THE IMPACT OF STATE OWNED BANKS ON INTEREST RATES SPREAD

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Abstract

This paper develops the hypothesis that the co-existence of state owned banks with privately owned banks together tends to raise interest rates spreads and profitability of privately owned banks. This hypothesis can help explain the relationship between the share of state owned banks on total banking assets and economic growth, as reported in the literature. Three empirical tests of the two parts of the main hypothesis are presented. Two of them rely on Brazilian monthly time series data and the other one uses a cross section regression with data for a sample of countries. One of them builds on an estimation of an expanded version of the composition of a rate of return of an asset under the market efficient hypothesis. Another one estimates a factor augmented vector autoregression (FAVAR) model. All of these tests give support to the hypotheses tested.

Sumário

Este trabalho desenvolve a hipótese de que a co-existência de bancos públicos com bancos privados tende a aumentar os *spreads* das taxas de juros e o lucro dos bancos privados. Esta hipótese pode ajudar a explicar a relação entre a participação dos bancos públicos nos ativos totais das instituições financeiras e o crescimento econômico, como é descrito na literatura. Três testes empíricos que compõem as duas partes da hipótese central são apresentados. Dois deles baseiam-se em séries temporais mensais brasileiras e o outro utiliza uma regressão *cross section* para dados de uma amostra de países. Um dos testes baseia-se na hipótese do mercado eficiente e estima uma versão expandida da equação de composição da taxa de retorno de um dado ativo. Um outro teste estima uma autoregressão vetorial aumentada por fatores (FAVAR). Todos esses testes dão sustentação às hipóteses testadas.

Key Words: State owned banks; Interest rate spreads; banking profitability; FAVAR
Palavras-Chave: Bancos públicos; *Spread* de taxas de juros; lucros bancários; FAVAR
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1. Introduction

State Owned Banks (SOBs) have been the focus of many studies lately.[1] Most of these studies have focused on their ability to promote economic growth and financial development. There was an original view among development economists that several market failures took place in the financial sector, especially in developing countries,[2] which could justify the introduction of State Owned Banks as a market player that could improve social welfare. Nevertheless, more recent studies have pointed that perhaps such market failures are not adequately tackled by state ownership and proper regulation could have a more efficient role to improve welfare.[3]

There are four sources of justification for state intervention in the banking sector.[4] They are: (i) avoiding crises in the financial sector, which can emerge from its intrinsic potential instability;[5] (ii) reducing the perverse effect of asymmetric and costly information, which jeopardize the efficiency of this market; (iii) financing projects relying proportionally more on social returns, rather than on private returns only, which implies in taking into consideration externalities emerging from the projects; (iv) expanding the access to financial services for poor and isolated populations. All of them rely on the hypothesis that there are failures in the financial services markets.

These failures could justify two types of state interventions. The first one is a direct involvement in the sector through the establishment of state owned banks. The second one is a regulatory intervention, combined with some subsidies, which could bias the market outcome to socially welfare-improved equilibrium. This first alternative was widely used in the sixties and seventies, even in industrial economies. Calculations by Micco and Panizza (2004) indicate that in 1970 almost 40% of the banking assets in industrial economies were in hands of SOBs. This number reached more than 90% in South Asia and more than 60% in Latin America. Although these shares have been falling all around the world, in 2002 they were still high and reached 10% in industrial economies, more than 60% in South Asia and more than 15% in Latin America. Nevertheless, the attraction of this alternative has been falling lately, as these data indicate.

Recent theoretical developments have pointed the existence of many inefficiencies arising from the confidence on SOBs as a policy instrument, relying heavily on the literature on the efficiency of State Owned Enterprises.[6] The major setbacks are: (i) politicization of resource allocation decisions;[7] (ii) incentives to corruption;[8] and (iii) high costs of control. All these setbacks are also identified on the state owned banks, although most criticism of their performance is empirical.[9]

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[1] For good surveys, see Yeyati, Micco and Panizza (2004 and 2005).
[2] See, for example, Lewis (1950 and 1955), Gerschenkron (1962), Wai (1956) and Patrick (1966).
[3] See, for example, La Porta, Lopez-de-Silanes and Shleifer (2002).
[4] Extracted from Yeyati, Micco and Panizza (2004).
[5] See, for example, Stiglitz (1994).
[6] For surveys, see Shleifer (1998) and Meggison (2003 and 2004).
[7] See, for example, Shleifer and Vishny (1994) for the general argument and Sapienza (2004), Khawaja and Mian (2004) and Kane (1977) for the particular argument on the banking industry.
[8] See, for example, Khawala and Mian (2004).
[9] Some of the major references are La Porta, Lopez-de-Silanes and Shleifer (2002) and Yeyati, Micco and Panizza (2004). See also Sapienza (1999).

This paper focuses on a particular source of inefficiency generated by state owned banks, which very often arises on developing countries, when SOBs compete in the market with private institutions and there are barriers to access the banking market. In such cases, SOBs are often used as financial instruments for public policies. As a consequence, they carry some costs of these policies and push up equilibrium prices on the market for their services. As a consequence, they increase the profits of local private banks and can even lead to higher banking spreads.

Higher profits and banking spreads have two important economic consequences. First of all they can slow down long-term economic growth, and, in this case, the theoretical relationship stressed here, together with theoretical results reached by Antunes, Cavalcanti and Villamil (2005),[10] would help justify the results forwarded by La Porta, Lopez de Silanes and Shleifer (2002) and to some extent by Yeyati, Micco and Panizza (2004 and 2005). Higher interest rates should also reduce the relationship between private agents debts and GDP, what could also help explain the relationship between the degree of indebtedness and growth, as has also been stressed by some empirical studies.[11]

Higher interest rate banking spreads can also lead to higher income concentration. Two are the reasons for that. Firstly, the higher income agents tend to have higher share of private banks stocks. Secondly, higher interest rates tend to increase the income of all assets holders, not only bank shareholders. High income agents normally extract a higher share of their income from assets yields. Therefore, their income tends to rise more or fall less with the increase of assets returns.[12] This could also be another source of slowing down economic growth, as there is a vast literature that indicates that income concentration can harm economic growth.[13]

This paper is organized as following. The next two sections present a model which gives support to the main hypotheses of this paper and section 4 develops some tests of the main hypotheses. Section 6 summarizes the conclusions and discusses some policy implications of the model.

2. Modelling a banking market with SOBs and POBs

The major hypothesis of this paper is that when governments enforce state owned banks to bear part of the transaction costs of public policies, they force such banks in their optimal strategy to push up the prices of their services. This increases the relative competitiveness of privately owned banks (POB) and also allows than to practice higher prices on their services, which is not matched by proportionally higher costs. Therefore, they benefit from higher profits and higher spread of interest rates paid and charged from their customers. Restrictions to enter in the banking market assure that these higher profits and spreads are not worn out by competition.

A second hypothesis presented by this paper is that when there is an increase in the salaries of employees of the SOB, there is also an increase on the profits of privately owned banks and the spread they charge on interest rates. The intuitive explanation for this hypothesis is very similar to the previous one, in which there is a higher burden from public policies. SOBs are forced to increase their prices (spreads) and the POBs benefit from higher demand and the possibility of charging more for their services, which also means charging higher spreads between borrowing and lending interest rates.

[10] They show that intermediation costs, which increase interest rates spreads, reduce long-term growth in the economy.
[11] See, for example, Beck, Levine and Loayza (2000).
[12] This hypothesis is developed in a formal model by Cavalcanti and Villamil (2005).
[13] This relationship is still under dispute in economics, as some empirical and theoretical studies indicate that such relationship must hold, while others argue that the relationship is inverse. Galor and Moav (2004) and Alesina (1994) forward models that justify such relationship and Persson and Guido (1994) and Perotti (1996) reached empirical results in support of such hypothesis. Banerjee (2003) and Forbes (2000) support the inverse relation hypothesis, which is justified theoretically by the traditional Neoclassical models in economics.

Although the simple intuition is very appealing, a more thorough understanding of these hypotheses could be reached through a formal model, which is presented henceforward.

Both types of banks are service suppliers that employ some inputs to offer specific services, in exchange for payments. In general, banks have two major functions, which are receiving deposits and lending funds to firms and citizens. In their first function, they pay an interest to depositors. In their second function they earn an interest on the funds lent. Their incomes come from a spread among these two interest rates. Therefore, it is possible to define a full transaction of these institutions as a unit of service or output. A full transaction involves a unit loan with the consequent deposits that are necessary to make this loan. The unit in which these full transactions are measured could be a monetary unit. Collection of payment of bills and other services are even simpler to be seen as services provided in exchange for a payment. Nevertheless, to simplify the argument, the developments below will focus only on this service previously described, which is a chain of monetary resources collection and its loan to another agent who is willing to pay an interest on its immediate availability. In this sense, the interest rate spread is the price charged by banks for its services.

Banks face a demand for their outputs, which is similar to what is found in most industries. Working under monopolistically competitive markets, they face a negative correlation between the price they get for a transaction and the total amount of services sold. If they attempt to increase loans and capture more customers, they will have to reduce interest rates charged on loans or to increase their borrowing rates. Partial information and the tendency of costumers to sticky to their suppliers explain this relationship. Furthermore, an extra loan made will be more risky. Consequently, its gains will also be lower than before. These facts imply that the marginal spread from a full transaction, which is the price of the banking service, is lower when the amount of transactions increases. Therefore, the demand function for the output of banks can be represented as:

$$Y_i = B_i P_i^{-\eta} P^{\delta\eta} \qquad (1)$$

Where Y_i is the demand for services of a representative bank of type i, for i=S or i=P, for a state owned bank or a privately owned bank, respectively. P_i is the price of a unit transaction, which is the spread obtained by the representative bank of type i. P is a market reference price for all the banks, which will be better defined subsequently. B_i is a market power coefficient, which determines the quantity and quality of clients each financial institution can attract. η is a parameter, so that $\eta>1$.[14] It measures the level of competition among institutions and the relative fidelity of their customers. More formally, it is the price elasticity of the demand faced by financial institutions.

The inclusion of P in this equation is a consequence of the potential substitution by customers. If prices of other institutions rise, consumers will shift part of their demand for these representative institutions, so that it will sell more services at the same price it had before. δ in this model is such that $0<\delta<1$. This implies that the elasticity of demand with respect to its own price is higher than this same elasticity with respect to the index of other banks prices.

The sectorial price index P is defined as:[15]

$$P = P_S^{\frac{a}{1+(a+m)\delta}} P_P^{\frac{m}{1+(a+m)\delta}} \qquad (2)$$

[14] This is necessary to assure that when Y grows, so does the total revenue from sales in this market if there is no consumer surplus.

[15] Appendix A justifies the use of such weighted geometric mean.

Where *a* is the number of state owned banks and *m* is the number of privately owned banks in the economy. These numbers will be both taken as given, as there are several barriers to entry in this market in most countries, including legal approval by Central Banks in some cases.

The higher the coefficient B_i is, the larger is the market power of a financial institution. The value of B_i for a particular financial institution depends on: (i) the social capital of its managers and (ii) its reputation in the market. The higher the social capital of its manager, the lower will be the incentive to default of his/her clients.[16] The higher this social capital, the lower will be the adverse selection and moral hazard problems faced by the firm.

In this model, two different assumptions will be made for the two Bs. While B_P is exogenous and fixed, B_S is not given. It varies according to the public policies burden SOBs have to carry. Therefore, it is possible to define:

$$B_S = BR^{\gamma} \qquad (3)$$

Where R is the total expenditures on public policies management and services provision. B is a constant and γ is a parameter such that $0<\gamma<1$. This restriction implies that the higher the burden of public policies the less internally efficient the state owned banks will be in order to benefit from their management, through fidelity expansion of potentially good customers and sales of other services for the customers attracted by these policies. It is also reasonable to assume that $R>0$.

These banks face a production function similar to the one of any other sector. For simplicity, it will be assumed that they only employ labour as a factor of production. Therefore, when the amount of labour employed increases, so does the output. Nevertheless, this relationship is not linear, as a consequence of some factors:

(i) Economies of scale. Capturing an extra unit of transaction demands more labour and some resources, but it does not demand an increase of all the resources in the proportion. Physical installations, for example does not have to expand in the same proportion. This leads to decreasing marginal cost of output.

(ii) For a given market structure, capturing an extra unit of resource will involve higher cost of advertising or higher interest rate paid. This extra cost involves extra resources for this additional unit of transaction. This makes the marginal cost to be higher for each extra unit, as each time it becomes more difficult to be captured.

(iii) Agency costs. When there are additional transactions, the cost to control managers and their incentives to sheet also increase. Therefore, the costs tend to increase more than proportionally and this fact leads to increasing marginal cost of output.

(iv) Falling productivity of additional labour. Oncoming workers normally will have less qualification than those previously selected by firms.

Although the non-linearity of the production function is not obvious from these causes, it will be assumed that the effect of economies of scale is overcome by the three others and there is increasing marginal cost of output.[17] Therefore, this production function may be defined as following:

$$Y_i = A_i L_i^{\rho} \qquad (4)$$

Where Y_i is the total output of firms in sector i, L_i is the amount of hours of labour used in production and A_i is a productivity parameter, which is assumed as constant. ρ is a fixed parameter

[16] For an empirical study which supports this hypothesis, see Guiso, Sapienza and Zingales (2004).
[17] This is a standard assumption in economics, but it is not fully necessary to some conclusions ahead.

with $0<\rho<1$, so that there is decreasing marginal return in the production function or increasing marginal cost.

Given these specifications, the problem of the managers of private banks is to choose Y_P to maximize:

$$\pi_P = B_P^{\frac{1}{\eta}} P^{\delta} Y_P^{\frac{\eta-1}{\eta}} - w_P \left(\frac{Y_P}{A_P} \right)^{\frac{1}{\rho}} \tag{5}$$

Where w_P is the wage rate of private banks employees. In the same way, state owned banks managers have to choose Y_S to maximize their profit function:

$$\pi_S = B^{\frac{1}{\eta}} R^{\frac{\gamma}{\eta}} P^{\delta} Y_S^{\frac{\eta-1}{\eta}} - w_S \left(\frac{Y_S}{A_S} \right)^{\frac{1}{\rho}} - \varphi R \tag{6}$$

Where φ is the share of R that effectively represents cost to the SOBs, as a consequence of their management of public policies expenditures and w_S is the wage rate of public banks employees.

First order condition for the problems defined in equations (5) and (6) yields:

$$Y_P^{\frac{1-\rho}{\rho}+\frac{1}{\eta}} = \left(\frac{\eta-1}{\eta} \right) B_P^{\frac{1}{\eta}} P^{\delta} \frac{\rho}{w_P} A_P^{\frac{1}{\rho}} \tag{7}$$

and

$$Y_S^{\frac{1-\rho}{\rho}+\frac{1}{\eta}} = \left(\frac{\eta-1}{\eta} \right) B^{\frac{1}{\eta}} R^{\frac{\gamma}{\eta}} P^{\delta} \frac{\rho}{w_S} A_S^{\frac{1}{\rho}} \tag{8}$$

These two equations, together with equation (2) and the two demand functions represented by equation (1) determine simultaneously the equilibrium values for Y_P, Y_S, P_P, P_S and P.

It is possible to substitute these two equations on the profit functions defined in equations (5) and (6) to obtain:

$$\pi_P = B_P^{\frac{1}{\eta}} P^{\delta} Y_P^{\frac{\eta-1}{\eta}} \left[1 - \rho \left(\frac{\eta-1}{\eta} \right) \right] \tag{5'}$$

and

$$\pi_S = B^{\frac{1}{\eta}} R^{\frac{\gamma}{\eta}} P^{\delta} Y_S^{\frac{\eta-1}{\eta}} \left[1 - \rho \left(\frac{\eta-1}{\eta} \right) \right] - \varphi R \tag{6'}$$

If $Y_P>0$ and $P>0$, equation (5′) implies that $\pi_P>0$, given the postulated values for the parameters. Nevertheless, even if $Y_S>0$ and $P>0$, π_S can be negative if R is too large. Equation (5′)

indicates that if the impacts on Y_P and P of a change in R or w_S are determined, it is also possible to establish the impact on π_P. The qualitative analysis of such impacts is the object of next section.[18]

3. The impact of changes in the policy burden and of state owned banks salaries on the profit of privately owned banks

The two demand functions represented in equation (1) can be used to substitute for P_P and P_S in equation (2). As a consequence, equations (7), (8), and this new version of equation (2) together can determine Y_P, Y_S and P, simultaneously. Taking natural logarithm from these three equations, the system they form can be represented in a matrix form as:

$$\begin{vmatrix} \frac{1}{1+(a+m)\delta} & \frac{a}{\eta[1+(a+m)\delta]} & \frac{m}{\eta[1+(a+m)\delta]} \\ -\delta & 0 & \frac{1-\rho}{\rho}+\frac{1}{\eta} \\ -\delta & \frac{1-\rho}{\rho}+\frac{1}{\eta} & 0 \end{vmatrix} \begin{vmatrix} \ln P \\ \ln Y_S \\ \ln Y_P \end{vmatrix} = \begin{vmatrix} \frac{a\gamma}{\eta[1+(a+m)\delta]}\ln R \\ \ln\left(\frac{\eta-1}{\eta}\right)+\ln\left(\frac{\rho}{w_P}\right) \\ \ln\left(\frac{\eta-1}{\eta}\right)+\ln\left(\frac{\rho}{w_S}\right)+\frac{\gamma}{\eta}\ln R \end{vmatrix} \quad (9)$$

From these equations, it is possible to get:

$$\Delta = -\left[\frac{1-\rho}{\rho}+\frac{1}{\eta}\right]\left(\frac{1}{1+(a+m)\delta}\right)\left[\frac{1-\rho}{\rho}+\frac{1}{\eta}+\frac{\delta(a+m)}{\eta}\right] < 0$$

$$\Delta_{1R} = -\frac{\gamma a(1-\rho)}{\eta[1+(a+m)\delta]\rho}\left(\frac{1-\rho}{\rho}+\frac{1}{\eta}\right) < 0 \qquad \Delta_{3R} = -\frac{\delta\gamma a(1-\rho)}{\eta[1+(a+m)\delta]\rho} < 0$$

$$\Delta_{1Ws} = -\frac{a}{\eta[1+(a+m)\delta]}\left(\frac{1-\rho}{\rho}+\frac{1}{\eta}\right) < 0 \qquad \Delta_{3Ws} = -\frac{\delta a}{\eta[1+(a+m)\delta]} < 0$$

and:

$$\frac{\partial \ln P}{\partial \ln R} = \frac{\Delta_{1R}}{\Delta} > 0 \quad (10)$$

$$\frac{\partial \ln Y_P}{\partial \ln R} = \frac{\Delta_{3R}}{\Delta} > 0 \quad (11)$$

$$\frac{\partial \ln P}{\partial \ln w_S} = \frac{\Delta_{1Ws}}{\Delta} > 0 \quad (12)$$

$$\frac{\partial \ln Y_P}{\partial \ln w_S} = \frac{\Delta_{3Ws}}{\Delta} > 0 \quad (13)$$

Equations (10) and (11), when combined with equation (5′), imply that the profit of POBs, π_P, rises when there is an increase in the burden of public policies for state owned banks, R. In the same

[18] The restrictions to the parameters assure that second order condition for a maximum is always satisfied.

way, equations (12) and (13), together with equation (5´), also imply that there is a rise in π_P when w_S increases. The results for the impact on the spread charged by POBs when these two variables, R and w_S, increase are seen directly from equations (10) and (12), respectively. Therefore, the solution of this model reaches the following conclusions:

i. When there is an increase in the burden of public policies for SOBs, there is a rise in the profits of POBs and the interest rates spreads charged by the banking sector in the economy.
ii. When the salaries of employees of SOBs are raised, profits of POBs and interest rates spreads in the economy also rise.

4. Empirical tests

The main hypothesis of this paper is that when there is an increase in the costs of SOB as a consequence of the burden of public policy costs, there are increases in interest rates spreads and in the profitability of private banks. The two parts of this hypothesis will be tested separately. Therefore, two hypotheses will be tested. One that checks the existence of a positive impact of the costs of SOBs on the profitability of privately owned banks. The second one tests the existence of a positive impact of costs of SOB on the banking spreads.

4.1. Test of the impact on profitability

The test for this hypothesis lay on data for some Brazilian POBs, as SOBs in Brazil operate side by side with POBs and, as a consequence, all conditions of competition mentioned above are satisfied. The SOBs are allowed to make all the commercial and investment banking activities and they can compete in all banking markets with POBs.[19] The only difference is that they bear some of the costs of public policies. This hampers substantially their profitability.

Brazilian SOBs have also a great advantage to be used in the test of the hypothesis developed in the model of previous sections. Although they are State controlled companies, some of them have shares in the major stock exchange in the country, which is BOVESPA (Bolsa de Valores de São Paulo), so that changes in their expected profitability can be easily captured by the performance of these shares. As many privately owned Brazilian banks also have shares in this same stock exchange, an investigation on the relationship among the returns of these two types of shares may be a good way to test the hypothesis on the impact of cost changes in SOBs on the expected profitability of POBs. This section proceeds to such an exercise.

Similarly to all shares, the rate of return of any bank can be represented as:

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it} \qquad (14)$$

This is a standard representation, where R_{it} is the rate of return of the shares of the bank i in period t and R_{Mt} is a market rate of return in period t, which represents the return of the portfolio that includes all market assets in the exact proportion they are available in the economy. The coefficients α_i and β_i are parameters, which are assumed to present some intertemporal stability. The term e_{it} is a random deviations of R_{it} from its stable relationship with R_{Mt} in period t, such that $E(e_{it})=0$ and $Var(e_{it})<\infty$, where E(.) and Var(.) represent the statistical expected value and variance of the variable within brackets, respectively. R_{Mt} and e_{St} are such that $E(R_{Mt}e_{St})=0$ by construction.

[19] Among the four banks controlled by the Federal Government, only BNDES (Banco Nacional de Desenvolvimento Econômico e Social) has a different focus, which is to be a development bank, with concentration of its activities in long-term loans.

It is possible to define a portfolio that includes the shares of all banks in the economy whose rate of return is represented here as R_{bt}. By construction, it is reasonable to expect that $E(R_{bt}e_{it})\neq 0$, as part of the orthogonal deviations of R_{it} from R_{Mt} is explained by particular shocks to the rate of return of the banking sector, which are not explained by changes in the rate of return of the whole set of assets in the economy.[20] Furthermore, it is possible to define:

$$e_{it} = \alpha'_i + \beta_{Bi} R_{Bt} + e'_{it} \qquad (15)$$

Where, α'_i and β_{Bi} are parameters and β_{Bi} particularly relates the deviations of the rate of return of the bank i to the rate of return of the banking sector. The term e'_{it}, such that $E(e'_{it})=0$ and $Var(e'_{it})<\infty$, Substitution of equation (15) in equation (14) yields:

$$R_{it} = \alpha''_i + \beta_i R_{Mt} + \beta_{Bi} R_{Bt} + e'_{it} \qquad (16)$$

Where $\alpha_i''=\alpha_i+\alpha_i'$ and the other variables and parameters are as previously defined.

It is also possible to define a R_{St} that is the rate of return of a portfolio including all state owned banks in the economy. This rate of return will be particularly affected by public policies towards SOBs, such as the salaries of their employees, costs emerging from burden of public policies, etc, although it is also affected by general economic developments and particularities of the banking sector. Therefore, this rate may be decomposed as:

$$R_{St} = \delta_0 + \phi_0 R_{Bt} + v_t \qquad (17)$$

The market rate R_{Mt} was not included in equation (17) because its effect on R_{St} is already captured by its impact on R_{Bt}. As δ_0 and ϕ_0 are stable parameters in this equation, v_t is the variable that captures the impact of public policies on the return of SOB. By construction, it is possible to say that $E(v_t)=0$ and by assumption $Var(v_t)<\infty$. Whenever the government reduces the economic efficiency of SOB through some policy, v_t is negative and R_{St} also falls, *ceteris paribus*. Normally, it is reasonable to assume that $\phi_0>0$, as the rate of return of SOBs tend to increase when the rate of return of the bank sector in the economy rises.

Given these definitions, the hypothesis under scrutiny here implies that $E(e'_{Pt} R_{St})\neq 0$ and more precisely:

$$e'_{Pt} = \delta_1 + \phi_1 R_{St} + u_t \qquad (18)$$

Where e'_{Pt} is e'_{it} for the privately owned bank P and u_t is an error term such that $E(u_t)=0$ and $Var(u_t)<\infty$. The parameters δ_1 and ϕ_1 are also stable and $\phi_1<0$. This means that the rate of return of privately owned banks respond negatively to changes in the rate of return of state owned banks.

Substitution of equation (17) in equation (18) yields:

$$e'_{Pt} = \delta_2 + \phi_2 R_{Bt} + \phi_1 v_t + u_t \qquad (19)$$

Where $\delta_2=\delta_1+\phi_1\delta_0$, $\phi_2=\phi_1\phi_0$. Equation (19) can be substituted back into equation (16) to yield:

[20] Obviously, it is reasonable to expect that $E(R_{Bt}R_{Mt})\neq 0$, as the portfolio that includes all banks also will have its rate of return in any period affected by the market rate. When the economy goes well, the banks also tend to perform well.

$$R_{Pt} = \alpha_{P1} + \beta_P R_{Mt} + \beta'_{BP} R_{Bt} + \phi_1 v_t + u_t \qquad (20)$$

Where $\alpha_{P1} = \alpha''_P + \delta_2 = \alpha''_P + \delta_1 + \phi_1\delta_0$, $\beta'_{BP} = \beta_{BP} + \phi_2 = \beta_{BP} + \phi_1\phi_0$. As $\phi_1<0$, $\phi_0>0$ and β_{BP} can be positive, the sign of β'_{BP} is not defined a priori. Furthermore it can have different signs for different banks. Nevertheless, if equation (20) is estimable, the test of the hypothesis $\phi_1<0$ can be made from the coefficient for v_t. The method of the empirical test of this subsection is exactly to estimate equation (20).

There are three non-observable variables in equation (20). They are R_{Mt}, R_{Bt} and v_t. The two first ones will be estimated through a principal component analysis method. The market rate of return R_{Mt} very often is taken as the rate of return of a broad index of the stock exchange. In Brazil this would be IBOVESPA. Nevertheless, another way to estimate it is to take the first principal component of the rate of return of a set of assets. Both procedures were used in the tests below. The assets included in the second approach were (i) IBOVESPA; (i) Interbank Certificate Deposits (Certificados de Depósitos Interbancários), which is an asset traded by banks with each other to adjust their liquidities; (iii) US dollars in Brazilian currency, which is also a potential asset for Brazilian agents, (iv) US Federal discount rate, (v) LIBOR (London Interbank Operational Rate), which are both not assets but alternatives for financial resources applications; (vi) Dow Jones index and (vii) Nasdaq index.

The hypothesis underlying this method of estimation of the market ratio is that there is a common movement for all these assets that represents the market behavior, as the rate of return of all these assets to some extent are closely related to the weighted rate of return of all the market assets of the economy. Some of them fluctuate with the total market assets, such as the stock exchange indexes and US dollar price in Real, while others are important to determine the performance of the market, such as LIBOR and US Federal discount rate. The data on the tests below are presented for the two hypotheses on the definition of market rate of return, the first principal component and the rate of return for IBOVESPA.

The estimation of the ratio of return for the banking sector, R_{Bt}, relied on the same method as the one for the market ratio. In this case the principal component included the share of all Brazilian banks quoted in BOVESPA, whose shares were available for the whole period, January 1994 to February 2004, and they had a clear classification, either as a privately owned or a state owned bank. Only BANESPA was left out of the sample, as it changed its control during this period.[21]

The estimation of v_t was made in two steps. The first one created a rate of return for the state owned banks. In this case the first component from a principal component analysis including the rate of returns of the shares of all SOBs in the sample was obtained. This component was considered to be R_{St}. The shares included in this case were for Banco do Brasil, Banco da Amazônia S.A. and Banco do Nordeste. Then, equation (17) was estimated with R_{Bt} defined as above. The residual was taken to be v_t.

With all variables estimated, estimation of equation (20) proceeded. Two alternative hypotheses on the error term were introduced. The first one is that they are not serially correlated. This arises directly from the market efficient hypothesis. Nevertheless, the variance of the error was still left free to differ among periods. In this case White (1980) correction for heteroskedasticity of the errors was used. The second hypothesis was that the efficient market hypotheses could fail and a

[21] Banrisul was left out of the sample because the data for its share was not for the whole period. The sample included Bradesco, Itaú, Unibanco, Alfa, Mercantil, BASA (Banco da Amazônia S.A.), Banco do Brasil, and Banco do Nordeste.

simultaneous correction for heteroskedasticity and auto-correlation of the errors using the method of Newey and West (1987) was introduced.[22]

Equation (20) was estimated for each privately owned bank in the sample separately. The data was monthly. The rates of returns were calculated as the first difference of the natural logarithm of the monthly averages prices of stocks. The results of the estimation, with the two definitions of the market rate of return and with the two assumptions for the existence of autocorrelation of the error terms, are all included in tables 1 to 4.

The results indicated that all estimated coefficients for v_t, which is the estimated value for ϕ_1, are negative. Most of them are significantly different from zero at standard p-values. These results strongly support the hypothesis that there is a negative impact running from the economic performance of state owned banks to the expected profitability of privately owned banks, as predicted by the model of the previous sections.

Table 1
Models with calculated market return and White correction for heteroskedasticity

		Constant	R_m	SOB (V_t)	Banks (R_B)	R^2	Durbin Watson
Bradesco	Coefficient	0.0136	-0.0048	-0.3369	0.6571	0.9009	1.9154
	t-statistics	2.1754**	-7.7936***	-3.2039***	20.3189***		
Alfa	Coefficient	-0.0041	0.0066	-0.1002	0.0612	0.3527	1.4182
	t-statistics	-0.4370*	9.0035***	-0.6376*	2.6439***		
Itaú	Coefficient	0.0020	0.0042	-0.3290	0.1561	0.5419	2.0011
	t-statistics	0.2668*	4.3587***	-2.9749***	5.3664***		
Mercantil	Coefficient	0.0000	0.0022	-0.3032	0.2034	0.3682	1.8247
	t-statistics	3.0575*	2.2125**	-2.2617**	4.8402***		
Unibanco	Coefficient	-0.0069	0.0049	-0.7586	0.0964	0.3395	1.8065
	t-statistics	-0.6279*	3.7245***	-3.3970***	1.6895*		

Note: * indicates that the coefficient is significantly different from zero at 10%
** indicates that it is significant at 5%
*** indicates it is significant at 1%.

Table 2
Models with Ibovespa as market return and White correction for heteroskedasticity

		Constant	IBOVESPA	SOB (V_t)	Banks (R_B)	R^2	Durbin Watson
Bradesco	Coefficient	-0.0066	-0.5293	-0.3673	0.7439	0.9155	1.6884
	t-statistics	-1.2330*	-6.3427***	-3.9439***	22.3361***		
Alfa	Coefficient	0.0261	0.1340	-0.0965	0.1074	0.1785	1.2798
	t-statistics	3.0586***	0.9439*	-0.5204*	2.2558**		
Itaú	Coefficient	0.0189	0.5914	-0.2941	0.0436	0.6733	1.7873
	t-statistics	3.5259***	8.0934***	-3.0991***	1.6934*		
Mercantil	Coefficient	0.0086	0.4056	-0.2788	0.1181	0.4190	1.8389
	t-statistics	0.9739*	3.2840***	-2.1230**	2.2630**		
Unibanco	Coefficient	0.0135	0.5890	-0.7245	-0.0057	0.3982	1.6634
	t-statistics	1.4210*	4.3250***	-3.6316***	-0.1078*		

Note: * indicates that the coefficient is significantly different from zero at 10%
** indicates that it is significant at 5%
*** indicates it is significant at 1%

[22] In some estimated models the Durbin-Watson statistics indicated that this was the case. The parameter ℓ of Newey and West was set equal to one.

Table 3
Models with calculated market return and Newey and West correction for heteroskedasticity and autocorrelation

		Constant	R_m	SOB (V_t)	Banks (R_B)	R^2	Durbin Watson
Bradesco	Coefficient	0.0136	-0.0048	-0.3369	0.6571	0.9009	1.9154
	t-statistics	2.1302**	-7.3814***	-3.4498***	19.5631***		
Alfa	Coefficient	-0.0041	0.0066	-0.1002	0.0612	0.3527	1.4182
	t-statistics	-0.3898*	9.7238***	-0.6034*	2.5297**		
Itaú	Coefficient	0.0020	0.0042	-0.3290	0.1561	0.5419	2.0011
	t-statistics	0.2638*	4.2389***	-2.8903***	5.3460***		
Mercantil	Coefficient	0.0000	0.0022	-0.3032	0.2034	0.3682	1.8247
	t-statistics	0.0003*	2.1923**	-2.3582**	4.7251***		
Unibanco	Coefficient	-0.0069	0.0049	-0.7586	0.0964	0.3395	1.8065
	t-statistics	-0.5964*	3.2515***	-3.5814***	1.5980*		

Note: * indicates that the coefficient is significantly different from zero at 10%
** indicates that it is significant at 5%
*** indicates it is significant at 1%.

Table 4
Models with Ibovespa as market return and Newey and West correction for heteroskedasticity and autocorrelation

		Constant	Ibovespa	SOB (V_t)	Banks (R_B)	R^2	Durbin Watson
Bradesco	Coefficient	-0.0066	-0.5293	-0.3673	0.7439	0.9155	1.6884
	t-statistics	-1.1534*	-5.6222***	-4.0231***	20.0861***		
Alfa	Coefficient	0.0261	0.1340	-0.0965	0.1074	0.1785	1.2798
	t-statistics	2.6984***	0.8115*	-0.5067*	2.0374**		
Itaú	Coefficient	0.0189	0.5914	-0.2941	0.0436	0.6733	1.7873
	t-statistics	3.3616***	7.7365***	-2.9810***	1.6794*		
Mercantil	Coefficient	0.0086	0.4056	-0.2788	0.1181	0.4190	1.8389
	t-statistics	0.9262*	3.1272***	-2.1583**	2.1084**		
Unibanco	Coefficient	0.0135	0.5890	-0.7245	-0.0057	0.3982	1.6634
	t-statistics	1.3292*	4.3271***	-3.6422***	-0.1062*		

Note: * indicates that the coefficient is significantly different from zero at 10%
** indicates that it is significant at 5%
*** indicates it is significant at 1%.

4.2. Test of the impact on the interest rate spread

Another conclusion of the paper is that the interest rate spread charged by the banks increases with the inefficiency of state owned banks. The more the government intervenes in these banks and the more it imposes to them a larger part of the burdens of public policies, the higher will be the banking spreads.[23] The test of this hypothesis in this subsection relies on other hypothesis, which is that the higher the share of SOBs on the total assets of the banking sector in the economy, the more the governments tend to rely on them to bear a higher share of the costs of public policies. This happens because when this share of assets is higher, the less impact on the market competition of SOBs this strategy will imply and the higher the tendency of the government to include these banks as part of their policy instruments. Therefore, these two hypotheses together imply that the higher the share of SOBs on the banking assets, the higher will be banking spreads in the economies. This is the hypothesis that is tested here.

[23] This hypothesis arises directly from equation (10).

The test of this hypothesis relies in a cross-country regression in which the share of SOBs in total banking assets is included as one of the determinant variables of the banking spread. The data for banking spread were from IMF financial statistics for the years 1994, 1995 and 1996. An average spread for these three years was the dependent variable. The shares of SOBs on total banking assets were obtained from La Porta, Lopez-de-Silanes and Shleifer (2002). They refer to 1995 and are for the ten largest banks in each country only.

Alternative equation specifications were estimated. Some of them including other variables, such as per capita GDP, inflation rate, government deficit as a percentage of GDP and government expenditures as a percentage of GDP. All these data were for 1995 too. All estimations included a correction for heteroskedasticity through the method developed by White (1980).

The estimations were made for four proxies for the share of SOBs assets on total assets of the ten largest banks in each country. They are better specified below:[24]

i.AGB95 is the share of the assets of the top 10 banks in a given country owned by the government of that country in 1995.

ii. GB50 is the share of the assets of the top ten banks in a given country controlled by the government at the 50% level in 1995.

iii. GB90 is the share of the assets of the top ten banks in a given country controlled by the government at the 90% level in 1995.

iv. GB20 is the share of the assets of the top ten banks in a given country controlled by the government at the 20% level in 1995.

There are estimated results for 12 equations in table 5. Three estimated equations for each proxy for the share of SOBs on total assets of the ten largest banks. One of these models includes only this variable. The second one includes also per capita GDP and average inflation rate for the three years. The third model includes all these variables plus the share of government expenditure on GDP and the share of the public sector deficit on GDP.

All the estimated coefficients for the shares of assets of SOBs (3^o to 6^o columns in table 5) are positive in all equations. This implies that all point estimations of the impact of the share of SOBs on interest rate spreads are positive, as predicted by the model and the additional hypothesis introduced in this test. Furthermore, all the estimated coefficients for AGB95 and GB90 are significantly different from zero at least at a 90% significance level. Only one model for GB50 is not significant at standard p-values. Nevertheless, it is significantly different from zero for a p-value of 10,31%. The proxy GB20 is the only one with a poor performance, as the coefficient for this variable is not significantly different from zero in two out of the three models. It is important to stress that this is the less relevant proxy, as 20% is a level of state control of the bank that does not give effective control of them. Therefore, despite the failure of the models with this proxy, it is still possible to conclude that these estimations give support to the hypothesis under scrutiny in this subsection.

[24] More details on the meaning of these variables and on the way they were collected, see La Porta, Lopez-de-Silanes and Shleifer (2002).

Table 5
Regression results - Dependent variable interest rate spread

Equation	Constant	AGB95	GB20	GB50	GB90	Per capita GDP	Average inflation rate	Government expenditure as a % of GDP	Government deficit as a % of GDP	R^2	N
(1) Coefficient	4.9683			0.0638						0.1469	65
T-Stat	6.4693			3.0651							
p value	0.0000			0.0022							
(2) Coefficient	9.6559			0.0282		-0.0003	-0.0350			0.3078	62
T-Stat	5.7941			1.6926		-4.0808	-0.6562				
p value	0.0000			0.0905		0.0000	0.5117				
(3) Coefficient	4.6954	0.0727								0.1743	65
T-Stat	6.2166	3.4515									
p value	0.0000	0.0006									
(4) Coefficient	9.3351	0.0350				-0.0003	-0.0356			0.3170	62
T-Stat	5.5641	1.8894				-3.9627	-0.6822				
p value	0.0000	0.0588				0.0001	0.4951				
(5) Coefficient	5.0513		0.0545							0.1212	65
T-Stat	6.4962		2.8402								
p value	0.0000		0.0045								
(6) Coefficient	9.8372		0.0230			-0.0003	-0.0387			0.3026	62
T-Stat	5.9870		1.5126			-4.2151	-0.7275				
p value	0.0000		0.1304			0.0000	0.4669				
(7) Coefficient	5.0388				0.0798					0.2053	64
T-Stat	7.7960				3.7802						
p value	0.0000				0.0002						
(8) Coefficient	9.3468				0.0395	-0.0003	-0.0351			0.3206	61
T-Stat	5.6208				1.9862	-3.7313	-0.6626				
p value	0.0000				0.0470	0.0002	0.5076				
(9) Coefficient	10.1423			0.0284		-0.0003	-0.0312	-0.0424	-0.2335	0.3200	58
T-Stat	5.7004			1.6300		-3.6114	-0.6647	-0.9701	-1.8360		
p value	0.0000			0.1031		0.0003	0.5062	0.3320	0.0664		
(10) Coefficient	9.9123	0.0372				-0.0003	-0.0328	-0.0489	-0.2295	0.3310	58
T-Stat	5.5610	1.9162				-3.4330	-0.7180	-1.1143	-1.8343		
p value	0.0000	0.0553				0.0006	0.4728	0.2651	0.0666		
(11) Coefficient	10.3600		0.0261			-0.0003	-0.0350	-0.0532	-0.2549	0.3191	58
T-Stat	5.9404		1.5613			-3.5885	-0.7555	-1.1464	-2.0044		
p value	0.0000		0.1185			0.0003	0.4499	0.2516	0.0450		
(12) Coefficient	9.6060				0.0379	-0.0003	-0.0304	-0.0262	-0.2062	0.3290	57
T-Stat	5.2034				1.9111	-3.4596	-0.6559	-0.6219	-1.6299		
p value	0.0000				0.0560	0.0005	0.5119	0.5340	0.1031		

4.3. Time series test of the impact on banking spread of shocks to perspective of profitability of state owned banks

Another test for the impact on banking spread of autonomous changes on the perspective return of state owned bank was developed relying on Brazilian time series data and a Factor-Augmented Vector Auto-regression, a method developed by Bernanke, Boivin and Eliasz (2005). In this model SOB and POB returns were taken to be unobservable variables while banking spreads were taken to be observable. The three variables were taken to have their dynamics determined by:

$$\begin{bmatrix} 1 & a_{12} & a_{13} \\ a_{21} & 1 & a_{23} \\ a_{31} & a_{32} & 1 \end{bmatrix} \begin{bmatrix} R_{St} \\ R_{Pt} \\ \Delta S_t \end{bmatrix} = \phi(L) \begin{bmatrix} R_{St-1} \\ R_{Pt-1} \\ \Delta S_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix} \quad (21)$$

Where ΔS_t is the monthly change in the natural logarithm of the banking spread in Brazil and R_{St} and R_{Bt} are the rates of return of SOB and POB, respectively, a_{ij} are coefficients. $\phi(L)$ is a 3x3 polynomial in the lag operator and u_{it} is the autonomous innovation to equation i, all with mean zero and finite variance. R_{St} and R_{Pt} are taken to be unobservable variables, while banking spread is defined as the difference between lending and borrowing interest rates.[25]

By construction, innovation u_{it} is fully associated with innovations to the variable whose coefficient is $a_{ii}=1$. This happens because by assumption it is orthogonal to the other two endogenous variables in the model. Therefore, u_{1t} represents exogenous innovations to R_{St} and, by the hypotheses of the paper, it has a negative impact on S_t. In words, it means that a positive shock to the expected performance of state owned banks will reduce the banking spread, or that any autonomous change that make SOBs less efficient (negative shocks) will increase the interest rate spreads in the economy.

The method used consisted on a two step estimation, where the first step estimates the variables R_{Bt} and R_{St} by a principal component, as made in section 5.1, and the second step estimates the VAR represented in equation (21).[26] Estimation of equation (21) was made by instrumental variable method, which relied, as instruments, on distributed lags of LIBOR, US Federal discount rate, and the implicit rates of return of Dow Jones and Nasdaq indexes.

The model strategy selection was the Akaike criteria, which indicates that the two rates of return equations had two lags of each variable, while the equation for changes in the natural logarithm of spreads had three lags of each variable. A constant and a set of seasonal dummies were introduced as exogenous variables. Some outliers were identified and were easily related to policy measures trying to reduce spreads. Dummies were introduced to isolate the changes which are caused by such policies.

There was a test of the hypothesis that there is at least one vector co-integrating vector relating the variables S_t, P_{St}, P_{Pt}, where P_{St} and P_{Pt} are indexes of the natural logarithm of the estimated price of the assets of SOBs and POBs, respectively, which are obtained from integration of R_{St} and R_{Pt}. This test indicated that there was a co-integrating vector. Consequently, another variable, Z_t, which represents the deviations from the long term equilibrium among these variables in level was also included in the model as an exogenous variable. This variable was estimated as the errors of a simple regression of the variables in level, as suggested by Engle and Granger (1987).

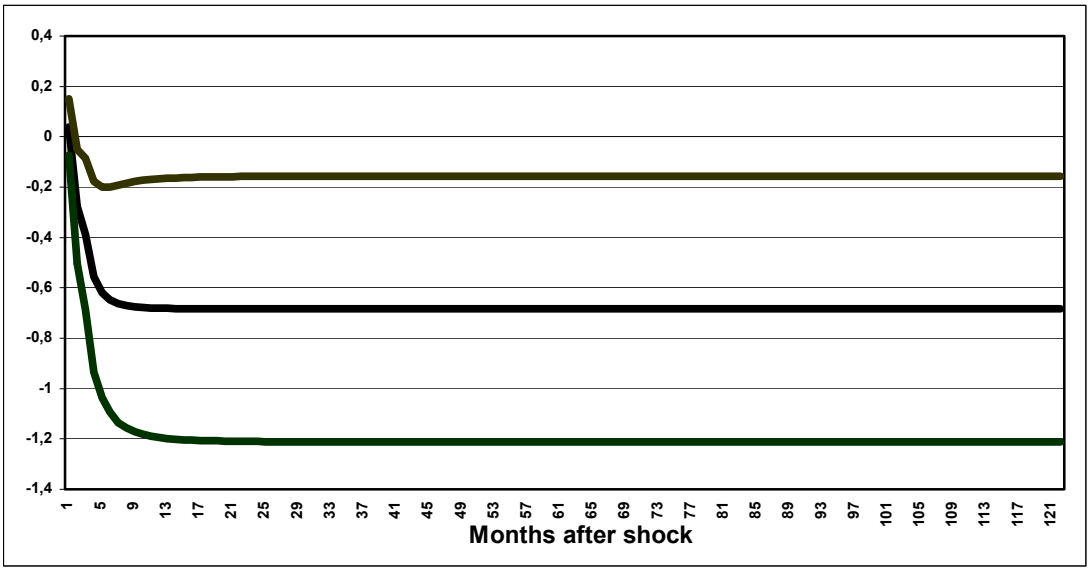
An impulse response analysis was carried on with the estimated results from the model. This impulse was estimated under the imposed assumption that the errors are orthogonal among them. A confidence interval with two standard deviations around the mean value was estimated by a Monte Carlo simulation of the model, with estimated variances for the coefficients. The results of the impulses that indicates the dynamic impact of a shock in the expected performance of state owned banks on the spread rate is presented in figure 1.

[25] CDB (bank deposit certificates) rates were used as borrowing rates and an average of rates for firms and consumers was used as lending rates.

[26] An alternative maximum likelihood method is also possible and theoretically more efficient, but the gains in precision are small and the estimation costs are substantially high. See Bernanke, Boivin and Eliasz (2005).

The results in figure 4 indicate that the exercise pursued in this subsection gives support to one of the main hypotheses of the paper. The point estimation of the impact of a fall in the perspective of profit by state owned banks increases the interest rate spread in the economy. Although this impact is not immediately observed in the short run, it is strong and robust in the long run.

Figure 1
Dynamic impact on the interest rate spread of an autonomous innovation to the expected return of state owned banks



6. Concluding remarks and Policy implications

The empirical literature on the state ownership of banks have stressed that it can reduce growth and financial development, as it tends to reduce the relationship between credit and GDP. Theoretical developments that explain the relatively low efficiency of public companies is the most common argument to elucidate such empirical conclusion. This paper offers a theoretical model that can enlighten this causality, relying on other mechanisms, although the intention is neither to refute the alternative explanations nor to claim that the two together are the only sources of such relationship.

The reliance on state owned banks to carry part of the costs of public policies can boost the interest rate spreads and profitability of private banks, leading to less credit and less investment than would be possible, otherwise. This jeopardizes long term economic growth and can even promote income concentration in the hands of the richest agents. These are consequences of public policies that are normally seen as unpleasant. Therefore, the final impact of state ownership of banks can be the reverse of the initial goals.

This major hypothesis was split into two parts, both stressing the consequences of state ownership and the reliance of governments on the state controlled banks to bear part of the costs of public policies. The first part stresses the impact of such ownership on profit of privately owned banks. The second part stresses the impact of such ownership and inefficiency on the prevailing interest rates spreads. Both hypotheses, which emerge from the economic model forwarded above, were tested empirically, using time series and cross section data.

All tests of these hypotheses gave strong support to them. The one that relied on the efficient market hypothesis and built on time series data for Brazilian banks concluded that the shares of most privately owned banks quoted in the Brazilian major stock exchange (BOVESPA) respond negatively to an increase in the expected return of the shares of SOBs. This is an indication that profits of POBs

increases when government imposes a higher burden of costs of public policies to SOBs and consequently harms their expected profitability.

A cross section of data for a large set of countries in the world also indicated that the higher the share of SOBs on the total assets of banks, the higher tend to be the interest rate spread in that country. If it is assumed that the higher the share of SOBs, the more the governments tend to rely on them to bear the costs of public policies, it is reasonable that this is also a support of the major hypotheses of this paper, in this case its second part, which relates the burden of public policies and the interest rate spreads.

A second test of this hypothesis that higher burden of public policies on SOBs and banking spreads was also pursued. A factor augmented vector auto-regression (FAVAR) model was estimated for Brazilian data, including interest rates spreads, expected rates of return of privately owned banks and state owned banks. The results indicated that an autonomous shock to the expected return of SOBs has a negative and persistent impact on the interest rates spreads. This means that whenever governments push costs of public policies to SOBs and their expected profitability falls, interest rate spreads rises.

Although simple, the major hypotheses of this paper have important policy implications. First of all, they have indicated that state owned banks should not be used as an instrument to subsidize the operational mechanisms of some public policies, as it often happens in Latin American countries, for example. This could penalize the whole economy with higher interest rates for the borrowers and generates higher than necessary spreads. High spreads may cause unnecessary liquidity restraints to the public and to the non-banking private sector, having a negative impact on domestic economic activity.

The best practice toward state owned banks is to avoid carrying the policies directly through them, without public competition and any directly indication of actual costs of these policies for these banks. All the demand for banking services of public policies should be object of a public competition, in which both privately and public owned banks have equal opportunity to compete. The resulting costs of the banking services demanded by these policies should be disbursed by the government, as an additional cost of the policy. The profits accruing to the Government from the state owned banks can be part of the resources it can rely upon to expand its policies, but both the costs of the policies and the profits generated by SOB must be part of the public budget, one in the income side and the other one in the expenditures side. Implicit compensations, avoiding this way through the public budget, can hurt the whole society with higher interest rates than is necessary.

Another important policy implication is that the Government should be very careful when negotiating salaries with workers of the state owned banks. An excessive generosity may have non-marginal impact on the whole economy, as it will increase the interest rate through its impact on the spread charged by banks. A tentative to attract the sympathy of banking workers can have a high social cost. Therefore, the idea of having a collective negotiation in which privately owned banks and public owned banks negotiate the salaries jointly and the private sector representatives take the lead on negotiations, with the government being a mere follower, is the best strategy to avoid damaging the whole society because of particular sectorial interests.

Appendix A: generation of price index for the banking sector

Following Blanchard and Kiyotaki (1987), it is possible to define a demand function for the whole banking sector as:

$$Y = BP^{-\eta} \qquad \text{(A1)}$$

Where Y is an index for the output of the whole sector, P is the sectorial price index and η is a parameter. By normalization, the price index for the other goods and services demanded by consumers was made equal to one. By definition:

$$\ln Y = \frac{1}{m' + a'} \sum_{i=1}^{a'} \ln Y_{Si} + \frac{1}{m' + a'} \sum_{i=1}^{m'} \ln Y_{Pi} \qquad \text{(A2)}$$

Where the output index is a geometric average of individual banks outputs, which appears divided between the two major categories in equation (A2), state owned banks, with subscript S, and privately owned banks, with subscript P. By assumption, there are a´ SOBs and m´ POBs in this economy.

By assumption, the output of all POBs will be made equal and, in the same way, the output of all SOBs will also be made equal. Therefore:

$$\ln Y = a \ln Y_S + m \ln Y_P \qquad \text{(A3)}$$

Where:

$$a = \frac{a'}{a' + m'} \qquad\qquad m = \frac{m'}{a' + m'}$$

Substituting equation (1) from the main text, it is possible to get:

$$\ln Y = a \ln B_S - a\eta \ln P_S + a\eta\delta \ln P + m \ln B_P - m\eta \ln P_P + m\eta\delta \ln P \qquad \text{(A4)}$$

Given equations (A1) and (A4), it is possible to define:

$$B = B_S^a B_P^m$$

In the same way, (A1) and (A4) together yields:

$$P = P_S^{\frac{a}{1+(a+m)\delta}} P_P^{\frac{m}{1+(a+m)\delta}} \qquad \text{(A5)}$$

That is exactly equation (2) on the main text.

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