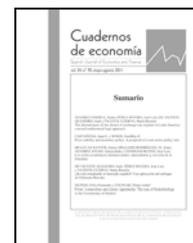




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ARTÍCULO

Assessing competition in the private banking sector in Ecuador: an econometric approach with the Panzar-Rosse model.

Segundo Camino-Mogro^a y Grace Armijos-Bravo^b

^a Invited Professor in the School of Economics and Administrative Sciences of Universidad Católica de Santiago de Guayaquil and the National Director of research and economic studies in the Superintendencia de Compañías, Valores y Seguros del Ecuador.

^b Invited Professor in the School of Economics and Business of Ecotec University.

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Abstract: This paper assesses empirically the competitive conditions in the private banking sector in Ecuador from 2000 to 2015. First, we measure the competition in the private banking sector, using the Panzar-Rosse H-statistic by the total revenue equation; we apply POLS, year fixed effects, bank fixed effects, and random effects. Second, we determine whether there is equilibrium in the long run in this sector by ROA regression equation and finally we aim to identify evidence of economies of scale in the private banking sector. In this path, we analyze three different panels, 2000 - 2015, 2000 - 2006 and 2007 - 2015. The main results indicate that private banks in Ecuador operate under monopolistic competition. In addition, this competition increased during the 2007 - 2015 period; other result shows that there is no equilibrium in the long run for this sector. Finally, there are not economies of scale, therefore we can argue that small banks do not operate with disadvantages compared to medium and large banks.

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Resumen: Este documento evalúa empíricamente las condiciones de competencia en el sector de la banca privada en Ecuador de 2000 a 2015. Primero, medimos la competencia en el sector de la banca privada, utilizando el estadístico H de Panzar-Rosse por la ecuación de ingresos totales; aplicamos POLS, efectos fijos de año, efectos fijos de bancos y efectos aleatorios. En segundo lugar, determinamos si hay equilibrio a largo plazo en este sector mediante la ecuación de regresión del ROA y, finalmente, buscamos identificar evidencia de economías de escala en el sector de la banca privada. En este camino, analizamos tres paneles diferentes, 2000 - 2015, 2000 - 2006 y 2007 - 2015. Los principales resultados indican que los bancos privados en Ecuador operan bajo competencia monopólica. Además, esta competencia aumentó durante el período 2007 - 2015; otro resultado muestra que no hay equilibrio a largo plazo para este sector. Finalmente, no hay economías de escala, por lo tanto, podemos argumentar que los bancos pequeños no operan con desventajas en comparación con los bancos medianos y grandes.

^a Autor de correspondencia, Email: scaminom@superacias.gob.ec; Segundo.camino@gmail.com

I. Introduction

During years 1998 and 1999 Ecuadorian banking sector was affected by a deep economic and political crisis that impacted on all socioeconomic areas. Thus, the country went through one of the worst economic crisis that have taken place, mostly caused by the meteorological phenomenon “El Niño” that killed the agricultural plantations of a huge zone of the coast of the country making the production fall to dramatic levels, the decrease of the production in this sector was around 2%. In addition, oil prices experienced low levels with a minimum of 10 USD per barrel. These factors, among others, caused an accelerated decrease in the macroeconomic indicators; the GDP decreased by 7.3%, the private and public investment by -35.5%, the household consumption by -9.7% and the unemployment rate went from 11.15% to 15.1%¹. The high interest rates and monetary devaluations limited more and more the savings and investment in local currency. Thus, in only 2 months the “Sucre”, the former local currency, had lost around 50% of its value causing negative effects on bank’s results further harming their solvency. With this background, the distrust in the financial system caused by the negative expectations of the society, besides the increase of the inflation, reduction in production and international isolation took the banking system into a situation of illiquidity and insolvency which finally ended up in a bank run in 1999.

Due to this bank run, the banking sector made legal and financial reforms in order to stabilize the system that had fell into a total state of distrust in the society. Thus, Ecuador placed the American dollar as the new official currency in 2000 with a fixed exchange rate of 25.000 Sucres per dollar which generated some changes in the monetary policy in favor of savers and investors. It is worth mentioning that during this economic crisis, the Sucre depreciated around 274% from 1999 to 2000 and in addition to this, of 40 banks that existed in 1999, 16 broke.

Talking deeper about the legal reforms, these were focused on the strengthening of control mechanisms for banks, micro-financing and liquidity risk. Furthermore, a new institution was created to manage information related to the banking system, this institution established that banks must get and publish a quarterly risk rating, redefined credit risk and how to calculate it and tightened the rules regarding consumer credit operations, among others.

Since the American dollar was adopted as the official currency, Ecuadorian’s financial system has gone through a stage of transition and change showing at the beginning of the new millennium and until 2015 a gradual recovery of the financial indicators of liquidity, profitability and solvency generating in this way a stabilization of the sector and restoring the confidence of the society in the system.

In Ecuador, there is an institution that is responsible for supervising, evaluating, regulating and proposing regulatory, financial, economic and market reforms for the correct functioning of the banking system. This entity called Superintendency of Banks (SB) supervises and regulates private, public, mutual, savings and credit cooperatives.

The financial market (mainly the private banking sector) is a fundamental pillar for development and economic stabil-

ity, and it is therefore important to assess the competitive conditions in which they operate. For example, according to Bain (1951) when there are few and large firms (high concentration) it is easier to engage in anticompetitive behavior (collusion). In the same line, it is also well known that the interest rate is the equivalent to the price of the good (service) when comparing to other markets, therefore in the face of greater competition, a lower interest rate would be expected in favor of the whole market.

This study assesses competition in the Ecuadorian private banking sector from 2000 to 2015, using the methodology proposed by Panzar-Rosse that is a formal approach and the most used to analyze the competition degree in banking sector. The authors are unaware that similar studies have been applied in Ecuador from an econometric point of view. For this work an analysis has been made only for private banks and not for public banks since the management of the business differs from one to another. On the other hand, it has been excluded the savings and credit cooperatives institutions since they are regulated by another entity due to the behavior of its relevant market. The objectives of this study are: first, to evaluate the competition of the private banking sector, second to determine whether there is a long run equilibrium in this sector and finally, to identify if there are economies of scale in the private banking system.

The structure of the document is as follows: Section 2 defines the structure and competence of the banking sector in Ecuador, section 3 shows a review of the literature, section 4 reviews the methodology and materials used, section 5 shows the empirical results and discussion, finally, section 6 presents the conclusions.

II. Structure of the private banking system in Ecuador.

Ecuadorian banking system is composed by public and private institutions which are qualified to operate and are regulated by the SB. These institutions operate in financial intermediation, through deposits that are later used in credit and investment operations. According to the Ecuadorian legislation SB (2016) the banking system is also composed by financial companies, savings and credit cooperatives and mutualists.

The SB performs an annual classification of bank size resulting in “large, medium and small” banks. This classification is obtained using a “percentile methodology” in which the key variable is the total assets of the last period reported (usually the last fiscal year). Thus, a bank is classified as large if its total asset is greater than 36%, medium between 12% - 36% and small less than 12% of the total assets of the private banking system². (Superintendencia de Bancos del Ecuador, 2016)

² In 2015, the SB published the following ranking: “Pichincha Bank”, “Pacific Bank”, “Guayaquil Bank” and “Produbanco” as large banks with this position since 2001; “Austro Bank”, “Bolivariano Bank”, Citibank, “Rumiñahui General Bank”, “Internacional Bank”, “Loja Bank”, “Machala Bank”, “Solidario Bank” and “Procredit Bank” as medium size banks; and “Amazonas Bank”, “Manabí Comercial Bank”, “Litoral Bank”, “Cooperativa Nacional Bank”, “Capital Bank”, “Finca Bank”, “DelBank Bank”, “D-Miro Bank”, “Desarrollo Bank” as small banks. The above mentioned banks are those that made up the Ecuador’s private banking system in 2015.

¹ Data obtained from Central Bank of Ecuador

The distribution of private banking sector, according to the SB percentile methodology, has undergone some changes in its structure. For example, from 2005 to 2007 there were 9 banks considered as medium and 12 as small size banks; from 2008 to 2010 there were 6 medium, number that increased to 7 for 2012. Meanwhile, small banks remained in 15 institutions during the period 2008-2012. In 2013 there were 8 medium size banks and 14 small. For 2014 there were 7 medium banks and 16 small. Finally, in 2015 the system has 9 medium and 9 small size banks that reflects a decrease in 43,75% the number of small banks. Regarding the large banks there have been no changes since 2001 with its 4 institutions already mentioned. Such changes in market structure have been due to merges, regulated disappearance, etc. For example, in 2014 one large bank merge with one medium bank; from 2012 to 2015 three small banks were closed because of regulated disappearance.

Regarding market shares, the Ecuadorian private banking system in the credit account for the year 2015 had the following quotas: the large banking sector had a 65.6% share, the medium banking 31.9% and the 2.4% participation belonged to the small banks. In addition, the average credit share of large private banks is 16.4%, while only 3.6% and 0.2% to medium and small banks respectively. On the other hand, for the same year but in the deposit account the large banking sector had a 65.8% share, the medium banking 32.1% and the 2.1% participation belonged to the small banks. A broader information about market share and concentration is exposed in table A1 in the appendix section.

By 2015, the large banks of the total loans mainly allocated their placements to corporate commercial loans (24.4%), corporate priority commercial loans (16.1%) and commercial SMEs (16%). Medium-sized banks accounted for the largest proportion of total loans (36.4%) and corporate priority commercial loans (26.7%), while microloans were served in greater volume by small banks, representing 55.2% of their loans.

About interest rates (maximum), they are determined by the Central Bank of Ecuador (BCE). Banks have the ability to set their active interest rates below or at the same level of the maximum rates established by BCE. These rates can be affected by competition among banks and also they are a key component of the financial system as they set an important share of utilities in all kind of banks. From September 2007 during Rafael Correa's government important reforms have been made to the "Law of Financial System Institutions" and "Law of monetary regime". Thus, a policy of reduction of maximum lending rates was implemented, remaining stable until 2010, with the exception of consumer segments, retail microcredit, microcredits with simple accumulation which had slight fluctuations. As of December 2010, the regulations of the Board of Directors of the Central Bank of Ecuador established that the maximum rate in each credit segment is equal to the weighted average of the interest rates agreed in the credit operations granted by private financial institutions, causing the active interest rates decrease gradually in all the segments of credits, nevertheless from 2013 they have remained stable.

Finally, it is worth mentioning that Ecuadorians private banking system is characterized by an absence of the presence of international banks. In 2002 Citibank and Lloyds

Bank were the only international banks and were considered as medium-size³. Nowadays Citibank is the only international bank in the country and remains its category of medium bank⁴.

III. Literature review

Empirical measurement of competition degree in banking market has increase because of the importance of banks in the economy as well as its relative ease of computation due to the availability of bank-level data. For these purposes, theory suggests that banking competition can be estimated directly from the markup of prices over marginal costs (Lerner, 1934). However, getting this data and measurement is often very difficult or even impossible, is that so that many indirect measurement tools have been developed and proposed to assess competition. Thus, measurement of competition can be divided in two branches of study; those that adopt a structural or informal approach and those that favor a non-structural or formal approach (Claessens, 2009).

Regarding informal measures, one of the most used is the SCP (Structure-Conduct-Performance) approach which is based on the study of concentration of the financial system, the number of banks and market share. This approach argues that there is an inverse relationship between concentration of industry and competition. Therefore, the higher the concentration the greater market power, decreasing efficiency and vice versa. The SCP model has two hypotheses: first it assumes that the structure of the market affects behavior, while the second hypothesis states that it is behavior that influences performance.

Formal measures are the most used to assess competition in the banking sector and are part of the methods of the new industrial organization. This approach uses optimization models, from which, the competitive indicators are derived, such as the Lerner index, the Panzar and Rosse "H-statistic" (used in the present study) conjectural variation and the Boone indicator. These indicators are based on assumptions about cost and production functions, by passing the weaknesses of the SCP approach, as it does not take into account the conduct of banks in the market and the impact of banks' performance on the market structure.

The model of Panzar and Rosse (1987) P-R, is a technique from the new industrial organization and often applied to studies about competition in the banking industry due to its reasonable data requirements. To measure the competitiveness of the banking industry, this model defines the associated measure of competition - generally called the H-statistic - as the sum of the elasticities of gross income with respect to the input prices. This approach estimates an equation of reduced form in relation to the gross income of a vector of input prices and other variables of control. The H-statistic measures the percentage change in the equilibrium of a bank generated by a change of one percent in input costs.

Authors like Shaffer (1982; 1985), Nathan & Neave (1989), Perrakis (1991) and Molyneux et al. (1994), in their studies

³ Lloyds bank closed its activities in the country in 2011

⁴ During 2014 Citibank was categorized as small bank

on competition of the banking sector using the P-R model offer different interpretations about the H-statistic. In particular, the H-statistic is not positive if the firm is a profit-maximizing monopolist or an oligopoly with short-term conjectural variations (Panzar & Rosse, 1987). In such a case, an increase in input prices increases marginal cost and can reduce equilibrium production and total revenues. On the other hand, if the H-statistic is equal to one, there is a natural monopoly in a perfectly contestable market, and the firm also maximizes sales at the point of equilibrium Shaffer (1982). The H-statistic is also the unit when there is perfect competition. In such a case, an increase in entry prices increases both marginal and average costs that affect the optimal output of any individual firm.

Rosse & Panzar (1977) show that H is negative for a neoclassical monopolist or collusive oligopoly, between 0 and 1 for a monopolist competitor, and equal to one for a competitive long run equilibrium price-competitive bank. On the other hand, Shaffer (1982; 1983) shows that H is negative for conjectural oligopolistic variations or short run equilibrium and equal to one for a natural monopoly in a contestable market or for a firm that maximizes sales subject to an equilibrium constraint.

In the application of this model to the banking sector, banks are treated as producers of intermediation services through the inputs of factors such as labor, capital and financial capital. There are numerous studies that have applied the methodology of Panzar and Rosse to measure the degree of competition in the banking sector. Some of these are: Gelos and Roldos (2004) for Latin America and Europe; Nathan and Neave (1989) for Canada; Claessens and Laeven (2004) for 50 countries; De Bandt and Davis (2000) for European countries; Masood and Aktan (2010) for Turkey.

Roldós and Gelos (2004) studied the structure of the banking sector in several countries of Europe and Latin America where they found that bank consolidation was not a significant factor in explaining the decrease in the number of banks. The reduction in the number of banks did not reflect an increase in the consolidation of the banking sector, as measured by the standard concentration ratio, so that competition did not increase. Declining competitive pressures were a result of the reduction of barriers to entry through increased participation of foreign banks.

Table 1 shows several studies performed for Latin America and its empirical results.

Table 1. Review of empirical studies analyzing competition in the banking sector in Latin American countries.

Authors	Period	Country	Approach	Results
Cortez (2006)	1995-2005	Peru	Panzar-Rosse	Monopolistic competition
Bikker et al. (2009)	1986-2004	Argentina, Brasil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama, Paraguay, Perú, Uruguay, Venezuela	Panzar-Rosse	Argentina: monopolistic competition close to zero Brasil: perfect competition Chile: perfect competition Colombia: monopolistic competition close to zero Costa Rica: monopolistic competition Ecuador: monopolistic competition Mexico: perfect competition Panama: monopolistic competition close to zero Paraguay: monopoly Peru: monopolistic competition close to zero Uruguay: monopoly Venezuela monopolistic competition close to one
Gelos & Roldós (2004)	1990s	Argentina, Brasil, Chile, Mexico	Panzar-Rosse	Argentina: monopolistic competition Brasil: : monopolistic competition Chile: : monopolistic competition Mexico: monopolistic competition
Schaeck et al. (2009)	1980-2003	Argentina, Colombia, Costa Rica, Ecuador, Honduras, Mexico, Panama, Paraguay, Venezuela	Panzar-Rosse	Argentina: monopolistic competition close to 1 Colombia: monopolistic competition Costa Rica: monopolistic competition close to 1 Ecuador: monopolistic competition Mexico: monopolistic competition close to 1 Panama: monopolistic competition Paraguay monopolistic competition close to 1 Venezuela: monopolistic competition close to 1
Oda & Silva (2010)	1997-2009	Chile	Boone	Similar levels of competition for 1997-2002 and for 2007-2009, between 2007 and 2005 the population indicator is equal to zero and therefore a low level of competition is assumed.
Castellanos (2010)	2005-2009	Guatemala	H Panzar-Rosse & Lerner	Monopolistic competition
Durán et al. (2009)	1995-2009	Costa Rica	Panzar-Rosse & Shaffer	Monopolistic competition
Gutiérrez et al. (2008)	1995-2007	Colombia	Panzar-Rosse	Monopolistic competition
Gallego (2013)	1995-2011	Colombia	HHI	Monopolistic competition
Bolivar & Rodriguez (2015)	2001-2012	Mexico	Índice Lerner	Monopolistic competition

Mosquera & Gómez (2013)	1994-2009	Colombia	Índice Lerner & H Panzar-Rosse	Monopolistic competition
Tábor (2007)	1996-2005	Honduras	Panzar-Rosse	Perfect competition
Lucinda (2010)	2001-2008	Brasil	Panzar-Rosse	Perfect competition

Elaboration: The authors. Based on the authors listed in the table above

Analytical theory of the Panzar-Rosse model (P-R)

The derivation of the P-R model H-statistic in this section is based upon the work of Buchs & Mathisen (2005) and Abel & Le Roux (2016). They consider the bank maximization problem, where bank i have total revenue (R) and total costs (C). These revenue and cost functions depends on level of production (y) and exogenous variables (z, x) that affects revenues and costs respectively, but also variables that affects the revenue function like the number of firms (n) and a vector of input prices (p) that affects the cost function:

$$R_i = R_i(y_i, n, z_i) \tag{1}$$

$$C_i = C_i(y_i, p_i, x_i) \tag{2}$$

Banks profits are defined as $\pi_i = R_i - C_i$ which implies that banks maximizes its profits in the point where marginal revenue $R'_i(y_i, n, z_i)$ is equal to marginal cost $C'_i(y_i, p_i, x_i)$ as shown in equation (3):

$$R'_i(y_i, n, z_i) - C'_i(y_i, p_i, x_i) = 0 \tag{3}$$

$$y_i^* = y_i^*(z_i, p_i, x_i) \tag{4}$$

$$R_i^* = R_i^*(z_i, p_i) \tag{5}$$

The production (y) of the bank i depends on a set of exogenous variables (z) that affect revenue, a vector of input prices (p) and exogenous variables (x) that affect the cost function. Therefore the equilibrium production is written as equation (4). To obtain the reduced form of the revenue equation which is the product of equilibrium production and price level, we replace (4) in (1) and assuming that n is endogenous in the model, we get equation (5).

Panzar and Rosse model provides a competition measure, H-statistic, that is defined as the sum of elasticities of firm total revenue with respect to changes in input prices. Equation (6) shows that changes in input prices are represented by (∂p_i) and (∂R_i^*) represents equilibrium revenues earned by the bank i.

$$H = \sum \frac{\partial R_i^*}{\partial p_i} \frac{p_i}{R_i^*} \tag{6}$$

The H-statistic can take zero or negative values if the market structure is a monopoly, collusive oligopoly or a conjectural variation of oligopoly and this may happen when an increase in input prices (p) will increase the marginal cost; in consequence it reduces the level of equilibrium production, total revenues and profits. On the other hand, if the H-statistic lies between zero and the unity, banks compete under monopolistic competition, in this competitive environment total revenues increase less than proportional changes in input prices (p), Bikker & Haaf (2002), mention this interaction as the most plausible. Finally, the H-sta-

tistic could be one if any increase in input prices (p) will increase marginal and average costs in the same proportion without changing the equilibrium product of banks; in this assumption those banks that cannot solve the problem of changes in input prices (inefficient banks) will be forced out of the market. Table 2 summarizes the different values that can take the H-statistic.

Table 2. Panzar and Rosse-H-statistics

H values	Implicit market structure
$H \leq 0$	Monopoly, collusive monopoly, Conjectural variations of oligopoly
$0 < H < 1$	Monopolistic competition
$H = 1$	Perfect competition Natural Monopoly in perfect market

Source: (Panzar & Rosse, 1987; Nathan & Neave, 1989; Buchs & Mathisen, 2005).

Elaboration: The authors. Based on the authors listed in the table above

One of the main assumptions of the P-R model and H-statistic is that the market under analysis must be in long run equilibrium. However, Matthews et al. (2007) argued that this assumption is only valid for markets that operate under perfect competition, in the same line Stavarek & Řepková (2014) mention this restriction for Polish banking sector. To measure the equilibrium test it is necessary to estimate on return on assets (ROA) instead of total revenue as dependent variable in the regression equation to measure the H-statistic. The equilibrium test in the long run involves a test where $E = 0$. If $E < 0$, there is an unbalance in the long run and if $E = 0$ then there is equilibrium in the long run. The E statistic is derived from the equilibrium test and measures the sum of elasticities of rate of return with respect to input prices (Fu, 2009). Table 3 summarizes the different situations of E statistic.

Table 3. Long-term equilibrium test

E values	Equilibrium Test
$E = 0$	Equilibrium
$E < 0$	Disequilibrium

Elaboration: The authors.

Source: (Panzar & Rosse, 1987; Nathan & Neave, 1989; Buchs & Mathinsen, 2005)

IV. Materials and Methods

A. Materials

The data set used in the present study comes from the balance sheets and financial statements registered in the web-

site of the SB from 2000 to 2015 (annually). With this data a panel was built resulting in an unbalanced panel with 383 observations distributed according to the banks size. This division results in banks that have no observations during the whole period or parts of it mainly because some banks closed their operations. However, we have decided to include them in the analysis because in some cases these banks belong to the “large and medium size” group. In table A2, we show the evolution over time of the most principal variables for each bank such as the ratio between total income and total assets, personal expenses and total assets, other expenses that do not generate interests and total fixed assets that include machinery, equipment, land, among others, interest expense on deposits and other liabilities.

Tables 4 and 5 show the distribution of the number of banks per year and the number of observations per bank size. This classification is made by the Superintendency of Banks on an annual basis based on the total assets of each bank.

Table 4. Distribution of banks per year

Years	# Banks	% Banks	Cum.
2000	24	6.27	6.27
2001	23	6.01	12.27
2002	22	5.74	18.02
2003	22	5.74	23.76
2004	24	6.27	30.03
2005	25	6.53	36.55
2006	24	6.27	42.82
2007	24	6.27	49.09
2008	25	6.53	55.61
2009	25	6.53	62.14
2010	24	6.27	68.41
2011	26	6.79	75.20
2012	26	6.79	81.98
2013	24	6.27	88.25
2014	23	6.01	94.26
2015	22	5.74	100.00
Total	383	100.00	

Elaboration: The authors. Based on data from the Superintendency of Banks of Ecuador.

Table 5. Number of observations per bank size

Size	Freq.	Percent	Cum.
Large	65	16.97	16.97
Medium	117	30.55	47.52
Small	201	52.48	100.00
Total	383	100.00	

Elaboration: The authors. Based on data from the Superintendency of Banks of Ecuador.

To build the data set only private banks, not public ones, have been considered since business management differs from one another. Private Banks have revenues from other services such as credit cards, demand deposits, interbank transactions and banks public do not have this income and only have those related to financial intermediation (interest earned).

Definition of variables

Table 6 shows the definition of every variable included in the analysis. The description of each variable was made based on what is established by the SB on its catalog of accounts of the national financial system.

Table 6. Definition of variables

Variable	Description
Total revenue	Records the ordinary and extraordinary financial, operating and non-operating income generated in the performance of the firms' activities in a given economic period.
Total assets (TA)	Includes available funds, interbank operations, investments, loan portfolio, acceptances, accounts receivable, assets receivable, payable, leasing and unused by the institution, property and equipment and other assets (includes expenses incurred for the constitution and organization of the entity whose allocation to future periods or years is expressly authorized)
Personal expenses	It registers the amounts paid to the staff for salaries and other benefits established in the laws and regulations, as well as the provisions that give rise to social benefits from social security.
Other expenses that do not generate interest	All other operational expenses, except personal expenses.
Total Fixed Assets	It includes the accounts that represent the properties of a permanent nature, used by the firm, including constructions and remodeling in progress, which serve to fulfill its specific objectives, which have a relatively long useful life and are subject to depreciation, except for land, library and gallery.
Interest on deposits	It records the value of the interest due, which must be paid at the expiration of the obligations. The provision of interest will be made on a daily basis. The credits to this account will be made with simultaneous debit to accounts of results debtors.
Other liabilities	It records the accounts that comprise internal transactions between the different agencies and branches, anticipated income, payments received in advance, funds in administration, employee reserve fund, subsidies received by the public financial institutions, the Badwill of the inversions in actions. The resources that constitute sources of financing for the granting of educational credit and IECE scholarships, and other miscellaneous liabilities that cannot be classified in other groups.
Equity	It represents the ownership of the assets of the company. Amount is determined between the difference between the asset and the liability. It groups the accounts that record the contributions of the shareholders, partners or National Government, the premium or discount on placement of shares, reserves, other equity contributions, surplus for valuations and accumulated results or the year results.

Loan Portfolio	The credit portfolio group includes a main classification according to the activity to which the resources are allocated, these are: for private and public financial institutions: commercial, consumer, housing, microenterprise, education and public investment. Commercial loans include participatory loans, which are a special type of credit operation characterized by the joint participation of a group of institutions of the financial system, which concur in the granting of a loan that, due to its high amount or other characteristics, needs the collaboration of some institutions. This classification of operations in turn includes segregation due to maturity in the portfolio due, refinanced, restructured, non-interest bearing and past due.
REV	Ratio between Total revenue and Total assets
PL	Ratio between Personal expenses and Total assets

PF	Ratio between Interest expense on deposits and other liabilities
PK	Ratio between the other expenses that do not generate interests and total fixed assets that include machinery, equipment, land, among others

Source: (Superintendencia de Bancos del Ecuador, 2016).

Elaboration: The authors.

Table 7 describes the principal statistics of the Ecuadorian private banking system by size. About the dependent variable (ratio of total revenue/total assets) we can see that small banks show the higher mean across the selected years compared to large and medium size banks. Regarding the ratio PF, small banks have a higher mean possibly because small banks have lower liabilities than large banks. As expected, the mean value for total assets, equity, loans and total fixed assets is bigger for large banks compare to medium and small institutions.

Table 7. Descriptive Statistics by Bank size

Large Banks					
Variable	Observations	Mean	Standard deviation	Minimum	Maximum
REV	64	0,124	0,597	0,748	0,488
PF	64	1,349	2,879	0,002	17,285
PK	64	1,487	1,579	0,019	5,986
PL	64	0,017	0,005	0,009	0,039
TA	64	2617544	2160071	423252	9883037
Equity	64	264256	209604	12219	882978
Loans	64	1337281	1238825	153481	5499785
Total fixed assets	64	71506	38892	8494	156728
ROA	64	0,560	0,699	-0,163	2,576
Medium Banks					
Variable	Observations	Mean	Standard deviation	Minimum	Maximum
REV	118	0,136	0,083	0,064	0,588
PF	118	2,221	3,001	0,000	14,267
PK	118	2,486	3,228	-0,071	20,412
PL	118	0,024	0,012	0,011	0,084
TA	118	668217	637474	52731	2794406
Equity	118	59737	57045	6031801	252928
Loans	118	365946	342205	30406	1550993
Total fixed assets	118	13713	12152	588	82976
ROA	118	0,402	0,527	-0,391	1,745
Small Banks					
Variable	Observations	Mean	Standard deviation	Minimum	Maximum
REV	201	0,164	0,077	0,044	0,424
PF	194	65684,420	914624,400	0,000	1.27e+07
PK	201	2,454	3,332	-0,915	17,415
PL	201	0,038	0,023	0,008	0,133
TA	201	106082	117689	5325	614198
Equity	201	14369	14014	1066439	73466
Loans	201	60511	73781	1605609	344529
Total fixed assets	201	2659	2623	83	12442
ROA	201	0,178	1,237	-9,320	2,503

Elaboration: The authors. Based on data from the Superintendency of Banks of Ecuador.

B. Methods

An unbalanced data panel from 2000 to 2015 is used on an annual basis to build the model proposed by Panzar & Rosse (1987) and its H-statistic. This statistic is the sum of the elasticities of the reduced form of firm's income with respect to its traditional inputs.

One of the main problems with the initially proposed model is the use and application of the dependent variable in the estimation of the H-statistic. Thus, some authors prefer to use other variables. For example, Pawlowska (2005), Mkrtchyan (2005), Chan et al. (2007), Lee & Nagano (2008), Bikker & Spierdijk (2008), Deltuvaitè et al. (2015) use interest income or earned interest, while other studies use total revenue or net revenue Hondroyiannis et al. (1999), Hempell (2002), Al-Muharrami et al. (2006), Gutiérrez de Rozas (2007), Bikker et al. (2009), Anzoategui et al. (2010), Stavarek & Řepková (2014), Abel & Le Roux (2016). Finally, some authors use a combination of the two dependent variables, so they use more than one equation Chun & Kim (2004), Mensi (2010), Buchs & Mathisen (2005).

With this background, we have decided to use a single equation where the dependent variable is the ratio of total revenues and total assets of each private bank. We have chosen this ratio as the dependent variable because in Ecuador the share of non-interest revenues⁵ has a non-negligible participation in total revenues contrary to what may occur in other countries where the ratio interest revenues/total assets could be more appropriate. In fact, in Ecuador, for the periods under analysis non-interest revenues has doubled since interest rates were regulated pursuing private banks to innovate and find new sources of higher earnings (mainly services provided) other than interest gained or financial spread.

Thus, we follow Nathan & Neave (1989), Claessens & Laeven (2004), Yildirim & Philippatos (2007) with the proposed model to measure private banking competition in Ecuador setting the following equation expressed in logarithms:

$$\ln(\text{REV}_{it}) = \alpha + \beta_1 \ln(\text{PL}_{it}) + \beta_2 \ln(\text{PK}_{it}) + \beta_3 \ln(\text{PF}_{it}) + \gamma_k \ln(\text{BSF}_{it}) + \sum_{t=1}^t \delta_t D_t + \varepsilon_{it}$$

$$\varepsilon_{it} = \mu_i + \varphi_{it} \quad (7)$$

Where i represents each private bank and t is every year of bank study. The dependent variable REV is the ratio between total revenue and total assets (proxy of real income). The independent variables are three input factors: labor, capital, and deposits where PL, PK and PF correspond to the three input prices assuming that all banks use these three productive factors. Thus, PL is the ratio between personal expenses and total assets (proxy for input price of labor); PK is the ratio between the other expenses that do not generate interests and total fixed assets that include machinery, equipment, land, among

⁵ We refer to fee-based products, services (interbank transfers, withdrawal of deposits, management of current accounts, issuance of credit card statements), etc.

others (proxy for input price of capital) Molyneux et al. (1994). PF is the ratio between interest expense on deposits and other liabilities (proxy for input price of funds). In addition, we have added a vector of specific factors BSF to be able to control differences in size, risk and operational capacity, within this BSF vector we find the following variables: Total assets (TA) variable that is included to be able to account if it exists possibility of economies of scale. As we mention in section II, in Ecuador the SB uses a "percentile methodology" in which the key variable is the total assets to classified size banks. If Ecuadorian private banking sector has economies of scale we expected a positive and significant coefficient of the variable and it implies that large banks seem to be more efficient compared to smaller banks in revenue generation, if the coefficient is negative but significant, this suggest that large banks seem to be less efficient compared to smaller banks in revenue generation. Other control variables we use are equity (Eqty), loan portfolio (Loans) and fixed assets (FA). To control for possible macroeconomic changes within each year, dummy year and size variables (D) have been created.

The model assumes a one-way error component as observed in equation 7, which denotes the unobservable effect of specific banks and also a random term that is not observed by the bank or the researcher.

In agreement with the calculation of the H-statistic and the P-R model, the H-statistic will be equal to the sum of the income elasticities with respect to the three price inputs:

$$H = \beta_1 + \beta_2 + \beta_3$$

Once the value of H is obtained, the hypothesis tests are carried out to determine if the value is consistent with the theory. If the value of H is equal to 1, the banking sector is in perfect competition, if the value of H is equal to or less than 0, the sector is in a monopoly, but if $0 < H < 1$ the sector is in a monopolistic competition.

As we mention in the previous section, P-R model should be used if the sector is in long run equilibrium, but this assumption is only valid if the market operates under perfect competition. The long run equilibrium can be tested using the H-statistic, in which case it measures the sum of elasticities of return on assets (ROA) or return on equity (ROE) with respect to input prices. ROA and/or ROE should be uncorrelated with input prices; this condition is measured to obtain the equilibrium conditions in the long run, the model is established as follows:

$$\ln(\text{ROA}_{it}) = \alpha + \beta_1 \ln(\text{PL}_{it}) + \beta_2 \ln(\text{PK}_{it}) + \beta_3 \ln(\text{PF}_{it}) + \gamma_k \ln(\text{BSF}_{it}) + \sum_{t=1}^t \delta_t D_t + \varepsilon_{it} \quad (8)$$

We decided to use ROA because it isolates the effect of leverage and focuses on the profitability of the bank's assets, which is indistinct from the sources of financing. ROA is the return on assets or the return before taxes on the assets and as it can take negative values we used the natural logarithm of $(1 + \text{ROA})$ (Utrero-Gonzalez, 2004).

The equilibrium of the private banking market is calculated as follows:

$$E = \beta_1 + \beta_2 + \beta_3 \quad (9)$$

The equilibrium test in the long run involves a test where $E = 0$. If $E < 0$, there is an unbalance in the long run and if $E = 0$ then there is equilibrium in the long run. The equilibrium test in the long run is calculated using the Wald coefficient constraint test that tests whether $E = 0$ or not.

We use three econometric techniques for the estimation; one is Pooled Ordinary least squares (POLS), then fixed effects (FE) and random effects (RE). We chose to include the FE estimator to identify whether individual banks features have a significant influence on the competitive structure exploiting the within variation of the data. To decide whether what estimator between FE and RE is more efficient we applied the Hausman test (Wooldridge, 2002).

In addition, we have selected three periods of time to assess competence in the private banking system of Ecuador. The first period ranges from 2000, just right after the dollarization process, to 2015 (whole sample). The second period goes from 2000 to 2006 during which Ecuador went through moments of political instability which highly contributed to economic instability. The last period from 2007 to 2015 is characterized by political stability from the point of view of democracy which may have influence the improvement of several macroeconomic indicators. We tested whether working with these 2 additional subsamples results relevant by including a year dummy for 2007 in the complete sample (2000-2015). T test shows that we can reject the null hypothesis that the coefficient of the year dummy 2007 equals to zero⁶ suggesting that there is evidence in favor of generating estimates for two additional periods of time. Moreover, separates estimates will give some indicator of the movement of H-statistic over time.

Finally, for all estimates we have included year dummies, even after breaking the sample, to account for time macroeconomics effects that may have occurred from one year to another.

V. Results and discussion

Table 8 shows the econometric results obtained from equation 7 using POLS, fixed effects and random effects with standard errors robust to heteroskedasticity. Thus, for the first period (2000-2015) results show that the estimated coefficients of the inputs used by each bank are mostly statistically significant different from zero. In particular, variables (PL), (PK), (TA), (FA) whereas variable (PF) is not statistically significant in any of the estimations. The variable (PL) is significant in POLS and random effects estimation, while with fixed effects estimation is not statistically significant with a positive coefficient. This result, in principle, goes in line with the fact that personal expenses are important in the structure of expenses of Ecuadorians banks.

The variable (PK) has a positive relation with the variable total income and results statistically significant in the three

estimations (POLS, FE, and RE) which might suggest that certain capital expenses are more relevant than expenses in commissions and payments for use of services. The variable (PF) is not statistically significant in any of the estimates and its coefficient is very close to zero, result that is not as expected but shows that the cost of the capital (money loans) does not have a significant influence on total income. This variable captures the market interest rate from the point of view of deposits. Clearly for Ecuador the estimation is very valid since the passive interest rate that the banks pay for the deposit protection is extremely low.

With respect to the variables (TA), (Eqty), (Loans) and (FA) which have been used as control variables regarding size, risk and operational capacity, the results show that variable (TA) is statistically significant in all the estimation but with a negative sign, suggesting that the size-induced differences between banks may lead to lower income per dollar in assets Hondroyiannis et al. (1999), the sign also shows that there are no economies of scale and that small banks appear to have no disadvantages in competition, also large banks seem to be less efficient compared to smaller banks in revenue generation. The variables (Eqty) and (Loans) are positive and no significant (individually) in all the estimates, except (Loans) that is significant for the POLS estimation. This suggests that the equity that banks own doesn't have a positive influence on total income whereas loans does influence on a positive way on total income when estimating using POLS. The variable (FA) is significant and positive in all estimates and unlike the total assets, the fixed assets do help the total income of the banks in Ecuador. With this, we found that there is evidence of economies of scale, although if the variable (TA) were positive this hypothesis would be even stronger.

To determine which estimate is more efficient between FE and RE we applied the Hausman test obtaining that FE estimate is more efficient. However, and in line with other studies with aggregated data for Ecuador, we have chosen the coefficients from POLS estimate to finally compute the H-statistic Yildirim & Philippatos (2007). This choice is supported by the fact that the results obtained from the POLS econometric estimate are the one that fits the best to the P-R model.

As mentioned before, we divided in three groups the data sets because in 2007 during Rafael Correa's government important reforms were made to the banking sector and also financial regulation tightened⁷. For the first period we also calculated the H-statistic proposed by P-R, obtaining an estimated value of 0,64. To test whether the result is consistent with the theory a we performed an F Wald test where the null hypothesis of monopoly/perfect competi-

⁷ In 2007 new reforms were made: "Law of Financial System Institutions" and "Law of monetary regime" these laws regulated the creation, organization and extinction of the institutions in the financial system and also eliminate the "General Law of institutions in the financial system" of 1994 that promotes banks liberalization that causes the bankrupt in 1999. We also tested the structural change with a year dummy variable that takes the number of 1 if 2007 and 0 for other years. The result of the year dummy variable was significant at 10% level for POLS estimation. We also tested the structural change with a year dummy variable that takes the number of 1 if 2006 or 2008 and 0 for other years and the result were not significant at 10% level for POLS estimation.

⁶ Explicit results of the t-test are available upon request.

tion is rejected implying that competency in the private banking system of Ecuador can be described as monopolistic competition (H-statistic between 0 and 1). This result is similar to other aggregate studies where the H-statistic for Ecuador is calculated but for different periods (Bikker et al., 2009), (Bikker & Spierdijk, 2008).

For the second period of analysis, 2000-2006, the results are very similar for the three estimates (POLS, FE, and RE) in the case of input prices and the control variables risk, operational capacity and bank size. The variable (PF) in this period is positive but again not statistically significant. The variable (PL) is positive in all the three estimations but only significant in the POLS method. With regards to the variable (PK), it is positive in all the estimations and not significant in the FE. The variables (TA), (Eqty), (Loans) and (FA) have the same behavior as in the period 2000-2015. Once again the preferred estimation between FE and RE is FE according to the Hausman test.

Regarding the value of H-statistic for the second period, we used the estimates from POLS obtaining an H of 0,52. Once the F Wald test is performed, the null hypothesis that the private banking system behaves as market in perfect competition or monopoly is rejected. Therefore, being the H-statistic between 0 and 1 there is evidence of monopolistic competition in private banking system in Ecuador for the period 2000-2006.

For the last period, 2007-2015, once again the results are very similar in three estimates for the price inputs and control variables. The variable (PL) is now positive and significant in all the estimates, the variable (PK) is also positive and significant in the FE estimate, the variable (PF) shows the same behavior as in 2000-2015 as well as the control variables. With respect to the Hausman test it suggests that FE estimate is more efficient than RE. The result for the H-statistic, which was calculated from the POLS estimates, is 0,76 that after applying the F Wald test rejects the null hypothesis that the private banking system behaves as market in perfect competition or monopoly. Thus, the empiric evidence suggests that the private banking system behaves as monopolistic competence.

From the results of the H-statistic of the P-R model for each of the three estimated periods we obtain evidence that the competition has improved in the last period (2007 - 2015) compared to the period (2000 - 2006), although in both cases the banking sector behaves as a market in monopolistic competition. This situation of improved competition in the private sector of Ecuador's banking sector could be due, in general terms, certain regulatory measures implemented by the Government through the Superintendency of Banks, being the most notable the elimination of charging for certain banking services such as bank transfers, withdrawal by ATMs, payment for maintenance of savings and current accounts, collection for issuance of account statements, among others. These services favored mostly banks considered large to have a greater proportion of account savers and account holders in addition to having a higher installed capacity than the rest of banks.

On the other hand, the results of the H-statistic for Ecuador during the period 2000 - 2015 are in agreement with the competition of the same sector for other countries with

similar economies reported in other studies Gelos & Roldós (2004), Yeyati & Micco (2007), Anzoategui et al. (2010). Another important comparison to highlight, even though it was carried out in another study period, shows that competition in South America according to the H-statistic is at 0.61, thus showing a monopolistic competition (Bikker & Spierdijk, 2010).

As a final step, we estimated long run equilibrium of the private banking sector in Ecuador by using equation 8. The econometric results are shown in Table 9. The estimated coefficients have different signs, and there have been included control variables such as year and size dummies.

As in testing competency through H-statistic, we have divided the sample in three periods to assess long run equilibrium. Regarding the first period of analysis, 2000-2015, after testing the null hypothesis, using an F Wald test, that $\beta_1 + \beta_2 + \beta_3 = 0$, where E was estimated with POLS giving a coefficient 0,29 we rejected the null hypothesis. Therefore, there is evidence that during the mentioned period there was no long run equilibrium for the private banking sector.

For the period 2000-2006 we obtained an E statistic of 0,02 from an POLS estimation and after testing the null hypothesis $E = \beta_1 + \beta_2 + \beta_3 = 0$ using an F Wald test, the null hypothesis was rejected suggesting that during 2000-2006 there was no long run equilibrium for the private banking system even though the E statistic is very close to zero. Something very similar occurs for the period 2007-2015 where $E=0,5$ and no long run equilibrium is found either.

Something relevant to mention is that even though we find that there is no long run equilibrium for the private banking system the results are still valid as argued by Matthews et al. (2007) who states that the $E=0$ restriction (market equilibrium) is needed for perfect competition but not for monopolistic competition. Molyneux et al. (1994) and Shaffer (1982) argues that if the market is in disequilibrium, an increase (decrease) in factor prices would be reflected in a temporary decline (increase) in ROA. Thus, we can still estimate the H-statistic as there are several theories supporting this fact in situations where there is no long run equilibrium.

Table 8. P-R Model, aggregate results for the private banking sector in Ecuador divided into periods of time. Dependent variable: $\ln(REY)$

Independent Variables	2000 - 2015			2000 - 2006			2007 - 2015		
	POLS	Fixed Effects	Random Effects	POLS	Fixed Effects	Random Effects	POLS	Fixed Effects	Random Effects
PL	0,356***(0,05)	0,159 (0,11)	0,291***(0,08)	0,269***(0,09)	0,024 (0,13)	0,181 (0,12)	0,356***(0,06)	0,170*(0,10)	0,277***(0,08)
PK	0,276***(0,06)	0,224*(0,11)	0,219***(0,09)	0,248***(0,07)	0,141 (0,12)	0,186***(0,09)	0,397***(0,06)	0,331***(0,08)	0,374***(0,08)
PF	0,001 (0,00)	-0,000 (0,01)	-0,000 (0,01)	0,006 (0,02)	0,035 (0,02)	0,016 (0,02)	0,003 (0,01)	-0,009 (0,01)	-0,004 (0,00)
TA	-0,548***(0,11)	-0,432***(0,19)	-0,443***(0,15)	-0,690****(0,17)	-0,643***(0,29)	-0,615***(0,24)	-0,537****(0,1)	-0,438****(0,14)	-0,460****(0,15)
Eqty	0,098 (0,06)	0,131 (0,12)	0,092 (0,10)	0,125 (0,09)	0,140 (0,24)	0,133 (0,14)	0,028 (0,05)	-0,051 (0,20)	-0,019 (0,16)
Loans	0,161***(0,07)	0,071 (0,07)	0,105 (0,07)	0,270***(0,12)	0,355 (0,23)	0,252 (0,17)	0,093*(0,06)	0,031 (0,02)	0,042***(0,02)
FA	0,356****(0,07)	0,298***(0,12)	0,292****(0,10)	0,301****(0,09)	0,334***(0,14)	0,231***(0,10)	0,496****(0,06)	0,366****(0,11)	0,445****(0,09)
constant	0,231 (0,32)	-0,381 (1,17)	-0,210 (0,35)	0,493 (0,47)	-1,931 (2,35)	0,050 (0,74)	0,313 (0,20)	0,933 (1,32)	0,428 (0,43)
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Size dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
R ²	0,7	0,49	0,46	0,56	0,46	0,39	0,83	0,59	0,58
H-statistic	0,64 ^{a,b}	0,34 ^{a,b}	0,51 ^{a,b}	0,52 ^{a,b}	0,19 ^b	0,38 ^{a,b}	0,76 ^{a,b}	0,49 ^{a,b}	0,65 ^{a,b}
No. Observations (Banks)	363 (34)	363 (33)	363 (33)	147 (28)	147 (27)	147 (27)	216 (30)	216 (29)	216 (29)
Hausman Test		0,000			0,008			0,010	

Elaboration: The authors. Based on data provided by the Superintendency of Banks of Ecuador.

Notes: Estimates correspond to equation 7. Robust standard errors to heteroskedasticity of estimated coefficients in parentheses. ***, **, * indicates the significance at 1%, 5%, 10% confidence level respectively. ^a significance different from zero in the Wald test F, ^b different significance of one in Wald test F. It includes 16 year dummies for the period 2000 - 2015, 7 year dummies for the period 2000-2006, 9 year dummies for the period 2007 - 2015 and 3 dummies of size according to classification of the Superintendency of Banks of Ecuador.

Table 9. Equilibrium test, aggregate results for the private banking sector in Ecuador divided into periods of time ⁸.
Dependent variable: $\ln(1+ROA)$

Independent variables	2000 - 2015			2000 - 2006			2007 - 2015		
	POLS	FE	RE	POLS	FE	RE	POLS	FE	RE
PL	0,308*** (0,11)	0,265(0,16)	0,308*** (0,08)	0,025** (0,01)	0,036** (0,02)	0,037*** (0,01)	0,485 (0,31)	1,167** (0,50)	0,453 (0,29)
PK	-0,001 (0,05)	0,045 (0,08)	-0,001 (0,05)	0,005 (0,01)	0,010 (0,01)	0,010 (0,01)	0,019 (0,29)	-0,071 (0,63)	0,063 (0,38)
PF	-0,002 (0,02)	0,005 (0,02)	-0,002 (0,02)	0,002* (0,00)	0,003* (0,00)	0,003* (0,00)	-0,006 (0,03)	0,071 (0,05)	0,001 (0,04)
TA	-0,047 (0,10)	0,029 (0,21)	-0,047 (0,09)	0,035* (0,02)	0,003 (0,02)	0,013 (0,02)	-0,034 (0,33)	0,381 (0,51)	-0,037 (0,32)
Eqty	-0,139* (0,07)	-0,564* (0,32)	-0,139 (0,09)	-0,021* (0,14)	-0,018 (0,02)	-0,018 (0,02)	-0,349* (0,21)	-2,282*** (0,78)	-0,443 (0,29)
Loans	-0,058 (0,07)	0,136 (0,08)	-0,058 (0,07)	-0,034** (0,01)	-0,009 (0,01)	-0,017 (0,01)	-0,070 (0,11)	0,408** (0,15)	-0,015 (0,11)
FA	0,106 (0,07)	0,039 (0,11)	0,106* (0,06)	0,022 (0,01)	0,017** (0,01)	0,026** (0,01)	0,195 (0,31)	-0,287 (0,70)	0,229 (0,38)
constant	2,220*** (0,81)	4,300* (2,48)	1,874** (0,77)	0,121** (0,06)	0,280 (0,23)	0,201*** (0,08)	3,581 (1,23)	19,932*** (6,23)	3,848*** (1,31)
Year dummies	YES								
Size dummy	YES								
R ²	0,41	0,42	0,46	0,36	0,48	0,47	0,38	0,47	0,34
E statistic	0,29 ^a	0,30 ^a	0,29 ^a	0,02 ^a	0,05 ^a	0,05 ^a	0,50 ^a	1,17 ^a	0,51 ^a
No. Observations (Banks)	288 (34)	288 (33)	288 (33)	147 (28)	147 (27)	147 (27)	141 (30)	141 (29)	141 (29)
Hausman test		0,000			0,000			0,000	

Elaboration: The authors based on data provided by the Superintendency of Banks of Ecuador

Notes: Estimates correspond to equation 8. Robust standard errors to heteroskedasticity of estimated coefficients in parentheses. ***, **, * indicates the significance at 1%, 5%, 10% confidence level respectively. ^a significance different from zero in the Wald test F. It includes 16 year dummies for the period 2000 - 2015, 7 year dummies for the period 2000-2006, 9 year dummies for the period 2007 - 2015 and 3 dummies of size according to classification of the Superintendency of Banks of Ecuador.

⁸ The results of this table come from the estimation of a theoretical model previously developed by Panzar and Rosse (1987), where it is established that to measure the competition equilibrium in the long run it is necessary to use the same independent variables as the competition model where the only difference is that the dependent variable now instead of the total income / total assets is the ROA or ROE. In the document it is justified because the ROA is used as a dependent variable, in addition it is justified why despite of finding a result of unbalance in the long run, the model of competition was estimated.

Discussion

The present study assesses competition in the private banking sector in Ecuador in the period 2000 - 2015. The main contributions of this research are as follows. First, to the knowledge of the authors, this is the first paper that evaluates competition in the private banking sector in Ecuador through an econometric model using national data reported in each bank's balance sheets. Second, the long-term equilibrium of this sector is analyzed in two sub-periods delimited by political and economic stability. Finally, the results can be taken as a first evaluation of competition in this sector as well as market equilibrium.

With regard to the assessment of competition, as already mentioned, it improved in the second period of analysis and in general is in agreement with the results for countries with similar economies and private banking system similar to Ecuador. Ecuador has a private banking market that competes under conditions of monopolistic competition, as do other countries in the region.

The econometric results are similar when evaluating competition with some concentration indicators such as CR4 and Herfindahl-Hirschman as found by Camino & Morán (2016) where it is shown by these indices that the private banking sector operates under conditions of oligopolistic competition in the deposit and loan portfolio segments.

On the other hand, in the estimation of the long run equilibrium test, it is shown that there is no evidence of such equilibrium in any of the periods of analysis. However Bikker et al. (2009) mention that if the market is not found in a long-run equilibrium but is a market in monopolistic competition, as is the case in Ecuador, one can conclude that market behavior is largely competitive, but there is a certain degree of structural unbalance in the sample used.

The present study has some limitations. First, those derived from the nature of the data source used since banks may not report certain expenses in a real way or place them in other types of accounts. Second, the evaluation of the competition of the private banking sector leaves aside the public banks although this has already been justified. Third, regarding the variable used as proxy of the product or total income, as mentioned, there is a wide debate as to which dependent variable should be used. We have chosen the ratio total revenue/total assets as it is more appropriate in the Ecuadorian context where other types of revenues, and not only interest revenues are representative. Fourth, the evaluation of the competition is done by a parametric econometric model and not semi-parametric or dynamic. Finally, it is necessary to take into account the limitations of a panel data analysis, as well as the fact that there are few banks per year in the private banking system.

VI. Conclusions

In this paper we have used the methodology proposed by Panzar and Rosse to evaluate the conditions of competition in the private banking sector in Ecuador during the period 2000 - 2015. A reduced form equation of total income was estimated using 3 different methods, POLS, Fixed effects

and random effects, all robust to heteroskedasticity following some methodologies proposed by other researchers.

The results show that during the period 2000-2015 the private banking sector in Ecuador operates through monopolistic competition similar to other countries in the region. The competition of the sector improved in the period 2007 - 2015 probably due to a better regulation of the market where policies were established to avoid the collusive behavior and abuse of market power. On the other hand, when we estimated long-term equilibrium the results indicated that this market operates in an unbalance, but despite this, the market operates mostly in a competitive way but showing a structural unbalance due to the nature of the data used.

Another important conclusion of this study is that there is no evidence of economies of scale for private banks suggesting that small banks do not operate with disadvantages talking about the core business (of banks) in comparison with large banks.

One important public policy recommendation for this sector beyond the analysis of the competitive environment is that an improvement in fiscal adjustments could likely increase the efficiency of competition in Ecuador's private banking system through the PF variable. In this way, apart from the improvement of the fiscal policy to this sector, other improvements could be given as the more efficient use of information technologies in the services provided by banks, the improvement of the transparency in the structure of its costs and the increase of the placement of credits in the different productive sectors.

This research has been a first step for the evaluation of the competition of the banking sector in Ecuador, so it opens the way to future research where this sector can be evaluated through the use of semi parametric, dynamic tools or applying some other model that can be contrasted with the one done here.

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Appendix

Table A1: Concentration Index for Ecuadorian private banks

Year	HHI Credits	HHI Deposits	Cr4 Credits	Cr4 Deposits	#Banks
2000	1314,59	1304,01	63,87	65,31	24
2001	1151,48	1392,23	58,70	61,49	23
2002	1258,71	1329,18	61,45	60,65	22
2003	1205,33	1316,07	59,12	60,39	22
2004	1094,30	1206,91	54,86	59,14	24
2005	1162,90	1177,86	55,15	58,28	25
2006	1177,36	1596,97	55,14	68,68	24
2007	1281,48	1297,75	57,03	60,05	24
2008	1433,70	1327,89	59,64	60,98	25
2009	1389,30	1352,69	59,79	61,78	25
2010	1429,43	1370,94	61,14	61,78	24
2011	1327,10	1375,23	60,01	62,45	26
2012	1366,03	1396,75	61,03	62,19	26
2013	1420,21	1422,65	62,10	62,60	24
2014	1489,41	1511,36	62,10	65,46	23
2015	1468,03	1519,33	65,39	65,77	22

Elaboration: The authors based on data provided by the Superintendency of Banks of Ecuador

Table A2: Evolution over time of selected variables for each bank

ID	2000				2007				2015			
	REV	PF	PL	PK	REV	PF	PL	PK	REV	PF	PL	PK
1	0,488	0,011	0,020	0,257	0,139	0,252	0,019	1,084	0,127	0,423	0,018	2,143
2	0,126	0,008	0,033	0,180	0,121	0,210	0,011	0,448	0,111	0,932	0,017	1,343
3	0,121	0,026	0,011	0,020	0,112	8,392	0,014	0,623	0,119	17,285	0,020	0,764
4	0,108	0,007	0,021	0,233	0,114	1,225	0,018	4,297	0,089	1,213	0,017	4,048
5	0,205	0,006	0,018	0,163	0,106	0,781	0,014	2,048	0,086	1,822	0,014	1,660
6	0,588	0,003	0,025	-0,072	0,124	0,242	0,018	1,217	0,114	1,145	0,014	1,961
7	0,100	0,001	0,018	0,111	0,110	9,994	0,017	0,753	0,094	7,966	0,014	1,734
8	0,220	0,031	0,033	0,156	0,125	2,382	0,019	3,565	0,130	3,612	0,023	0,714
9	-	-	-	-	0,148	0,197	0,016	0,992	0,147	0,167	0,025	0,466
10	0,314	0,053	0,024	0,829	0,104	0,296	0,027	8,170	0,084	0,018	0,020	20,413
11	0,260	0,000	0,047	-0,169	0,121	8,787	0,041	0,193	-	-	-	-
12	0,152	0,000	0,023	0,030	0,127	0,016	0,024	0,520	0,127	0,204	0,032	0,778
13	-	-	-	-	-	-	-	-	0,077	9,927	0,019	3,051
14	-	-	-	-	0,424	0,257	0,055	1,773	0,238	0,706	0,079	11,193
15	-	-	-	-	-	-	-	-	0,209	5,229	0,062	3,446
16	-	-	-	-	-	-	-	-	0,283	58,288	0,106	2,467
17	0,214	0,001	0,020	0,217	0,134	3,194	0,023	4,730	0,140	1,591	0,024	7,779
18	0,045	0,005	0,009	1,103	0,183	0,046	0,049	9,111	0,153	0,651	0,055	5,945
19	0,127	0,002	0,026	0,167	0,109	0,629	0,016	1,051	0,115	0,646	0,020	1,613
20	0,288	0,025	0,042	-0,044	0,120	1,087	0,027	0,577	0,106	2,303	0,028	1,252
21	-	-	-	-	0,097	6,521	0,017	1,733	-	-	-	-
22	-	-	-	-	0,150	12,644	0,034	1,046	0,123	3,852	0,024	1,282
24	0,190	0,087	0,028	0,044	0,224	10,334	0,052	1,120	0,219	2,829	0,050	2,181
25	0,224	0,015	0,008	0,030	0,140		0,029	0,152	-	-	-	-
26	0,153	0,002	0,050	0,016	0,337	0,498	0,028	1,957	-	-	-	-
27	0,184	0,008	0,050	-0,385	0,445	6,310	0,039	5,358	-	-	-	-
34	0,331	0,003	0,014	0,128	-	-	-	-	-	-	-	-
40	0,267	0,000	0,081	0,206	-	-	-	-	-	-	-	-
49	0,085	0,040	0,022	0,586	0,088	1,084	0,023	5,089	-	-	-	-
50	0,117	0,009	0,037	0,009	-	-	-	-	-	-	-	-
60	0,168	0,005	0,036	-0,289	-	-	-	-	-	-	-	-
62	-	-	-	-	-	-	-	-	0,138	1,692	0,035	0,878

Elaboration: The authors based on data provided by the Superintendency of Banks of Ecuador