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Credit determinants and their impact
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Credit determinants and their impact on firm's growth in Colombia*

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Abstract

In recent years, credit growth has been accelerated recording higher levels of credit as a percentage of GDP, compared to previous years in some countries of Latin America. In Colombia, credit to GDP indicator had increased almost 10 percentage points in the last five years. For this reason, it is interesting to study the behavior in Colombia analyzing credit boom episodes, and the possible impacts on the economy. This paper provides an econometric analysis of economic determinants of credit portfolio as a percentage of GDP, in order to find the level of this indicator which is supported by its determinants. We found that Interbank rate, National-debt-to-GDP, Household-consumption-to-GDP and the level of investment-to-GDP are the main determinants of credit portfolio-to-GDP. On the other hand, we determine the level of commercial credit-to-GDP that is consistent with its determinants. Then we evaluated how this indicator of financial deepening affects firms growth rate in Colombia.

The results suggest in Colombia the portfolio to GDP ratio is not significantly above from its consistent level at ends to 2011. It was also found the effect of financial deepening in business growth is positive and quite significant. Also as expected the effect of being in debt depends heavily on the sector to which the firm belongs. In general being in debt increased the firm's rate growth and brings an externality that affects not indebted firms. This opens the debate if macro prudential measures that affect all types of portfolio are more damaging than those that are specialized.

JEL classification: *G21, O12, O16*

Keywords: Financial deepening, lending boom, microeconomic development, macroeconomic determinants, firms growth.

*The opinions contained herein are the sole responsibility of the authors and do not reflect those of Banco de la República or its Board of Governors. All errors and omissions remain our own.

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1. Introduction

In the last year, the rate of annual credit growth in some countries in Latin America was at levels close to 20%. In countries like Argentina, this rate was near to 45% in September 2011, a behavior that, in general terms to any economy, can lead to an increase the leverage of economic agents, augmenting their vulnerability to economic shocks and ultimately, affecting financial stability.

For this reason, we identify episodes of lending booms for Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico and Peru. These countries are located in the same region, with relatively similar socioeconomic characteristics and, given their economic structure, facilitate comparisons with Colombia.

Was defined an episode of lending boom based on the deviation between Credit / GDP and its trend¹. In particular, the following indicator was calculated for each country in the sample:

$$\text{Absolute deviation} = \left(\frac{\text{Loan portfolio}}{\text{GDP}} \right)^{\text{observed}} - \left(\frac{\text{Loan portfolio}}{\text{GDP}} \right)^{\text{trend}} \quad (1)$$

Following P. Gourinchas, R. Valdés and O. Landerretche (1999), the beginning of lending boom episode is identified when the absolute deviation indicator (1) is larger than 2 percentage points (pp). It should be noted that this indicator is just one of many found in the international literature for measuring lending booms. Although we use this indicator for its simplicity and it allows to easy compare the results between countries. Results of this exercise can be seen in Figure 1.

Loans as a percentage of GDP in Latin American countries here examined have been rising steadily for the past year. In September 2011, the largest deviation above the trend of this indicator is observed in Argentina (1,26 pp), followed by Ecuador (1,64pp) and Colombia (80 basis points, bps)². However, when compared with the highest recorded episodes of lending booms since the mid-nineties (Table 1), we see that these deviations are minimal.

TABLE 1: Lending Boom episodes in Latin America

Country	Lending Boom episodes		
	Start	End	Maximum deviation (pp)
Argentina	Mar-99	Mar-02	4.2
Brazil	Mar-93	Sep-94	95.6
Brazil	Jun-00	Mar-03	4.6
Brazil	Sep-07	Mar-09	4.1
Chile	Sep-01	Sep-02	3.6
Chile	Jun-08	Mar-10	7.3
Colombia	Sep-97	Sep-99	3.6
Colombia	Sep-07	Dic-07	2.1
Costa Rica	Jun-08	Dec-99	5.5
Ecuador	Jun-00	Jun-02	4.2
México	Sep-93	Sep-95	8.2
Peru	Sep-98	Dec-99	3.0
Peru	Dec-08	Mar-09	2.9

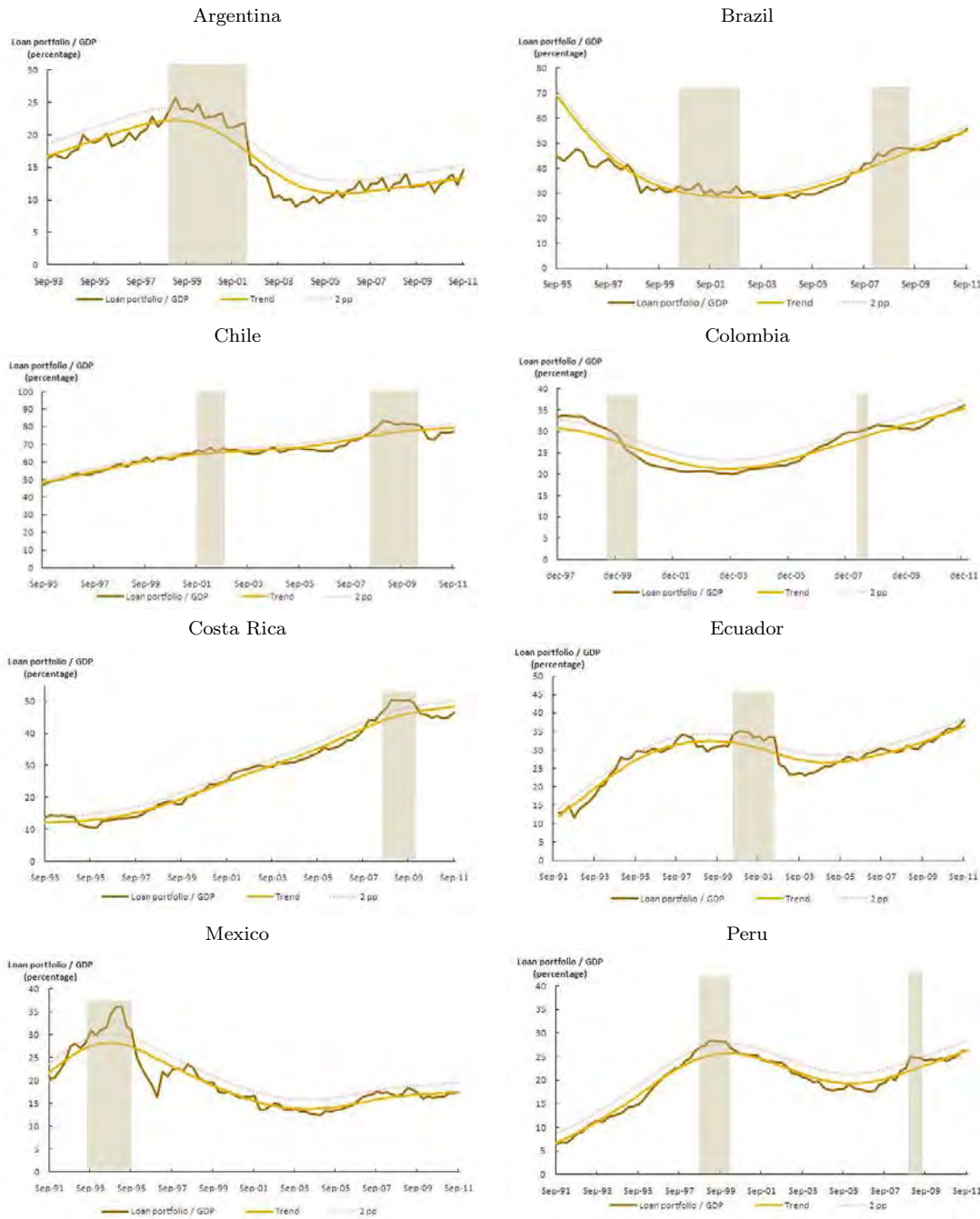
Note: Taken into account the highest deviation in Brazil, the average for the sample is 11.5 pp. Without this episode, the average maximum deviation would be 4.4 pp.

Source: IMF, own calculations.

¹The trend is calculated using the Hodrick-Prescott filter for quarterly data from the early nineties to September 2011 for all countries except Colombia, which is calculated through December 2011.

²This corresponds to December 2011 for Colombia.

FIGURE 1: Financial deepening, trend and absolute deviation for some countries in Latin America



Source: Central Banks and Financial Regulators in each country, International Monetary Fund (IMF), Departamento Administrativo de Estadística (DANE); own calculations.

Recall for Table 1, we observed credit to GDP indicator for Colombia is 2 pp off its trend (in absolute terms) in the following periods:

- September 1997, this could be considered the beginning of a mortgage credit boom that ended in September 1999, and peaked in the same month in 1998.
- Between September and December 2007, this was effectively a period of significant consumer loan growth.

At December 2011, in Colombia we do not identify the beginning of a lending boom episode; however, credit-to-GDP indicator was above its trend. For this reason, it is necessary to analyze whether economy level of indebtedness is supported by its macroeconomic determinants.

In the economic theory, there are three principal ideas about the importance of the credit in economic development: (1) countries with better functioning banks and markets grow faster; (2) simultaneity bias does not seem to drive these conclusions and (3), better functioning financial systems ease the external financing constraint that impede firm and industrial expansion, suggesting that this is one mechanism through which financial development matters for growth P. Aghion and P. Howitt (2009).

To this end, we developed an econometric analysis which identifies the main determinants of credit-to-GDP indicator in Colombia. Results show, in addition to the interbank rate, variables such as household consumption, level of investment and foreign direct investment positively affect the behavior of this indicator. On the other hand, we found variables such as national debt and the spread between domestic and foreign interest rates negatively affect this variable.

Additionally, the estimation suggest the growth rate of total loans from September 2010 to the same month of 2011 should had been 20.7%. However, for this period the observed growth rate of total portfolio was located at 23.46%, or 2.76 pp (higher than the growth rate supported by macroeconomic determinants, measure of credit "excessive")

Analyzing last lending boom episode³, credit portfolio in Colombia grew at real annual rates close to 28%, mainly driven by consumption pattern (Figure 2). In this episode to slow down credit growth, regulators imposed a macro prudential measure whose impact was observed in all modes of portfolio.

This measure was a change in marginal reserve requirement and increased it in savings accounts and similar. Moreover, the marginal reserve was established for all deposits. This resulted in a slowdown in total loans rate growth to 13% in real terms a year later (2008), and even reached negative growth rates years after. Before the macro prudential measure, growth of different branches of economic activity was about 8.5% in real terms. Also, there was a slowdown in this dynamic: two years after the measure implementation, the main economic sectors grew to 1.2% in real terms.

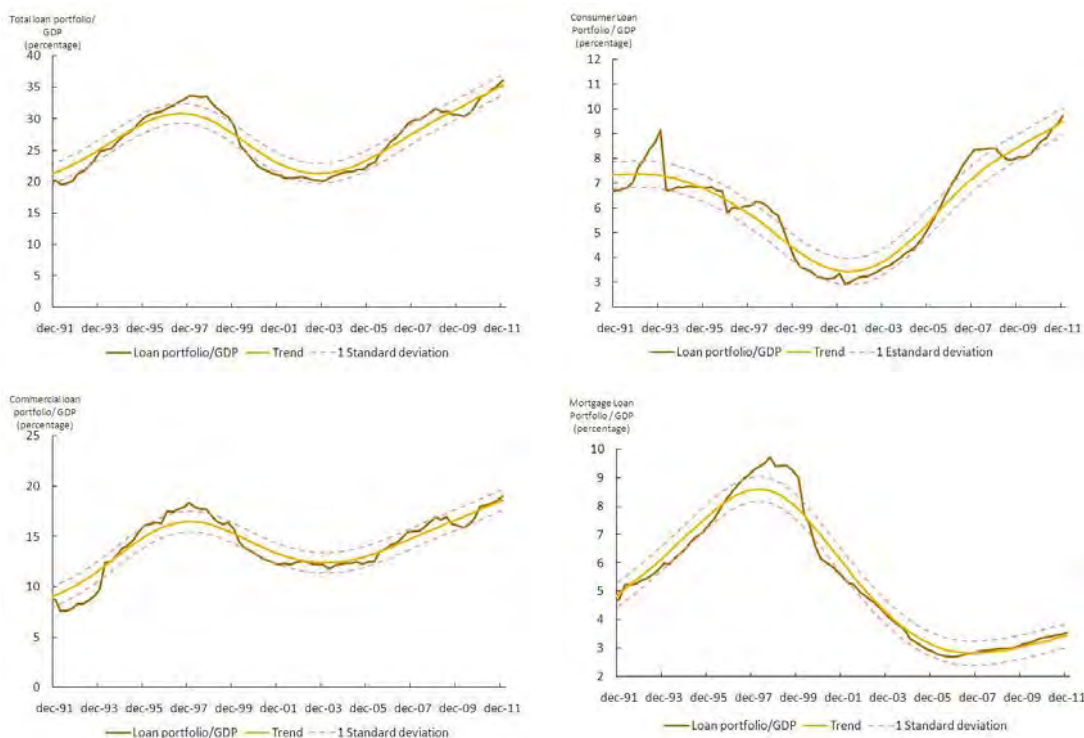
Currently, the rapid growth of credit is mainly due consumer portfolio dynamics (Figure 2). Therefore, to avoid affecting all economy sectors, a macro prudential measure should be directed only to this type of loan.

While the last episode of credit boom (2007) was a time when the world economy was going through the most recent financial crisis, there is the question whether the slowdown to total gross loans affected the growth of economic sectors. To measure this effect in the economy we calculated the impact of commercial-loan-to-GDP on firm growth.

We developed a dynamic panel to study how Colombian firms growth, measured as the change in operating income, is affected by internal characteristics (specific) of the company, as well as financial

³As mentioned, between September and December 2007.

FIGURE 2: Loan portfolio by mode



Source: Superintendencia Financiera de Colombia; own calculations.

deepening (commercial loans). This methodology was based on the work of F. Gallego and N. Loayza (2000).

We found commercial-loan-to-GDP significantly affects the growth of firms in Colombia. Also, times when financial intermediaries show preferences for investing their resources in government bonds, negatively affect firms revenue growth, because there are fewer resources to finance the firm's projects (crowding out). On the other hand, we found indebted firms grow at a faster rate. Further, we found a positive effect of commercial loans for firms who do not have business credit, suggesting the existence of positive externalities on firms' growth.

As a result, it was possible to identify the importance of credit in firms growth, and therefore, a macro prudential measure implemented to reduce the growth of the entire portfolio could have an undesirable negative impact on economic growth. In Colombia a firm indebted presents a growth rate, on average, 87 bp faster than a firm without debt. Furthermore, an increase in 1 percentage point (pp) of commercial-portfolio-to-GDP affects positively in 78 basic points (bp) firms growth rate.

The paper is organized as follows. Section 2 includes a brief literature review that examined empirical models applied in this topic. Section 3 analyzes the macroeconomic determinants that effect total credit-to-GDP and commercial credit-to-GDP in Colombia. Section 4 evaluates how commercial loan portfolio-to-GDP affects the firm's growth in Colombia estimating a panel data. Section 5 analyze some stylized facts commercial-credit-to-GDP effects on the economy. We include the results of section 3 to describe the real effect of consistent level of commercial-portfolio-to-GDP in the firms growth. Finally, section 6 concludes.

2. Theoretical framework and literature review

The importance of knowing how financial development affects economic growth has been an important topic which has been discussed by many economists throughout history. Thus, economic theory and empirical studies have focused on analyzing credit growth, financial depth and lending boom episodes in the economy.

According to Schumpeter, J.A. (1934), the services provided by financial intermediaries that stand between savings, project evaluation, risk management, monitoring and improving the efficiency of transactions, positively affect economic development. He proposed a model considered financial constraints into multisector growth model, another with ex ante screening and finally a model with ex post monitoring and moral hazard. We use these theoretical models to develop our empirical approach.

Due the growing trend of credit in some emerging economies in recent years, the literature concerning to identification and analysis of episodes of credit boom has become very important today. This growth can be attributed to several factors such as macroeconomic stabilization, financial reforms, legal reforms, privatization of financial sector and the introduction of new external financial institutions to market.

Studies like those of B. Égert, P. Backé and T. Zumer (2006) and F. Boissay, O. Calvo-Gonzales and T. Kozluk (2005) focused their analysis on the recent lending boom episode in Central and Eastern Europe (CEE) examining whether credit growth in this period was supported by the countries of this region in the long term. The authors proposed two econometric models which found the equilibrium level of the portfolio as a percentage of GDP consistent with macroeconomic determinants. In this study we use this model as a basis for identifying the consistent level of portfolio as a percentage of GDP in Colombia. Variables such as GDP growth, prices and interest rates are commonly used as explanatory variables.

Thus, we identified episodes of lending booms in Colombia in order to analyze whether a level of loan portfolio-to-GDP is consistent with the macroeconomic determinants. Furthermore we analyze what happened with the indicator and its determinants in these episodes. In America, a very interesting study of this topic was proposed by P. Gourinchas, R. Valdés and O. Landerretche (1999) and P. Gourinchas, R. Valdés and Oscar Landerretche. (2001), which proposed a model to identify the beginning of a lending boom episode. They studied the relationship of these episodes with the main macroeconomic variables concluding a positive relationship between credit growth and economic growth. In Colombia, there is a pair of interesting studies about firms growth and credit constraints. The first one is Eslava, M., Galindo, A. Hofstetter, M. and Izquierdo, A. (2010), where they use the Colombian manufacturing establishments dataset to illustrate potential scarring effects of recessions operating through credit constraints. They find that financially constrained businesses might be forced to exit the market during recessions even if they are highly productive. The second one is Eslava, M., Maffioli, A. and Meléndez, M. (2012), whose objective is to analyze the impact of Bancoldex, Colombia's publicly owned development bank, on access to credit. The paper assesses effects on access to credit by comparing Bancoldex loans to loans from other sources and study the impact of receiving credit from Bancoldex on a firm's subsequent credit history. They show that credit relationships involving Bancoldex funding are characterized by lower interest rates, larger loans, and loans with longer terms.

In addition to the empirical literature, there are strong indications from the positive relationship between credit and economic growth. Therefore, the level of financial deepening as measured by portfolio as a percentage of GDP has been studied by economists as R. King and R. Levine (1993) and Levine,

R. (1997) which suggested that financial deepening accelerates aggregate economic growth, the rate of capital accumulation and improves the efficiency of capital use. The efficiency of capital use is particularly due to a positive effect on smaller firms that have less difficulty in accessing the financial services sector. Other interesting works in this area are those proposed by T. Beck, A. Dermigüç-Kunt, L. Leaven and R. Levine (2008) and R. Carpenter and B. Petersen (2002) who support the positive relationship between credit and firms growth.

Finally, on the basis of this positive relationship we studied microeconomic and macroeconomic determinant of firms growth in Colombia. We attempted to replicate the work of F. Gallego and N. Loayza (2000) which was based on Levine, R. (1997) and Levine, R., N. Loayza, and T. Beck. (2000) where they studied the relationship between financial development and growth of GDP. These studies support the Schumpeter, J.A. (1934) thesis who analyzed the relationship of the banking system to economic growth by identifying certain characteristics of the innovation that directly affect funding constraints profitable projects.

3. Determinants for credit-to-GDP

In this section, we propose an econometric model to explain the equilibrium level of credit-to-GDP ratio. We based on F. Boissay, O. Calvo-Gonzales and T. Kozluk (2005) where they explain credit-to-GDP as function of real interbank rate and a variable that captures the effect of financial liberalization on credit supply. However, our interest is focused on macroeconomic determinants that affect the indicator, therefore our contribution is to explain the effects of other different variables to the traditional interbank rate, which can affect the credit-to-GDP ratio in development countries.

This model allows us to estimate differences between the estimated and observed ratio. The comparison provides a measure of credit "excessive". We will consider the ratio is "excessive" when it is higher than level supported by its macroeconomic determinants.

For Colombia, the evolution of credit-to-GDP indicator can be depend not only of credit interest rate (interbank rate), but also on variables such as household consumption, the level of investment, nominal exchange rate (COP/US), foreign direct investment, national debt and the spread between domestic and foreign interest rates. For this exercise were included variables industrial wage index and the unemployment rate which were not significant when running the model.

The proposed model is:

$$\begin{aligned} \frac{c_t}{GDP_t} &= \beta_0 + \beta_1 IBR_t + \beta_2 \frac{ND_t}{GDP_t} + \beta_3 \frac{HC_t}{GDP_t} + \beta_4 \frac{INV_t}{GDP_t} + \beta_5 \frac{FDI_t}{GDP_t} + \beta_6 NER_t + \beta_7 spread_t + \beta_8 Z_t \\ &= \left(\frac{c}{GDP} \right)_t^* + \epsilon_t \end{aligned} \quad (2)$$

$$Z_t = \gamma_{i1}t + \gamma_{i2}t^2 \quad (3)$$

Where $\frac{c_t}{GDP_t}$ is the credit-to-GDP ratio, $\frac{ND_t}{GDP_t}$, $\frac{HC_t}{GDP_t}$, $\frac{INV_t}{GDP_t}$, $\frac{FDI_t}{GDP_t}$ denote the ratio in real terms of national debt, household consumption, level of investment, and foreign direct investment to GDP respectively, GDP_t is real GDP, IBR_t is the interbank rate, NER_t is the nominal exchange rate (COP/US), $spread_t$ is the spread between domestic and foreign interest rate, and Z_t captures the effects of finan-

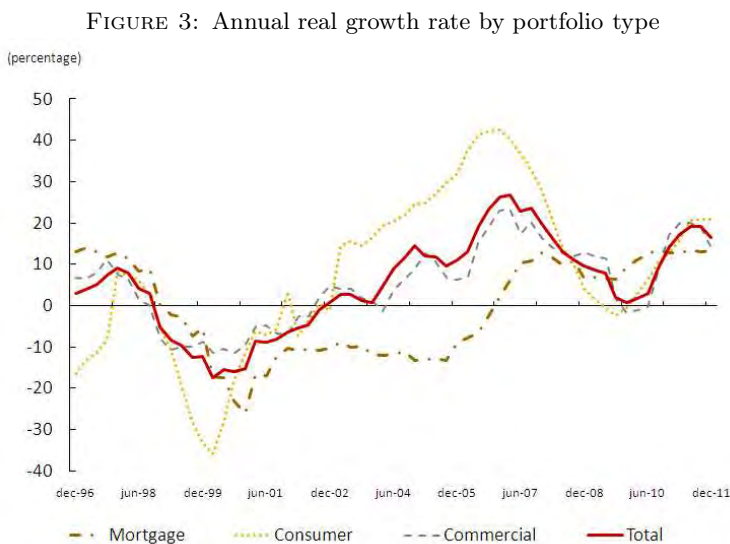
cial deepening. In the right sight of equation 2, $(\frac{c}{GDP})_t^*$ denotes the credit-to-GDP ratio supported by macroeconomic determinants and ε_t is the gap between the observed and estimated ratios.

An important approach is that level of credit-to-GDP does not only depend of macroeconomic determinants, but also depend of few recent circumstances that affect the banking sector and credit supply. For example, in the last year in Colombia the financial deepening affect positively growth rate of new credits, and the expansion of financial conglomerates supply the public with new financial services. For simplicity, we will assume that these types of effects over time can be approximated by a deterministic non-linear time trend Z_t .

Given the increased participation that has commercial loans on total credit and its importance in firm's growth, we performed the same exercise for this modality.

3.1. Data

The data set is a time series spanning from 1996Q4 to 2011Q3. The indicator total credit-to-GDP went from 31.75% in December of 1996 to 35.23% in September of 2011. During this period, credit-to-GDP indicator not changed significantly, but reached a minimum of 20.1% when the real annual growth rate of total loan portfolio was negative (December of 2003) (Figure 3).



Source: Superintendencia Financiera de Colombia; own calculations.

The composition of total loan portfolio during the full sample period has changed. The proportion of commercial loans to total portfolio has fluctuated between 52% and 61% (mean of 57.6%), consumer loan between 13.7% to 30.7% (mean of 21.9%) and mortgages between 10% and 31.3% (mean of 19.3%). Importantly, the household debt - measured as the sum of housing and consumer loans - has presented a substitution, where the late 90's the highest concentration was in mortgage credits, actually the largest concentration occurs in consumption.

Our analysis includes the following macroeconomic variables. Interbank rate refers to an interest rate at which financial intermediaries lend funds to each other by one day (overnight loans). Loans between entities are not collateralized and therefore the rate reflects the credit risk associated with the

TABLE 2: Main statistics macroeconomic variables

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Credit-to-GDP (%)	60	27.111	5.096	20.107	35.234	-0.071	1.394
Interbank rate (%)	60	11.401	9.583	3.013	50.879	2.093	7.473
National debt-to-GDP (%)	60	32.280	8.564	12.300	42.960	-0.967	2.828
Household consumption to GDP (%)	60	83.919	4.029	76.935	90.965	0.070	1.611
Level of investment to GDP (%)	60	19.772	3.236	12.821	24.247	-0.556	2.123
Nominal exchange rate (COP/US)	60	2,079	468	1,001	2,959	-0.372	2.754
Spread between domestic and foreign interest rate	60	8.006	8.488	0.812	45.191	2.388	9.020
Foreign direct investment to GDP (%)	60	3.296	1.402	1.469	7.596	1.353	4.669

Source: Dane, Superintendencia Financiera de Colombia; own calculations.

counterparts involved in transactions. Additionally, the level of this rate reflects the liquidity conditions in the local money market.

The national debt includes the total debt balance of the central national government and is a measure of liquidity that government injects into economy. Meanwhile, the household consumption and the level of investment are the GDP component denoting the expenditure of households, and gross fixed capital formation and changes in stocks, respectively. The nominal exchange rate is denominated in Colombian pesos to US dollar. The spread between domestic and foreign interest rate is the difference between the Colombian interbank rate and the 3 month Libor. The foreign direct investment is the long-term financial resources from abroad that are injected into an economy. Table 2 presents the main statistics of these data⁴.

On one side, we expect a positive impact to credit-to-GDP ratio for the interbank rate and a negative influence from the national debt, as the higher values recorded for the interbank rate means a higher level of liquidity to credit institutions, while the second one means a higher level of liquidity in the economy, that can be a substitute of credit with private institutions. On the other side, if exist increments in these variables, we forward a positive impact from household consumption, the level of investment and foreign direct investment as they mean a greater likelihood of an increase the credit demand. Additionally, we expect a negative impact from the spread between national and international interest rates, as the higher the difference is, the more expensive domestic credit becomes relative to external loans.

3.2. Results

We estimate the model in equation 2 and 3 making unit root and cointegration tests. The test results show that the series are I(1) processes. However when we analyze the error term in equation 2 in levels and make a unit root test we discover that is stationary, I(0), a sign of cointegration, allowing us to estimate the first model in levels⁵. The main results are in Table 3.

⁴The sources of this data are in Appendix A.

⁵These results are not reported in the paper but are available from the authors upon request.

TABLE 3: Results: determinants of credit to GDP model

Variable	Total loan portfolio	Commercial loan portfolio
	Coefficient	Coefficient
Constant	-0.922 [0.123]***	-0.315 [0.075]***
Interbank rate	0.348 [0.083]***	0.095 [0.050]*
National debt-to-GDP	-0.625 [0.064]***	-0.265 [0.039]***
Household consumption-to-GDP	1.270 [0.119]***	0.493 [0.072]***
Level of investment-to-GDP	0.401 [0.083]***	0.126 [0.050]**
nominal exchange rate (COP/US)	0.001 [0.001]***	0.001 [0.001]***
Spread between domestic and foreign interest rate	-0.358 [0.082]***	-0.113 [0.050]**
Foreign direct investment to GDP	0.139 [0.0976]*	0.071 [0.045]
T	0.002 [0.001]***	0.001 [0.001]
T2	0.001 [0.001]***	0.001 [0.001]***
Adjusted R-squared	0.988	0.977
F-statistic	483.925	254.408
Akaike info criterion	-7.369	-8.369
Durbin-Watson stat	1.652	1.410

Note: *, ** and *** indicate statistical significant at the 10%, 5% and 1% significant levels, respectively.
Source: own calculations.

In Figure 4, we see a very good fit of the model to the series in general, giving evidence that we incorporated the principal determinants of credit-to-GDP indicator. Importantly, the model was controlled by the change in the prices of the economy. This allow us establish a comparison point from observed and consistent levels of the ratio given a quantitative measure when is above or below of its determinants.

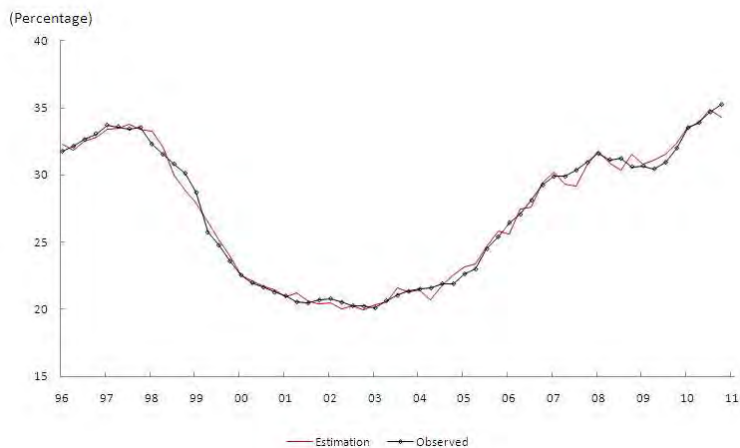
For all macroeconomic variables considered, estimated coefficients are statistically significant (Table 3) and have the expected sign, compatible with the argument explained in section 3.1. Also, the model in equation 2 applied to commercial credit, similar results were found (Figure 5).

As we mentioned, the interbank rate, household consumption-to-GDP, level of investment-to-GDP, foreign-direct-investment-to-GDP and Z_t affect positively. Otherwise, the national-debt-to-GDP and the spread between domestic and foreign interest rate affect negative credit-to-GDP ratio.

The variables that have the greatest impact are household-consumption-to-GDP, national-debt-to-GDP, and the level of investment-to-GDP. Importantly, foreign-direct-investment positively affects both models. However, in Table 3 there was no mark of a significative level of the coefficient in commercial-loan-portfolio model, but it is at 15%.

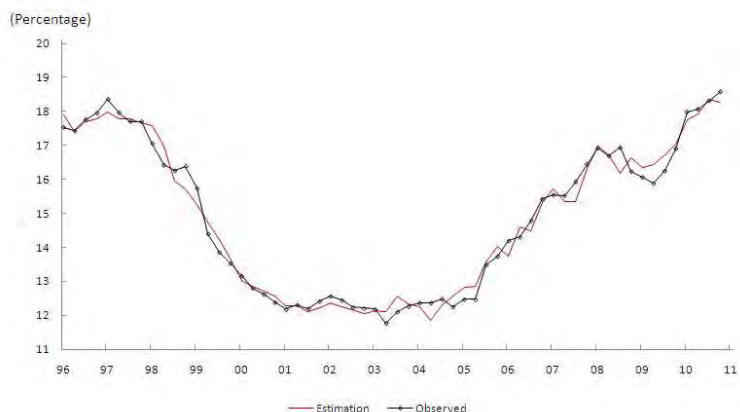
For the latest estimated indicator of total-loans-portfolio-to-GDP under the proposed model, the growth rate of total loans from September 2010 to the same month of 2011 should grow to 20.7%.

FIGURE 4: Estimated and observed Total loan portfolio to GDP



Source: Banco de la Republica, Superintendencia Financiera de Colombia, DANE, own calculations.

FIGURE 5: Estimated and observed commercial loan portfolio to GDP



Source: Banco de la Republica, Superintendencia Financiera de Colombia, DANE, own calculations.

However, for this period the observed growth of the total portfolio was located at 23.46%, or 2.76 pp (higher than the growth rate supported by macroeconomic determinants, measure of credit "excessive"⁶).

Taking into account these results, it is possible to perform a retrospective analysis of credit situation to see macroeconomic determinants behavior, and therefore, evaluate in a qualitative manner, if actually there is a dynamic in macroeconomic variables such as in credit boom episodes. Thus, this analysis will focus on periods identified as credit boom and those where the observed indicator is significantly below its estimate.

⁶When we use only the credit interest rate (interbank rate) and the deterministic non-linear time trend Z_t as F. Boissay, O. Calvo-Gonzales and T. Kozluk (2005), the estimation of total-loan-portfolio-to-GDP is 37%, for this reason the growth rate of total loans from September 2010 to the same month of 2011 should grow to 29.66%. This is explained because only takes into account variables on the supply side, and therefore the total-loan-portfolio-to-GDP accounted for by these variables is much higher than observed.

When we make a Hodrick-Prescott filter to the independent variables, we notice during episodes of lending boom the interbank rate, investment-to-GDP and foreign-direct-investment-to-GDP, are significantly above its trend⁷. While household-consumption-to-GDP and national-debt-to-GDP in lending boom episodes are below their trends (See Figure 6). It is important to note household-consumption in absolute terms grew considerably in the last episode of lending boom.

Actually, when we analyze the macroeconomic determinants we observe a similar dynamic for these variables in episodes of lending booms. Interbank rate, investment-to-GDP and foreign-direct-investment-to-GDP are above their trend; while household-consumption-to-GDP is below its trend. However, the national-debt-to-GDP behaves contrary to what were observed in periods of lending boom. For the last data observed, this variable is above its trend, suggesting a possible source of liquidity in the economy other than credit (See Table 4).

TABLE 4: Summary macroeconomic variables deviations on credit boom

Period	IBR	ND/GDP	HC/GDP	INV/GDP	FDI/GDP	NER	spread
1 Boom Episode	up	down	down	up	up	down	up
2 Boom Episode	up	down	up	up	down	down	up
Currently	up	up	down	up	up	up	up

Note: where $\frac{ct}{GDP_t}$ is the credit-to-GDP ratio, $\frac{ND_t}{GDP_t}$, $\frac{HC_t}{GDP_t}$, $\frac{INV_t}{GDP_t}$, $\frac{FDI_t}{GDP_t}$ denote the ratio in real terms of national debt, household consumption, level of investment, and foreign direct investment to GDP respectively, GDP_t is real GDP, IBR_t is the interbank rate, NER_t is the nominal exchange rate (COP/US), $spread_t$ is the spread between domestic and foreign interest rate.

Source: Banco de la Republica, Superintendencia Financiera de Colombia, DANE, own calculations.

This behavior coupled with the fact that the observed data of credit-to-GDP is above its estimated, gives lights that may be possible credit growth is higher than what the economy can attend. However, it arises the question how this behavior is affecting the real sector in the economy?. Particularly, in the next section we analyze the impact of commercial loan portfolio over firms growth.

4. Impact of credit level as a percentage of GDP on firm growth rate

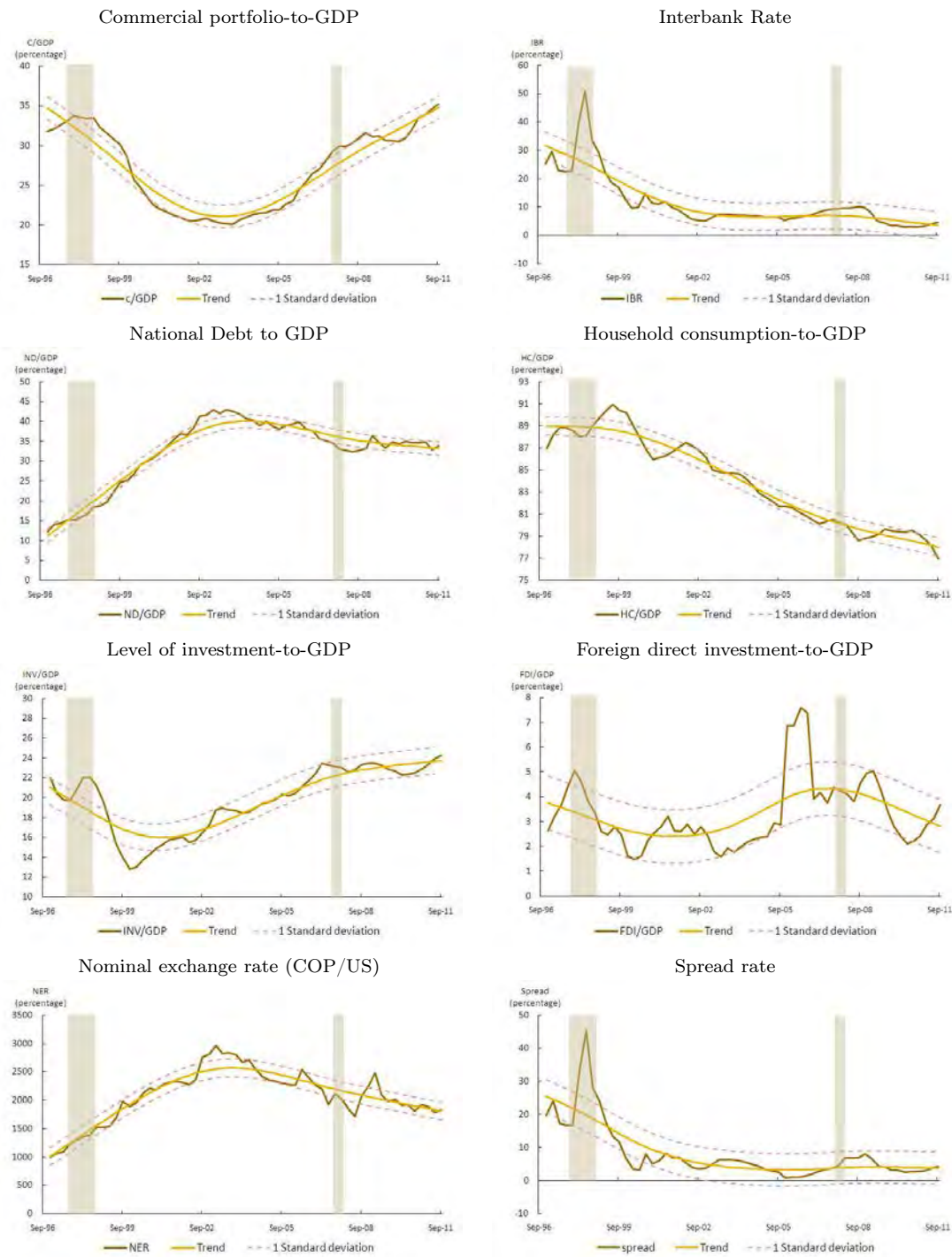
In this section we analyze the microeconomic model of firm's growth, as measured by the increase in operating revenues. Our objective is to study the impact of financial deepening in firm's development. We use a methodology based on F. Gallego and N. Loayza (2000) work. The proposed dynamic panel data specification model is:

$$GOR_{i,t} = \beta_0 + \beta_1 GOR_{i,t-1} + \beta_2 ILL_{i,t} + \beta_3 \left(\frac{I}{OR} \right)_{i,t} + \beta_4 \left(\frac{D}{A} \right)_{i,t} + \beta_5 Matfin_t + \epsilon_{i,t} \quad (4)$$

where the subscripts i and t denote the cross sectional of firms and time dimension of the panel sample respectively, $GOR_{i,t}$ is the annual growth rate in operational revenues, $ILL_{i,t}$ is the initial (lagged) level of operational revenues and its include to capture convergence effects to the firm's steady-state size, $\left(\frac{I}{OR} \right)_{i,t}$ is investment ratio to operational revenue, $\left(\frac{D}{A} \right)_{i,t}$ is the ratio of debt with financial intermediates and

⁷The trend is calculated using the Hodrick-Prescott filter for quarterly data December of 1996 to September 2011.

FIGURE 6: Financial deepening, trend and absolute deviation for some countries in Latin America



Source: Central Banks, Departamento Administrativo de Estadística (DANE); own calculations.

total assets and works to control for the effects of financial deepening. $Matfin_t$ is a vector of variables

representing macro financial outcomes, as GDP growth and observed commercial-loan-portfolio-to-GDP. The regression residual is represented by $\epsilon_{i,t}$.

This process will be modified⁸ to test which economic sector is more affected by financial deepening, and if there exists some externalities of firms loans to those who do not have debt.

In this point, is important emphasize that all explanatory variables that are specific of firms are treated as weakly endogenous. For this reason, we use GMM estimator applied to the regression in levels. This choice is supported by Sargan and serial-correlation specific test.

4.1. Data

The data we use in this section come from two separate sources. First we use the balance-sheet information by Superintendencia de Sociedades database (Supersociedades for short), which reports the balance sheet statements of large companies for the period 1995-2010. A second source of information is the Format 341 constructed by Superintendencia Financiera de Colombia (Superfinanciera for short). In this format the Superfinanciera recorded the characteristics of credits by individual debtor.

The Supersociedades is the government office in charge of overseeing corporations. The criteria for inclusion in the database have change over time. However, currently this database include firms whose total assets, annual accounting or total revenue as of December 31 by year, are equal to or greater than 20,000 monthly legal Colombian minimum wages⁹. As a result of the criteria for inclusion, some firms appear intermittently, while other are included every year. We use financial information from Supersociedades dataset to construct the main variables that describe internal characteristics (specific) of firms. Following F. Gallego and N. Loayza (2000), we construct the annual growth rate of firm's revenues, the firm's investment as ratio to revenues and we construct some dummies whether the firm is classified in a specific economic sector and if it has debt or not.

Format 341 constructed by Superfinanciera records individual debt information with lending institutions. With this information we calculated the total debt that firms in Supersociedades dataset have with the financial system. This type of debt is classified as commercial portfolio loan and is available from 1999 to 2010.

With these two separate sources of information and using some macroeconomics series of Superfinanciera and Banco de la República de Colombia (The central Bank of Colombia) we constructed an unbalanced panel with 196,461 observations and 37,542 firms since 1999 to 2010. This panel has the information of main accounts of financial statements and total debt with lending institutions of every firm of Supersociedades dataset. Also, we include in the unbalanced panel macroeconomics variables like the real growth rate of GDP and the level of commercial loan portfolio to GDP. From the 196,461 observations, 65.3% has debt and 34.7% doesn't. At firm's level, we found that 74.8% of firms have been in debt at some time during the study and 52.8% doesn't. An important fact is that 93% of firms with debt in period t will continue into debt in period $t + 1$; while 82% of firms not indebted in period t , will continue without borrow in period $t + 1$.

⁸Additionally, to make a further analysis about the impact of credit on firms growth, we transform the model described in equation 4, adding some new variables like dummies identifying each economic sector (industry, commerce, services, transport and so on), another dummy categorizing if the firm has a debt with the financial system and some interaction between these variables and those ones that were described in the equation 4.

⁹For 2011, this represent an amount nearly to US\$6 millions.

We applied a method based on modified Z-score¹⁰ of an observation to detect possible outliers. This is necessary because we detect some error in the data especially in the early years of the study period; it also allows us to compare companies with similar characteristics. Applying this method we construct an unbalanced panel with 172,322 observations and 37,289 firms. Table 5 presents the main statistics of microeconomic variables.

TABLE 5: Main statistics microeconomic model of firm's growth

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Annual growth rate (%)	130,846	5.3	26.6	-90.2	87.2	-0.08	3.5
Initial level of operational revenues(thousands COP \$)	135,033	16,400,000	133,000,000	-14,175	32,700,000,000	123.3	27,865.6
Investment/Revenues(%)	157,602	51.7	239.9	-1,745.7	3,034	390.8	154,710.8
Debt/Total Assets (%)	170,576	9	35,214.9	0.1	62.3	233.5	57,635
Commercial Loan Portfolio to GDP (%)	172,322	14.9	2.0	12.2	18.0	0.1	1.6
GDP Growth (%)	172,322	4.7	2.4	-1.2	8.0	-0.6	3.0

Note: The main statistic of Investment-to-Revenues and Debt-to-Total Assets excluded observations belonging to 99th percentile. Source: Dane, Superintendencia Financiera de Colombia and Superintendencia de Sociedades de Colombia; own calculations.

4.2. Results

We estimate equation 4 using GMM estimator applied to the regression in levels. Table 6 represents the results on firm's growth. In the first column we use commercial-loan-to-GDP and GDP growth as vector of variables representing macro financial outcomes. In the second model, we include a dummy variable that identifies if a firm is indebtedness and the interaction between being indebted and commercial-loan-to-GDP.

The significantly positive sign of lagged value of annual growth rate reveals the firm's growth rate has a persistent effect over time. The negative sign of initial level of operational revenues exposes a convergence effect; as the firm gets larger, its rate of growth slows down. It is interesting that firms do not appear to growth differently taking into account the level of investment to revenues. Not surprisingly, the level of debt with financial sector to total assets has a positive effect on firm's revenue growth. For the control variables, commercial-loan-to-GDP and growth rate of GDP has a positive sign. In particular, an increase in 1 pp of commercial-portfolio-to-GDP affects positively in 78 bp firms growth rate. The effect of commercial-loan-to-GDP support the theory that greater financial deepening, firms are more likely to access credit as most of the credit institution are willing to grant loans.

It is not contradictory that the level of investment has no distinct impact on firm's growth, while the level of debt has it. The explanation is that level of investment of unlevered firms comes from their own resources limiting the profit margin. While in the case of indebted firms, the margin of growth is higher as the funding source is external and payment is softened in fees.

When we conduct an exercise introducing the debt dummy variable and the interaction between debt and commercial-loan-to-GDP, we see that the effect of debt is positive. On average, a firm indebted

¹⁰Boris Iglewicz and David Hoaglin (1993), "Volume 16: How to Detect and Handle Outliers", The ASQC Basic References in Quality Control: Statistical Techniques, Edward F. Mykytka, Ph.D., Editor.

presents an annual growth rate 87 pb higher than a firm without debt. However, analyzing the interaction we see a negative effect in the firm's growth of revenues, reveals the positive externalities in firm's growth without debt.

TABLE 6: Firm Growth: Firm and financial deepening effects.

Estimation Technique: Instruments:	GMM-Levels Levels and Diff	GMM-Levels Levels and Diff
	(1)	(2)
Variable	Coefficient	Coefficient
Lagged Annual growth rate	0.121 [0.006]***	0.051 [0.025]***
Initial level of operational revenues	-0.001 [0.001]***	-0.001 [0.001]***
Investment / Revenues	0.001 [0.001]	-0.001 [0.001]
Debt / Total Assets	0.849 [0.061]***	
Debt (1 = has debt)		0.869 [0.390]**
Debt*Commercial Loan/GDP		-11.13 [2.184]***
Commercial Loan Portfolio/GDP	0.776 [0.113]***	10.17 [1.915]***
GDP Growth	1.591 [0.052]***	1.383 [0.083]***
Number Firms	17397	17397
Number Observations	68414	68414
SPECIFICATION TESTS (P-Values)		
a)Difference-in-Hansen tests	0.359	0.00
b)Serial Correlation		
First-Order	0.000	0.00
Second-order	0.130	0.29

Note: *, ** and *** indicate statistical significant at the 10%, 5% and 1% significant levels, respectively. Source: own calculations.

In order to verify if there is a differential impact of the credit by economic sector, we modify the model of equation 4 adding dummy variables that identify whether the company is in debt and which economic sector belongs. It was also introduced an interaction between these two dummies. It is important emphasize total effect of credit on a given economic sector relative to the rest, is measured as the sum of variables coefficients (dummies and interaction). Table 7 presents the proposed model results summary¹¹.

We found services and trade concentrates the highest firm proportion (48.8%) in sample. The credit impact over these firms that have debt is higher than those without debt that belongs to other economic sectors. On the other hand, the effect of debt to industrial firms is negative; however it is important to emphasize when we discriminate by type of industry, we found a positive effect in Textile subsector.

In agriculture and construction sectors we not found a difference between revenues growth rate of indebted and unlevered firms. About the first one, smaller firms frequently cannot access to formal financial system because lack of guaranties. In this way, the estimator may have a noise due to this limitation of the smaller firms. About the construction sector, the absence of a positive impact could be explained because, in Colombia, for caution these types of firms begin to build if the 80% of the work has

¹¹In appendix B are the complete results of the proposed model with economic sector dummies.

TABLE 7: Total effect of financial deepening by economic sector

Variable	(1)	Firms
	Total effect	distribution
Industry	-0.939	19.4%
<i>Textile</i>	<i>13.313</i>	<i>9.1%</i>
<i>Printing</i>	<i>-17.237</i>	<i>8.7%</i>
<i>Food</i>	<i>-6.340</i>	<i>17.3%</i>
<i>Other industry</i>	<i>-1.032</i>	<i>64.9%</i>
Agriculture	-8.049	6.2%
Construction	-0.444	6.6%
Mining	5.598	1.6%
Transportation	0.658	3.6%
Real estate bussiness	-3.111	13.7%
Other service and trade	2.126	48.8%

Source: own calculations.

already been sold. For this reason they can have another funding different to a direct debt with financial intermediaries.

In the mining industry, we found a positive impact of financial deepening to revenues growth rate. However, there exist few mining firms as they only represent 1.6% of our sample, but this sector presents the largest effect of debt in revenues rate growth between sectors. This is expected because mining is a segment with high fixed and operational costs and therefore the importance of access to external funds.

Moreover, this exercise allowed analyzes the indirect effect of the macro prudential measure implemented in 2007¹². To this end, we compare the difference in firm's growth per year. We estimated two regressions, one including dummy variables that identify the years before the macro prudential measure and another including those years after the measure.

We expect that signs of year variables dummies of first regression are positive and the signs of the second regression are negative. This would reflect the negative impact of macro-prudential measures to slow credit growth patterns applied to the entire portfolio (See Table 8).

As shown in Figure 4, after the economic crisis of the late 90's, the level of financial deepening remained stable until mid-2005. During this period there were the highest positive coefficients of year dummies analyzed, reflecting the positive effect on firms growth by a significant increase in commercial portfolio.

Moreover, after 2005 the annual real growth rate of total credit portfolio increased significantly to the extent that the regulator in 2007 implemented the macro prudential measure. This negatively affected the growth of companies in Colombia which is reflected in the year's coefficients in the second column of Table 8.

Taking into account the above results and Figure 2, it is important to note that in 2007 the type of portfolio that was above its trend was consumer-portfolio-to-GDP. Therefore we consider it would have been less damaging to economic growth a measure that will only affect this type of credit.

¹²This measure was a change in marginal reserve requirement and increased it in savings accounts and similar. Moreover, the marginal reserve was established for all deposits.

TABLE 8: Firm Growth: Firm, financial deepening and macro prudential effects.

Estimation Technique: Instruments:	GMM-Levels Levels and Diff	GMM-Levels Levels and Diff
	(1)	(2)
Variable	Coefficient	Coefficient
Lagged Annual growth rate	0.075 [0.006]***	0.055 [0.006]***
Initial level of operational revenues	-0.001 [0.001]	-0.001 [0.001]
Investment / Revenues	0.001 [0.001]	0.001 [0.001]
Debt / Total Assets	0.561 [0.048]***	0.307 [0.040]***
Commercial Loan Portfolio/GDP	1.590 [0.138]***	1.898 [0.230]***
GDP Growth	3.609 [0.119]***	0.814 [0.064]***
2000	0.171 [0.008]***	
2001	0.346 [0.010]***	
2002	0.275 [0.009]***	
2003	0.205 [0.007]***	
2004	0.065 [0.006]***	
2005	0.083 [0.006]***	
2006	0.025 [0.005]***	
2007		-0.067 [0.006]***
2008		-0.139 [0.010]***
2009		-0.187 [0.008]***
2010		-0.182 [0.012]***
Number Firms	17,397	17,397
Number Observations	68,414	68,414
SPECIFICATION TESTS (P-Values)		
a)Difference-in-Hansen tests	0	0.242
b)Serial Correlation		
First-Order	0.000	0.000
Second-order	0.124	0.022

Note: *, ** and *** indicate statistical significant at the 10%, 5% and 1% significant levels, respectively.
Source: own calculations.

5. Stylized facts of credit-to-GDP on firms growth

In this section we analyze the effect of different commercial-portfolio-to-GDP rates on firm's growth. First, we estimate the difference in the impact of credit on firm growth, as the financial deepening variable is consistent with macroeconomic determinants. Second, we considered a extreme scenario calculating the effect of maximum changes in macroeconomic variables in the firm's growth through financial deepening.

In the first exercise, we re-estimate the Equation 4 except the $(\frac{C}{GDP})_t$ variable in $Matfin_t$ vector. In this case we introduce the level of commercial-loan-portfolio-to-GDP supported by macroeconomics determinants (results of equation 2), $(\frac{C}{GDP})_t^*$.

The idea of this exercise is calculate the effect of consistent level of commercial-loan-portfolio-to-GDP in firm's revenues growth rate. Thus, we calculated the micro economic effect of not reach the consistent level.

TABLE 9: Firm growth explained by consistent financial deepening

Estimation Technique: Instruments:	GMM-Levels Levels and Diff	GMM-Levels Levels and Diff
	(1)	(2)
Variable	Coefficient	Coefficient
Lagged Annual growth rate	0.115 [0.006]***	0.080 [0.007]***
Initial level of operational revenues	-0.001 [0.001]***	-0.001 [0.001]***
Investment / Revenues	0.001 [0.001]	-0.001 [0.001]
Debt / Total Assets	0.787 [0.058]***	
Debt (1 = has debt)		1.823 [0.160]***
Debt*Commercial Loan/GDP		-12.185 [1.154]***
Commercial Loan Portfolio/GDP	0.418 [0.122]***	10.21 [0.977]***
GDP Growth	1.626 [0.052]***	1.326 [0.058]***
Number. Firms	17397	17397
Number. Observations	68414	68414
SPECIFICATION TESTS (P-Values)		
a)Difference-in-Hansen tests	0.361	0.00
b)Serial Correlation		
First-Order	0.000	0.00
Second-order	0.274	0.08

Note: *, ** and *** indicate statistical significant at the 10%, 5% and 1% significant levels, respectively. Source: own calculations.

Analyzing the results of the proposed exercise shown in Table 9, we observe a positive effect on firms growth as expected. However, this effect is smaller than founded in Equation 4, where we used the observed indicator. Furthermore, we see a greater effect of being in debt on firms revenue and the externality in firms without debt is greater when we use the consistent indicator.

The above results are a sign that the effect of consistent financial deepening in firms growth is somewhat lower than the observed, but it has not necessarily implied that the higher level of credit in the economy has had a negative impact. Nevertheless, it positively affected firms performance increasing financial deepening effect on firms growth in Colombia. Additionally, both effects support the existence of positive externality of increases commercial-portfolio-to GDP over without debt firms performance.

For the second exercise we calculated the maximum difference of each macroeconomic variable to estimate the effect of firm's growth through to commercial-portfolio-to-GDP. Given these variables are relative to GDP, we will consider the interpretation should be given as additional increase to GDP growth (see Table 10).

Analyzing macroeconomic variables annual major differences during 1996Q2 to 2011Q3, the greatest differences were presented at ends of 90's due to the economic crisis. The effects of all macroeconomic variables over commercial-loan-to-GDP can be seen in Table 10, where the major effects are attributed to rapid interest rate increases (absolute effect of the interbank-rate and the spread between domestic and foreign interest rates).

TABLE 10: **Impact over commercial-loan-portfolio-to-GDP on extreme events**

Variable		Quarter	Maximum difference	Change in CC/PIB pp
Interbank rate	Min	1999Q2	-32.412	-3.100
	Max	1998Q2	27.945	2.600
National debt-to-GDP	Min	2007Q2	-4.860	1.288
	Max	2000Q2	6.889	-1.826
Household consumption-to-GDP	Min	2000Q4	2.844	-2.085
	Max	1999Q2	-4.230	1.402
Level of investment-to-GDP	Min	1999Q3	3.276	-0.921
	Max	2003Q1	-7.313	0.413
Nominal exchange rate (COP/USD)	Min	2007Q2	676.680	0.000
	Max	2003Q1	-618.480	0.000
Spread between domestic and foreign interest rate	Min	1999Q2	28.051	3.605
	Max	1998Q2	-31.903	-3.170
Foreign direct investment to GDP	Min	2007Q1	0.047	-0.273
	Max	2006Q2	-0.027	0.331

Source: own calculations.

In September 2011, the biggest annual differences are in consumption expenditure of households and level of investment to GDP. Giving the results of equation 4, this difference may affect commercial loan portfolio as percentage of GDP decreasing it in 1.3 pp and augmenting it in 0.22 pp, respectively. These effects can be transferred to variations in firms growth rate through the financial deepening ratio (Equation 4) reducing their current growth rate by 1 pp and an increase of 17 basis points by consumption and investment effect, respectively¹³. Importantly, the negative effect of the consumption-to-GDP should be seen as other GDP components are growing faster than the household consumption expenditure.

6. Conclusions

In the last year, annual rate of credit growth in some countries in Latin America was at levels close to 20%. This behavior potentially can lead an increase the economic agents leverage, augmenting their vulnerability to economic shocks and ultimately, affecting financial stability. We found the rate of credit to GDP in Colombia is above its trend, but consumer credit portfolio is the only modality presenting this behavior. This study provides an econometric analysis of credit-portfolio-to-GDP economic determinants, in order to find the level of this indicator which is supported by economic determinants. We replicate this exercise with commercial-loans and we evaluated how this indicator of financial deepening affects Colombia firms growth rate.

We found in Colombia the evolution of credit-to-GDP depends not only of credit interest rate (interbank rate), but also on variables such as household consumption, the level of investment, foreign direct investment, national debt and the spread between domestic and foreign interest rates. Currently, when we

¹³It takes into account the ceteris paribus assumption of other macroeconomics variables

analyze the macroeconomic determinants we observe similar dynamic for these variables like in episodes of lending booms. Interbank rate, investment-to-GDP and foreign-direct-investment-to-GDP are above their trend; while household-consumption-to-GDP is below its trend. However, the national-debt-to-GDP behaves contrary to what were observed in periods of lending booms. For last data observed, this variable is above its trend, suggesting a possible source of liquidity in the economy other than credit. Additionally, the estimation suggest the annual growth rate of total loans at September of 2011 should had been 20.7%. However, for this period the observed growth rate of total portfolio was located at 23.46%, or 2.76 pp, higher than the growth rate supported by macroeconomic determinants.

Moreover, we found commercial-loan-to-GDP significantly affects the firms growth in Colombia. We found an increase in 1 pp of commercial-portfolio-to-GDP affects positively in 78 bp firms growth rate. The effect of commercial-loan-to-GDP support the theory that greater financial deepening, firms are more likely to access credit as most of the credit institutions are willing to grant loans. On average, a firm indebted presents an annual growth rate 87 bp higher than a firm without debt. In addition, in periods when financial intermediaries show preferences for investing their resources in government bonds, negatively affect firms revenue growth, as there are fewer resources to finance the firm's projects (crowding out). On the other hand, we found a positive effect of commercial loans for firms who do not have private credit, suggesting the existence of positive externalities on firm's growth.

Additionally, when we include the consistent commercial-loan-portfolio-to-GDP in firms growth, we found a lower effect than the impact of the observed ratio, however it has not necessarily implied that the higher level of credit in the economy, should result in a negative impact. Actually, the observed ratio positively affects the firms growth rate. Finally in September 2011, we found that the biggest annual differences in macroeconomic determinants are in consumption expenditure of households and level of investment to GDP. Giving the macroeconomics determinants and firms growth rate models, these differences may affect commercial loan portfolio as percentage of GDP decreasing it in 1.3 pp and augmenting it in 0.22 pp, respectively. These effects can be transferred to variations in firms growth rate through the financial deepening ratio reducing their current growth rate by 1 pp and an increase of 17 basis points by consumption and investment effect, respectively.

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Appendix A. Sources

TABLE 11: **Sources**

Definition	Source
Credit-to-GDP (%)	SFC-BR
Interbank rate (%)	BR
National debt-to-GDP (%)	BR
Household consumption-to-GDP (%)	BR
Level of investment-to-GDP (%)	BR
Nominal exchange rate (COP/US)	BR
Spread between domestic and foreign interest rate	BR-Bloomberg
Foreign direct investment to GDP (%)	BR

Note: SFC means Superfinanciera and BR Banco de la República.

Source: Superintendencia Financiera de Colombia and Banco de la República de Colombia.

Appendix B. Financial deepening effect by economic sector

TABLE 12: Financial deepening effect by economic sector

Estimation Technique:	GMM-Levels	Estimation Technique:	GMM-Levels
Instruments:	Levels and Diff	Instruments:	Levels and Diff
Variable	Coefficient	Variable	Coefficient
Industry		Debt (1 = has debt)	0.044
Debt (1 = has debt)	0.264		[0.084]
	[0.357]	Construction	-0.965
Industry	-0.087		[1.848]
	[1.260]	Construction*Debt	0.477
Industry*Debt	-1.116		[1.666]
	[1.028]	Debt (1 = has debt)	0.305
<i>Debt (1 = has debt)</i>	-0.311		[0.156]***
	[0.489]	Mining	-8.715
<i>Textile</i>	34.492		[4.016]**
	[17.826]*	Mining*Debt	14.008
<i>Textile*Debt</i>	-20.868		[5.602]**
	[10.993]*	Debt (1 = has debt)	0.159
<i>Printing</i>	-26.948		[0.166]
	[14.964]*	Transportation	11.246
<i>Printing* Debt</i>	10.022		[5.042]**
	[12.665]	Transportation*Debt	-10.747
<i>Food</i>	-10.572		[3.745]***
	[8.770]	Debt (1 = has debt)	0.612
<i>Food*Debt</i>	4.543		[0.261]**
	[5.149]	Real estate business	-2.257
<i>Other industry</i>	-1.004		[1.453]
	[1.990]	Real estate*Debt	-1.466
<i>Other industry*debt</i>	0.283		[0.566]
	[0.739]	Debt (1 = has debt)	-0.136
Debt (1 = has debt)	0.062		[0.611]
	[0.164]	Other service and trade	1.982
Agriculture	-9.026		[1.196]*
	[2.269]***	Other service*Debt	0.28
Agriculture*Debt	0.915		[0.715]
	[0.862]		
No. Firms	17397		
No. Observations	68414		
SPECIFICATION TESTS (P-Values)			
a)Difference-in-Hansen tests	0.359		
b)Serial Correlation			
First-Order	0		
Second-order	0.13		

Source: own calculations.