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XI

Volume XI, Number 1, May 2008

Journal of Applied Economics

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UCEMA

Edited by the Universidad del CEMA

Print ISSN 1514-0326
Online ISSN 1667-6726

Journal of Applied Economics. Vol XI, No. 1 (May 2008), 61-90

THE INCIDENCE OF RESERVE REQUIREMENTS IN BRAZIL: DO BANK STOCKHOLDERS SHARE THE BURDEN?

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Submitted January 2005; accepted January 2007

There is consensus in the economic literature that reserve requirements are a tax levied upon financial intermediation, yet the incidence of the tax remains controversial. In this paper, we test whether changes in reserve requirements in Brazil impact the stock returns of the Brazilian financial system distinctly from the rest of the economy. We show that Brazilian bank stock returns may have been affected by changes in reserve requirements on both time deposits and transaction accounts, which implies that the tax burden of required reserves has not been fully passed through to banks' borrowers or clients. Stock returns of non-financial firms may also have been affected by changes in reserve requirements, suggesting that in some cases reserve requirements on time deposits and transaction accounts served as a non-neutral instrument of monetary or fiscal policy in Brazil.

JEL classification codes: E5, E6
Key words: tax incidence, reserve requirements, event studies

I. Introduction

Reserve requirements serve a number of purposes. Policymakers have extensively called upon their role as a monetary policy instrument to justify higher ratios or higher incidence, relying on theoretical arguments that reserve requirements may help stabilize the demand for money (Hardy 1997), prices (Siegel 1981), the demand

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for goods (Bental and Eden 2002), or the output gap under certain types of shocks to the economy (Baltensperger 1982). Several other papers dispute this stabilizing function, especially when monetary policy does not target monetary aggregates. However, policymakers around the world, particularly in economies lacking fully fledged securities' markets, still see them as a feasible alternative to stabilize inflation or output.

Reserve requirements may also contribute to prudential regulation. Bris and Cantale (2003) show that positive reserve requirement ratios help restore market efficiency when there are external agency problems, i.e., when banks have incentives to take excessive risks but credit risk cannot be directly observed by regulators. In contrast, reductions in reserve requirements may help restore the efficient equilibrium in circumstances where banks have incentives to take insufficient risks, regulators cannot observe credit risk and bank owners cannot perfectly assess managers' efforts.

Some authors advocate that the driving motive for the introduction of reserve requirements was in fact their fiscal role (De Kock et. al. 1964, and Goodfriend and Hargraves 1983, for the United States). In the Brazilian case, Fernandes (1992) mentions a number of occasions when fiscal concerns affected reserve requirement decisions. Whether this is true for other countries is still an open question, but reserve requirements have certainly been an important source of revenues for governments throughout the world. In Brazil, if the government were to invest the balance of non-interest bearing reserve deposits at the central bank at a benchmark reference rate, interest accrued to these deposits would roughly account for 1% of federal government monthly revenues, as of 2007, peaking at 7% in November 1998 (Figure 1). Furthermore, the Central Bank of Brazil has incurred a much lower cost to maintain required bank reserves than if it were to issue ordinary debt (Table 1).

Reserve requirements are a tax on financial intermediation when interest accrued to required reserves deposited at the central bank is lower than the rates of return on alternative bank investment. Although the question "who pays the tax?" is of relevance to any study of economic distortions or fair income allocation, the literature has not yet reached an agreement on the answer. Black (1975) and Fabozzi and Thurston (1986) argue that the incidence of the tax falls entirely on depositors. Fama (1975) and James (1987), on the other hand, do not find any relation between reserve requirement ratios and interest rates paid on bank deposits in the United States. Fama thus infers that the tax is entirely transferred to borrowers, and James finds empirical evidence to support Fama's argument.

Figure 1. Potential revenue from interest accrued on monthly reserve deposits at the Central Bank of Brazil (as a share of total revenues actually collected by the federal government)

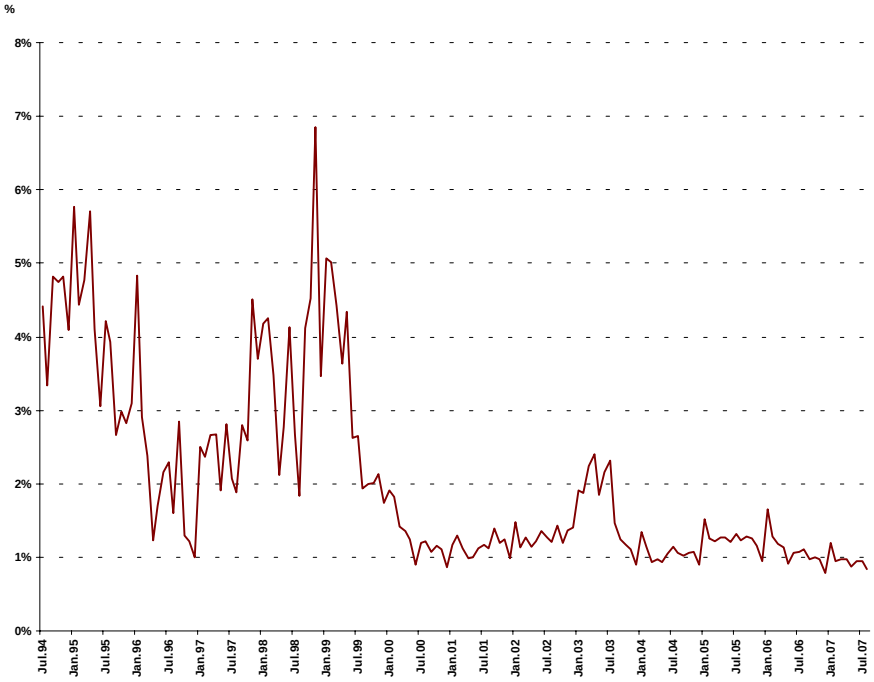


Table 1. Financial cost of reserve requirements on transaction accounts (% per year)

	Interest accrued on reserve requirements (excludes non-bearing interest bank reserves on transaction accounts)	Interest accrued on total reserve requirements	Overnight Selic rate
Dec.00	7.36	3.60	16.19
Dec.01	8.13	4.26	19.05
Dec.02	10.82	7.48	23.03
Dec.03	8.42	6.02	16.91
Dec.04	8.98	6.32	17.50
Dec.05	8.98	6.22	18.24
Dec.06	8.01	5.56	13.19
Sep.07	6.52	4.68	11.22

Source: Central Bank of Brazil.

More recently, the literature has been focusing on the possibility that the tax burden of reserve requirements be mutually shared by depositors, borrowers and banks' shareholders. On theoretical grounds, Davis and Toma (1995) find that borrowers and shareholders may share the burden of reserve requirements altogether in a framework where banks have comparative advantage in monitoring loans and assessing the risk of potential borrowers. On empirical grounds, Kolari et al. (1988), Slovin et al. (1990), Osborne and Zaher (1992), Cosimano and McDonald (1998), and Hein and Stewart (2002, 2004) all find evidence supporting the argument of shared incidence in the United States.

The literature on the Brazilian case has focused on the question of whether reserve requirements affect the interest spreads on loans advanced by banks to their clients. If they do, as is the case in Cardoso (2003), the literature concludes that the tax burden of reserve requirements is passed through to borrowers. A number of studies produced by Central Bank of Brazil's staff have in fact assumed that the incidence of the tax falls entirely on borrowers.[1]

Cardoso and Koyama (1999) argue that default ratios and operational costs are the main determinants of bank spreads in Brazil, and show that the ratios of reserve requirement on time deposits matter little to bank interest spreads because required reserves on time deposits accrue interest at the central bank. They thus infer that the tax burden is not passed through to borrowers.

To take a more straightforward stance on the issue of who really pays the tax implied by reserve requirements in Brazil, this paper follows the recent trend of the international literature that investigates the incidence of reserve requirements by employing event study methods to the Brazilian case. What we do in the paper is test whether banks' shareholders bear part of the burden of reserve requirements in Brazil, and, likewise, benefit from reductions in required reserve ratios or calculation base. We also investigate whether the response of stock returns of Brazilian banks is in any way different from stock returns from the non-financial sector.

Reserve requirements in Brazil equal more than a quarter of their respective deposits and the regulation on reserve requirements is also very cumbersome. Tax ratios, interest accrued on reserves, form of compliance (cash, securities or vault

[1] Every year, the Central Bank of Brazil publishes a report on the evolution, determinants, and future prospects of banking spreads in Brazil (www.bcb.gov.br). In *Juros e Spread Bancário: Avaliação do Segundo Ano do Projeto*, p. 51, the Central Bank of Brazil assumes that the tax burden of time deposits is zero because their reserves at the central bank accrue the overnight reference interest rate.

cash), and authorized deductions from the reservable base all differ across types of banks' liabilities and assets, and have changed remarkably often over the past 12 years.

The Brazilian sample is also very challenging. In addition to a reduced number of companies listed in the stock market compared to the US, the impressive number of changes in reserve requirement regulation during these past 12 years makes the work of any econometrician very hard, and using data prior to the Real Plan poses another challenge to empirical investigations because of the distortions caused by hyperinflation. A careful sample selection provided us with three events of changes in reserve requirements on transactions accounts and four events of changes in requirements on time deposits. It is not an easy task to reach an agreement on whether the net effect of some changes was a reduction or an increase in the tax burden. The last event of change in reserve requirements on transaction accounts that is analyzed here, for instance, refers both to an increase in the reserve requirement ratio and to an increase in authorized deductions on the taxable base, the latter functioning as a reduction in the ratio. Because of this difficulty in determining whether a change in reserve requirement would be perceived as positive, neutral or negative for stockholders, we decided to analyze each event separately and try to draw general conclusions from the individual results we were able to achieve.

The results were sensitive to alternative test methodologies employed. Under reasonable assumptions, we find evidence that some changes in reserve requirements on time and transaction accounts had important effects on the stock returns of the banking system. Non-financial corporations were most likely affected only by decisions on reserve requirements on time deposits. These results suggest that the tax implied by reserve requirements in Brazil is shared amongst banks' clients and owners, and it is sometimes born by owners alone. Thus, the widespread perception that reserve requirements on time deposits imply zero costs to banks and that reserve requirements on transaction accounts are always an efficient instrument of monetary policy cannot find much support from the results obtained here.

The paper is presented in the following sequence. Section II provides some stylized facts on reserve requirements in Brazil. Section III discusses the event study methods employed in this paper to test for abnormal returns. Section IV describes the sample. Section V reports the results. Finally, Section VI concludes the paper.

II. Reserve requirements in Brazil[2]

A. History

Fernandes (1992) reports that reserve requirements in Brazil were first introduced in 1932. By then the central bank had not yet been created, and the monetary authority operations were carried out by Banco do Brasil, a state-owned commercial *cum development* bank.

Throughout the entire history of reserve requirement regulation in Brazil, concerns other than those attached strictly to monetary policy permeated reserve requirement decisions. Cardoso (2003, p. 8) argues that until 1993, reserve requirements were mainly implemented to (imperfectly) tax bank profits that accrued with high inflation rates. Fernandes (1992) suggests that other fiscal issues have also been a determinant of reserve requirement decisions.

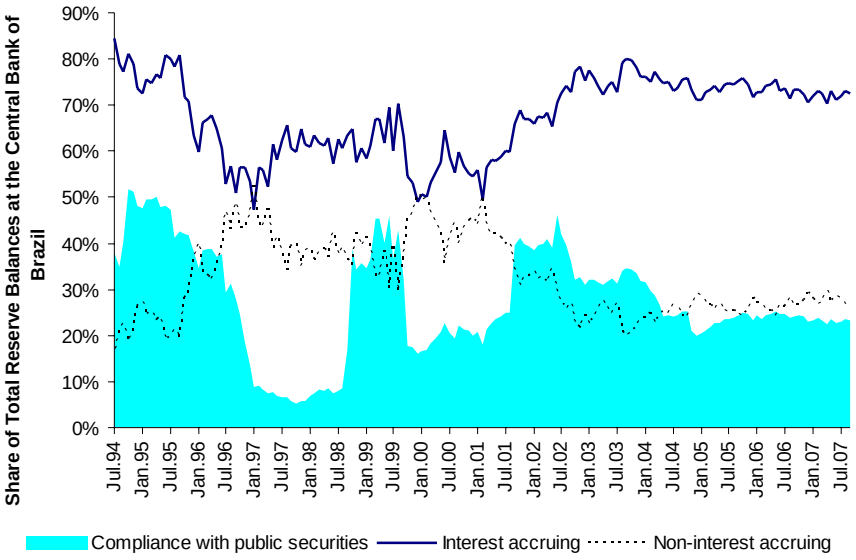
In 1945, as an attempt to part the monetary authority from Banco do Brasil, the agency Superintendência da Moeda e do Crédito (SUMOC) was created to control money market operations and to set the grounds for a Brazilian central bank. One of the measures SUMOC implemented was to introduce interest-bearing required reserves, partly complied with required investment in public bonds. It was then that the Brazilian monetary authority started to use reserve requirements to sustain an artificial demand for public securities, a policy that still prevails nowadays (Figure 2).

SUMOC was not operationally independent from Banco do Brasil, as commercial banks were required to hold their reserves at the federal commercial bank. As a result, reserve requirements also functioned as an alternative funding for Banco do Brasil to implement credit operations on behalf of the central government. Upon inflationary concerns, the Central Bank of Brazil was created in 1964. Since then reserve requirement regulation has been successively altered in accordance with prevailing economic policy purposes. In 1986, federal government deposits were finally transferred to the Central Bank of Brazil, with the central bank not allowed to finance National Treasury's overdraft positions. Therefore, central bank's autonomy enhanced.

Until 1993, reserve requirements were used for distributional purposes, with required ratios being higher for bank branches located in richer regions of the country (Table 2). Required ratios on transaction accounts increased over time.

[2] This section is strongly based on Fernandes (1992) and Cardoso (2003).

Figure 2. Composition of required reserves at the Central Bank of Brazil



For non-poor regions, the ratios were 27% from 1969 to 1975, 33% and 35% in 1976, and 40% from 1977 to 1993. In spite of a long-lasting period of hyperinflation in Brazil, reserve requirements were not a focal instrument of monetary policy during this period.[3]

In 1994, the perverse inflationary dynamics finally came to a halt with the successful implementation of the Real Plan. Along with a monetary reform also came a brief fiscal adjustment, the use of the exchange rate as a nominal anchor, and tight monetary policy.4 From 1994 until the end of 1998, the Central Bank of Brazil adopted rediscount rates as its main monetary policy instrument, but kept very close attention to monetary aggregates.

Reserve requirements were intensely used for monetary policy purposes during the Real Plan. In mid-1994, the central bank increased required ratios on transaction accounts to 100% (from 40%), on savings accounts to 20% (from 15%), and on time deposits to 20% (from 0%). In the 18 months following June 1994, there were 53 changes of all sorts in the reserve requirement regulation. Furthermore, in this specific period, the central bank, attempting to curb the ability of banks

[3] Cardoso (2003). Required ratios on time deposits were in place only in part of the 1984-1985 period.

[4] Cardoso (2003), p.5.

Table 2. Reserve requirements in Brazil (% of deposits), 1969 – 1993

	Demand Deposits[1/]		Time Deposits	
	Region A [2/]	Region B [2/]	Region A [2/]	Region B [2/]
Apr-69	27	18	9	4.5
May-71[3/]	27	18	9	4
Jan-73	27	18	0	0
Mar-73[4/]	27	18	0	0
Jul-73[5/]	27	18	0	0
Jul-74[6/]	27	18	0	0
Feb-75[7/]	27	18	0	0
Jul-75[8/]	27	18	0	0
Apr-76	33	18	0	0
Jul-76	35	18	0	0
Oct-77	40	18	0	0
Jul-79[9/]	40	18	0	0
Dec-84	40	18	22	22
Jun-85	40	18	20	20
Jan-92	40	18	0	0
Nov-93	40	40	0	0

Notes: [1/] The periods and formula for calculating average deposits on which required reserves were to be based changed many times between 1969 and 1993. [2/] Region B: Acre, Amazonas, Pará, Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Espírito Santo, Goiás, Mato Grosso. Region A: All other states. [3/] A reduction of half percentage point in required reserves will make up resources from demand deposits destined to loans to small and medium enterprises. [4/] A reduction of 2 percentage points in required reserves rates will make up resources from demand deposits to be destined to loans to exporters. [5/] Percentage of demand deposits destined for rural credit increased from 10% to 15%. [6/] Amount to be destined to loans to small and medium enterprises increases to 4% of demand deposits. [7/] Mandatory loans for working capital of small and medium enterprises increases to 8% of demand deposits. 8/ 55% of required reserves to be held in government bonds (LTN or ORTN). 9/ Percentage of demand deposits destined for rural credit increased from 15% to 17%. Source: Cardoso (2003).

to innovate on their funding and thus to bypass reserve requirements, created new requirements on a number of banks' assets and liabilities, in addition to the already existing requirements on investment funds, savings accounts, transaction accounts, judicial deposits and deposits from realized guarantees (*recursos de depósitos e garantias realizadas*).[5]

Even when monetary policy purposes prevailed in reserve requirement decisions, fiscal issues were still important. The high level of domestic real interest rates and the sharp appreciation of the Real during the 1994-1998 period resulted in

[5] The accounts that started to be subject to reserve requirements were "contratos de assunção de obrigações", credit operations (*operações de adiantamento, empréstimos, financiamento e de crédito*), "operações ativas e passivas", and time deposits at indetermined tenure (*depósitos a prazo de reaplicação automática*).

increased external borrowing. External inflows were partly sterilized to avoid pressure on domestic liquidity and interest rates. These countervailing measures, associated with high debt servicing rates, exerted strong pressure on the fiscal accounts. In 1998, a year of intense capital flight and increased difficulties to roll over the domestic debt, reserve requirements were overtly used to sustain an artificial demand for public securities.

The international confidence crisis of 1997 and 1998 and increased concerns about debt sustainability led to strong capital outflows, culminating in the floating of the exchange rate in January 1999. A new policy framework was then envisaged to keep inflation under control without further compromising the fiscal accounts. In May 1999, the central bank abandoned the use of rediscount rates as its operational target to focus on overnight interest rates. In June 1999, the country formally adopted an inflation-targeting regime, in which reserve requirements lost some of their importance as a monetary policy instrument.

However, fiscal concerns have still played a role in reserve requirement decisions, even under an inflation targeting regime. Upon the implementation of the new monetary policy regime, the central bank committed itself to gradually reduce reserve requirement ratios "as long as good fiscal results continue and inflation is under control".[6] However, the easing path of reserve requirements on transaction accounts did not last long. In 2002, the central bank inaugurated an additional requirement: interest-bearing reserve requirements on transaction accounts and time deposits and savings accounts. The purpose was to reduce some of the pressure on the liquidity that was freed to the market because of an innovation in instruments used to rollover domestic debt indexed to foreign currency. [7] The liquidity freed to the market had to be channeled out to daily repo operations with the central bank or the pressure would be too strong on interest rates and thus on inflation. This placed the central bank at a very uncomfortable position of rolling over high amounts of very short term debt. In 2002, this excess liquidity reached R$ 70 billion and as of November 2006 (date for the last revision in this paper) stood at R$ 80 billion, of which 28% was withdrawn with very short term repo operations and 47% with repos redeeming in 5 months.

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[6] Juros e Spread Bancário, *primeiro ano*.

[7] As an attempt to improve on the supply of financial hedge to the volatility of the exchange rate, and because of constraints on the issuance of domestic-debt indexed to foreign currencies, the government decided to rollover maturing domestic-debt indexed to foreign currencies using derivatives, which had some monetary impact.

In February 2003, the required ratio on transaction accounts increased as part of a set of measures to control accelerating inflation. In this event, the Monetary Policy Committee made it explicit that the central bank was changing reserve requirements for monetary policy purposes. After inflationary pressures dissipated, reserve requirement ratios reduced.

B. A brief international comparison

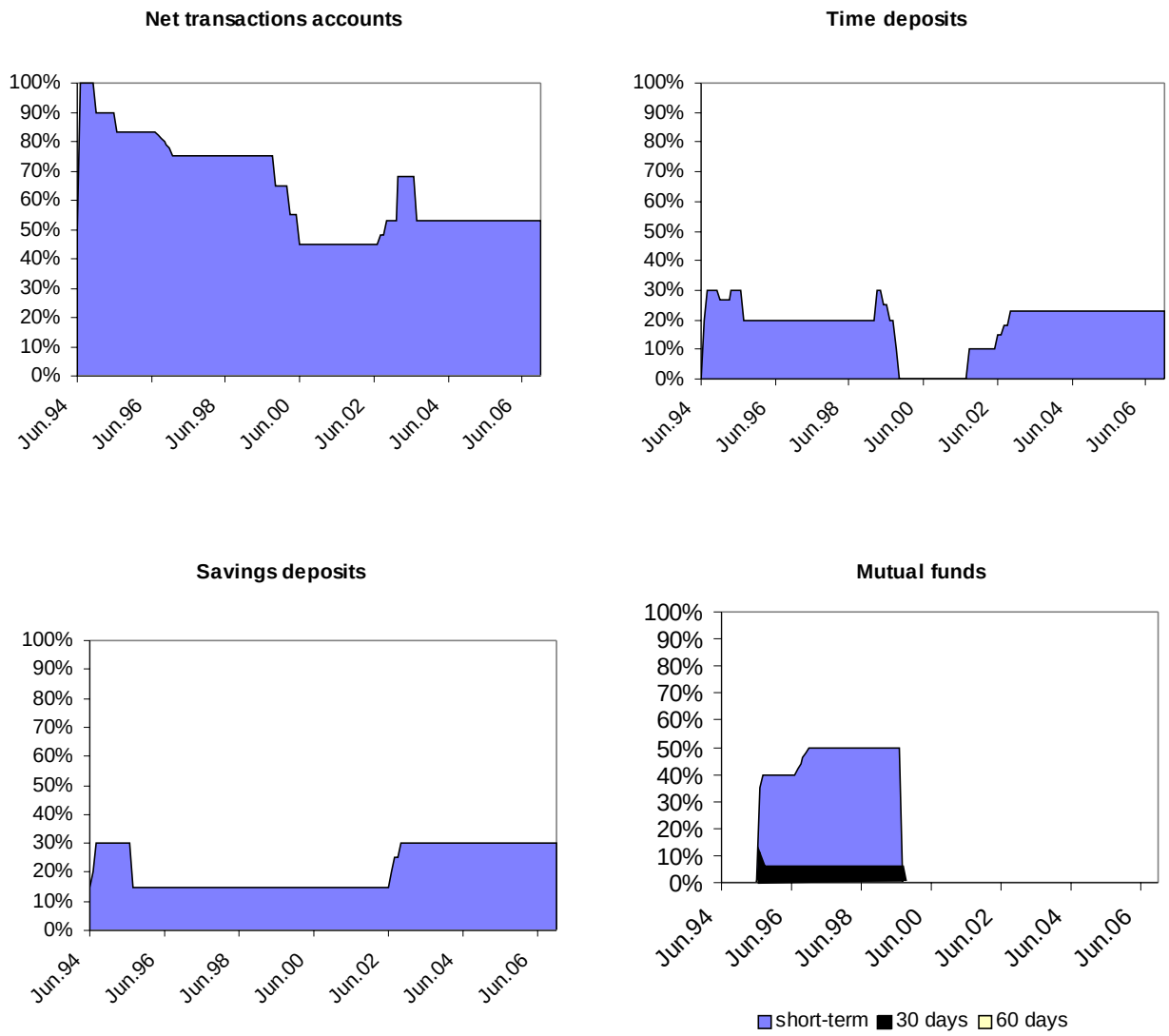
García (1995) reports that, contrary to Brazil, advanced economies have followed a trend of reducing reserve requirements over time. This trend has arisen from the widespread adoption of interest rates, rather than monetary aggregates, as the main instrument of monetary policy.

In Brazil, even after the explicit adoption of interest rates as the main monetary policy instrument, and despite the fact that reserve requirements have not been used as policy instruments since 2003, their phasing out has been hindered by the entanglements of fiscal and monetary policy. For one thing, the banking credit market is still not deep enough to absorb the liquidity that would be freed to the market should required reserves be strongly reduced. In addition, as of September 2007, around 23% of total reserve requirements were complied with mandatory investment in public securities (Figure 2), which guarantees an artificial demand of R$ 44 billion for government debt, or 4% of federal government bonds in the market.

In September 2007, the requirements that remained in Brazil were on transactions accounts (40% in cash-in-vault plus 5% in non-interest bearing reserves at the central bank plus 8% interest-bearing reserves at the central bank), time deposits (15% in the form of mandatory investment in public securities plus 8% in interestbearing reserves at the central bank), and savings accounts (30% in the form of both mandatory investment in public securities and interest-bearing reserves at the central bank plus 65% in required concession of loans). The share of required reserves on transaction accounts that accrue interest yield the Selic rate (reference overnight rate), and so do required reserves on time deposits and additional reserves on savings accounts. At end-2006, interest paid to required reserves on savings accounts (excluding the additional requirement that yields the Selic rate) was 6.7% per year plus Taxa Referencial (TR, another base rate set by the Central Bank) for some types of savings accounts (*poupança livre, pecúlio* and *rural*) and TR plus 3% per year for another type (*poupança vinculada*).

Compared to the United States, reserve requirements in Brazil bring about an additional difficulty to depository institutions: the relatively high frequency of changes in the regulation (Figure 3). A quick search on Banco Central do Brasil's

Figure 3. Reserve requirement ratios in Brazil*

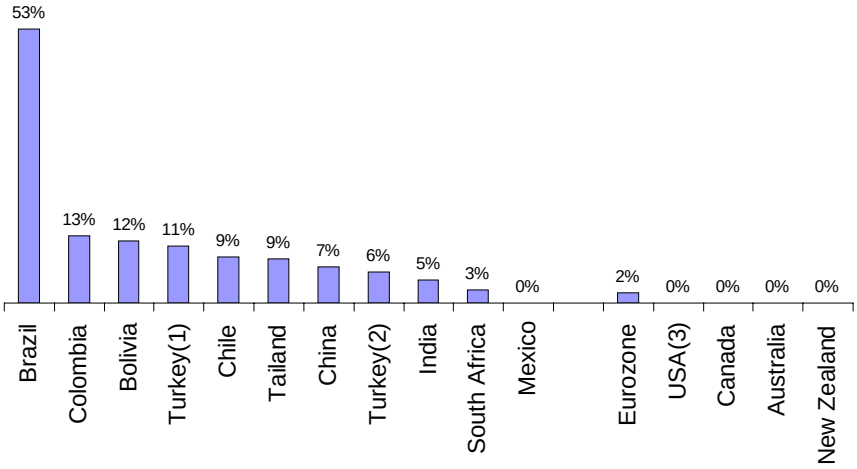


website for reserve requirement regulation from January 2004 to December 2006 returns a record of a dozen changes of all sorts – although not all of them meant increases in requirements. For the past twenty years in Brazil, the number of changes in reserve ratios, calculation and maintenance periods, exemption base, required daily balances as a share of total requirement, and reporting procedures has been substantial. In the United States, the most frequent changes usually occur once a year, and refer to the bounds on the volume of net transaction accounts over which distinct reserve ratios apply. Nonetheless, the market is not caught by surprise upon these changes, as the yearly changes were envisaged by the Monetary Control Act of 1980 and the Garn-St Germain Act of 1982. For requirements other than net transaction accounts, no changes have occurred for the past 16 years.

One could argue that the reason why there have been so many changes in reserve requirement regulation in Brazil is that financial innovations in Brazil are more frequent, as the market is in a less mature state. However, of the 12 changes in the regulation over the 2 years ending in 2006, only 2 of them comprised changes to the list of liabilities included in the reservable base.

Table 3 compares reserve requirement regulation on transactions accounts in the United States and in Brazil, as of December 2006. There were important differences not only regarding the ratios, but also the form of compliance, calculation and maintenance periods, and minimum required daily balances. More generally, these ratios are still significantly high under international comparisons (Figure 4).

Figure 4. Ratios of reserve requirement on transaction accounts in selected emerging markets and developed countries (as of 2004)



III. Event study

Most of the literature that tests the impact of changes in reserve requirements on stock returns has employed the one-factor model derived from CAPM.[8] Quoting Brown and Warner (1980), the abnormal return for a given security in any time *t* is defined as the difference between its actual *ex post* return and that which is predicted under the assumed return-generating process:[9]

$$AR_{it} = R_{it} - E(R_{it}), \text{ with} \tag{1}$$

$$E(R_{it}) = \begin{pmatrix} \hat{\alpha}_i & \hat{\beta}_i \end{pmatrix} \begin{pmatrix} 1 \\ MKT_t \end{pmatrix}. \tag{2}$$

where AR_{it} = portfolio *i*'s abnormal return at time *t*, R_{it} = portfolio *i*'s return at time *t*, MKT_t = benchmark market return at time *t*, and $\begin{pmatrix} \hat{\alpha}_i & \hat{\beta}_i \end{pmatrix}$ = vector of parameters of the market model estimated for portfolio *i* using data from the estimation period.

What varies significantly in the literature is the way the parameters $\hat{\alpha}_i$ and $\hat{\beta}_i$ are estimated. Slovin et al. (1990), and Cosimano and McDonald (1998) add dummies to the model to capture abnormal returns on the day of the change in reserve requirements (t = 0), and on the previous day (t = -1), the latter also test for eventual leaks in policymakers' intentions. They estimate the parameters through pooled cross-section time series regressions, using ordinary least squares errors in the hypothesis tests. Osborne and Zaher (1992), nonetheless, argue that models using dummies have the drawback of not being able to identify the size of abnormal returns relative to the size of the tax change. To overcome this problem, they employ the event-study method, which is widely used in the finance and accounting literature to identify the impact of certain events on stock returns, and which is also employed here. Many authors criticize the use of OLS errors to test the hypothesis of abnormal returns when events are clustered in calendar time, as is the case in this paper. With clustering of events, the errors estimated through OLS will present cross-sectional dependence and probably heteroscedasticity, and will thus jeopardize hypothesis tests if additional techniques are not introduced in the

[8] Brown and Warner (1980) show that multi-factor models or more complicated risk adjustment models do not yield significant improvements in assessing abnormal returns compared to the one-factor model.

[9] Brown and Warner (1980), p. 207.

Table 3. Regulation on reserve requirements on transaction accounts in the United States and in Brazil, as of December 2006

	USA	Brazil
Ratios[1/]	US$ 0 – US$ 7.8 million: 0% US$ 7.8 million – US$ 48.3 million: 3% More than US$ 48.3 million: 10%	R$ 0 – R$ 44 million: 0% More than R$ 44 million: 45%
Exemptions	Institutions with a daily average of net transactions accounts below	1. Institutions with a daily average of reservable US$ 7.8 billion deposits below R$ 44,000,010 thousand 2. Deposits from payment orders in foreign currencies 3. Demand, prior notice and investment deposits of government, autarchies and government-controlled institutions with their respective federal and state-controlled banks 4. Demand, prior notice and investment deposits of city governments with their respective state-controlled banks
Deductions	N/A	R$ 44 million from total reservable deposits
Share of Vault Cash	At the discretion of the depository institution, up to the amount of the reserve requirement, provided that reserve balances at the FRB are non-negative	Up to 40% of the reservable base
Reservable Accounts	1. Demand Deposits 2. Automatic transfer service accounts 3. NOW accounts 4. Share draft accounts 5. Telephone or preauthorized transfer accounts 6. Ineligible acceptances 7. Obligations issued by affiliates maturing in 7 days or less	1. Demand Deposits 2. Prior notice deposits 3. Share draft accounts 4. Deposits from tax levied 5. Business cheques 6. Deposits from services supplied 7. Deposits from realized guaranties 8. Investment deposits *9. Contratos de Assunção de Obrigações Vinculados a Operações Realizadas no País*

Table 3. Regulation on reserve requirements on transaction accounts in the United States and in Brazil, as of December 2006

	USA	Brazil
Total Required Reserves	US$ 41.05 billion (as of August 2006)	
Depository Institutions	Commercial banks, savings banks and loan associations, credit unions, US branches and agencies of foreign banks, Edge act corporations, and agreement corporations	Universal banks with a commercial portfolio, commercial banks, investment banks, savings banks
Calculation Period	For institutions that file reports on a weekly basis: 2 weeks	2 weeks
	For institutions that submit reports on a quarterly basis[2/]:	1 week
Maintenance Period	For institutions that file reports on a weekly basis: 2 weeks, beginning 17 days after the end of the associated calculation period	
	For institutions that submit reports on a quarterly basis: 13 consecutive 1-week periods, beginning 24 days after the end of the calculation period	2 weeks, overlapping with the last week of the calculation period
Minimum daily balances in the maintenance period	0%, provided that the reserve requirement is met on average over the maintenance period	80% of the reservable base, and provided that the reserve requirement is met on average over the maintenance period

Notes: [1/] Bound values refer to daily averages of reservable deposits. For the US, net deposits correspond to total deposits less amounts due from other depository institutions and less cash items in the process of collection. In Brazil, cash items in the process of collection are also deducted from the reservable base. [2/] These institutions are usually the ones with a low record of transactions deposits. More accurately, the FRB clarifies that an institution with net transaction accounts greater than the exemption amount for either of the two weeks and with total deposits less than the nonexempt deposit cutoff for both weeks will continue to submit the FR 2900 on a quarterly basis. An institution with net transaction accounts less than or equal to the exemption amount for both of the two report weeks and with total deposits less than the reduced reporting limit for both of the report weeks will no longer be required to submit the FR 2900. Source: FRB and Central Bank of Brazil (www.bcb.gov.br).

estimation. Brown and Warner (1980, 1985) suggest that aggregate measures of stock performance be used instead of individual portfolio returns to overcome the problem of cross-sectional correlation.

Our null hypothesis is of no abnormal returns over the event period (the period when the event may be affecting stock returns). To test the null we employed two alternative test procedures, based on Dann and James (1982) and Dodd and Warner (1983). To apply Dann and James' *T*-test statistics, we averaged the stock returns of companies listed in Bovespa, the most important Brazilian stock exchange, over two groups: financial and non-financial, weighing each company's return by its daily financial volume of transactions. We then ran OLS on each of the two groups of companies over the estimation period (when the event was likely not affecting the return generating process) to obtain the parameters in (2). We would then identify the size of the abnormal return in (1) by comparing the result we obtained in (2) with the actual average stock returns in each group over the event period.

The *T*-statistic for each day in the event window is defined as:

$$T = AR_{p,t} / S_{p,t}\,, \tag{3}$$

where $S_{p,t} = \left\{ S_p^2 \left[1 + \frac{1}{L_p} + \frac{(MKT_t - MKT)^2}{\sum_{\tau=1}^{L_p} (MKT_\tau - MKT)^2} \right] \right\}^{1/2}$, p = industry (in this study financial or non-financial), L_p = number of days in the estimation period, S_p^2= variance of the market-model residuals for industry p (calculated over the estimation period), MKT_t = return of the benchmark portfolio at time t in the event window, MKT_τ = return of the benchmark portfolio at time τ in the estimation period, MKT = average return of the benchmark portfolio over the estimation period. As cross-section correlation and heteroscedasticity were properly treated, market model residuals are independent and identically distributed. Therefore, the *T*-statistic is distributed as two-tailed Student-*t* with (L_p-2) degrees of freedom.

To test for the significance of cumulative abnormal returns over a sub-period (*I*) of the event window, or even over the entire event window itself (*A*), the first method employed was to calculate the T_2 statistics:

$$T_2 = \left[\frac{1}{n} \sum_{t \in I} AR_{p,t} \right] / \left[\frac{1}{n(N-n-1)} \sum_{\substack{t \in A \\ t \notin I}} \left(AR_{p,t} - AR \right)^2 \right]^{1/2}, \tag{4}$$

where n = number of days in the impact period (I), defined as a sub-period within the event window, N = number of days in the event window, AR = average abnormal return calculated over the subset of the event window that does not include the impact period. Under the null of no abnormal returns, the T_2 statistics is distributed as a two-tailed t-Student with N-n-1 degrees of freedom.

The alternative method to the T_2 statistics used in this study is Dodd and Warner (1983)'s Z-statistics. For each firm i, we calculate the standardized abnormal return:

$$SAR_{i,t} = AR_{i,t} / S_{i,t}, \tag{5}$$

where $S_{i,t} = \left\{ S_i^2 \left[1 + \frac{1}{L_i} + \frac{(MKT_t - MKT)^2}{\sum_{\tau=1}^{L_p} (MKT_\tau - MKT)^2} \right] \right\}^{1/2}$.

We thus calculate the standarized cumulative abnormal return for each firm i:

$$SCAR_i = \sum_{t \in A} \frac{SAR_{i,t}}{\sqrt{n}}, \tag{6}$$

and finaly obtain the equally weighted Z-test statistics for each industry p:

$$Z = SCAR_p \sqrt{k_p}, \tag{7}$$

where $SCAR_p = \frac{1}{k_p} \sum_{i \in p} SCAR_i$ and k_p is the number of firms in industry p. Under the null of no abnormal standardized returns, Z is distributed as a standard normal.

IV. The sample and the events

The sample consisted of ordinary (voting) shares negotiated at Bovespa. The series was obtained from Economatica®, and was adjusted for dividends, splits, and grouping. However, following Mandelker (1974), Watts (1978), Asquith and Mullins (1986), and Osborne and Zaher (1992), we removed from our sample those companies that distributed or announced dividends, stock dividends, capital gains, splits, grouping, new stock offers, unresolved ownership disputes, mergers, buyouts, and acquisitions during the estimation period and event window. There is a problem that remains when this procedure is implemented, and to our knowledge it is not explicitly addressed in the literature investigated.[10] The benchmark market index does not exclude companies that may be under the effect of such events. Thus, in some occasions their abnormal returns may influence the test-result and imply that the industry analyzed is showing abnormal returns when in fact it is the market index that is abnormal. Such an issue seemed to play a role in one of the events analyzed below. We shall address it then.

Mergers and acquisitions were a serious problem in the Brazilian sample. During the entire period analyzed in this paper, financial institutions went through significant changes in ownership, not only due to the privatization program of state and federal banks, but also due to a fierce competition for higher stakes of the domestic market. In the non-financial sector many industries also went through similar processes of ownership transfers, but to a lesser extent.

Seven events of reserve requirement changes were analyzed. As shown in Table 4, events 1 to 4 refer to changes in reserve requirements on time deposits, and the three remaining events refer to changes in reserve requirements on transaction accounts. Table 4 also shows the non-event (estimation) period used for each event.

The estimation period selected for each event was the largest possible, given the number of changes in reserve requirements that occurred during the analyzed period. The selected events had their estimation window free of any possible influence from other reserve requirement changes. This is the reason why we selected so few events, compared to the universe of reserve requirement changes that have occurred since 1994.

For events 1 and 3, the estimation period spans a period prior to the event window. For events 4 to 7, we used a post-event estimation period because the

[10] We thank an anonymous referee for bringing this issue to our attention.

Table 4. Selected events

Event #	Announcement Date[1/]	Event	Estimation Period (EsP)	Business days in EsP	# of firms in the sample
1	Sep. 17th, 1998	Time deposits: instead of depositing reserves that accrued the TBC rate, banks were required to invest in federal securities	Jul. 13th, 1998 to Sep. 14th, 1998	45	70
2	May 6th, 1999	Time deposits: reduction in reserve requirement ratio to 25% from 26.5%	Apr. 19th, 1999 to May 4th, 1999 and May 24th, 1999 to Jun. 30th, 1999	38	83
3	Jul. 7th, 1999	Time deposits: reduction in reserve requirement ratio to 20% from 25%	May 24th, 1999 to Jul. 5th, 1999	30	75
4	Oct. 10th, 1999	Time deposits: reduction in reserve requirement ratio to 0% from 10%	Oct. 25th, 1999 to Mar. 10th, 2000	93	103
5	Mar. 14th, 2000	Transaction accounts: reduction in reserve requirement ratio to 55% from 65% [2/]	Oct. 25th, 1999 to Mar. 10th, 2000	93	84
6	Sep. 28th, 2000	Transaction accounts: reduction in reserve requirement calculation base	Oct. 19th, 2000 to Dec. 28th, 2000	48	73
7	Feb. 19th, 2003	Transaction accounts: increase in reserve requirement ratio to 60% from 45% and increase in exempted base	Mar. 19th, 2003 to Jun. 20th, 2003	64	64

Notes: [1/] We thank an anonymous referee for mentioning that in events 1, 2, 3, 5 and 7, the announcement was made after the market had closed. Therefore the D0 impact day was chosen as the first business day following the announcement. [2/] The previous ratio of 65% was applicable to demand deposits and deposits on notice. The ratio to other deposits that were also very short term was 60%.

period before the event had important economic announcements that could adversely impact the estimation of the market model. Distinctly from the other events, the estimation period of the second event was split in two. The number of days that could be used for the estimation period either before or after the event window was too small to allow for reasonable econometric inference. To prevent the event dynamics from having any impact on the estimation period, we left a span of 7 working days (12 week days) between the end of the event window and the beginning of that subset of the estimation window. The use of pre- and postevent estimation periods is not an innovation here (see, e.g., Osborne and Zaher 1992). Under the assumption that the event will only affect the stock return dynamics in the event period, the econometrician can choose pre-event, postevent or a mix of both for the estimation period.

For daily *T*-tests and the *Z*-tests, the event window tested here consisted of 6 business days (D-2 to D+3). D0 was either the announcement date, when it was made with the markets still open, or the business day that immediately followed the announcement, when it was made after markets had closed. For more robustness in the analysis, we let the event window be comprised of either 5 or 11 business days for cumulative *T*-tests. As the results for these two alternative event periods are very similar, Tables 6 and 7 report only the 5-day period. Specifically for event 4, the event window tested consisted of either 6 or 8 business days. The choice of the length of the event period is ad-hoc in the literature. In the literature that employs event-methods to detect abnormal returns from changes in reserve requirements in the United States, for instance, Dann and James (1982) and Kolari et al. (1988) use a 26-business day event period whereas Osborne and Zaher (1992) use an 11-day window. A rule of thumb is that the event period should not be too short to let out eventual price corrections or too lengthy to be contaminated by normal price dynamics or other innovation. A lengthy period would be more problematic in the Brazilian case because of the high frequency of news that impact stock returns in the country, both at a macro level, affecting all listed companies alike, and at more micro levels, affecting only a subgroup of listed companies.

There are two representative benchmark rates that can be used in Brazil: Ibovespa and IbrX. Both are traded in Bovespa, the main stock exchange in Brazil, but significantly differ as to their calculation methodologies. Ibovespa's theoretical portfolio dates from 1968 and accounts for around 80% of the amount and financial volume traded in the spot market. IbrX, on the other hand, comprises

the 100 stocks with the greatest number of negotiations and financial volume traded.

V. The results

Table 5 shows the results of the market model estimation and the tests for abnormal returns using Dann and James (1982)'s T-tests and Dodd and Warner (1983)'s Ztest. As the market model estimations using IBrX had a better performance (Table A1 in Appendix), we chose to test for abnormal returns using the IBrX as the proxy for the market return.

For each event we tested the null hypothesis of no abnormal returns in the event period. We will first analyze each event separately and then draw general conclusions.

In event 1, the central bank changed the regulation on reserve requirements on time deposits by requiring banks to comply with the requirement by investing in federal securities. The regulation that was previously in place required banks to deposit reserves at the central bank, accruing the TBC interest rate, which was lower than the rates accrued to federal securities. Thus, this change in reserve requirement regulation would be expected to cause net positive abnormal returns to the banking industry and/or to the non-financial system over the event window. However, two days prior to the announcement, there were significant negative abnormal returns in banks' stocks. On that specific day, there is no evidence in the newswires of any false rumor about a change in reserve requirements. Thus, negative abnormal returns in the banking industry are likely to have occurred because of a temporary overreaction of the benchmark market return stemming from a previous successful auctioning of a domestic energy generation firm (Gerasul).

The tests for cumulative abnormal returns over the entire event period are sensitive to the methodology employed. Using Dann and James (1982)'s twotailed T-test statistics, we found no evidence of cumulative abnormal returns in the stocks of the financial or non-financial system. Notwithstanding, Dodd and Warner (1983)'s Z-test points to significant cumulative negative abnormal returns to the banking industry even at the 99% confidence level. There is an important methodological difference between these two test alternatives. Whilst the T-test for cumulative abnormal returns uses a stock return series that is weighted by the daily traded financial volume, the Z-test is equally weighted. Therefore, significant

abnormal returns of stocks that are less liquid will be attributed greater importance by the Z-test than by the T-test.

The Z-test result for the banking industry is probably capturing not only the exaggeration in the benchmark market index on the first day of the event period but also a negative reaction on the last day caused by some news that Standard and Poor's had lowered the outlook for the external debt of the country and of 3 privately-owned banks, amongst which was Unibanco, included in the sample analyzed in the event.

The *T*-test, on the other hand, is highly influenced by the neutrality of the event in the stock returns of Banco do Brasil, the bank by far with the highest financial volume traded over the event. This neutrality is ambiguous, though. One could reason that if it had not been for the positive news about the reserve requirements, the turmoil surrounding the domestic economy (e.g., capital flight, increased interest rates, debt downgrading) would have caused important negative abnormal returns to the stocks of Banco do Brasil. As we do not know of a way to solve this issue, we take the more conservative stance of interpreting the results as suggesting that this change in reserve requirement regulation was neutral to the banking industry.

In the non-financial system, the *Z*-test indicates significant cumulative positive abnormal returns. The presence of stocks of non-financial firms (albeit not the most liquid ones) being positively affected by this change in required reserves on time deposits can thus suggest that the change was interpreted as a relief of the tax burden imposed to the non-financial system.

In events 2, 3 and 4, the central bank reduced the ratios of reserve requirements on time deposits. Although the absolute reduction was most pronounced in the last events, abnormal returns in the financial system were only observed in event 2. The *T*-tests for daily abnormal returns indicate positive abnormal returns in bank stocks on the day prior to the announcement and on the three days following the announcement. The *Z*-test result for cumulative abnormal returns in the banking industry is also in line with the daily *T*-tests, and suggests a significant positive abnormal return to bank shareholders in the event period.

The evidence of abnormal returns to the banking industry only in event 2 suggests that banks' shareholders may have anticipated the future downward trajectory of required ratios, as the central bank had previously announced that reduction of reserve requirements was a medium term goal.

That may also have been the case for the non-financial system. Although daily and cumulative *T*-tests do not support the evidence of abnormal returns in event

2, the *Z*-test rejects the null hypothesis at the 99% confidence level. Once again, the difference in the test results stems from the distinct weighting methodology of each test.

We should thus interpret these results as supporting the evidence that for corporate stocks that are not highly liquid, reserve requirements on time deposits are a tax shared amongst banks' clients and owners. These conclusions contrast with those in Cardoso and Koyama (1999). Our view is that, in spite of yielding market returns on securities, the fact that reserve requirements on time deposits require banks to allocate their portfolio in a certain class of investment may be in itself distortional. It may also be misleading to assume that these types of reserve requirements do not impose any kind of burden to the real sector.

We now turn to changes in reserve requirements on transaction accounts in Table 6. Event 5, which reduced the required ratio by 10 percentage points, had a neutral effect on the stock returns of the non-financial system. This evidence holds for both *T*- and *Z*- tests. On the other hand, although daily *T*-tests and the cumulative *Z*-test did not point to significant abnormal bank stock returns, cumulative *T*-tests strongly reject the null for both the sub-period following the announcement and for the entire event period. We thus interpret these results as suggesting that banks whose stocks were highly traded during the event period were significantly more impacted by these changes in reserve requirements than those with low negotiation volumes. Under this reasoning, required reserves on transaction accounts would be interpreted as a tax born upon banks' shareholders, and not clients.

Event 6, which exempted one liability account from the taxable base, had a significant impact on bank stock returns two days prior to the announcement. However, this impact was offset throughout the event period, and both cumulative *T*- and *Z*-tests could not reject the null hypothesis of no abnormal return.

The daily and cumulative *T*-tests do not indicate presence of abnormal returns in the non-financial sector. On the other hand, the *Z*-test points to counter-intuitive negative cumulative abnormal returns in the event period (at a 90% confidence level). Traded volume in the stock exchange was very low over the event period due to uncertainty stemming from the international environment and negative news from major foreign stock exchanges. We thus take the conservative stance of accepting the results of the *T*-tests as indicative that this change in the reserve requirement regulation had a neutral impact on both the banking and the nonbanking industry.

Table 5. Tests for abnormal returns with aggregated portfolios: events 1 to 4

Event	Event day	D-2	D-1	D0	D+1	D+2	D+3	Σ D-2 to D0	Σ D+1 to D+3	Σ D-2 to D+3
1 financial	Abnormal return	-8.80%	3.30%	0.80%	0.40%	-1.10%	-3.80%	-4.80%	-4.40%	-9.20%
	t-test (5 day)	-3.22***	1.39	0.33	0.18	-0.47	-1.6	-1.29	-0.4	
	Z-test									-17.78***
1 non-financial	Abnormal return	1.60%	-3.30%	1.20%	-1.80%	-0.60%	2.30%	0	0	-0.01
	t-test (5 day)	0.77	-1.62	0.61	-0.88	-0.3	1.15	-0.13	-0.01	
	Z-test									3.06***
2 financial	Abnormal return	-0.20%	4.10%	1.30%	2.80%	3.50%	2.70%	5.30%	9.00%	8.30%
	t-test (5 day)	-0.11	2.69**	0.89	1.88*	2.37**	1.78*	6.55**	2.4	
	Z-test									3.02***
2 non-financial	Abnormal return	1.80%	1.00%	0.40%	1.10%	-1.00%	-2.30%	3.10%	-2.10%	2.50%
	t-test (5 day)	1	0.59	0.2	0.65	-0.55	-1.3	1.05	-1.74	
	Z-test									4.50***
3 financial	Abnormal return	1.30%	-0.10%	0.80%	1.60%	-1.70%	1.00%	2.00%	0.90%	2.30%
	t-test (5 day)	1.07	-0.08	0.63	1.28	-1.37	0.82	0.66	0.75	
	Z-test									0.21
3 non-financial	Abnormal return	0.20%	0.30%	1.50%	2.10%	-1.40%	1.40%	2.00%	2.20%	3.90%
	t-test (5 day)	0.16	0.32	1.45	2.09**	-1.35	1.38	0.61	1.74	
	Z-test									0.14
4 financial	Abnormal return	3.60%	0.60%	-0.30%	-1.80%	-1.80%	-0.50%	3.90%	-4.10%	-1.50%
	t-test (5 day)	1.58	0.27	-0.14	-0.79	-0.77	-0.22	3.02*	-1.15	
	Z-test									0.37
4 non-financial	Abnormal return	-0.01	0.01	0.01	0	-0.01	0	1.40%	-1.60%	1.50%
	t-test (5 day)	-0.32	0.47	0.57	-0.23	-0.73	0.12	0.98	-1	
	Z-test									1.24

Notes: Source of data is IBx. 5 day stands for 5 day event period. *, ** and * rejects null hypothesis at 0.10, 0.05 and 0.01 level (two-tailed test).**

In event 7, the central bank increased the reserve requirement ratio and also increased deductions from the taxable base. Contrary to the events analyzed above, this change was justified purely as a monetary policy decision. However, the event was contaminated by a concomitant central bank decision to increase basic interest rates. Although we cannot conclude that evidence of abnormal returns during this event would be solely or even partially due to the change in reserve requirements, it should be interesting to check whether the use of two instruments together to further restrict monetary conditions would cause negative abnormal returns in the stocks of the non-financial sector.

In the non-financial sector, the event induced negative abnormal returns on the day following the announcement. Cumulative *T*-tests also point to negative abnormal returns over the sub-period after the announcement and over the entire event period. However, and surprisingly, the *Z*-test points to positive abnormal returns over the event period. In this particular event, we find that the *T*-tests are to be more trusted than the Z-test for the non-banking sector. On the second day of the event, a particular firm stock (Telebras Remanescente ON) posted a 100% daily return, partially offset the following day, but with negligible traded volume.

On the other hand, the *Z*-test for the banking industry points to negative abnormal returns over the event period, whereas the daily and cumulative *T*-tests present no evidence of abnormal returns. This time, the banks more severely affected by the event were the ones whose stocks had lower financial negotiation.

Looking at these results, we conclude that reserve requirements on transaction accounts in Brazil were not a tax born exclusively by banks' clients. From the events that were not contaminated by concomitant monetary policy decision, we further infer that they are a tax born solely by banks' shareholders, and thus not operative for the credit channel of monetary policy. This latter conclusion should be taken with caution, as it is derived from two events only. We advise that in the future more events be analyzed to draw more robust conclusions.

Our findings are in line with most papers that investigate the incidence of reserve requirements using event-study methods. Kolari et al. (1998), Slovin et al. (1990), Osborne and Zaher (1992), Cosimano and McDonald (1998), and Hein and Stewart (2002, 2003) all find that reserve requirements are a tax shared by banks' shareholders and clients in the US. Slovin et al. (1990) go on further to argue that in this case they are not an efficient instrument of monetary policy.

Table 6. Tests for abnormal returns with aggregated portfolios: events 5 to 7

Event	Event day	D-2	D-1	D0	D+1	D+2	D+3	Σ D-2 to D0	Σ D+1 to D+3	Σ D-2 to D+3
5 financial	Abnormal return	0.80%	0.00%	0.60%	3.00%	-0.10%	-0.40%	1.40%	2.50%	3.60%
	t-test (5 day)	0.35	0.02	0.29	1.43	-0.05	-0.19	0.43	3.78*	
	Z-test									-1.03
5 non-financial	Abnormal return	0.20%	0.20%	0.70%	0.10%	0.00%	-0.50%	1.10%	-0.40%	1.00%
	t-test (5 day)	0.09	0.08	0.32	0.05	-0.02	-0.21	2.15	-0.74	
	Z-test									0.45
6 financial	Abnormal return	-3.60%	-1.10%	0.10%	-1.10%	1.60%	-0.30%	-4.60%	0.20%	-2.20%
	t-test (5 day)	-2.88***	-0.9	0.06	-0.91	1.29	-0.26	-1.89	0.05	
	Z-test									-0.46
6 non-financial	Abnormal return	0.60%	1.00%	-0.40%	0.20%	1.30%	0.10%	1.10%	1.60%	0.80%
	t-test (5 day)	0.53	0.93	-0.39	0.18	1.24	0.06	0.95	1.26	
	Z-test									-1.87*
7 financial	Abnormal return	0.60%	-2.60%	0.70%	0.00%	-1.20%	1.30%	-1.20%	0.20%	-1.80%
	t-test (5 day)	0.23	-0.91	0.27	0.01	-0.43	0.48	-0.54	0.05	
	Z-test									-8.71***
7 non-financial	Abnormal return	0.50%	-0.20%	0.80%	-5.90%	-0.40%	-1.30%	1.10%	-7.60%	-5.30%
	t-test (5 day)	0.48	-0.16	0.75	-5.75***	-0.4	-1.22	0.22	-9.13**	
	Z-test									2.84***

Notes: Source of data is IBx. 5 day stands for 5 day event period. *, ** and * rejects null hypothesis at 0.10, 0.05 and 0.01 level (two-tailed test).**

VI. Conclusion

In this paper we tested the hypothesis of shared incidence of reserve requirements in Brazil. By employing an event-study method, we investigated whether changes in reserve requirements on transaction accounts and time deposits caused abnormal stock returns in the financial and non-financial sector of the economy.

The results obtained are sensitive to the test procedure adopted, implying that the conclusions should be taken with caution. What is reported below is based on a discretionary choice by the authors of taking a more conservative stance upon choosing among conflicting test results.

Some results from the aggregate portfolio model oppose the assumption that interest bearing required reserves on time deposits are not distortional. In one of the events investigated, there is evidence that a reduction in required ratios caused positive abnormal returns to the banking industry. The results also oppose the assumption that reserve requirements on time deposits are neutral to non-financial corporations. In spite of yielding market returns on securities, the fact that reserve requirements on time deposits require banks to allocate their portfolio in a certain class of investment may be in itself distortional. It may also be misleading to assume that these types of reserve requirements do not impose any kind of burden to the real sector. In two events investigated, stock returns of the non-financial system were positively impacted by announcements that the required ratio would fall or interest accrued on the required reserves would increase to market rates.

Some authors (e.g., Slovin et al. 1990) advocate that when reserve requirements affect stock returns of non-financial corporations, then reserve requirements are a non-neutral instrument of monetary policy. However, when fiscal concerns drive reserve requirement decisions, as has been the case on a number of occasions in Brazil, we could extend this argument to state that reserve requirements are a nonneutral instrument of fiscal policy when stock returns of non-financial firms are affected by these requirements.

Of the two events that were most likely not contaminated by concomitant decisions on basic interest rates, changes in reserve requirements on transaction accounts were neutral to the non-financial sector, implying that if reserve requirements on transaction accounts were being used to affect the credit channel of monetary policy, they were inefficient. In one of these events, the banking industry seems to have benefited from the change, thus suggesting that the tax implied by these required reserves was most likely born by banks' shareholders.

Importantly, as banks' shareholders bear part or (as the events analyzed here

suggest) the bulk of the burden of reserve requirements, reductions in their ratios are likely to be of limited impact in bank spreads. In this respect, this paper adds support to the work of Nakane and Koyama (2001a,b) and Afanasieff et al. (2002), where the authors find no significant relation between reserve requirements and bank spreads on bank loans in Brazil.

Appendix

Table A1. Estimation of the market model for the financial and non-financial systems using OLS

A. Financial system							
Event	Data source	β	t-test	p-value	R2	F	p-value
1	Ibovespa	1.13	6.24	0.00	0.48	39.00	0.00
	IBx	1.32	6.90	0.00	0.53	47.65	0.00
2	Ibovespa	1.06	4.10	0.00	0.32	16.80	0.00
	IBx	1.23	4.40	0.00	0.35	19.33	0.00
3	Ibovespa	1.07	4.62	0.00	0.43	21.35	0.00
	IBx	1.27	5.16	0.00	0.49	26.61	0.00
4	Ibovespa	1.21	4.01	0.00	0.15	16.05	0.00
	IBx	1.53	4.53	0.00	0.18	20.51	0.00
5	Ibovespa	0.50	1.83	0.07	0.04	3.35	0.07
	IBx	0.61	2.00	0.05	0.04	3.98	0.05
6	Ibovespa	1.12	5.70	0.00	0.41	32.48	0.00
	IBx	1.35	5.85	0.00	0.43	34.28	0.00
7	Ibovespa	1.70	3.67	0.00	0.18	17.50	0.00
	IBx	1.48	2.05	0.05	0.06	4.19	0.04
B. Non-financial system							
Event	Data source	β	t-test	p-value	R2	F	p-value
1	Ibovespa	2.28	14.82	0.00	0.84	219.56	0.00
	IBx	2.57	15.60	0.00	0.85	243.39	0.00
2	Ibovespa	1.93	6.38	0.00	0.53	40.72	0.00
	IBx	2.18	6.59	0.00	0.55	43.49	0.00
3	Ibovespa	1.74	8.81	0.00	0.73	77.57	0.00
	IBx	1.99	9.64	0.00	0.77	92.98	0.00
4	Ibovespa	1.73	6.91	0.00	0.34	47.78	0.00
	IBx	2.05	7.29	0.00	0.37	53.15	0.00
5	Ibovespa	1.89	6.51	0.00	0.32	42.43	0.00
	IBx	2.16	6.53	0.00	0.32	42.69	0.00
6	Ibovespa	1.55	8.52	0.00	0.61	72.60	0.00
	IBx	1.93	9.64	0.00	0.67	92.95	0.00
7	Ibovespa	1.41	7.66	0.00	0.49	58.67	0.00
	IBx	2.08	7.75	0.00	0.49	60.11	0.00

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