Economic Activity and financial institutional risk: an empirical analysis for the banking industry*

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Abstract
The main objective of this article is to evaluate the effect of the increase in capitalization on risk appetite and to show empirical evidence for the output-financial institutional risk trade-off 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 denote 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.

Key words: banking firms, risk, profit, output, Brazilian economy.

JEL classification: G15, G18, G14.

Resumo
O principal objetivo deste artigo é avaliar o efeito do aumento da capitalização no apetite pelo risco e mostrar evidências empíricas para o trade off que existe entre atividade econômica e risco das instituições financeiras na economia brasileira. Para tanto, é apresentada uma análise baseada em dados de painel dinâmico, considerando 73 bancos, e uma análise de vetores auto-regressivos, no período 2001-2008. Os resultados indicam que os aqueles bancos que adotam estratégias mais arriscadas alcançaram maior rentabilidade. Além disso, os resultados sugerem que a regulação bancária é um instrumento importante para alcançar o equilíbrio entre o crescimento econômico e a baixa exposição ao risco das empresas de serviços bancários em mercados como o brasileiro.

Palavras - chave: firmas bancárias, risco, lucro, produto, economia brasileira.

Área 3 - Macroeconomia, Economia Monetária e Finanças

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

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).

One of the main objectives of the New Basel Capital Accord (New Accord) is an attempt to reduce the incentive for financial institutions to assume a high risk position. This accord establishes that the banks may reveal which part of their capital will be available for covering all sorts of risks. In brief, the New Accord 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 - the New Accord establishes recommendations and requirements of disclosure in several areas including how each institution calculates and discloses its capital adequateness and methods of evaluation of risks.

The necessity of transparency in the information is an important factor for how the market discipline works. An effective transparency in the information to the private sector is efficacy in monitoring financial institutions.[1] It is important to note that the regulators, besides publishing credit ratings, have the role of leading the banks to be transparent in regard to their risk exposition. Through auditors, official regulators have the competence of discovering confidential information regarding possible problems that may be incurred by financial institutions (Ceuster and Masschelein, 2003). Therefore the New Accord, based on the incentive of the disclosure of information, hopes to give conditions to the market participants to create mechanisms for mitigating the risk.

Even before the subprime crisis in the USA the idea that the minimum capital requirements could imply an extension 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.[2] Through the definition of the capital regulation associated with the degree of risk assumed by financial institutions, the rules proposed in the New Accord imply an extension or an anticipation of the business cycles. In other words, the business cycles are extended as a function of minimum capital required to mitigate the losses due to the risks assumed by the financial institutions. In recession periods the banks tend to constrain the credit postponing investment decisions and thus a possible retaking of a new economic growth phase (Allen and Saunders, 2004).

The New Accord defines that the capital used to support the risks of loss must remain invested in liquidity assets. It cannot be used in an operational mode and, as a consequence, it will reduce the amount of free reserves that could be used in new credit operations. Therefore, the capital requirement can imply a constraint on banking leverage with direct effects on profitability of sector (Kashyap and Stein, 2004). The

[1] See, for example, Flannery (1998); Deyoung *et. al.* (2001); and Jagtiani *et. al.* (2002).
[2] See, Allen and Saunders (2004); Gordy and Howells (2004); and Kashyap and Stein (2004).

strategy of changing prudential regulation of liquidity (such as in the Capital Accord of 1988) for another which defines the capital based on risk estimations can block banking resources available for operational activities.

Having gone by the acute stage 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 that takes into account the expected loss over the economic cycle, is gaining strength. Thus, provisions for losses should be calculated based on the likelihood of default associated to the economy over the ongoing cycle and not on the probability measured at each moment.

The crisis triggered by the Lehman Brothers breakdown showed that the practice of using past data to project future losses proved to be an ineffective method, since the lower market volatility in the years preceding the crisis has provided data that underestimated risks of loss involved in the market. The limitation of models as tools to represent reality became clear.

One of the proposals under discussion by central banks to limit the pro-cyclicality of the current model of prudential regulation is to establish an additional requirement of regulatory capital during the growing phase of business cycles, above the minimum requirement of 8% set in the New Basel Accord, forming a "cushion" of capital. In a crisis, the additional requirement would be reduced or even eliminated, mitigating the effects of the crisis on the rest of the economy.

It is a fact that the relationship between the capitalization and the willingness to take more 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 the level of 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. In other words, the literature concerning this subject did still not present a solution for this tricky case and the subject is particularly relevant for emerging economies because there is a scarcity of studies. Hence, the main objective of this article is to evaluate the effect of the increase in capitalization on risk appetite and to show empirical evidence for the output-financial institutional risk trade-off taking into account 73 Brazilian banks from 2001 to 2008.

The justification for the analysis concerning the Brazilian case is that besides being one of the most important emerging economies, since the beginning of 2000, this economy has been marked by an improvement in macroeconomic stability which has contributed to the development of financial markets.[3] As a consequence the private agents have tended to migrate to riskier investments (stock market, subordinated debts, etc.) with more profitability (see, de Mendonça and Loures, 2009) and thus this environment has created a "potential laboratory experiment".

This article is organized as follows. The second section presents the empirical

[3] Brazil, in June of 1999, adopted an explicit inflation targeting regime which implied an improvement in the transparency and in the conduction of the monetary policy contributing to the macroeconomic stabilization. For an analysis concerning the adoption of inflation targeting and its consequences in Brazil, see de Mendonça (2007).

analysis. The first part makes an empirical analysis from dynamic panel data (Generalize Method of Moments) taking into account 73 banks (quarterly data spans from first quarter 2001 to second quarter 2008). The second part, based on a vector autoregression analysis, shows empirical evidence for the relation between profitability and banking risk as well as for output gap and banking risk in the Brazilian economy. Finally, section 3 concludes the article.

2. Empirical evidence

Failures attributed to models of risk management were pointed out recursively, by different market actors, as major causes that originated the crisis of the *subprimes*. The current model of financial regulation possesses procyclical characteristics where optimistic expectations, created from the feeling experienced amid a cycle of economic prosperity, diminish investors' aversiveness to risk making them more liable to take risks and so transferring to the economy a condition of vulnerability (Minsky, 1982).

The financial intermediations are intensified in periods of economic expansion and thus making this cycle longer. Notwithstanding, they also create an environment conducive to bubble formation in which, after the close of the expansionary phase, a downturn starts which can culminate with the collapse of the price of the assets and the credit rationing.

The use of high interest rates as a tool to prevent the formation of new bubbles can at the same time harm all other prices of assets. According to the Tinbergen's rule (Tinbergen, 1952), in order to achieve a specific objective the monetary authorities need to use an effective instrument, however, to reach more than one goal, they have to use tools that should be independent and with the same number of tasks to be accomplished (Mundell, 1968). Therefore, if by hypothesis the interest rate is used as a tool of monetary policy to achieve price stability, the same tool should not be used to achieve financial stability.

Taking into account Tinbergen's rule and the position of the President of the Federal Reserve (Ben Bernanke[4]), the use of regulatory and supervisory methods is the best way to prevent financial bubbles. Consequently, the creation of a cash cushion is a strategy capable of limiting the leverage of the banks in times of economic expansion. 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 is higher in periods of expansion or lower during the contraction smooth cycles working as an anti-cyclical tool. The minimum capital of reference shall continue to be used for calculating the maximum level of leverage of the banks, being 8% of assets weighted by the risk (proposed by the Basel Committee). The capital cushion shall not be a new minimum capital, but an additional capital to be achieved in times of economic expansion that will be used in times of recession.

As the cash cushion is being implemented it will be directly reflected in the calculation of Basel index (BI), which is the ratio of the capital of financial institutions and the minimum capital of reference (value of assets weighted by the corresponding risks), a key indicator of resistance to shocks. Focusing on the top 50 banks in Brazil (in terms of total assets), it is observed that the majority showed a steady decline in the capital ratio due to the credit crisis that followed the housing crisis which started with the *subprime* securities in the U.S. Many have got close to the limit imposed by the

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

Central Bank of Brazil (11%) (see table 1), which implies being called on by regulatory authority to rebuild their assets before it becomes a problem.

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.

The hypothesis concerned in this study is that institutions that are more capital-intensive, with *BI* higher than the minimum 11%, represent institutions prone to risk and allowing greater profitability. In these cases, an increase in minimum capital requirements for creating a cushion of liquidity will have a damping function on the growth cycle in a clear anti-cyclical policy. Hence, before the loss of the effectiveness of the interest rate as a tool to restore the economy in recessions, the fact of reducing or eliminating the rate of additional regulatory capital used to build a liquidity cushion could eliminate the downturn. Although the simple reduction of taxation will not lead to an immediate increase in the level of supply of credit, since there are other exogenous factors competing with this variable, the improvement in the condition of solvency of financial institutions will improve its operational capacity in the granting of new credits.

2.1. Panel data analysis

Aimed to make an empirical analysis for the Brazilian case in regard to the risk and profitability of the financial institutions as well as in regard to the output and bank risks, data from the first quarter of 2001 to the second quarter of 2008 were gathered. Furthermore, this study takes into consideration information regarding 73 Brazilian banking firms (see appendix – table A.1) totalizing 2190 observations for panel data.

Hence, the following variables in logs were used in this analysis:[5]
(i) net profit (*NP*) – 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 in logs (constant prices of 2001);[7]
(iii) Basel index (*BI*) - capital over assets measured by risks – 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 2682 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 variables, the following instrumental variables (in logs) were considered in the analysis: basic interest rate (*IR*); index of stock market activity (IBOVESPA index - *IBOV*); exchange rate (*EX* = R$/US$).

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

It is important to highlight that the beginning of the period (first quarter of 2001) is due to the Central Bank of Brazil's resolution 3490/2007 which determined the methodology concerning the Basel index. Aimed to analyze both relations (Basel index and output; and Basel index and net profit), four models regarding the size of banking institutions are estimated according to the following pattern (see descriptive statistics in table 2):
(i) panel 1 – total assets less intermediation greater than 50 billions of Reais – total of 11 banks;
(ii) panel 2 - total assets less intermediation with values between 10 billions of Reais and 50 billions of Reais - total of 10 banks;
(iii) panel 3 – total assets less intermediation with values lower than 10 billions of Reais – total of 52 banks; and
(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.

[5] All data is available at Central Bank of Brazil Web Site (www.bcb.gov.br).
[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.
[8] Table A.1 (see appendix) shows the institutions, with respective classification, used in this analysis.

Table 2

Descriptive statistics

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

It is important to stress that even with the premises of GMM, when there is no correlation on the first difference of endogenous regressors, testing the presence of unit root in the series is needed. Based on Bond, Nauges, and Windmeijer (2005) several tests were created for testing unit roots in panel data. This study takes into consideration the following tests: Levin-Lin- Chu (LLC), Im-Pesaran-Shin (IPS), Fisher-ADF (ADF), and Fisher-PP (PP). The LLC test assumes the presence of only one unit root common to all cross-sections. For the other tests the existence of different unit roots in different cross-sections is assumed. The null hypothesis is the non-stationarity of series in all tests. Furthermore, the tests were applied for series in level, and the selection of lags was made applying Schwarz criterion. Table A.2 (see appendix) presents the results of tests for unit roots. As a consequence, the series *NP*, *BI*, and *X* were used in level, while the series *IR* and *IBOV* were considered in the first difference.

Taking into account the relation between the net profit (*NP*) and the Basel index (*BI*), four models regarding the size of the banking firms were estimated. The following equation is used in all panels:

(1) $$NP_t = \beta_1 NP_{t-1} + \beta_2 BI_t + \beta_3 X_{t-1} + \beta_4 \Delta IR_{t-3} + \beta_5 \Delta IBOV_{t-2} + \varepsilon_t, \quad \varepsilon_t \sim N(0,\sigma^2).$$

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

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.	**t-Stat.**	**Coef.**	**t-Stat.**	**Coef.**	**t-Stat.**	**Coef.**	**t-Stat.**	**Coef.**	**t-Stat.**	**Coef.**	**t-Stat.**	**Coef.**	**t-Stat.**	**Coef.**	**t-Stat.**
NP_{t-1}	-0.23	-2.00**	0.20	3.07***	-0.27	-82.50***	-0.19	-20.30***								
X_{t-1}	-0.01	-5.41***	0.00	-0.93	0.00	23.66***	0.00	9.80***	-0.36	-31.11***	-0.31	-47.33***	-0.38	-194.26***	-0.38	-205.37***
BI_t	-0.78	-3.12***	0.01	0.31	-0.03	-29.19***	-0.06	-6.62***								
BI_{t-1}									-60.41	-12.26***	-17.56	-4.46***	-10.95	-85.03***	-15.10	-64.74***
ΔIR_{t-2}									-33.61	-16.76***	-32.03	-33.58***	-21.51	-89.03***	-22.35	-93.00***
ΔIR_{t-3}	-0.05	-0.63	-0.09	-1.83*	0.02	26.84***	0.00	0.92								
$\Delta IBOV_{t-2}$	-0.25	-1.40	-0.01	-0.40	0.00	12.45***	0.03	8.77***								
ΔEX_{t-3}									32.19	10.97***	10.87	2.97***	26.50	561.73***	25.28	76.60***
N. instrum.	19		19		18		18		40		40		50		50	
Obs.	264		240		1300		1825		176		160		884		1241	
Sargan test	9.23		3.97		49.73		52.51		10.94		9.95		52.00		72.99	
(p-value)	0.16		0.55		0.37		0.74		0.14		0.13		0.32		0.14	
m1	-5.26		-6.98		-7.22		-5.10		-2.75		-4.03		-6.48		-5.73	
(p-value)	0.00		0.00		0.00		0.00		0.01		0.00		0.00		0.00	
m2	1.50		-1.15		-1.27		2.19		-0.75		-0.49		0.33		-0.23	
(p-value)	0.13		0.25		0.20		0.03		0.46		0.62		0.74		0.81	

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

With the exception of the case of the medium banks (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 the case of 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 relation between the output gap (X) and the Basel index (BI) is made based on four different panels also taking into account the size of banking institutions using the following equation:

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

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 not a 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. This result suggests that an increase in the exposition to the risk by banking firms can contribute to a greater output gap.

2.2. VAR analysis

The previous section show evidence that, independently of the size of the banks, the Basel index and thus the risk for financial institutions is relevant for the determination of net profit of banks and the 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.3 - 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.6 - 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 individually 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.4 (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.5 - 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.7, A.8, 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.

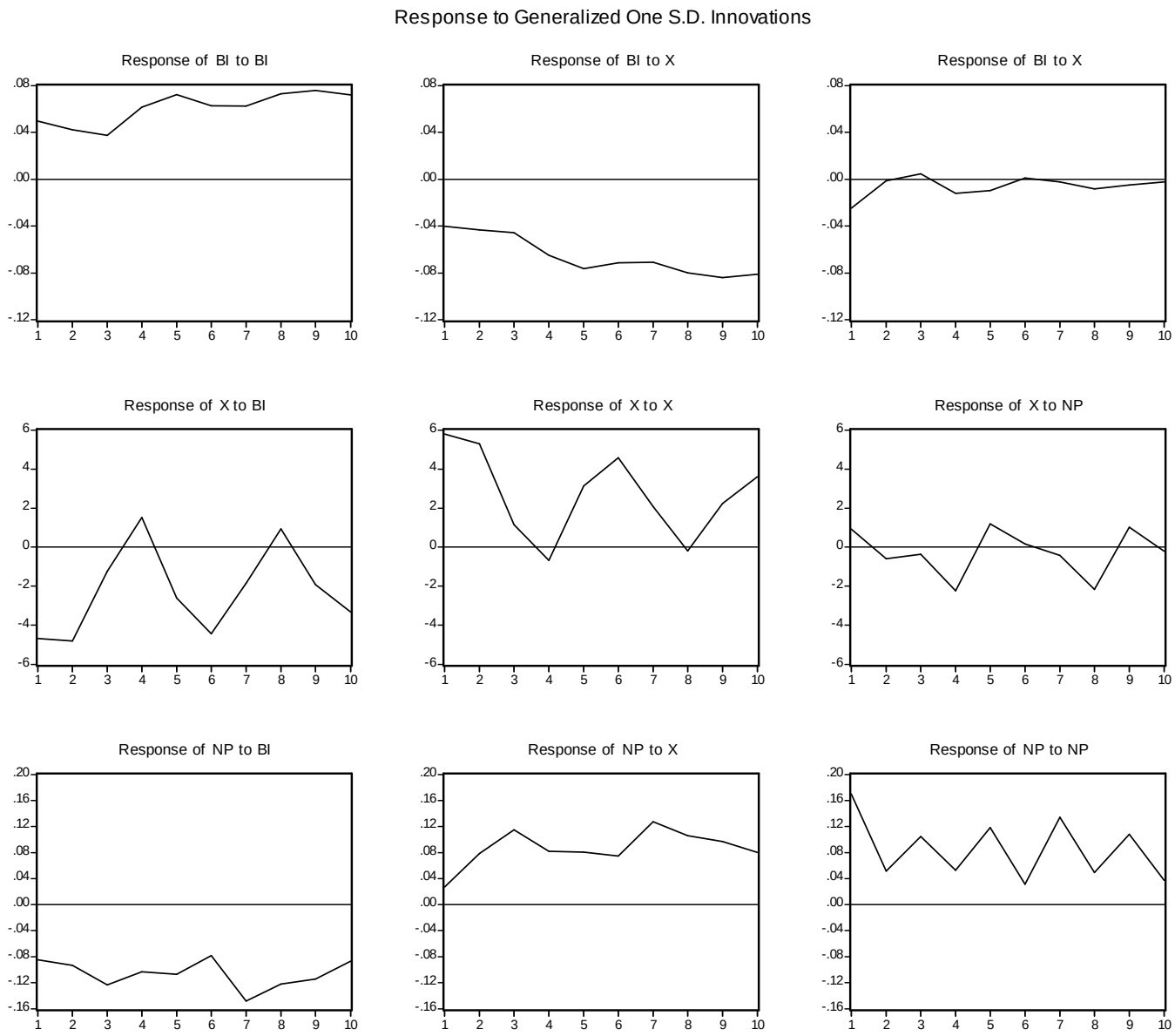
Figure 1 shows the results of the generalized impulse-response functions and are plotted out to the 10th quarters. In regard to responses of *BI*, it is observed that the effect of a shock on output gap is negligible and it is eliminated in the next period. In a different way, the innovations on *BI* 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 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.

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.

Figure 1
Impulse-response



3. 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 banking risk in the Brazilian economy indicates the presence of a possible trade-off between bank risk and output. In other words, the findings are aligned with works that identified a positive relationship between levels of capitalization and risk, which could suggest the ineffectiveness of this measure as a strategy to make the financial

system better prepared to face new crises.

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 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

Panel unit roots tests

			Constant				Constant and trend				Without constant or trend		
			LLC	**IPS**	**ADF**	**PP**	**LLC**	**IPS**	**ADF**	**PP**	**LLC**	**ADF**	**PP**
Painel 1	*X*	Estat.	2.1741	-5.1005	62.2744	315.2690	4.8566	-2.7399	32.8760	276.6020	-10.6069	118.5480	469.0540
		Prob.	0.9851	0.0000	0.0000	0.0000	1.0000	0.0031	0.0636	0.0000	0.0000	0.0000	0.0000
	NP	Estat.	3.1297	-1.3223	61.0121	185.2600	5.4209	-5.5162	75.3689	521.9630	2.1958	7.1684	95.7602
		Prob.	0.9991	0.0930	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.9859	0.9988	0.0000
	BI	Estat.	-4.9713	-4.8155	66.7853	65.4828	-1.0402	-1.2939	48.2990	51.5849	-0.2544	11.2137	11.2847
		Prob.	0.0000	0.0000	0.0000	0.0000	0.1491	0.0978	0.0010	0.0004	0.3996	0.9716	0.9704
	IR	Estat.	-2.2945	-0.9165	20.9133	2.7898	-3.3724	-3.8555	48.7356	21.6684	-2.1641	18.8186	18.0831
		Prob.	0.0109	0.1797	0.5261	1.0000	0.0004	0.0001	0.0009	0.4798	0.0152	0.6565	0.7010
	D(*IR*)	Estat.	-6.6968	-5.1720	63.3453	46.6178	-5.7905	-2.6644	35.9339	17.6340	-9.5422	117.0320	103.7330
		Prob.	0.0000	0.0000	0.0000	0.0016	0.0000	0.0039	0.0309	0.7275	0.0000	0.0000	0.0000
	IBOV	Estat.	2.8147	6.0743	0.8819	0.5976	-3.5821	-4.0373	49.1761	55.7176	6.1477	0.3656	0.2080
		Prob.	0.9976	1.0000	1.0000	1.0000	0.0002	0.0000	0.0008	0.0001	1.0000	1.0000	1.0000
	D(*IBOV*)	Estat.	-16.6605	-14.7812	202.6270	202.7240	-15.2370	-13.6655	168.4870	171.3880	-16.0906	241.6630	242.1820
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	EX	Estat.	6.2807	5.3523	0.8530	3.3696	-7.4440	-2.6003	34.1391	125.3300	-1.8737	17.0981	16.9210
		Prob.	1.0000	1.0000	1.0000	1.0000	0.0000	0.0047	0.0475	0.0000	0.0305	0.7579	0.7677
	D(EX)	Estat.	-6.8698	-6.4438	80.1962	91.4890	-8.5956	-8.8393	105.6190	129.6220	-11.8847	159.5560	154.2690
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Painel 2	*X*	Estat.	2.0729	-4.8632	56.6131	286.6080	4.6306	-2.6124	29.8873	251.4570	-10.1133	107.7710	426.4130
		Prob.	0.9809	0.0000	0.0000	0.0000	1.0000	0.0045	0.0717	0.0000	0.0000	0.0000	0.0000
	NP	Estat.	-1.3898	-1.6554	61.5140	121.6280	0.5699	-3.0286	71.5796	241.2770	-10.8914	308.0640	86.1174
		Prob.	0.0823	0.0489	0.0000	0.0000	0.7156	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000
	BI	Estat.	-2.0892	-2.9490	42.2414	58.9064	-4.9172	-5.1924	60.4613	57.7533	-1.0014	14.9859	30.7370
		Prob.	0.0183	0.0016	0.0026	0.0000	0.0000	0.0000	0.0000	0.0000	0.1583	0.7772	0.0588
	IR	Estat.	-2.1877	-0.8739	19.0121	2.5362	-3.2155	-3.6760	44.3051	19.6985	-2.0634	17.1078	16.4392
		Prob.	0.0143	0.1911	0.5210	1.0000	0.0007	0.0001	0.0014	0.4769	0.0195	0.6460	0.6890
	D(*IR*)	Estat.	-6.3852	-4.9313	57.5866	42.3798	-5.5211	-2.5404	32.6672	16.0309	-9.0981	106.3930	94.3026
		Prob.	0.0000	0.0000	0.0000	0.0025	0.0000	0.0055	0.0367	0.7147	0.0000	0.0000	0.0000

	IBOV	Estat.	2.6837	5.7916	0.8017	0.5432	-3.4154	-3.8494	44.7056	50.6523	5.8616	0.3324	0.1891
		Prob.	0.9964	1.0000	1.0000	1.0000	0.0003	0.0001	0.0012	0.0002	1.0000	1.0000	1.0000
	D(*IBOV*)	Estat.	-15.8851	-14.0933	184.2070	184.2940	-14.5279	-13.0295	153.1700	155.8080	-15.3418	219.6940	220.1650
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	EX	Estat.	5.9884	5.1032	0.7754	3.0632	-7.0976	-2.4793	31.0356	113.9360	-1.7865	15.5437	15.3828
		Prob.	1.0000	1.0000	1.0000	1.0000	0.0000	0.0066	0.0547	0.0000	0.0370	0.7445	0.7541
	D(EX)	Estat.	-6.5501	-6.1439	72.9057	83.1718	-8.1956	-8.4279	96.0177	117.8380	-11.3316	145.0510	140.2440
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Painel 3	*X*	Estat.	4.7269	-11.0897	294.3880	1490.3600	10.5593	-5.9572	155.4140	1307.5700	-23.0618	560.4100	2217.3500
		Prob.	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0008	0.0000	0.0000	0.0000	0.0000
	NP	Estat.	-4.2988	-6.3868	299.4840	627.5580	-4.4547	-6.6776	268.5990	1090.0600	-2.5820	296.6330	470.0570
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0049	0.0000	0.0000
	BI	Estat.	-6.1230	-7.2134	243.1510	219.6760	-6.4646	-7.1043	233.6590	230.7260	-2.2533	92.0600	93.9382
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0121	0.7925	0.7501
	IR	Estat.	-4.9887	-1.9928	98.8628	13.1883	-7.3324	-8.3826	230.3870	102.4320	-4.7053	88.9608	85.4838
		Prob.	0.0000	0.0231	0.6239	1.0000	0.0000	0.0000	0.0000	0.5251	0.0000	0.8534	0.9069
	D(*IR*)	Estat.	-14.5605	-11.2451	299.4500	220.3750	-12.5900	-5.7931	169.8690	83.3607	-20.7468	553.2430	490.3740
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9321	0.0000	0.0000	0.0000
	IBOV	Estat.	6.1197	13.2069	4.1688	2.8248	-7.7884	-8.7780	232.4690	263.3920	13.3665	1.7283	0.9832
		Prob.	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
	D(*IBOV*)	Estat.	-36.2237	-32.1377	957.8750	958.3300	-33.1288	-29.7119	796.4820	810.2000	-34.9846	1142.4100	1144.8600
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	EX	Estat.	13.6557	11.6371	4.0323	15.9288	-16.1850	-5.6536	161.3850	592.4680	-4.0739	80.8275	79.9904
		Prob.	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.9552	0.9613
	D(EX)	Estat.	-14.9364	-14.0102	379.1090	432.4930	-18.6888	-19.2186	499.2920	612.7580	-25.8400	754.2640	729.2700
		Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Painel 4	*X*	Estat.	5.5768	-13.1608	414.0190	2098.7500	12.5279	-7.0739	218.5790	1874.9400	-27.3229	787.0100	3124.9700
		Prob.	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
	NP	Estat.	-2.6844	-6.4938	422.0100	934.4470	-1.1838	-8.9376	415.5480	1853.2900	-6.1228	611.8650	651.9350
		Prob.	0.0036	0.0000	0.0000	0.0000	0.1182	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	BI	Estat.	-7.8641	-9.0193	351.4010	343.2820	-7.7110	-8.4484	343.4320	340.8760	-2.3195	118.1930	136.4430

	Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0102	0.9558	0.7029
IR	Estat.	-5.7351	-2.2154	137.2150	19.7740	-8.5222	-9.7327	319.6470	145.6570	-5.5940	125.3690	119.4800
	Prob.	0.0000	0.0134	0.6864	1.0000	0.0000	0.0000	0.0000	0.4924	0.0000	0.8906	0.9471
D(*IR*)	Estat.	-17.4582	-13.6339	431.8200	321.9720	-14.9177	-7.0733	244.1220	129.8210	-24.8362	790.1720	702.8270
	Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8276	0.0000	0.0000	0.0000
IBOV	Estat.	7.2509	15.6480	5.8523	3.9656	-9.2280	-10.4006	326.3510	369.7620	15.8371	2.4263	1.3803
	Prob.	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
D(*IBOV*)	Estat.	-42.9193	-38.0780	1344.7100	1345.3500	-39.2523	-35.2038	1118.1400	1137.4000	-41.4512	1603.7600	1607.2100
	Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EX	Estat.	16.1799	13.7881	5.6607	22.3616	-19.1767	-6.6986	226.5600	831.7330	-4.8270	113.4690	112.2940
	Prob.	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9787	0.9825
D(*EX*)	Estat.	-17.6973	-16.5998	532.2110	607.1540	-22.1433	-22.7710	700.9290	860.2180	-30.6162	1058.8700	1023.7800
	Prob.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

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.4

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.5

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.6

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.7

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.8

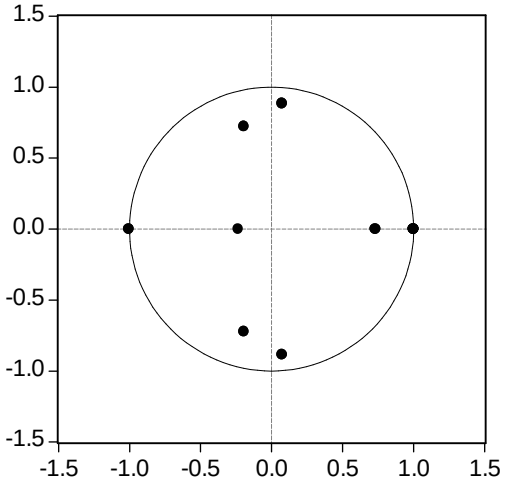
VAR Residual Normality Tests

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.