



# Economic Watch

## EAGLEs

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Economic Analysis

### Emerging Economies

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## Credit deepening: the healthy path

- **The credit<sup>1</sup> cycle in the emerging world has been the opposite of the developed one during the last few years**

Developed economies (DEs) are undergoing a deleveraging process after a long lasting credit growth episode during the 00s. On the contrary, credit growth was subdued in most of (EMs) in the years before the global crisis as these countries were making the necessary adjustments after their excess credit growth episodes came to an end in the late nineties (Asian and Latin American crisis). During the last few years, GDP growth has driven credit expansion in emerging markets (EMs) and we expect the process to continue although more moderately. In 10 years' time China will account for more than a fifth of the stock of global bank credit to while the rest of developing and emerging economies will nearly reach the G 6 levels (G 7 countries except for the US) with close to a 20% share.

- **We introduce a new econometric model that allow us to estimate the structural determinants of the Credit-to-GDP ratio**

We develop an empirical model for the private credit-to-GDP ratio that analyses the determinants of the Private Credit Ratio and allow us to estimate its "structural" level determined by the long-term components of different macroeconomic and institutional variables, and also the deviations from such structural level. The so-called "credit gaps" estimated in this way suggest that growth of private credit ratios could be considered as excessive for developed economies and Emerging Europe but not for the majority of emerging markets<sup>2</sup>.

- **Structural drivers explain the bulk of credit dynamics in EMs**

Despite excessive credit growth, structural drivers were also in place prior to the crisis in developed economies (DEs): in particular part of the sustained economic growth in the case of European countries was reinforced by a downward trend in interest rates and a favourable regulatory and institutional framework. However, the impact of some of these variables has now faded away and the incipient recovery in credit growth could eventually been offset by tighter regulation. On the contrary, the ongoing income growth, further macro stability and institutional improvements will support credit deepening in EMs. These countries will progressively enter the credit "acceleration area" with higher elasticity to income gains, supporting credit growth.

- **Idiosyncratic factors behind China's higher long-term ratios**

China has had a credit ratio much higher than what its economic development level would suggest for decades. Its higher long-term investment ratio is one of the key factors that outweigh the lower income per capita when compared with other EMs. Thus, the re-balancing of the Chinese economy should contribute to moderate private credit growth, especially given the fact that Chinese families will not necessarily need to borrow to increase consumption given their large savings.

- **Income gains to boost credit deepening in Latin America**

Contrary to common thought, private credit-to-GDP ratios in the region are not significantly far from the levels implied by income per capita. Brazil, Chile and Colombia are a few percentage points above their long-term structural levels, while Mexico and Peru are around the structural benchmark. Looking forward, improvements in the regulatory and institutional conditions will help to boost further credit deepening in the region and cope with increasing pressure from rapid growth.

- **A better framework is critical not only for emerging economies**

We estimate a long-term scenario in which improvements in regulatory and institutional factors in EMs could substantially increase their credit ratios in a sustainable way (a range of 25-40pp of GDP for regional averages). Some advanced economies could also reduce their current "credit gaps" (i.e. their need for deleveraging) by increasing their structural levels through a better institutional framework. However, the recently introduced tougher banking regulations, especially regarding capital requirements, will lower the structural levels of credit. This is more the case in the DEs since regulatory tightening is much more advance.

1: Domestic credit to private sector refers to financial resources such as loans, purchases of non-equity securities, and trade credits and other accounts receivable that establish a claim for repayment.

2: A forthcoming Economic Watch will concentrate on the analysis of these credit gaps and its relationship with banking crises.

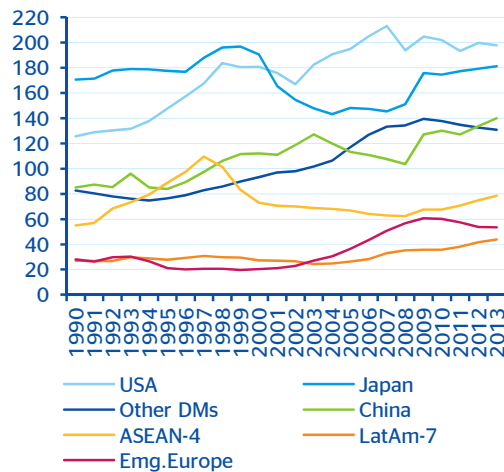
## Credit business is shifting to the emerging world

This section focuses on the recent trends observed in credit markets worldwide since the early 90s and in particular in the evolution of the Credit-to-GDP ratio. Next section introduces the results of an econometric model developed in order to estimate the determinants of such trends. In the methodological box we briefly explain the methodology employed and its technical advantages.

**Up to the outbreak of the current crisis**, credit cycles, as well as boom and busts episodes, had been already recurring events during the last decades for both developed and emerging economies. According to the relative performance of credit to GDP in different regions, the following **periods in the 90s and 00s** are worth highlighting (Chart 1):

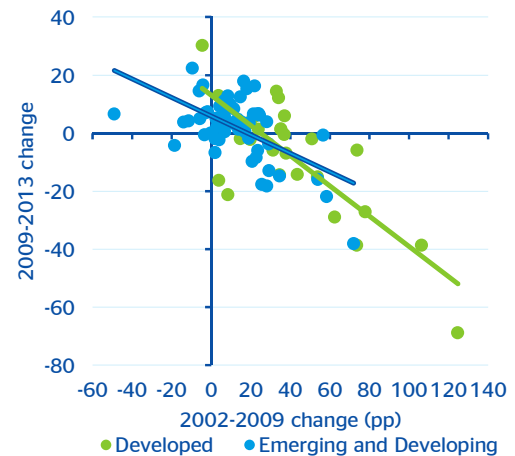
- In **developed economies (DEs)**, credit growth accelerated since mid-nineties, a period followed by deleveraging processes in the Nordics, US and Japan. The 00s could be described as the longest and steady episode of credit growth during the last decades, including booms in the US and in a number of European economies.
- In **emerging economies (EMs)**, credit-to-GDP remained flat in the 90s for most of the regions in with the exception of the boom and bust episode in the ASEAN region and some Latam countries and the upward trend recorded for China. During the 00s and until the crisis, credit only grew at a significant pace in Emerging Europe while Asian and Latam countries were facing their own de-leveraging process until the beginning of the recent crisis.

Chart 1  
Credit to private sector over GDP by region (%) (simple average)



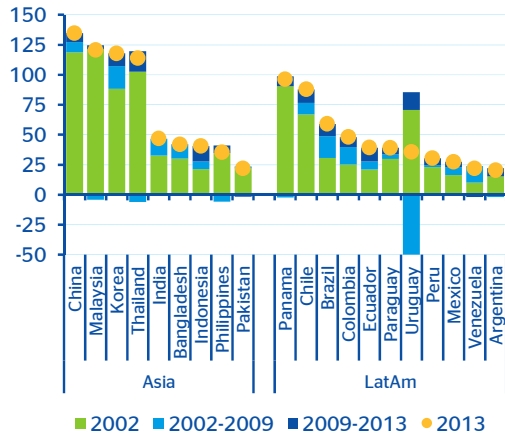
Note: E&N exCh = EAGLEs and Nest countries excluding China.  
Source: BBVA Research

Chart 2  
Change of the ratio of credit-to-GDP in selected periods (pp)



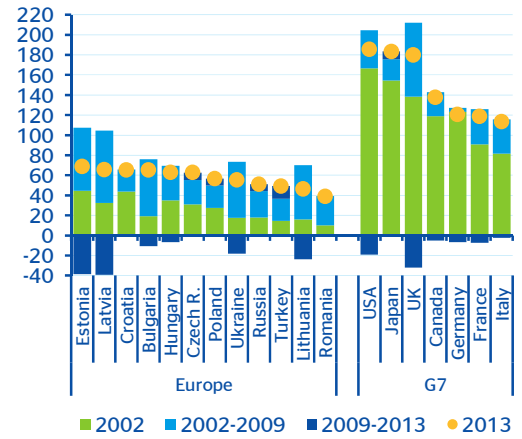
Source: BBVA Research

Chart 3  
Ratio of credit to the private sector over GDP by countries (% and contributions in pp)



Note: E&N exCh = EAGLEs and Nest countries excluding China.  
Source: BBVA Research

Chart 4  
Ratio of credit to the private sector over GDP by countries (% and contributions in pp)



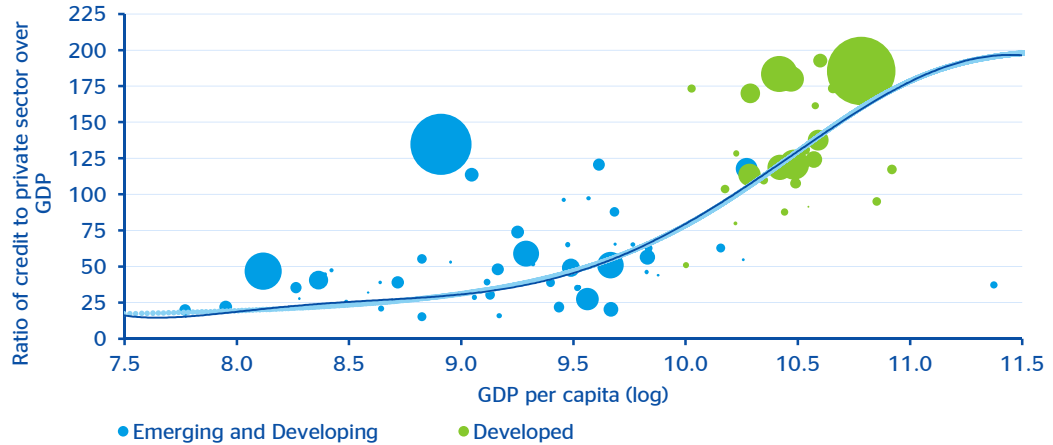
Source: BBVA Research

As a result of the current crisis, credit-to-GDP ratios have substantially fallen in some countries although **the regional picture is far from being homogenous** (Charts 2 to 4):

- Especially when **comparing the situation in DEs and EMs we observe that:**
  - DEs are predominant among the group which has undergone a boom and bust episode in the last decade.
  - There is a strong correlation between those countries which experienced credit booms in the 00s and those economies under subsequent stronger de-leveraging (e.g. EU-periphery, USA and New Zealand).
  - Those countries with higher starting levels of leverage, mainly advanced economies, show a larger relative correction after 2009.
  - All in all, with the crisis as a common trigger, the degree of credit excess was different among countries as well as the amount of deleveraging.
- Some important divergences also exist among **EMs:**
  - A number of countries in Eastern Europe are facing the largest deleveraging process, in particular the Baltic economies and some of the Central Europe Economies.
  - On the contrary, relatively low vulnerabilities and strong steady growth are behind further credit deepening in Asia and Latin America, as well as in Turkey and Russia.
  - Overall in EMs credit-to-GDP ratios are at present still well below those in AEs except for some Asian countries such as China, in which other factors beyond income per capita, play a relevant role (read below).

Chart 5

Ratio of credit to the private sector over GDP (%) and income per capita (PPP-adj. real USD) (2013)



Note: the trend represents long-term relation between GDP per capita and the ratio of credit regardless of other variables which play a relevant in our model; the size of the bubbles are proportional to the absolute value of GDP.  
Source: BBVA Research and IMF

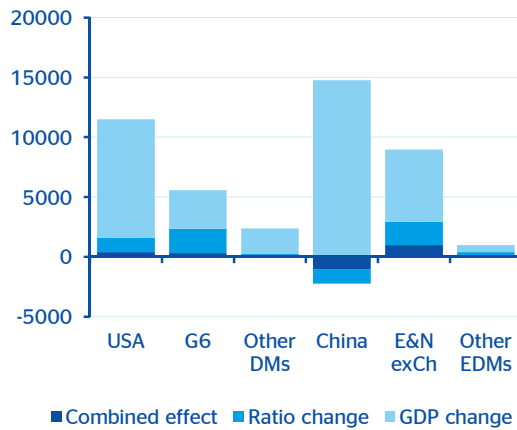
Looking ahead, the credit developments of the next decade will be shaped by excess corrections in some DEs further credit deepening in EMs (Charts 5 to 7):

- Among DEs, **the US is expected to be an outlier, with credit already in an upward trend** under a more positive growth scenario and after strong deleveraging. The contributions of the US to the net increase of credit will more than double that of the G6 economies.
- **China will continue to lead credit expansion not only in EMs but worldwide**, as a consequence of a higher level of economic activity rather than to further increases in the Credit-to-GDP ratio. Something similar applies to the rest of the EAGLEs and the Nest countries<sup>3</sup>. However, it is important to notice that in our empirical analysis we do not include shadow banking activities, which are known to be significant in the case of China. Considering shadow banking activities, the Credit-to-GDP ratio in China would be currently around 50 points higher, and the resultant level must be considered as in a serious disequilibrium, which should warrant a future rebalancing and a clear slowdown in the credit growth rate.
- **Notwithstanding the fragilities that such credit growth is bringing to China**, there is still a size effect worth mentioning: **In 10 years' time China will account for more than 20% of the stock of global bank credit to the private sector in PPP-adjusted terms**, surpassing the G6 group. This represents a considerable leap from less than 10% at the beginning of this century.
- **The stock of credit in the rest of EMs will have climbed almost to the G6 levels** compared to a 1:3 ratio 10 years ago.

The shift of credit from DEs to EMs could be exacerbated by the regulatory tightening in developed markets.

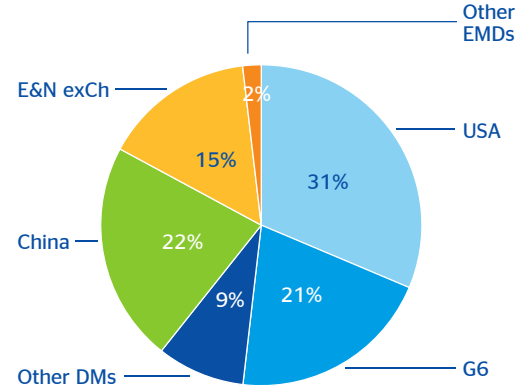
<sup>3</sup> Read about the EAGLEs at [www.bbvarsearch.com/KETD/ketd/ing/nav/geograficas/eagles/index.jsp](http://www.bbvarsearch.com/KETD/ketd/ing/nav/geograficas/eagles/index.jsp)

Chart 6  
Change of credit to the private sector between 2013 and 2022 by group (mn 2012 USD, PPP-adjusted)



Note: E&N exCh = EAGLEs and Nest countries excluding China.  
Source: BBVA Research and IMF

Chart 7  
Stock of credit to the private sector in 2022 by group (%) (based on PPP-adjusted 2012 USD)



Note: E&N exCh = EAGLEs and Nest countries excluding China.  
Source: BBVA Research and IMF

## Credit excesses concentrated in DEs contrary to previous crises

We have developed an econometrical panel data model to assess the main determinants of the private credit-to-GDP ratio (see methodological box):

- The credit ratio depends on several **macroeconomic, regulatory, market structure, and institutional variables**.
- The specification allows us to **differentiate the effects of the long-term components** of the explanatory variables **versus their medium and short-term components**.
- We estimate a **“credit gap”** to the **difference between the actual level of credit and its long-term level**. This will allow us to assess whether a country is going through an unsustainable credit boom or a healthy deepening path.

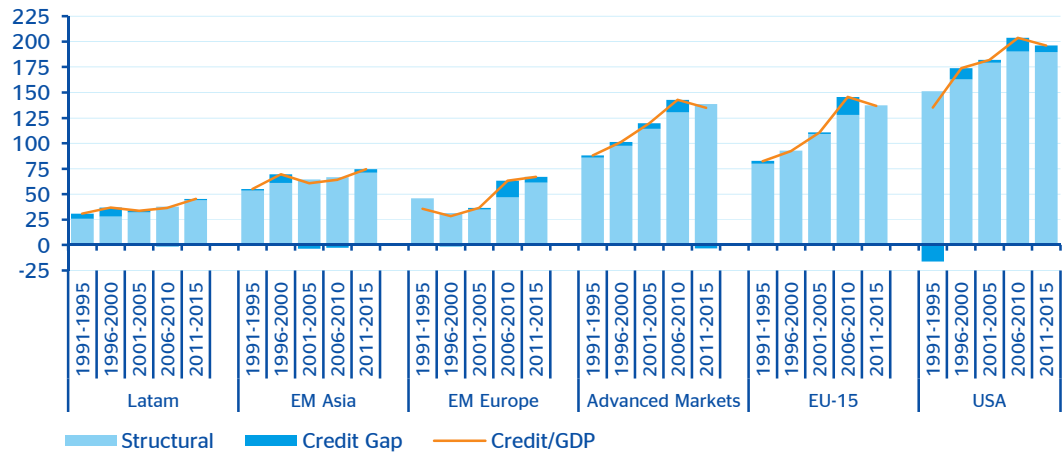
A forthcoming Economic Watch will analyze “credit gaps” more extensively and their information content as crisis predictors. In this watch we decompose the private credit ratio into its structural component (determined by structural factors) and the credit gap (stemming from cyclical conditions) for different regions (Chart 8):

- **The private credit ratio grew above the structural level in DEs before the crisis**, particularly in some countries in the European Union. The credit gap in US reached around 23 pp of GDP in 2007. However, the actual credit disequilibrium in the US was in fact much larger due to large growth of shadow banking activities before the crisis. In chart 8, the average gap between 2006 and 2010 was 14 pp of GDP for the US.
- **A positive gap** (i.e. excess credit growth) **explains a substantial share of the ratio increase in Emerging Europe during the second half of the 00s**.
- **Latin America and Emerging Asia had a negligible credit gap during the 00s** as a result of starting healthy conditions after some excesses in the 90s:

- Brazil, Chile and Colombia are at present a few percentage points above long-term structural, while Mexico and Peru are around the structural benchmark.
- Among Asian economies, China presents a persistent and large positive credit gap since the 90s, which has accelerated its growth after the global recession in 2009, mainly due to the large growth of shadow banking activities.

Chart 8

Decomposition of the observed credit-to-GDP ratio between the structural level and the credit gap (simple averages for each region and period)

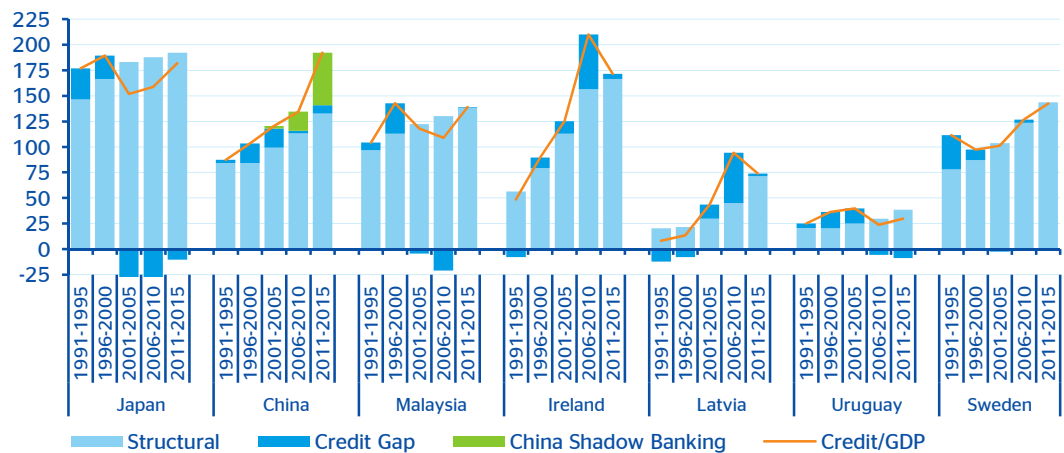


Source: BBVA Research

Data in Chart 8 are shown in terms of regional averages and five-year periods. Since episodes of excessive credit growth could be more acute in particular years and are not homogeneous across all countries inside a region, the decomposition into structural and credit gap cannot be observed so clearly in most cases. We therefore present some selected **country cases** in Chart 9, showing a **positive credit gap during early 90s in Japan and Sweden, in the second half of the 90s in Malaysia and Uruguay, and during the second half of the 00s in Ireland and Latvia**. All of these episodes were followed by deleveraging periods.

Chart 9

Decomposition of the observed credit-to-GDP ratio between the structural level and the credit gap (simple averages for selected countries and period)



Source: BBVA Research

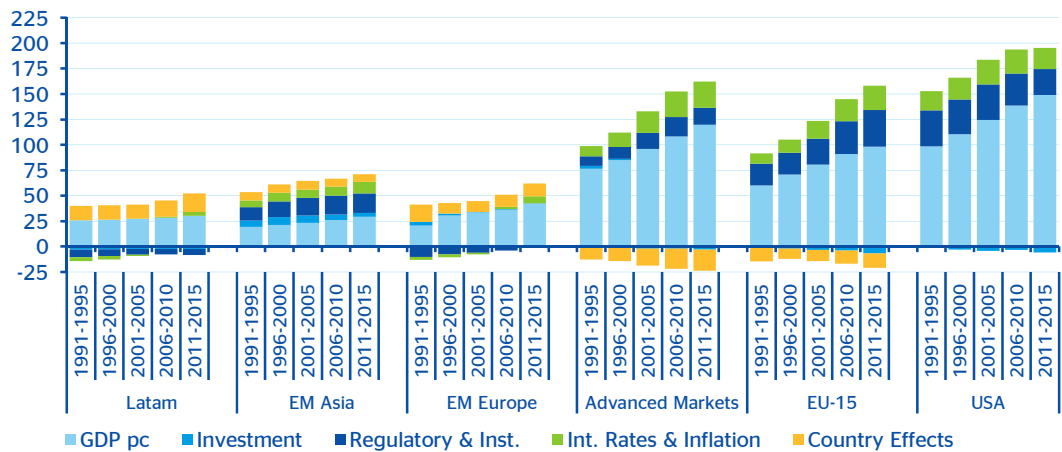
## Structural drivers explain the bulk of credit dynamics

The structural level can be decomposed in different factors, bringing a clearer view of credit drivers in each region from a long-term perspective (Charts 10 and 11):

- **The contribution of GDP per capita has been much more relevant so far for DEs than EMs**, although this picture is expected to change due to: 1/ developed markets reaching **saturation levels**; and 2/ emerging countries developing further and entering the **credit acceleration area with a higher elasticity to income** (chart 5).
- **Since the 90s, the secular downward trend in interest and inflation rates has played a significant role in DEs**. The cumulative effect is around 15pp, although it's not expected to change further as new potential reductions are marginal.

Chart 10

**Decomposition of the structural credit-to-GDP ratio by determinant (simple averages for each region and period)**

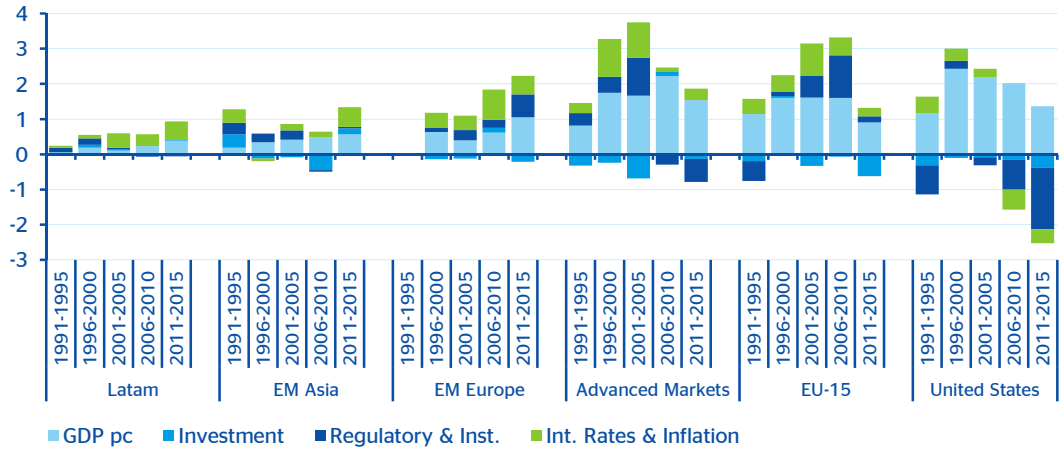


Note: It is important to highlight that this decomposition of the structural ratio can only be understood as an approximation, because as the estimated model is highly non-linear, it obviously cannot be exactly decomposed in a linear way.  
Source: BBVA Research

- **Macroeconomic stability is one salient feature of EMs** since the beginning of this century and following severe crises in the 90s. As a result, **interest and inflation rates have also moved structurally downwards in the last decade**, with the most significant effect on credit recorded for Latin America.
- **In general terms, investment has a relatively limited role adding explanatory power on its own**. However, **some significant exceptions are present; particularly China** as mentioned before, which still enjoys an investment rate well above the world's average, contributing positively to credit expansion (Charts 11 and 12).
- Some specific comments are worth making on **regulatory and institutional variables**:
  - These variables have a **positive contribution to structural credit ratios for DEs** although country differences arise.
  - **Among emerging markets**:
    - **The framework is friendlier in Asia than in Latin America or Europe**, although it is slightly improving in these two areas as well.
    - **China shows a relevant contribution of regulatory and institutional variables to credit growth in the last decade**.
    - **The rapid growth of income will increase pressure on keeping a suitable framework** for credit business (some variables are computed as the error term of a simple regression on GDP per capita).

Chart 11

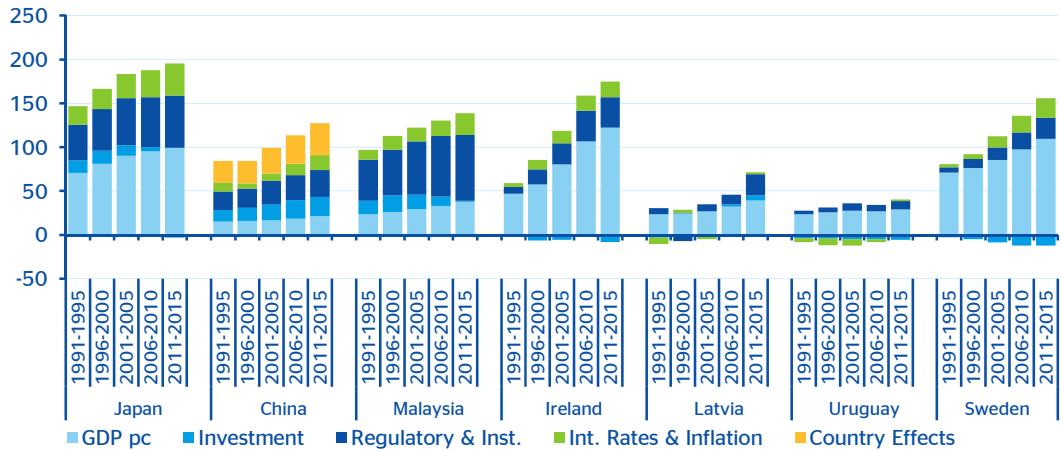
Change of the structural credit ratio by determinant  
(average annual change over simple averages for each region and period)



Note: It is important to highlight that this decomposition of the structural ratio can only be understood as an approximation, because as the estimated model is highly non-linear, it obviously cannot be exactly decomposed in a linear way.  
Source: BBVA Research

Chart 12

Decomposition of the structural credit-to-GDP ratio by determinant (some country-specific examples)  
(simple averages for each country and period)

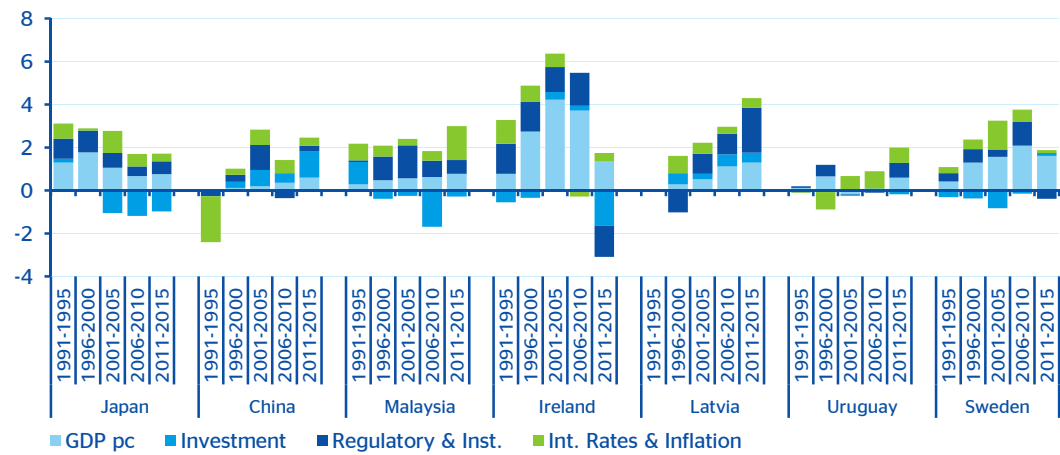


Note: It is important to highlight that this decomposition of the structural ratio can only be understood as an approximation, because as the estimated model is highly non-linear, it obviously cannot be exactly decomposed in a linear way.  
Source: BBVA Research



Chart 13

Change of the structural credit ratio by determinant (some country-specific examples)  
(average annual change over simple averages for each country and period)



Note: It is important to highlight that this decomposition of the structural ratio can only be understood as an approximation, because as the estimated model is highly non-linear, it obviously cannot be exactly decomposed in a linear way.  
Source: BBVA Research

## A better institutional and regulatory framework is critical and not only for EMs

In order to understand which countries have a friendlier regulatory, structural and institutional framework, **we build a ranking based on the contribution of these variables to its estimated credit ratio** (in logarithms) (Table 1). We prefer to rank countries in this way rather than using the final contribution of the variables to the estimated value of the model (in pp of GDP) because since the model is highly non-linear these contributions depend on the value of the ratio for each country and therefore it could be difficult to compare them across different countries.

The Institutional and Regulatory Determinants included in the model are:

- Strength of Creditors' Legal Rights index
- Enforcing Contracts Cost Index
- Registering Property Cost Index
- Recovery value of assets after insolvency
- Information Quality Index
- Private Bureau Coverage
- Activity Restrictions Index
- Entry of new banks difficulty Index

Structural Determinants:

- "Rule of Law" Index
- Gini Index
- Banking Concentration
- Chinn-Ito Index of financial openness

- Regulatory Capital to Risk-Weighted Assets ratio
- Regulatory minimum capital requirement
- Population Density

The interpretation of this index would be as follows: a positive value would indicate that the regulatory, institutional and structural variables are such that the total structural credit ratio should be above the one implied by a country's long-term GDP per capita, and a negative value would indicate that it should be below<sup>4</sup>. According to this index:

- **The country with the best regulatory and institutional environment in our sample is Malaysia, followed by Portugal**, a factor that explains the higher structural ratio of these two countries relative to other countries with similar levels of economic development (income per capita).
- **EM Asia is one of the regions with the best regulatory and institutional environment** according to its average score in our index.
- **For most countries in Latin America their institutional environment contributes negatively to the credit ratio.** A couple of small economies such as Peru and Uruguay seem to be the ones with the better framework and Brazil and Venezuela appear to have a very unfriendly framework.

Furthermore, the index allows us to understand the effects of all the different variables included in the analysis. Consequently, we have decomposed the index shown in Table 1 into its different components, which could be seen in Chart 14. We can observe for instance that:

- Although **Latin America is the worst region in terms of legal environment problems (rule of law and legal creditors' protection), it is the best region in terms of the "information sharing" framework.** It is also the region with the worst inequality of income, although this problem is not homogeneous across all countries.
- **Emerging Europe problems seems to be concentrated on the weakness of information sharing** (low coverage of private bureaus and public registries and a low quality of the information provided by them), together with "modest" values in the rest of indicators.

**In many advanced markets** (although there is also a lot of heterogeneity) **structural weaknesses arise basically from the lack of public registries** and a relatively low quality of the information provided by the private bureaus (despite their high coverage levels).

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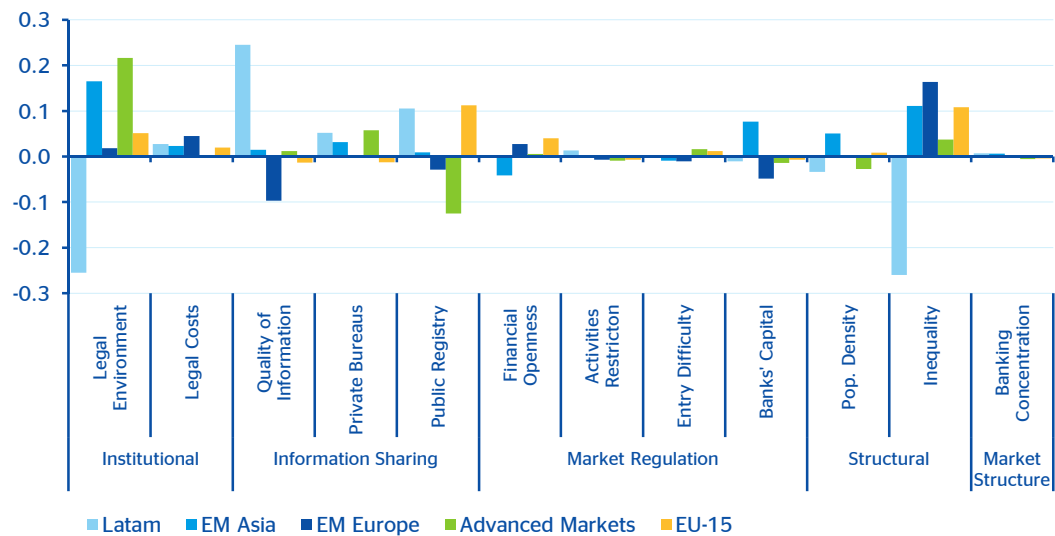
4: Keeping constant the rest of the long-term components of variables such as interest rates, inflation and banks' spreads.

Table 1  
Ranking of countries according to regulatory, institutional and structural variables Index, by regions (2012)

Latam		EM Asia		EM Europe		MEN & Africa		Advanced Markets		EU-15	
	Index		Index		Index		Index		Index		Index
Peru	0.45	Malaysia	1.19	Latvia	0.59	Pakistan	0.48	Japan	0.52	Portugal	0.95
Uruguay	0.32	Bangladesh	0.80	Poland	0.52	Nigeria	0.19	New Zealand	0.51	Spain	0.57
Chile	0.30	India	0.69	Bosnia & H.	0.45	South Africa	0.03	Australia	0.31	UK	0.55
Argentina	0.09	Vietnam	0.52	Romania	0.45	Egypt	0.01	Canada	0.21	Belgium	0.54
Paraguay	-0.15	Korea	0.51	Hungary	0.42	Morocco	-0.30	United States	0.21	Germany	0.49
Mexico	-0.20	China	0.51	Czech Rep.	0.42	Lebanon	-0.37	Hong Kong	0.17	Austria	0.34
Ecuador	-0.22	Indonesia	0.15	Bulgaria	0.35	Namibia	-0.43	Iceland	0.05	Ireland	0.33
Bolivia	-0.24	Thailand	-0.04	Israel	0.28	Tunisia	-0.50	Switzerland	-0.01	Sweden	0.25
Colombia	-0.29	Philippines	-0.33	Slovak Rep.	0.27	Botswana	-0.54	Norway	-0.12	Denmark	0.21
Brazil	-0.38			Lithuania	0.15	Cameroon	-0.57	Singapore	-0.28	Italy	0.13
Venezuela	-1.07			Estonia	0.07	Algeria	-0.80			Netherlands	0.09
				Slovenia	0.05	Angola	-0.99			France	0.08
				Armenia	0.04					Finland	0.04
				Croatia	-0.11					Greece	-0.26
				Ukraine	-0.16						
				Turkey	-0.19						
				Cyprus	-0.28						
				Belarus	-0.36						
				Azerbaijan	-0.37						
				Russia	-0.76						

Source: BBVA Research

Chart 14  
Decomposition of regulatory, institutional and structural variables Index, by regions (2012).



Source: BBVA Research

## Assessing the impact of changes in the institutional and regulatory framework

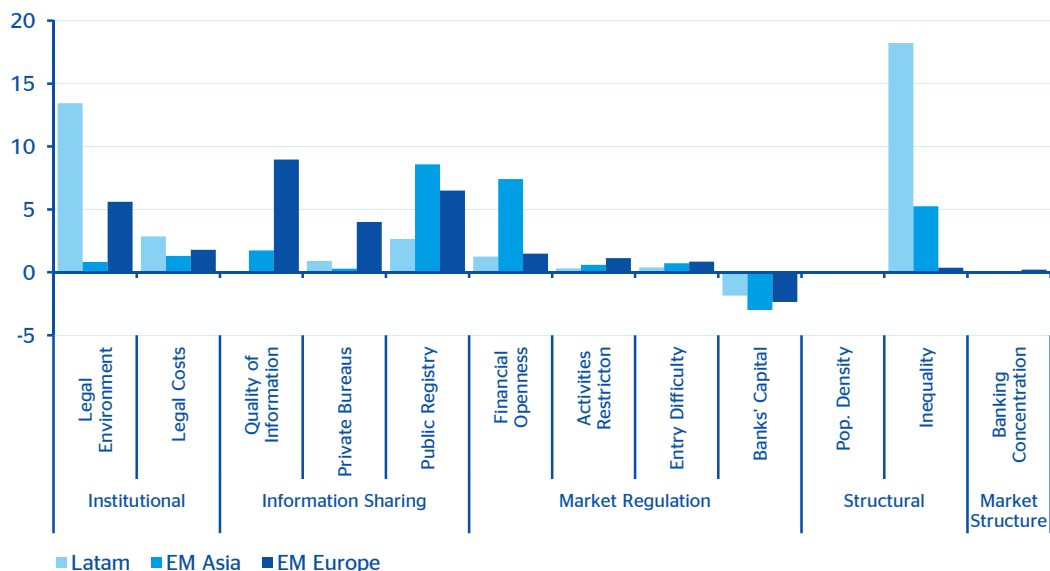
Finally, our model allows us to perform a simulation exercise in order to estimate the possible impact of an improvement in the regulatory and institutional variables across different countries in the actual ratio.

In Chart 15 we can observe the results of such simulation. The exercise consists of making all those countries that have “negative” values in any particular variable to converge to the world’s average level of such variable while countries above the average are left unchanged. Additionally, for those variables “corrected” by the income per capita, such as the legal environment, we change the positive values to have values equal to zero (equivalent to make the countries with legal environment levels lower than the corresponding to their income per capita, to have a legal environment level in line with its respective development level).

It is important to highlight that the simulation assumes a “once and for all” change in the explanatory variables, but given that these variables are long-term averages, in reality it would take several years in order to make such long-term averages to converge to the simulated values<sup>5</sup>. In Chart 15 we can observe the average impact for the years 2013 to 2022 on the three most important emerging economies regions:

- If all Latin-American countries had legal environment indicators in line with their income per capita levels, the structural credit ratio in the region would be nearly 13 points higher.
- Emerging Europe could on average increase its structural credit ratio by about 20 points by improving altogether its information sharing variables.
- Emerging Asia could further improve its structural ratios by about 15 points through improving public registries’ coverage and by increasing financial openness.

Chart 15  
Estimated impact of a change in regulatory, institutional and structural variables in Credit-to-GDP ratio, in pp. (average 2013-2022)



Source: BBVA Research

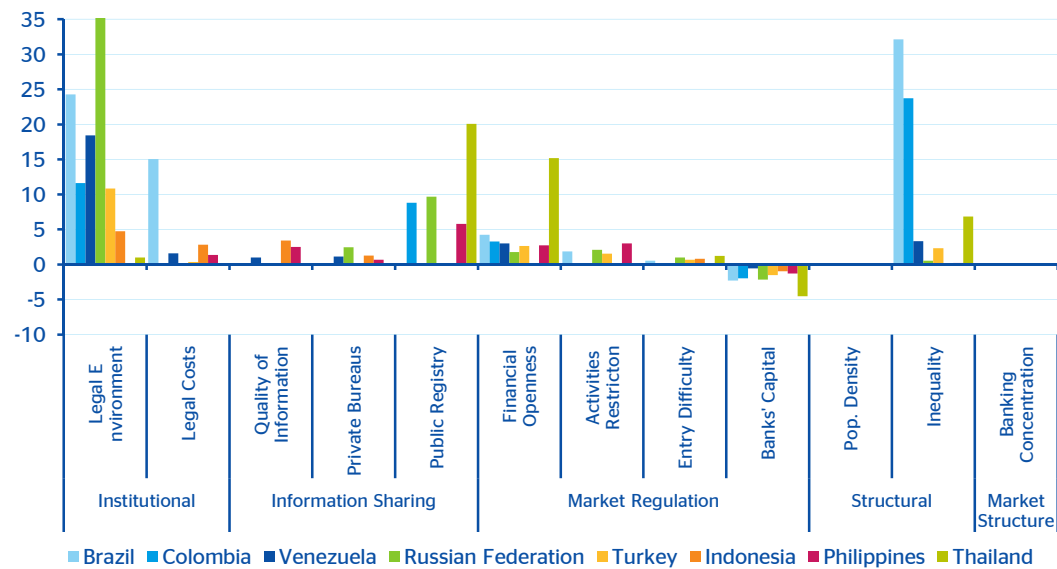
5: For instance, let's say that the long-term (20 years) average of the variable "Public registry coverage" is 20% for a given country "A", and that the world's average is 40. In this simulation we are assuming that in one year the long-term average of country "A" goes from 20 to 40. However, in reality, if the value of this variable goes from 20 to 40 in one year, its long-term average would not be 40, but 20.9. Country "A" would actually need 20 years in order that its long-term average converges to 40.

Furthermore, and considering that there is a large heterogeneity across countries within different regions, in Chart 16 we show the results of the same simulation exercise for some of the countries with the lowest scores in the index of regulatory and institutional variables:

- **Brazil could improve its structural credit ratio by 25 points** by improving the “rule of law” and the protection of creditors, and by 15 points by reducing legal costs (cost of enforcing contracts, cost of registering property and the recovery value of assets after insolvency).
- **Thailand could achieve a 20 points improvement** by increasing the coverage of public registries.
- **Russia could increase its structural ratios by around 40 points** by improving the “rule of law” and the protection of creditors to levels in line to its income per capita levels.

Chart 16

Estimated impact of a change in regulatory, institutional and structural variables in Credit-to-GDP ratio, in pp. (average 2013-2022)



Source: BBVA Research

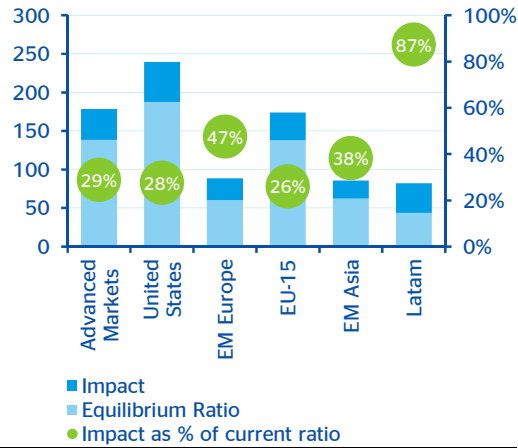
Finally, in order to have a better idea of the magnitude of the total impact of the simulation exercise, in Chart 17 and Chart 18 we show the sum of the impact of the variables altogether. In terms of the current structural ratio:

- **The most benefited region would be Latin America**, because its average structural ratio would increase by 87% (38 points of GDP), **Emerging Europe could increase its current structural ratio about 47% (29 points of GDP)**.
- The most developed regions could also increase their structural ratios significantly. **EU-15 countries could on average increase their current structural ratios by 26% (36 points of GDP)**.

This is a good remainder that improving the regulatory and institutional framework could be a way of reducing the pain of deleveraging. There are two well-known ways of deleveraging, which are to reduce credit (without decreasing GDP or by decreasing it less than credit) or to increase GDP (without increasing credit or increasing it less than GDP). However, how much should a credit ratio be reduced? According to our model, credit should be reduced until it equals the structural level. Therefore, it arises another way of reducing a credit gap, which would be to increase the structural level of credit by improving the regulatory and institutional framework.

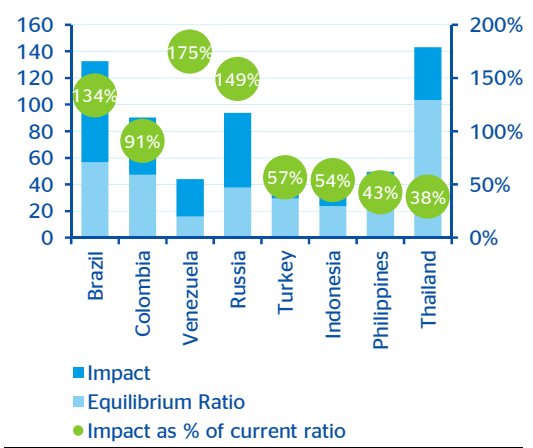
- By countries, **Brazil** could increase its current ratio by 134% (76 points of GDP) and **Russia** by 149% (56 points of GDP).
- Although the increase in countries such as **Turkey** and **Philippines** does not seem so large in terms of GDP (17 and 15 points respectively) it is an important increase considering their current levels (57% and 43% respectively).

Chart 17  
Total impact on the credit ratio  
(average between 2013 and 2022)



Source: BBVA Research

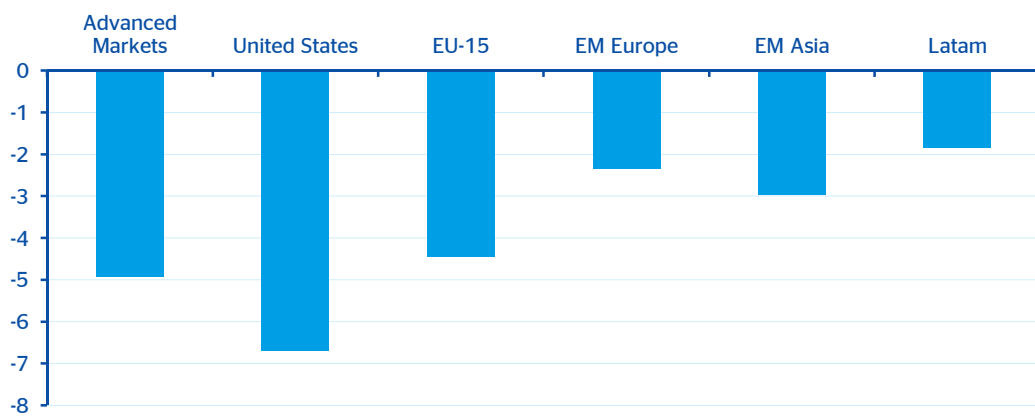
Chart 18  
Total impact on the credit ratio  
(average between 2013 and 2022)



Source: BBVA Research

In order to show another important application of the model regarding regulatory changes, we have depicted in Chart 19 the estimated impact of a one point change in the banking system regulatory capital (averaged within different regions). The reason why the impact is larger in the most developed economies is because the non-linearity of the model, which generates that the estimated effect is larger the larger is the credit ratio.

Chart 19  
Estimated impact of a one point change in regulatory capital in Credit-to-GDP ratio, in pp.  
(average 2013-2022)



Source: BBVA Research

### Methodological Box: Non-linear model for the Credit-to-GDP ratio

We propose a methodology based on the idea that the long-run relationship between the Private Credit-to-GDP ratio and income per capita follows a logistic type of relationship with a saturation level at the highest levels of income, i.e. a Gompertz-curve type of relationship.

We first assume the following relationship between the credit ratio and income per capita:

$$\frac{c}{Y} = \alpha \cdot \exp(\gamma \cdot \exp(\beta Ypc)) \quad (1)$$

Where  $\alpha$  is the constant “maximum” saturation level. If there were no other variables in place, this is the level that a country will approach as long-term per capita income tends to infinity.  $\gamma$  is the parameter that defines the curvature of the Gompertz curve and  $\beta$  defines the sensitivity to income per capita. We estimate the regression using non-linear maximum likelihood techniques.

We also account for an additional characteristic of the credit ratio that has usually been ignored by most of previous empirical models, which is the fact that the ratio cannot take negative values. Considering the different methodological alternatives to deal with this problem, we follow Nichols (2010), Wooldridge (2010) and others and we assume a Poisson-like distribution of the dependent variable. Thus, we assume the following specification:

$$\frac{c}{Y} = \exp[\alpha \cdot \exp(\gamma \cdot \exp(\beta Ypc))] \quad (2)$$

We are also interested in estimating and testing whether the sensitivity of the credit ratio to income per capita and to other explanatory variables could differ in the long-term versus the medium-term or the short-term. The idea that there could be different sensitivities is based on the notion that the structural relationship between credit depth and income per capita originates in a long-term process of development, whereas the actual credit ratio could diverge from such structural relation in the medium-term and in the short-run. For instance, episodes of credit booms/bubbles are medium-term processes in which credit grows excessively in response to changes in income, investment, interest rates or other variables. Therefore, the sensitivity of the credit ratio to such changes in the medium-term may differ from the sensitivity to these variables’ long-term levels.

- Consequently, we take advantage of the cross-section and time series characteristic of a panel data and estimate the Gompertz-curve type of relationship using the following assumptions about

the relationship between the dependent variable and income per capita:

1. The Financial development level of a country is related to the most “structural” part of income per capita, i.e. to its long-term level. We measure the long-term component of income using a long-term (15 years) moving average. Thus, we estimate a specific sensitivity of the credit ratio to such long-term component of income.
  2. In the medium-term, there could be periods of time in which the observed credit ratio is more sensitive to deviations of income per capita and investment. We thus assume that there could be a different sensitivity of the ratio to medium-term deviations of macroeconomic variables. We measure medium-term deviations as the difference between the 5-years moving average and the long-term “structural” average.
  3. Agents may react differently to short-run deviations in income and other variables and thus, we may also observe a different sensitivity in this case. We measure short-run deviations as the difference between the observed level of the variable and the medium-term (5-years) moving average.
- Therefore, we extend the specification shown in (2) and include different sensitivities to income per capita:

$$\frac{c}{Y} = \exp[\alpha \cdot \exp(\gamma \cdot \exp(\beta_{LT} \overline{Ypc}_{it}^{15yr} + \beta_{MT} \widehat{Ypc}_{it} + \beta_{ST} \widehat{Ypc}_{it}))] \quad (3)$$

Where  $\overline{Ypc}_{it}^{15yr}$  represents the long-term (15 years) moving average of GDP per capita,  $\widehat{Ypc}_{it}$  represents the medium-term deviation of income per capita with respect to its long-term level, i.e.  $\widehat{Ypc}_{it} = (\overline{Ypc}_{it}^{15yr} - Ypc_{it})$ , and  $\widehat{Ypc}_{it}$  represents the short-run deviation of the observed income per capita with respect to its medium-term (5-years) moving average, i.e.  $\widehat{Ypc}_{it} = (Ypc_{it} - \overline{Ypc}_{it}^{5yr})$ . Therefore,  $\beta_{LT}$ ,  $\beta_{MT}$  and  $\beta_{ST}$  represent the long-run, medium-term and short-run sensitivities to income respectively.

In addition to the different sensitivities of the credit ratio to income per capita, we also estimate different sensitivities to other macroeconomic according to the time-horizon components. Moreover, the saturation level and the shape of the relationship between credit deepening and income should depend on institutional and regulatory determinants such as creditors’

protection, information sharing, banking structure, the long-run evolution of interest rates and so on. Therefore, within the Gompertz-curve framework, we allow each country to have a different saturation level that depends on the long-term level of institutional and structural variables:

$$\frac{c}{y} = \exp\left[\{\alpha + \phi_{LT}\bar{X}_i + \eta_i\} \cdot \exp(\gamma \cdot \exp(\beta_{LT}\bar{Y}pc_{it} + \beta_{MT}\bar{Y}pc_{it} + \beta_{ST}\bar{Y}pc_{it})) + \phi_{MT}\bar{X}_{it} + \phi_{ST}\hat{X}_{it} + u_{it}\right] \quad (4)$$

Where  $\bar{X}_i$  represents the country average of an explanatory variable across all sample years,  $\bar{X}_{it}$  represents the medium-term deviation of a variable with respect to its long-term level, i.e.  $\bar{X}_{it} = (\bar{X}_{it}^{5yr} - \bar{X}_i)$  and  $\hat{X}_{it}$  represents the short-run deviation of the observed variable with respect to its medium-term (5-years) moving average, i.e.  $\hat{X}_{it} = (X_{it} - \bar{X}_{it}^{5yr})$ . Therefore,  $\phi_{LT}$ ,  $\phi_{MT}$  and  $\phi_{ST}$  represent the long-run, medium-term and short-run sensitivities to an explanatory variable respectively.

- We can summarize the main advantages of our methodology with respect to previous empirical exercises exploring the determinants of credit depth in the following three assumptions:
  - A more realistic type of relationship between the credit ratio and income per capita (Gompertz-curve);
  - We allow for different sensitivities to macroeconomic variables depending on the time-horizon.
  - We account for the non-negativity of the dependent variable.

We apply our proposed methodology to a large (unbalanced) panel dataset of 83 countries between 1990 and 2012 and a total of 1683 observations. The analysis includes around 20 explanatory variables that can be broadly classified into macroeconomic determinants, regulatory and institutional variables and structural determinants. As explained in the methodology section, the macroeconomic variables are the ones that are decomposed into the three time components, whereas in the case of the institutional, regulatory and structural variables we only include their long-term (country) average.

#### Macroeconomic Determinants:

- Income (GDP) per capita in PPP terms and in constant US dollars
- Lending-Deposits Banking Spread
- Short-term interest (short-term money-market rate or the Treasury-bill rate when money-market rate is not available)
- Investment to GDP ratio
- Inflation rate

#### Institutional and Regulatory Determinants:

- Strength of Creditors' Legal Rights index
- Enforcing Contracts Cost Index
- Registering Property Cost Index
- Recovery value of assets after insolvency
- Information Quality Index
- Private Bureau Coverage
- Activity Restrictions Index.
- Entry of new banks difficulty Index

#### Structural Determinants:

- "Rule of Law" Index
- Gini Index
- Banking Concentration
- Chinn-Ito Index of financial openness
- Regulatory Capital to Risk-Weighted Assets ratio
- Regulatory minimum capital requirement
- Population Density

The variables "Enforcing Contracts Cost Index", "Registering Property Cost Index" and "Recovery value of assets after insolvency" were used to construct a new variable through PCA called "Legal Costs Index". Similarly, the variables "Strength of Creditors' Legal Rights Index" and the variable "Rule of Law" were used to construct a new indicator called "Legal Environment Index".



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