Spatial Competition in the Colombian Deposit Market[1]

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Abstract

This paper presents a spatial competition oligopoly model for the Colombian deposit market in line with the New Empirical Industrial Organization (NEIO) approach. In this framework, banks use price and non-price strategies to compete in the market, which allows us to study the level of bank competition in the whole country and the regional level. The theoretical model is applied to quarterly Colombian data that covers the period 1996-2005. Our results suggest that, although the Colombian deposit market appears to be more competitive than the Nash equilibrium, there are some local areas within the country that present evidence of market power.

Resumen

Este documento presenta un modelo oligopólico de competencia espacial para el mercado de depósitos. En este escenario los bancos usan otras variables, además de las tasas de interés, para competir en el mercado. Esta aproximación permite analizar el nivel de competencia bancaria a un nivel nacional y regional. El modelo teórico es aplicado al caso colombiano por medio de datos trimestrales que abarcan el periodo 1996-2005. Los resultados sugieren que, aunque en el mercado nacional no existen problemas de competencia, en ciertas regiones del país algunos bancos poseen poder de mercado.

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I. INTRODUCTION

To justify the study of competition in the banking sector we need to describe how banks behave in a competitive scenario. As Freixas and Rochet (1997) mention, in perfect competition the optimal choice for banks is given by the point where the intermediation margins are equal to the marginal management cost. In this scenario, the behavior of a bank does not affect the market equilibrium. In contrast, when a bank has market power it can affect prices, which would lead to a reduction on deposit rates and an increment on the rates on loans given that the bank is maximizing its profits. In this context, part of the consumer surplus would be passed to the bank and efficiency would be lost by a reduction in the volume of loans and deposits. Therefore, regulation concerned with limiting the creation, extension and exploitation of market power is more than justified. However, the only guide for the optimal implementation of regulation are the empirical studies that describe the characteristics of the relevant market, and in this way, their importance is more than clarified.

In Colombia, the existing empirical literature related with the study of market competition in the banking system has followed two tendencies: i) it has focused either on price or quantities to explain banks' behavior, ignoring that banks consider other type of strategic instruments; ii) and it has always analyzed the market in a national dimension without questioning if the conclusions obtained for the national market are applicable to a regional dimension. In this paper, we specify a spatial competition oligopoly model in which banks use price and non-price instruments to compete in the market. In this context, we propose a two stage model in which banks choose the optimal interest rate for the whole country in the first period and in the second, given the optimal interest rate, they select the number of branches they will open in each region. The model is useful for identifying the level of competition in the regions and subregions of the country, to test if the traditional aggregated measures that have been used in the Colombia leave aside many regional particularities that may lead to wrong regulatory measures, meaning, that if we analyze the market in a more disaggregated approximation we may get different results.

The paper is structured in five additional sections. The first one presents a brief overview of the international literature related with bank and spatial competition. The following section summarizes the empirical Colombian literature related with the study of competition in the banking sector. Section III introduces the theoretical model. Section IV deals with the empirical implementation, which concerns functional forms, data, estimation techniques and results. Finally, section V concludes.

II. AN OVERVIEW OF THE INTERNATIONAL LITERATURE

The literature on the measurement of competition can be broadly divided in two streams: the structural approach and the non-structural approach[3]. The structural approach follows traditionally the Structure-Conduct-Performance (SCP) paradigm. The SCP suggests a relationship between concentration and competition in which high levels of concentration are reflected in market power, more precisely, it states that highly concentrated markets generate incentives for collusive behavior among banks[4]. Although a theoretical basis exists for this view, it has been

[3] See Bikker and Haaf (2000) and Levy and Micco (2003).

[4] For a detailed survey of the authors that use this methodology see Schmalensee (1989) and Gilbert (1984).

criticized for its theoretical deficiencies and because some empirical cases have shown that there can be a competitive conduct without regard of the number of firms in the market.

In response, the *New Empirical Industrial Organization* (NEIO) paradigm was originated. It consists of a non-structural approach based on the hypothesis of contestability between firms in the profit maximization scenario. It was developed mainly under two different methodologies: the *Panzar and Rosse* (P-R) model and the *Bresnahan and Lau model*[5]. The P-R model infers the market structure on the basis of a reduced form revenue equation based on cross section data. Market power is measured as the sum of the elasticities of the reduced form with respect to input prices, which constitutes the H statistic that reflects firms' competitive behavior in the long run equilibrium[6]. The authors prove that under monopoly, H is smaller or equal that zero *(H < 0)*, while in a competitive industry H takes a value of one *(H = 1)*. Thus, values between zero and one *(0 < H < 1)* indicate that the market works under monopolistic competition. This methodology has been applied in several studies in which the result of monopolistic competition tends to predominate[7].

On the other side, Bresnahan and Lau estimate the degree of market power of the average bank in the short run developing the methodology employed by Iwata (1974). The authors measure the degree of competition in a conjectural parameter (λ), which is defined as the change in the output of other firms anticipated by the focus firm in response to an initial change in its own output[8]. Theory predicts a certain response from a monopolist and no response for the competitive firm. In this context, if the average firm operates under perfect competition the conjectural parameter must be zero ($\lambda = 0$), and in the extreme case of monopoly it would take the value of one ($\lambda = 1$)[9].

Although the SCP and the NEIO streams have been the two traditional approaches in the study of competition in the banking system, in recent years, a new trend has been developing. This tendency focuses on the idea that banks compete also in a spatial dimension which incorporates more than price or quantities as the strategic variables[10]. For instance, Chiappori *et al.* (1993) specify a model in which banks compete simultaneously with interest rates and branches to analyze the effect of regulation,

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5 See respectively, Bresnahan (1982), Lau (1982) and Panzar and Rosse (1987).

6 The H statistic is derived as:

$$H = \sum_{i=1}^{n} \left(\frac{dR_i^* w_k}{dw_k R_i^*} \right)$$

where w_k represent input prices and R_i represents the reduced-form revenue equation. See Vesala (1995) for further details.

7 For developed countries Bikker and Haaf (2000) show that the banking markets in the industrial world are characterized by monopolistic competition. For the developing countries Levy and Micco (2003) and Gelos and Roldos (2002) found evidence of monopolistic competition as well.

8 Although Iwata was the first to present an empirical measure of a firm's conjectural variation the concept was introduced by Bowley (1924).

9 Several studies have used this approach to identify the market structure in the banking system. For instance, Shaffer (1989,1993) applies it to the Canadian and American financial markets, Suonemin (1994) and Swank (1995) analyze a two product market in the Finnish and the Dutch banking sectors, Bikker and Haaf (2000) found evidence of perfect competition in the Euro area, Angelini and Cetorelli (2000) evaluated competition in the Italian financial banking, and Canhoto (2004) finds evidence of high market power features in the Portuguese banking sector. Among other papers that use this approach, some else worth mentioning are Berg and Kim (1994,1996), Frazer and Zakoohi (1998), Hannan and Liang (1993) and Toolsema (2002).

10 The first one to introduce this idea was Salop (1979).

Barros (1997) proposes a spatial competition model to explain price differences across banks in the deposit market and Kim and Vale (2001) set up an oligopolistic model to test for the role of the branch network as a non-price strategic variable in the Norway banking sector[11].

III. Empirical literature for Colombia

Barajas *et al.* (1999) was the first paper that tried to study the market structure of the Colombian loan market. The authors use the Bresnahan and Lau methodology for two periods, a preliberalization (1974-1988) and a postliberalization period (1992-1996). Their results show that the Colombian loan market was not competitive throughout the first period although it became significantly more competitive after the 1990s. Afterwards, they apply the P-R approach finding evidence of monopolistic competition for domestic and private banks (H = 0.382), with domestic banks exhibiting a lower degree of competition (H = 0.265) than foreign banks (H = 0.527), especially after the 1990s[12].

Later, Levy and Micco (2003) apply the SCP approach and the P-R methodology to measure the competition level in the banking sector of eight Latin American countries, including Colombia[13]. They found that concentration appears to have no influence in competition, while foreign penetration weakened it seriously in this area. For Colombia, they obtain evidence of monopolistic competition although the Colombian banking sector appeared to be only more competitive than Argentina[14].

Mora (2004) uses a new measure of competition in which he divides the conjectural parameter by the demand elasticity to evaluate the market power for Bolivia, Costa Rica, Colombia, Ecuador and Venezuela. His estimations show that in all of these countries the loan and deposit markets have an oligopolistic structure. In particular, the paper reveals that Colombia is one of the less competitive markets in Latin America[15].

In a more recent work, Estrada (2005) applies the SCP paradigm using the Herfindahl- Hirschman concentration index (HHI) concluding that in the Colombian financial system the level of concentration is not significantly high[16], and later, in the second part, he employs the Bresnahan and Lau's method for the deposit market in which the results show that it is not characterized by a collusive scenario.

Finally Salamanca (2005), employs the Bresnahan and Lau's approach to analyze the Colombian market structure in the loan and deposit market using a Bertrand model for the period 1994-2004. He concludes, that the deposit market tends to be more competitive than the loan market. Particularly, the deposit market appears to be more competitive than the Nash equilibrium, while on the contrary,

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[11] See also Kim, *et al.* (2003).

[12] See Barajas *et al.* (2000)

[13] Argentina, Brazil, Chile, Costa Rica, el Salvador, Mexico and Peru were studied as well.

[14] The H statistic was between 0.57 and 0.59 for the regression with ordinary least squares (OLS) and weighted least squares (WLS), respectively.

[15] Colombia turned to be only more competitive than Costa Rica in both markets.

[16] The HHI is a convex function of the average weight of the firms in the market, given by the expression:

$$\sum_{i=1}^{n} (S_i^2)$$

where S_i represents the share of the firm i in the market. The index grows when the number of firms in the market decreases or when there are high differences in the firms size.

the loan market shows a less competitive behavior close to a monopolistic competition structure.

To summarize, the existing empirical literature leaves clear three ideas: i) that the Colombian banking sector is one of the less competitive markets of Latin America; ii) that the deposit market is more competitive than the loan market; iii) and finally, that the loan market presents a monopolistic competition market structure. Nevertheless, as pointed out in the introduction, each of the aforementioned models focus traditionally in a national measure of the market and leaves aside the very likely possibility that banks employ non-price variables as strategic instruments. This article intends to be a contribution in this research, focusing in the evaluation of the competitive conditions within the regions for the Colombian deposit market, for the 1996-2005 period, considering a framework in which banks optimize their profit taking into account spatial variables such as branching network.

IV. THE MODEL

We specify a framework derived from a static partial equilibrium oligopoly model inspired by earlier models developed in Freixas and Rochet (1997) and Canhoto (2004). Under this perspective banks operate in the loan, deposit and security market. In the loan and deposit markets there is product differentiation but high substitution elasticity between products, which makes bank's demand for loans and supply for deposits dependent on their own interest rate and on the vector of the rivals' rates. There is separability between the loan and deposit markets and banks act as price-takers in the security market[17].

We assume as well a two-stage model in which banks have two strategic variables: interest rates and number of branches in each region. In this context, each bank chooses their loan and deposit interest rates to satisfy its objective function in the first period following a Bertrand model. For the second period, given the optimal interest rate, each bank determines the optimal number of branches for each region. More specifically, each bank establishes the same interest rate in all of its branches, which is a way of maintaining the interrelations among different regional markets in the theoretical perspective[18]. The Bertrand model was applied because as Chiappori *et al.* (1993) argue, prices should be considered as the main instrument of competition between financial institutions.

A. First Period

Given the assumptions mentioned before, each banks chooses the interest rate that maximizes its national profit function in the first period. In this way, the profit function of the bank i for the first period would be given by:

$$\prod_i = r_i^l L_i + (r^s(1-p) + mp - r_i^d)\, D_i - C_i(D_i, L_i, S_i, n_i) \quad (1)$$

where L_i, S_i and represent respectively, the amount of loans, the net holding of securities and the quantity of deposits received by the bank i, r stands for the interest rate in each market, p is the reserve requirement rate, m is the return on these reserves, n_i represents the number of branches that the bank i has in the

[17] The assumption of separability between markets has been used widely in the literature. For instance Chiappori, Perez-Castrillo, and Verdier (1993) and Barros (1997) use this assumption to analyze the deposit market.

[18] In Colombia each bank establishes a reference deposit rate for the whole country. Then, each branch of the bank has the possibility of fixing a rate that differs in a small margin from the fixed rate. However, there is no existing data of these margins.

whole country, stands for the variable costs, which are assumed to be separable for each activity.

The assumption about separability for the loan and deposit markets allows us to specify the supply of the deposits for the bank *i* as:

$$D_i = D_i\,(r_i^d,\ r_{-i}^d,\ z_i) \qquad (2)$$

where r_{-i}^d represents the vector of deposit rates set by the rivals in the market and z_i stands for other exogenous variables that affect the supply for deposits of the bank. In this context, all the rivals' interest rates determine the deposits supply for each bank i which constitutes in itself a very complicated problem. To simplify it we employ Canhoto's methodology, who replaces the individual rivals' interest rate by a weighted average, such that:

$$r_{Ri}^d = \sum_{j \neq i} \left(\frac{D_j}{\sum_{j \neq i} D_j}\right) r_j \qquad (3)$$

Given this definition, theory states that the amount of deposits supplied by the public to the bank *i* will increase if its own interest rate goes up and that it will decrease if the rivals' weighted average increases. With the above specifications for the deposit supply and the profit function, the first order condition for the deposits interest rate is given by:

$$r_i^{*d} = \left(r8\ (1 - p) + mp - \frac{dC_i(D_i)}{dD_i}\right) - D_i\lambda \qquad (4)$$

where λ can be written as:

$$\lambda = \frac{\partial r_i}{\partial D_i} = \frac{1}{\left(\left(\frac{dD_i}{dr_i^d}\right) + \left(\frac{\partial D_i}{\partial r_{Ri}^d}\right)\left(\frac{\partial r_{Ri}^d}{\partial r_i^d}\right)\right)} = \qquad (5)$$

$$\frac{1}{\left(\left(\frac{\partial D_i}{\partial r_i^d}\right) + \left(\frac{\partial D_i}{\partial r_{Ri}^d}\right)(\lambda)\right)}$$

In this expression, the parameter $\lambda = \frac{\partial r_{Ri}^d}{(\partial r_i^d)}$ represents the conjectural parameter of the firm, defined as the change in the interest rates of other firms anticipated by the focus firm in response to an initial change in its own rate. As can be seen in equations *(4)* and *(5)*, ceteris paribus, the value of this parameter defines if the interest rate on deposits is higher or lower. Given that in a more competitive market the bank i will offer higher deposit rates, contains relevant information of the level of competition of the market[19]. More explicitly, the case where takes the value of zero represents the Nash equilibrium[20]. If a determined value of takes a negative value the interest rate on deposits is higher which would mean that we are in a more competitive environment than the Nash equilibrium, on the contrary, positive values of should be analyzed carefully. For values of λ that are bigger than one ($\lambda > 1$), the interest rate of deposits is smaller than the value it would take under the Nash equilibrium, therefore, this scenario is consistent with a collusive market structure. However, when λ is between zero and one ($0 < \lambda < 1$), the interest rate for the Nash equilibrium (when $\lambda = 0$) must be compared with the value of the interest rate obtained with the estimated value, to state if the interest rate would be higher or lower, and in this way, determine if we are in a scenario more or less competitive than the Nash equilibrium.

[19] We expect that if interest rates are higher than the value they would take in the Nash equilibrium banks are willing to sacrifice surplus to gain deposits, that behavior is in line with a more competitive market, whereas, if interest rates are lower than the value they would take in the Nash equilibrium, banks are capable of keeping higher surplus that they take away from the depositors, that behavior would be consistent with a less competitive market.

[20] In this scenario, the representative bank is not reacting to what it expects its competitors will do, and therefore, the banks are in a situation where they will not benefit by changing its strategy while the others keep their strategies unchanged.

It is important to clarify the difference between the Nash and the competitive equilibrium. On one hand, the Nash equilibrium is a situation in which no firm can benefit by changing his strategy while the others keep their strategies unchanged. On the other hand, a competitive equilibrium consists of a vector of prices that clears the market, equating the aggregate demand and supply. From these definitions, we may conclude that the Nash equilibrium is more realistic given the fact that it allows for an outcome characterized an equilibrium with imperfect competition. Therefore, we use it as the reference situation.

Likewise, although the credit market is not of our interest in this paper, it is important to take into account that banks would also choose the loan interest rate in this period using a demand credit function such that:

$$L_i = L_i\,(r_i^l,\ r_{Rf}^l,\ w_i) \qquad (6)$$

where w_i stands for the exogenous variables that affect the loan demand of the bank *i*.

B. Second Period

Once each bank has established the optimal interest rate in the whole territory, it proceeds to determine the optimal number of branches that it must open in each region *k*. In this context, the profit function for the bank *i* in the region *k* is given by:

$$\prod_{ik} = r_i^l L_{ik} + (r_i^d(1 - p) + mp - r_i^d)D_{ik} - \qquad (7)$$

$$C_{ik}\,(L_{ik},\ D_{ik},\ S_{ik},\ n_{ik})$$

where r_i^l and r_i^d represent the optimal interest rates determined in the first period by each bank and n_{ik} is the number of firms that the bank *i* has in the region *k*.

Within a particular area of the territory, we expect that banks with more branches would have higher deposit supplies because individuals would have bigger facilities for transactions or to withdraw money from the bank. In this way, the deposit supply for the bank *i* would be related positively with its own number of branches (n_{ik}) and negatively with the number of branches that the rivals have in the same region (n_{-ik}). The above, explains that the deposit supply would be given by:

$$D_{ik} = D_i\,(r_i^{d*},\ n_{ik},\ n_{-ik},\ z_{ik}) \qquad (8)$$

where z_{ik} represent the exogenous variables that affect the deposit supply for the bank i in the k region. From these expressions we derive the first order condition for the number of

$$(r^s\,(1 - p) + mp - r_i^{d*} - \frac{dC_{ik}\,(D_{ik})}{dD_{ik}})\,\psi = \frac{dC_{ik}\,(n_{ik})}{dn_{ik}} \qquad (9)$$

branches. The latter could be written as: where ψ can be expressed as:

$$\psi = \frac{\partial D_{ik}}{\partial n_{ik}} + \frac{\partial D_{ik}}{\partial n_{-ik}}\frac{\partial n_{-ik}}{\partial n_{ik}} = \frac{\partial D_{ik}}{\partial n_{ik}} + \frac{\partial D_{ik}}{\partial n_{-ik}}\phi \qquad (10)$$

As in the first period, in this expression the parameter ψ represents the conjectural parameter of the bank *i* in the *k* region, which in this period is defined as the change in the number of branches of other firms anticipated by the focus firm in response to an initial change in its own number of branches. If this conduct parameter has a nil value ($\psi = 0$) it would describe a scenario consistent with the Nash equilibrium. If it has a positive value ($\psi > 0$) it would reveal a less competitive scenario than the Nash equilibrium, because as it is shown in equation *(9)* and *(10)*, it will indicate that the representative bank is investing a less quantity of money per branch

(which is interpreted as a lower quality per branch, a lower service level). On the contrary, it would indicate a scenario more competitive than the Nash equilibrium ($\psi < 0$) given that the representative bank has a higher cost per branch (which is interpreted as high quality per branch, a higher service level).

To summarize, the framework described above generates one first order condition for each period derived from the interaction of the deposit supply and the marginal cost of the deposits in the profit function. These two functions would allow to test for banks' behavior within the regions, in particular, we would be able to determine the local areas in which banks have market power within the country by analyzing the numerical value of ψ in each region.

V. EMPIRICAL IMPLEMENTATION

A. Functional Forms

The model is estimated in two stages that correspond to each of the periods mentioned in the last section. The empirical implementation for the model in the first period follows closely the one made in Canhoto (2004), in this context, the specification of the deposit supply and the marginal cost of the deposits is given by the following expressions:

$$D_i = a_0 + a_1 r_{Ri}^d + a_2 r_{Ri}^d + a_3 gdp + a_4 emp_i + \varepsilon_i \qquad (11)$$

$$\frac{dC_i(D_i)}{dD_i} = MC_i = b_0 + b_1 wl_i + b_2 wk_i + b_3 D_i + \epsilon_i \quad (12)$$

where *gdp* represents the gross domestic product of the whole area, *emp* is the total number of employees of the bank *i*, w_l and w_k stand for the price of labor and physical capital, respectively, and finally ε_i and ϵ_i represent the error terms[21]. Theory predicts, ceteris paribus, that the deposit supply of the bank *i* would depend positively of its own interest rate and of the *gdp*, while on the contrary, it would be inversely related with the weighted average of the rivals' rates. The number of employees is an exogenous variable that accounts for the size of the firms in the market and is expected to increase with the amount of deposits supplied to the focus bank[22]. The marginal costs are positively related with the price of labor and physical capital, thus we will expect positive signs for a_1 and a_2. On the other hand, the sign of a_3 would depend of the returns of scale of the bank *i*.

The following equations are specified as well for the empirical implementation of the model for the second period:

$$D_{ik} = c_0 + c_1 r_i^{d*} + c_2 n_{ik} + c_3 n_{-ik} + c_4 gdp + c_5 \left(\frac{pop_k}{km_k^2}\right) + \mu_i \qquad (13)$$

$$\frac{dC_i(D_i)}{dD_i} = MC_{ik}^d = f_0 + f_1 wl_{ik} + f_2 wk_{ik} + f_3 D_{ik} + \nu_i \quad (14)$$

In the case of the regional deposit supply the interest rate that the bank chose in the first period is taken as given, expecting a positive sign for c_1 taking into account that the interest rate has relevance at the regional level as well. As pointed out in a previous section, the amount of deposits in each region is expected to increase with the number of branches and, on the contrary, it is expected to decline if the rivals of the bank *i* set up more branches. As in the first period, we include the general domestic product

[21] The stochastic errors are assumed to be normally distributed.

[22] In order to overcome the NEIO assumption that states that the marginal cost cannot be directly observed within firms' behavior we would not estimate it in an independent way. See Canhoto (2004) and Bresnahan (1982).

because it explains important fluctuations of the individuals wealth and of their deposits, and finally, the variable population per square kilometer was included to control for region size. For the regional marginal costs of the bank *i* the same variables of the first period were taken, however, now they stand for a regional dimension. In this way, the expected signs of the parameters are positive for and.

B. Sample and Data

The data employed for the estimation of the model covers the period between January 1994 and September 2005, and has a quarterly frequency obtained from the information published by the Colombian Financial Superintendency[23]. The sample includes 26 banks, that account for the 94.4 % of the deposit Colombian banking system throughout the indicated period.

Proxy variables were constructed for the input prices. The labor price was calculated by dividing labor expenditures by the number of employees for each bank and the capital price was represented by the sum of administrative expenditures, capital depreciation and the income tax paid divided by the total fixed assets. On the other side, the deposit interest rate was represented by the ratio between the interest expenditures and the total amount of deposits taken from the bank's balance sheets and the loss and profit accounts[24]. For the regional and subregional input prices we took the product of a constructed weight for each bank in each area and the country input prices. Additionally, the security´s market rate is measured by the interbank money market rate[25]. Finally, information concerning the gross domestic product, the inhabitants and the square kilometers of each local market needed to estimate the demand and cost functions was taken from the information published by the National Department of Statistics (DANE) and the Colombian atlas of the geographical institution Agustín Codazzi for 2005.

C. Data Analysis

Given that for the first time there is available data to describe the banking system throughout the country, we spend this subsection analyzing it. More specifically, we study the information concerning the spatial concentration of banks and the weight of each area in the country deposit market to get a more accurate characterization of the Colombian scenario. In order to examine these characteristics we divide the country in regions and subregions. For the regional division we follow traditional geography which divides the country in five areas: Amazonic, Orinoquia, Pacific, Carribean and Andean. On the other side, to obtain the subregions we used the political division of the country which splits Colombia in 32 areas and the capital city, Bogotá (see Graph 1).

To analyze the spatial concentration of banks we use the total number of branches per a 100,000 habitants as a measure. Firstly, we calculate it for the regional scenario. As Table 1 shows, the variable reveals that the area with the highest branch concentration for 1996 was the Andean (5.13), followed in order by the Pacific (4.1), Caribbean (3.74) and Amazonic

[23] The information is available in the web page of the Financial Superintendency: http://www.superfinanciera.gov.co/

[24] This type of estimation for the interest rates has been applied widely in the empirical literature. For instance see Barajas *et al.* (2000), Reyes (2004), Uchida and Tsutsui (2005) and Salamanca (2005).

[25] We assume as well that the reserve requirement rate tends to zero, which would mean that $m = 0$.

Graph 1. POLITICAL AND REGIONAL DIVISION OF COLOMBIA

Source: Authors' estimates.

Table 1. SPATIAL DISTRIBUTION FOR REGIONS

Regións	1996		2005	
	Bra /100,000 hab.	Population	Bra /100,000 hab.	Population
Andean	5.13	23,052,579	6.31	26,802,092
Pacific	4.10	6,977,005	4.62	8,092,164
Orinoquia	3.74	1,177,549	6.84	1,475,815
Caribean	3.16	6,745,027	4.21	7,987,971
Amazonic	1.98	910,563	3.44	1,134,102

Source: DANE, Superintendencia Financiera, Authors' estimates

(1.98) regions. However, for 2005, the order changes and Orinoquia takes the first place, duplicating the value that it had in the first year of study (6.84). This table shows as well, the poor financial development of the Amazonic region, that had the lowest number of branches per habitant in the country through the whole period in study. Furthermore, we calculate the variable for each of the subregions for 1996 and 2005, the results are presented in Tables 2 and 3. On one hand, Table 2 shows that the departments with more branches per habitant for 1996 were Atlántico (37.18), San Andrés (12.17) and Bogotá (8.51), while

Table 2. SPATIAL DISTRIBUTION FOR DEPARTMENTS IN 1996

Region/subregion	Population	Bran/100,000 hab.
Amazonic		
Amazonas	62,823	3.18
Caqueta	386,157	2.85
Guaviare	104,825	0.95
Putumayo	297,134	1.35
Andean		
Antioquia	4,987,824	5.15
Bogota	5,815,511	8.51
Boyaca	1,323,093	4.76
Caldas	1,055,143	5.02
Cundinamarca	1,967,873	3.81
Huila	870,377	3.33
Norte de Santander	1,227,641	2.20
Quindio	519,509	3.66
Risaralda	879,352	2.50
Santander	1,861,391	4.46
Tolima	1,281,504	4.68
Caribbean		
Atlantico	207,099	37.18
Bolivar	1,946,374	2.21
Cesar	892,992	2.69
Cordoba	1,263,361	1.58
Guajira	450,541	3.33
Magdalena	1,184,269	1.86
Sucre	734,641	1.63
Orinoquia		
Arauca	207,099	2.90
Casanare	253,682	3.94
Meta	646,348	4.18
Vichada	70,420	1.42
Pacific		
Cauca	1,171,747	1.45
Choco	403,266	0.74
Nariño	1,513,005	1.45
Valle	3,888,987	6.27
San Andres		
San Andres	65,750	12.17

Source: Authors' estimates.

the least concentrated were Chocó (0.74), Guaviare (0.95) and Putumayo (1.35). On the other hand, Table 3, reveals that in 2005 the subregions with the highest values were in order Nariño (70.74), Bogotá (52.11) and Santander (47.26), whereas, the ones with the lower values were Chocó (0.29), Putumayo (0.21) and Vaupés (0.01). When we check for the banks with the higher number of branches within the country, we found that the Banco de Bogotá (343), Bancafé (297) and Banco Ganadero (163) had the biggest numbers for 1996. Nevertheless, for 2005, the banks that had more branches were the Banco Agrario (723) and Bancolombia (379).

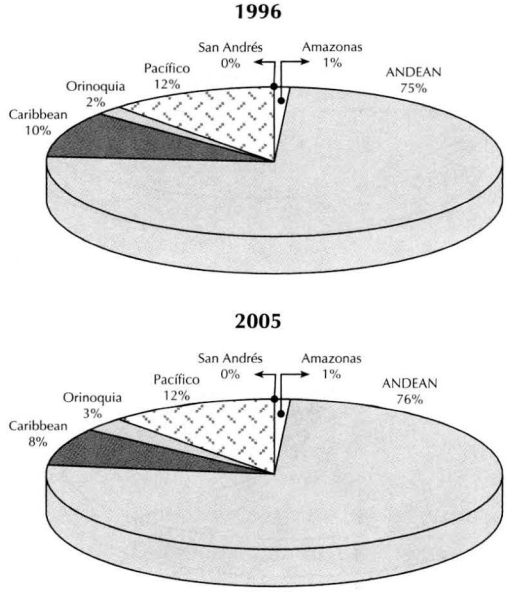
Table 3. SPATIAL DISTRIBUTION FOR DEPARTMENTS IN 2005

Region/subregion	Population	Bran/100,000 hab.
Amazonic		
Amazonas	80,487	3.73
Caqueta	465,078	4.30
Guainia	133,411	0.75
Guaviare	378,790	0.53
Putumayo	5,761,175	0.21
Vaupes	7,185,889	0.01
Andean		
Antioquia	1,413,064	24.13
Bogota	1,172,510	52.11
Boyaca	2,340,894	4.66
Caldas	996,617	5.92
Cundinamarca	1,494,219	10.77
Huila	612,719	9.79
Norte de Santander	1,025,539	4.88
Quindio	2,086,649	1.39
Risaralda	1,316,053	3.19
Santander	281,435	47.26
Tolima	2,370,753	4.09
Caribbean		
Atlantico	1,053,123	9.97
Bolivar	1,396,764	4.44
Cesar	526,148	6.65
Cordoba	1,406,126	3.63
Guajira	870,219	1.72
Magdalena	281,435	13.15
Sucre	325,389	9.53
Orinoquia		
Arauca	772,853	1.42
Casanare	96,138	28.08
Meta	1,367,496	4.24
Vichada	416,318	1.20
Pacific		
Cauca	1,775,972,807	2.76
Choco	4,532,378	0.29
Nariño	83,403	70.74
Valle	4,532,378	5.58
San Andres		
San Andres	83,403	9.59

Source: Authors' estimates.

On second place, to analyze the weigh of each area in the country deposit market we employ a simple ratio of the total deposits of the area and the total deposits of the country. As we did for the number of branches per 100,000 habitants we also calculated this variable for the regional and subregional dimensions. For the regional division, as Graph 2 presents, in 1996 the Andean region accounted for 75% of the deposit market, while the Pacific, Carib-

Graph 2. DISTRIBUTION OF DEPOSITS FOR EACH REGION

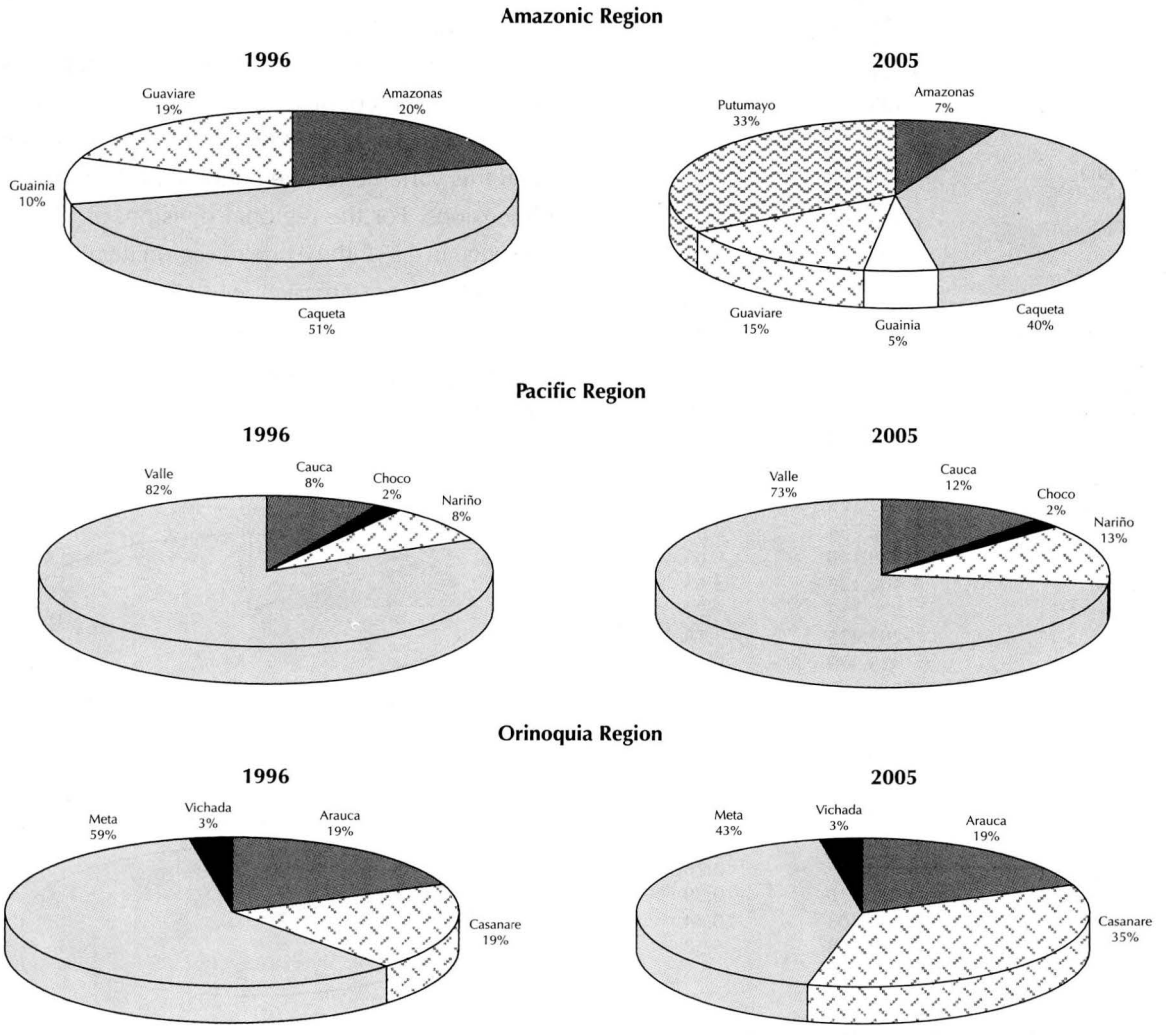


Source: Authors' estimates.

bean and Orinoquia regions stand for the 12, 10 and 2% of the market, respectively. For 2005, the scenario is quite the same given that the Andean region represents 76%, and the Pacific, Caribbean and Orinoquia accounted for a 12, 8 and 3% of the market. It is worth mentioning that the Amazonic region reduced its market participation from 3 to almost zero percent between these two years.

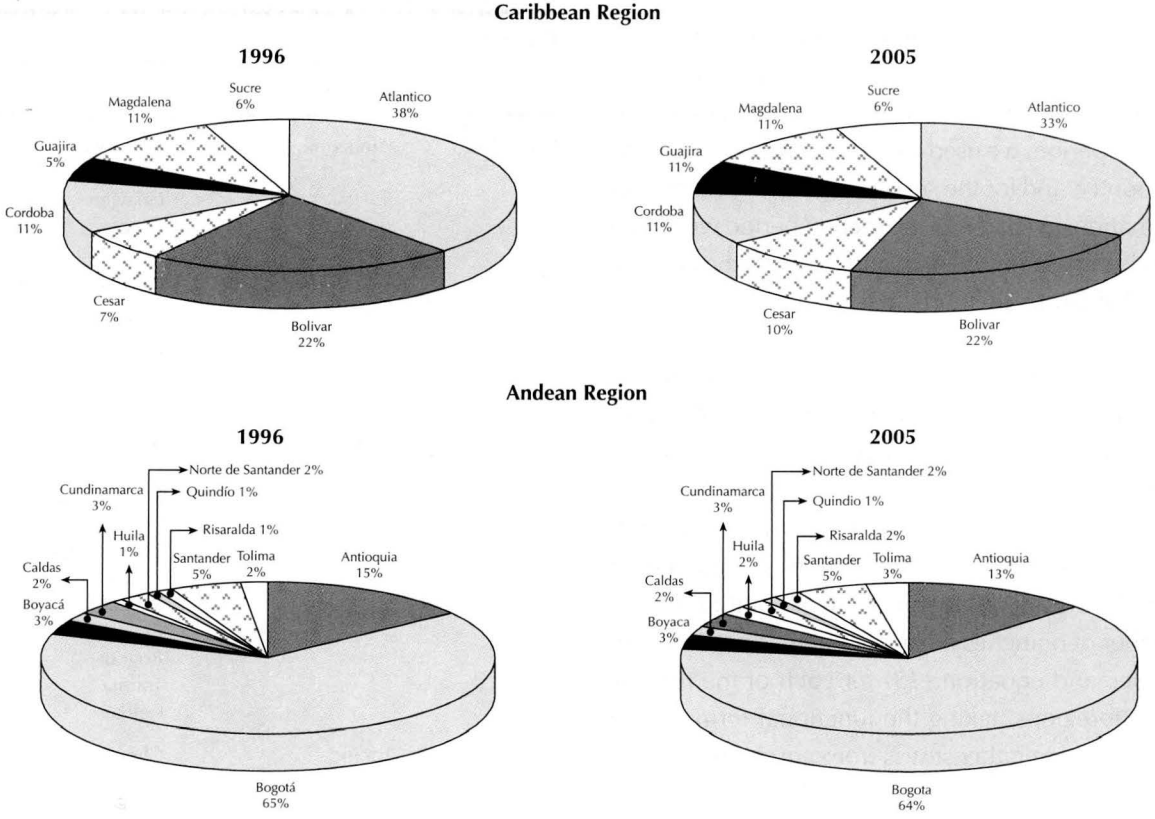
More deeply, the weigh of each department inside each of the regions is presented in Graph 3. For the Amazonic region, we found that the most important subregions are Caquetá, (which reduced its share in the market between 1996 and 2005) and Putumayo (area that gain importance through the period in study). In the Orinoquia region for 2005, the biggest markets were Meta and Casanare, while

Graph 3. DISTRIBUTION OF DEPOSITS WITHIN EACH REGION



Source: Authors' estimates.

Graph 3. DISTRIBUTION OF DEPOSITS WITHIN EACH REGION *(Continued)*



Source: Authors' estimates.

for the Carribean region, Atlántico was the most important. Finally, in the Andean region the most relevant market in 2005 was Bogotá accounting for 64% of the market of this region. For a brief summary of the variable used for the empirical estimation see Table 4.

Table 4. COLOMBIAN BANKING: SAMPLE DESCRIPTIVE STATISTICS FOR 1996 AND 2005

	1996		2005	
	Average	**Median**	**Average**	**Median**
Deposits	445973323.4	313469448.5	3137285066	1943985681
wl	37549.06135	22274.36581	46918.11174	20275.22707
wk	2.666434695	2.647224659	3.806171451	3.514046784
r^d	0.186013163	0.188642616	0.052052311	0.050732414
Branches	79.63636364	27	170	123

Source: Authors' estimates.

D. Estimation

As pointed out the model was estimated in two stages, one concerning each period. In both periods, time-series and cross section data were pooled[26]. In the first period, we used aggregated data for the whole country, and for the second period, we made two estimations. In part A of the second period we divide the country in five regions and in part B the country was divided in 33 subregions (see Table 5).

For the first period we estimate the equation that specifies the first order condition for the deposit interest rate (4.4) and the demand equation *(11)* by full information maximum likelihood method, taking the functional form for the marginal cost from equation *(12)*. Using the same method, for the second period we estimate as well the first order condition for the number of branches in each local market (4.9), and the demand equation *(13)* for each of the regions and subregions, taking the functional form for the regional marginal cost was from equation *(14)*.

E. Results

Tables 6, 7, 8 and 9 present the results of the complete estimation of the two period model. For the first period (Table 6) we obtained parameters that are statistically significant and consistent with the microeconomic theory. For the deposit supply, the partial derivative with respect to the own interest rate is positive, while the partial derivative with respect to the weighted average of the rivals interest rate is negative. Additionally, the relation between the deposit supply and the general domestic product is positive, and the coefficient for the number of employees reveals that larger firms face bigger deposits supply. For the marginal cost function the results are as well satisfactory showing positive signs for b_1, b_2 and b_3.

For this estimation, the conjectural parameter rejected the existence of market power in the deposit

Table 5. TERRITORY DIVISIONS TAKEN FOR THE ESTIMATION

Period 1	Period 2	
	Part A	Part B
Colombia	Amazonic	Amazonas Guainia Guaviare Vaupes Caqueta Putumayo
	Orinoquia	Arauca Casanare Vichada Meta
	Andean	Antioquia Santander Norte de Santander Boyaca Cundinamarca Huila Risaralda Quindio Bogota Tolima Caldas
	Pacific	Choco Valle Cauca Nariño
	Caribbean	Guajira Cesar Magdalena Atlantico Bolivar Sucre Cordoba

Source: Authors' estimates.

[26] This estimation follows the procedure applied in Canhoto (2004).

Table 6. ESTIMATION RESULTS FOR THE FIRST PERIOD

Parameters	Estimate	St. Error	T-statistic	p-value
a_0	3.91E+08	4.79E+08	0.817193	0.414
a_1	1.62E+09	7.61E+08	2.13157	0.033
a_2	-1.22E+10	1.03E+09	-11.9066	0.000
a_3	55.8835	20.0602	2.78579	0.005
a_4	478833	21222.9	22.5621	0.000
b_0	-0.99722	0.0892	-11.1796	0.000
b_1	7.83E-03	1.76E-03	4.43983	0.000
b_2	0.016598	4.22E-03	3.93026	0.000
b_3	0.037086	4.21E-03	8.80852	0.000
γ	-2.6108	0.395549	-6.60044	0.000

Source: Authors' estimates.

market, given that the estimate was less than zero. This result is in line with the empirical research made for the Colombian deposit market in which Estrada (2005) and Salamanca (2005) who have found evidence of a market structure more competitive than the Nash equilibrium for the deposit market[27].

On the other side, the results for the estimation of the part A of the second period, in which the country was divided in five regions, are presented in Table 7. We made two estimations for the Andean region, Andean 1 includes the capital city of the country and Andean 2 does not includes it. For this division we found non significant parameters for the Amazonas and

the Orinoquia regions, which could be explained by the size of the markets and its poor development. For the other regions, most of the parameters were significant and showed the expected signs[28]. With respect to the conjectural parameters (ψ), we found that all the regions appear to have competitive markets[29]. More specifically, the Caribbean region appeared to have the lower conjectural parameters ($\psi = -1023.8$), followed by the Pacific ($\psi = -962.381$) and Andean1 ($\psi = -640.028$).

The results concerning the estimation of the second period in a more disaggregated approach are presented in Tables 8 and 9. For this phase, the parameters could not be estimated or were non significant for Arauca, Casanare, Guainía, Chocó, Guaviare, Quindío, Sucre, Tolima, Vaupés, Meta, Huila y Putumayo. For the rest of the subregions the conjectural parameters were significant and signs were consistent with theory. In this estimation we found some areas that present evidence of market power. More specifically, we found that Caquetá ($\psi = 2569$), Cauca ($\psi = 1848$) and Norte de Santander ($\psi = 793$) are the less competitive subregions of the country.

Summarizing, although we found evidence of a competitive national deposit market, when we analyze the market in a more disaggregated approximation we found that there are some subregions that present evidence of market power. In particular, we found that Caquetá, Cauca and Norte de Santander present collusive market structures in their deposit markets. In this context, within these regions regulation policies should be carefully addressed to avoid bigger market structure problems, or even better, to improve competitive conditions. Finally, these results prove that market structure is not properly analyzed in very

[27] In the international literature Bikker and Haaf (2000) found also evidence of competitive behavior for the deposit market in a group of European countries.

[28] There are some problems with the signs of some parameters in the marginal costs. However, problems that concern incoherence of the coefficients of the marginal costs are common in the literature of conjectural parameters.

[29] Excluding Orinoquía and Amazonas in which was not significant.

Table 7. **ESTIMATION RESULTS FOR THE SECOND PERIOD - PART A**

	Amazonic		Andean 1		Andean 2	
Parameters	**Estimate**	**p-value**	**Estimate**	**p-value**	**Estimate**	**p-value**
c_0	-353255000	0.000	-15951300000	0.000	-15013400000	0.000
c_1	-123417000	0.000	3640080000	0.000	6312990000	0.000
c_2	19638.3	0.073	3992670	0.000	2298570	0.000
c_3	-2438440	0.000	-381673	0.000	-251509	0.000
c_4	1.18294	0.232	49.0959	0.005	40.5938	0.004
c_5	171422000	0.000	137024000	0.000	144218000	0.000
f_0	-73.0769	0.986	-0.17727	0.000	-0.158849	0.000
f_1	-7.55544E-07	0.986	5.9972E-11	0.000	1.75692E-10	0.000
f_2	0.050331	0.986	-9.37909E-09	0.062	-7.00704E-08	0.493
f_3	-621.666	0.986	-0.000963456	0.684	-0.062934	0.000
ϕ	-0.00308063	0.996	-640.028	0.012	-655.235	0.000
	Caribbean		**Orinoquia**		**Pacific**	
Parameters	**Estimate**	**p-value**	**Estimate**	**p-value**	**Estimate**	**p-value**
c_0	-2187690000	0.000	-3838010000	0.000	-7430000000	0.000
c_1	949286000	0.000	3656240000	0.000	4180000000	0.000
c_2	5.05E+05	0.000	218439	0.000	610217	0.000
c_3	-1.70E+05	0.000	-70935.7	0.039	-193789	0.003
c_4	7.49424	0.008	5.43705	0.497	14.1772	0.079
c_5	3.60E+07	0.000	639067000	0.000	117000000	0.000
f_0	-0.170694	0.000	-0.150246	0.000	-0.189509	0.000
f_1	5.54E-10	0.000	1.70501E-09	0.000	5.87E-10	0.000
f_2	-1.55E-07	0.039	-6.53394E-07	0.889	0.000000382	0.066
f_3	-0.073643	0.000	-0.833892	0.000	-0.124972	0.000
ϕ	-1023.81	0.000	-4841.54	0.186	-962.381	0.000

Source: Authors' calculations.

big markets were the results are too general and may lead to wrong regulatory measures.

VI. CONCLUDING COMMENTS

The purpose of the proposed model was to test for competitive conditions in Colombia in a more disaggregated approach, in order to state if the conclusions obtained by studying each region and subregion of the country are different from the ones obtained by the analysis of the whole national markets. Our empirical results for the first period reveal, that the deposit market in the whole country is characterized by a competitive market structure. In this same way the results show that the deposit market of the Caribbean, Pacific and Andean regions are as well competitive markets. However there are some local areas that present evidence of market power. In particular, we identify three critical markets: Caquetá, Cauca and Norte de Santander. Therefore, regulation policies should be carefully addressed in these three critical markets to avoid bigger competition problems.

Table 8. ESTIMATION RESULTS FOR THE SECOND PERIOD - PART B

Department	c_0	c_1	c_2	c_3	c_4	c_5
Amazonas	-2.40E+08	3.01E+08	NE	881994	0.149872	**3.3E+08
Antioquia	*-1.8E+10	*1.2E+10	*5758330	*-241150	**33.2666	*1.9E+08
Arauca	-9.81E+09	1.50E+10	1.60E+06	-1.98E+06	3.18E+01	7.41E+08
Atlantico	*-2.6E+08	*1.9E+08	*5674000	*-329296	0.932553	*3629370
Bogota	*-7.3E+09	*2.8E+09	*12257800	*-700903	**24.3169	*1899800
Bolivar	*-5.8E+08	*3.6E+08	*1526000	-47051.3	*2.16744	*6187480
Boyaca	*-3.1E+09	*7.0E+08	*2121770	*-220286	2.8152	*51362900
Caldas	*-9.3E+08	*3.8E+08	*5187030	-46034.3	*1.94209	*6071100
Caqueta	*-1.1E+08	*3.7E+07	*513298	113611	0.310923	*23278400
Casanare	*-1.6E+13	*1.9E+13	340209	-85781	63355.5	1.93E+12
Cauca	*-5.8E+08	*3.3E+08	*2155520	*138265	2.01306	*12148100
Cesar	*-3.1E+09	*1.2E+08	*2359800	*-300152	*0.945732	*7243140
Choco	-1.13E+10	2.83E+09	604323	906076	5.70251	1.25E+09
Cordoba	*-4.2E+09	*2.1E+09	*1833920	*-280249	5.746	*73730600
Cundinamarca	*-2.8E+09	*2.1E+09	*2032240	*-270290	*7.82205	*27773700
Guainia	4.51E+09	-1.98E+10	NE	5.55E+06	-44.3583	-5.26E+09
Gua jira	*-1.3E+09	*8.4E+08	*3034290	*-1471290	2.5893	*52676800
Guaviare	-2.79E+08	**3.6E+08	NE	1.08E+07	1.86025	9.78E+07
Huila	*-5.5E+08	*1.5E+08	*909407	**-77094.7	*1.39148	*11355100
Magdalena	*-2.9E+08	*1.2E+08	*2025630	*-155761	*1.01577	*4957050
Meta	*-1.6E+08	-7.09E+07	64280.8	1381.43	-1.46073	*28210500
Norte de Santander	*-3.7E+08	*2.1E+08	*2543610	226277	1.02662	*5426890
Nariño	-3.57E+09	2.75E+09	*596128	-22548.4	7.65294	6.32E+07
Putumayo	*-1.6E+08	-1.42E+08	*-2697530	-718168	1.33806	*14268200
Quindio	-3.03E+10	2.80E+10	170835	-3.81E+04	62.862	8.41E+07
Risaralda	*-3.7E+08	*1.4E+08	*5797340	*-226826	*0.82286	*1528390
Santander	*-1.4E+10	*1.2E+10	*2207590	*-881473	*29.2664	*271441000
Sucre	*4.3E+13	-1.15E+14	68507.1	-2.04E-05	*-1368370	-638617
Tolima	-5.71E+11	8.66E+10	*1207020	-194246	253.833	1.01E+10
Valle	*-4.8E+09	*2.6E+09	*5288270	*-307278	*10.0526	*23266300
Vaupes	3.06E+09	-1.48E+10	NE	NE	-27.8194	-3.64E+09
Vichada	*-2.5+E08	*3.7E+08	-2.40E+06	5.98E+06	-1.04607	*305058000

Source: Authors estimates.

Table 9. ESTIMATION RESULTS FOR THE SECOND PERIOD - PART B

Department	f_0	f_1	f_2	f_3	ψ
Amazonas	**4585150	5234.24	1.20E+08	*-0.854899	NE
Antioquia	*-0.161108	*2.01295E-06	*-0.604809	*1.00212E-09	**-1253.02
Arauca	*-0.138958	-1.95E-05	*-1.16669	*3.57453E-09	-97.2559
Atlantico	*-0.157279	*-0.400559E-07	*-0.079261	*1.07066E-09	*-460.717
Bogota	*-0.177302	**-9.22785E-09	-1.04E-03	*9.5709E-11	*-399.093
Bolivar	*-0.21762	-4.36E-08	*-0.109921	*3.81219E-19	*-3683.01
Boyaca	*-0.134089	*-1.33349E-05	*-0.410156	*1.47714E-09	*-928.902
Caldas	*-0.128577	1.52E-07	*1.52078E-07	*1.02645E-09	*-2649.84
Caqueta	*-0.187033	*-0.0000563726	6.68E-02	*8.17598E-09	*2569.62
Casanare	-0.269125	-1.91E-04	-5.94347	1.18E-08	-8527.9
Cauca	*-0.152278	*-0.0000126883	*-0.498274	*2.83899E-09	*1848.01
Cesar	*-0.150596	*-0.0000164335	*-0.716753	*3.54418E-09	*-822.75
Choco	*-0.188187	-8.30E-06	-1.52325	*7.9E-09	376.096
Cordoba	*-0.170218	-8.82E-06	*-3.65047	*7.02E-09	*-872.336
Cundinamarca	*-0.157036	*-0.00000245623	*-0.328134	*1.5E-09	*-993.436
Guainia	-3.15E+08	-275714	-1.28E+10	33.3261	NE
Gua jira	*-0.127416	*-0.0000873574	*-2.56471	*4.9E-09	*-194.757
Guaviare	7.77E+06	4181.19	4.49E+07	*-0.639803	NE
Huila	*-0.154926	*-0.0000190607	*-0.24298	*2.9E-09	-6113.07
Magdalena	*-0.184234	*-0.00000710101	-0.033951	*4.7E-09	**-2401.99
Meta	-4.04133	2.84E-04	-36.8656	-8.55E-08	189.064
Norte de Santander	*-0.174544	*-0.00000303999	*-0.508143	*2.82197E-09	*793.597
Nariño	*-0.170376	*0.0000026164	*-0.747875	*3.01824E-09	*-8932.56
Putumayo	-0.349578	-3.09E-03	42.1371	1.53E-07	-3.00581
Quindio	*-0.085774	*0.0000469452	*-3.50385	*2.29446E-09	*-2053.27
Risaralda	*-0.146353	-1.18E-07	-0.021445	*9.76345E-10	*-481.207
Santander	*-0.178559	*0.00000602752	*-0.763949	*2.03916E-09	*-238.119
Sucre	-1.36E+09	-733.949	-2.88E+07	77.5182	-8.46E+13
Tolima	1.79731	4.65E-05	-17.4433	1.69E-08	-12009
Valle	*-0.181632	*0.000000328566	*-0.106415	*6.48948E-10	*-578.46
Vaupes	-2.95E+08	65414.1	-9.73E+09	22.0264	NE
Vichada	-0.122635	-5.10E-04	-14.8492	1.53E-08	-32.1951

Source: Authors estimates.

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