Buying Risks to Improve Economic Activity: is it possible? *

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Abstract

The main objective of this paper is to analyze the impact on economic activity caused by a greater exposition of the financial institutions to risk taking into account macroeconomic factors. Hence, this paper considers two indicators for perceiving the banking risk for the Brazilian case. The first is the Basel index as a measurement of prudential regulation. The second one is the risk of total loss, that is, the default risk of an institution which can create a systemic crisis. Empirical evidence is presented based on dynamic panel data, ordinary least squares, and quantile regression for a sample of 66 Brazilian banks in the period from 2001 to 2009. The findings denote that an increase in the banking risk is associated with a greater economic activity. Therefore, there exists indication that the use of a liquidity cushion in the periods of economic growth can be used as an anti-cyclical tool for avoiding bubbles in the financial market.

Key words: financial regulation, business cycle, Basel index, risk of total loss.
JEL classification: G15, G18, G14.

Resumo

O principal objetivo deste artigo é analisar o impacto que uma maior exposição ao risco das instituições financeiras exerce sobre a atividade econômica levando em consideração fatores macroeconômicos. Nesse sentido, são considerados dois indicadores como *proxies* do risco bancário para o caso brasileiro. O primeiro é o índice de Basiléia, utilizado como uma medida de regulação prudencial. O segundo é o risco de perda total, entendido como uma medida do grau de risco de inadimplência da instituição capaz de gerar uma crise sistêmica. Evidências empíricas são apresentadas por meio da metodologia de dados em painel dinâmico, mínimos quadrados ordinários, e regressão quantílica, com base em uma amostra de 66 bancos brasileiros no período de 2001 a 2009. Os resultados indicam que um aumento no risco dos bancos está associado a uma maior atividade econômica. Portanto, há indícios de que o uso de um colchão de liquidez nos períodos de crescimento da economia possa ser utilizado como uma ferramenta anti-cíclica para evitar a formação de bolhas no mercado financeiro.

Palavras chave: regulação financeira, ciclo de negócios, índice de Basiléia, risco de perdas totais.
Classificação JEL: G15, G18, G14.

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1. Introduction

One of the main objectives of the New Basel Capital Accord (New Accord) is mitigating the incentive of financial institutions assuming riskier positions in an attempt to make profits. As a consequence, there emerges a tricky case in the financial market where the role of the regulator is to avoid systemic crises while the market searches for ways to achieve greater profits with lower risks (Estrella, 2004).

The New Accord implied an incentive to the banking industry to improve the risk management practice (BIS, 2004). In particular, the idea of the minimum capital requirement becoming sensitive to the risk assumed by financial institutions due to the effect on business cycles is not new. Even before the subprime crisis in the USA, the idea that minimum capital can affect the economic cycles was known. Under this view, several authors show the procyclical relation between the minimum capital for covering the credit risk operations and economic activity.[1]

After the subprime crisis peaked it became possible to identify some measures which may be included in a near future regulatory reform: (i) the introduction of an austere pattern of prudential regulation; (ii) the search for transparency and a strengthening of market discipline; (iii) the increase in international cooperation; and (iv) the relevance of macroeconomic effects in the financial regulation. It is important to note that an excessive financial market regulation cannot be an advantage because it can inhibit financial innovations which in turn can provoke a financial disintermediation process.

In a general way, although financial intermediation increases and extends the periods of economic growth, it foments an environment favorable to the creation of bubbles. After the expansionist period, a downturn is initiated and thus, as a result of this process, a collapse in the prices of the assets and a credit rationing may occur.

One difficult problem which monetary policymakers need to be concerned with, due to the bubble crash which began in the middle of 2008, is how to identify and to mitigate the creation of new financial booms. Even if it is possible to identify the bubble crash, it can be more pernicious for the real economy. According to Ben Bernanke (President of the Federal Reserve) the best choice for avoiding financial crises is the use of regulatory and supervision methods for constraining excessive risks and to guarantee the system in the case of bubble crash.[2]

Although the relation between banking risk and economic activity has gotten attention in the last years due to the subprime crisis, empirical evidence which proves this relation is still scarce. This type of analysis is very important because it allows policymakers to search for more efficient strategies for mitigating the risk and economic downturns. This paper contributes to this matter through empirical evidence for the Brazilian case taking into account a sample of 66 banks in the period from 2001 to 2009.

The main objective of this paper is to analyze the impact on economic activity due to a greater exposition of financial institutions to the risk taking into consideration macroeconomic factors. Hence, this analysis considers two indicators for capturing the banking risk for the Brazilian case. The first is the Basel index as a measurement of prudential regulation. The second is the risk of total loss, that is, the default risk of an institution which can create a systemic crisis. It is important to highlight that another contribution of this paper is the presentation of a ranking of Brazilian banks based on the risk of total loss.

Besides this introduction, this paper is structured in 4 more sections. Section 2 presents the main points regarding the debate about the new framework on financial regulation after the peak of the subprime crisis. Section 3 presents empirical evidence, based on dynamic panel data, for the effect of banking risk (measured by Basel index) on banking profit and economic activity taking

[1] See, Allen and Saunders (2004); Gordy and Howells (2004); and Borio (2004).
[2] See, http://www.soxfirst.com/50226711/bernanke_more_regulation_to_control_bubbles.php.

into account the size of financial institutions. Section 4, besides considering Basel index and macroeconomic variables, introduces the risk of total loss for presenting empirical evidence regarding banking risk on output gap through ordinary least squares and quantile regression. Finally, section 5 presents the concluding remarks.

2. Subprime crisis and business cycles

The roots of subprime crisis can be summarized by the sequence of events which began with the increase of international liquidity in response to accelerated economic growth in China and the rise in the oil price and other commodities. Add to these facts the mistaken strategy adopted by the Federal Reserve in attempting to arouse the economy through the practice of low interest rate. The result was the creation of an environment propitious for an explosive combination of interests of three financial agents (commercial banks, investment banks and insurance companies).

The commercial banks supply mortgage credit with low interest rates for customers with low credibility and without a real guarantee of receiving (subprime bonds). This procedure implied an expressive increase in credit supply in the USA and the United Kingdom, with a fall in the exigencies for credit and an increase in the price of houses which thus facilitated the creation of the second mortgage.

In addition to the above-mentioned point, investment banks were avid regarding the securitization of mortgage loans by converting them into other financial products and spreading out these derivatives throughout the market. Finally, insurance companies also participated in the process of selling other derivatives that they believed would work as a hedge for those investments.

An important point which can be observed from the subprime crisis is that the use of a minimum capital requirement, one of the main tools in the prudential regulation proposed by the New Accord for assuring the financial system stability, was not enough to inhibit the system of using the securitization as a way of deceiving the regulation. It is natural to observe a demand for more regulation and supervision by official agencies. The more common reaction is the proposal for increasing the minimum capital requirement, the increase for covering assets and the reduction of dependency of short term funds. However, these measures neglect an essential set of problems related with corporate governance and internal management conflicts which are specific to each bank.

According to Caprio and Honohan (2008), there exists empirical evidence which suggests that the policies which will be adopted by monetary authority must assure a greater market discipline. Hence, the proposal of a “new normal” concerns the search for transparency and a strengthening of the market discipline. The main idea would promote the competition and arouse self-regulation as a way to identify and punish, through market tools, the riskier institutions.

A third proposal for the new regulatory framework is the increase in international cooperation. A crisis with global dimensions demands global measures as a way of avoiding the back of jurisdictional arbitrage. In this case, it is important to highlight that the USA started before the others in approving an extensive reform since the Glass-Steagall Act. Some G-20 countries, such as Germany, France, and Japan, with the intention of not impeding the economic recuperation after the subprime crisis, are pressuring for a period of 10 years (limit is 2019) until implementation of the new rules.

At the end, another proposal which must be considered in the next regulatory framework concerns the macroeconomic effects on financial regulation. Ellul and Yerramilli (2010), based on a sample of 74 USA Bank Holding Companies, found empirical evidence that banks with more severe internal controls refrained from the risk and thus the consequence was a lower effect due to the subprime crisis.

Regarding the macroeconomic effects on financial regulation, the proposal of substituting the current model of minimum capital required for covering losses of financial institutions, based on past losses, by a mechanism which considers the expected losses over the business cycles is growing. In the Brazilian case, one proposal for bounding the procyclicality of the current model of prudential regulation is to define an addition to the minimum capital required above 11% (Basel Committee defines 8%) for creating a liquidity cushion in the period of growth in the economic activity. As pointed out by Tombini (2009) - Brazil's Central Bank Director for Norms - when facing a new crisis in the financial system, the capital buffer can be reduced or even be eliminated thus mitigating the effects of the crisis on economy.[3]

2.2. Procyclicality of risks

The current model of financial regulation has procyclical characteristics. The optimistic expectations created during expansion business cycle reduce the investor's aversion to risk. In this sense, as identified by Minsky (1982), the greater exposition to risk makes the economy more susceptible to financial crisis. Based on a model of business cycles, Gorton (1988) observed that the worst 5 recessions in the USA economy were succeeded by crises in the banking system. Furthermore, the findings indicated that crises in the financial system are related to business cycles.

Allen and Gale (2000) also developed a model which associates financial crises with business cycles. According to the premise of the model, the fall in the value of the bank's financial assets is related to downturns. One conclusion of the authors is that the possibility of crisis works as a brake for financial institutions to take greater risks. De Bandt (1995), using as a reference the analysis developed by Jacklin and Bhattacharya (1988), elaborated a model of information which uses the concept of aggregated uncertainty for explaining the cyclical risks of business. The results denote that the information regarding difficulties in achieving returns of only one bank can make depositors anticipate their withdrawals in an anticipated way and thus initiate a bank run.[4]

The relation between financial crises and business cycles peaks was analyzed by Kindleberger and Aliber (2005). According to this view asset bubbles grow until a shock stops this process. At this moment, the profit realization is not compensated by the entrance of new agents in the market. The consequence is a run for liquidation of positions which provokes the blow-out of the bubble. In other words, the failure of a bank or of a big company can provoke a domino effect which brings panic and the crash of financial markets.

Allen and Sauders (2004) show that financial intermediation is increased in the periods of expansion in economic activity and thus prolongs the business cycle. However, this fact also creates an environment favorable to the creation of bubbles which, after an expansionist period, would be preceded by a quick downturn and thus would culminate with a collapse of asset prices and rationing credit. Therefore, in an environment of expansion in the business cycle, the procyclical nature of the prudential regulation can imply a loss of the efficiency in the system. Furthermore, during recessions this dynamic provokes a loss of liquidity in the market which may make the return on investment unviable and thus damages the economic growth.

2.3. Regulation and the crisis in Brazil

In 2008, the transmission channels of subprime crisis to Brazil were the same as those observed in the 1930's crisis.[5] An external crisis, initiated in the banking system from the crash of the Lehman Brothers in September 2008, spread out for other financial markets through a sudden stop of credit lines. Nevertheless, contrary to the situation of the previous crises, Brazil in the subprime crisis could be seen as a country with excess of regulation. Furthermore, as highlighted by

[3] In January of 2011, Tombini became the Governor of the Brazilian Central Bank.

[4] See Jacklin and Bhattacharya (1988), Chari and Jagannathan (1988), Gorton (1988), and Calomiris and Gorton (1991), for an analysis concerning bank run with asymmetric information.

[5] The New York stock market crash of 1929 reached the Latin American economies through the contagious effect. The cut of the USA credit for these economies implied a fall in exportation and thus a fall in commodities prices. As a consequence, there was a sudden fall in the international price of coffee and the result was the failure of the monetary regime adopted by Brazil initiating a new period with devaluation of the currency (Campa, 1990).

Franco (2009) – Brazil's ex-central banker - the firms were underleveraged and the crisis arrived during business cycles with clear signs of overheating.

An important fact which characterized the Brazilian economy in the subprime crisis was the role of the public banks. While the private banks reduced dramatically the credit supply when the crisis strengthened around the world, the Brazilian government adopted an anti-cyclical policy for banks such as Banco do Brasil, Caixa Econômica Federal and Brazilian Bank of Development (BNDES) to increase the volume of loans and liquidity for the market.

Another point is that the adoption of inflation targeting (June 1999) implies an increase in the transparency of the financial system and in the conduction of the monetary policy which, in turn, contributed to the macroeconomic stabilization of the Brazilian economy. The result from this stability allowed a fast development of the financial market and aroused the private agents, in the search for higher profits, to migrate for riskier investments – stock markets, subordinated debts, etc. Hence, the changes observed in the financial market call attention to follow the prudential regulation rules.

3. Effect of risk on financial institution profits and economic activity

With the objective of measuring the effect of the risk assumed by the Brazilian banking industry on economic activity, the Basel index (*BI*) becomes an important variable in the model. The relevance of this variable is due to the fact that it measures the solvency of banks and can be understood as an attempt in observing prudential regulation in the financial market. Hence, *BI* is a proxy variable capable of representing a measure of banking risk.

The Brazilian current capital obligation is 11% of exposures net of provision and it obeys Central Bank of Brazil's Resolution 2682/1999 which prescripts minimum provisioning percentages according to a classification criteria. While the *BI* is near the limit of 11% (defined by the Central Bank of Brazil), the regulatory agency demands a recomposition of the banking firm's capital or that it reduces its exposition to risk for continuing its operations in the market. In brief, a greater *BI* indicates a greater banking solvency and thus less exposure to risk and the bank is more capitalized.

Since the search for higher profits by financial institutions is associated with greater risks and that this behavior can promote an increase in the economic activity, besides *BI*, two other variables are considered:

(i) Net profit (*NP*) – is the division between net profit (*np*) and assets less financial institutions' intermediation (*FII*),

(1) $$NP = np/FII + 1;$$ and

(ii) Economic activity – which is specified as a function of the output gap (*X*) and corresponds to the division between observed output (X^O) – prices of 2000 – and the potential output (X^P).[6] Hence,

(2) $$X = X^O / X^P .$$

Besides the above-mentioned variables, based on the literature concerning this subject (see Kaminsky and Reinhart, 1999) the following control variables were used in the models: basic interest rate (*Selic*); stock market index – Ibovespa (*Ibov*), and exchange rate (*EX* = R$/US$).

Data (in logs) has quarterly frequency and the period of analysis is from the first quarter of 2001 to the second quarter of 2009.[7] The information is gathered from 66 Brazilian banking firms totalling 2,244 observations for panel data.[8] Table 3 presents the descriptive statistics.

[6] Due to the fact that the HP filter decomposes the time series in a cyclical component and the trend, the trend obtained by the HP filter can be understood as the potential output.

[7] The analysis starts in the first quarter of 2001 due to the Central Bank of Brazil's Resolution 2682/1999 which determines the obligation of Basel index calculation.

[8] The financial institutions considered in this study are in table A.1 (see appendix).

Table 3
Descriptive statistics

	BI	*NP*	*X*	*Selic*	*Ibov*	*EX*
Mean	-1.4140	0.0082	-0.0001	0.0380	10.1571	0.8728
Median	-1.5950	0.0068	0.0024	0.0379	10.1561	0.8442
Maximum	6.4089	0.1814	0.0555	0.0564	11.1193	1.2998
Minimum	-3.0098	-0.2842	-0.0690	0.0236	9.2021	0.5040
Std. dev.	0.7070	0.0245	0.0303	0.0085	0.5895	0.2005
Observations	2,244	2,244	2,244	2,244	2,244	2,244

With the intention to avoid traditional problems in macroeconomic time series, as heteroskedasticity and endogeneity between variables, this study considers the estimation of the first difference of Generalized Method of Moments (GMM). As highlighted by Arellano and Bond (1991), an advantage of this method in relation to others (for instance, ordinary least squares and generalized least squares) is that the estimations are reliable even in the case of omitted variables, measurement error and simultaneity (Wooldridge, 2001).

In particular, the use of instrumental variables allows the estimation of parameters in a more consistent way even in the case of endogeneity in the explanatory variables and in the occurrence of errors of measurement (Bond, Hoeffler, and Temple, 2001). In the proposed estimations, the three hypotheses of endogeneity (omitted variables, measurement error and simultaneity) are likely to occur. In short, not all explanatory variables of the estimation are known and measurable. For example, the Basel index and risk of total loss are just proxies of banking risk. Furthermore, the banking risk can suffer influence from output gap and from net profit which in turn, validates the hypothesis of simultaneity. Finally, a macroeconomic shock can affects both output gap and banking risk. Those phenomena violate the exogeneity hypothesis and justify the use of GMM. For analyzing the two relations (net profit - Basel index and economic activity – Basel index) 4 panels are estimated which take into account the size of the Brazilian banking institutions:

(i) panel 1 – considers the 9 biggest banks. These banks together (mostly financial conglomerates) represent 90% of assets less total of banking intermediation in this study;

(ii) panel 2 – is composed of 21 medium banks. This sample (mostly investment banks) represents around 8% of assets less total of banking intermediation;

(iii) panel 3 – considers 36 small banks. This group (mostly finance durable consumption goods) constitutes 2% of assets less total of banking intermediation; and

(iv) panel 4 – total of banks (66) are considered.

With the intention of observing the Brazilian banking behavior concerning the size of assets, the 9 biggest banks were separated from others. This division allows a better comprehension of the Brazilian bank system. Furthermore, it is possible to verify the existence of some similarity for banks with high assets in comparison with those in an intermediary position.

With the objective of correcting the heteroskedasticity problem in the estimations, the covariance matrices were estimated by the White method. Concerning the relevance of the instruments in the model, the test of overidentifying restrictions (Sargan test) is made as proposed by Arellano (2003). Furthermore, as suggested by Arellano and Bond (1991), two tests of first-order (m1) and second-order (m2) serial correlation are made.

Even with the premises of GMM and when there is no correlation on the first difference of endogenous regressors, testing the presence of unit root in the series is needed. Taking into account the methodology applied by Bond, Nauges, and Windmeijer (2005) several tests were created for testing unit roots in panel data. This study considers the following tests: Levin-Lin- Chu (LLC), Im-Pesaran-Shin (IPS), Fisher-ADF (ADF), and Fisher-PP (PP). The null hypothesis is the non-stationarity of series in all tests. The tests were applied for series in level, and the selection of lags was made applying Schwarz criterion. The results of tests for unit roots (see table A.2 – appendix) indicate that the series *NP*, *BI*, and *X* must be used in level, while the series *Selic*, *EX* and *IBOV* in the first difference.

3.1. Empirical evidence – net profit and Basel index

Based on the relation between net profit (*NP*) and Basel index (*BI*), equation (3) is used in 4 models which consider the size of banking firms,[9]

$$(3) \qquad NP_t = \beta_0 NP_{t-1} + \beta_1 BI_{t-1} + \beta_2 \Delta Selic_{t-2} + \beta_3 \Delta Ibov_t + \beta_4 X_t + \varepsilon_t, \qquad \varepsilon_t \sim N(0,\sigma^2).$$

Table 4 shows the results of the regressions. In the 4 panels, the Sargan test indicates that the instruments used are correct. Furthermore, both tests of first-order (m1) and second-order (m2) serial correlations do not detect problem of serial correlation.

The results indicate that there exists a positive relation between the current net profit of banking firms and the past net profit. In other words, the achievement of a high profitability in the current period tends to provoke positive results in the subsequent periods. Regarding the relation between the Basel index and the banking profit, a negative relation is observed. Therefore, this result is in accordance with the idea that greater risks are associated with greater profits. Furthermore, the variable X_{t-1} has a positive relation with net profit of banks in all models and thus indicates that an increase in the economic activity contributes to a greater profitability of the financial institutions.

Table 4

Dynamic panel data (GMM) – Dependent variable: net profit

	Panel 1		Panel 2		Panel 3		Panel 4	
	Coef.	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
NP_{t-1}	0.154	4.464***	0.272	8.776***	0.255	157.125***	0.230	327.470***
BI_{t-1}	-0.015	-4.547***	-0.003	-2.231**	-0.004	-8.527***	-0.001	-5.225***
$\Delta Selic_{t-2}$	2.749	1.665*	0.288	1.516	0.029	1.702*	0.081	11.864***
$\Delta Ibov_t$	-0.021	-1.059	0.007	3.935***	-0.017	-28.364***	-0.011	-83.868***
X_t	0.069	4.314***	0.061	16.637***	0.070	28.941***	0.065	96.051***
N. instrum.	16		13		12		13	
Obs.	252		588		1008		1848	
Sargan test	4.868		17.250		33.095		65.449	
(p-value)	0.301		0.370		0.365		0.325	
m1	-3.261		-9.117		-5.822		-5.962	
(p-value)	0.001		0.000		0.000		0.000	
m2	-0.206		1.551		-0.215		-0.163	
(p-value)	0.837		0.122		0.829		0.870	

Note: significance at the 1% (***), 5% (**) and 10% (*) levels, respectively.

It is observed in all panels that the basic interest rate has a positive relation with the net profit of banks. In the first panel, the coefficient regarding the *Selic* suggests the existence of a high participation of the public bonds in the portfolio of the big banks. In the second panel, the coefficient is lower than in the previous case and has statistical significance only at 15%. In brief, this result denotes a lower volume of public bonds in the portfolio of medium banks. In regard to panel 3, the positive relation between *Selic* and *LL* is due to the fact that small banks, in most cases, finance consumption goods and these operations are indexed by the basic interest rate. As a consequence, increases in the basic interest rate tend to increase the profitability of small banks.

[9] The selection of models considers the parsimonious principle. Regarding the instruments, besides the lags in the explanatory variables, the monetary aggregate M2 (see Kaminsky and Reinhart, 1999) was considered, but it was not relevant in the model.

Panels 1, 3, and 4 exhibit a negative relation between *Ibov* and *NP*. In a different way, panel 2 shows a positive relation. A possible justification for this result is that, contrary to big banks which have a great volume of public bonds (indexed by *Selic*), medium banks have a high participation of stocks in their portfolios implying a more aggressive behavior and thus greater risk than the other cases. In panel 3, the negative relation is a consequence of small banks financing consumption goods. Hence, an increase in *Ibov* can create a wealth effect which in turn implies a fall in borrowings through an increase in cash purchase.

3.2. Empirical evidence – output gap and Basel index

Such as in the previous section, the analysis concerning the relation between output gap and Basel index is made through 4 panels which consider the size of banking firms. The equation used in the estimations is given by:

(4) $$X_t = \alpha_0 X_{t-1} + \alpha_1 BI_{t-1} + \alpha_2 \Delta Selic_{t-2} + \alpha_3 \Delta EX_{t-3} + \upsilon_t, \qquad \upsilon_t \sim N(0,\sigma^2).$$

The tests for the models in table 5 do not indicate a problem of serial correlation and validate the instruments used. The results indicate the presence of a negative relation between current output gap and the output gap of the previous period. This finding is due to the fact that in the periods when the economic activity is increasing, there emerges a pressure on demand which obligates the monetary authority to adopt a tight monetary policy (increases in the interest rate). Moreover, the negative relation suggests that there is not a sustainable economic growth because an increase in output gap is followed by a decrease in the subsequent quarter implying a stop-and-go behavior.

Table 5

Dynamic panel data (GMM) – Dependent variable: output gap

	Panel 1		**Panel 2**		**Panel 3**		**Panel 4**	
	Coef.	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**	**Coef.**	**t-stat.**
X_{t-1}	-0.100	-5.573***	-0.111	-12.928***	-0.130	-52.129***	-0.017	-17.029***
BI_{t-1}	-0.111	-11.444***	-0.097	-17.483***	-0.048	-20.640***	-0.034	-40.179***
$\Delta Selic_{t-2}$	-2.702	-19.010***	-2.620	-43.093***	-2.503	-100.957***	-2.503	-241.603***
ΔEX_{t-3}	0.055	6.520***	0.046	18.993***	0.045	31.354***	0.129	133.204***
N. instrum.	15		14		14		43	
Obs.	252		609		1044		1452	
Sargan test	8.929		20.950		35.977		65.998	
(p-value)	0.112		0.229		0.143		0.108	
m1	-4.438		-3.862		-3.681		-3.224	
(p-value)	0.000		0.000		0.000		0.001	
m2	1.519		0.633		0.327		0.281	
(p-value)	0.130		0.527		0.744		0.779	

Note: significance at the 1% (***), 5% (**) and 10% (*) levels, respectively.

All panels denote a negative relation between *Selic* and *X*. This result is in consonance with the theory of the monetary transmission mechanism which indicates that an increase in the basic interest rate promotes a decrease in the output. The validity of the above-mentioned theory is also observed for the exchange rate. The positive relation with statistical significance for the 4 panels denotes that devaluations of the currency imply a better performance by the current account of balance of payments and thus an increase in the output.

At last, the coefficient regarding the Basel index presents a negative relation with the output gap and has statistical significance in all models. This result is very important because it permits identifying the presence of a trade-off between output and financial risk. In other words, an increase in the bank's risk position (decrease in Basel index) contributes to an increase in the economic activity.

4. Risk of total loss, Basel index, and economic activity

Although the Basel index is one of the most important indicators of health of the banking industry, it cannot perceive events which can cause risk of total loss. This fact cannot be neglected because these events have the potential of being contagious and causing problems of systemic risk which undermines the regulatory policy (Allen and Bali, 2007). Hence, this section adds the risk of total loss to the empirical analysis regarding the effect of the risk assumed by financial institutions on economic activity.

A good example of the effect of the risk of total loss is the case of Citigroup in 2007. In the last quarter of 2007, the largest U.S. bank at the time registered losses of over US$ 170 billion in assets (7.24% of total assets). In summary, the risk of total loss (*RTL*) is the maximum risk loss in value of the institution. In other words, the risk of total loss measures how much of its assets a banking firm can lose in one quarter. In this study *RTL* is obtained through the difference between total assets and financial intermediation (*AT*) of the banks[10]. With the objective of considering the assets return (*AR*), the *AT* at the period *t+1* was divided by the *AT* at the period *t* less 1, that is,

(5) $$AR = \left(AT_{t+1} \big/ AT_t \right) - 1 .$$

After finding the *AR* of 66 banks for the period which spans from the second quarter of 2001 to the second quarter of 2009, the return matrix ($MA_{i,j}$) was made. The lines represent the periods (33 lines – *i*) and the columns the banks (66 columns – *j*), then,

(6) $$MA_{i,j} = \begin{bmatrix} AR_{1,1} & \cdots & AR_{1,66} \\ \vdots & \ddots & \vdots \\ AR_{33,1} & \cdots & AR_{33,66} \end{bmatrix}.$$

After obtaining the *AR*, the risk of total loss for each bank was calculated (columns in $MA_{i,j}$ matrix) and, in the sequence, the risk of total loss for each period (lines in $MA_{i,j}$ matrix). Both risks were measured by Monte Carlo simulation and by the application of Value at Risk (VaR) of market regarding a significance level of 95%. In short, the risk of total loss of each bank (RTL_j) is a result of:

(7) $$RTL_j = VaR(AR_j; \mu, \sigma, 0.05) ,$$

where μ is the mean and σ is the standard error of the AR_j, considering a normal distribution.[11]

Taking as reference the financial institutions present in the panels of the prior section, table 6 shows the ranking (in a decreasing order) concerning the risk of total loss in each group. Besides the risk of total loss, table 6 shows the Basel index for each financial institution. It is observed that the risk exposure of each bank is not perceived in the same way by both indicators. On average, the *BI* indicates that big banks are subject to greater risks. On the other hand, the *RTL* shows the contrary. Notwithstanding, as both indicators represent a measure of banking risk, it is expected that the result observed due to the empirical analysis in the prior section be confirmed. In other words, a greater risk of the financial institutions (lower *BI* or greater *RTL*) may be associated with an increase in the economic activity (an increase in the output gap).

[10] A similar measure was proposed by Allen and Saunders (2004), Cotter (2006), and Bozhkov (2009), to define the catastrophic risk.

[11] The literature considers the normal distribution as the more relevant for explaining return in portfolios (Jorion, 1999).

Table 6

Risk of total loss and Basel index – Q2/2001 to Q2/2009

Panel 1			Panel 2						Panel 3					
Institution	***RTL***	***BI***	**Institution**	***RTL***	***BI***	**Institution**	***RTL***	***BI***	**Institution**	***RTL***	***BI***	**Institution**	***RTL***	***BI***
CITIBANK	0.2189	0.1498	**BNP**	0.6151	0.1632	**BNB**	0.0462	0.1744	**CARGILL**	0.7685	0.5930	**SCHAHIN**	0.2048	0.1495
SAFRA	0.1538	0.1358	**PACTUAL**	0.5784	0.2089	**MB**	0.0447	0.1324	**BARCLAYS**	0.6810	0.5882	**IB**	0.1971	0.2242
SANTANDER	0.1109	0.1611	**DEUTSCHE**	0.5456	0.1822	**BANRISUL**	0.0215	0.1821	**PROSPER**	0.6180	0.1863	**RURAL**	0.1970	0.1451
HSBC	0.1030	0.1315	**BBM**	0.5081	0.2017				**ING**	0.5937	0.3362	**INDUSVAL**	0.1685	0.2213
VOTORANTIM	0.0732	0.1639	**SG**	0.4309	0.2984				**OPPORTUNITY**	0.5336	1.4918	**TRIANGULO**	0.1258	0.2339
CEF	0.0720	0.2024	**FIBRA**	0.3929	0.1722				**VR**	0.5282	0.5033	**BANPARA**	0.1228	0.3372
ITAU	0.0693	0.1741	**IBIBANK**	0.3528	0.3828				**MODAL**	0.4653	0.2823	**GUANABARA**	0.1204	0.3356
BRADESCO	0.0514	0.1700	**SOFISA**	0.2247	0.2152				**RENDIMENTO**	0.3975	0.2578	**BONSUCESSO**	0.1110	0.2109
BB	0.0498	0.1458	**RABOBANK**	0.2171	0.1340				**FATOR**	0.3568	0.4210	**CLASSICO**	0.1051	32.7869
			PINE	0.2164	0.1945				**GERDAU**	0.3348	0.2820	**CEDULA**	0.1030	0.4043
			ABC	0.1677	0.1591				**GE**	0.3223	0.1904	**MATONE**	0.0961	0.2561
			DAYCOVAL	0.1610	0.2813				**CREDIBEL**	0.3020	0.4527	**BANSICREDI**	0.0887	0.2611
			BIC	0.1197	0.1518				**LAPROVINCIA**	0.2813	0.8180	**RP**	0.0688	0.3362
			BASA	0.0927	0.4089				**SMBC**	0.2402	0.5297	**LUSO**	0.0634	0.1956
			BANCOOB	0.0876	0.1451				**FICSA**	0.2365	0.3214	**POTTENCIAL**	0.0595	0.1179
			BMG	0.0737	0.1776				**BANCNACION**	0.2332	0.4030	**LAREPUBLICA**	0.0563	2.2487
			ALFA	0.0702	0.1958				**INTERCAP**	0.2252	0.2984	**BANESE**	0.0425	0.1901
			BANESTES	0.0472	0.1642				**BCOMURUGUAI**	0.2067	0.2748	**RENNER**	0.0055	0.3382
Mean	0.1003	0.1594	**Mean**				0.2388	0.2060	**Mean**				0.2573	0.4125*

Note: (*) Due to the fact that the Bank Clássico is an outlier, it is excluded from the mean in panel 3.

With the objective of making the above-mentioned analysis and strengthening the empirical evidence, a series for the *BI* is built (average of the Brazilian banks) and the *RTL* for the period which spans from the second quarter of 2001 to the second quarter of 2009 is considered. In brief, each observation in the series is representative of the Brazilian banks behavior measured by Basel index and risk of total loss.

Besides the *RTL* and *BI*, the variables *X* and *EX*, were also considered in this analysis. In accordance with the arguments presented by Kaminsky and Reinhart (1999), the variation of the monetary aggregate *M2* (*ΔM2*) is also included as a control variable. In particular, it is expected that positive variations of *M2* are connected with an increase in the economic activity.[12] Table 7 shows the descriptive statistics of the variables (in logs).

Table 7

Descriptive statistics

	BI	***EX***	***X***	***ΔM2***	***RTL***
Mean	-1.3872	0.8780	-0.0010	0.0417	-1.2914
Median	-1.3914	0.8510	0.0015	0.0363	-1.2776
Maximum	-1.1235	1.2998	0.0555	0.1220	-0.7465
Minimum	-1.6237	0.5040	-0.0690	-0.0121	-1.7271
Std. dev.	0.1033	0.2043	0.0307	0.0296	0.2364
Observations	33	33	33	33	33

In this section besides ordinary least squares (*OLS*) estimations, quantile regressions (*QR*) are presented. It is important to note that the use of quantile regression has increased in the last years for analyzing macroeconomics and financial system problems. This method allows a more complete description of the conditional variable than the analysis of mean. In short, the use of this method allows a more complete map of the impact of risk of financial institutions (measured by *BI* and *RTL*) on economic activity because it reveals how each quantile responds to it instead of only considering the mean.

In particular, three advantages in the use of the quantile regression must be highlighted (Koenker e Bassett, 1978): (i) it is possible to use it even when the errors do not present a normal distribution and thus can imply more efficient estimators than in OLS case; (ii) based on a set of regressors it is possible to characterize the totality of the conditional distribution of only one response variable; and (iii) it considers the totality of the data for estimating the coefficients and it is robust to the presence of outliers.

In a very simplified way, it is possible to say that the quantile regression can be understood as an extension of the sample quantiles for the case of a linear model $u_t = y_t - x_t\beta$ with F-distribution. Hence, the quantile *n* (θ) of the sample, $0<\theta<1$, must be defined as a solution for the minimization problem:

$$(8) \qquad \min_{\beta\in\mathbb{R}^k}\left[\sum_{t\in\, t:y_t\geq x_t\beta}\theta\left|y_t - x_t\beta\right| + \sum_{t\in\, t:y_t<x_t\beta}(1-\theta)\left|y_t - x_t\beta\right|\right],$$

wher $\{x_t{:}t=1,\ldots,T\}$ denotes a sequence of (lines) *K*-vectors of a matrix of known explanatory variables and $\{y_t{:}t=1,\ldots,T\}$ is a random sample in the regression process.[13]

[12] Other variables, as *Selic* and *Ibov* were considered in the estimations, but did not present statistical significance.

[13] For a detailed analysis concerning quantile regression, see Koenker (2005).

4.1. Empirical evidence

For analyzing the relation between banking risk and output gap, two specifications were considered. The first considers the risk of total loss, while the second the Basel index. Hence,

(9) $X_t = \phi_0 + \phi_1 X_{t-1} + \phi_2 RTL_t + \phi_3 \Delta M2_t + \phi_4 EX_{t-2} + \xi_t ,$ $\xi_t \sim N(0,\sigma^2)$; and

(10) $X_t = \gamma_0 + \gamma_1 X_{t-1} + \gamma_2 BI_{t-1} + \gamma_3 \Delta M2_t + \gamma_4 EX_{t-2} + \zeta_t ,$ $\zeta_t \sim N(0,\sigma^2)$.

Table 8 shows the results for both specifications.[14] In a similar way, as observed in section 3, the coefficient on *X* is negative and has statistical significance in all models. Except for the quantile 0.2 in the first specification, the coefficient on *ΔM2* has statistical significance and reveals a positive relation with the output gap for all cases. In other words, increases in money supply tend to increase the economic activity. Considering the exchange rate, although the statistical significance has been observed for few cases (QR 0.2, 0.6, and 0.8 in the first specification and QR 0.8 in the second), the sign is positive and thus is alike to the evidence found for the estimations with the panel data. In brief, currency devaluations promote an improvement in the current account of balance of payments which in turn implies an increase in the output.

In a general way, the coefficient on risk of total loss has statistical significance and presents a positive sign in all quantiles (specification 1).[15] Therefore, a greater risk of total loss of the banking firms is associated with a greater level of economic activity. Figure 1 allows one to see a significant fall in the coefficient associated with the risk of total loss while the quantiles are increasing (the coefficient of *RTL* decreases from 0.07 in the quantile 0.2 to 0.02 in the quantile 0.8).

[14] ARCH LM and Breusch-Godfrey LM tests indicate that the OLS estimations do not present problem of autocorrelation or heteroskedasticity.

[15] The risk of total loss did not present statistical significance only in the QR 0.6.

Table 8

Effect of banking risk on output gap – OLS and QR

Effect of risk of total loss on output gap (specification 1)

	OLS		***QR 0.2***		***QR 0.4***		***QR 0.5***		***QR 0.6***		***QR 0.8***	
	Coef.	**Stat.**	**Coef.**	**Stat.**	**Coef.**	**Stat.**	**Coef.**	**Stat.**	**Coef.**	**Stat.**	**Coef.**	**Stat.**
Constant	-0.013	-0.472	0.006	0.188	-0.013	-0.455	-0.023	-0.922	-0.042	-1.380	-0.054	-2.235**
X_{t-1}	-0.473	-5.126***	-0.523	-2.995***	-0.478	-2.972***	-0.474	-4.497***	-0.344	-2.163**	-0.214	-1.975*
RTL_t	0.033	2.577**	0.070	3.941***	0.035	1.854*	0.036	2.729**	0.030	1.645	0.023	1.983*
$\Delta M2_t$	0.815	2.997***	0.349	1.580	0.928	3.880***	0.967	3.622***	0.992	7.398***	1.025	9.017***
EX_{t-2}	0.021	0.969	0.049	2.306**	0.019	0.867	0.032	1.633	0.051	2.281**	0.059	3.871***
Adj. R^2	0.521		0.274		0.299		0.331		0.353		0.358	
F-statistic	9.171	(0.000)										
ARCH (1)	0.063	(0.803)										
ARCH (2)	0.973	(0.391)										
ARCH (4)	0.973	(0.442)										
ARCH (8)	1.992	(0.124)										
LM (1)	0.544	(0.468)										
LM(2)	0.707	(0.503)										

Effect of Basel index on output gap[16] (specification 2)

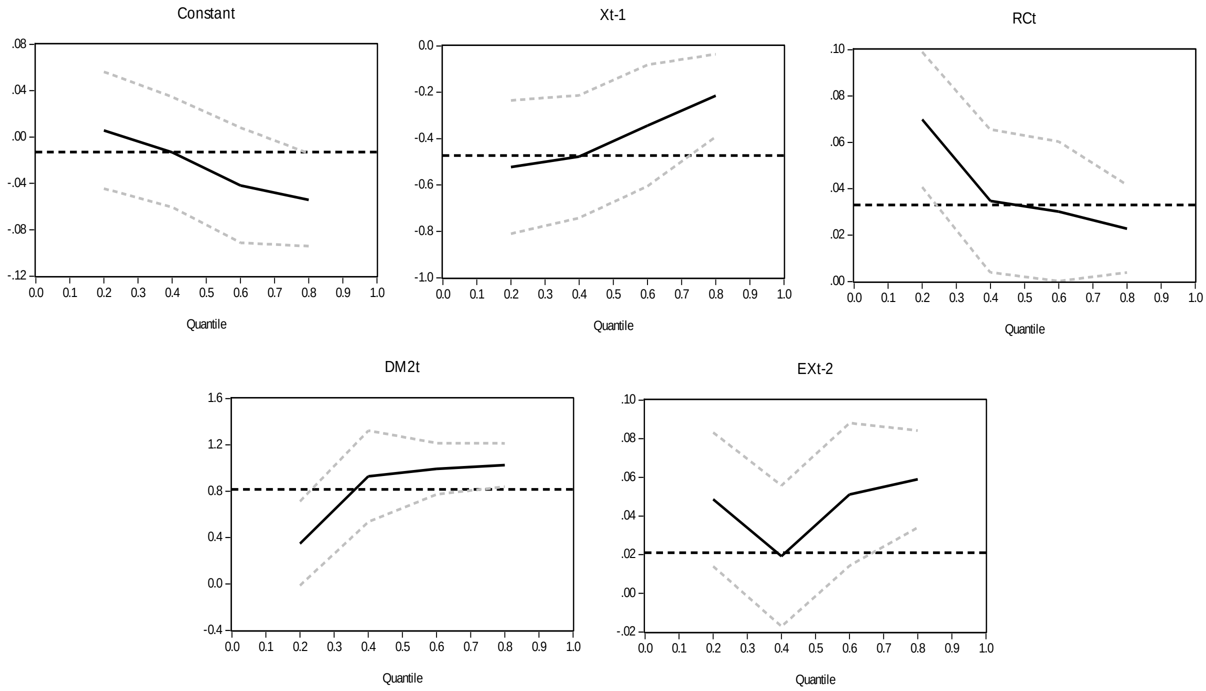
	OLS		***QR 0.2***		***QR 0.4***		***QR 0.5***		***QR 0.6***		***QR 0.8***	
	Coef.	**Estat.**	**Coef.**	**Estat.**	**Coef.**	**Estat.**	**Coef.**	**Estat.**	**Coef.**	**Estat.**	**Coef.**	**Estat.**
Constant	-0.173	-2.966***	-0.144	-1.646	-0.217	-2.437**	-0.217	-2.536**	-0.144	-2.194**	-0.18	-4.389***
X_{t-1}	-0.433	-4.629***	-0.507	-2.641**	-0.350	-1.727*	-0.345	-1.846*	-0.313	-3.830***	-0.368	-3.775***
BI_{t-1}	-0.073	-2.752**	-0.036	-0.673	-0.102	-1.919*	-0.101	-2.016*	-0.064	-1.567	-0.082	-3.792***
$\Delta M2_t$	0.808	3.043***	1.121	3.448***	0.906	2.869***	0.900	4.023***	0.821	5.595***	0.825	6.501***
EX_{t-2}	0.039	1.433	0.032	0.959	0.041	1.147	0.045	1.202	0.030	1.127	0.049	2.679**
Adj. R^2	0.5047		0.2526		0.2913		0.3288		0.3431		0.3816	
F-statistic	8.643	(0.000)										
ARCH (1)	0.373	(0.546)										
ARCH (2)	0.313	(0.734)										
ARCH (4)	0.665	(0.623)										
ARCH (8)	1.012	(0.470)										
LM (1)	0.010	(0.920)										
LM(2)	0.005	(0.995)										

Note: significance at the 1% (***), 5% (**) and 10% (*) levels, respectively.

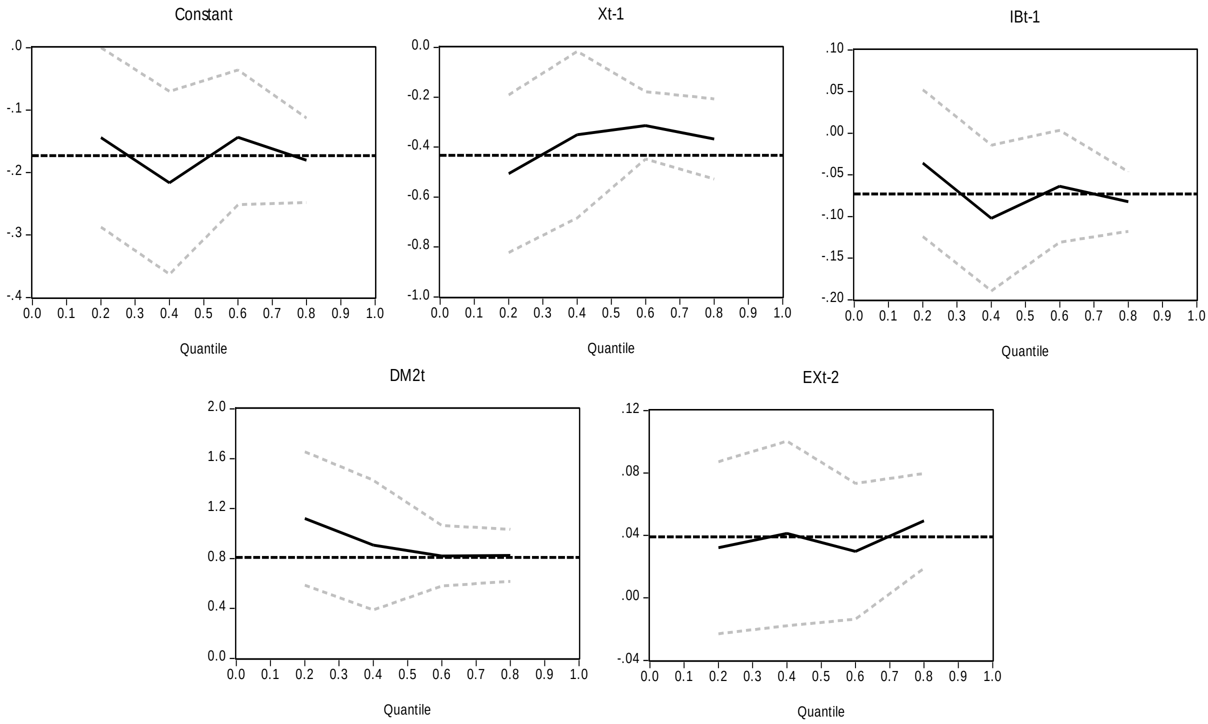
[16] Due to the fact that the Clássico Bank is an outlier and thus causes problems in OLS estimations, it was excluded from the sample.

Figure 1
OLS and QR – output gap

Specification 1



Specification 2



Note: The two gray dotted lines in the graphs represent the interval confidence at 90% for quantile regressions. The black dotted line in the graphs is the OLS estimation.

Therefore, the lower the quantile analyzed, the greater the impact of the risk of total loss on output gap.[17] As the biggest Brazilian banks present the lowest risks of total loss (see table 6), the analysis regarding quantile regression permits one to conclude that the risks of the largest institutions affect the output gap in major proportions. It is important to note that this result is not possible to see through the OLS regression (indicated by horizontal dotted line in the graphs) and thus justifies the use of the quantile regression in this analysis.

In specification 2 the coefficient regarding the Basel index presents a negative sign for all models and has significance statistics in most cases which in turn is in consonance with the empirical evidence shown in section 3. In brief, the estimations achieved indicate that a greater exposure to the risk by banking firms tends to heat the economy. In a different way from the prior case where the quantile regression allowed new perceptions in the analysis, in this specification, this method did not present results which distinguish it from the OLS estimations. It is easy to see through figure 1 that the line from estimations of the several quantiles is near that from OLS estimation.

5. Concluding remarks

The empirical evidence in this study considered the effect caused by the risk assumed by the Brazilian financial institutions, measured by both Basel index and risk of total loss, and considered macroeconomic effects on the output gap. In a general way, concerning the Basel index, the results from the panel data indicate that the well capitalized financial institutions, and thus with a Basel index greater than 11%, represent institutions with lower profitability and promote a fall in the economic activity. In a similar way, the findings from OLS estimation and quantile regression also denote that a higher Basel index is associated with a lower economic activity.

The analysis concerning risk of total loss deserves to be highlighted. Taking as reference Allen and Bali (2007), it is possible to conjecture that the risk of total loss is a measure adequate for studying events which can provoke a systemic risk and thus has a greater impact on the economic activity. Therefore, the risk of total loss is a distinct manner of observing the banking risk from that presented by Basel index. Besides the presentation of a ranking in relation to the risk assumed by the Brazilian banks, different from that observed through the Basel index, the evidence from quantile regression denotes that the risk assumed by the biggest banks has more relevance for explaining economic activity.

Although the risk of the Brazilian financial institutions is perceived in a distinct way through Basel index and risk of total loss, the empirical evidence indicates that in both cases an increase in the risk is associated with an increase in the economic activity. In other words, there exists a trade-off between banking risk and output gap in the Brazilian economy. This result allows one to conjecture that Borio's (2004) proposal concerning the creation of a liquidity cushion in the periods when the economy is growing can be used as an anti-cyclical tool capable of avoiding the creation of new financial bubbles.

Therefore, it is expected that an increase in the minimum capital requirement for the creation of a liquidity cushion has the function of absorbing the impact caused by an overheating in the economy as a clear anti-cyclical monetary authority's policy. Likewise, in the periods of economic downturns, the elimination of the rate for the creation of the liquidity cushion will imply a reverse effect. As a consequence, there is an improvement in the liquidity of the banks which in turn promotes an increase in the new loans.

[17] This result is confirmed through slope equality test and symmetric test (see table A.3- appendix).

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Appendix

Table A.1

Banking institutions in the panels

PANEL 1	PANEL 2		PANEL 3		
BANCO DO BRASIL	BNP PARIBAS	DAYCOVAL	BANSICREDI	TRIANGULO	GERDAU
ITAU	BANRISUL	MERCANTIL DO BRASIL	CLASSICO	FATOR	CREDIBEL
BRADESCO	PACTUAL	ABC-BRASIL	BARCLAYS GALICIA	MODAL	LUSO BRASILEIRO
CAIXA ECONÔMICA FEDERAL	BNB	SOFISA	ING	SMBC	CEDULA
SANTANDER	ALFA	RABOBANK	SCHAHIN	PROSPER	RENNER
HSBC	BBM	PINE	INDUSVAL	VR	OPPORTUNITY
VOTORONTIM	DEUTSH	IBIBANK	RURAL	RENDIMENTO	BCOMURUGUAI
SAFRA	BIC	BANCOOB	BANESE	GUANABARA	LA PROVINCIA
CITIBANK	FIBRA	SOCIETE GENERALE	GE CAPITAL	MATONE	FICSA
	BMG		BANPARA	INTERCAP	BANCNACION
	BANESTES		INDUSTRIAL DO BRASIL	CARGILL	POTTENCIAL
	BASA		BONSUCESSO	RIBEIRAO PRETO	LA REPUBLICA

Table A.2 – *Unit root tests*

				Constant				Constant and trend				Without Constant or trend		
				LLC	IPS	ADF	PP	LLC	IPS	ADF	PP	LLC	ADF	PP
Schwarz*	**Panel 1**	*X*	Stat.	6.038	-2.670	29.763	277.113	8.779	-0.750	14.167	244.325	-7.384	67.874	437.431
			Prob.	1.000	0.004	0.040	0.000	1.000	0.227	0.718	0.000	0.000	0.000	0.000
		IB	Estat.	-5.271	-5.486	67.904	65.696	-3.740	-3.960	48.127	44.548	-2.306	23.112	24.145
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.186	0.150
		NP	Stat.	-11.793	-7.833	81.394	199.160	-16.761	-10.115	316.258	216.713	-3.010	57.849	105.878
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
		Selic	Stat.	-0.125	-0.656	15.919	7.498	-4.547	-5.948	65.766	21.245	-2.479	18.216	15.419
			Prob.	0.450	0.256	0.598	0.985	0.000	0.000	0.000	0.267	0.007	0.442	0.633
		D(Selic)	Stat.	-9.289	-8.188	97.456	32.749	-8.296	-7.255	78.766	18.844	-12.177	148.108	74.175
			Prob.	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.402	0.000	0.000	0.000
		Ibov	Stat.	1.386	3.737	2.022	2.566	-1.174	-3.313	38.125	14.613	3.994	0.876	1.234
			Prob.	0.917	1.000	1.000	1.000	0.120	0.001	0.004	0.688	1.000	1.000	1.000
		D(Ibov)	Stat.	-10.123	-7.659	88.877	74.256	-9.758	-7.012	78.039	47.207	-10.656	129.717	123.135
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		EX	Stat.	0.302	0.587	9.392	11.683	-2.954	-3.147	36.566	29.368	-0.734	9.507	9.653
			Prob.	0.619	0.722	0.950	0.863	0.002	0.001	0.006	0.044	0.232	0.947	0.943
		D(EX)	Stat.	-13.100	-11.732	149.145	95.115	-11.522	-10.121	116.719	84.361	-11.842	150.718	141.746
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Schwarz*	**Panel 2**	*X*	Stat.	9.223	-4.078	69.446	646.597	13.411	-1.145	33.055	570.093	-11.279	158.372	1020.670
			Prob.	1.000	0.000	0.005	0.000	1.000	0.126	0.837	0.000	0.000	0.000	0.000
		IB	Stat.	-7.510	-8.037	147.367	137.536	-6.108	-5.574	109.917	179.699	-0.655	26.537	26.004
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.256	0.970	0.975
		NP	Stat.	-32.991	-16.148	195.953	337.970	-9.268	-9.913	191.113	622.750	-11.587	394.951	219.843
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Selic	Stat.	-0.191	-1.002	37.143	17.496	-6.946	-9.085	153.454	49.573	-3.787	42.505	35.978
			Prob.	0.424	0.158	0.684	1.000	0.000	0.000	0.000	0.197	0.000	0.449	0.732
		D(Selic)	Stat.	-14.190	-12.508	227.397	76.415	-12.673	-11.083	183.787	43.970	-18.600	345.586	173.074
			Prob.	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.388	0.000	0.000	0.000
		Ibov	Stat.	2.117	5.708	4.719	5.988	-1.793	-5.061	88.958	34.096	6.101	2.045	2.880
			Prob.	0.983	1.000	1.000	1.000	0.037	0.000	0.000	0.802	1.000	1.000	1.000
		D(Ibov)	Stat.	-15.463	-11.700	207.380	173.264	-14.906	-10.710	182.090	110.149	-16.278	302.674	287.314
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		EX	Stat.	0.461	0.897	21.915	27.260	-4.512	-4.807	85.321	68.524	-1.121	22.183	22.524
			Prob.	0.678	0.815	0.996	0.962	0.000	0.000	0.000	0.006	0.131	0.995	0.994
		D(EX)	Stat.	-20.011	-17.922	348.006	221.936	-17.600	-15.460	272.344	196.842	-18.089	351.675	330.740
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

		X	Stat.	12.076	-5.339	119.051	1108.450	17.559	-1.499	56.666	977.302	-14.767	271.496	1749.720
			Prob.	1.000	0.000	0.000	0.000	1.000	0.067	0.907	0.000	0.000	0.000	0.000
		IB	Stat.	-3.685	-5.167	147.463	133.522	-3.960	-3.756	130.285	115.067	-0.543	82.973	80.054
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.294	0.177	0.241
		NP	Stat.	-11.466	-12.017	320.196	538.920	-11.813	-10.183	283.841	539.961	-10.161	268.109	414.454
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Selic	Stat.	-0.251	-1.312	63.674	29.993	-9.094	-11.895	263.064	84.982	-4.958	72.866	61.677
			Prob.	0.401	0.095	0.747	1.000	0.000	0.000	0.000	0.141	0.000	0.449	0.802
Schwarz*	**Panel 3**	*D(Selic)*	Stat.	-18.579	-16.377	389.824	130.997	-16.593	-14.511	315.063	75.378	-24.353	592.432	296.699
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.370	0.000	0.000	0.000
		Ibov	Stat.	2.771	7.473	8.089	10.266	-2.347	-6.627	152.499	58.451	7.987	3.505	4.936
			Prob.	0.997	1.000	1.000	1.000	0.010	0.000	0.000	0.875	1.000	1.000	1.000
		D(Ibov)	Stat.	-20.245	-15.319	355.508	297.025	-19.517	-14.023	312.155	188.826	-21.313	518.869	492.539
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		EX	Stat.	0.603	1.175	37.569	46.731	-5.908	-6.293	146.264	117.470	-1.467	38.028	38.613
			Prob.	0.727	0.880	1.000	0.991	0.000	0.000	0.000	0.001	0.071	1.000	1.000
		D(EX)	Stat.	-26.201	-23.465	596.582	380.461	-23.044	-20.241	466.876	337.443	-23.684	602.872	566.983
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		X	Stat.	16.351	-7.229	218.260	2032.160	23.775	-2.030	103.888	1791.720	-19.995	497.742	3207.830
			Prob.	1.000	0.000	0.000	0.000	1.000	0.021	0.966	0.000	0.000	0.000	0.000
		IB	Stat.	-8.391	-9.838	361.403	335.732	-7.173	-6.987	284.648	336.276	-1.980	133.468	130.186
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.448	0.528
		NP	Stat.	-35.672	-20.875	597.223	1075.010	-21.697	-16.854	791.125	1378.050	-15.472	720.756	739.740
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Selic	Stat.	-0.339	-1.777	116.736	54.988	-12.314	-16.106	482.284	155.799	-6.713	133.587	113.074
			Prob.	0.367	0.038	0.826	1.000	0.000	0.000	0.000	0.077	0.000	0.445	0.882
Schwarz*	**Panel 4**	*D(Selic)*	Stat.	-25.156	-22.174	714.677	240.162	-22.467	-19.648	577.615	138.192	-32.974	1086.130	543.947
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.339	0.000	0.000	0.000
		Ibov	Stat.	3.752	10.119	14.830	18.820	-3.179	-8.972	279.582	107.160	10.815	6.426	9.050
			Prob.	1.000	1.000	1.000	1.000	0.001	0.000	0.000	0.945	1.000	1.000	1.000
		D(Ibov)	Stat.	-27.412	-20.741	651.765	544.545	-26.426	-18.987	572.283	346.181	-28.857	951.261	902.987
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		EX	Stat.	0.817	1.591	68.877	85.673	-7.999	-8.521	268.150	215.363	-1.987	69.718	70.791
			Prob.	0.793	0.944	1.000	0.999	0.000	0.000	0.000	0.000	0.024	1.000	1.000
		D(EX)	Stat.	-35.476	-31.771	1093.730	697.512	-31.202	-27.407	855.939	618.645	-32.069	1105.270	1039.470
			Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: (*) The final choice of lag was made based on Schwarz criterion. LLC – Levin-Lin-Chu test – common root processes – H_0: $\alpha = 0$. IPS – Im-Pesaran-Shin test– individual root processes – H_0: $\alpha = 0$ (for each i). ADF – Fisher-ADF test – individual root processes – H_0: $\alpha = 0$ (for each i). PP – Fisher-PP test – individual root processes – H_0: $\alpha = 0$ (for each i).

Table A.3

QR – Slope equality test and Symmetric test

	Specification 1 (*RTL*)		Specification 2 (*BI*)	
	Stat.	**Prob.**	**Stat.**	**Prob.**
Slope Equality Test	39.362	0.000	7.429	0.828
Symmetric Test	20.722	0.023	4.851	0.901