DETERMINING FACTORS TO MAINTAIN CAPITAL BUFFERS IN BRAZILIAN BANKING INSTITUTIONS

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ABSTRACT

The aim of this research study is to identify the determining factors of how capital buffers were held by Brazilian financial institutions during the period between 2001 and 2011, and used the Generalized Method of Moments - GMM method for the purpose of estimating the parameters involved, since the sampling forms a dynamic panel data. Capital buffer is given by means of a trade-off between the cost to maintain capital and costs of adjustment and insolvency. The research survey concluded that there is a significant capital buffer adjustment cost in Brazil. With regards to insolvency costs, a positive relationship was found between the risk profile and capital buffer. However, as regards costs to maintain capital, the variable used was not representative.

Keywords: *Banking Institutions; Banking Risk; Capital buffer; Dynamic Panel Data*

1 INTRODUCTION

The banking institutions (banks) play an essential role in the present economy, both from the point of view of companies, who need resources to supplement a momentary cash flow deficit or to make new investments, as well as from the point of view of clients and investors, who need to invest their surplus resources.

Acting as a financial intermediary between investors and brokers means that banks are left open to a series of risk, and because of these risks, the banking regulatory authorities demand that banks retain a minimum capital to withstand the inherent risks of their business, and thereby maintain a secure operating environment to support the financial system. Rime (2001) states that regulating banking capital is necessary because of the possibility that banks keep less capital than is needed to cover their risks, and this will avoid a future problem with a bank reflecting on the market.

Although regulators demand that banks maintain a regulatory minimum capital sum, several research studies have noted that the banks keep a higher amount of capital than the official sum required, and that the difference between the capital maintained by the bank and the minimum regulatory requirements is called a capital buffer (Jokipii & Milne, 2008; Stolz & Wedow, 2011).

Rime (2001) argues that if the banks allow their capital to fall below the minimum sum required, they can be penalized by the regulatory body or, even have their operations closed down. Thus, banks need to maintain a capital buffer since it is impossible to make instantaneous adjustments to their capital structure, as this is seen as a capital adjustment cost.

Estrella (2004) and Ayuso (2004) also describe other factors that can influence banks in relation to maintaining capital buffer, which include capital maintenance expenditure and insolvency costs. These costs have a direct influence on the capital structure that should be maintained by the banks, since the definition of the capital buffer amount to be maintained by the banks will be given by the trade-off between these three types of costs: adjustment, capital maintenance and insolvency costs.

Capital maintenance expenditure affects the decision about how much capital will be maintained by the bank, since the capital that the bank maintains involves a certain opportunity cost that will be required by the owner of the bank. Thus, the higher the cost to the bank to maintain this capital, the lower the capital buffer it maintains will be.

On the other hand, there is the cost of insolvency, which can be related to the cost that an extrapolation of the minimum capital index can have with the regulator or the cost of not receiving the investments made by the banks with their resource borrowers.

In addition to these main factors, there are several others described in literature that can affect the decision of the banks to maintain capital above the minimum regulatory amount required, some of which include the size of the bank, the country's economic cycle, the demand for credit, merger and acquisition operations, bank regulations, among others. Thus, the banks, when they plan their capital structuring policies, should seek to obtain the maximum return on their existing capital, considering a trade-off between the three principal types of cost previously mentioned, as well as other factors that can affect their capital structure.

2 BANK REGULATIONS AND REGULATORY CAPITAL

In 1988, the *Bank of International Settlements* (BIS) met to create an accord (Basel I) to discipline the minimum amount of capital that the banks should hold, with the view to maintaining the stability of the international financial system. Later, during the period from 2004 to 2006 (Basel II), the Committee of Basel issued new statements detailing how the banks should measure their risks (Pillar I) and how they should manage their level of capital in view of the risks to which they are exposed (Pillar II).

In order to check the solvency rating of the banks, the regulatory bodies use the Basel Index, which is an indicator that checks if the capital that the bank holds (Reference Equity) is sufficient to withstand the inherent risks of its operations, which are evidence by the way the required reference equity is shaped. This verification is related to the context of Pillar I of Basel II, which investigates the minimum requirements of an institution's capital.

For regulatory reasons, the capital held by banks is divided into two tiers. Tier I capital ratio is where the base capital of a bank is found. According to Glantz (2007), the Tier I capital ratio is the one which is most valuable to the bank. The principle components that can be classified at this level are ordinary shares, perpetual preferred stock, classified as non-cumulative and accumulated profit. Others that should also be discarded are the revaluation reserves, contingency reserves and special profit reserves relative to obligatory dividends that are not distributed; preferential stock that is issued with a buy-back clause and preferred assets with cumulative dividends; tax credits; deferred fixed assets, less premiums paid when investments are acquired; as well as the balance of unrealized gains and losses due to adjustments to the market value of assets and securities classified under disposable assets held for sale and of derivative financial instruments used to hedge cash flow.

With regards to Tier II capital, some equity accounts that do not form part of Tier I, for example, the revaluation reserve and contingency funds. Also allowed on Tier II, are instruments of debt that are not part of the equity, such as hybrid debt capital instruments and subordinated debts, preferred issued with a buy back clause and cumulative dividend preferred stock that is issued by financial institutions and other institutions authorized to function in the country by the Central Bank of Brazil – Bacen; and the balance of unrealized profits and losses resulting from adjustments to the market value of assets and securities classified as disposable assets for sale and derivative financial instruments used to hedge cash flow.

2.1 Capital buffer

When the banks maintain a capital structure where the regulatory capital held is greater than the minimum required by the regulatory body, this excess capital is known as capital buffer (Jokipii & Milne, 2008; Stolz & Wedow, 2011).

According to Peura and Keppo (2006), the capital structure chosen by the banks is defined, in essence, by their decision to manage risk, since banks do not use capital as a form of financing, but rather as a buffer against their risk-exposed assets, that need to be managed to satisfy the minimum capital required in relation to possible future adversities to which the banks may be exposed. According to these authors, it is implicit that any violation of this minimum capital sum will incur costs for the bank, or the need to restrict its asset portfolio or new capitalization

Shrives and Dahl (1992) relate some of the factors that affect the capital maintained by the banks as insolvency costs, created by exposing their assets to risk, and an aversion to risk management, caused by pressure on the administrators from stockholders to maintain lower leverage. The authors also cite other factors that affect the

capital maintained by banks, which include the need to observe the minimum level of capital required by the regulatory body as well as regulatory costs.

In addition to the risk and costs that banks can incur when they are unable to maintain the minimum capital required, they also have to maintain a capital structure compatible to market expectations and which will enable them to explore future investment opportunities, with enough capital at hand to make new loans and investments according to market demands (Berger, Herring, & Szegö, 1995; Jokipii & Milne, 2008). Estrella (2004) further highlights the fact that the capital structure of banks should also seek to optimize their capital, in view of their probable costs and anticipated returns.

Estrella (2004) and Ayuso, Perez and Saurina (2004) underline that the decision model used by banks in relation to their capital results from a trade-off involving three types of cost, which are the cost to maintain capital, insolvency costs and the adjustment costs. Since the banks are required to maintain the minimum capital sum required by the regulatory body, their decisions can only be made in relation to the amount of the capital buffer to be maintained.

According to Ayuso *et al* (2004), maintaining capital incurs a direct cost to the banks since, due to the nature of information asymmetry, this source of resources is more expensive that other financing options.

With regards to information asymmetry and the order of preference of companies for financing, described by Myers (1984) as the *pecking order* theory, companies choose income retention as their first financing option, since these resources are generated within the banks and therefore involve no transaction costs.

In view of these facts, income retention is one of the methods most frequently used by the banks to increase their capital buffer, which has a positive impact on income deriving from the capital buffer. However, in view of the fact that high returns mean that the bank has the capacity to continue to generate high income, this should have a negative impact on the capital buffer, because of the possibility that these returns will eventually become incorporated into the bank's capital, which will bear the growth of its risk-weighted assets (Stolz & Wedow, 2011).

In relation to insolvency costs, maintaining a capital buffer reduces the probability of a bank becoming insolvent, the loss of their reputation and costs incurred in the insolvency process (Ayuso *et al*, 2004). Within the definition of insolvency costs, additional costs resulting from a failed system are also taken into account, involving probable losses on the investments made by the banks. According to Bikker and Metzemakers (2004), this cost depends on each bank's specific risk profile.

The level of risk to which each bank may be exposed can be measured in several ways. Basically, we can view a risk measurement as a form of *ex-ante*, by anticipating its effects, or *ex-ante*, by observing its after effects.

Bikker and Metzemakers (2004) and Boucinha and Ribeiro (2007) say that a when an *ex-ante* risk measurement is used, a positive relationship between the bank's capital and the risk to its investment portfolio is to be expected, since banks at greater risk should maintain a large amount of capital. According to Ayuso *et al* (2004) and Boucinha and Ribeiro (2007), an *ex post* risk measurement presents a negative relationship between the bank's capital and the risk to its investment portfolio. This negative relationship can be explained by the capital consumption that occurs when the risk materializes, through losses or by means of the provision that affect the bank's capital. However, according to Jokipii and Milne (2008), an ex-post measurement should also show a positive relationship between the capital of a bank and the risk to their investment portfolio, since the *ex post* risk also shows the risk profile of a bank.

With regards to adjustment costs, Ayuso *et al* (2004) argue that changes to the level of the capital of banks incur costs, since this is the main adjustment costs related to the information asymmetry problem. Since the bank retains a higher level of information than the market, a greater level of remuneration is requirement to ensure that the bank can recompose its capital layout. Stolz and Wedow (2011) also argue that the banks cannot make instant adjustments to or risk their capital (investment portfolio). Since recomposing capital, or selling or changing investments requires a certain amount of time to be carried out, the banks need to maintain their capital buffer. Thus, there should be a positive relationship between the adjustment costs and the bank's capital.

Jokippi and Milne (2008) argue that, among the many factors that affect capital buffer, the one with the greatest impact relates to the size of the bank. Stolz and Wedow (2011) discuss some of the different reasons why the size of a bank can affect capital buffer, such as the fact that most banks can offer better investment and diversification

opportunities and, therefore, have a lesser chance of sustaining negative shocks to their capital amount, since they can maintain lower buffers as security against such risks. Another reason is that, when financial crises occur, there is a greater probability that the larger banks will be rescued by the government, thereby avoiding potentially major damage to the financial system. This type of government rescue measure is known as "too big to fail" (Berger *et al*, 1995; Rime, 2001; Ayuso *et al*, 2004; Lindquist, 2004; Jokippi & Milne, 2008; Araújo, Jorge Neto & Linhares, 2008).

Most literature on capital buffer deals with the influence that the economic cycle has on the way a bank's capital buffer behaves (Ayuso *et al*, 2004; Lindquist, 2004; Ferreira, Noronha, Tabak & Cajueiro, 2010; Stolz & Wedow, 2011). Research studies aim to discover if the behavior of the capital buffer is pro-cyclical or counter-cyclical. If the behavior is pro-cyclical, then the expectation is that, during periods of economic growth, the volume of loans will increase without the need to raise enough funds to withstand the risks involved, which would entail reducing the capital buffer. However, if the behavior is counter-cyclical during economic growth, then the hope is that the volume of loans increases to raise more funds or, at least, which are sufficient to withstand loan risks, caused by an increase or the maintenance of capital buffer.

So in a sense, one of the reasons to seek a relationship between the economic cycle and capital buffer is because, with a growth in the economy, greater lines of credit will be extended by the banks, which can have an effect on their capital buffer. Thus, another variable that can influence a bank's capital buffer is the demand for credit by borrowers. When the demand for credit rises, and the banks comply by loaning resources, the risk to assets increases, which will consume the bank's capital buffer.

3 Research Methodologies

3.1 Population and Sampling

This research was carried out during the period covering the first quarter of 2001 to the fourth quarter of 2011, totaling forty-four quarters. Some filters were used in this study to improve the quality of the data used, such as using banks that had a performance history that was longer than fifteen months, excluding banks that were under investigation or had been put into liquidation by the Bacen, as well as banks that were being investigated for financial statement fraud, excluding such banks that presented a volatility of coefficient of variation greater or equal to two. As a result, this research surveyed 121 banks.

The data used in this research, for the purpose of calculating the dependent variable and most of the explicative variables, were sourced from the report entitled "The 50 Largest Banks and the Consolidation of the National Financial System", which is accessible via the Bacen website. The explicative variable of the gross domestic product (GDP) Variation, used as proxy for the economic cycle, was obtained from the website of the Brazilian Institute of Geography & Statistics (IBGE). The Mergers and Acquisitions dummy variable was obtained from the Fusions & Acquisitions report issued by the RISKbank, which carried out a survey of fusions and acquisitions that took place during the period from 1998 to 2012, based on information provided by that company.

3.2 Variables used in this Research Study

According to the revision of literature carried out in relation to the factors that influence the maintenance by banks of capital buffer, and by means of the analysis of variables used in research studies related to this subject, the present survey used various variables related to the three main costs that affect capital buffer, which are the costs of capital maintenance, insolvency costs and adjustment costs, in addition to other control variables that can alter their behavior.

3.2.1 Capital buffer

The dependent variable used in our research, is the additional amount of capital that the banks maintain over and above the regulatory amount required by the Bacen. As can be seen in previous sections, during the period covered by this survey, 2001 to 2011, the Basel Index (BI) demanded from Brazilian banks was 11%.

Thus, the capital buffer was calculated as if it was excess capital for the period, based on the BI presented by the bank during the period less the BI regulatory capital requirement (11%), divided by the BI minimum regulatory capital requirement (11%), which therefore established the excess capital percentage of the minimum regulatory requirement.

3.2.2 Adjustment Cost

The adjustment cost represents the speed by which the banks adjust their capital between two periods. Thus, the adjustment cost is represented by the bank's capital buffer during the previous period (t-1). A positive signal is expected for this variable and that its coefficient will be greater than 0.

When the coefficient gets close to 0, this means that the bank will have a low adjustment cost and, in consequence, that the capital buffer for period t will depend little on the capital buffer for the period t-1, meaning that the bank has the agility or capacity to make great changes to its capital buffer. When the coefficient is further away from 0, this means the bank will have a higher adjustment cost and as a result, the capital buffer for period t will depend a great deal on the capital for the period t-l, which means the bank lacks agility or does not have the capacity to make great changes to its capital buffer.

3.2.3 Cost to Maintain Capital

As discussed in section 2.4, one of the ways most frequently used by the banks to increase their capital buffer is through profit retention. The owner of the bank demands remuneration on the capital maintained by a bank, for which the ROE (*Return on Equity*) variable is used as a proxy for the cost to maintain equity capital, which is calculated based on the difference between net profits and the average equity shareholders' funds.

If the ROE variable represents a good proxy for the shareholders' capital maintenance costs (opportunity cost), a negative signal should be found. A negative signal may also be seen, if banks believe that greater profits mean they are able to continue to generate high returns, and therefore maintain a lower capital buffer.

A positive signal can also be expected for the ROE variable, in the event that banks are using profit retention to increase their capital buffer. Thus, this research study expects an ambiguous signal for the ROE variable.

Another variable used by the banks in the context of profit retention to increment their capital buffer, is the Return Volatility. Lindquist (2004) argues that the banks can increase their capital buffers through result retention, but this option becomes uncertain when the returns present a high-level of variation. So, it is expected that the Return Volatility presents a positive signal in relation to capital buffer. The variable consists of the natural logarithm of the standard deviation of net profit during the last twelve trimesters.

3.2.4 Insolvency Cost

According to Rime (2001), the measurement and definition of banking risk is already problematic, with several different suggestions outlined in literature. For Stolz and Wedow (2011), the main determining factor of risk for traditional banks is a credit risk. According to the Central Bank of Brazil, in their Report on Financial Stability (2012), the main component of risk of a Required Reference Equity (RRE) of the national financial system is credit risk sharing, which represented 91% of the RRE in December 2011. The variables used as a proxy for the insolvency cost are therefore related to the credit risk, as follows: Risk, Weighted Portfolio and Liquidity,

The Risk variable is defined by the provision for doubtful debts (PDD) stock supply on the total credit portfolio. The PDD stock represents the values already accounted for according to criterion issued by the National Monetary Council, contained in Resolution No. 2.682/99. In accordance with this resolution, the operational risk should be calculated, taking into account the characteristics of both the client and the operation, the delay period, among others. Thus, as this variable represents the profile of the credit risk of the bank's credit portfolio, a positive signal is expected, seeing that banks with a worse risk profile (greater provisions) should hold larger capital buffers.

The Weighted Portfolio variable is defined by the sum total of credit leasing operations on the bank's total assets. Thus, the variable shows the proportion of assets that is invested in a weighted portfolio. According to Bikker and Metzemakers (2004), a lower percentage of this variable can indicate that the bank has invested more in low risk operations and in loans to the government, showing a lower risk profile and representing an *ex-ante* measure of risk. In view of this, a positive signal is expected for this variable.

The Liquidity variable is defined by the sum total of its liquid assets, together with inter-financial applications, plus securities and derivative financial instruments, on the bank's total assets. In this way, the variable shows what proportion of the total assets is invested in securities which, in most cases, will have greater liquidity than the bank's credit operations. Since these assets have very low levels of liquidity-risk exposure, the regulatory body insists that little or no capital is held, which means that banks have a lower consumption of capital buffer, and therefore a positive signal is expected from this variable.

3.2.5 Size

The Size variable was used as a Proxy for the size of the bank as well as two dummy variables, Large Banks and Small Banks;

The Size variable is defined by the natural logarithm of the bank's total assets. A negative signal is expected from this variable since, the larger the bank, the lower their capital buffer should be. The Large Bank dummy variable

is defined by value 1 when the bank belongs to the group of ten percent (10%) of the largest banks in terms of total assets held during the period of the sampling, and 0 in the event that the bank does not belong to this group. A negative signal is expected for this variable.

The Small Bank dummy variable is defined by the value 1 when the bank belongs to the group of thirty percent (30%) of the smaller banks in terms of assets held during the period of the sampling, and 0 if they do not. A positive signal is expected from this variable.

3.2.6 Economic Cycle/Credit Demand
The economic cycle can affect the capital buffer in two ways, having a positive impact in the case of counter-cyclical behavior, and a negative impact in the case of pro-cyclical behavior.

The variable used as a Proxy for the economic cycle was the GDP Variation, calculated by the variation of the nominal GDP for a period in relation to the previous one; an ambiguous signal is expected in this case.

The demand for credit, when serviced by the banks, generates a higher number of approved loans, which results in an increase in risk-weighted assets. Thus, a demand for credit consumes the capital buffer, which is thereby reduced. The variable used as a proxy for credit demand was the Credit Variation, which is defined by the variation of the sum total of credit operations and leasing operations of one period in relation to the previous one. A negative signal is expected for this variable.

3.2.7 Control Variables
Other variables will be used in this study to check if these affect the capital buffer held by the banks, the dummy variables being: Control, Origin, Small Portfolio, Merger and Basel II.

The dummy variable for Control is defined by the value of 1 when a bank is controlled by federal or state public institutions and 0 when the bank is controlled by private institutions. According to Medeiros and Pandini (2008), the nature of the shareholders' control of a banking institution has implications regarding strategic decisions, management styles, and accountability, amongst others. In view of this, this variable will be used to determine what influence the control of a bank has on capital buffers, and an ambiguous signal is expected in this case.

The dummy variable for Origin is defined by the value of 1 when the bank is controlled by foreign institutions and 0 when it is controlled by Brazilian institutions. In view of the fact that the Basel II principles were implemented in other countries before being adopted by the Bacen, it is expected that the foreign-controlled banks will have been more active with regards to the management of their risks and capital. In this case, a positive signal is expected for this variable.

The dummy variable for Small Portfolio is defined by the value of 1 when the bank owns less than twenty percent (20%) of its total assets formed by a credit portfolio, and 0 if it owns more than twenty percent (20%). According to Silva and Divino (2012), banks with this characteristic represent a low level of financial intermediation, basically operating as a treasury operation within their own economic conglomerate and showing higher capital buffers. A positive signal is therefore expected for this variable.

The dummy variable for Merger is defined by the value of 1 during the period when the bank actively participates in a process of merger and/or acquisition, and 0 during the remaining periods. When a banks makes a merger and/or acquisition, it incorporates within its own condensed consolidated balance sheet all the assets and liabilities of the other institution. Thus, during the period of merger and/or acquisition, the bank's risk-weighted assets will be high, resulting in a reduction in its capital buffers. As a result, a negative signal is expected for this variable.

The dummy variable for Basel II is defined by the value of 1 as from the third quarter of 2008, and 0 for the previous quarters. As previously discussed, once the Basel II accord was established, the banks had to improve and implement their risk and capital management. It is therefore expected that, from the date that Basel II was adopted by the Bacen, the banks held a larger capital buffer, which means that a positive signal is expected for this variable.

3.3 Econometric Modeling
The econometric modeling used to analyze the behavior of the capital buffer of the banks during the period analyzed was the dynamic panel of data, since there was a lagged dependent variable which seemed like a variable explicative.

An estimation of the model will be made based on the equation (1) where the capital buffer is established by the trade-off between capital maintenance costs, insolvency and adjustment costs among other variables that could have had an influence on the capital buffer. This theoretical model is adapted from the research work developed by Ayuso *et al* (2004).

$$BUF_{i,t} = \beta_0 BUF_{i,t-1} + \beta_1 ROE_{i,t} + \beta_2 RISCO_{i,t} + \beta_3 \omega_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where $BUF_{i,t}$ represents the capital *buffer*, $BUF_{i,t-1}$ represents adjustment costs, $ROE_{i,t}$ represents capital maintenance costs, $RISCO_{i,t}$ represents insolvency $costs_{i,t}$, $\omega_{i,t}$ represents other factors that could affect the capital buffer, as mentioned previously, and $\varepsilon_{i,t}$ represents the composed error term.

The parameters of equation (1) will be estimated by Generalized Method of Moments (GMM), according to procedures established by Arellano and Bover (1995) and Blundell and Bond (1998).

4 FINDINGS AND ANALYSIS

In order to analyze which factors influenced the maintenance of capital buffers by Brazilian banks, this research study used as its base the equation (1), using this in several of the extensions of the standard model. All extensions of the standard model were estimated using the Stata 12 statistical application, by means of the dynamic panel data estimated by the GMM system method in two stages, based on Arellano and Bover (1995) and Blundell and Bond (1998), which is an extension of the original model proposed by Arellano and Bond (1991). An estimation of the model in two stages is asymptotically more efficient that if this was done in one stage, but may cause bias in standard errors in small samples (Stolz & Wedow, 2011; Silva & Divino, 2012). To correct this bias in standard errors, the correction matrix proposed by Windmeijer (2005) was used, which is known as the WC-robust estimator.

In order to avoid the problem of correlating endogenous variables with the term of error, the model used ROE and RISCO as variable instruments, according to the approach suggested by Jokipii and Milne (2008), as well as the lagged dependent variable (adjustment cost).

The autocorrelation test of the terms of error indicated an autocorrelation of the first order, rejecting the null hypotheses of absence of autocorrelation for all the extensions of the model used, and indicated a non-rejection of the null hypothesis of the absence of auto-correlations of the second order in all of the extensions of the model. The Sargan test, used to test the validity of variables used as (BUF_{t-1}, ROE e RISCO) instruments, did not allow the rejection of the null hypotheses that all instruments are valid, and thereby indicated that the variable instruments used are valid. The results of these two tests showed that the specifications of the instruments used were valid. A stationarity test of the variables was also undertaken to see if there was a unit root problem. The Im, Pesaran and Shin (IPS) test, proposed by Im Pesaran and Shin (2003), was carried out which, in accordance with Baltagi (2008), made it possible to identify the coefficients of the heterogeneity between the individuals by means of a procedure based on the unit root test for the individual-specific mean. The IPS test was undertaken and showed that the null hypotheses to the effect that all the data series was not stationarity, was rejected with a confidence level of 99%.

The estimation of the econometric model represented in the equation (1) was undertaken in four extensions, in that in every one of these a different set of the variables described previously were used. The econometric model was estimated with these different extensions to establish the robustness of the variables selected. The findings for the four estimations of the model can be seen in Table 1.

Extension 1 was based on the theoretical model outlined by Auyo *et al* (2004), where a capital buffer is established by the adjustment cost, by the capital maintenance costs, by the insolvency cost, by the size of the bank and by the economic cycle.

In extension 2, the economic cycle, represented by the GDP Variation variable, has been replaced by the demand for credit, represented by the Credit Variation variable. Since the purpose of using the economic cycle is to capture the behavior of the capital buffer for all the banks included in the sampling, without considering their individual particularities, since the GDP Variation variable only alters in time (time series) and not for the individual, the economy's demand for credit is used, represented by the Credit Variation, which considers all the peculiarities of the bank over the whole period.

In extension 3, the proxy used is altered so as to confirm the influence that the size of a bank has on the capital buffer, and the Size variable is replaced with the Large Bank and Small Bank dummy variables. The purpose of changing this model was to observe the specific behavior of these two characteristics in the banks involved.

In extension 4, extension 2 was used as a base; the other variables mentioned previously being added, so that the Large Bank and Small bank dummy variables were not the only ones used, in order to observe their respective results in conjunction with each other.

The Adjustment Cost variable showed a positive and significant signal at the level of 1% for all extensions of the model, presenting a slight variation in its coefficient. The greatest reduction occurred in extension 4, which must have occurred as a result of the inclusion of more explicative variables in the model. Due to these findings, it may be inferred that there is a significant adjustment cost involved in the capital buffers of Brazilian banks.

The capital maintenance cost, represented by the ROE variable, presented a positive signal, but was not significant in all the extensions. However, with regards to its coefficient, this showed little variation in the extensions used. Since the findings were positive in the case of all extensions of the model used, it may be inferred that the returns obtained by the banks were used to increase their capital buffers, even though it is not possible to statistically confirm this fact, since two extensions of the model were not significant at the confidence level of 5%. Even though the findings were not significant, the positive signal found for all the variables shows that the ROE variable is not a good proxy for capital maintenance costs, since it was expected that a higher capital maintenance cost would bring about a reduction in the capital buffer held by the bank.

The insolvency cost, represented by the Risco variable, presented a positive signal and is significant at the level of 1% for all its extensions. However, its coefficient presented a small variation between extensions 1, 2 and 3, and a greater variation in extension 4, probably caused by the inclusion of more variables in the model with characteristics of the banks' risk profile. Based on these findings, it is understood that the Risk variable had a positive effect on the maintenance of capital buffers by the banks.

The size of the bank, represented by the variable Size, presented a negative signal and is significant at the level of 1% in all the extensions. There was practically no variation in the estimated coefficients of this variable. These findings were expected, making it possible to infer that the largest banks maintained a lower capital buffer.

The Large Bank dummy variable showed a negative signal and is significance at the level of 1%. The Small Bank dummy variable showed a positive signal and the same significance level of 1%. The signal found for these variables was the same as expected. The negative signal found for the Large Bank dummy variable is the same as the signal found for the Size variable in extensions 1, 2 and 3, which shows that the banks that belong to group of the 10% largest banks in terms of total assets maintained, held a lower capital buffer. The findings for the Small Bank dummy variable, showed an additional feature to the findings for the Size variable in extensions 1, 2 and 3, where the smaller banks held more capital buffers for that period.

The economic cycle, represented by the GDP Variance variable, showed a positive signal, but which was not significant for all extensions. If just the signal is analyzed, a positive signal will show that the economic cycle demonstrates counter-cyclical behavior, which is to increase the capital buffer during periods of economic growth or, at the other extreme, to reduce the capital buffer during an economic recession.

Since the coefficient found for the variable was very close to 0, it had an interval of confidence of 95%, which varied between positive and negative values. Thus, an analysis of the findings of the variable did not make it possible to infer if the economic cycle behaves in a pro-cyclical or counter-cyclical fashion.

The Credit Variation variable presented a negative signal and is significant at the level of % in all the extensions, in that its estimated coefficients were maintained practically unaltered in all the extensions. These findings were expected, since an increase in the number of credit operations increases the weighted risk assets of the banks, thereby resulting in a reduction in their capital buffer.

The Volatility variable presented a negative signal, but was not significant at a confidence level of 5%. The signal found for this variable was the opposite of what was foreseen by this survey, since it was expected that the banks would increase their capital buffer by means of profit retention, so that the existence of a high level of volatility in the findings means they cannot count on this source of funding, which means they need to hold a larger capital buffer. These findings can be interpreted as the effects of volatility in their capacity to retain banking profits, seen that the volatility of the findings does not allow for the incorporation of the results when composing their capital buffers. Since this variable had a high non-significant result (0, 90), the analysis of these findings remains inconclusive.

The Liquidity variable presented a positive signal and had a significant result at the level of 1%. The signal found for this variable was as expected, since the assets that these represent have little or no risk weight. Another

conclusion that may be inferred, is that the fund-raising activities carried out by the banks, as a means to anticipate their capital requirements, should be used to acquire liquid assets, since it is impossible to invest these resources in credit operations at the same time they are raised.

The Weighted Portfolio presented a positive signal and which is significant at a level of 5%. This variable is related to the bank's insolvency costs, illustrating its risk profile. By the result found, it is inferred that the banks which have the highest percentage of their assets applied in credit operations hold a larger capital buffer, to withstand the risks underlying their operations, this variable being an *ex-ante* measure of risk for Brazilian banks.

The Control dummy variant presented a positive signal, but is not significant at the level of 5%. The signal presented by this variable shows that banks controlled by federal and state public institutions held higher capital buffers than the banks controlled by private institutions. This analysis was inconclusive due to the non-significance of this variable.

The Origin dummy variable presented a positive signal and was significant to the level of 5%. The signal for this variable was as expected. This result made it possible to infer that, in view of the fact that the principles of Basel II have been implemented for a longer period by countries abroad, their administrators are more actively engaged in managing their risks and capital, in adherence with the Pillar II concepts of Basel II.

The Merger dummy variable presented a negative signal, but which is not significant at the level of 5%. The signal for this variable was in accordance with our expectations, since it was expected that the risk-weighted portfolios of banks that participated in a merger and/or acquisition process would have been increased, consumed by their capital buffer. Since the result had a high-level of non-significance, the analysis of this variable was inconclusive.

The Low Portfolio dummy variable presented a positive signal, but was not significant at the level of 5%. The sign for this variable was in accordance with our expectations. The analysis of this variable was therefore inconclusive.

The Basel II dummy variable presented a positive signal and was significant at the level of 1%. The signal for this variable was in accordance with our expectations. This result enables us to infer that, by adopting the Basel II accord in Brazil, the banks implemented and improved their risk and capital management models, which resulted in better procedures to monitor their own solvency needs which led to the maintenance of greater capital buffers.

5 FINAL CONSIDERATIONS

The purpose of this research study was to find the factors that determine the maintenance of regulatory capital buffers by Brazilian banking institutions. A representative sampling of 121 banks was used, covering the period between the first quarter of 2001 until the fourth quarter of 2011. The econometric model used was the dynamic data panel analysis, estimated in two stages by the GMM system technique, based on the model proposed by Arellano and Bover (1995) and Blundell and Bond (1998).

With regards to the Adjustment Cost variable, it was found that there is a significant adjustment cost involved in the capital buffers of Brazilian banks.

The capital maintenance cost was not shown to be present in this research study when using the ROE variable. Even though this variable was not significant in any of the extensions of the model, the signal presented was always positive, indicated that it is possible that the high returns on capital are being used to increase the banks' capital buffers.

However, the Volatility variable was not significant and presented a different result from the one expected, which meant we were unable to deduce which banks with the highest profit volatility held the biggest capital buffers.

The Cost of Insolvency was also present in the case of Brazilian banks by means of variables used as a proxy for Risk, Liquidity and Weighted Portfolio. The findings showed that Brazilian banks adjust their capital buffers in accordance with the profile risk of their operations, incrementing capital buffer when there is a greater profile risk.

With regards to the size of banks, it may be seen that, the larger the bank, the smaller their capital buffer, which is consistent with the hypothesis of obtaining better investments and a more diversified portfolio and the "too big

to fail" theory. The Large Bank and Small Bank dummy variables also showed that the larger banks hold a lower capital buffer and that the smaller banks hold a greater capital buffer.

With regard to the economic cycle, the results did not enable us to confirm if the behavior is pro-cyclical or counter-cyclical, due to the non-significance of the findings. With regards to the demand for credit, it was observed that when more credit is issued the lower the capital buffers held, which shows that the banks are not raising enough funds to withstand the risks involved in these new operations, which leads to a reduction in their capital buffers.

With regards to the qualitative variables for Control and Small Portfolio, it was not possible to make conclusive deductions from these findings, since these were not significant. However, in relation to the Origin variable, it was shown that foreign banks maintained a greater capital buffer than Brazilian banks, which means that foreign administrators are possibly more actively engaged in managing their capital.

With regards to the occurrence of mergers and acquisitions, it was expected that in these cases there would be a reduction in the capital buffers. The signal found were the same as those expected, but were inconclusive, due to the non-significance of the Merger variable.

The findings also showed that, with the implantation in Brazil of the Basel II Accord, the banks began to hold a greater level of capital buffers, due to the implantation and improvement of risk and capital management models, which resulted in better procedures to monitor their own solvency needs.

The contribution made by this research study relates to the study of factors that influence decisions involving the capital buffers held by the banks, since this topic has been little studied to date, especially in relation to Brazilian banks. Furthermore, this research study can also be useful in the area of accounting and in the financial market, since a study into factors that determine the maintenance of capital buffers will provide a better understanding of the structure of capital maintained by the banking sector, a segment that is generally excluded from research studies that focus on capital structure.

It is suggested that future research should attempt to find a proxy that better represents capital maintenance costs, since the ROE variable failed to supply a signal that was consistent with the theory in the case of Brazilian banks.

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Tables

Table 1. Estimation of GMM System Model for Capital Buffer

Variables	Extension 1		Extension 2		Extension 3		Extension 4	
Buffer i.t-1	0,66	(0.00)***	0,66	(0.00)***	0,70	(0.00)***	0,59	(0.00)***
ROE i.t	1,68	(0.00)***	1,63	(0.07)*	1,45	(0.00)***	1,74	-0,33
PDD i.t	7,32	(0.00)***	6,85	(0.00)***	8,69	(0.00)***	4,72	(0.00)***
Size i.t	-1,20	(0.00)***	-1,23	(0.00)***	-	-	-1,25	(0.00)***
GDP Variation t	0,00	-0,59	-	-	-	-	0,00	-0,27
Credit Variation i.t	-	-	-0,24	(0.00)***	-0,23	(0.00)***	-0,24	(0.00)***
Volatility i.t	-	-	-	-	-	-	-0,01	-0,90
Liquidity i.t	-	-	-	-	-	-	12,87	(0.00)***
Weighted Portfolio i.t	-	-	-	-	-	-	5,41	(0.05)**
Control i.t	-	-	-	-	-	-	1,96	-0,69
Origin i.t	-	-	-	-	-	-	2,69	(0.02)**
Merger i.t	-	-	-	-	-	-	-0,01	-0,98
Small Portfolio i.t	-	-	-	-	-	-	0,37	-0,40
Basel II t	-	-	-	-	-	-	0,58	(0.00)***
Large Bank i.t	-	-	-	-	-0,87	(0.01)***	-	-
Small Bank i.t	-	-	-	-	1,73	(0.00)***	-	-
Constante t	17,35	(0.00)***	17,85	(0.00)***	0,25	(0.01)**	9,62	(0.00)***
AR(1)	-2,25	(0.02)**	-2,20	(0.03)**	-2,22	(0.03)**	-2,16	(0.03)**
AR(2)	-0,90	-0,37	-0,94	-0,35	-0,94	-0,35	-0,96	-0,34
Sargan	$\chi^2(292)=119$ -1		$\chi^2(292)=118$ -1		$\chi^2(292)=118$ -1		$\chi^2(291)=115$ -1	

Note: p-value in parenthesis.
Obs.: * p < 0.10; ** p < 0.05; *** p < 0.01.