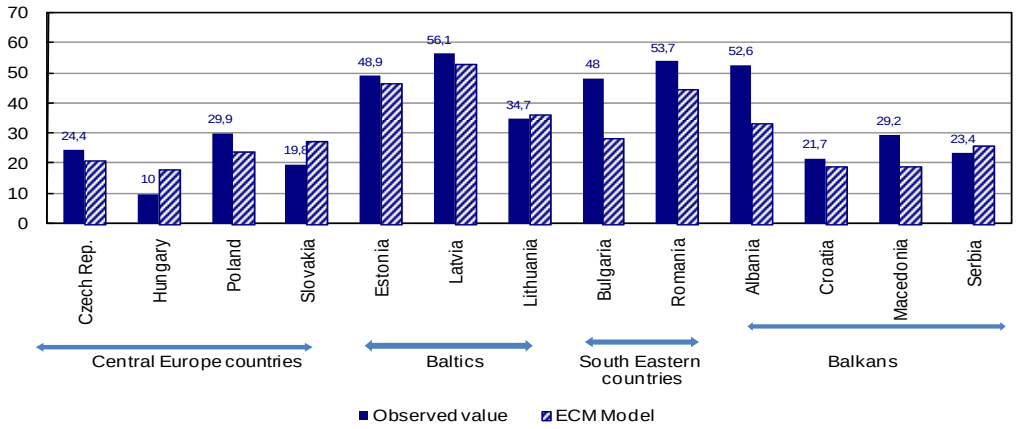
Explanatory variables	**Panel ECM estimations**
constant	-0.875 *** (-6.0)
$\varepsilon_{i,t-1}$	-0.007 *** (-5.4)
$\Delta c_{i,t-1}$	0.081 *** (5.3)
$\Delta c_{i,t-2}$	0.201 *** (13.7)
$\Delta c_{i,t-3}$	0.057 *** (4.0)
$\Delta c_{i,t-4}$	0.036 *** (2.6)
$\Delta \tilde{y}_{i,t-1}$	0.474 *** (2.3)
$\Delta \tilde{y}_{i,t-2}$	-0.602 * (-1.7)
$\Delta \tilde{y}_{i,t-3}$	0.527 (1.5)
$\Delta \tilde{y}_{i,t-4}$	0.631 *** (3.1)
Adjusted R2 , SEE, nb of observations	0.14; 4.69; 3,697

Note: estimation of Equation (10). $\varepsilon_{i,t-1}$ *residual of panel cointegration estimation,* $\Delta c_{i,t-k}$ *quarter-on-quarter credit/GDP growth,* $\Delta \tilde{y}_{i,t-k}$ *PPP-GDP per capita quarter-on-quarter growth, *** significant at the threshold of 1 %, ** 5% ; * 10 %. Student t-statistics are in brackets. Source: authors' calculations, based on IMF data.*

3. 3.2 Identifying credit booms in the CEECs

We now compare the credit growth rates recently observed in the CEECs to the model's estimates. We first consider the last available period before the outburst of the subprime crisis, i.e. 2007:02. To give more readable results, all the figures are expressed in terms of year-on-year growth in nominal credit (taking into account the observed value of GDP growth). Results are displayed on Chart 4.

Chart 4: Credit growth, observed and estimated by the ECM model in 2007:02. Year on year % change, in nominal terms.

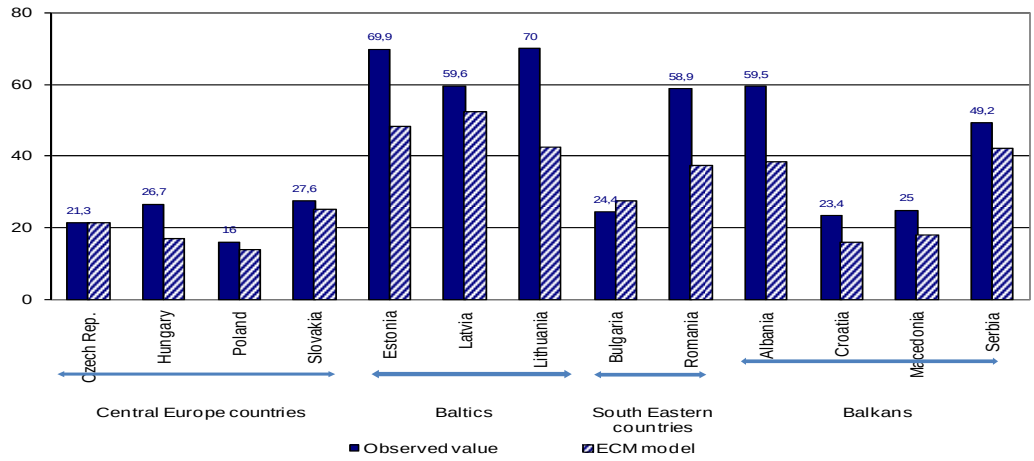


Source: authors' calculations, based on IMF data.

Strikingly, credit growth exceeds the results estimated by the model for most CEECs, i.e. 9 out of 13. This suggests that these countries were experiencing a credit boom in 2007, just prior the global crisis. The only exceptions are Hungary, Slovakia and Serbia, but they are not very significant, since two of them are also detected as having a credit boom a year earlier, as we will see below. The gaps between observed and estimated credit growth is especially high in Bulgaria and Albania, around 20 percentage points. In Romania and Macedonia, observed values also considerably exceed estimated values, by roughly 10 percentage points.

However, mid-2007 is not the peak of the credit boom in the CEECs. Credit was actually receding at that time, compared to the previous year. To check this, we do the same simulations for one year before, i.e. 2006:02. The results are shown on Chart 5. 11 out of the 13 countries were in credit boom at that time. Comparing the results with the previous ones, we see that the gaps narrowed in 9 countries out of 13 between early 2006 and mid-2007. In other words, the credit boom was more marked in 2006:02 in most countries. In Estonia, Lithuania, Romania, Hungary and Serbia, the gaps between the observed and estimated rates are especially large in 2006:2, as they range between 7 and 27 percentage points. Conversely, the credit boom has gained considerable momentum in Bulgaria between early 2006 and mid-2007.

Chart 5: Credit growth, observed and estimated by the ECM model in 2006:02. Year on year % change, in nominal terms.



Source: authors' calculations, based on IMF data.

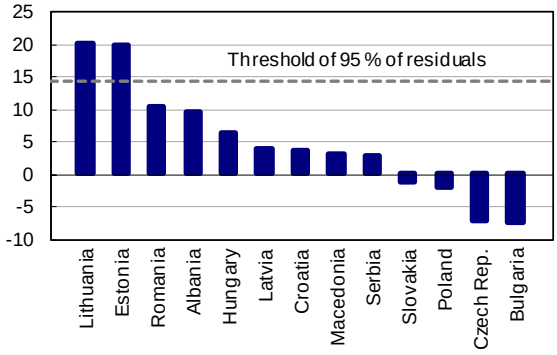
Changes in the results between 2006 and 2007 stem more from observed developments in credit than from changes in our estimates. The slowing down of credit growth seems to have been entailed by a monetary policy reaction in many countries. For example, in Serbia, the swing from a credit boom in 2006:02 to a very low credit growth in 2006:04 results from the tightening of macro-prudential regulations on consumer credit, decided by the National Bank of Serbia at the end of 2006 and the beginning of 2007. Conversely, the increase in the credit boom in Bulgaria seems to stem, on the one hand, from a private investment boom, characterised by a 10% increase in the private investment/GDP ratio in five years, and on the other hand, from the Bulgarian National Bank's removal of administrative limits on growth in bank loans at the end of 2006 - beginning of 2007.

One criticism of this method is that it assimilates the positive residuals of estimates to "credit booms", while they could stem from the model inadequacy. One way to respond to this is to check whether the gaps between observed values and those estimated by the model are particularly large over the recent period or whether they are within the normal range of the model's residuals. To achieve this, we compare the model latest residuals for the CEECs to the residuals for the whole the sample. We consider them to be "abnormal" if they are above 95% of the residuals of the whole sample (Chart 6).[12] Results show that Albania and Bulgaria exceeded this value in 2007:02, indicating that the gap reached an abnormal level, which is the sign of a credit boom. The gap observed in 2006:02 was also abnormal in Albania, Estonia, Lithuania and Romania.

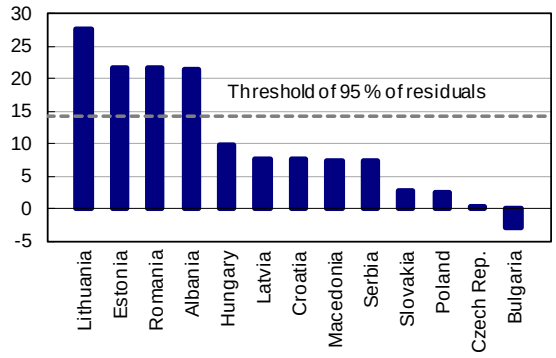
[12] 95 % of the residuals have a value lower than 14.1 percentage points for the ECM Model.

Chart 6 : Gaps between observed credit growth rates and estimates, in % .

In 2007:2



in 2006:2



Source: authors' calculations based on IMF data.

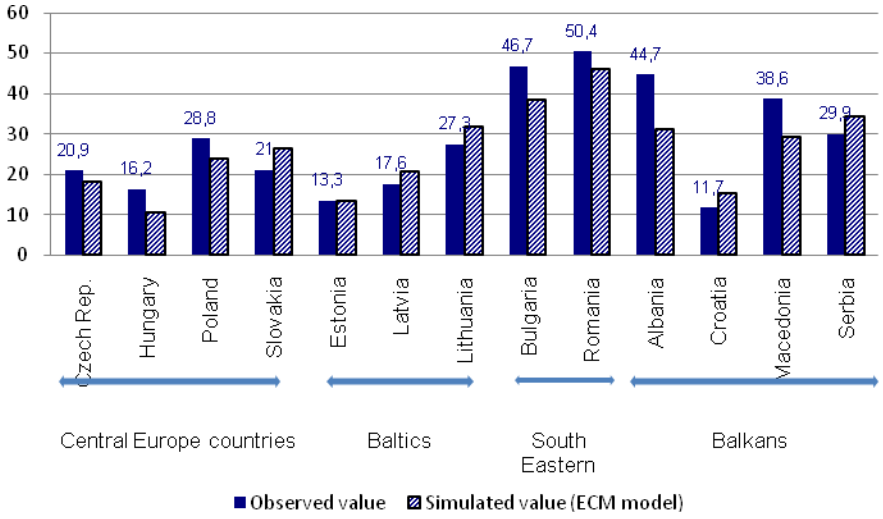
3.4 Results for 2008

As the 2006-2007 credit booms in the CEECs was followed by a severe financial crisis, we try to determine if there is a link between the two phenomena. In other words, we try to identify a credit bust in the latest data. To do so, we make out-of-sample simulations by applying the coefficients previously obtained by the ECM model to 2008:02 or 2008:03 depending on data availability,[13] in order to simulate a "normal" credit growth at that date. We then compare the simulated values with the observed credit growth, to determine whether a credit bust has been at play following the bursting of the worldwide financial crisis.

According to the results, the subprime crisis, that outburst in July 2007 in the United States, spread to the CEECs with some lag. In fact, the crisis outburst there only after the Lehman Brothers' bankruptcy in September 2008, as in many other emerging countries. Indeed, in 2008:02 or 2008:03, the credit boom was still in progress in 7 of the CEECs: especially in Albania, where the gap between the observed and the simulated growth rates was close to 15%, in Macedonia and in Bulgaria, where it was close to 10 % (see Charts 7 and 8).

[13] Data end in 2008:2 for Albania.

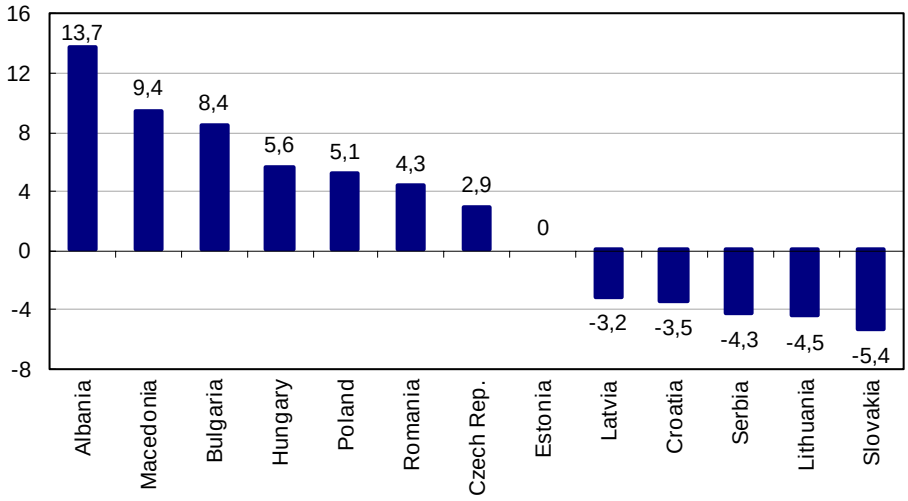
Chart 7: Credit growth, observed and simulated by the ECM model in 2008:03. Year on year % change, in nominal terms.



Note: 2008:2 for Albania. Source: authors' calculations, based on IMF data.

By contrast, the credit crunch was already occurring in five countries in 2008:02-03: Latvia, Croatia, Lithuania, Serbia and Slovakia. For example, in Latvia, where credit growth was the highest in 2007:02, the credit bust considerably worsened in early 2009, as capital flows withdrew from the country. These facts confirm that high credit growth may be a leading indicator of credit bust and financial crises.

Chart 8: Gaps between observed and simulated credit growth rates in 2008:3, in %



Note: 2008:2 for Albania. Source: authors' calculations, based on IMF data.

4. Conclusion

High credit growth rates in emerging countries are often due to catching-up effects, as more investment opportunities and easier access to credit go with economic development; another reason is the initially low credit stock in these economies, compared to the advanced countries. However, soaring credit growth could also result in "credit booms", paving the way to future "busts". We try to disentangle these two types of situation for the CEECs. For this, we compare the results of a number of methods to detect possible excessive credit growth. We use complementary approaches, based both on measures in levels and in evolution, on deviations from long-term trends and econometric regressions on fundamentals. We show that these methods lead to different results. Nevertheless, most of them point to an excessive credit growth in the CEECs just prior the 2007 crisis.

Firstly, a statistical analysis shows that credit/GDP ratios growth rates largely exceeded their long-term trend in 2006-2007 in several CEECs. This indicator thus identifies excessive credit growth in a number of CEECs, such as the Baltic States, Hungary, Poland, Romania, Albania, Macedonia and Slovenia. However, results are different if the same method is applied to the real credit growth rates. On the whole, these purely statistical indicators are useful but should be completed with other methods, based on economic developments.

Secondly, we carry out an econometric analysis in order to evaluate credit growth in relation to fundamentals. In particular, we try to determine whether the high credit growth can be explained by catching-up effects, by making panel estimations on a large set of countries. We show that in most CEECs, some catching-up effects were still at work in 2006-2007, but they are not sufficient to justify the very high rates of credit growth observed in 2006-2007. Results show that credit trends exceeded the model estimates in most CEECs, 11 out of the 13 considered, in mid-2006. The gaps were especially high in the Baltic States, Romania, Hungary and Serbia. Just before the outburst of the subprime crisis, credit growth was already receding in some of these countries due to the monetary authorities' reaction. However, 9 of the 13 considered CEECs were still experiencing a credit boom in 2007:2, especially Bulgaria and Albania.

The relationship between the credit booms in 2006-2007 in the CEECs and the following crisis is not straightforward, as the global crisis was triggered from abroad. However, the credit crunch was more severe in countries where excessive credit had been developed. The underlying question regards the solvency of lenders. As the distributed volume of credit increases, lenders' solvency is likely to deteriorate, as either the same lenders become more indebted, or new lenders who may be less solvent have recourse to credit. Here, we have examined this issue only indirectly by using macroeconomic fundamentals as explanatory variables. The implicit hypothesis is that the overall solvency of lenders improves in line with GDP growth. One way of improving this research would be to analyse the composition of loans in more detail and compare them to the solvency indicators of the groups of lenders concerned.

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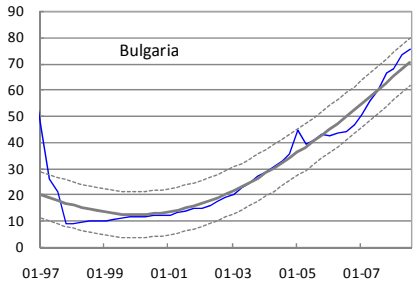
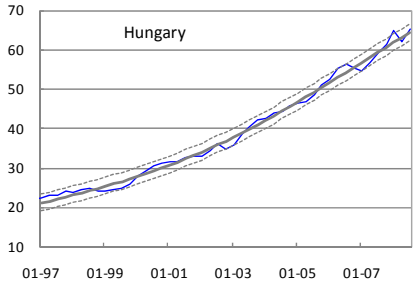
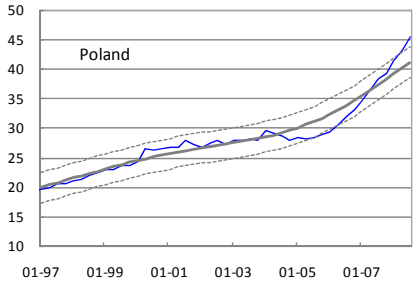
Appendix 1

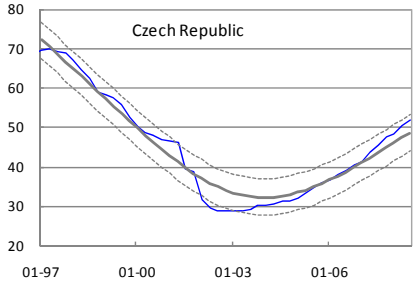
Chart A1. Credit/GDP and real credit growth rate, for the CEECs, in %. Observed value, long-term trend and interval of 1.75 times around the trend

Credit/GDP

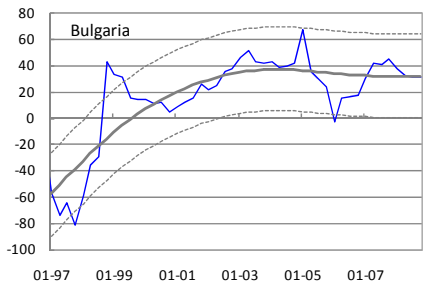


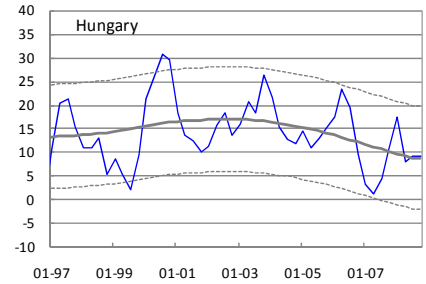


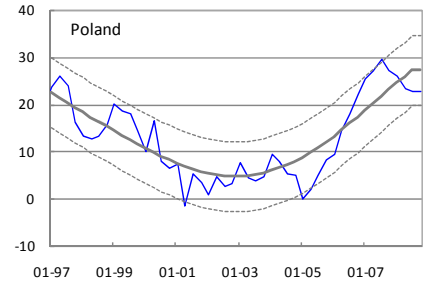


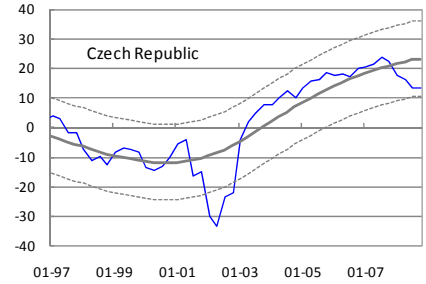


Real credit growth rate

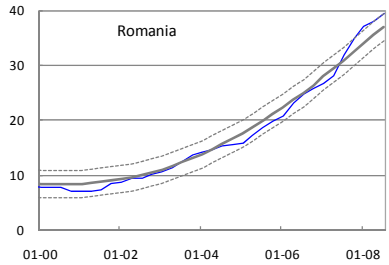


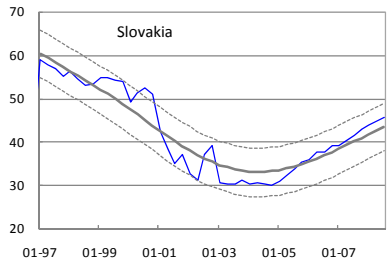


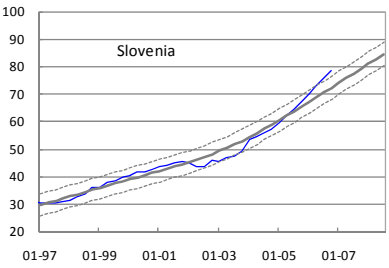


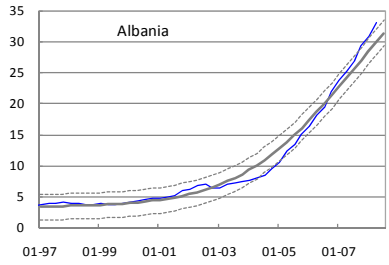


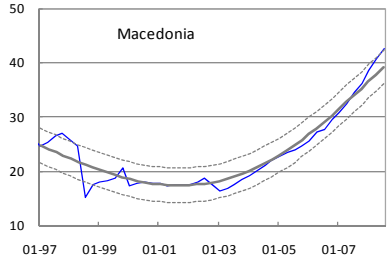
Credit/GDP



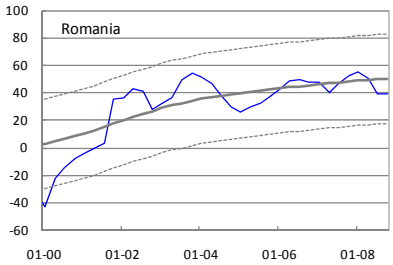


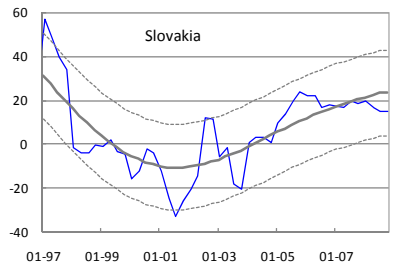


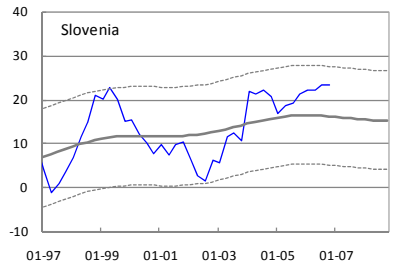


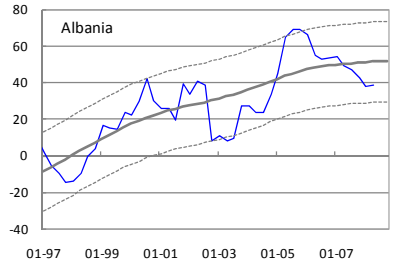


Real credit growth rate









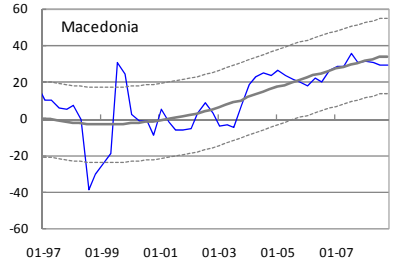
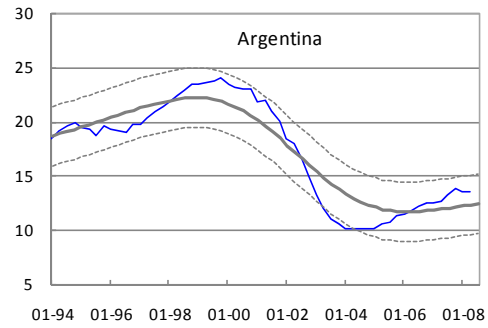
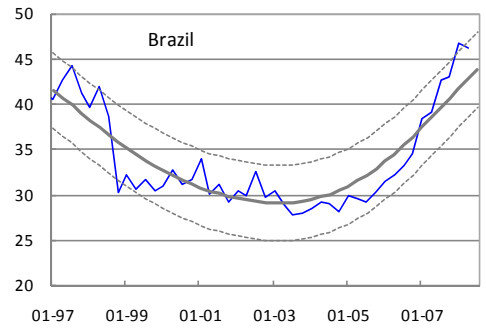


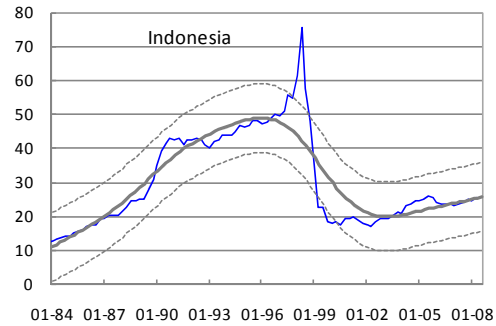
Chart A2: Credit/GDP and real credit growth rate, for emerging countries, in %.

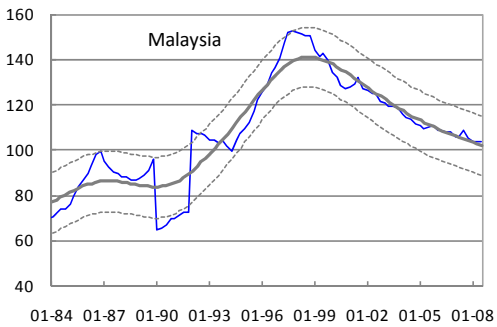
Observed value, long-term trend and interval of 1.75 times around the trend

Credit/GDP

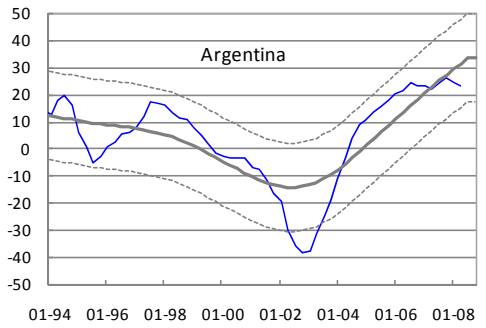


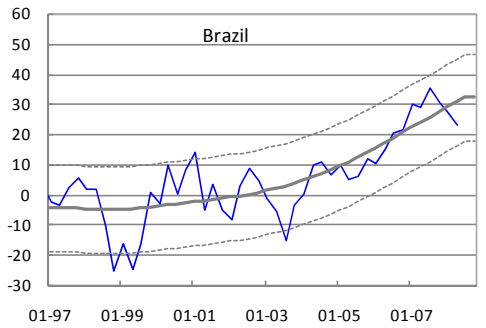


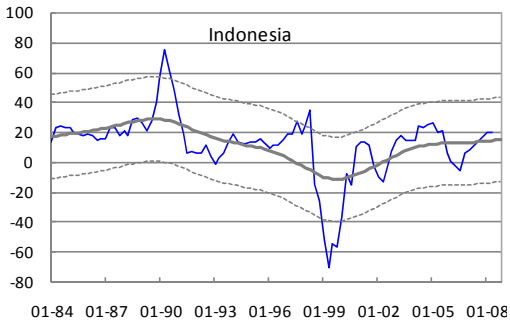


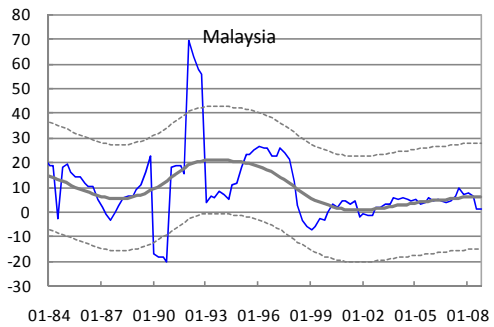


Real credit growth rate

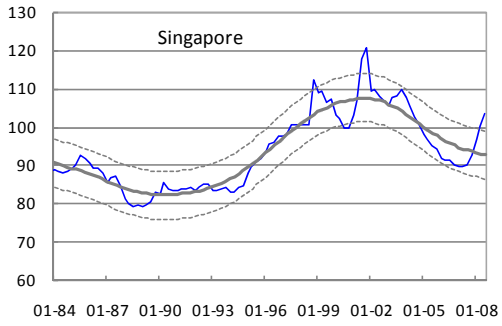


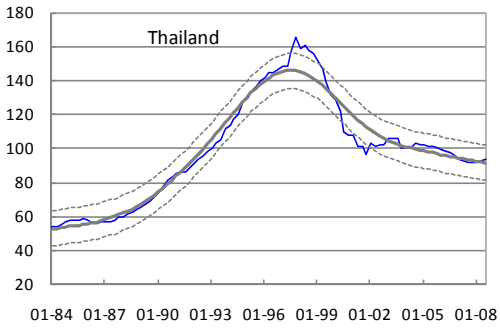




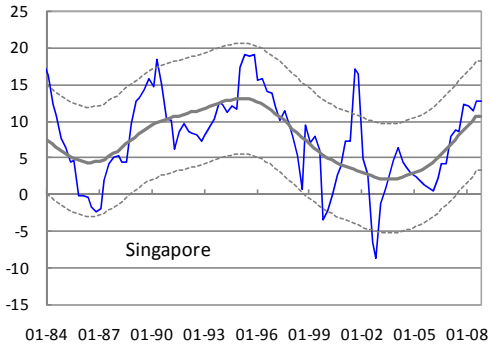


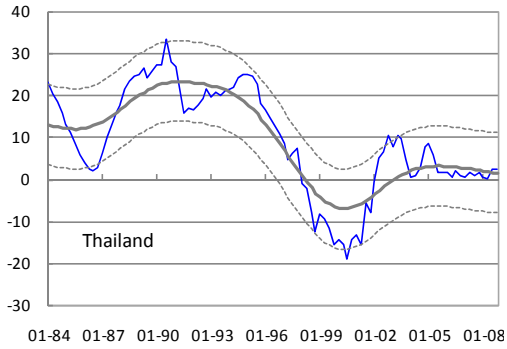
Credit/GDP





Real credit growth rate





Appendix 2- data description

The sample includes 52 countries: 21 developed countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States); 17 emerging countries outside Europe (Argentina, Brazil, Chile, China, Hong Kong, India, Indonesia, South Korea, Malaysia, Mexico, Peru, the Philippines, Singapore, Thailand, Turkey, Uruguay and Venezuela); 14 Central and Eastern European emerging countries (Albania, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia).

The time period ranges from the 1st quarter 1980 to the 3rd quarter 2008 for developed countries, for most Asian emerging countries (India, Indonesia, South Korea, Malaysia, Singapore, Thailand) and Latin American countries (Chile, Mexico, Uruguay and Venezuela), and for Turkey. It starts in the 1st quarter 1990 for Argentina and Peru, and in 1st quarter 1993 for transition countries and the remaining emerging countries (China, Hong Kong, the Philippines, Brazil). The end of the period is 2006:4 for Slovenia, because of a time series break due to the adoption of the euro.

The stock of credit granted by domestic banks to resident private sector is taken from the IMF *International Financial Statistics* (IFS, line 22d). In case of a break in credit series (sharp developments due to a methodology change for Austria, Belgium, Finland,

France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain), we have carried out a backward calculation, by applying the credit growth rate observed before the date of the break in the series and starting from the level observed just after the date of the break. For Poland, as the series taken from the IFS ends in the 4th quarter 2005, we have complemented it with data taken from the National Bank of Poland after that date. For Slovenia, we have ended the series in 2006:4, as there was a time break in 2007:1 that was not possible to correct even by taking into account the adoption of the euro.

GDP is taken from the IMF's *World Economic Outlook*, so is the PPP-GDP per capita series. The consumer price index is also taken from the IMF' IFS (line 64). Our real credit variable is given by calculating the ratio of the domestic credit stock to this index. In order to calculate its change, we express it in year-on-year terms, so as to eliminate seasonality. The interest rate series is drawn from the IMF' IFS. We have used the lending rate, which is the bank rate that usually meets the short- and medium-term financing needs of the private sector. The series regarding Serbia is discontinuous before the 4th quarter 2001; therefore, the examination period for this country starts at that date. The financial account balance series is given only in annual terms for China; therefore, we have quarterlised it by dividing figures by 4. As regards Slovakia, the series is drawn from the Statistical Office of the Slovak Republic. Stock market capitalisation series are obtained from Datastream and complemented by data from national stock exchanges for Bulgaria, Croatia, Macedonia, Slovakia and Slovenia; and from OMX for the Baltic States. As regards Bulgaria and Slovakia, stock market capitalisation data are annual; therefore we have converted them from annual to quarterly frequency, using a linear interpolation method and a moving average on the four preceding quarters. Exchange rate regime dummy has been constructed from IMF classification, Levy-Yeyati and Sturzenegger (2002) and Egert and Morales-Zumaquero (2005) for the CEECs.

The legal origin dummy is obtained from the database constructed by La Porta et al. (1998) and extended to transition countries by Djankov et al. (2005).

Appendix 3- panel unit root and cointegration tests

We use unit root tests on panel data developed by Levin, Lin and Chu; Breitung; Im, Pesaran and Shin; as well as augmented Dickey-Fuller and Phillips-Perron tests carried out on country series and aggregated using Fisher's method (Maddala and Wu). The null hypothesis in all these tests is the presence of a unit root, with a common unit root in the first two tests and an individual one per country in the other tests.

Beforehand, we test the presence of a deterministic trend in the series. For almost all countries, there is a significant trend for the credit/GDP, the PPP-GDP per capita and the stock market capitalisation/GDP series.

PPP-GDP per capita, credit/GDP and stock market capitalisation/GDP are first-order integrated according to these tests. All of them do not reject the null hypothesis of unit root (except that of Levin, Lin and Chu for the credit/GDP) (see table A3-1). In contrast, the net capital inflows series is stationary. So are the real credit growth rate, the GDP growth rate and the real interest rate.

Credit/GDP, PPP-GDP per capita and stock market capitalisation/GDP (the first two are expressed in log) are cointegrated. As regards Pedroni tests' results, 9 in 11 tests reject the null hypothesis of no cointegration at the threshold of 5 % (8 at the threshold of 10 % and 9 at the threshold of 10,5%). Johansen tests on country data, aggregated using Fisher's method, give the same results. They reject the null hypothesis of no cointegration and accept the hypothesis of the existence of a cointegration relationship between the two variables.

Table A3-1: Unit root tests

Series	**Levin, Lin and Chu (t-stat)**		**Breitung (t-stat)**		**Im, Pesaran and Shin (W-stat)**		**Augmented Dickey-Fuller (Fischer Chi²)**		**Phillips-Perron (Fischer Chi ²)**	
	H0= common unit root				**H0= individual unit root**					
	stat.	**p-value**	**stat.**	**p-value**	**stat.**	**p-value**	**stat.**	**p-value**	**stat.**	**p-value**
Log (PPP-GDP)	-0.70	0.24	-1.38	0.08	-0.21	0.41	105.5	0.44	110.93	0.30
Log (Credit/GDP)	-2.19	0.01	0.39	0.65	-0.57	0.29	112.66	0.26	115.04	0.22
Stock market capitalisation/GDP	3.51	1.00	4.57	1.00	0.42	0.66	121.7	0.05	88.90	0.73
Net capital inflows/GDP	-5.88	0.00	-2.78	0.00	-16.63	0.00	565.74	0.00	1522.99	0.00
Real credit growth	8.58	1.00	-5.69	0.00	-7.13	0.00	257.15	0.00	383.43	0.00
GDP growth	7.62	1.00	-5.89	0.00	-11.4	0.00	349.04	0.00	493.31	0.00
Real interest rate	71.82	1.00	-1.94	0.03	-4.7	0.00	217.54	0.00	547.42	0.00

Lags are selected by Akaike criterion. The tests regarding the first 4 variables include a constant and a trend.

Table A3-2: Cointegration tests for the credit/GDP, PPP-GDP per capita and stock market capitalisation/GDP series. Individual Johansen tests aggregated by using Fisher's method (Maddala and Wu, 1999)

Null	**test**	**p-value**
r=0	219.0	0.000
r≤1	101.2	0.556

r *is the number of cointegration relationships.*