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Economic Activity and Financial Institutional Risk: an empirical analysis for the Brazilian banking industry*

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Abstract

This paper analyzes the impact of the changes in capital requirements on bank's risk and the trade-off between economic activity and the risk of financial institutions in the Brazilian economy. Hence, an analysis based on dynamic panel data taking into account 73 banks and a vector autoregression analysis for the period from 2001 to 2008 is made. The findings underscore that banks which adopt riskier strategies reach higher profitability. Moreover, the results suggest that the banking regulation is an important instrument for reaching the balance between the economic growth and the low exposition to the risk of banking firms in markets such as the Brazilian one.

Key words: banking firms, capital buffer, risk, profit, output, Brazilian economy.
JEL classification: G15, G18, G14.

* The views and opinions offered in this article do not necessarily reflect those of the Central Bank of Brazil.

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1. Introduction

The organization of banking systems is subject to excessive risks because riskier investments tend to be more profitable. In fact, there exists a delicate conflict in the financial sector. On the one hand it is the task of the regulatory agencies to mitigate the occurrence of systemic crises, but on the other hand banks desire the highest profits for their stockholders and depositors although this procedure tends to be associated with higher risks (Estrella, 2004).

Even before the subprime crisis in the USA the idea that a decrease in the minimum capital requirements could imply an amplification of the business cycle was much diffused. In a general way, academics, practitioners, and policymakers stress the relation of the procyclical characteristic of the capital necessary to cover the risk in credit operations with the business cycles.[1] In other words, the business cycles are amplified as a function of minimum capital required to mitigate the losses due to the risks assumed by the financial institutions (Allen and Saunders, 2004).

After the peak of the subprime crisis it is possible to identify some measures that should be part of the broad regulatory reform ahead:[2] (i) the introduction of stricter standards of prudential regulation; (ii) the pursuit of transparency and the strengthening of market discipline; (iii) the intensification of international cooperation; and (iv) a greater emphasis on macroeconomic effects from financial regulation.

With respect to the macroeconomic effects from financial regulation, the proposal to replace the current model of provision of capital to cover losses of financial institutions, based on preterit losses, by a mechanism which considers the expected loss over the economic cycle, is gaining strength. Under this view, provisions for losses should be calculated based on the likelihood of default associated with the economy over the ongoing cycle and not on the probability measured at each moment.

Some emerging economies, such as Brazil, have a strong banking system and the amount of riskier investments is increasing (stock market, subordinated debts, etc.).[2] Hence, empirical evidence from Brazil which shows how the risk of the financial institutions affects both banking profit and output gap allows one to observe if the strategy of using a capital cushion for smoothing economic cycles could be useful for similar economies.

[1] See, Allen and Saunders (2004); Gordy and Howells (2004); and Kashyap and Stein (2004).
[2] See, de Mendonça and Loures (2009).

With the objective of contributing to the literature surrounding financial market regulation and business cycles in emerging economies, this paper shows empirical evidence on the Brazilian financial market. Assuming the Basel index as measure of the bank's risk and considering data from 73 banks for the period which spans from 2001 to 2008, empirical analysis based on dynamic panel data (Generalized Method of Moments) and on vector autoregression analysis is made.

This paper is organized as follows. The next section makes a brief presentation of the main reasons for the proposal of a capital cushion as an anti-cyclical tool. The third section which is divided in two steps provides an empirical analysis for the relationship between profitability and bank's risk as well as for output gap and bank's risk in the Brazilian economy. The first step applies dynamic panel data (Generalize Method of Moments) considering 73 banks (quarterly data spans from first quarter 2001 to second quarter 2008). The second step makes use of a vector autoregression analysis. Finally, the fourth section concludes the paper.

2. Minimum capital requirement and financial regulation

It is a fact that the relationship between the capitalization rates on assets and risks in financial institutions is present in the literature, however the results are contradictory. According to Koehn and Santomero (1980) and Kim and Santomero (1988) there is a positive relationship between risk and capitalization of financial institutions. Contrary to this view, Furlong and Keeley (1989) and Keeley (1990), found evidence that a higher capitalization implies institutions which are more risk-averse.

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 market discipline as a way to identify and punish, through market tools, the riskier institutions.

One of the main objectives of the Basel II Accord is an attempt to reduce the incentive for financial institutions to assume a high risk position. Basel II established that the banks may reveal which part of their capital will be available for covering all sorts of risks. In brief, Basel II brought an incentive to the banking sector to improve the risk management practice and it is based on three pillars (BIS, 2004): (i) Minimum capital for

covering the credit, market, and operational risks - central banks must define a minimum coefficient of capital charge for the banks under their supervision. (ii) Banking supervision - the new framework demands that the regulator of each country, after a complete analysis of the risks, assures that each institution has an adequate internal process for evaluation of its capital. (iii) Market discipline – there are recommendations and requirements of disclosure in several areas including how each institution calculates and discloses its capital adequateness and methods of evaluation of risks.

According to Basel II, the capital used as a protection against risks of loss must remain invested in liquidity assets. Therefore, the capital requirement could imply a constraint on banking leverage with direct effects on profitability of banks (Kashyap and Stein, 2004). Nevertheless, the subprime aftermath revealed that the minimum capital requirement was not enough to avoid the use of securitization as a way to circumvent the regulation.

The current model of financial regulation possesses procyclical characteristics. As identified by Minsky (1982), optimistic expectations caused by economic booms reduce investors' risk aversion and thus create an environment propitious for the creation of financial bubbles. Taking into account Tinbergen's rule and the position of the President of the Federal Reserve (Ben Bernanke),[3] the use of regulatory and supervisory methods is the best manner to prevent financial bubbles.

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. Central bankers from G-20 (BIS meeting on September 2009) propose to develop a flexible equity structure so that the requirement for a capital ratio works as an anti-cyclical tool. According to this proposal, the minimum capital of reference shall continue to be used for calculating the limit on bank leverage, being 8% of assets weighted by the risk (proposed by the Basel Committee).

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 capital buffer in periods of expansion in economic activity. As pointed out by Tombini (2009) - Brazil's Central Bank

[3] See, http://www.soxfirst.com/50226711/bernanke_more_regulation_to_control_bubbles.php.

Director for Norms[4] - 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. Empirical evidence

The implementation of the cash cushion will strengthen the solvency of the banks, and thus will change the outcome from the Basel index (BI). Focusing on the largest 50 banks in Brazil (total assets) it is observed that the Basel index in most of the institutions decreased considerably due to the subprime crisis (see Table 1). This observation matters because, by hypothesis, banks that are less capital-intensive, with *BI* closer to the minimum required of 11% (imposed by the Central Bank of Brazil), are riskier (less solvent) and more profitable (more leveraged). Therefore, the use of a cushion of capital will work as a clear anti-cyclical policy due to the improvement in the bank's operational capacity for new loans.

Table 1

Solvency of Financial Institutions (Basel index %)

	2007 June	2008 July	Δ2008/07
5 better outcomes			
ING	27.9	51.4	+
MORGAN STANLEY	23.0	38.9	+
SOCIETE GENERALE	20.4	34.7	+
WESTLB	15.6	33.8	+
UBS PACTUAL	18.9	30.7	+
5 worst outcomes			
BRB	14.0	11.9	-
SAFRA	12.4	11.9	-
BANCOOB	12.7	11.9	-
MERCANTIL DO BRASIL	16.2	11.6	-
FIBRA	14.1	11.5	-
Selected outcomes			
BANCO DO BRASIL	15.8	12.5	-
BRADESCO	18.2	14.4	-
ITAU	18.5	17.1	-
SANTANDER	16.3	13.6	-
HSBC	13.2	13.1	-
UNIBANCO	14.0	13.7	-
CITIBANK	13.7	13.2	-

Source: Central Bank of Brazil.

[4] In January of 2011 Tombini became the Brazilian Central Bank governor.

3.1. Panel data analysis

The empirical analysis is focused on the effects of the risk of financial institutions on both profitability and output gap in the Brazilian economy. The data is from the first quarter of 2001 to the second quarter of 2008 based on information regarding 73 Brazilian banking firms (see appendix – table A.1) totaling 2190 observations for panel data. Hence, the following indicators were used in this analysis:[5]

(i) net profit (*NP*) – net profit is the percentage variation taking into account constant prices of 2001 (in billions of Reais – R$) ;[6]

(ii) output gap (*X*) – corresponds to the difference between the GDP and the potential output (constant prices of 2001);[7]

(iii) Basel index (*BI*) - capital over assets measured by risks (in log) – a proxy of risk for financial institutions. A higher indicator reveals a higher solvency of the bank. The indicator is calculated through: *BI=11% (Capital / regulatory capital).* The Brazilian current capital obligation is 11% of exposures net of provision (Basel Committee defines 8%) and it obeys resolution nº 2682/1999 which prescripts minimum provisioning percentages according to a classification criteria. Capital is defined as the sum of: equity, net income, reserves, preferred stocks, subordinated debts, and hybrid instruments. Regulatory capital is the sum of risk weighted assets and other capital requirements (capital for credit risk of swaps, capital for interest rate market risk, and capital for foreign exchange rate market risk).

Besides the above-mentioned indicators, the following control variables (in logs) were considered in the analysis: basic interest rate (*IR*); index of stock market activity (IBOVESPA index - *IBOV*); exchange rate (*EX* = R$/US$).

As a manner of eliminating the non-observed effects in the regressions, the methodology proposed by Arellano and Bond (1991) - Generalized Method of Moments (GMM) panel data - is applied in this analysis. An advantage of this method in relation to others (for example, Ordinary Least Squares and Feasible Generalize Least Square) is that

[5] All data is available at Central Bank of Brazil Web Site (www.bcb.gov.br). It is important to highlight that in the first quarter of 2001 Central Bank of Brazil's Resolution nº 3.490/2007 determined the methodology concerning the Basel index.

[6] Prices were deflated by National Consumer Price Index (extended) – IPCA (official price index). As the net profit has negative values, its percentage variation was initially considered and after the application of logs was made.

[7] 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.

it is not inconsistent with omitted variables. Furthermore, the use of instrument variables permits the estimation of consistent parameters even when in the presence of endogenous variables (Bond, Hoeffler, and Temple, 2001).

With the intention of realizing the difference in the empirical results due to the size of banking institutions, four panel data models are estimated (see descriptive statistics in table 2):

(i) panel 1 – total assets less intermediation greater than 50 billions of Reais – total of 11 banks (mostly financial conglomerates);

(ii) panel 2 - total assets less intermediation with values between 10 billions of Reais and 50 billions of Reais - total of 10 banks (mostly investment banks);

(iii) panel 3 – total assets less intermediation with values lower than 10 billions of Reais – total of 52 banks (mostly finance durable consumption goods);

(iv) panel 4 – all institutions in the sample – total of 73 banks.[8]

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

Table 2
Descriptive statistics

	Panel 1			**Panel 2**			**Panel 3**			**Panel 4**		
	NP	***X***	***BI***	***NP***	***X***	***BI***	***NP***	***X***	***BI***	***NP***	***X***	***BI***
Mean	0.47	0.00	2.78	0.06	0.00	2.85	0.01	0.00	3.34	0.08	0.00	3.19
Median	0.32	1.30	2.75	0.03	1.30	2.84	0.00	1.30	3.22	0.01	1.30	3.01
Maximum	2.77	14.79	3.51	1.05	14.79	3.86	0.18	14.79	11.01	2.77	14.79	11.01
Minimum	-6.76	-22.17	1.60	-2.37	-22.17	1.95	-0.81	-22.17	1.99	-6.76	-22.17	1.60
Std. Dev.	0.72	9.76	0.23	0.20	9.76	0.25	0.03	9.75	0.76	0.33	9.75	0.70
Observations	330	330	330	300	300	300	1560	1560	1560	2190	2190	2190

Taking into account the relation between the net profit (*NP*) and the Basel index (*BI*), the following equation is used in all panels:

[8] Table A.1 (see appendix) shows the institutions, with respective classification, used in this analysis.

(1) $$NP_t = \beta_1 NP_{t-1} + \beta_2 BI_t + \beta_3 X_{t-2} + \beta_4 IR_{t-2} + \beta_5 IBOV_{t-2} + \varepsilon_t, \quad \varepsilon_t \sim N(0,\sigma^2).$$

Table 3 shows the outcomes of the estimations. The four panels have acceptable Sargan's statistics and thus validate the instrumental variables used (regressors lagged). In regard to the tests of first-order (m1) serial correlation, non-autocorrelation problem is detected. However, tests of second-order (m2) indicate that panel 4 has this problem and thus implies that the t-statistics are not reliable.

With the exception of the case of the panel 2, the findings denote a negative relation between the current net profit and the past net profit (NP_{t-1}). In other words, the profit of the previous period is not sufficient to assure high profits in the subsequent periods. In regard to the relation between Basel index and the banking profitability, once again except for panel 2 (sign is positive and without statistical significance), a negative relation is observed. Therefore, this result is in agreement with the idea that the exposition of the banks to higher risks tends to increase the profitability.

Such as in the analysis for the relation between risk and profitability, the analysis of the relationship between the output gap (*X*) and the Basel index (*BI*) is made based on four different panel data models also taking into account the size of banking institutions using the following equation:

(2) $$X_t = \alpha_1 X_{t-1} + \alpha_2 BI_{t-1} + \alpha_3 IR_{t-2} + \alpha_4 EX_{t-3} + \upsilon_t, \quad \upsilon_t \sim N(0,\sigma^2).$$

According to the estimations in table 3, the tests of first-order and second-order serial correlation indicate that there are no autocorrelation problems in any models. Moreover, Sargan's statistics are approved for all panels.

The estimations in table 3 show that there is a negative relation between the current output gap and the output gap in the previous period. This result suggests that there is no sustainable economic growth because a decrease in the output gap is followed by an increase in the output gap. In other words, the economy has a behavior of "stop-and-go". In a general way, the coefficients on the Basel index indicate a negative relation to the output gap. Therefore, as expected, this result suggests that an increase in the exposition to the risk by banking firms can contribute to a greater output gap.

Table 3

Dynamic panel data (GMM)

	Effect on net profit of banking firms								***Effect on output gap***							
	Panel 1		**Panel 2**		**Panel 3**		**Panel 4**		**Panel 1**		**Panel 2**		**Panel 3**		**Panel 4**	
	Coef.	**Std. Error**	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**
NP_{t-1}	-0.515***	0.089	0.098***	0.022	0.224***	0.000	-0.215***	0.000								
X_{t-1}									-0.348***	0.006	-0.266***	0.002	-0.465***	0.001	-0.462***	0.000
X_{t-2}	0.008***	0.001	0.002***	0.000	0.000***	0.000	0.004***	0.000								
BI_t	-0.334**	0.155	-0.134***	0.029	-0.002***	0.000	-0.207***	0.000								
BI_{t-1}									-26.785***	2.128	-31.131***	3.275	-5.981***	0.110	-8.679***	0.053
IR_{t-2}	0.210*	0.118	0.029	0.068	-0.006***	0.000	-0.050***	0.000	-18.368***	0.195	-17.069***	1.975	-23.867***	0.101	-23.584***	0.112
$IBOV_{t-2}$	0.276***	0.039	0.070*	0.036	-0.007***	0.000	0.066***	0.000								
EX_{t-3}									8.170***	0.862	9.876***	2.022	12.963***	0.154	13.519***	0.356
N. instr.	13		13		13		13		12		12		39		39	
Obs.	275		260		1300		1825		275		250		884		1241	
Sargan	6.6821		2.7289		49.0575		71.4657		10.9806		9.8046		51.9954		72.9930	
(p-value)	0.35		0.74		0.39		0.43		0.14		0.13		0.32		0.14	
m1	-1.6777		-3.1453		-2.3867		-4.2999		-5.7928		-6.0865		-7.3173		-2.5688	
(p-value)	0.09		0.00		0.02		0.00		0.00		0.00		0.00		0.01	
m2	-1.3830		-0.9161		-1.0864		1.7622		-1.0430		-0.1073		0.0924		-0.4549	
(p-value)	0.17		0.36		0.28		0.08		0.30		0.91		0.93		0.65	

Note: Asterisks denote significance at the 1% (***), 5% (**) and 10% (*) levels, respectively. Standard errors between parentheses and t-statistics between brackets.

3.2. VAR analysis

The previous section presented evidence that, independent of the size of the banks, the Basel index and thus the risk for financial institutions is relevant for the determination of bank's net profit and output gap. Hence, one important point is to ascertain the relative importance of these variables under a dynamic perspective. In this sense, a vector autoregression analysis (VAR) based on output gap, Basel index, and net profit (average of 73 Brazilian banks used in the previous section – see table A.1 appendix) is made. It is important to note that the VAR allows analyzing the dynamic impact of random disturbances on the system of variables. In particular, the analysis through impulse-response is attractive because it permits the evaluation of the response of *BI* caused by shocks (or innovations) provoked by residual variables over time (Sims, 1980).

Before the VAR estimation, the unit-root tests (Augmented Dickey-Fuller – ADF and Kwiatkowski-Phillips-Schmidt-Shin - KPSS) were made. Both tests indicate the series are non-stationary in level. On the other hand, first difference series are stationary, and thus all series in this analysis are I(1) (see table A.2 - appendix). As a consequence, the use of first difference of series in VAR would be adequate. Furthermore, with the objective of defining the VAR order, Akaike (AIC), Schwarz (SC) and Hannan-Quinn (HQ) criteria are used. The three criteria indicate that the lag order for VARs is 3 (see table A.5 - appendix).

It is important to note that the use of first difference series can imply a loss of relation in the long run among series. Hence, it is necessary to evaluate if a linear combination among series is stationary even if individual series are nonstationary. In other words, it is essential to verify if the series are cointegrated because, in this case, it is recommendable to use a Vector Error Correction (VEC) in the estimations. With the intention of verifying the cointegration of variables of the VAR, the cointegration test proposed by Johansen (1991, LR test statistic), based on the significance of the estimated eigenvalues was performed. The inclusion of the intercept and trend was defined based on Pantula principle (see Harris, 1995). The result present in table A.3 (see appendix) denotes for the set of series – *X*, *BI*, and *NP* - that the adequate specification has intercept in the cointegrating vector. The cointegration test, indicates that the trace statistic rejects the non-cointegration hypothesis at the 5% significance level and reveals that there exists 1 cointegrating equation (see table A.4 - appendix). Therefore, the cointegration tests indicate that there is a long-term equilibrium relationship among the variables under

analysis.

In a general way, it is usual in VAR estimations to apply the "orthogonality assumption" and thus the result may depend on the ordering of variables (Lutkenpohl, 1991). Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998) developed the idea of the generalized impulse response function as a manner of eliminating the problem of the ordering of variables. The main argument is that the generalized impulse responses are invariant to any re-ordering of the variables in the VAR (or VEC). Hence, there are two potential advantages with this method (Ewing, 2003): (i) the generalized impulse response function provides more robust results than the orthogonalized method; and (ii) due to the fact that orthogonality is not imposed, the generalized impulse response function allows for meaningful interpretation of the initial impact response of each variable to shocks on any of the other variables.

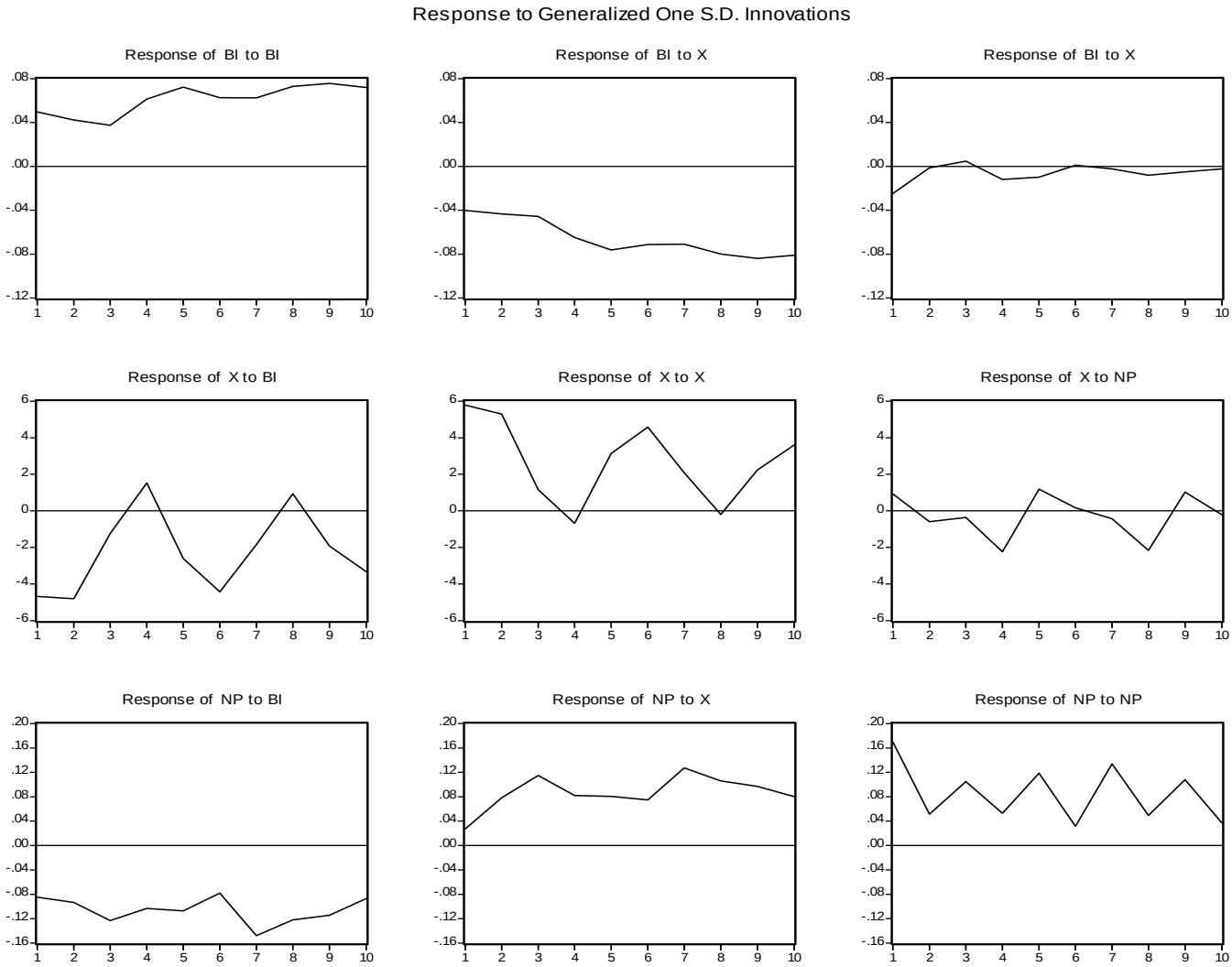
With the objective of giving robustness to the results from the VEC estimated, autocorrelation (LM), normality (Jarque-Bera), and stability (AR roots) tests were performed (see tables A.6, A.7, and figure A.1). The results indicate that there is no serial correlation, the residuals are normal, and the VEC is stable. Hence, the impulse-response analysis from this VEC is valid.

Figure 1 shows the results of the generalized impulse-response functions and are plotted out to the 10th quarters. In regard to responses of *BI*, it is observed that the effect of a shock on output gap is negligible and it is eliminated in the next period. In a different way, the innovations on *BI* and *X* transmitted to *BI* cannot be neglected. The results suggest a persistence of *BI*. In other words, when the Basel index is increased by banks voluntarily or by regulatory mandate this behavior tends to remain unchanged. An interesting implication is the effect caused by a shock on output gap. An increase in economic activity contributes to a decrease in Basel index over time. Therefore, under this environment the capital over assets measured by risks becomes lower.

Concerning the responses of output gap, it is possible to see that the effects are not durable. The effect transmitted by a shock on net profit of banks is not significant for a response by the output gap. On the other hand, the effects of an innovation on itself and on Basel index indicate a short-term effect. The outcome regarding the output gap is in consonance with the presence of the business cycle. Moreover, as observed by Allen and Saunders (2004), a positive shock on Basel index (an increase in the bank's risk aversion), although the effect is limited to the first 3 quarters, can imply a credit constraint which

promotes a fall in economic activity.

Figure 1



The responses of net profit of banks are relevant for the three cases and denote that the effects caused by the transmission of shocks are not eliminated over 10 quarters. The graph regarding the response to an innovation on the net profit reveals that there exists a persistence of the positive effect. It is also observed that an expansion in economic activity (increase in the output gap) promotes an increase in the net profit of banks which is not eliminated. A possible justification for this result is that there exists an increase in the public's demand for credit and the risk of nonpayment decreases considerably. Furthermore, a very interesting result is observed from the innovation on Basel index transmitted to the net profit of banks. The graph shows that a positive shock on Basel index

decreases the net profit of banks over time. In other words, the result indicates that banks that are less averse to risk achieve sustainable profit.

4. Conclusion

The empirical evidence suggests that banks which adopt riskier strategies reach higher profitability. Moreover, the observation of a positive relation between output gap and the bank's risk in the Brazilian economy indicates the presence of a possible trade-off between bank's risk and output. In other words, the findings are aligned with Furlong and Keeley (1989) and Keeley (1990) that have identified a negative relationship between capitalization rates on assets and risk.

In the search for higher profits the banks are subject to a greater exposition to risk. Hence, due to a lower severity in the concession of credit, the volume of credit available tends to increase in the market. Furthermore, the strategy of reducing the rate of application of capital buffer in periods of recession may contribute to smooth cycles. The idea is that there is an increase in the liquidity of the economy that is favorable to new investments and thus a stimulus to the economic growth is created.

It is a fact that, in the short term, an increase in the risk exposition of financial institutions can be considered a positive factor, however high risk expositions foster the possibility of new financial crisis. Therefore the economic growth due to a higher exposition of banking firms to risk may be considered jeopardized. In other words, there exists a trade-off between bank risk and output. Hence, banking regulation is an important instrument for reaching the balance between the economic growth and the low exposition to the risk of banking firms in markets such as the Brazilian.

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Appendix

Table A.1

Classification of banking firms

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

Table A.2

Unit root tests (ADF and KPSS)

	ADF				**KPSS**			
Series	lag	test	critical values 1%	critical values 5%	lag	Test	critical values 10%	Critical values 5%
BI	8	-2.9100	-4.4679	-3.6450	4	0.1787	0.1190	0.1460
D(BI)	5	-4.5098	-4.4163	-3.6220	0	0.0268	0.1190	0.1460
X	4	-2.7574	-4.3743	-3.6032	7	0.1540	0.1190	0.1460
D(X)	4	-4.3760	-4.3943	-3.6122	5	0.1133	0.1190	0.1460
NP	4	-3.1311	-4.3743	-3.6032	9	0.2643	0.1190	0.1460
D(NP)	2	-5.1408	-4.3561	-3.5950	6	0.0884	0.1190	0.1460

Note: Series BI and X are in logs. ADF test – the final choice of lag was made based on Schwarz criterion (SC). KPSS test – lag is the lag truncation chosen for the Bartlett kernel.

Table A.3

Number of Cointegrating Relations by Model (BI, X, NP)

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	1	1	1
Max-Eig	1	1	1	1	1

Note: Selected (0.05 level) - critical values based on MacKinnon-Haug-Michelis (1999)

Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
0	3.2278	3.2278	3.2762	3.2762	3.1321
1	2.9392	1.8371	1.8222*	1.8942	1.8512
2	3.1888	2.0656	2.0484	2.0575	1.9631
3	3.6217	2.4568	2.4568	2.3651	2.3651

Note: Akaike Information Criteria by Rank (rows) and Model (columns)
(*) Critical values based on MacKinnon-Haug-Michelis (1999)

Table A.4

Johansen's Cointegration Test (BI, X, NP)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (0.05)	Prob.**
None *	0.8502	58.1223	29.7971	0.0000
At most 1	0.1960	6.8651	15.4947	0.5934
At most 2	0.0355	0.9750	3.8415	0.3234

Note: (*) denotes rejection of H_0 at the 5% significance level. (**) MacKinnon-Haug-Michelis (1999) p-values.

Table A.5

VAR lag order selection criteria

Lag	AIC	SC	HQ
0	6.3385	6.4837	6.3803
1	5.5554	6.1361	5.7226
2	2.9295	3.9456	3.2221
3	1.9731*	3.4247*	2.3911*
4	2.2375	4.1246	2.7809

Note: * indicates lag order selected by the criterion.

Table A.6

VEC Residual Serial Correlation LM Tests

Lag	LM-Stat	Prob
1	4.3927	0.8837
2	4.4487	0.8795
3	4.1468	0.9015
4	21.626	0.0101
5	9.4771	0.3945

6	3.5325	0.9394

Note: Probs from chi-square with 9df.

Table A.7

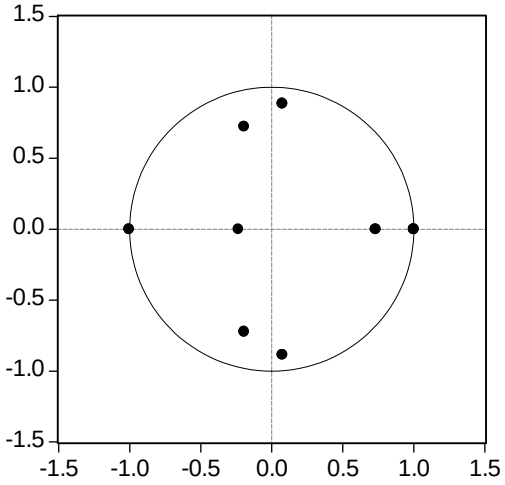
VAR Residual Normality Tests

Component	Jarque-Bera	df	Prob
X	6.0211	2	0.0493
BI	3.4403	2	0.1790
NP	1.1785	2	0.5547
Joint	22.6894	25	0.5957

Note: Orthogonalization: Residual Covariance (Urzua, 1997).

Figure A.1

Inverse Roots of AR Characteristic Polynomial



Note: VEC specification imposes 2 unit roots.

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