Empiric Study on the Economy of Scale of the Brazilian Banking System

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Abstract

This article presents an empiric study about the banks' economies of scale in Brazil. The models used were cost function, profit function and tabular analysis. The sample used represents about 98% of the total assets of the Brazilian financial system. As a conclusion, scale economies were detected and there were signs of decreasing returns. This study represents a progress in relation to existent Brazilian research because recent international studies were used as references and it was the first one that clearly detected the presence of scale economies in Brazil.

Key words: Economy of scale; return; banking system

Résumé

L'article présente une étude empirique des économies d'échelle des banques au Brésil. Les modèles utilisés sont des fonctions de coût, des fonctions de bénéfice et une analyse tabulaire. L'échantillon utilisé représente environ 98% de tous les titres du système financier brésilien. Comme conclusion, des économies d'échelle ont été détectées et il y avait des signes de rentabilités décroissantes. Cette étude représente un progrès par rapport à la recherche brésilienne existante car elle utilise des études internationales récentes et est la première qui détecte clairement la présence d'économies d'échelle au Brésil.

Mots-Clés : économies d'échelle, rentabilité, système bancaire.

Empiric Study on the Economy of Scale of the Brazilian Banking System

The Brazilian financial system went through deep transformations during the 1990s. The liberalization of the country's financial system to the foreign capital, the decline of the inflation, the world financial crises and Real Plan had great impact on the system. In the second half of 1990s, the banks became more efficient, computerized and the competition became more ruthless. Starting early 1996, leading international financial groups began to enter the country in order carry out important fusions and acquisitions and, therefore, those institutions conquered an important slice of the Brazilian internal market. The Brazilian banks also consummated a great number of fusions and acquisitions to gain market share. Hence, a great wave of unprecedented bank fusions and acquisitions in the history of the Brazilian economy took place during that period of time. The banks started to adopt as growth strategy, and, consequently, as a snap attempt to gain market share, the purchase of preexistent financial institutions, since it is much faster to grow like this, than through an organic growth.

This contemporary theme is frequently discussed in academic works and broadly explored by the media, be it in newspapers' and magazines' articles, or, television and radio programs. Many times, it is affirmed that banks aim to acquire scale - that achieve fusions and acquisitions to obtain scale economies. The objective of this article is to empirically evaluate the existence of scale economies in the Brazilian banks, in the post-Real Plan era. Through econometric models and tabular analysis, the work aims to detect the presence of economy of scale.

Financial statements of eighty-five commercial and multiple banks of the Brazilian financial system were employed in the research. The sample is quite significant, because it represents 94% of the population, since in total there are 90 banks in operation in the country. Besides, the total of assets of the banks sampled represents about 98% of the total of assets of the Brazilian financial system.   Half-yearly data between December, 1997 and June, 2001 were used.

The most difficult part of the work was collecting data. In Brazil, it is not easy because there is little information available about banks. Brazil's Central Bank does not provide the bank's financial statements. The data can be acquired only through consultancies for a large some of money. For these reasons, the sample took almost three years to be consolidated.

The remainder of the paper is organized as follows. Section I describes the theoretical reference and methodology. Section II analyzes the results of the empiric study. Section III concludes the paper.

I.   Theoretical Reference and Methodology

After meticulous analysis of twelve empiric studies[1], it was verified that the models more used to measure scale economy - isolated or jointly with other methods - are tabular analysis (used in 49.67% of the cases), and, cost and profit functions (used in 50% of the cases). The production function was not relevant in most of the studies, having being employed, together with other models, in only 16.67% of the cases. Therefore, in this article, the adopted models were the ones most often used for measuring scale economies, which are tabular analysis and cost and profit functions.

The tabular analysis consisted of the construction of thirteen economic-financial indexes related to cost, efficiency, and profitability. The indexes are of authorship of Assaf Neto (1998), Brito and Franco (1981), Mallmann and Rabbi (1996) and Matias and Siqueira (1996). Chart I presents the indexes employed in the above-mentioned analysis.

Chart I
Economic-financial Indexes

This chart lists the economic-financial indexes related to cost, profitability and efficiency.

	Formula	Index Information
Cost Indexes	(Expenses of financial intermediation + personnel's expenses + general and administrative expenses) / (total assets - fixed assets - net assets)	Relationship between the level of total expenses and the portion of the assets linked to the revenue generation.
	(Personnel's expenses + general and administrative expenses) / (total assets - fixed assets - net assets)	Relationship between the level of personnel's and administrative expenses and the portion of the assets linked to the revenue generation.
	(Expenses of financial intermediation + operational expenses) / total deposits	Relationship between total expenses and total deposits.
	(Expenses of financial intermediation + operational expenses) / total assets	Relationship between total expenses and total assets.
Profitability Indexes	Net profits / owner's equity	Revenues resulted from profit and from operational efficiency.
	Net profits /total assets	Efficiency influenced by the assets' profit management and liabilities' interest.
	Net profit/ financial intermediation revenues	Part of profit, witch is represented by the financial intermediation.
	Operational revenues/ total assets	Efficiency influenced by the administration of the operational revenues of assets and of the liabilities' interest.
	Net result of financial intermediation/ total assets	Efficiency influenced by the administration of the net results of financial intermediation of assets and liabilities' interest.
	Revenues of financial intermediation/ total assets	Efficiency influenced by the administration of the revenues resulted from the financial intermediation of assets and liabilities' interest.
Profitability Indexes	Operational revenues / owner's equity	Gains generated by the operational revenues of the operational efficiency.
	Profit before the taxes and contributions/total assets	Efficiency influenced by the administration of the profits before the taxes and contributions, and of assets, and liabilities' interest.
Efficiency Indexes	(Personnel's expenses + general and administrative expenses) / operational gross revenues	Efficiency of the total expenses opposed to the operational revenues.

Source: Assaf Neto (1998), Brito and Franco (1981), Mallmann and Rabbi (1996) and Matias and Siqueira (1996)

In the Mullineaux model, the independent variables used in regression models originate from the Mullineaux's (1978) – with the aim of finding an approximate regression model to the referred author's one. Actually, data limitations required the adoption of an adapted Mullineaux model. The profit function of Mullineaux can be described in the following way:

$$\ln \pi = a_0 + \sum_{i=1}^{m} a_i \ln P_i + \sum_{j=1}^{n} b_j \ln q_j + \sum_{m=1}^{t} s_m \ln v_m + \frac{1}{2} \sum_{m=1}^{t} \sum_{j=1}^{t} h_{mj} \ln v_m \ln v_j + \sum_{k=1}^{w} c_k Z_k \quad \textbf{(1)}$$

Where π represents the profit, P_i the prices of the products, m the number of products, q_j the prices of the n inputs, except labor, and Z_k the amount of the fixed factors of production. The variables v_m (m=1,...,t) and v_j (j=1,..., t) correspond to the prices of the labor categories. These categories (managers and employees) vary between m and j and the levels within these categories vary between 1 and t. Therefore, within the labor category **employee**, for example, there are employee 1, employee 2, etc..., until employee t. In every translog function there is a double sum that in the specific case of this profit function means that all labor prices have to be incorporated. In other words, the prices of all categories and labor levels must be added. The Mullineaux Model (1978) can be enlarged by substituting the variable dependent on profit for a variable dependent on cost and, in this case, the result is a cost function. Berger and Mester (1997), and Stiroh (1999) used that resource to estimate cost and profit functions and showed that this substitution is acceptable and brings good results in the detection of economies of scale.

In the Adapted Mullineaux´s Model, there is a lot of detailed information about the inputs and the fixed factors of production that include the prices of the inputs (administrators' and employees salaries; interest taxes paid in cash and term deposits and in savings,) and the amount of factors (number of bank branches and average size of the branches). As this work does not have available data with the same level of detailing as the Mullineaux's model, the option was to work with proxies, in the selection of the coefficients that will determine the scale economies and the returns to scale, and in the listing of the independent variables. Chart II presents information on the used proxies. In the Adapted Mullineaux's Model, the economies or diseconomies of scale can be observed as:

- To the dependent variable profit "before taxes and contributions / total asset", when the coefficients of the fixed factors of production (total assets and owner's equity) are positive or negative, can be detected, respectively, increasing returns to scale and decreasing returns to scale.
- For the dependent variable "(operational expenses + expenses of financial intermediation)/ total assets**"**, when the coefficients of the fixed factors of production (total assets and owner's equity) are positive or negative can be detected, respectively, scale diseconomies and scale economies.

Chart II
Information on the Adapted Mullineaux's Model

This chart explains the dependent variable, the independent variable and the dummy variables used on the Adapted Mullineaux's Model.

Adapted Mullineaux's Model	Observations
Dependent Variables	
Variable Profit profit before taxes and contributions / total assets	Increment of the variable cost. Berger and Mester (1997), and Stiroh (1999) employed that resource.
Variable Cost (operational expenses + financial intermediation expenses) / total assets	
Independent Variables	
Price of product (loans' revenues - leasing) / risk assets (revenues of financial intermediation – revenues of loans) / risk assets other operational revenues /(total assets – leasing – fixed assets - risk assets)	Adaptation of the variables. The author used interest rates of loans to individuals and businesses, and to the agricultural sector.
Price of input interests of deposits / total deposits (expenses of financial intermediations - interests of deposits) / (net assets – total deposits) total assets / expenses with personnel	Adaptation of the variables. The author used the administrators' and employees' wages.
Amount fixed assets owner's equity	Adaptation of the variables. The author used number and average size of branches.
Dummy **Time** (half-yearly) **Size of the bank** (small, medium, large) **Nature of the bank** (public, national/private, foreign/ private)	Adaptation of the variables. The author used dummies for subsidiaries and holdings.

Source: Authors (2002)

Besides the dependent variable cost, the dependent variable profit was also used to enlarge the model. That resource is perfectly acceptable and it was already used in the studies of Berger and Mester (1997), and Stiroh (1999). Chart III lists the dependent and independent variables of the Adapted Mullineaux's Model. The independent variables are related to product's price, production factors' prices, and amount and variables dummy of time, size and nature of the bank. The variables dummy of time were used in the regression, since data of temporary series were being combined (half-yearly data between December 1997 and January 2001) with data in cross section (eighty five banks).

Chart III
Variables used on the Adapted Mullineaux's Model
This chart details the dependent variables, the independent variables and the dummy variables used on the Adapted Mullineaux's Model.

Dependent Variables
Variable of profit
latc/at = Profit before taxes and contributions/ total assets
Variable of cost
doif/at = (operational expenses + expenses of financial intermediations) / total assets

Independent Variables
Price of product
re/tar = (revenues of loans - leases) / risk assets
rife/tar = (revenues of financial intermediation - revenues of loans) / risk assets
oro/a = other operational revenues / (total assets - leases and finances - fixed assets - risk assets)
Price of factors of production
je/dt = interests of deposits / total deposits
di/a = (expenses of financial intermediation - interests of deposits) / (net assets - total deposits)
at/dp = total assets / expenses with personnel)
Amount
af = fixed assets
pl = owner's equity
Dummy
Time (2°/1997. 1°/1998. 2°/1998. 1°/1999. 2°/1999. 1°/2000. 2°/2001. 1°/2001)
Size of the bank (small, medium, large)
Nature of the bank (public, national/private, foreign/private)

Source: Authors (2002)

Brito and Franco's model (1981) was adapted so that the independent variables used in the regression models originate from of the referred authors' original model, with the intention of achieving an approximate regression model. The authors used a profit function estimated through the analysis of multiple regressions. Three dependent variables were used for profitability: "operational profit / adjusted asset", "operational profit/owner's equity", and "net profit/owner's equity". Brito and Franco (1981) used the following profit function:

$$Y = a + \sum_{i=1}^{4} b_j D_j + \sum_{j=1}^{5} c_j x_j + u$$

(2)

where Y = profitability measure to be examined; a = constant associated to national private banks, which belong to financial conglomerates; D_1 = dummy for national private banks which do not belong to financial conglomerates; D_2 = dummy for foreign private banks, which do not belong to financial conglomerates; D_3 = dummy for foreign private banks, which belong to financial conglomerates; D_4 = dummy for public banks; X_1 = total deposits of total deposits of the sample or logarithm of total deposits; X_2 = cash deposits of total deposits; X_3 = obligations for loans on total deposits; X_4 = loans made by the bank (credit operations) on its adjusted assets; X_5 = availability of adjusted assets; and u = stochastic term of error. Adjusted assets corresponds to the difference between the total assets and the net balance of the values in transit, allocated in the bills of interbank and interdepartmental accounts. In Brito and Franco's model, the scale economies or scale diseconomies can be observed as:

- To the dependent variable "profit before taxes and contributions/ total assets", when the coefficient of the variable "deposits total / total deposits of the

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sample" is positive or negative, are detected, respectively, increasing returns to scale and decreasing returns to scale.

- To the dependent variable "(operational expenses + expenses of financial intermediation)/ total assets**", when the coefficient of the variable "deposits total / total deposits of the sample " is positive or negative, are detected, respectively, scale diseconomies and scale economies.

The Adapted Brito and Franco's Model introduces few modifications to the original Brito and Franco (1981) one. There was an expansion of the model when, besides the dependent variable cost, the dependent variable profit was used. As previously mentioned, other authors already employed that resource. The variables used, accordingly with an approximation of the Brito and Franco's model (1981), for modeling the set of data of the banks correspond to the proxies on Chart IV.

Chart IV
Information on the Adapted Brito and Franco's Model
This chart explains the dependent variables, the independent variables and the dummy variables used on the Adapted Brito and Franco's Model.

Adapted Brito and Franco´s Model	OBSERVATIONS
Dependent Variables **Variable profit**: profit before taxes and contributions / total assets **Variable cost**: (operational expenses + finance intermediate expenses) / total assets	Addition of the variable cost. Berger and Mester (1997) and Stiroh (1999) used that resource. The author used three variables for profit. Here, it was employed only one variable profit, so that it could present the same standards of the Adapted Mullineaux's Model.
Independent Variables Total deposits / total deposits of the sample Cash deposits / total deposits Leases and finances / total Deposits Leases and finances / Total Assets Net Assets / Total Assets	The variables are the same as Brito and Franco original model.
Dummy Time (half-yearly) Size of the bank (small, medium, large) Nature of the bank (public, private national, private foreign)	The same dummies of the original model of Brito and Franco (1981) were used, and dummies of time were added.

Source: Authors (2002)

Chart V lists the dependent and independent variables of the Adapted Brito and Franco's Model. The dependent variable profit corresponds the variable "profit before taxes and contributions/ total assets," and the dependent variable cost corresponds the variable "(operational expenses + financial intermediation expenses)/ total assets." The independent variables correspond to: "deposits total / total deposits of the sample", "cash deposits / total deposits," "leases and finances / total deposits, " "leases and finances / total assets," "net assets / total assets." The dummy variables of time, size and nature of the bank were also employed.

Chart V
Variables used on the Adapted Brito and Franco's Model

This chart details the dependent variable, the independent variable and the dummy variables used on the Brito and Franco's Model.

Multiple Lineal Regression
Dependent Variables
Variable Profit
latc/at = profits before the taxes and contributions / total assets
Variable Cost
doif/at = (operational expenses + expenses of financial intermediation) / total assets
Independent Variables
dt/dta = total deposits / total deposits of the sample
dv/dt = cash deposits / total deposits
af/dt = leases and finances / total deposits
af/at = leases and finances / total assets
al/at = net assets / total assets
Dummy
Time (2º/1997. 1º/1998. 2º/1998. 1º/1999. 2º/1999. 1º/2000. 2º/2000. 1º/2001.2º/2001.)
Size of the bank (small, medium, large)
Nature of the bank (public, national private, private foreign)

Source: Authors (2002)

II. Analyses and Results of the Empiric Study

A. Tabular Analysis

The indexes were calculated for each bank, in each period and then, a simple arithmetic average of the indexes of the banks was calculated, accordingly with their size, for each period. When cost indexes are used, the results indicate that scale economies are observed. The profitability indexes reveal indications of the existence of decreasing returns to scale. Those data reveal that the banks are, comparatively, able to reduce more their expenses that to increase their assets, in other words, the banks are enduring difficulties to increase their revenues and profits compared their assets. That information can mean that, in a first moment, the banks are able to reduce costs, through fusions and acquisitions, and restructurings - but the banks were not able yet, to effectively increase their revenues and profits. Besides, as most of the banks works with standardized products, they are not taking advantage of scope economies; in other words, the banks are not increasing their profits through the improvement of the production, and are only reducing costs.

B. Econometrical Analysis

The econometrical analysis consists of the evaluation of Mullineaux (1978), and Brito and Franco (1981) models, in what it refers to the evaluation of the financial system as a whole, and to the evaluation of the banks' sample stratified by size (small, medium and large).

B.1 Analysis of the Financial System

B.1.1. Adapted Mullineaux's Model

Table I reveals that, for the financial system as a whole, the dependent variable is being well explained, therefore, the adjusted determination coefficient is quite satisfactory (0.690) and F>2.5. As the coefficient of the fixed assets' variable it is negative, although it is not significant, and the coefficient of the variable owners' equity is negative and significant, it can be said that there are indications of the existence of scale economies, for the financial system as a whole. The dummy variables for size detect the presence of scale economy,

because the coefficients of the dummy variables for medium and large size are negative, and the P_{value} of both it is close to zero.

Table I
Adapted Mullineaux's Model - Analysis of the Financial System - Variable Cost
This table reports the results of the regression for the financial system as a whole using the dependent variable cost on the Adapted Mullineaux's Model.

	Dependent Variable:			
	(operational expenses + expenses of financial intermediation) / assets totals			
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	,595	,490	1,214	,225
Fixed assets	-,00004164	,000	-,634	,527
Owner's equity	-00002856	,000	-1,925	,055
LN re/tar	,191	,019	10,256	,000
LN rife/tar	,287	,061	4,726	,000
LN oro/a	-,149	,091	-1,637	,102
LN je/dt	,106	,024	4,338	,000
LN di/a	2,755E-02	,072	,381	,703
LN at/dp	-,141	,016	-8,645	,000
Medium size	-,112	,034	-3,269	,001
Large size	-,226	,060	-3,768	,000
Private national	-2,243E-03	,043	-,052	,959
Private foreign	6,985E-02	,045	1,569	,117
R^2	,699			
Adjusted R^2	,690			
Standard error	,323943			
F	73,262			

Source: Authors (2002)

Table II reveals that - for the financial system as a whole - the dependent variable is not being explained in a satisfactory way, because the adjusted determination coefficient is quite reduced (0.124). Besides, F presents a high value, turning the regression ambiguous. Therefore, it is not possible to infer anything from that table.

Table II
Adapted Mullineaux's Model - Analysis of the Financial System - Variable Profit
This table reports the results of the regression for the financial system as a whole using the dependent variable profit on the Adapted Mullineaux's Model.

Dependent Variable: profit before the taxes and contributions /assets totals				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	-,214	,229	-,935	,350
Fixed assets	-,00001758	,000	-,572	,568
Owner's equity	,0000204	,000	2,936	,003
LN re/tar	5,149E-03	,009	,590	,556
LN rife/tar	7,265E-03	,028	,255	,799
LN oro/a	-6,298E-02	,042	-1,484	,138
LN je/dt	6,523E-03	,011	,570	,569
LN di/a	-2,902E-02	,034	-,859	,391
LN at/dp	4,853E-02	,008	6,235	,000
Medium size	-5,613E-02	,016	-3,490	,001
Large size	-5,101E-02	,028	-1,822	,069
Private national	3,408E-03	,020	,167	,867
Private foreign	9,609E-03	,021	,460	,646
R^2	,151			
Adjusted R^2	,124			
Standard error	,1515			
F	5,573			

Source: Authors (2002)

B.1.2. Adapted Brito and Franco`s Model

Table III reveals that, for the financial system as a whole, the dependent variable is being explained in a satisfactory way. The adjusted determination coefficient is satisfactory (0.517) and the F value is extremely high. The coefficient of the variable "total deposits/ total deposits of the sample" is negative, what could suggest a scale economy, but, as the variable is not significant, because the P_{value} is high, there isn't a possible conclusion to evaluate the subject of scale economies in the financial system as a whole. However, the dummy variables for medium and large size show that there are scale economies, since the coefficients of the two dummies are negative and significant (the P_{value} is quite reduced). The Adapted Mullineaux's Model captures the effects of the dummy variables better, once it presents larger adjusted R^2 (0.690), larger F (73.262) and smaller P_{values} for the two variables (0.001 and 0.000).

Table III
Adapted Brito and Franco`s Model - Analysis of the financial system - Variable cost
This table reports the results of the regression for the financial system as a whole using the dependent variable cost on the Adapted Brito and Franco 's Model.

Dependent Variable: (operational expenses + expenses of financial intermediations)/ total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	-1,363	,202	-6,752	,000
dt/dta	-8,515	5,291	-1,609	,108
dv/dt	-3,637E-03	,020	-,184	,854
af/dt	-4,243E-05	,001	-,066	,948
af/at	,201	,190	1,061	,289
al/at	-,370	,194	-1,910	,057
Medium size	-,125	,042	-2,991	,003
Large size	-,179	,069	-2,593	,010
Private national	-,136	,057	-2,390	,017
Private foreign	-,115	,056	-2,050	,041
R^2	,529			
Adjusted R^2	,517			
Standard error	,419348			
F	45,121			

Source: Authors (2002)

Table IV reveals that, for the whole financial system, the dependent variable is not explained in a satisfactory way, since the adjusted determination coefficient corresponds to 0.051. Therefore, as the regression it is extremely bad; it is not possible to appoint conclusions whether the existence, or not, of returns to scale.

Table IV
Adapted Brito and Franco´s Model - Analysis of the Financial System - Variable Profit
This table reports the results of the regression for the financial system as a whole using the dependent variable profit on the Adapted Brito and Franco's Model.

Dependent variable: profit before taxes and contributions/ total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	-8,741E-02	,105	-,831	,406
dt/dta	,353	2,756	,128	,898
dv/dt	-1,028E-02	,010	-,998	,318
af/dt	3,805E-04	,000	1,132	,258
af/at	-,388	,099	-3,934	,000
al/at	-,293	,101	-2,904	,004
Medium size	-6,276E-02	,022	-2,888	,004
Large size	-3,204E-02	,036	-,893	,372
Private national	2,287E-02	,030	,774	,439
Private foreign	1,954E-02	,029	,666	,506
R^2	,074			
Adjusted R^2	,051			
Standard error	,218441			
F	3,203			

Source: Authors (2002)

It is not hard to apprehend that, for the financial system as a whole, there are indications of scale economy and the dummy variables of size detected the presence of scale

economy. The Adapted Mullineaux's Model has proven to be more effective to exhibit scale economy than the Adapted Brito and Franco´s Model, as it captures the effect of the dummy variables better, and presents larger adjusted R^2 (0.690), larger F (73.262) and smaller P_{values} for the two variables of size (0.001 and 0.000). However, in what it refers to returns to scale, there are not possible conclusions, because the regressions are not good.

B.2. Analysis - Stratified by Size

Considering that, as observed in the previous item, the Adapted Mullineaux's Model is more efficient to present scale economy, than the Adapted Brito and Franco`s Model, it was opted, in this part of the work, to stratify the sample in sizes (small, medium and large), and to employ, hence, the Adapted Mullineaux's Model only. Table V reveals that the dependent variable is being explained in a satisfactory way, because the adjusted R^2 and the F present high values. However, there is not a way to capture the scale economy, because, although the coefficient of the owner's equity is negative, it is not significative - and the coefficient of fixed assets is significative, but positive. Therefore, in this case, a possible conclusion does not exist.

Table V
Adapted Mullineaux`s Model -Stratified Analysis – Small Size - Variable Cost
This table reports the results of the regression for small size banks using the dependent variable cost on the Adapted Mullineaux's Model.

Dependent variable: (operational expenses + expenses financial intermediations)/total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	-2,747	4,366	-,629	,531
Fixed assets	,01153	,004	2,664	,009
Owner's equity	-,0009505	,001	-1,562	,121
LN re/tar	,265	,037	7,111	,000
LN rife/tar	,213	,200	1,065	,289
LN oro/a	,138	,833	,165	,869
LN je/dt	,176	,053	3,337	,001
LN di/a	,489	,740	,661	,510
LN at/dp	-9,646E-02	,050	-1,942	,055
Private National	,211	,141	1,494	,138
Private foreign	,239	,162	1,475	,143
R^2	,770			
Adjusted R^2	,733			
Standard error	,334875			
F	20,726			

Source: Authors (2002)

Table VI reveals that the dependent variable is being explained in a satisfactory way, because the adjusted R^2 and the F present high values. In this case, the existence of scale economy is clearly noticed, once the coefficients of fixed assets and owner's equity are negative and significative (the P_{value} of each coefficient is zero).

Table VI
Adapted Mullineaux`s Model - Stratified Analysis – Medium Size - Variable Cost

This table reports the results of the regression for medium size banks using the dependent variable cost on the Adapted Mullineaux's Model.

Dependent variable: (operational expenses + expenses of financial intermediations)/total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	,801	,527	1,519	,129
Fixed assets	-,00233	,001	-3,622	,000
Owner's equity	-,0002059	,000	-3,872	,000
LN re/tar	,140	,024	5,760	,000
LN rife/tar	,307	,069	4,441	,000
LN oro/a	-,145	,095	-1,533	,126
LN je/dt	7,979E-02	,033	2,399	,017
LN di/a	2,029E-02	,080	,253	,800
LN at/dp	-,182	,021	-8,651	,000
Private national	-8,055E-02	,061	-1,313	,190
Private foreign	1,105E-02	,062	,178	,859
R^2	,690			
Adjusted R^2	,676			
Standard error	,333370			
F	49,774			

Source: Authors (2002)

Table VII reveals that the variable is being well explained, as the adjusted R^2 and the F present high values. There are indications of scale economy, as the owner's equity coefficient is negative and significant. However, one cannot categorically affirm that there is scale economy, because the coefficient of fixed assets is positive, although not significant.

Table VII
Adapted Mullineaux`s Model - Stratified Analysis – Large Size - Variable Cost

This table reports the results of the regression for large size banks using the dependent variable cost on the Adapted Mullineaux's Model.

Dependent variable: (operational expenses + expenses of financial intermediations)/total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	-2,383	17,628	-,135	,893
Fixed assets	,00001956	,000	,588	,558
Owner's equity	-,00001429	,000	-2,291	,025
LN re/tar	,236	,044	5,367	,000
LN rife/tar	,500	,108	4,637	,000
LN oro/a	,613	4,170	,147	,883
LN je/dt	3,548E-02	,026	1,379	,172
LN di/a	1,979E-02	,091	,217	,828
LN at/dp	-,124	,040	-3,136	,002
Private National	6,227E-02	,038	1,653	,102
Private foreign	,193	,043	4,513	,000
R^2	,932			
Adjusted R^2	,917			
Standard error	,118718			
F	62,596			

Source: Authors (2002)

Table VIII reveals that, for the small size banks, the variable is being explained in a satisfactory way (adjusted R^2 and F are both high). There are indications of increasing returns to scale, because the owner's equity coefficient is positive and significant. However, one cannot categorically affirm that there are increasing returns to scale, because the coefficient of fixed assets is negative, although not significative.

Table VIII
Mullineaux's Model - Stratified Analysis – Small Size – Variable Profit

This table reports the results of the regression for small size banks using the dependent variable profit on the Adapted Mullineaux's Model.

Dependent variable: profit before taxes and contributions/ total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	9,334	1,068	8,742	,000
Fixed assets	-,0001864	,001	-,176	,860
Owner's equity	,0006122	,000	4,116	,000
LN re/tar	3,907E-03	,009	,429	,668
LN rife/tar	-2,280E-02	,049	-,467	,641
LN oro/a	-2,361	,204	-11,592	,000
LN je/dt	2,845E-03	,013	,220	,826
LN di/a	2,664E-02	,181	,147	,883
LN at/dp	1,394E-02	,012	1,148	,254
Private national	7,470E-02	,035	2,163	,033
Private foreign	5,561E-02	,040	1,406	,163
R^2	,678			
Adjusted R^2	,626			
Standard error	8,18940E-02			
F	13,013			

Source: Authors (2002)

Table IX reveals that, for all the medium size banks, the dependent variable is not explained in a satisfactory way, because the adjusted R^2 is very low. Therefore, as the regression is very bad; it is not possible to surmise conclusions whether the existence of returns to scale.

Table IX
Adapted Mullineaux´s Model - Stratified Analysis - Medium Size - Variable Profit

This table reports the results of the regression for medium size banks using the dependent variable profit on the Adapted Mullineaux's Model.

Dependent variable: profit before taxes and contributions/ total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	-,607	,382	-1,588	,113
Fixed assets	,0002057	,000	,441	,660
Owner's equity	,0002554	,000	6,620	,000
LN re/tar	3,359E-02	,018	1,901	,058
LN rife/tar	1,012E-02	,050	,202	,840
LN oro/a	-1,971E-02	,069	-,287	,774
LN je/dt	-1,111E-02	,024	-,461	,645
LN di/a	-3,507E-02	,058	-,603	,547
LN at/dp	,112	,015	7,354	,000
Private National	-4,254E-02	,045	-,956	,340
Private foreign	-5,350E-02	,045	-1,184	,237
R^2	,264			
Adjusted R^2	,231			
Standard error	,2419			
F	8,035			

Source: Authors (2002)

Table X reveals that, for all the large sized banks, the dependent variable is not explained in a satisfactory way, because the adjusted R^2 is very low. Therefore, as the regression is very bad, it impossible to infer conclusions whether the existence of returns to scale. Hence, one can perceive, in the analysis stratified by size, that when the variable cost is considered as a dependent variable, scale economy occurs only in the medium sized banks, there is only and few evidences of scale economy in the large sized banks. It was not possible to prove the existence of scale economies in the small size banks. When the variable profit is considered as a dependent variable, the situation is less elucidating. It is not possible to determine whether increasing returns to scale occur at the banks of medium and large sizes. For the small size banks, there are indications of increasing returns to scale.

Table X
Adapted Mullineaux´s Model - Stratified analysis – Large Size - Variable Profit
This table reports the results of the regression for large size banks using the dependent variable profit on the Adapted Mullineaux's Model.

Dependent variable: profit before taxes and contributions/ total assets				
Independent variables	Coefficients	Standard Deviation	T	P value
Constant	9,648	3,381	2,853	,006
Fixed assets	,00001657	,000	2,597	,011
Owner's equity	,00000029	,000	,242	,809
LN re/tar	1,372E-02	,008	1,625	,108
LN rife/tar	-4,052E-03	,021	-,196	,845
LN oro/a	-2,396	,800	-2,995	,004
LN je/dt	-2,220E-03	,005	-,450	,654
LN di/a	1,966E-02	,017	1,126	,264
LN at/dp	3,393E-03	,008	,447	,656
Private National	2,245E-02	,007	3,107	,003
Private foreign	1,262E-02	,008	1,539	,128
R^2	,358			
Adjusted R^2	,218			
Standard error	2,277E-02			
F	2,558			

Source: Authors (2002)

III. Final Considerations

Through tabular analysis for the variable cost the presence of scale economy was detected, and for the variable profit, there were indications of decreasing returns to scale. In the econometrical analysis, it was observed that, for the financial system as a whole, the variable cost pointed indicators of scale economy, and the dummy variables of size detected the presence of scale economy. In the analysis stratified by size, scale economies were detected only in the medium size banks; as for the large size banks there was only small evidence of scale economies. It was not possible to determine whether increasing returns to scale exist, or not. For the small size banks, there were indications of increasing returns to scale.

Finally, in this work, the econometrical models and the tabular analysis detected the presence of scale economies. This means that, as the banks increase their size, they reduce their average cost. In what it concerns the returns to scale, the results were not very clear, because the tabular analysis detected indications of decreasing returns to scale. For the financial system as a whole, the econometrical models didn't find conclusive results. Just in the stratified analysis of small size banks indications of increasing returns to scale were found.

Chart VI displays a summary of the results of the empiric study. Those data reveals that the banks are able to reduce costs more easily than to increase revenues, that is, although the relative costs are decreasing, the relative profits are not increasing. The banks are looking for cost economy through technical efficiency, in other words, producing with fewer inputs and reducing costs. The banks are not taking advantage of scope economies, that is, they are not aiming to increase the profits through the improvement of the production; they work with standardized products, and do not show interest in the diversification their product's scope. One of the reasons that could possibly justify the banks' posture is the application of resources in public notes that present a high profitability and a relatively low risk. Therefore, the banks try much harder to reduce costs (through fusions and acquisitions, operational

rationalization and service computerizing) than to increase revenues. Another important point to approach is that, as the fusions and acquisitions are very recent, there has not been enough time to figure out the increasing returns to scale, as the average costs were reduced, but there were not significant increases in the profitability. It is believed that, for those reasons, the results obtained with the returns to scale were not, yet, conclusive.

Chart VI
Results

This chart reports a summary of the result of the empiric study.

Models	Total of the Financial System		Stratification by size					
	Variable cost	Variable profit	Variable cost			Variable profit		
			Small	Medium	Large	Small	Medium	Large
Adapted Mullineaux`s Model	There are indications of scale economy.	There is not a possible conclusion.	There is not a possible conclusion.	There is scale economy.	There are indications of scale economy.	There are indications of increasing returns to scale.	There is not a possible conclusion.	There is not a possible conclusion.
Adapted Brito and Franco´s Model	There is scale economy.	There is not a possible conclusion.						
Tabular analysis	There is scale economy.	There are indications decreasing returns to scale.						

Source: Authors (2002)

In academic terms, it can be concluded that this article contributes to the debate about economies of scale in the Brazilian banks, once, inside of the accomplished research, this empiric study was the only one that clearly detected the presence of scale economy in Brazil. Chart VII displays a comparison among the results of the Brazilian empiric studies. It is noticed that most of the authors either present inconclusive results or just indications of the scale existence. Only Vital (1973) detected the presence of economies of scale, even so, only in banks of large size. Therefore, this article represents a progress in relation to the existent Brazilian works, as it in incorporates recent international studies in the empiric study, demonstrates comparisons among national and international studies and detects and shows the presence of scale economy.

Chart VII
Comparison

This chart reports a comparison among the results of Brazilian empiric studies.

Authors	Methodology	Models	Results
Oliveira (2002)	Analysis of the regression and Tabular analysis	Cost and profit functions; indexes of profitability and efficiency	There are scale economies. Indications of decreasing returns to scale were detected for the financial system as a whole, and indications of increasing returns to scale in the small banks.
Mallmann and Rabbi (1996)	Tabular analysis	Indexes of costs	Suggestion of scale economies in the small and medium banks, and of scale diseconomies in the large banks.
Paiva (1986)	Analysis of the regression	Profit function	The results were not conclusive, because, in a generic way, there are increasing returns to scale, but for the ten larger banks there are decreasing returns to scale.
Brito and Franco (1981)	Analysis of the regression	Profit function	Suggestion of existence of decreasing returns to scale; suggestion that there is not any significant effect of scale; and scale effects detected.
Vital (1973)	Analysis of the regression and Tabular analysis	Production Function; cost/product	There are scale economies in large size banks. The situation is not clear for medium and small size banks.
Bouzan (1972)	Analysis of the regression	Cost and production functions	Indications that only the large banks present scale economies. There is not a causal relation between bank concentration and scale economies.
Moura (1967)	Tabular analysis	Function cost/deposits	The results do not indicate the existence, or not, of scale economy, because great oscillation of the function cost/deposits was observed.

Source: Authors (2002)

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[1] The twelve empiric studies mentioned in this article refer to the following works: Alhadeff (1954), Schweiger and Mcgee (1961), Mullineaux (1978), Berger and Mester (1997), Stiroh (1999), Cavallo and Rossi (2001), Moura (1967), Bouzan (1972), Vital (1973), Brito and Franco (1981), Paiva (1986), Mallmann and Rabbi (1996).