ESTIMATING THE CREDIT- GDP ELASTICITY: THE CASE OF BRAZIL

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ABSTRACT

This paper estimates empirical relationship between credit and GDP using a Vector Error Correction model applied to Brazilian time series data. The estimated elasticities are useful in evaluating the impact of financial institutions behavior and of policy actions on macroeconomic activity and therefore are crucial for policy analysis.

Keywords*: Credit, Elasticity, Vector Error Correction Models, Emerging Markets*

1. INTRODUCTION

The maintenance of financial stability has been a growing concern for central banks. To assess the stability and also the effects of corrective policies, several tools are used, including macroeconomic structural models of general equilibrium (Goodhart et al., 2006), which contains interactions between the financial system and the rest of the economy. In a Colombian case study (Saade et al., 2007), in order to calibrate the model with the data and features specific to Colombia, the authors estimate the influence of the following period GDP expectation over the credit demand and also the current aggregate credit supply elasticity regarding future GDP.

The study of the effect of GDP on demand for credit is carried by the assumption that better economic conditions increase the consumers and investors optimism. With higher expectations on future income, they tend to smooth consumption by increasing borrowing.

The study of credit demand follows suggestions that its development contains information on the risk of price stability (Turkalj et al., 2007). Inflationary concern has been addressed mainly in monetary aggregates studies. Moreover, the recent credit boom in the Central and Eastern Europe stimulated research on the causes of credit growth and its macroeconomic consequences. The rapid credit expansion affects financial stability, and it is often determined as the cause of banking crises. The authors also point out the difficulty of distinguishing the effects of credit demand and supply.

Similarly, in another study comprehending the euro area, a model is estimated to measure the development of credit and to compare it with a benchmark, providing information on the economy, instability and inflationary risks (Calza et al., 2006). Through Granger causality tests, they find an influence of GDP on credit, but the opposite is not true.

The second estimation required by the calibration in the model was addressed in the context of the relationship between financial development and economic growth. Besides the concern of whether there is such causality, literature also analyzes which factor influences the other, that is, in which direction does it occur. Some argues that credit availability has a wide impact on macroeconomic activity while others believe that credit has its substitutes, implying in no influence of the banking system on economic productivity. Even negative effects may be expected considering that rapid expansion of financial sectors has resulted in crises and lower growth.

In the present paper, we estimate both GDP and credit elasticities for the Brazilian financial system, also including the Brazilian short-term interest rate (SELIC) data. Cointegration vectors are estimated through the vector error correction model, following Johansen cointegration tests (Johansen, 1995).

The remainder of the paper is organized as follows. Section 2 provides an overview of the literature. Section 3 describes the methodology pursued and the applied data. Section 4 presents the empirical results and section 5 concludes.

2. BRIEF LITERATURE REVIEW

The studies related to the estimation of GDP elasticity of demand for credit find coefficients in the approximated range of 1 to 5. For example, a value of 3.09 is reported for Croatia (Turkalj et al., 2007) and 1.49 for the euro area (Calza et al., 2006). In the Colombian case, it was found an elasticity of 4.89 (Saade et al., 2007).

Works related to the effect of financial development on economic growth are controversial. Some results do not indicate the existence of causality (Favara, 2003) and , depending on the period in consideration, even show a negative relationship, while others found a two-way causality between finance and growth (Shan and Jianhong, 2006).

The relationship between per capita GDP growth rate and the private sector credit / GDP ratio, used as a proxy for financial development, is estimated in a work for 77 countries (Beck et al., 2000). They find that more developed levels of financial intermediary can improve resource allocation and accelerate long-run economic growth. The reported elasticity is 1.443, meaning a rise of one percentage point in GDP growth rate per year when doubled the credit ratio.

The Finnish case is studied through a period of severe recession (Anari et al., 2002), and a large impact of credit availability on economic growth is found. That way, they enhance the intermediation role of government to avoid banking crisis spreading over economy.

TABLE 1. EMPIRICAL RESULTS OBTAINED IN THE LITERATURE

Reference	Country	Data Sample	Frequency	GDP Elasticity (ε)	Credit/GDP Elasticity (φ)
Saade et al. (2007)	Colombia	1995:01-2006:02	Quarterly	4.89	0.159*
Brzoza-Brzezina (2005)	3 emergent and 3 developed EU member states	1981:01-2004:02	Quarterly	$1.45 \leq \varepsilon \leq 3.39$	
Calza et al. (2006)	12 Euro countries	1980:01 – 2001:03	Quarterly	1.485	
Hofmann (2001)	16 industrialized countries	1980:01-1998:04	Quarterly	$1.04 \leq \varepsilon \leq 2.49$	
Turkalj et al. (2007)	Croatia	1997:01 – 2006:03	Quarterly	3.09	
Beck et al. (2000)	77 countries	1960-1995	Annual		1.443[a]
Guryay et al. (2007)	Northern Cyprus	1986-2004	Annual		0.018
Rioja and Valev (2004)	74 countries	1960-1995	Annual		0.033[a]

* credit elasticity
[a] credit ratio elasticity regarding GDP growth rate

In another work, countries are distinguished into three levels of financial development (Rioja and Valev, 2004), since the relationship to be estimated is not uniform, showing smaller effects in the region of higher development level and uncertain effects in the region of lower one. They find a value of 0.033 to the middle region, where data from Brazil of the 1990 decade is included. The finding implies an elevation of 3.3 percentage points in growth rate from an increase in 1 percentage point in the credit ratio. Finally, a credit elasticity of future GDP of 0.159 is found for Colombia (Saade et al., 2007).

Table 1 on previous page compares the GDP and credit elasticities found in the literature. The papers not included do not explicitly report an elasticity, as it is not a major objective of their study.

3. METHODOLOGY AND DATA SAMPLE

To estimate credit and GDP elasticities in the case of Brazil, we apply the vector error correction model (VEC) to a monthly data beginning in January 1995 and ending in July 2007. The model also includes the Brazilian short-term interest rate (SELIC) to control for the effects of monetary policy. The data from GDP is deflated by the market price index IGP-M while credit and interest rate are deflated by the consumer price index IPCA.

Real GDP is expressed in terms of the total accumulated in the previous 12 months and the credit measure corresponds to the total financial system credit accumulated over the same period. All variables are expressed in logarithms.

The VEC model is given by:

$$\Delta GDP_t = a_0 + pz_{t-1} + \sum_{i=1}^{p} a_i \Delta credit_{t-i} + \sum_{i=1}^{p} b_i \Delta selic_{t-i} + \sum_{i=1}^{p} c_i \Delta GDP_{t-i} + \varepsilon_{1,t}$$

$$\Delta credit_t = \alpha_0 + \pi z_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta credit_{t-i} + \sum_{i=1}^{p} \beta_i \Delta selic_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta GDP_{t-i} + \varepsilon_{2,t}$$

$$\Delta selic_t = \mathrm{A}_0 + \Pi z_{t-1} + \sum_{i=1}^{p} \mathrm{A}_i \Delta credit_{t-i} + \sum_{i=1}^{p} \mathrm{B}_i \Delta selic_{t-i} + \sum_{i=1}^{p} \Gamma_i \Delta GDP_{t-i} + \varepsilon_{3,t}$$

where $z_{t-1} = Credit_{t-1} - \mu - \theta GDP_{t-1} - \delta selic_{t-1}$ is the cointegrating equation.

4. EMPIRICAL RESULTS

We first compute unit root tests to confirm the series non-stationarity. Table 2 on next page reports the Augmented Dickey-Fuller, Philips-Perron, Kwiatkowski-Phillips-Schmidt-Shin and Elliott-Rothenberg-Stock tests of the credit, Selic and GDP variables, including an intercept in the last two tests. The null hypothesis of the KPSS test is of stationarity, while the others assume the presence of unit root.

Considering GDP, the null hypothesis of a unit root cannot be rejected by the ADF, PP and ERS tests at the 1% significance level and it is rejected considering 1st difference by the ADF and PP. Regarding the credit, the null hypothesis is not rejected by the ADF, PP and ERS tests in level, and the hypothesis of stationarity is rejected by the KPSS. The 1st difference tests confirm the assumption of unit root. For the selic variable, the ADF, PP and ERS tests in level does not reject the null hypothesis at the 1% significance level, while the KPSS reject the hypothesis of stationarity.

TABLE 2. UNIT ROOT TESTS

	ADF	PP	KPSS	ERS
GDP				
level	0.84	1.76	0.31	136.89
1st difference	-6.31*	-6.85*	0.50 **	19.47
CREDIT				
level	2.06	1.94	0.79*	40.62
1st difference	-10.43*	-10.37*	0.63**	0.43*
SELIC				
level	-0.94	-0.95	0.89*	2.99**
1st difference	-14.09*	-26.59*	0.07	0.16*

*, ** rejection of the null hypothesis at the 1%, and 5% significance levels.

That way, we assume all variables are integrates of order one, so they can be tested for the presence of cointegration relationships between them. We also employ LM serial correlation tests, which indicate no serial correlation for lags 1 to 6.

Table 3 reports the results of the Johansen cointegration test for lags 1 to 6.

TABLE 3. COINTEGRATION TESTS

Lags	Number of CE	Eigenvalue	Trace	Max
1	None	0.28	65.88*	46.41*
	At most 1	0.13	19.47**	19.11**
	At most 2	< 0.01	0.36	0.36
2	None	0.15	34.26	23.17
	At most 1	0.08	11.10	10.92
	At most 2	< 0.01	0.17	0.17
3	None	0.16	37.69*	23.62
	At most 1	0.10	14.07	14.07
	At most 2	< 0.01	< 0.01	< 0.01
4	None	0.23	45.80*	34.49*
	At most 1	0.08	11.31	11.26
	At most 2	< 0.01	0.04	0.04
5	None	0.24	46.27*	34.98*
	At most 1	0.08	11.29	11.25
	At most 2	< 0.01	0.04	0.04
6	None	0.28	50.88*	41.09*
	At most 1	0.078	9.79	9.72
	At most 2	< 0.01	0.07	0.07

*, ** rejection of the hypothesis of none and one cointegrating equation(s) at the 0.05 level.

One can observe the presence of one cointegration vector in both Trace and Max tests for the equations with 4, 5 and 6 lags and two cointegration relations considering 1 lag. This indicates the existence of a stable long-run relationship among credit, GDP and interest rate.

Estimations of the elasticities, obtained from the cointegrating vector after coefficients normalization, are reported in table 4 for lags 1 to 6. The Akaike Information Criteria (AIC) determines a model with intercept and trend for the estimation.

TABLE 4. ELASTICITIES

	Normalized with respect to GDP		Normalized with respect to credit	
Lags	Credit [-1]	Selic [-1]	GDP [+1]	Selic
1	0.37	0.16	2.70	-0.43
	(0.14)	(0.03)	(0.47)	(0.08)
2	0.42	0.11	2.38	-0.26
	(0.16)	(0.04)	(0.52)	(0.09)
3	0.45	0.10	2.22	-0.23
	(0.15)	(0.04)	(0.48)	(0.08)
4	0.51	0.07	1.95	-0.14
	(0.11)	(0.03)	(0.32)	(0.05)
5	0.56	0.06	1.80	-0.10
	(0.10)	(0.03)	(0.28)	(0.05)
6	0.50	0.08	1.98	-0.16
	(0.09)	(0.02)	(0.27)	(0.04)

Standard errors in ( ). -1 and +1 mean past realizations and future expectations respectively.

The results indicate a 0.37% to 0.56% increase in GDP when expanding credit supply in 1%, which supports the credit view of lending effects on aggregate output.

The elasticities found when evaluating the impact of future GDP on credit demand range from 1.80 to 2.70, meaning an elevation of 1.8% to 2.7% in credit with a 1% higher GDP. The positive effect of economic growth on credit demand is explained by higher income and profit expectations, which lead to higher consumption and investments through loans. The selic elasticity is between -0.10 and -0.43, confirming that loans and their cost are negatively related. These results are similar to the estimations reported by Saade et al. (2007), with a credit elasticity slightly higher and a lower GDP elasticity.

5. FINAL CONSIDERATIONS

Following the increasing concern of central banks in financial stability, this paper looked for tools to assess financial soundness and different policy actions impacts. Inspired by the work of Saade et al. (2007), we estimate the Brazilian credit, GDP and interest rate elasticities that might be useful in future studies of structural macroeconomic models as implemented by those authors.

For now, our findings indicate a significant impact of credit supply on future income, which corroborates the credit view hypothesis that financial development has an important role in economic growth. Also, the inverse direction causality is verified. Expectations of higher productivity, measured as future GDP, implies in higher individual income prediction and consequently in larger demand for credit.

Both results highlight the importance of monitoring aggregate economic activity and the financial sector. The association between credit booms and financial instability, with the consequent depreciation of assets quality and bank crisis supports financial control to assure the output of economy. The opposite can also be true, justifying the fostering of economy to heat up investment and consume.

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The author gratefully acknowledges financial support from CNPQ and FAP-DF Foundation. All opinions expressed in the paper are those of the authors and do not necessarily reflect those of the Central Bank of Brazil.