Revisiting the Methodology for the Bank Interest Spread Decomposition in Brazil: An Application of the Theory of Cost Allocation*

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Abstract

Decomposition of banking spreads presents some difficulties; one of them concerning the cost allocation methodology under a multiproduct environment, such as the one characterizing a universal banking firm. Brazilian Central Bank has adopted, originally, a proportionality assumption when allocating administrative costs for loan concessions and calculating banking spread decomposition. This paper presents a new methodology, based on the estimation of a cost function for the Brazilian banking sector and on the calculation of the Aumann-Shapley prices for banking outputs. The use of this methodology allows more accurate calculation of banking spread decomposition and the analysis of cross subsidies between banking products pricing, minimizing measurement errors that have been captured by the "banking net profits" variable in the original calculation. In addition, we also deal with selection biases by enlarging the sample of banks considered in the application.

1 Introduction

Private credit is an important driver of economic growth. From Bagehot (1873)[6] and Schumpeter (1912)[24] to more recent works such as King and Levine (1993)[17] and Levine (1997)[18], the economic literature has stressed the relevance of financial markets to the economic development of countries. In the case of Brazil, where the capital market represents a relatively restricted share of private financing, bank credit plays a particularly important intermediation role in making viable investment projects. A well-fuctioning credit market requires, in turn, ample access to funds at costs that do not hinder the feasibility of projects. High loan costs not only limit the volume of credit available, but

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also give rise to other phenomena that modern economic theory has called attention to. Problems of moral hazard and adverse selection, structurally linked to banking contracts - from the viewpoint of both the depositor and borrowers - impose additional restrictions on the banking market that affect equilibrium allocations.

In this context, high banking interest rates give rise to problems of adverse selection - where only high-risk projects are financed. Difficulties of collateral recovering generate moral hazard, with perverse incentives determining the behavior of agents. These are questions that emerge in environments with informational problems and that are present in the operation of financial intermediation. Situations with equilibrium credit rationing emerge, where the market functions with lower volumes of credit available than would be the case in situations with complete information.

Brazil is an importat case study to evaluate some of these issues from an applied perspective. The ratio of private credit to GDP is very low in Brazil (around 26%) when compared to countries like Chile (54%) Japan (nearly 85%), or the Euro area (over 100%), for example (Belaisch (2003))[9]. On the other hand, Brazil is also characterized by extremely high interest rates on loans. Thus, credit is both scarce and expensive in the country. There are several good explanations for this situation. High yields on public bonds, which present very attractive returns at low risk, crowd out private lending; high rates of default, perpetuated by an institutional and legal system that favors debtors, does not recognize guarantees and makes collateral reposession an expensive and protracted businesses; and uncertainties related to economic instability discourage credit, particularly of the long-term variety.

There is, however, another factor that negatively affects the volumes of private credit offered in Brazil, which is linked to issues related to credit risk, adverse selection and moral hazard. Such factor is the bank interest spread - the difference between the interest paid to savers and charged from borrowers. The study of the how the bank interest spread is formed is important to define policies that can potentially lower the cost of credit and expand loan volumes while at the same time minimizing adverse selection problems in banks' loan portfolios. This is one route that both enables expanded financing of productive investment on one hand, and, on the other, maintenance of incentives to private saving in a stable banking environment.

The question of the interest rate and banking spreads has been receiving great attention in Brazil. The explanation for this is related in large part to the high rates charged on bank loans and to the relatively low volumes of credit extended by banks. Some few basic points need to be clarified, however, to avoid some mistaken interpretations.

One must, initially, precisely define what is meant by banking spread. In the current study, bank spread is the difference between banks' cost of raising funds and the price charged from borrowers. This concept must be distinguished from bank profits, because one must deduct the costs of obtaining funds and maintaining lending activity. Moreover, there are other sources of profit not necessarily associated with credit activity. But in any event, the rates charged on

loans naturally have a lower bound determined by the domestic cost of funding, based on the Central Bank reference rate (Selic rate).

While the basic reference rate can explain the lower limit on bank interest, it does not explain the amplitude of the spread, though. The magnitude of the bank spre also deserves some closer examination to understand its formation. In general, and particularly in Brazil, the bank spread is formed by aggregating various cost and margin factors.

The cost factors refer to i) the administrative and other operating costs associated with banking activity; ii) the regulatory costs of financial intermediation - reserve requirements, cross-subsidies and costs of deposit insurance; iii) the cost of the various taxes levied on financial intermediation; and, iv) the cost of default that is implicit in lending activity.

The interest spread also includes a margin for bank profits, a factor that is often focus of passionate discussion in the country. Margin is the bank's return, which is determined by the gains on intermediation activity less the intrinsic costs of such activity. As a share of the overall interest spread, margin is the portion that is appropriated by banks after deducting all the costs incurred by their lending activity, including losses with bad loans. This portion can vary from bank to bank, according to aspects such as efficiency, market power or scale.xx

From a more formal point of view, we have the classic problem of optimization, where the bank - just as any firm - maximizes an objective function, which is a profit function, subject to a set of restrictions: normative restrictions, involving taxes, reserve requirements, minimum capitalization levels, deposit insurance and directed allocation of credit; situational constraints, associated mainly with the macroeconomic environment; and institutional restrictions, based on microeconomic factors that encompass problems of asymmetric information and the structure of the market, these latter ranging from legal aspects and recovery of guarantees to unobservable characteristics of borrowers and levels of competition. And in this general problem, the price/quantity of credit granted is an endogenous variable, i.e., it arises as the result of this restricted maximization problem and hence, given the objective function of the banks, responds only to changes in these restrictions.

For purposes of this study, then, we define spread as the difference between the rate paid to depositors and the rate that defines the loan cost to borrowers. In this form, we separate out the distortion created by the CPMF (a tax on bank debits, currently 0.38%), which although reflected both in the yield to depositors and final cost to borrowers, is not a differential charged by the bank and is thus not part of the definition given to bank spread here.[1]

In recent years a few studies have examined this area. However, in the specific case of Brazil, there have been few academic works to date. The main studies reported have come from the Research Department of the Central Bank of Brazil (CB), beginning in 1999.

[1] The introduction of the CPMF in the model - and thus in the results of the work - does not present major difficulties.

The main reason for these works - in line with our present objective - has been to diagnose the composition of the bank spread in Brazil, explaining its components and in this way trying to tackle factors that restrict the supply of credit in the country.

The big difference of this study rests in the development of a methodology that seeks, on the one hand, to correct problems identified in previous CB studies, and on the other, to provide an understanding of the Brazilian bank spread in a broader sense. Here the focus is on the spread per bank, which has the advantage of permitting an analysis of two points up to now little explored in the literature: the question of allocation of administrative and operational costs among the various bank portfolios, and a more precise assessment of the potential profit margins in the Brazilian banking sector. On the first point, we seek to correct a problem of proportional allocation identified in the original study. On the second point, we correct the bias of previous analyses of the Brazilian banking sector - and reach some conclusions on its profit margins - by applying improved data from an expanded sample.

This article is divided as follows: Section 2 presents an alternative methodology and estimates a cost function for the Brazilian banking sector based on a flexible functional form, the hybrid translog. Section 3 applies the theory of comon costs allocation to the division of administrative costs among the diverse business units of the banking firm, in particular the unit of "free" credit suply (freely allocated or discretionary lending, as opposed to obligatory or "directed" lending under government programs or regulations), thus substituting the criterion of proportionality adopted originally. Section 4 contains a new decomposition of the spread. The conclusions are detailed in Section 5.

2 An Alternative Model of Bank Spread

The observed situation of low volumes and high costs of loans, characteristics of the Brazilian credit market, shows a need to study possible instruments to reduce the bank spread in Brazil. Nevertheless, there are methodological limits that hinder a precise diagnosis of the question.

We seek in this section to contribute to a discussion of the theme, developing an alternative approach in an attempt to reach a deeper understanding of the composition of the banking spread and with this enable identification of other sources of distortions and potential instruments to lower it.

Among he methodological problems touched on previously, three will be addressed in this part of the work:[2]

1. Selection bias introduced by using a sample of only 17 large banks for the

[2] An identification problem in the original methodlogy, not dealt with here, refers to the disregard of the contribution of banks that have been liquidated or suffered Central Bank intervention. With this, the calculation of the average spread does not consider banks that operated with negative net margins and that suffered the negative impacts of the mismatch of rates or high levels of default. This problem remains in the approach presented here, in view of the lack of available data on these institutions for the chosen cross section.

composition of the average interest rate on loans. Although representative of the bank credit market, this choice limits analysis of the current situation, disregarding not only the past behavior of spreads but also the differences among the various segments of the banking sector.

2. Allocation of administrative costs. The CB methodology assumes as a hypothesis that banks allocate their administrative costs proportionally to the gross operating revenue generated by their various areas. This disregards the existence of directed lending that absorbs administrative resources irrespective of the associated return (often even negative).

3. Reserve requirements as a component of the spread. Originally, this variable was included in the decomposition. Since the second BC work [3], it standed out of it, assuming a zero aliquot of reserve requirements and under the hypothesis that banks do not finance credit operations with checking deposits funding. The first hypothesis does not correspond to reality, once both checking and time deposits are subject to compulsory reserve requirements during the analysed period. Besides, although some theoretical models sugest the independence between deposit and loan markets, there is no empirical result that corroborates this hypothesis.

Selection bias, widely discussed in the applied literature and responsible for the low representative power of the results, is minimized here by expanding the sample used. We work with an initial universe of 148 banks - commercial, multiple and investment banks, the Caixa Econômica Federal (CEF - the federal savings and loan institution) and Banco do Brasil (BB - federally owned full service bank) - of the 167 active banks as of December 2002. We thus achieve a better representation, both in quantitative terms and in relation to the overall composition of the system - a fact not considered in the initial sample used in works by the Central Bank, which was composed of only 17 private banks.

The allocation of administrative costs based on the hypothesis of maximizing behavior, although intuitive *a priori,* ignores the effects of legal and regulatory restrictions on bank behavior. Consequently, if the restrictions are active - and observation of the Brazilian banking sector indicates they are - the result is underestimation of this variable in relative terms. Within this context, we have chosen to adopt an alternative cost allocation methodology, which allows prorating these costs based on notions of restricted efficiency and from a standpoint of costs and not revenues.

Regarding the net margin component - which for purposes of this work will be called "residual" - it continues to be treated as a residual. This is due to a difficulty in calculating the portion relative to the cross-subsidy between operations in the free and directed lending portfolios, also potentially composing this variable. This difficulty is linked to the detailing of the data on compulsory operations, available in specific databases, requiring careful treatment to maintain consistency with the calculation made here.

A fourth point - only partly resolved here - refers to expenses due to loans losses. The data used in this work continue to be based in provisions for non-

performing loans, whose proportion for the system winds up correcting measurement errors in the original works. We must point out, however, that the accuracy of this measurement, based as it is on an accounting position presented by the banks, depends on the provisioning policy used by the institutions. It will be nearer reality the greater the level of adequacy of the provisions, which has been rising in recent years, mainly through adoption of risk classification criteria by financial institutions. (pursuant to Central Bank Resolution 2682 of 1999).

Besides this, we return here to the calculation of the participation of the cost of mandatory reserves in the decomposition of the spread. This position is justified by a simple theoretical analysis, based on Barajas *et al.*(1998), in which a bank that maximizes profit, restricted by reserve requirements, faces an equilibrium condition that relates the loan rate and percentage of required reserves.

The alternative methodology proposed in this work, besides dealing with the mentioned problems, starts from a cost function for the Brazilian banking sector. This cost function permits calculating the Aumann-Shapley prices of every output used in bank production and allocating the corresponding costs to each product. Based on this new allocation, then we recalculate the decomposition of the spread to minimize measurement errors and imprecisions present in the previous methodology and totally captured by the "net bank margin" variable. In this form, we suggest a new decomposition that should more accurately reflect the real price structure of the Brazilian banking sector.

The literature on efficiency and productivity in the banking sector has made significant advances regarding the use of more flexible functional forms than the traditional Cobb-Douglas or CES ones to represent the cost structures of banks. Since Hall (1970)[15], one of the pioneers in discussing the technology specifications for multi-product firms, there have been many improvements in this field, mainly from the introduction of transcendental logarithmic (translog) forms and the application of the theory of duality in the applied analysis of economic problems (Diewert (1971))[14]. The translog form for the cost function was originally proposed in the work of Christensen, Jorgenson and Lau (1973)[13] as a way to resolve the limitations imposed by hypotheses of homogeneity and additivity present in the prior formulations. Subsequently, Caves, Christensen and Tretheway (1979)[11] generalized the multi-product translog form, seeking to eliminate the limitations on empirical applicability, among them the presence of observations with zero quantity for some products,[3] which made it impossible to use the logarithmic structure in the estimation. More recently, Pulley and Braunstein (1992)[20] presented a compound form for the cost function.[4]

[3] The literature presents some different forms to deal with the zeros in the sample, such as simply discarding observations that present zero output for some product or replacement of the zeros with arbitrarily small quantities(Kim (1987)).

[4] Another approach argues for the use of a semi-parametric estimation approach, based on Fourrier series. It adopts the flexible functional Fourrier form to approximate the real cost function of the banking sector. However, there is a trade-off between the specification and approximation error that must be considered. Mitchell and Onvural (1996).

2.1 The Translog Cost Function for the Banking Firm

The formulation of a model of bank production presents a particular difficulty from the outset, which is to define a bank's products and inputs. This is a controversial question, still unresolved in the economic literature. Different approaches - with equally diverse justifications - arise with each new analysis of banking output, cost or efficiency.

The main points of the dispute revolve around the categories of demand and time deposits. From a strictly technical standpoint, the natural tendency would be to treat them as products, since both at first glance are a result of banking operations supplied by the bank and demanded by customers. But the analysis is not as direct as it first seems. As shown by Sealey and Lindley (1977)[22], analysis of the operation of the banking sector, within the overall concept of the profit-maximizing firm, must go beyond a purely technical approach. An economic approach of the financial firm must hold sway. In this context, we consider as products only those that are intimately involved in the profit-maximization process, i.e., those associated with bringing in revenue and more valued by the market relative to inputs.

In view of this approach, we consider deposits as inputs and not products, since they are used in producing lucrative assets for the bank. Under this concept, we define the following categories of products and inputs:

Products: The banks offer four types of products: treasury products, loans (free and directed) and foreign exchange operations. In other words, we consider treasury and credit operations as bank products, with the latter divided into resources allocated freely (in local and foreign currency) and earmarked in a compulsory basis to certain borrowers.

We thus define:

- tvm = balances of bonds and other securities held in the bank's portfolio, which serve as a proxy for treasury operations.
- $livre$ = balances of freely allocated loans.
- $obrig$ = balances of directed loan operations (rural and housing credit).[5]
- $cambio$ = balances of foreign exchange operations (import and export financing operations).

Inputs: The inputs are composed of the variables needed in the productive process of the banks, which incur costs for the use of physical capital, labor (wages and social contributions), administrative expenses and deposits, represented as follows:

- cap = fixed capital in use.
- $trab$ = personnel expenses.

[5] In the case of rural credit, the accounting plan of financial institutions contemplates the division between free and obligatory operations. For housing finance, however, this division is not made explicit. To define this variable, we adopt the hypothesis that all the funds allocated to these operations are obligatory. This is consistent with the observation that banks allocate resources to this credit modality only at the lower limit required by current law.

- adm = administrative expenses.
- dep = deposits.

Consequently, we define the prices of the inputs as being:

- $pcap$ = fixed capital in use by the bank relative to permanent assets.
- $ptrab$ = expenses for wages and compensation for employees and executive officers.
- $padm$ = administrative expenses relative to short-term assets.
- $pdep$ = expenses for funds taken in relative to the total of deposits.

In view of the classification chosen, the next step is to estimate a cost function for the Brazilian banking sector. Following Caves, Christensen and Tretheway (1979)[11], we have chosen a flexible general quadratic form, using natural logarithms and the Box-Cox transformation as a metric for the quantity of the products. In this way, the function is defined for observations where some product may be zero, and by imposing the usual restrictions, we ensure linear homogeneity in the prices of the products. Besides this, the adoption of the hybrid translog form is justified by the traditional arguments of not imposing restrictions on the possibilities for substituting between the production factors and variability of the scale economies in relation to the product levels, which permits the observation of cost functions with the usual U format.

Let:

$$\begin{aligned}\ln Custo \quad = \quad & \alpha_0 + \sum_{i=1}^{4}\alpha_i Y_i^* + \sum_{i=1}^{4}\beta_i \ln P_i \\ & +1/2\sum_{i=1}^{4}\sum_{j=1}^{4}\alpha_{ij} Y_i^* Y_j^* \\ & +1/2\sum_{i=1}^{4}\sum_{j=1}^{4}\beta_{ij} \ln P_i P_j \\ & +\sum_{i=1}^{4}\sum_{j=1}^{4}\gamma_{ij} Y_i^* \ln P_j\end{aligned}$$

where $Custo$ refers to the sum of administrative, operating, labor and fund raising costs, P_j is the price of inputs, with $j = (cap, trab, adm, dep)$, and Y_i^* is the Box-Cox transformation for the product quantity, with

$Y_i^* = \dfrac{Y_i^{\lambda} - 1}{\lambda}$, for $\lambda \neq 0$

$Y_i^* = \ln Y_i$, for $\lambda = 0$

$i = (tvm, livre, obrig, cambio)$

Besides this, as pointed out in Christensen and Greene (1976)[12], the cost function has the convenience and facility of calculating demand functions by inputs, allowing derivation of cost share equations, from Shepard's lemma, since:

$$CS_i = \frac{\partial \ln Custo}{\partial \ln P_i} = \frac{\partial Custo}{\partial P_i} \times \frac{P_i}{Custo} = \frac{P_i X_i}{Custo}$$

where X_i represents the quantity of input i used and CS_i is the cost-share equation for input i.

We thus have:

$$CS_i = \beta_i + \sum_j \gamma_{ij} Y_i^* + \sum_j \beta_{ij} \ln P_i$$

with the usual restrictions of homogeneity of prices of the factors and symmetry imposed, in this way ensuring the dual relation between the transformation and cost functions of the bank:

$$\begin{aligned} \sum_i \beta_i &= 1 \\ \sum_j \beta_{ij} &= 0 \quad , i = 1, 2, 3, 4 \\ \sum_i \gamma_{ij} &= \sum_j \gamma_{ij} = 0 \end{aligned}$$

and

$$\begin{aligned} \alpha_{ij} &= \alpha_{ji} \\ \beta_{ij} &= \beta_{ji} \end{aligned}$$

The data The data used in this work come from the database of the Central Bank of Brazil, specifically the information reported by banks under the Accounting Plan for Institutions of the National Financial System (COSIF). We have taken a cross-section of 148 commercial and full-service banks, along with the Caixa Econômica Federal (federal savings and loan), using the figures reported for December 2002. Besides this, the justification for using the hybrid translog form is based on the sample profile, which presents several banks with zero quantities for some products. Specifically, of the total of 148 banks, 7 have zero for *tvm*, 12 for *livre*, 102 for *obrig* and 86 for *cambio*.[6]

In the Appendix we explain the COSIF accounts used in composing each of the outputs and inputs, as defined previously. A list of the banks of the sample is also in the Appendix.

The characteristics of the sample are given by Table 1, which presents the mean, standard deviation and the minimum and maximum amounts for each of the variables used. All amounts are expressed in Reais (R$).

[6] Although for December 2002 there were 167 banks in operation in these categories, the lack of some of the information necessary caused us to limit the sample to 147 institutions with enough available data.

Table 1: Sample Characteristics

Series	Obs	Mean	St. Dev.	Minimum	Maximum
tvm	148	2.084.476.362	7.571.773.599	0	67.419.186.996
livre	146	1.824.272.378	4.901.443.157	0	39.086.426.292
obrig	146	275.587.892	1.426.687.562	0	14.752.029.280
cambio	146	268.226.405	961.456.737	0	8.405.263.065
adm	148	83.742.453	247.130.526	397.261	1.933.443.506
depósitos	148	4.063.003.561	13.044.493.511	6.613	101.555.143.108
trabalho	148	98.915.557	338.185.592	1.120	2.794.414.971
capital	148	73.100.968	258.531.506	16.230	2.128.344.511
custo	148	4.318.762.538	13.864.195.027	1.585.304	108.411.346.095
despdep	148	547.300.590	1.580.829.585	1	14.328.362.556
recserv	148	75.749.367	305.430.641	0	2.217.728.923
ptrab	148	157.591	505.959	144	4.782.412
pdep	148	10,4076	124	0	1.505
padm	148	0,1761	0,7138	0	6,9790
pcap	148	0,3194	0,3298	0	0,9850

The estimation method follows Christensen and Greene (1976)[12]. The $\ln Custo$ function and the participation functions CS_j are treated as a nonlinear multivariate regression system and estimated jointly by nonlinear least squares, seeking in this way to expand the amount of information available and obtain more efficient estimated parameters. Given that the cost participation functions must add to one, the CS_{cap} cost participation function relative to the capital input was eliminated, thus avoiding the singularity of the residuals matrix.[7] We add a residual to each of the equations included, adopting the usual hypothesis of joint normal distribution of the residuals. Besides this, of the 46 initial coefficients, we only maintained 31, by excluding non-significant coefficients, opting for a more parsimonious model.[8]

We verified the standard regularity of the cost function - namely that it must be non-decreasing for price of the factors and have non-negative marginal costs - in order to test its level of adequacy. The cost function chosen is non-decreasing for price of the administrative and deposit factors for 97.9% of the 147 observations, for 97.3% of the observations for the capital factor and for 41.8% for the labor factor. Marginal costs are non-negative for 100% of the observations of the *tvm*, *livre* and *cambio* products and for 93.3% of the observations of the *obrig* product. We can conclude, then, that the estimated cost function is well behaved.

The results of the estimation are showed in Table 2 and suggest a high

[7] Extension of the result of Barten (1969)[8] to a multivariate system permits suggesting that the results are invariate to the eliminated cost participation function (Christensen and Greene (1976))[12].

[8] The estimation of the cost function was done by means of the WinRats econometric software, version 5.

significance of the coefficient λ of the Box-Cox, reinforcing the choice of the hybrid translog form.

Table 2: Estimated Parameters - Cost Function Dez/2002

Estimated Parameters - Dec/2002				
Variable	**Coefficient**	**Std. Dev.**	**T-Stat**	**P-Value**
constante	15,76562078	0,44351847	35,5467	0,0000
lambda	0,09491581	0,01445551	6,5661	0,0000
tvm	0,04618015	0,01126806	4,0983	0,0000
obrig	0,02433414	0,01213728	2,0049	0,0450
ptrab	0,05891999	0,03381789	1,7423	0,0815
padm	0,30979584	0,03087324	10,0345	0,0000
pdep	0,63128417	0,04567969	13,8198	0,0000
tvm*pcap	0,00344949	0,00094273	3,6591	0,0003
tvm*ptrab	-0,00102761	0,00033062	-3,1082	0,0019
tvm*padm	-0,00242188	0,00074894	-3,2337	0,0012
livre*livre	0,00208192	0,00084815	2,4547	0,0141
livre*obrig	-0,00100853	0,00033913	-2,9739	0,0029
livre*pcap	0,00764731	0,00143038	5,3463	0,0000
livre*ptrab	-0,00122181	0,00031599	-3,8666	0,0001
livre*pdep	-0,00478870	0,00099085	-4,8329	0,0000
livre*padm	-0,00163680	0,00057409	-2,8511	0,0044
obrig*obrig	0,00128550	0,00067822	1,8954	0,0580
obrig*pcap	-0,00374585	0,00137541	-2,7234	0,0065
obrig*ptrab	0,00070802	0,00018575	3,8118	0,0001
obrig*padm	0,00068544	0,00038126	1,7979	0,0722
obrig*pdep	0,00235238	0,00128430	1,8316	0,0670
cambio*ptrab	0,00020153	0,00012007	1,6785	0,0933
cambio*pdep	-0,00020153	0,00012007	-1,6785	0,0933
pcap*pcap	0,16343009	0,00884454	18,4781	0,0000
pcap*padm	-0,01348025	0,00361854	-3,7253	0,0002
pcap*pdep	-0,14994984	0,00781908	-19,1774	0,0000
ptrab*ptrab	0,00959680	0,00296910	3,2322	0,0012
ptrab*padm	0,00249029	0,00141874	1,7553	0,0792
ptrab*pdep	-0,01208709	0,00337921	-3,5769	0,0003
padm*padm	0,01098996	0,00382111	2,8761	0,0040
pdep*pdep	0,16203693	0,00803392	20,1691	0,0000
Non-linear Least Squares Convergence in 40 Iterations. Final criterion was 0.0000088 < 0.0000100 Usable Observations 146 Total Observations 148 Skipped/Missing 2				

3 Decomposition of the banking spread in Brazil: An application of the common cost allocation methodology

One of the difficulties of decomposing banking spreads is how to divide administrative costs among the various operations banks carry out. Until now, the works developed by the Central Bank of Brazil on allocation of administrative costs (included in the work on the methodology of the CB itself) among the various modalities of free credit start with the hypothesis that banks allocate their administrative resources - and hence the portion of joint costs - proportionally to the return that these modalities generate. In this form, the aggregated costs stated on banks' balance sheets are divided to allocate greater portions of total administrative costs to more profitable operations, weighted by the volumes of each modality. This then, is a methodology based on simple proportionality criteria that does not necessarily reflect a bank's true allocative choice, principally considering regulatory restrictions such as directed credit aimed at certain classes of borrowers.

Consequently, problems emerge from this assumption, which can to some extent compromise the decomposition calculation. The first problem refers to the division between particular and common costs. This is reflected in the cost structure by not considering the real cost of each product, and hence affects the very definition of profitability. Another problem is associated with the question of cross-subsidies. By not considering the existence of products that generate negative return because their prices are fixed exogenously, the calculation of administrative costs is skewed to those modalities that operate at freely set prices - exactly those that are considered in the decomposition of the spread.

Within this context, we intend here to present an alternative methodology to determine the administrative costs per product, aiming to correct these problems and obtain a more accurate estimation of the costs of each modality of credit - both in the free and directed portfolios - of Brazilian banks. This methodology is based on the theory of common cost allocation, in turn developed from cooperative game theory, with emphasis on analysis of the formation of prices by regulated firms that offer various products. The idea here is to import this instrument to the banking firm, in view of the fact that banks, just as the companies that originally motivated the development of this theory, face the difficulty of allocating common resources in an environment of multiproduction. In the specific case here, this involves allocation of administrative costs among the various credit modalities offered, seeking a more accurate determination of the costs involved in each operation and hence in the spread charged on each credit modality.

The problem of allocation of common costs among different products offered by the same firm has gained importance in the economic literature mainly from the 1980s.[9] The basis of cost allocation models starts from an environment in

[9] Before the debut of game theory with publication of the seminal work of Von Neumann and Morgenstern in 1944, the problem of allocating common costs had already generated

which the firm faces a production function with joint technology where the total costs are not only represented by the sum of the individual costs of producing each good. To the contrary, the total costs are determined by the portion of particular costs added to the costs that are common to all the goods' (non-exclusive) costs. Consequently, the formation of costs for each product must consider the generation of revenues to cover both its particular costs and a portion of the common costs. This principally applies to regulated companies, where the competitive solution with price equal to the marginal cost may not cover the total cost.

The theory of cost allocation has advanced by borrowing techniques developed in cooperative game theory. The idea is to model the division of costs and benefits as a cost game where each product/service is treated as a player, to which particular costs and part of the joint costs are attributed. The objective is to solve the question of viability by incorporating situations where the company has increasing returns of scale and decreasing marginal costs. Notions of efficiency, incentives to cooperation, cross-subsidies and monotonicity are considered and various methods arise based on an axiomatic analysis.

Young (1994)[25] presents the most relevant methods of the theory of common cost allocation, such as the Shapley value, the weighted Shapley value, Ramsey prices and the Aumann-Shapley prices, the latter applied to continuous problems that, unlike Ramsey prices, are independent of demand elasticities.

It is specifically based on the Aumann-Shapley algorithm that we apply the theory of common cost allocation to the division of bank costs among the various products offered. Taking the banking firm as an industry that produces a range of products, and hence faces the problem of allocating common costs, the focus falls on some solutions for dividing administrative costs among the various credit modalities offered and permits suggesting a more precise estimation of the costs of each of the modalities considered.

In this context, the bank's problem becomes formalized as one of joint production, starting from a continuous common cost allocation model.

We define the pair (C, q) as the cost allocation problem, where:

$N = (1, 2, ..., n)$ is the set of credit modalities offered by the bank.

$C(q) \in \Re^n_{++}$ is the joint cost of granting a bundle $q = (q_1, q_2, ..., q_n)$ of modalities, with q_i non-negative, representing the volume of credit offered in each modality i.

$C(0) = 0$

$C \in \mathbb{C}^1$

A coomon cost allocation method is written through a function $\phi(C, q)$ that associates, to each pair (C, q), an individual cost vector $c = (c_1, c_2, ..., c_n)$ that allocates among the various credit modalities exactly the value of the total costs:

$$\sum_i q_i \phi(C, q) = C(q)$$

important results that served as a basis for the Tenessee Valley Authority Act (1933), which sought to resolve the problem of dividing common costs among three distinct objectives: electricity generation, flood control and navigation.

Vector c is said to belong to the core of the game (C, q) if it totally covers the costs of production (feasibility restriction) and is free of subsidies. Formally:

$c = (c_1, c_2, ..., c_n)$ belongs to the core of (C, q) if and only if

$$\sum_{i \in N} c_i = C(N)$$

and

$$\sum_{i \in S} c_i \leq C(S)$$

for all $S \subset N$.

Allocations belonging to the core of the game are allocations without cross-subsidies since they are allocations that cannot be blocked by any coalition. More specifically, the allocation belonging to the core has the property that no product can be produced individually at a lower cost than that being imputed to it by the allocation found (the same goes for any subset of products).

Various methods, and hence different functional forms for $\phi(C, q)$, have been developed. Each of them has specific properties associated with the choice of characteristics of the game that it is modeling and the objectives sought through the cost allocation (efficiency, incentive to cooperation, etc.).

There are two justifications for choosing Aumann-Shapley prices for the specific case of this work. First, because we seek to model allocation of bank administrative costs among banking products defined as volumes of credit, there is nothing more natural than working in a continuous environment, given the possibility these volumes can take on a variety of values. And in this case, the hypothesis of a continuous cost function does not present any great problems.[10]

Besides this, due to the concern with isolating the question of cross-subsidies generated by the obligation to direct resources to certain credit modalities, methods that generate allocations belonging to the core of the cost game are more interesting from an analytical viewpoint. This permits estimation of the real cost of a freely allocated credit operation, isolated from the part of the costs relative to directed operations. Heeding these two central concerns, and analyzing the inherent properties of the various available methods, we settled on the Aumann-Shapley price method as the natural choice.

3.1 Aumann-Shapley prices

The Aumann-Shapley cost allocation method was developed based on the original work of Aumann and Shapley (1974)[1] for non-atomic games, and is detailed in Billera, Heath and Verrecchia (1981)[10]. It was developed as an alternative approach to Ramsey prices (Ramsey (1927))[21], whose solution is linked to the demand elasticities. The motivation of Aumann and Shapley was to propose a procedure to allocate common costs in such way to preserve some of the basic properties present in an environment of separable costs: efficiency, monotonicity, additivity and consistency.

[10] The drawback we face it the need for choosing, arbitrarilly, one funcional form.

The AS cost allocation method can be specified as:

$$c_i = \int_0^1 \frac{\partial C\left(tq_1, tq_2, ..., tq_n\right)}{\partial q_i} dt$$

with $0 \leq t \leq 1$.

In other words, the price of each product is its marginal cost weighted by the vectors tq^*, where t defines the radius from 0 to q^* (Young (1994)[25]). The Aumann-Shapley price, then, defines the unit cost to be imputed to each product in line with its share of the total cost, obeying the criteria of efficiency.

Based on this theoretical formulation, we defined the cost function

$$C(tvm, livre, obrig, cambio, pcap, ptrab, padm, pdep)$$

estimated in the previous section, which enabled calculating the Aumann-Shapley prices $(c_{tvm}, c_{livre}, c_{obrig}, c_{cambio})$ for each of the four products previously defined, for each of the 148 banks in the sample.[11]

The Aumann-Shapley prices, thus defined from the marginal costs associated with each unit produced, permit associating a portion of the total cost to each product, obeying the efficiency criteria not contemplated in allocations based on simple proportionality. The prices calculated here and the respective administrative costs will be used to decompose the banking spread in Brazil, as explained in the next section. Table 3 presents de mean proportions, both for the complete sample - composed with banks that have zero volumes for at least one of the produtcs - and for the 28 banks sample that have positive volumes for all products, as previously defined: $tvm, livre, obrig$ e $cambio$.

Table 3: Output Participation on Total Costs

	Output			
	tvm	livre	obrig	cambio
Complete Sample	0,32	0,59	0,08	0,01
Restricted Sample	0,25	0,56	0,17	0,02

As showed, on avarage, freely allocated resources respond for near 60% of total administrative costs. For those banks that have a directed loan portfolio, the administrative resources use amounts to almost 20% of total administrative costs.

The prices calculated here and the respective administrative costs will be used for the spread decomposition, as explained in the next section.

[11] We used the Aumann-Shapley algorithm to calculate the prices of each bank in the sample, relying on the "pricing.m" package of the Mathematica software, version 4.0.

4 The Decomposition of the Banking Spread in Brazil: A revision of the original methodology

Based on the new approach for allocating administrative costs and using a larger sample, this section revises the original methodology for decomposing the spread developed by the Central Bank of Brazil in 1999.

Some methodological aspects, such as calculation of the cost of deposit insurance (FGC) and the tax wedge have been adopted here without alterations. On the other hand, we re-include measurement of the cost of reserve requirement, abandoned in 2000 and justified here starting from a simple theoretical model. Besides this, we aggregate the new approach to administrative cost allocation, which incorporates the proportions found based on the Aumann-Shapley algorithm, as presented in the previous section.

We start with the daily interest rate on loans to get the average monthly rate for each bank:

$$i_{emp} = [\prod_{t=1}^{T} \frac{\sum_j V_j \, (1 + i_j)}{\sum_j V_j}]^{21/T} - 1$$

where:

V_j is the standing volume of the loan modality j and

i_j is the interest rate on loan modality j.

From there we define the bank spread as the difference between the bank's lending rate and the cost of funds i_{cap}, given by the "pré x DI " swap rate, adjusted by the average term to maturity N of the loans.

The universe of banks was originally based on the same sample used in estimating the cost function in the previous section. However, this sample was reduced somewhat during the calculation process because all the necessary data were not available for some institutions, or the results turned out to be distorted in the case of institutions with some specific characteristics. We wound up with a final sample of 98 institutions to decompose the bank-by-bank spread, which gives a more accurate picture of the behavior of the sector.[12]

4.1 The Components of the Banking Spread in Brazil

Following earlier works, particularly those by the Central Bank of Brazil (CB), we analyze the banking spread as a composition of cost and margin factors: costs of the contribution to the deposit insurance system, cost of reserve requirements, administrative costs, loan losses and tax costs. After determining these costs, we calculate the residual in relation to the rate charged, which configures the possibility of gain for the bank. In calculating the costs of deposit insurance, reserve requirement and the tax wedge, we chose to use the same methodology

[12] The list of banks whose spreads were decomposed is in the Appendix.

originally formulated by the CB and that is described below.[13] For the other components, the calculation method will be explained in the particular subsections on them.

4.1.1 Cost of the FGC

The Deposit Guarantee Fund (Fundo Garantidor de Crédito - FGC) was created in 1995 as a private deposit insurance entity, funded *ex-ante* with compulsory contributions by members of the system. The rate was set at 0.025% per month on covered deposits.

If on the one hand the FGC was an important institutional advance, on the other, it represents an impact on the cost of financial intermediation. This is reflected both in the total volume of resources available for lending and the cost of raising these funds, since it functions as a tax on the amounts taken in.

The calculation methodology used here follows that developed by the CB, which defines the FGC cost as given by the financial cost over the cost of raising funds and the respective cost of the increased need to raise funds to cover the same volume of lending, i.e.:

$$FGC = 0,025\% C[(1 + i_{cap})^N]$$

4.1.2 Cost of Reserve Requirements

The issue of what portion of funds on deposit must be held in reserve, along with the tax question, has been the focus of intense discussions. Brazil has very high reserve requirements (45% over demand deposits, 15% over time deposits and 30% ever deposits in passbook savings accounts), which obviously impacts the pricing of bank credit.

Here we have chosen to include the cost of maintaining required reserves, given in terms of the limitation on leveraging.[14] The reason for re-including compulsory reserves as a component of the spread can be defended on the grounds of a simple optimization model, as in Barajas *et al.* (1998).

Let:

D_V and D_P be the volumes of demand and time deposits, respectively;

B, L_D and L_L be the volumes of bonds, directed loans and free loans;

α and β be the reserve requirement rates on demand and time deposits, respectively;

δ and γ be the percentages of directed lending over demand and time deposits, respectively;

r_B, r_D and r_L be the respective yields on bonds and loans;

[13] For more details about the CB methodology, see the Annex to the report "Juros e *Spread* Bancário no Brasil - Avaliação de 1 ano do projeto" (2000) ["Bank Interest and Spread in Brazil - Evaluation of 1 year of the project"].

[14] It must be pointed out, however, that in view of the voluntary option of banks to hold a portfolio of public bonds, there may be some positive bias in the composition relative to the cumpulsory reserves on term deposits. This bias does not exist in the component relative to checking deposits, which is responsible for the greatest cost of maintaining these reserves.

r, r_V and r_P be the interest rates paid on compulsory reserves, demand and time deposits, respectively; and

P_B, P_D and P_L the respective administrative costs.

By the bank's balance sheet condition we have:

$$D_V + D_P = B + L_L + L_D + \alpha D_V + \beta D_P \tag{1}$$

On the other hand, the bank's profit is given by:

$$\pi = r_B B + \sum_{i=D,L} r_i L_i + r\beta D_P - \sum_{j=V,P} r_j D_j - P_B B - \sum_{i=D,L} P_i L_i \tag{2}$$

subject to the following restrictions:

$$\begin{aligned} r_D &= \overline{r}_D \\ r_V &= 0 \\ L_D &\geq \delta D_V + \gamma D_P \end{aligned}$$

In other words, the interest rate on directed loans is given, the yield paid on demand deposits is nil and the amount of directed loans must be at least equal to the sum of the directed lending required on funds held in demand and time deposits.

Substituting (2) in (1), we have:

The bank chooses L_L so as to maximize π, which generates the following first-order condition, in view of the fact that by (), $\dfrac{\partial D_P}{\partial L_L} = \dfrac{1}{1-\beta}$:

$$\begin{aligned} r_L - \frac{r_P}{1-\beta} &= D_P \frac{\partial r_P}{\partial L_L} - L_L \frac{\partial r_L}{\partial L_L} \\ &\quad -\frac{1}{1-\beta}\left((r_B - P_B)(1-\beta-\gamma) + \gamma\left(\overline{r}_D - P_D\right) + r\beta\right) \\ &\quad +r_B - P_B + P_L \end{aligned}$$

In other words, reserve requirements impact the rate of interest on loans, and hence the bank spread, via a pricing process, besides the effects on leveraging, which are measured in the standard accounting methodology.[15]

The reserve wedge is defined, in the accounting methodology, as the sum of the cost of such reserves on time deposits, defined based on the portion of time deposits kept on reserve tx_{cDP} and the remuneration of these reserves at the basic rate i_{cDP}:

$$CCOMP^{DP} = \frac{tx_{cDP}.(i_{cap} - i_{cDP})}{(1 - FGC - tx_{cDP}) + DV/DP(1 - FGC - tx_{cDV})}$$

[15] One must note the effect of the sign of the rate of reserve requirements on the spread. This rate has effects through two channels: a first one that is clearly positive and a second whose sign is defined by the net yield on the directed loan operations.

and the cost of the compulsory reserves on demand deposits, defined analogously as the portion of demand deposits kept on reserve tx_{cDV} and the respective remuneration $i_{cDV} = 0$:

$$CCOMP^{DV} = \frac{DY/DP.tx_{cDV}.(i_{cap} - i_{cDV})}{(1 - FGC - tx_{cDP}) + DV/DP(1 - FGC - tx_{cDV})}$$

4.1.3 Administrative Expenses

The most important contribution of this study rests within this component. Unlike in the works of the CB, here we develop a way of calculating administrative costs outside the hypothesis of cost allocation based on generation of revenue. Such a hypothesis, as discussed earlier, disregards the obligation to allocate resources to directed credit operations, which although incurring high administrative costs, for the majority of banks produce lower returns than the average of their portfolios. In view of this, the estimation proposed here takes into consideration the notion of cost of granting free loans and not the revenue generated by these loans.

We do this by applying the Aumann-Shapley prices $c_{livre} = ASp$ of loan operations, defined as the total administrative cost of the freely allocated loan portfolio. This total portfolio cost, applied to the bank's overall cost, generates the proportion of cost relative to this business unit, which permits redefining the administrative cost rate as being:

$$ADM = N.ASp.E$$

4.1.4 Expenses from Default

We calculate expenses from loans losses based on provisions, adjusted by reversals, on the total volume of loans. This ratio defines a default rate that, deducted from the interest rate on loans, effectively defines the rate effectively received by the bank:

$$INAD = i_{emp} - ((1 + i_{emp})^{1/N} - t_{inad})^N - 1$$

with

$$t_{inad} = \frac{despprov - reversões}{empréstimos}$$

Here the problem remains (already mentioned) of how accurately the default rate estimate t_{inad} reflects the real default rate. Once again, however, the limitation of available data prevents any advance on this front.[16] On the other hand, if the provisions for bad loans reported by banks are consistent with the risk classifications determined by Resolution 2682/99, this problem will be minimized.

[16] Access to data from the new Central Bank Risk Bureau will permit a better estimation of loan default and its participation in the banking spread.

4.1.5 Tax Wedge

The tax wedge on financial intermediation, besides being the object of constant doubts as to its impacts on intermediation efficiency, is made up of a complex welter of different imposts. Currently, indirect levies include the Contribution to the Social Integration Program (PIS, 0.65%) and the Contribution to Finance Social Security (COFINS, 3.0% for purposes of this study, but raised to 4.0% as of September 2003). Besides these, there are the Tax on Financial Operations (IOF) and the Provisional Contribution on Bank Debits (CPMF), the latter levied both when funds are taken in and lent out. Under the rubric of direct levies, there are Income Tax (IR, 25%) and Social Contribution on Net Profit (CSLL, 9%), both charged on net bank income, thus being indirect functions of the rates of default and administrative expenses.

In calculating the participation of taxes in composing the spread, we use the CB's original methodology in full. The difference in the final results is due to the components referring to default and administrative costs, which differ here from their previous estimations.

4.1.6 Residual

After deducting the components related to the cost of deposit insurance (FGC), reserve requirement, administrative expenses, taxes and non-performing loans, the remainder from loan operations goes to remunerate the bank's capital - relative to the freely allocated loan portfolio:

$$R = i_{emp} - FGC - CComp - ADM - INAD - CTributos$$

In other words, besides being calculated by a residual, this variable indicates (discounting the remaining measurement errors) the portion of bank profit on freely allocated loan operations. It does not necessarily reflect the bank's general return, which includes the return from the other business units whose average yield may be more or less than that gained on loans at freely determined rates.

4.2 The New Decomposition of the Bank Spread in Brazil

This last section looks at a new decomposition of the spread on freely allocated loans in the Brazilian banking sector. The analysis focuses on operations at pre-fixed rates in the modalities normally used in works by the Central Bank on decomposition of the spread, namely:

- Individuals: Overdraft credit line, personal credit and loans for acquisition of goods.
- Companies: hot money, guaranteed accounts, factoring of trade bills and promissory notes, working capital loans, acquisition of assets and vendor finance.

The initial sample of 148 banks was limited to 98 because of the unavailability of data for some institutions and discrepancies in the results in cases of some banks with very specific operations. For the final calculation of the composition of the average spread we maintained the original composition of the National Financial System regarding the participation of private and government-owned banks.[17] The expanded sample permitted an important qualitative analysis by enabling decomposition by segment and thus uncovered differences between various groups of banks, notably between private and government ones.

Table shows the decomposition of the spread for the same sample of 17 banks used by the Central Bank in its works. It can be seen here that for these banks the spread decomposes almost evenly among administrative expenses (21,12%), tax costs (explicit and implicit) (24,07%) and default (23,03%), with some preponderance of the residual variable (31,56%). In other words, the spread breaks down between the two overall cost components - taxes and operating expenses (45,19%), risk and return (54,59%), with some prevalence of the latter.components for this sample.

Table 4: Sample 17 Banks

Proportions over the Spread	
FGC Cost	**0,22%**
Total Reserve Requirements Cost	**10,66%**
Checking Accounts RR	10,38%
Time Deposits RR	0,28%
Administrative Expenses	**21,12%**
Tax Cost	**13,41%**
Indirect Taxes	2,05%
Direct Taxes	11,35%
Loan Losses	**23,03%**
Residual	**31,56%**

The picture changes when the sample is expanded to 57 banks so as to represent the National Financial System, maintaining the relative shares of government (29%) and private (71%) banks in the total lending by the Brazilian banking sector. As presented in Table 5, the decomposition is quite different, with the administrative cost component significatively higher than its previous level (29,36%). As a consequence, the residual variable goes down significantly, indicating potential profit levels for the sector (relative to freely allocated loans) of 23,41%, way below that of the 17 banks in the usual sample.

Using a larger sample composed of 100 banks, abandoning the relative participation of government and private banks in the National Financial System

[17] The average spread - and hence the proportions - were calculated as a mean weighted by the value of the loan portfolios of the banks composing the sample.

Table 5: National Financial System

Proportions over the Spread	
FGC Cost	**0,24%**
Total Reserve Requirements Cost	**8,18%**
Checking Accounts RR	7,79%
Time Deposits RR	0,39%
Administrative Expenses	**29,36%**
Tax Cost	**11,18%**
Indirect Taxes	2,01%
Direct Taxes	9,16%
Loan Losses	**27,63%**
Residual	**23,41%**

shows results consistent with those presented previously, with administrative costs and non-performing loans accounting for 55,65% of the spread, as shown in Table 6:

Table 6: Complete Sample

Proportions over the Spread	
FGC Cost	**0,24%**
Total Reserve Requirements Cost	**8,31%**
Checking Accounts RR	8,00%
Time Deposits RR	0,31%
Administrative Expenses	**28,34%**
Tax Cost	**12,33%**
Indirect Taxes	2,04%
Direct Taxes	10,29%
Loan Losses	**27,31%**
Residual	**23,47%**

However, using a sample of 61 private banks, a third portrait emerges. In this case, as shown in Table 7, the participation of administrative costs falls significantly, representing only 22,47% of the spread, allowng more room for potential profit (29,35%).

We can conclude, then, that the chief culprit of the high participation of administrative costs in the composition of the spread - above that of the sample of 17 banks but also much higher than the average of private banks - is government-owned banks, whose decomposition is detailed in Table 8, for a

Table 7: Private Banks

Proportions over the Spread	
FGC Cost	**0,25%**
Total Reserve Requirements Cost	**9,76%**
Checking Accounts RR	9,45%
Time Deposits RR	0,30%
Administrative Expenses	**22,47%**
Tax Cost	**12,82%**
Indirect Taxes	2,03%
Direct Taxes	10,78%
Loan Losses	**25,35%**
Residual	**29,35%**

sample of 14 such banks. For this set of banks, the costs related to default and administrative expenses are responsible for almost 70% of the spread, a situation that configures lower potential profits on freely allocated loans that impacts the aggregates for the sector as a whole.

Table 8: Public Banks

Proportions over the Spread	
FGC Cost	**0,28%**
Total Reserve Requirements Cost	**7,23%**
Checking Accounts RR	6,82%
Time Deposits RR	0,41%
Administrative Expenses	**38,26%**
Tax Cost	**11,80%**
Indirect Taxes	2,22%
Direct Taxes	9,58%
Loan Losses	**30,44%**
Residual	**11,98%**

5 Conclusion

The decomposition presented in this study corrects the original one found by the Central Bank in various important aspects. Chief among these are the previous selection bias of using only 17 banks to represent the entire sector and the hypothesis of zero reserve requirement for term and demand deposits - and

hence the impact on the assessment of taxes and measurement of the default component, contaminated by the choice of a skewed sample.

Besides this, the main contribution of this study is its formulation of a new methodology to estimate the portion relative to administrative costs, based on cost instead of revenue of the business unit considered. This implicitly incorporates the presence of directed operations that generate less than average returns but are expensive to administer.

As a result of these corrections, the residual variable, which formerly incorporated measurement errors from the other variables, is represented more accurately. Hence, the overall decomposition of the banking spread in Brazil becomes more reliable.

Table 9 shows the decompositions for the original methodology, the new methodology applied to the original sample, and the new methodology applied to the expanded sample, enabling a broad comparison of the results:

Table 9: Comparative Results

	Original Sample and Original Meth.	**Original Sample and New Meth.**	**New Sample and New Meth.**	**Diference (%)**
Proportions over the Spread				
FGC Cost	**0,11%**	**0,22%**	**0,24%**	**121,60%**
Total Reserve Requirements Cost	**0,00%**	**10,66%**	**8,18%**	
Checking Accounts RR	0,00%	10,38%	7,79%	
Time Deposits RR	0,00%	0,28%	0,39%	
Administrative Expenses	**17,21%**	**21,12%**	**29,36%**	**70,61%**
Tax Cost	**27,66%**	**13,41%**	**11,18%**	**-59,59%**
Indirect Taxes	7,94%	2,05%	2,01%	-89,79%
Direct Taxes	19,72%	11,35%	9,16%	-45,22%
Loan Losses	**16,73%**	**23,03%**	**27,63%**	**65,15%**
Residual	**38,28%**	**31,56%**	**23,41%**	**-38,86%**

The original decomposition had two basic problems: first, a selection bias in the sample, by not including government banks and by being based on banks with greater than average efficiency. This has direct bearing on the overall decomposition.

Secondly, in eliminating this selection bias and using the same sample, methodological problems arise that affect the accuracy of the decomposition, starting with administrative costs, formerly underestimated in their absolute magnitude. Besides this, the portion relative to mandatory reserves and default - and hence tax costs - presents very different shares. As a result, the bank residual is smaller than that previously estimated.

Finally, based on this new decomposition, some important conclusions emerge on the mater of pricing loans in the free segment and the general situation of the Brazilian banking sector:

1. The portion related to administrative costs, along with a reduced number of more efficient banks, represents a significant part of the intermediation costs. This shows a high level of inefficiency in the sector, notably the government banks, the main culprits in the high level of this component.

2. Non-performing loan costs represent an important part of the banking spread in Brazil. This reflects an insecure environment, largely caused by the difficulty in foreclosing and recovering credits. This in turn generates problems of moral hazard that negatively impact the determination of interest rates on loans.

3. The private banks are much more efficient than the average for the sector. This is reflected in the participation of loans losses and administrative costs in the composition of the spread, which is on average much lower than the sector-wide average and even more so in relation to government banks. This has a direct impact on the residual variable and hence on the potential profit level of banks.

4. The National Financial System, although composed of some very efficient and profitable banks, does not have a very high average return on capital for freely allocated loans. Considering that the residual variable potentially incorporates costs relative to cross subsidies, the bank spreads in Brazil, unlike suggested in previous studies, on average have quite a small margin component on these operations.

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Apendix: COSIF Accounts Used for Output and Input Composition and Sample of Banks Used for the Cost Function Estimation

Table 10: COSIF Accounts

OUTPUTS		INPUTS	
Free Loans		**Personel**	
	16100004		81727003
	16210004		81730007
	16310007		81736001
	16340008		81733004
	16330001		81718005
	16610006		
	30130005	**Administrative Resources**	
	30185005		81703003
			81706000
Directed Credit Loans			81709007
	16320004		81712001
	16400003		81721009
			81724006
Foreign Exchange Operations			81739008
	16220001		81742002
	16225006		81745009
	16227004		81748006
	49207008		81751000
	49236000		81754007
	49248005		81757004
	30110001		81760008
	30115006		81763005
	30120008		81766002
			81772003
Treasury Operations			81775000
	13000004		81777008
			81799000
Services Fees			
	71700009	**Deposits**	
			41100000
			41200003
			41300006
Assets			41500002
	10000007		41800001
Permanente			43000005
	20000004		46000002
			81100008
			81200001
		Capital	
			22300001
			22400004
			22900009
			23000001

Table 11: Banks Composing the Sample

BB - BANCO DO BRASIL (+ $)	**BANCO BANIF PRIMUS S.A. (+ #)**	**BCO INDUSTRIAL DO BRASIL S.A. (#)**
BRB - BCO DE BRASILIA S.A. ($)	**BCO BANERJ S.A. (+ #)**	BCO CREDIT SUISSE FIRST BOSTON
BCO BNL DO BRASIL S.A. (+ #)	BCO BRASCAN S.A.	**BCO BVA S.A. (#)**
BCO GERDAU S.A.	BCO MÁXIMA S.A.	BCO LA NACION ARGENTINA
BCO POTTENCIAL S.A. (+ #)	**BCO NOSSA CAIXA S.A. (+ $)**	CITIBANK NA
CEF - CAIXA ECON. FEDERAL (+ $)	**BANCO MORADA S.A. (#)**	**BCO ABN AMRO REAL S.A. (*)**
BCO RIBEIRAO PRETO S.A. (+ #)	BCO LA PROVINCIA DE B AIRES	BCO SUL AMERICA S.A
BCO BGN S.A.	**JPMORGAN CHASE BANK**	**BCO FININVEST S.A. (* #)**
BCO EMBLEMA S.A.	LEMON BANK BANCO MULTIPLO S.A.	**BCO RURAL S.A. (+ #)**
BCO RABOBANK INTL BRASIL S.A.	ING BANK N.V.	**BCO CEDULA S.A. (+ #)**
BCO COOPERATIVO SICREDI S.A. (#)	**BCO UNION - BRASIL S.A.**	BANK BOSTON N.A
BCO BNP PARIBAS BRASIL S.A.	**BCO SCHAHIN S.A. (+ #)**	BCO J.P.MORGAN S.A
BCO BEG S.A. (+ #)	BCO LA REP ORIENTAL URUGUAY	**BCO CACIQUE S.A. (#)**
HSBC BANK BRASIL S.A. (* + #)	**BCO ARBI S.A. (+)**	BCO CREDIBANCO S.A.
BCO COOPERATIVO DO BRASIL S.A. (+ #)	**BCO FINASA S.A. (* + #)**	**BCO CITIBANK S.A (*)**
BCO KEB DO BRASIL SA	**BCO TRICURY S.A. (#)**	BCO SANTANDER S.A.
BCO DAIMLERCHRYSLER S.A. (#)	**BCO VOLVO (BRASIL) S.A.**	BCO REDE S.A.
BCO TOYOTA DO BRASIL S.A. (#)	**BCO SAFRA S.A. (* #)**	BCO FATOR S.A.
BCO CNH CAPITAL S.A.	**BCO SANTOS S.A.**	**UNIBANCO S.A. (* + #)**
BCO1.NET S.A. (+ #)	**BCO INTERCAP S.A. (+ #)**	**BCO LLOYDS TSB S.A. (+)**
BCO PSA FINANCE BRASIL S.A.	**BCO FIBRA S.A. (#)**	BCO OPPORTUNITY S.A.
BCO CARGILL S.A.	**BCO VOLKSWAGEN S.A. (+ #)**	**BBV ARGENTARIA BRASIL S.A. (+ #)**
BCO IBI S.A. - BM (+ #)	**BCO LUSO BRASILEIRO S.A. (+ #)**	**BCO PROSPER S.A. (+ #)**
BCO DA AMAZONIA S.A. (+ $)	**BCO PANAMERICANO S.A. (+ #)**	**BCO SANTANDER BRASIL S.A. (* + #)**
BCO DO EST. DO PA S.A. ($)	**BCO INTER AMERICANEXPRESS (+ #)**	BCO SOCIETE GENERALE BRASIL
BCO DO EST. DO MA S.A. (+ $)	BCO VOTORANTIM S.A.	**BCO ZOGBI S.A. (+ #)**
BCO DO EST. DO PI S.A. ($)	BCO AGF S.A.	**BCO PAULISTA S.A. (+ #)**
BCO DO EST. DO CE S.A. (+ $)	DRESDNER BANK LATEINAMERICA	**BCO CRUZEIRO DO SUL S.A. (#)**
BCO BMC S.A. (+)	**BANKBOSTON BCO MULTIPLO S.A. (* #)**	**BCO PINE S.A. (#)**
BCO DO NORDESTE DO BRASIL S.A. ($)	**BCO TOKYO-MITSUBISHI BR S.A. (+ #)**	**BCO DAYCOVAL S.A. (#)**
BCO INDUSTRIAL E COM. S.A. (+ #)	**BCO SUMITOMO MITSUI BRASILEIRO**	DEUTSCHE BANK S.A.BCO ALEMAO
BCO PERNAMBUCO S.A.-BANDEPE (+ #)	**BCO ITAU S.A. (* + #)**	**BCO GE CAPITAL S.A. (#)**
BCO SIMPLES S.A	**BCO BRADESCO S.A. (* + #)**	**BCO RENDIMENTO S.A.**
BCO DO EST. DE SE S.A. (+ $)	**BCO PECUNIA S.A. (+ #)**	**BCO CREDIBEL S.A. (+ #)**
PARANA BCO S.A. (+ #)	BCO SOFISA S.A.	**BANCO BONSUCESSO S.A. (+ #)**
BCO BBM S.A.	**BCO BCN S.A. (* + #)**	**BCO COMERCIAL URUGUAI S.A. (+ #)**
BCO CAPITAL S.A. (#)	**BCO SUDAMERIS BRASIL S.A. (* + #)**	BCO CREDIT LYONNAIS BRASIL S.A
BCO MERCANTIL DO BRASIL S.A. (+ #)	**BCO INDUSVAL S.A.**	**BCO BANESTADO S.A.**
BCO BEMGE S.A.	**BCO MERCANTIL DE SP S.A. (* + #)**	BCO VR S.A.
BCO TRIANGULO S.A. (+)	BCO BANDEIRANTES S.A	**BCO OURINVEST S.A.**
BANCO GM (+)	BCO WESTLB BRASIL S.A	BCO MAXINVEST S.A.
BCO BRJ S.A.	BCO BARCLAYS S.A	**BCO ESTADO DE SC S.A. ($)**
BCO BANESTES S.A. ($)	BANCO INVESTCRED UNIBANCO S.A.	**BCO SANT. MERIDIONAL S.A. (* +)**
BCO ABC BRASIL S.A. (+ #)	**BCO BMG S.A. (#)**	**BANCO JOHN DEERE S.A. (+)**
DRESDNER BANK BRASIL S.A. BM	**BCO DIBENS S.A. (#)**	**BCO DO EST. DO RS S.A. ($)**
BANCO UBS	BCO COM E INV SUDAMERIS S.A.	BANK OF AMERICA - BRASIL S.A.
BCO PACTUAL S.A.	BCO FICSA S.A.	**BCO A.J. RENNER S.A.**
BCO MODAL S.A. (+)	**LLOYDS TSB BANK PLC**	**BCO MATONE S.A.**
BCO ITAÚ-BBA S.A. (*)	**BANESPA (* + #)**	
BCO CLASSICO S.A.	**BCO GUANABARA S.A. (+ #)**	

Complete Sample (100 Banks)

* Sample "17 Banks"
\+ Sample "NFS" (57 Banks)
\# Sample "Private Banks" (61 Banks)
$ Sample "Public Banks" (14 Banks)