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Profit, Cost and Scale Efficiency for Latin American Banks: Concentration-Performance Relationship

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Abstract

Using a sample of 495 Latin American banks over the period 2001-2008, this paper investigates how bank concentration influences cost and profit efficiency. We calculate scale efficiency to assess whether these banks are close to their optimal size. We find that banks are more inefficient in profits than in costs; concentration impairs cost efficiency; larger banks have higher performance, but this advantage decreases in concentrated markets; private and foreign banks are the most efficient; most banks are operating under increasing returns of scale, which contributes to the discussion on Basel III.

Key Words: Stochastic Frontier Analysis, Efficiency, Latin America, Market Structure, Basel III.

JEL Classification: G21, G28

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1 Introduction

Due to its economic relevance, the literature has become very concerned in discussing about competitiveness, stability and efficiency of banking markets (Shaeck et al., 2009; Hasan et al., 2009; Berger et al., 2009). Since the 1990s, Latin American banks are facing a process of deregulation and consolidation. Therefore, important to determine how these changes are affecting efficiency in different banking markets in the region and to evaluate which variables better explain this efficiency, as well. Another motivation is the recent financial crisis that has boosted the significance in discussing bank market structure and optimal scale. This paper addresses to these concerns of the literature by estimating banking cost, profit and scale efficiency from banks of 17 Latin American countries in the period 2001-2008, and then measuring the impact of banking market concentration, among other factors, on the quality of bank management.

With the purpose of measuring bank cost and profit efficiency for Latin America, we employ the Stochastic Frontier Analysis (SFA) by Aigner et al. (1977) to estimate a common cost (profit) frontier for the whole region. The idea of the SFA is that it measures how distant a bank is from the minimum cost (maximum profit) in the sample, i.e. from the best practice bank. As in previous studies, we include country-specific variables in the cost (profit) translog specification to assess for cross-country differences in the banking sector (see Dietsch and Lozano-Vivas (2000) and Bonin et al. (2005a)). According to Bos and Kool (2006), profit and cost efficiencies should be equal in a perfect competitive market. Deviations in these scores may suggest a non-competitive environment in the banking market in question. Our results support this idea by pointing out that Latin American are indeed banks more inefficient in the revenue side.

Moreover, we investigate the effect of market concentration, and other bank-specific variables, on efficiency by employing the Battese and Coelli (1995) model. This method avoids the bias of estimating the frontier and the correlates in two steps (Wang and Schmidt, 2002) by estimating both in only one-step. As proxy of concentration, we propose to use an improvement of the Herfindahl-Hirschman Index (HHI), known as the HHI dual (employed by Chang et al., 2006). We use both assets and loans concentration HHI dual measures. It is of the bank regulators interest to know the implications of concentration on efficiency in order to opt for the regulation policy to improve performance of the financial sector as a whole. If the results show a positive relationship between these two variables, regulators should provide incentives for bank mergers and acquisitions. While the literature on banking efficiency is vast, few studies have actually analyzed this relationship,

specially in developing countries, such as Latin America. We propose to contribute to literature by evaluating this effect.

According to Berger and Humphrey (1997), the common wisdom states that mergers and acquisitions have been successful in improving cost and profit efficiency, although there was not much empirical proof of this at that time[1]. Berger and Hannan (1998) find a negative relationship between concentration and cost efficiency. They suggest that concentrated markets leads to collusion (an idea known as the SCP paradigm) and result in lower efforts of banks to maximize profits and minimize costs, resulting in inefficiencies (i.e. Hicks' quiet life hypothesis). On the other hand, Maudos and Guevara (2007) not only reject the quiet life hypothesis for the EU-15 countries over 1993-2002, but also show that the market concentration and market power have different impacts on cost efficiency[2]. Both Chang et al. (2006) and Beck et al. (2006) show that banking market concentration implicates lower financial fragility, measured by bank insolvency risk, for the Brazilian banking market and 69 different countries, respectively.

Still in the Battese and Coelli specification, we add dummies of different bank ownership (state-owned, private and foreign) to check if banking efficiency depends on the type of bank ownership. Regarding this matter, the literature has found that on developed countries foreign banks are usually less efficient than national banks, while on developing and transition countries foreign ownership seems to improve efficiency of banks (Bonin et al., 2005b; Berger et al., 2009; Bonin et al., 2005a; Hasan and Marton, 2003; Staikouras et al., 2008; Fries and Taci, 2005; Tecles and Tabak, 2010). However, analyzing banks from Latin America, Figueira et al. (2009) finds that, in 2001, performance of foreign and domestic banks were very similar, which casts some doubts in this common sense in developing economies.

[1]The literature regarding bank M&A has found that performance improvement was not the main motivator of the consolidation trend in the 80s and 90s (DeYoung et al., 2009). Therefore, studies have focused in various managerial motives for M&A, such as the maximization of CEO remuneration, the preference of lower competitive pressures, or to be viewed by the government as a Too-Big-Too-Fail bank and exploit subsidies due to this fact. Only after 2000, has the literature given more support to the view that M&A are efficiency improving.

[2]There is a growing concern in investigating if the common idea that concentrated markets leads to a less competitive market (known as the SCP paradigm), is in fact true. Several studies dismiss this paradigm, such as: Claessens and Laeven (2004) that find a positive relation between concentration and competition; Shaffer and DiSalvo (1994) that find a high degree of banking competition in a small Pennsylvania county, even though the market structure was a duopoly. On the other hand, Bikker and Haaf (2002) and Deltuvaite et al. (2007), regress competition indicators on market concentration and they do find a negative relationship, supporting the SCP paradigm.

Another topic we discuss to elucidate is how close are Latin American banks from their optimum size. The method consists in estimating scale efficiency scores from the translog cost function. This analysis has gained extreme relevance due to recent development of a Basel III accord. One aim of this regulation is to impose higher restrictions to larger banks, which is a measure defended by many specialists in the post crisis scenario (Cukierman, 2011). Bank regulators agree that too-big-to-fail (TBTF) financial institutions are too costly to maintain (Brewer and Jagtiani, 2009), since the protection by regulators may have generated a moral hazard problem, leading to excessive risk taking behavior and triggered the recent world financial crisis. In other words, banks had a strong incentive to become TBTF, since regulators had rewarded them because of their relevant size, which reduces their costs of maintaining this size. Supporting this view, Brewer and Jagtiani (2009) have found that American banks pay a monetary amount to become large (more than U$ 100 billion of assets).

Consequently, we propose to evaluate what would be the probable impact of the upcoming Basel III regulation on Latin American banks. This is a relevant contribution to literature, because this paper may show whether the financial sector of a region composed of developing economies also need the same regulation of those of developed countries, where the crisis has originally taken place. Should there be a large proportion of banks under diseconomies of scale whose size is not decreasing over the years, Basel III is indeed needed in order to increase efficiency in the regional financial sector. However, if the majority of Latin American banks are under economies of scale, there are still gains to be obtained from an increase in banks size from a microeconomic perspective. Furthermore, even medium size banks may impose threats to the banking system and their eventual failure may have a strong effect on the banking system[3].

We structure our paper as follows: in Section 2, we describe our methodology, defining the variables of interest and the regression approaches taken; in Section 3, we present and summarize the data sources; we demonstrate and discuss the empirical results in Section 4, and finally in Section 5 we make our the final remarks regarding the outcome of this paper.

[3]Although we evaluate only the bank efficiency side in this aspect, there is also an income distribution issue to consider. Beck et al. (2010) analyzes whether the process of bank consolidation has resulted in any improvements in the US income distribution. The authors find that the removal of these restrictions has improved the competitive environment, and also increased the income of those with lower incomes. Therefore, the expansion of large banks due to deregulation has indeed improved social conditions in the US, through the channel of an increase in bank performance.

2 Methodology

In this section, we specify the method as well as the variables to estimate bank efficiency for Latin America. We employ the Stochastic Frontier Analysis by Aigner et al. (1977) and Meeusen and van den Broeck (1977) to estimate a common frontier for all Latin American countries. It consists in the estimation of cost (profit) frontier by regressing a translog cost (profit) function, and decomposing the errors into two parts. One captures the random disturbances (ν), assumed to be normally distributed, and representing measurement errors and other uncontrollable factors. The other error term (υ) captures technical and allocative inefficiency, both under managerial control, and it is assumed to be half-normally distributed[4]. According to the literature, the estimation of a single frontier for the whole region allows banks from different countries to be compared against the same benchmark (Berger and Humphrey, 1997; Lensink et al., 2008). More specifically, we employ the Battese and Coelli (1995) SFA model, which estimates simultaneously the efficiency degree and the coefficients of the exogenous variables (one-step model). The Battese and Coelli (1995) specification avoids the bias of a two-step approach that considers the efficiency to be half-normally distributed in the first step, while in the second step one considers it as normally distributed and dependent of the explanatory variables.

The degree of efficiency represents how close a bank is to the minimum cost or the maximum profit, i.e. the stochastic frontiers. Cost inefficiency measures how much costs are raised above the frontier, while profit inefficiency reduces the profit in relation to the frontier give the output levels. In the literature, the best performance bank in the sample determines the maximum profits and minimum costs, and all the other bank's inefficiency levels are computed in relation to them.

As in Berger and Mester (1997), we employ an alternative profit function over the standard profit specification, by using output quantities rather than output prices in order to assess for bank market power over output prices[5].

[4]Both SFA and the data envelopment analysis (DEA) have been widely used by the literature. The SFA has the advantage of dividing error into two components, while the DEA considers that all deviation is due to inefficiency, dismissing the effect of random errors, (Yildirim and Philippatos, 2007b). However, the SFA has to assume a distribution to firm-specific technical efficiency related variables (Hasan and Marton, 2003).

[5]Among other advantages of employing the alternative profit specification, Berger and Mester (1997) state that this model provides a way of take into consideration the differences in output qualities. Since the profit function is equal to the cost specification, with the exception of the dependent variable, the former specification does not penalize banks from providing high quality services, while the latter might. Additionally, output quantities have a higher variability across banks than its prices and, thus, can better explain the

In order to estimate cost (profit) efficiency, we must first specify, for example, a translog cost function, which assumes the following specifications:

$$\begin{aligned}\ln\left(\frac{C}{w_2}\right)_{it} &= \delta_0 + \sum_j \delta_1 \ln y_{jit} + \frac{1}{2}\sum_j\sum_k \delta_{jk}\ln y_{jit}\ln y_{kit} + \beta_1 \ln\left(\frac{w_1}{w_2}\right)_{it} \\ &+ \frac{1}{2}\beta_{11}\ln\left(\frac{w_1}{w_2}\right)_{it}\ln\left(\frac{w_1}{w_2}\right)_{it} + \sum_j \theta_j \ln y_{jit}\ln\left(\frac{w_1}{w_2}\right)_{it} + \alpha_1 T + \alpha_2 T^2 \\ &+ Macroeconomic\ Variables + \nu_{it} + \upsilon_{it}, \qquad (1)\end{aligned}$$

where i and t refer to banks and time, respectively; C stands for the bank's total cost; y represents four outputs: total loans, total deposits, other earning assets, and non-interest income, which is a measure of bank non-traditional activity[6]; w consists in two input prices: interest expenses to total deposits, non-interest expenses to total assets[7]. The objective of normalizing the dependent variable and one input price (w_1) by another input price (w_2) is to ensure linear homogeneity. We also include a time trend T and its quadratic term T^2 as in Lensink et al. (2008) and Lozano-Vivas and Pasiouras (2010), since the translog function is a second order approximation.

Finally, in our estimation of one Latin American frontier, we employ country environment variables in order to control for cross-country heterogeneity of banking markets. The use of macroeconomic variables in the translog functions has been considered very important by the literature in the correct estimation of cross-country efficiency scores (Dietsch and Lozano-Vivas, 2000; Carvallo and Kasman, 2005; Fries and Taci, 2005). These variables reflect specific characteristics, such as geography, economic condition and financial dynamism. We employ, therefore, the following macroeconomic variables. The density of population, measured by the ratio of inhabitants per square kilometers. We believe that banks operating in a region with a high density of population will have lower expenses. The density of demand stands for

variation in the dependent variable, before-tax profits (DeYoung and Hasan, 1998).

[6]Even though there is not a consensus on the matter yet, the literature has given an increasing importance in incorporating variables of bank non-traditional activities (such as off-balance sheet and non-interest income) in the analysis of bank efficiency (Lozano-Vivas and Pasiouras, 2010). Ignoring these measures can be misleading, since it does not take into account the bank's balance sheet as a whole. Due to a high number of missing values on Latin American banks' off-balance sheet, we only employ the non-interest income as a non-traditional output. These authors find that the introduction of non-interest income in the translog increases both cost and profit efficiency in relation to the traditional model, without account for non-traditional activities.

[7]Total assets is employed instead of fixed assets due to several missing data of the latter.

the ratio of total deposits to square kilometers. Banks with low density of demand may have higher expenses. We employ the GDP per capita to assess for the general development of the economy. The purpose of employing the ratio of equity to assets is to control for the regulatory conditions. The ratio of loans to deposits measures how much of the deposits are converted into loan, i.e. the size of intermediation. Finally, we also use the real GDP growth, as a proxy of economic dynamics.

We use a similar approach to the translog profit function, but instead of total costs, the dependent variable is before-tax profits[8] and the composed error term is $\nu_{it} - \upsilon_{it}$. There is, however, a problem in applying the natural logarithm of profits, since this variable can take negative values as well. In order to solve this problem most of the studies so far had added a constant in the profit model, equal to one plus the minimum value of profit. We find this approach to be equivocated, and thus employ an additional independent variable - the Negative Profit Indicator (NPI) - that takes the value of 1 for observations where profit ≥ 0 and it is equal to the absolute value of profit, when profit < 0. We also change the dependent variable to take the value of 1, when it is negative (see Bos and Koetter (2009) for more information). Hasan et al. (2009) also use this method in the estimation of profit efficiency for 11 European Union countries between 1996 and 2004.

In the Battese and Coelli (1995) model, we estimate the efficiency correlates at the same time as the frontiers estimation. This means that the inefficiency term υ for both the cost and profit functions can be specified as follows:

$$\upsilon_{it} = \delta_0 + \sum_n \delta_{nit} z_{nit} \tag{2}$$

where z is a vector of n bank-specific variables that explains efficiency of bank i at time t. We use the maximum likelihood to estimate cost (profit) translog function and equation (2) simultaneously.

We explain the variables that compose z next. First, we include the equity ratio, measured as the ratio of equity and total assets, in order to assess for the influence on shareholders capital on the ability of banks to optimize both costs and profits. The natural logarithm of total assets, as a proxy of bank's size (SIZE). The ratio of total loan loss provisions to total loans (LLP) is a proxy of bank risks. It is rational to suggest that banks that become vulnerable to riskier assets have lower efficiency, due to

[8]The use of profits before tax is consistent with previous studies. Using after-tax profits would result in wrong inference about bank efficiency in countries with different tributary systems.

higher expected losses. We also use the return on assets (ROA) in the cost translog function as proxy of profitability, and due to a probable endogeneity problem we do not employ this variable in the profit efficiency estimation. Both translog functions also contain ownership dummies.

As to determine whether bank concentration has any effect on cost and profit efficiency and the direction of this influence, we employ, as a efficiency correlate, an improvement of the traditional HHI, the HHI dual (HHI^D), as a measure of market concentration. Tabak et al. (2009) and Chang et al. (2006) have already utilized this measure in empirical investigations regarding banking market structure. The idea of the dual is to associate a series Y to another series X, which represents the original market, and to its HHI. We call the former series the HHI-dual of X, constructed according the following assumptions:

(a)Y has the same number of observations as the original series, with m constant observations equal to K and $n - m$ observations equal to zero.

(b)$\sum_{i=1}^{n} x_i = \sum_{i=1}^{n} y_i$, i.e. total amount of X is equivalent to the total amount of Y.

(c) $HHI_Y = HHI_X$, i.e. the concentration measure remains invariant in the process (known as the *appearance maintainer principle*).

Y represents, therefore, a fictional banking market that preserves some properties of the original banking structure, but is stratified into two groups: one, composed of m banks that hold total, and equally shared, participation of the market, and the second, composed of $n - k$ banks, who holds zero participation in the market. Due to condition (c) above, X has the same HHI as Y, the original series. However, it is much more easier to understand the market concentration of X by considering the concentration of Y. We then define the dual as $d = 1 - m/n$, i.e. the proportion of banks that do not have any participation in the market. One can easily prove that $m = \frac{1}{HHI}$, and thus we calculate the dual as:

$$d = HHI^D = 1 - \frac{1}{n \cdot HHI}. \tag{3}$$

where n is the number of banks and HHI is the traditional HHI measured as the sum of the square of bank i market share (s_i), or $HHI = \sum_{i=1}^{n} s_i^2$. The dual varies from 0 (minimum value) to $1 - \frac{1}{n}$ (maximum value), and as the traditional HHI, it is monotonic on concentration.

We can summarize the other advantages of the dual as follows: the dual is still a concentration index, but normalized and undimensional; different concentration measures can be compared by the calculation of their duals;

concentration between countries and years can be also compared, since the dual does not depend on the number of individuals/groups in the series. In fact, this last observation is important when dealing with cross-country comparisons of market structure. A non-normalized concentration index can severely bias the results of estimations that employ these measures, since they depend on the amount of banks that operates in each country and in each time period. Note that, asymptotically, the maximum value of the dual tends to 1, but to avoid any bias in the estimation resulting of a small number of banks in a specific banking market, we employ the normalized dual (or $HHI^{D*} = HHI^{D}/(1 - 1/n)$) to always guarantee that $0 < HHI^{D*} < 1$.

To test the hypothesis that market concentration influences bank management, we employ four different specifications:

(a) The HHI^{D} in term of assets;

(b) The HHI^{D} in term of loans;

(c) The HHI^{D} in term of assets plus an interaction between this HHI^{D} and SIZE;

(d) The HHI^{D} in term of loans plus an interaction between this HHI^{D} and SIZE.

This results, therefore, in four different estimated cost and profit frontiers.

The objective of including the interaction between HHI^{D} and SIZE is that it is reasonable to suppose that the effect of banking market concentration on performance depends on bank's size. If we find that this interaction is positively related to efficiency, the recent trends of consolidation may be explained by banks willing to become larger in order to distance themselves from the competitors, increasing market concentration. A negative relationship suggests that banks are aiming to match their size with the other competitors, decreasing market concentration.

From the translog cost function, we also calculate the scale efficiency (SE), which can be measured as the cost elasticity in relation to all outputs, i.e.:

$$SE = \sum_{j=1}^{4} \frac{\partial ln\,(C/w_2)}{\partial ln\, y_j}, \tag{4}$$

where j refers the outputs in the translog specification. In this case, if SE < 1, then we have increasing returns of scale (economies of scale), since, supposing $X > Y$, an increase in X% in total outputs will increase costs in Y%. On the other hand, if SE > 1, decreasing returns of scale is the case

(diseconomies of scale), i.e. an increase in total outputs will increase even more total costs.

3 Data

Our sample consists in an unbalanced annual panel data of 495 Latin American banks over the period from 2001 to 2008, totalizing 2927 observations. Thus, our sample is very representative and rich in data for the empirical estimation. Table 1 shows the summary statistics of the variables used in the translog specifications. Instead of the natural logarithm of these variables, we present them in levels in order to be more informative.

Place Tables 1 and 2 about Here

We have extracted the necessary bank-specific data for the model from Latin American central banks, with variables measured in US dollars, which guarantees accounting uniformity between different countries. Initially, our base consisted in the population of four bank specializations: commercial, cooperative, real-state, specialized government institutions. After excluding banks/periods with missing, negative or zero values for inputs and outputs and other relevant data, we were left with a sample of 495 banks operating in 17 countries. In fact, table 2 shows the number of banks by year and country in the final database.

We also present the yearly average values of the HHI dual of assets and loans by country in tables 3 and 4, respectively [9]. We calculate these indices using the initial data, before excluding banks for missing data on some variables.

Place Tables 3 and 4 about Here

The interpretation of the values of the dual is that, for Argentina in 2001, bank concentration in term of assets (table 3) was equivalent to the market concentration of a banking industry, where 79.18% of the banks did not have any assets, and all assets were concentrated in the hands of 20.82% of the banks. In 2002 for the same country, concentration has increased, since now

[9] We have calculated the dual of the HHIs using the available data from central banks.

one can say that concentration is equal to a situation where 83.11% of the banks possess zero assets.

By looking only at the scores of the HHI^D in terms of loans and assets, one may say that Brazil and Argentina have the most concentrated banking markets in the region, while Bolivia, Paraguay and Nicaragua are among those with the most diversified banking markets. This comparison wouldn't be possible by comparing traditional HHIs, since their values would depend on the number of banks in each country. There is also evidence that the banking sector of most Latin American countries are becoming more concentrated. This confirms that the region has been facing a process of banking consolidation. Sometimes, however, each type of HHI give different results for the concentration as well. Argentinean banks, for example, presents an increasing concentration in assets, while in loans, there appears to be a decreasing trend. For Paraguay, the opposite occurs.

Place Table 5 about Here

Finally, table 5 presents the means and standard deviations of the country-environment variables. The translog specification includes these variables that represent economic and financial sector development indicators in order to access for cross-country differences in economic and financial conditions. These macroeconomic data were taken from the IMF's World Economic Outlook, World Bank's database, and Latin American central banks[10]. In fact, in Latin America, there are some essential economic differences between countries. While there are some with a dynamic economy and satisfactory social conditions, other countries are more vulnerable and present poor social indicators.

4 Results

4.1 Efficiency Scores

We estimate cost and profit efficiency scores for each bank from 17 different Latin American countries in the sample based in a common frontier. We employ the Battese and Coelli (1995) SFA model that estimates simultaneously efficiency scores and the exogenous variables that are supposed to explain efficiency (as in equation 2). We also employ country-specific variables

[10]Bank's deposits, loans, assets and equity by country have been aggregated using the original database from the central banks to proxy for total financial sector's deposits, loans, assets and equity.

and, as an additional output, a measure of bank non-traditional activity in both translog functions. The first is to control for the existing heterogeneity between banking markets making cross-country comparisons are more consistent. The latter is to consider the participation of bank non-traditional activities on its total income, which has been increasing in the last years.

Since we use four different specifications of the correlates of efficiency for each translog function, table 6 presents the intervals of the mean estimated scores of cost and profit efficiency.

Place Table 6 about Here

Latin American banks are found to be, on average, 91.8% cost efficient and from 50.6% to 52.5% profit efficient. These values are in line with the literature in the sense that banks appear to manage their costs better than their profits. Other articles have found similar efficiency scores for Latin America as ours (e.g Pasiouras et al., 2009; Lozano-Vivas and Pasiouras, 2010). An interesting fact is that the standard deviation of profit efficiency is equal to 22 p.p., pointing out that Latin America bank performance on the revenue size is particularly dispersed[11], while cost efficiency is much more centered over its mean value.

These results support the necessity to consider the revenue side as well, when evaluating banking efficiency. Profit efficient banks seem to be also cost efficient, but the inverse does not necessarily hold (Maudos et al., 2002; Yildirim and Philippatos, 2007b). An exception to that rule was found by Srari (2009), who has concluded that banks from countries of the Gulf cooperation council (GCC) are more efficiency in profits than in costs. Bos and Kool (2006) state that in a perfect competitive market, profit efficient banks are also cost efficient. However, in an imperfect competitive market this is not the case, since, for example, profit efficient banks may be inefficient in terms of costs or vice-versa. Apparently, our findings suggest that Latin American banks are under imperfect competition. There could be many other reasons why Latin American banks are operating with such inefficiency. We raise the hypothesis that factors related to the political and economic instability of the region may be dampening the banks management of costs and profits.

[11]Berger and Mester (1997) also finds this high standard deviation for several efficiency estimation techniques for a sample of 6000 US banks over the period of 1990-1995. Profits are considered to be more variable, since they may depend on several simultaneous factors. Besides the quality of management, unpredictable events, i.e. luck, can give banks large profits or, in contrast, they can make banks incur in high losses.

Regarding the evolution of efficiency throughout the years, one may see that cost efficiency scores remained somewhat stable being approximately equal to 92.2% in 2001 and 92.4% in 2008, even though between 2002 and 2007 scores appear to be slightly lower. This means that bank's ability to manage their costs have not changed considerably in these years. On the revenue side, however, management appear to have been improved. There is a clear increasing trend of profit efficiency from 2001 to 2007. In 2008, an interesting finding is that profit efficiency decreased in relation to the last year, possibly due to the world financial crisis. We can speculate that, because of this crisis, banks preferred to increase their management of costs and reduced their activities, which can be reflected by the decrease of revenue efficiency.

Place Table 7 about Here

Cross-country comparisons in banking efficiency scores are also important to take into account. In table 7 the minimum and maximum result from the four different translog specifications. Cost efficiency values are more homogeneous across countries than profit efficiency. Banking sectors from Argentina, Uruguay and Brazil are the least cost efficient, while Jamaica, Colombia and Ecuador's are the most efficient. On the other hand, Chile, Nicaragua and Venezuela have the highest profit efficiency values, while Paraguay and Uruguay, the lowest.

4.2 Efficiency Correlates

In this section, we present the results of the regression of efficiency scores on several independent variables. Our main goal is to see whether market concentration has any effect on both cost and profit efficiency. We employ the HHI dual in term of assets (HHI_A^D) and in term of loans (HHI_L^D) as proxies of market concentration. In addition, we interact the HHIs with the size variable to evaluate how the size effect on efficiency changes in higher concentrated markets. Tables 8 and 9 show the Battese and Coelli (1995) results of efficiency explanatory variables for the translog cost and profit functions, respectively.

Place Tables 8 and 9 about Here

As can be seen in columns [1] and [2] of Table 8, the coefficients of HHI_A^D and of HHI_L^D are positive and significant. Thus, market concentration appears to decrease overall cost efficiency. Regarding the other control variables, we find a positive coefficient for equity ratio, which means that the higher is the shareholders capital in relation to bank's assets, the less cost efficient the bank is. This may be a sign that a higher shareholders' leverage force banks to sacrifice costs in exchange of achieving better results. Bank's size presents a negative significant coefficient, meaning that the larger the bank, the better it manages its cost. Finally, foreign and private banks seems to be more efficient in costs than public banks, which is in line with the literature on performance in banks from developing countries.

Columns [3] and [4] show the results when we add an interaction between the HHI and the SIZE variable. The results for the other variables are similar to the two firsts. In particular, we still find that larger banks are more cost efficiency due to significant negative coefficient of SIZE. In both columns, the interactions between the HHI and SIZE were found to be significantly positive, while the coefficient for the HHI alone was significantly negative. This result means that, even though there are cost benefits for larger banks, a higher market concentration reduces the intensity of these benefits.

To determine the bank's size in which the impact of the HHIs turns positive, we take the first derivative of equation (2) with respect to the HHIs in columns [3] and [4] and equal it to zero or ($\frac{\partial u}{\partial HHI^D} = 0$). The value found is equal to 10.19 and 10.46 or U$ 26.5 million and U$ 34.9 million, respectively. In our data, approximately 97.3% and 96% of the banks have assets higher than these value, meaning that concentrated markets diminishes cost efficiency for the vast majority of banks. Only approximately 3% of the Latin American smallest banks may have their cost performance increased due to market concentration. Similarly, we can determine the value of HHI_A^D and of HHI_L^D in which the effect of SIZE on cost inefficiency turns to be positive. Again, we have to take the first derivative of the function, but now in relation to SIZE, and equal it to zero. The values found for HHI_A^D and HHI_L^D are 1.02 and 0.95, respectively. Note that the first is not even a possible value for the dual, and the second, despite being feasible, is still higher than any market concentration in the data. Therefore, market concentration reduces the effects of size on cost efficiency, but this effect remains positive for all levels of concentration.

Now, we turn to the analysis of impact of the explanatory variables on profit efficiency as in table 9. Again, columns [1] and [2] present the specification with the HHI dual in term of assets and loans, respectively, as independent variables. The estimated coefficients in both cases are found to be insignificant. Therefore, there appears to be no effect of market concentra-

tion on profit efficiency. Regarding the other variables, we find that equity ratio impacts positively bank profit efficiency, suggesting that the higher the participation of the shareholders in relation to total assets, the better the bank will feel obligated to achieve higher profits. In addition, the size of the bank seems to reduce inefficiencies in this case, as well. Loan loss provision, which is a proxy for bank risk, appear to affect negatively the bank efficiency, meaning that bank's with risk taking behavior are, *ceteris paribus*, more distant from the profit frontier. Private and foreign-owned banks are, on average, more efficient than public banks, as shown by the coefficients of the ownership dummy variables.

Columns [3] and [4] of Table 9 present the estimated coefficients when we add an interaction between the HHI and the SIZE variable. In both cases, we find a positive sign for this interaction, which means that the larger the bank is, in term of assets, the worse its performance in concentrated markets. In addition, the coefficient of SIZE alone is negative, as well. The other variables have similar results as in the first two columns.

Again, we are interested to determine the values of SIZE in which the impact of market concentration turns negative (in relation to inefficiency) in columns [3] and [4]. These are equal, respectively, to 12.38 and 12.33 (or U$ 238.5 and U$ 227.1 million). In our database, approximately 69.66% and 70.69% of the banks have higher assets than these values. One may conclude that larger banks have better profit performance, but concentrated markets reduces this effect. In another point of view, smaller banks are less profit efficient, but this negative effect is lower in concentrated markets. The values found for HHI_A^D and HHI_L^D, in which the effect of SIZE on profit inefficiency turns to be positive, are 1.04 and 1.09, respectively. Note that both values are not possible for the dual that only ranges between 0 and 1. Therefore the effect of size on profit efficiency is positive for all levels of concentration, even though higher concentration tends to diminish it.

To sum up, the results this section presents show that market concentration harms bank cost efficiency, but on the other hand has no effect on profit efficiency. The coefficient of bank's size is found to be significantly negative in all specifications, suggesting that larger banks are more cost and profit efficient. Finally, the interaction between the concentration measures and SIZE shows that this advantage of larger banks reduces proportionally to an increase of market concentration, even though SIZE remains positively related to efficiency for any market concentration. Due to the process of consolidation of Latin American financial sector, we suppose that some banks are increasing their size to "catch up" with others competitors, thus decreasing market concentration. In fact, this hypothesis explains the decrease of concentration in some periods and countries in Latin America. However, a

possible reaction of the largest banks in the region is to increase size, as well, in order to maintain their level of market power, and consequently increasing the market concentration again.

4.3 Scale efficiency scores and a brief discussion on bank regulation

This subsection presents scale efficiency scores. The main intent of calculating these scale efficiencies for Latin American banks is to determine whether these banks are close to the their optimal size. We calculate it by the sum of the marginal costs in relation to the outputs, as in equation (4). Banks with scale efficiency greater than 1 are operating under decreasing returns of scale and those with this score lower than 1 are under increasing returns of scale. Table 10 presents the results of the estimated efficiency scale, as well as its evolution through time.

Place Table 10 about Here

The results show that Latin American bank scale efficiency score is on average 0.940, i.e. they are 6% short of their optimal size, meaning that Latin American banks are close to the efficient scale. The time trend evidences a "V" shaped behavior, since scale efficiency had an decreasing trend until 2004, dropping from 0.9448 to 0.9383, and after this year, it has shown an increasing pattern reaching 0.9412 in 2008. Scale efficiency, therefore, has not changed significantly throughout the years.

Another conclusion we may take from these results is that most Latin American banks might still have efficiency gains if they increase their size. In fact, only 2 banks from the total of 495 operated in decreasing returns of scale in one year each (totalizing 2 observations). If a bank operating with decreasing returns of scale ($SE > 1$) was still increasing its size, a TBTF behavior would be configured. This is not the case for Latin American banks. These findings suggest that Latin American banking sectors are still under a process of consolidation. Consequently, there is the need of further research on the topic to determine how regulation policies affect each financial sector soundness and efficiency.

In fact, the empirical literature on this topic has gained importance in the last years. As proof of that, a cross-country database on bank regulation and supervision was constructed and updated by Barth et al. (2001,

2006, 2008)[12]. Agoraki et al. (2009), for example, use this database to study the impact of regulations on risk-taking behavior of banks from transition economies and also if this relationship changes with bank's market power. These authors and find that even though capital requirements reduce risk, they may have a opposite effect on larger banks. On the other hand, they also find that restricting bank's activities is effective in reducing risks of larger banks. Pasiouras et al. (2009) also uses this database for over 600 banks from 74 countries between 2000 and 2004, and find that regulations that enhance market discipline and leads to a higher official supervisory power, increases both profit and cost efficiencies. On the other hand, harsher capital requirements (restriction on bank activities) increase (decrease) cost efficiency, but decrease (increase) profit efficiency.

5 Final Remarks

The literature so far has given little attention in assessing for banking performance in Latin America, especially in the revenue side. This paper is the first to estimate both cost and profit efficiency of 495 banks from this region in the period of 2001-2008. We employ the stochastic frontier analysis in order to evaluate how these efficiencies have changed over time and across countries. In addition, we analyze whether market concentration has any effect on this performance in Latin America by regressing these efficiency scores on several variables, in special an improvement of the Herfindahl-Hirschman Indices in term of assets and loans, as proxies of concentration.

The SFA model estimates a common frontier by decomposing the error term into two parts. One captures random disturbances, and the other represents the inefficiency term that represent deviations from this frontier due to factors related to the management of costs/profits. We add country-environment variables to control for cross-country heterogeneity of banking markets. In the estimation of the profit frontier, we follow Bos and Koetter (2009) and employ an negative indicator in order to deal with banks with negative profits. Most studies add a constant to all profits equal to its minimum value plus 1, which may bias the result. Mean profit efficiency is likely to be lower with our approach than with the for the rescaled profit. This way,

[12]This database is not available for every years. The original 2001 database comprises regulatory environment data of 117 countries from 1998 to 2000. The 2003 database has data on 152 countries from the end of 2002. Finally, the 2008 database has data on 142 countries for 2007. A solution found by studies that use this database and employ an annual panel data specification (e.g. Demirguc-Kunt et al., 2004; Pasiouras et al., 2009; Agoraki et al., 2009) is to extrapolate the information of each year available in the database for other years, as well.

the fact that there are banks incurring in profit losses is explicitly included in our model.

Our finding from the SFA estimation of cost and profit efficiency suggest that Latin America banks operate in higher levels of cost efficiency than of profit efficiency. Thus, the better management of costs does not necessarily mean that the bank is achieving a desirable profit. This result is consistent with most of the literature, and may be related to a certain level of market collusion in the region, and also to the economic instability, which may impair the quality of bank profitability.

When we analyze the variables correlated with efficiency, we only find evidence of an effect of market structure on cost efficiency. An increase in concentration in terms of assets and loans overall cost efficiency but it does not seem to impact profit efficiency. Moreover, even though we find a positive influence of bank's size on cost and profit efficiency, concentrated banking markets seems to reduce this influence. In other words, small banks are the most benefited due to market concentration in terms of both cost and profit efficiency, although this advantage in relation to larger banks tends to disappear due to the size effect. One interpretation of the recent wave of merger and acquisitions in Latin America is that banks are seeking to improve their efficiency by increasing their size as a form to "catch up" with the size of other banks, and, thus, potentially increasing competition.

Regarding the effect of ownership on bank's performance, there are indications that private and foreign banks are more cost and profit efficient than public banks, a result consistent with the literature on developing countries. Policymakers should tackle, therefore, the relative inefficiency of public banks by, for example, providing incentives to foreign entry and private participation to enhance efficiency in Latin American banking sectors. In fact, Tecles and Tabak (2010) and Berger et al. (2009) suggest this measure for the Brazilian and Chinese banking sectors, respectively.

Finally, we find that Latin American banks are close to their optimal size, with the majority of banks operating under economies of scale. Banks do not appear to have a trade-off between cost efficiency an size. An implication is that we do not verify TBTF behavior for Latin American banks in the period considered, since the scale efficient level is being pursued.

A suggestion for future research is to analyze whether competition has a similar effect, as concentration, on efficiency in Latin America. There is no consensus in the literature regarding the effects of market structure on bank conduct (Bikker and Haaf, 2002). In fact, for Latin American banks, Yildirim and Philippatos (2007a) have proved empirically that concentration has no significant effect on competition in the period from 1993 to 2000. Another idea for future studies is to evaluate whether bank regulations, such as the

proposed by Basel III, has a positive impact in improving bank efficiency in other economies and regions.

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Table 1: Mean of the variables used in the profit/cost frontier model

	PBT[a]	Total Expenses[a]	Total Loan[a]	Total Deposits[a]	Liquid Assets[a]	OEA[a]	NII[a]	Price of Capital	Price of Funds
Argentina	7767.18	152748.84	672902.51	878409.28	360912.49	748336.47	82747.28	0.0815	0.1092
	68554.60	293837.28	1348217.70	1598626.38	978198.23	1557447.93	161820.94	0.0589	0.2127
Bolivia	4358.36	44399.51	257953.17	391303.92	45671.11	156721.71	16356.88	0.0605	0.0399
	9561.74	24939.13	153429.85	271762.60	38144.78	136787.46	12835.32	0.0317	0.0193
Brazil	184158.03	1383721.70	3212066.99	4230787.31	3489475.01	5301560.42	252383.52	0.0843	1.0740
	731851.39	3636440.76	9950336.39	13003616.94	9368506.64	15383537.86	781117.51	0.0747	6.5075
Chile	90182.46	405484.44	3682184.23	3558567.18	859849.56	1066382.68	80653.36	0.0376	0.0591
	153608.46	586899.30	5189674.66	5022152.90	1243951.54	1611387.06	108834.72	0.0261	0.0320
Colombia	62078.35	262048.50	1404781.27	1714300.07	468297.00	644982.55	121790.33	0.0645	0.1686
	109354.95	401354.04	2391685.84	2582392.73	650171.60	762195.77	180122.73	0.0416	0.8160
Costa Rica	11508.20	68401.86	323979.85	428316.20	66577.53	170969.48	12008.18	0.0564	0.1114
	19836.48	118204.89	501168.51	763407.67	142670.63	374817.97	23421.70	0.0272	0.1031
Dominican	12353.95	75123.71	279828.31	373063.13	146161.14	151416.01	19124.50	0.0845	0.6803
	23740.18	115846.36	507882.69	714573.76	250122.91	287854.79	40108.88	0.0628	5.3424
Ecuador	13041.59	69623.89	373267.26	566645.13	191272.57	254764.60	27136.28	0.0765	0.0343
	23136.90	100774.18	563652.25	766660.16	236569.30	313829.77	37574.54	0.0415	0.0177
El Salvador	15283.14	77781.09	718620.54	773051.66	183893.87	331829.04	6742.40	0.0394	0.0425
	19176.06	72228.07	731827.62	753007.20	171333.23	348176.24	7329.34	0.0196	0.0197
Jamaica	34998.42	118762.96	296351.39	613878.75	187867.75	715350.91	25518.81	0.0464	0.1982
	41710.11	99916.93	282842.91	571380.58	207077.44	688144.62	27480.84	0.0198	0.2444
Mexico	174509.81	1104383.83	4967056.53	6242088.07	2308020.74	2798891.16	207099.64	0.0576	0.1816
	436989.02	1668294.33	7441756.76	9761255.51	4881516.85	5637124.80	428361.36	0.0504	0.4520
Nicaragua	10046.97	32515.19	141351.61	251373.13	68429.61	173576.65	6236.45	0.0504	0.1699
	7439.34	16652.47	84435.19	153211.12	38439.79	118214.51	5204.82	0.0179	0.5514
Panama	23213.02	89518.24	811844.67	950589.17	228307.68	321957.31	25876.07	0.0287	0.0467
	44159.68	156322.33	1371756.23	1493163.72	369889.55	423777.10	53365.01	0.0220	0.0232
Paraguay	6223.92	114014.79	100267.59	151289.29	80380.84	57097.54	31355.51	0.1961	0.5708
	9636.73	213722.71	105271.91	123692.60	54681.10	55224.53	98094.50	0.2923	0.5735
Peru	57177.65	189919.71	1323919.74	1873478.96	736072.13	738553.41	63716.28	0.0552	0.0461
	94213.83	223805.33	1792065.08	2441571.93	1057179.06	932010.49	96516.98	0.0314	0.0334
Uruguay	-23586.53	521197.33	223297.26	466206.97	247048.16	246280.69	35937.89	0.1326	1.3229
	129540.05	1191785.34	440555.91	867367.16	527381.06	488346.94	98451.87	0.1738	1.6031
Venezuela	53322.35	191185.67	788013.79	1440600.25	567686.60	506640.92	51848.10	0.0707	0.0734
	92900.89	290064.63	1435133.40	2171726.43	982622.97	686350.13	82265.06	0.0329	0.0663
Total	67455.55	459682.49	1601232.02	2041617.11	1058314.70	1525236.69	98686.42	0.0717	0.3644
	348465.96	1726336.07	5198686.32	6659339.44	4446759.63	7052962.34	375055.71	0.0844	3.1008

Note: OEA = Total of Other Earning Assets; PBT = Profit Before Taxes; NII = Non-Interest Income. Standard errors in parenthesis.
[a] In thousands of Dollars (USD).

Table 2: Number of observations by year and country

	ARG	BOL	BRA	CHI	COL	COS	DOM	ECU	ELS	JAM	MEX	NIC	PAN	PAR	PER	URU	VEN	TOTAL
2001	27	9	58	17	31	21	10	12	9	7	27	6	35	13	10	25	28	345
2002	34	9	69	18	32	22	18	13	9	7	29	6	35	13	10	25	29	378
2003	41	10	77	19	32	24	21	14	10	7	30	7	42	13	12	25	31	415
2004	46	10	77	19	31	29	24	15	11	9	30	7	42	13	12	19	31	425
2005	48	11	75	22	25	30	24	15	10	9	30	5	29	13	12	n.a.	28	386
2006	50	9	70	23	21	30	25	16	7	9	27	n.a.	25	12	13	n.a.	27	363
2007	46	9	59	22	20	27	20	14	7	9	25	n.a.	20	11	13	n.a.	27	329
2008	46	8	50	20	18	25	17	14	7	n.a.	20	n.a.	18	11	13	n.a.	19	286

Table 3: HHI dual in term of assets by country

	2001	2002	2003	2004	2005	2006	2007	2008
Argentina	0.7918	0.8311	0.8361	0.8334	0.8361	0.8239	0.8172	0.8108
Bolivia	0.2786	0.2795	0.2610	0.2850	0.3239	0.4121	0.4329	0.4069
Brazil	0.8780	0.8957	0.8990	0.8850	0.8750	0.8894	0.8935	0.9044
Chile	0.5945	0.6897	0.6955	0.7016	0.7096	0.7044	0.6804	0.6582
Colombia	0.4153	0.4558	0.4995	0.5177	0.5334	0.5744	0.5826	0.5973
Costa Rica	0.7293	0.7362	0.7155	0.8472	0.8462	0.8467	0.8356	0.8316
Dominican Republic	0.7106	0.8015	0.8398	0.8258	0.8461	0.8436	0.8303	0.8198
Ecuador	0.7678	0.7957	0.7910	0.7720	0.7752	0.7855	0.7953	0.7898
El Salvador	0.5990	0.5947	0.5893	0.5807	0.5709	0.5598	0.5350	0.5175
Jamaica[a]	0.6155	0.5559	0.5692	0.4900	0.5450	0.5370	0.4854	n.a.
Mexico	0.7672	0.7695	0.7752	0.7627	0.7291	0.7768	0.7551	0.7334
Nicaragua[a]	0.2810	0.4255	0.4535	0.3012	0.2088	n.a.	n.a.	n.a.
Panama	0.6717	0.6954	0.7180	0.7545	0.7491	0.7786	0.7362	0.6762
Paraguay[a]	0.3947	0.3390	0.2980	0.2632	0.2581	0.2508	0.2475	0.2490
Peru	0.5548	0.6009	0.5880	0.6705	0.6676	0.6694	0.6510	0.6442
Uruguay	0.7328	0.8275	0.8051	0.7943	n.a.	n.a.	n.a.	n.a.
Venezuela	0.7485	0.7442	0.7531	0.7422	0.6218	0.6168	0.6162	0.6034

[a] The indices were not calculated for Nicaragua in the period of 2006-2008; Uruguay, 2005-2008 and Jamaica in 2008 due to the lack of sufficient data.

Table 4: HHI dual in term of loans by country

	2001	2002	2003	2004	2005	2006	2007	2008
Argentina	0.8145	0.8545	0.8250	0.8004	0.7983	0.7730	0.7626	0.7766
Bolivia	0.2801	0.3006	0.2924	0.3052	0.3231	0.4038	0.4223	0.3909
Brazil	0.8685	0.8854	0.8851	0.8791	0.8801	0.8937	0.8959	0.9040
Chile	0.5833	0.6801	0.6892	0.6884	0.6939	0.6907	0.6674	0.6395
Colombia	0.4123	0.4282	0.4819	0.5150	0.5523	0.6141	0.6078	0.6215
Costa Rica	0.6915	0.6843	0.6255	0.7832	0.7679	0.7698	0.7795	0.7809
Dominican Republic	0.7128	0.8043	0.8566	0.8589	0.8666	0.8591	0.8465	0.8331
Ecuador	0.7480	0.7816	0.7565	0.7835	0.8083	0.7987	0.8079	0.8007
El Salvador	0.6038	0.6078	0.5956	0.5986	0.5931	0.5873	0.5611	0.5442
Jamaica[a]	0.6375	0.6780	0.6162	0.5269	0.4889	0.4325	0.4150	n.a.
Mexico	0.7663	0.7316	0.7234	0.6939	0.6644	0.6965	0.7535	0.7132
Nicaragua[a]	0.1640	0.2144	0.2522	0.2617	0.1654	n.a.	n.a.	n.a.
Panama	0.6997	0.7369	0.7584	0.7733	0.7533	0.7877	0.7474	0.6844
Paraguay	0.3905	0.3196	0.2697	0.2716	0.3026	0.3484	0.3872	0.4020
Peru	0.5521	0.6026	0.6011	0.6307	0.6131	0.6557	0.6842	0.6814
Uruguay[a]	0.7856	0.8252	0.8066	0.7849	n.a.	n.a.	n.a.	n.a.
Venezuela	0.7593	0.7745	0.7547	0.7567	0.7042	0.6706	0.7011	0.6481

[a] The indices were not calculated for Nicaragua in the period of 2006-2008; Uruguay, 2005-2008 and Jamaica in 2008 due to the lack of sufficient data.

Table 5: Country-environmental variables

	GDP per cap.*	$\frac{Loans}{Deposits}$	$\frac{Deposits}{km2}$	$\frac{Population}{km2}$	GDP growth	$\frac{Equity}{Assets}$
Argentina	5.267	0.7569	16.111	13.872	4.452	0.1118
	(1.957)	(0.1469)	(4.445)	(0.328)	(7.706)	(0.0122)
Bolivia	1.114	0.6757	3.382	8.276	3.867	0.109
	(0.271)	(0.0713)	(0.7143)	(0.382)	(1.451)	(0.0099)
Brazil	4.857	0.9312	37.599	21.690	3.588	0.0930
	(2.044)	(0.0302)	(20.131)	(0.632)	(1.827)	(0.0045)
Chile	6.959	1.0207	95.799	21.399	4.211	0.0831
	(2.447)	(0.0445)	(40.283)	(0.534)	(1.274)	(0.0064)
Colombia	3.103	0.8031	40.286	37.267	4.583	0.1206
	(1.110)	(0.0772)	(19.854)	(1.249)	(2.075)	(0.0061)
Costa Rica	4.932	0.7417	222.580	83.795	4.964	0.1320
	(0.877)	(0.0893)	(69.409)	(3.515)	(2.697)	(0.0056)
Dominican	3.538	0.786	169.727	192.583	5.290	0.1149
	(0.974)	(0.1696)	(45.654)	(6.914)	(4.032)	(0.0104)
Ecuador	2.698	0.6043	31.398	45.782	5.007	-0.1383
	(0.7324)	(0.0684)	(11.617)	(1.246)	(1.796)	(0.0614)
El Salvador	3.0296	0.9578	348.771	287.567	2.833	0.1113
	(0.4776)	(0.0927)	(41.816)	(2.637)	(1.070)	(0.0098)
Jamaica	4.012	0.477	459.538	240.972	1.779	0.1262
	(0.506)	(0.100)	(84.359)	(2.45)	(0.954)	(0.0166)
Mexico	8.108	0.783	97.99	52.243	2.4210	0.1073
	(1.392)	(0.0394)	(13.60)	(1.314)	(1.778)	(0.0179)
Nicaragua	0.7811	0.53204	13.0381	40.9562	3.9920	0.02328
	(0.044)	(0.120)	(0.621)	(0.8446)	(0.884)	(0.0574)
Panama	4.898	0.8153	446.427	71.895	6.372	0.1073
	(1.000)	(0.0830)	(145.39)	(2.274)	(3.718)	(0.0083)
Paraguay	1.474	0.6513	4.685	14.3672	3.7188	0.1146
	(0.5746)	(0.1233)	(2.061)	(0.6658)	(2.133)	(0.0087)
Peru	2.9653	0.7102	17.826	21.507	5.938	0.1066
	(0.8395)	(0.03406)	(6.9458)	(0.6657)	(3.068)	(0.0099)
Uruguay	4.545	0.4521	77.125	18.759	-0.88625	0.03201
	(1.202)	(0.1092)	(20.8)	(0.019)	(5.338)	(0.0656)
Venezuela	6.045	0.5174	46.30	28.894	4.869	0.1566
	(2.71)	(0.089)	(30.388)	(1.218)	(9.275)	(0.0403)

[a]In thousands of Dollars (USD) per individual.
Source: World Bank, International Monetary Fund, and Latin American central banks.

Table 6: Mean Efficiency scores

	Cost Efficiency	Profit Efficiency
2001	0.9225-0.9228	0.475-0.492
	(0.0599-0.0606)	(0.236-0.239)
2002	0.9144-0.9153	0.488-0.506
	(0.0690-0.0699)	(0.228-0.232)
2003	0.9161-0.9171	0.499-0.517
	(0.0694-0.0706)	(0.227-0.231)
2004	0.9120-0.9129	0.493-0.514
	(0.0727-0.0735)	(0.209-0.212)
2005	0.9195-0.9203	0.518-0.538
	(0.0691-0.0700)	(0.205-0.211)
2006	0.9166-0.9173	0.518-0.537
	(0.0735-0.0745)	(0.203-0.209)
2007	0.9192-0.9201	0.547-0.563
	(0.0645-0.0661)	(0.206-0.213)
2008	0.9234-0.9241	0.525-0.540
	(0.0609-0.017)	(0.206-0.212)
TOTAL	0.9176-0.9184	0.506-0.525
	(0.068-0.069)	(0.216-0.222)

Note: this table presents the mean efficiency scores estimated by the stochastic frontier model. Since there are four different frontier specifications, only the minimum and maximum scores estimated were presented. Standard errors in parenthesis.

Table 7: Mean efficiency scores by country - Minimum and maximum values

	Cost Efficiency		Profit Efficiency	
	min	max	min	max
Argentina	0.9011	0.9026	0.4662	0.4855
Bolivia	0.9266	0.9278	0.4243	0.4332
Brazil	0.9072	0.9119	0.4867	0.5202
Chile	0.9169	0.9183	0.6276	0.6374
Colombia	0.9388	0.9419	0.5668	0.5690
Costa Rica	0.9214	0.9229	0.4806	0.5003
Dominican	0.9160	0.9170	0.4683	0.4853
Ecuador	0.9307	0.9319	0.5317	0.5546
El salvador	0.9131	0.9160	0.5486	0.5501
Jamaica	0.9458	0.9486	0.5938	0.5970
Mexico	0.9131	0.9146	0.5047	0.5228
Nicaragua	0.9284	0.9344	0.6107	0.6266
Panama	0.9228	0.9238	0.5226	0.5406
Paraguay	0.9221	0.9276	0.3339	0.3726
Peru	0.9143	0.9168	0.5670	0.5746
Uruguay	0.9046	0.9057	0.3310	0.3540
Venezuela	0.9226	0.9242	0.5960	0.6072

Note: his table presents the mean efficiency scores by country estimated by the stochastic frontier model. Since there are four different frontier specifications, only the minimum and maximum scores estimated were presented.

Table 8: Cost Inefficiency Correlates - Battese e Coelli (1995)

VARIABLES	[1]	[2]	[3]	[4]
intercept	-4.709	-5.496	17.610	25.180
	(2.742*)	(3.102*)	(9.477***)	(13.309*)
EQ	7.553	7.499	7.301	7.706
	(3.220**)	(2.391***)	(2.411***)	(2.836***)
ROA	-2.687	-2.554	-2.837	-2.966
	(1.457*)	(1.305*)	(1.495*)	(1.535*)
HHI_A^D	5.032		-22.53	
	(1.716**)		(11.656*)	
HHI_A^D x SIZE			2.212	
			(1.117**)	
HHI_L^D		5.721		-32.474
		(2.161***)		(17.003*)
HHI_L^D x SIZE				3.104
				(1.597*)
SIZE	-0.489	-0.444	-2.264	-2.960
	(0.158***)	(0.076***)	(1.099**)	(1.442**)
LLP	0.153	0.135	0.162	0.165
	(0.126)	(0.102)	(0.113)	(0.120)
Foreign	-0.66	-0.66	-0.698	-0.794
	(0.097***)	(0.137***)	(0.60)	(0.60)
Private	-2.93	-2.887	-2.754	-2.881
	(1.217**)	(0.921***)	(1.409*)	(1.310**)
SigmaSq	0.678	0.652	0.665	0.690
	(0.306**)	(0.230***)	(0.273**)	(0.299**)
Gamma	0.986	0.985	0.985	0.986
	(0.007***)	(0.005***)	(0.006***)	(0.006***)
ML	1849.65	1851.84	1852.21	1856.99

Note: this table presents the Battese and Coelli (1995) estimated coefficients of the cost efficiency correlates. Standard errors in parentheses.
*** p<0.01, **p<0.05,* p<0.1

Table 9: Profit Inefficiency Correlates - Battese e Coelli (1995)

VARIABLES	[1]	[2]	[3]	[4]
intercept	15.618	15.490	45.761	43.604
	(4.746***)	(4.420***)	(9.032***)	(12.411***)
EQ	-10.994	-10.982	-8.043	-8.775
	(3.572***)	(3.537***)	(1.036***)	(2.022***)
HHI_A^D	-0.061		-44.551	
	(0.89)		(10.85***)	
HHI_A^D x SIZE			3.598	
			(0.882***)	
HHI_L^D		0.082		-40.883
		(1.36)		(13.765***)
HHI_L^D x SIZE				3.315
				(1.122***)
SIZE	-1.496	-1.494	-3.756	-3.633
	(0.586**)	(0.573***)	(0.768***)	(1.119***)
LLP	0.403	0.400	0.309	0.340
	(0.207*)	(0.226*)	(0.150**)	(0.183*)
Private	-3.260	-3.262	-1.881	-2.187
	(1.484**)	(1.535**)	(0.363***)	(0.662***)
Foreign	-2.122	-2.116	-1.379	-1.532
	(1.001**)	(1.073**)	(0.442***)	(0.487***)
SigmaSq	8.831	8.822	5.614	6.369
	(3.957**)	(3.951**)	(0.656***)	(2.005***)
Gamma	0.964	0.964	0.948	0.953
	(0.015***)	(0.015***)	(0.006***)	(0.014***)
ML	-3960.48	-3960.48	-3944.908	-3950.255

Note: this table presents the Battese and Coelli (1995) estimated coefficients of the profit efficiency correlates. Standard errors in parentheses.
*** p<0.01, **p<0.05,* p<0.1

Table 10: Scale efficiency

	TOTAL	2001	2002	2003	2004	2005	2006	2007	2008
Mean	0.9405	0.9448	0.9433	0.9395	0.9383	0.9386	0.9397	0.9399	0.9412
S. Dev.	0.0157	0.0148	0.0158	0.0156	0.0172	0.0165	0.0154	0.0140	0.0144

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