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COLOMBIAN REGIONS: COMPETITIVES OR COMPLEMENTARIES?

by

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Abstract

This paper analyses the characteristics of interregional competition and complementarity in Colombia during the period 1960 - 2000. The analysis is based on an application of the Dendrinos-Sonis model which is estimated using the SUR estimator. The evidence shows a country with a low level of integration among the different regions and a high level of competition. The regions that have the major proportion of national GDP – Bogotá, West-Central and Pacific - exhibit a competitive relationship, and the New Departments which is the region with the larger GDP growth rate in the last decades shows only a significant relationship with itself. These findings are consistent with the observe income polarization process. Policy makers must take into account the competitive regional relationships to propose adequate policies such as the adoption of regional redistribution strategies, or other interventions that might enhance regional interaction and integration.

JEL: R11 Regional Economic Activity: Growth, Development, and Changes.

R12 Size and Spatial Distribution of Regional Economic Activity.

R15 Econometric and Input-Output Model.

Keywords: competition, complementarity, convergence, polarizatation, Dendrinos-Sonis Model.

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I. Introduction

At the beginning of the decade of 1990, there were two important changes in Colombia's economic policy. First, the government enforced a trade liberalization process. Secondly, fiscal decentralization was increased by the new political constitution of 1991. During this decade, several papers (Cardenas et. al. (1993), Meisel (1993), Mora and Salazar (1994), Birchenall et. al. (1996), Rocha and Vivas (1998), and Bonet and Meisel (1999), among others) that analyzed the process of convergence in Colombia found a polarization process in regional incomes in the post-war period². Contrary to what had been expected, the regional imbalances in the levels of economic development were greater notwithstanding the new policies that were implemented.

Bonet and Meisel (1999) considered three elements that seemed to have played an important role in the polarization process: the regional effects of the policies associated with the promotion of import substituting industrialization (ISI), the consolidation of Bogotá as the Colombian metropolis, and the continuation of the relative economic decline of the Caribbean Coast region.

These factors imply the existence of spatial relations between the different regions in Colombia in which the relative growth or decline of a region will determine the aggregate behavior of the country and vice versa. At this point, it is important to examine the type of relationships in order to study the impacts of regional dynamics on the national economy. Given the heterogeneity of the

² An exception is the paper by Cárdenas *et. al.* (1993). They concluded that between 1950 and 1989 Colombia experienced a very rapid process of regional economic convergence.

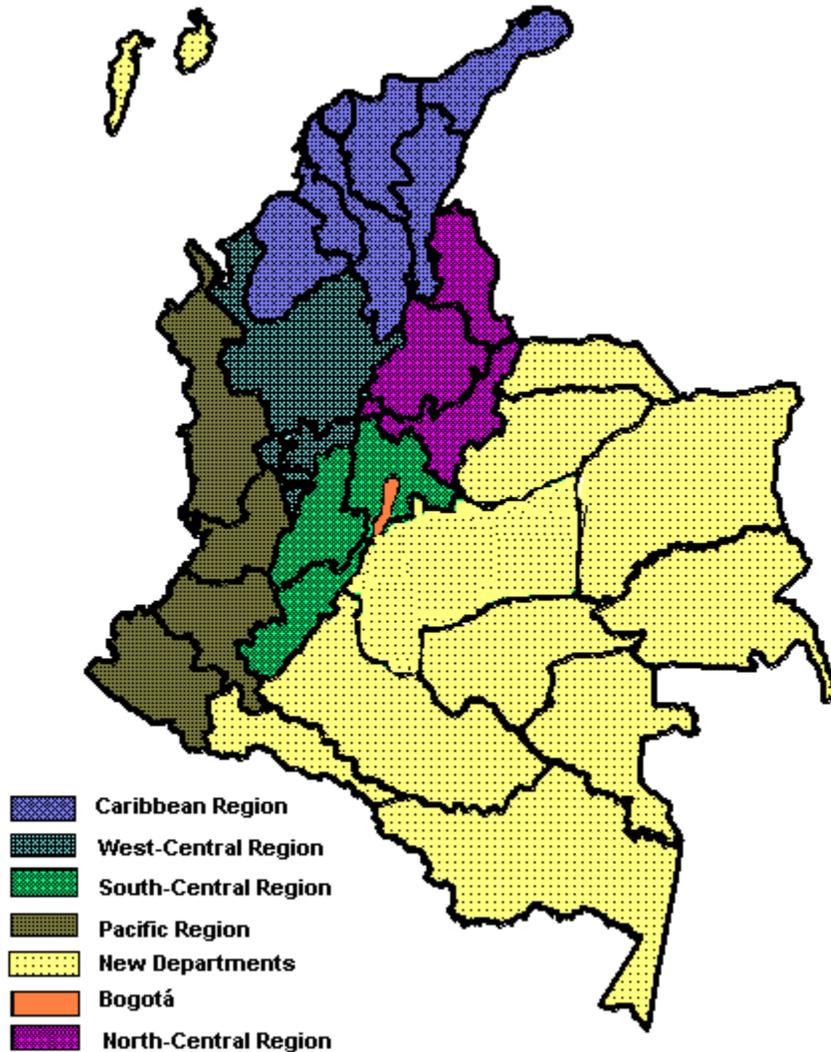
regional economies, the findings from this analysis will provide important inputs into the design of the country's regional policies.

Through the use of the Dendrios-Sonis Model, this paper analyzes the nature of interregional competition and complementarity in Colombia. A discussion of recent regional development in Colombia is presented in section 2; section 3 elaborates the Dendrios-Sonis model while section 4 presents the results of estimations and their analysis. The conclusions and policy implications complete the paper.

This paper focuses on the horizontal relationship among regions in Colombia at a macro level. According to their geographical interaction, the 33 Colombian territorial entities are aggregated in seven regions: Bogotá, Caribbean, West-Central, North-Central, South-Central, Pacific, and New Departments (see Figure 1).

The Caribbean region includes only seven of the eight departments that this region currently has, since San Andrés was included in the New Departments. The West-Central region is defined as Antioquia, Caldas, Quindío and Risaralda. The departments of Boyacá, Norte de Santander and Santander comprise the North-Central region. The South-Central region corresponds to the departments Cundinamarca, Huila, and Tolima. The departments of Cauca, Chocó, Nariño, and Valle del Cauca constitute the Pacific region. The category of New Departments includes those created by the Constitution of 1991, plus Caquetá and Meta. Finally, Bogotá is defined as a region by itself since it contributes more than 20% of national GDP.

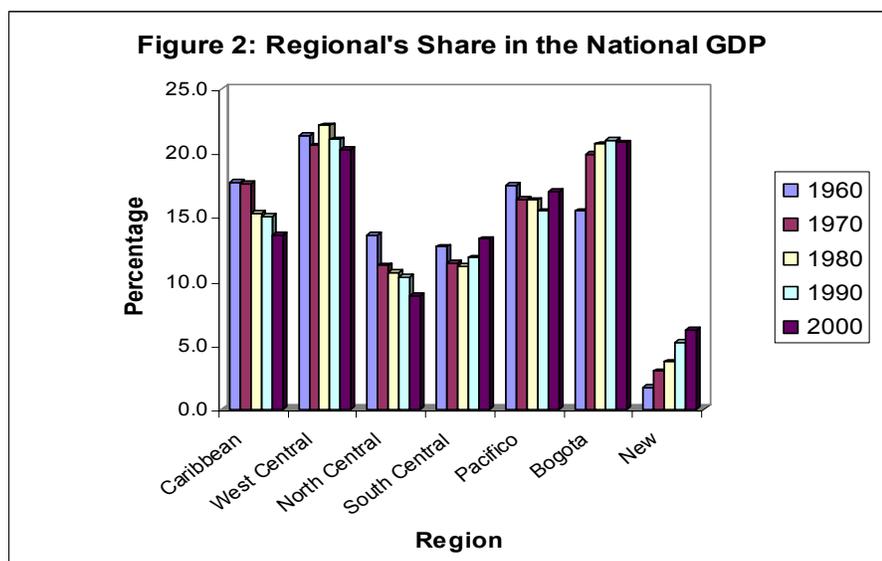
Figure 1: Colombian Regions



For the analysis of the period 1960-2000, the GDP of the departments is used as departmental income. There are three different sources of data for this time period, which use different methodologies for constructing their data series. From 1960 to 1975, departmental GDP data were calculated by a private firm (Inandes, 1977). For the period 1976 to 1979, there exists an estimation made by Universidad Javeriana (1992). Finally, from 1980 to 2000 the data comes from statistics by the National Statistical Agency (DANE). These sources were integrated expressing the GDP in pesos of 1975.

II. Regional Economic Development in Colombia

One of the salient features of regional economic development in Colombia in the last four decades has been the increasing importance of Bogotá in the country's urban network. What had been singular in Colombia until the 1960s was that urban growth was quite uniform among the four main cities. However, beginning in this decade, urban growth in Colombia became more like the typical Latin American pattern of one dominant city. At the end of the period 1960-1996, Bogotá had the major participation in the national GDP; in 1960, this region contributed 15% of the national GDP, whereas by 2000, this share increased to 20% (see Figure 2).



The growth of Bogotá was stimulated by the policies for the promotion of import substituting industrialization (ISI) that were actively pursued in Latin America since the 1950's under the intellectual stimulus of the Economic Commission for Latin America and the Caribbean (ECLA). In the Colombian case, Garcia (1999) has argued that ISI policies discriminated against the poorest regions in the

country. Tariff protection favored some activities and consequently, this protection privileged the regions in which the favored sectors were located.

This policy was biased in favor of the industrial areas because this sector was highly protected from foreign competition. Since the triangle defined by the cities of Bogotá, Cali and Medellín made up a large share of the Colombian industrial sector, these cities enjoyed the benefits associated with the high tariffs on imported industrial goods. For instance, 59 percent of the industrial value added in 1995 was generated by these three cities. Therefore, the high tariff on industrial imports worked as a subsidy for the industrial areas and as a tax on the other zones (Bonet and Meisel, 1999).

As is pointed out by Baer (1984), the industrialization programs have tended to accentuate regional concentration of income due to the importance of the size of the market in the firm location decision. New firms tended to locate in the large cities where they could benefit from economies of large-scale production. The localization factor has played the most important role in the increasing economic importance of Bogotá. It is clear that companies want to be located in or close to the location of the primary market, in this case, Bogotá since it is not only the largest city but has the smallest concentration of poor among all the Colombian cities (Goueset, 1998).

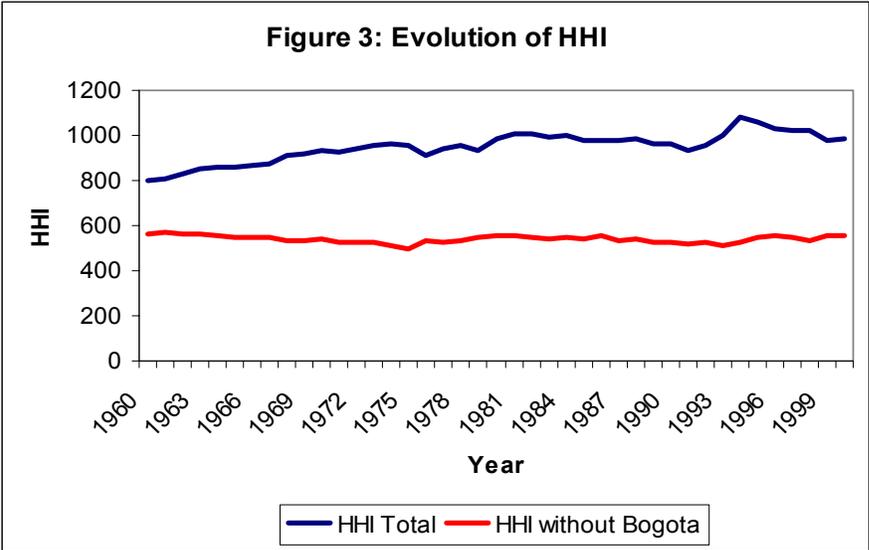
According to Goueset (1998), Bogotá has one third of the total population of the 13 cities inspected by the National Household Survey and more than half of household's income. The average household income in Bogotá is twice the income in the other cities considered in this survey. This spatial concentration in the household income has naturally generated a spatial concentration in consumption.

The impact of the ISI policies in the presence of the growth of large metropolitan areas in developing countries has been analyzed by Krugman and Livas (1996). They argue that a major reason for the concentration of manufacturing in the metropolitan areas was the powerful backward and forward linkages these sites offer. These linkages played a major role in overcoming the disadvantages of high rents, wages, congestion and pollution. In an application of this model to Colombian economy, Fernandez (1998) found that forward and backward linkages induce agglomeration in Bogotá. Also, this author concludes that there is a strong influence of internal freight charge over the agglomeration process.

Another element that has contributed to Bogotá's rapid growth in recent decades has been the enormous growth of the national government. While total government expenditures as a percent of GDP were 8.8% in 1950, by 1997 they had increased to 37.2% (García and Jayasuriya, 1997). Given that Bogotá is the capital of the country, not surprisingly, it received a large share of the increase in public sector jobs and investment.

By taking a look of the evolution of the Herfindahl-Hirschman index -HHI³-, we can have a more comprehensible idea about the Colombian concentration process and the impact of Bogotá in this process. The HHI increased from 800 in 1960 to 988 in 2000. However, when the national capital was excluded from the estimation of this index, growth turns into decline, with the HHI decreasing in value from 560 in 1960 and to 556 in 2000, implying that there was a small reduction in

the degree of concentration when Bogotá was excluded. Therefore, the importance of this city in the determination of the spatial production concentration in Colombia is clearly evident (see Figure 3).



Another relevant characteristic of Colombia’s regional economic development is the relative economic decline of the Caribbean Coast and North-Central regions. While the West-Central, South-Central and Pacific regions exhibited rather stable shares at 20%, 13%, and 16%, respectively, the Caribbean region share decreased from 18% in 1960 to 13% in 1996 and the North-Central from 14% to 9%.

Concurrently, while the ISI policy helped the industrial areas, it discriminated against the non-industrial sections of the country; these latter areas received little protection from foreign competition. This was one of the factors that contributed to the Caribbean’s economic decline because of the limited development of its industrial sector and high share of the agricultural sector in this region.

³ $HHI = \sum_i \left(\frac{y_i}{y} * 100 \right)^2$ Where y_i is the departmental GDP and y is the national GDP.

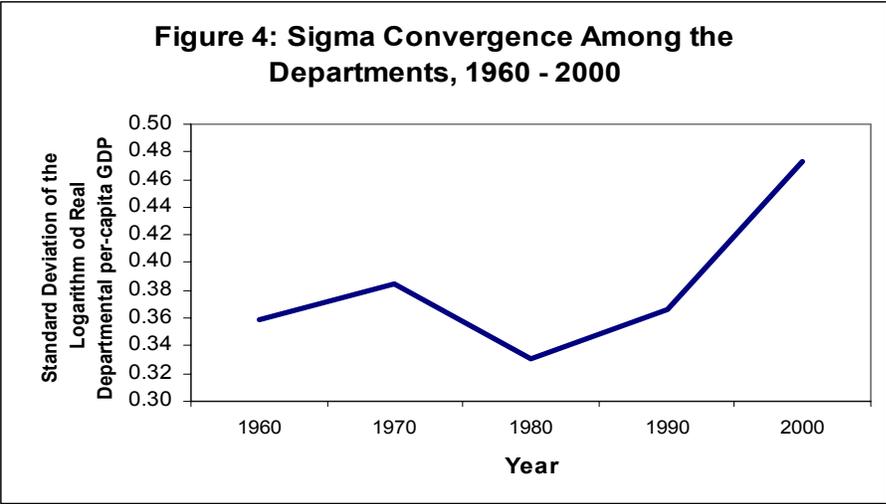
Further, agricultural policies were not a priority during the period in which ISI policies operated. Garcia and Jayasuriya (1997) consider that the government fixed the exchange rate attempting to stabilize prices and imposed trade restrictions to maintain external balance. These actions resulted in an appreciation of the peso and discriminated against agriculture. Government's food policies favored consumers and thus imposed quotas and others exports restrictions on products such as beef and rice, along with price controls on products like milk, and sold imported wheat at a loss.

Another factor mentioned by Meisel (1999) was the collapse of the Caribbean exports as a consequence of the macroeconomic impact of coffee exports. Meisel considers that Colombia suffered a Dutch disease that was detrimental to exports apart from coffee. Since the Caribbean Coast was not a coffee-producing area, its products were negatively affected by the macroeconomic conditions.

Finally, it is important to note that the New Departments registered a low but increasing participation in the national GDP, from 1.7% in 1960 to 6.1% in 1996. This performance is a result of the exploitation of oil fields in some of these departments during the last two decades.

By estimating the standard deviation of the logarithm of GDP per-capita of the departments, it is possible to draw some initial conclusion about the convergence process in Colombia. This estimator was relatively constant from 1960 to 1975. Starting in 1981, it began to increase reaching .47 in 2000, compared to .33 in 1981. The descent of the indicator between 1975 and 1980 could be reflecting the different methodologies used by the data's sources instead

of a real decline. Even do this possible limitation, it is quite evident that rather than convergence there was polarization in the period 1980-2000 (see Figure 4).

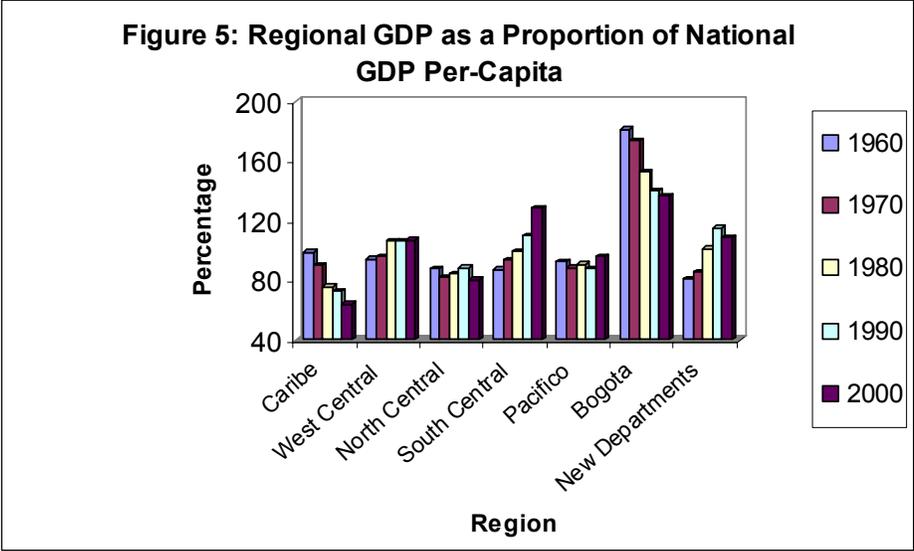


In order to have a complete panorama of the regional economic development in Colombia, we can also analyze the evolution of the per-capita regional GDP as a percentage of the per-capita national GDP. Although the per-capita GDP of Bogotá decreased during the period 1960-2000, it was still the highest in the country. By the end of this period, it was 137% of the national per-capita GDP (see figure 5).

Because of the relative decline of the Caribbean region’s economy, the proportion of its per-capita GDP in the national per-capita GDP reveals a dramatic fall. While in 1960 the Caribbean per-capita GDP was close to the national level (99%), by 1996 it was only 64%. This dramatic change did not happen in the other declining region: North-Central. This latter region maintained a reasonably stable proportion of its per capita GDP in the national per capita GDP during this period.

Similar to the evolution of the distribution of the national GDP in the regions West-Central and Pacific, the percentage of their GDP per-capita compared to the

national level were moderately stable during the period 1960-2000. The South Central Region had a significant increase in its proportion from 87% in 1960 to 129% in 2000.



The percentage of the GDP per-capita of the New Departments in the national level rose significantly, increasing from 53% in 1960 to 115% in 1996. The growth rate of GDP in this region was higher than the growth rate of its population. While the average of the first rate (GDP) was 1.6% per year, the second one (population) was 1.2% annually.

III. The Dendrios-Sonis Model

To capture possible spatial interaction effects, this paper uses a model proposed by Dendrios and Sonis (1988, 1990). Hewings, *et. al.* (1996) claimed that this model captures the spatial effects without making use of any *a priori* weighting matrix, such as an adjacency matrix that signifies interaction only with the nearest neighbors. In addition, this model is capable of generating results for the structure

of the spatial correlation among a given country's regions states. It is also possible to look at the effects of any individual region on the others.

As stated by Magalhaes *et. al.* (2001), growth in regional output is traditionally viewed in regional growth theory as either (i) a zero-sum game or (ii) generative. In the first approach, growth in one region can only happen at the expense of another region, so that regional interaction plays an important role in the development. In the second case, some endogenous process within a region can also generate regional growth. In the Dendrinos-Sonis model, the first approach is taken. Therefore, the model presented in this section represents a zero-sum game but the key feature is that this model operates with *relative* growth, not absolute growth, so that by definition, it is a zero-sum game. Hence, it is entirely possible for a region to experience a decrease in its share of GDP, at the same time that it experiences growth in its absolute GDP.

This paper follows an application of the Dendrinos-Sonis model to Indonesia made by Nazara *et. al.* (2001). The basic model, as applied to the case of regional income, is as follows. Denote x_{it} as the relative income of region i at the time t . In this paper, we use the regional share of the national GDP at constant prices of 1975. If we consider that there are n regions in the economy, we can define the vector X_t as it follows:

$$X_t = [x_{1t}, x_{2t}, \dots, x_{nt}] \quad i = 1, \dots, n \quad t = 0, 1, \dots, T$$

The relative discrete socio-spatial dynamics can be described as:

$$x_{i,t+1} = \left[\frac{F_i(x_t)}{\sum_{j=1}^n F_j(x_t)} \right] \quad i, j = 1, \dots, n \quad t = 0, 1, \dots, T \quad (1)$$

where $0 \leq x_{i,t} \leq 1$, $F_i[x_t] \geq 0$, and $\sum_{i=1}^n x_{i,t} = 1$. Note that the function $F_i(\bullet)$ can take any arbitrary form if it satisfies the positive value property. If the first region is selected as the numeraire or reference region, then:

$$G_j[x_t] = \frac{F_j[x_t]}{F_1[x_t]} \quad \forall j = 2, 3, \dots, n \quad t = 0, 1, \dots, T \quad (2)$$

By using (2), the process defined in (1) can also be represented by the following system of equations:

$$x_{1,t+1} = \frac{1}{1 + \sum_{j=2}^n G_j[x_t]} \quad \text{where } j = 2, 3, \dots, n. \quad (3)$$

$$x_{j,t+1} = x_{1,t+1} G_j[x_t] \quad (4)$$

Since the numeraire guarantees that the sum of all regional shares is equal to one, it plays an important function in this model. This implies that a region's economic growth is not independent of the share of other regions and therefore, the Dendinos-Sonis Model can be seen as a working framework of the competitive model in terms of proportions (Nazara, *et. al.*, 2001). In this model, each region is in a competition to reach a higher share of the national GDP, and, as it has been mentioned, an increase in absolute values does not ensure a rise in its share.

Following Dendrinos and Sonis (1988), a log-linear specification of $G_j[x_t]$ is adopted, so that:

$$G_j[x_t] = A_j \prod_k x_{kt}^{a_{jk}} \quad \text{where} \quad j = 2,3,\dots,n. \quad k = 1,2,\dots,n. \quad (5)$$

where $A_j > 0$ represents the locational advantages of all regions, $j = 2,3,\dots,n$, and the coefficient a_{jk} can be expressed in this way:

$$a_{jk} = \frac{\partial \ln G_j[x_t]}{\partial \ln x_{kt}} \quad \text{where} \quad j = 2,3,\dots,n. \quad k = 1,2,\dots,n. \quad (6)$$

These coefficients can be interpreted as the regional growth elasticities with $-\infty < a_{jk} < \infty$. In other words, a_{jk} is the percentage growth in region j relative to that in region 1, the numeraire, with respect to one percentage change of income in region k .

The adopted log-linear form allows the process to be rewritten as:

$$\ln x_{j,t+1} - \ln x_{1,t+1} = \ln A_j + \sum_{k=1}^n a_{jk} \ln x_{k,t} \quad \text{where} \quad j = 2,\dots,n. \quad k = 1,\dots,n. \quad (7)$$

This model captures the regional interactions in which each region competes to increase its share of gross domestic product. The performance of each region depends on two factors: (i) its comparative advantages, and (ii) the behavior of the rest of the regions. This second factor is revealed in the sign and magnitude of the elasticity a_{jk} . A negative sign in this coefficient implies a competitive relationship between the region j and k , i.e., if the GDP share of region j increases, the share of the region k will decrease relative to the numeraire region and vice-versa. In contrast, a positive coefficient indicates a complementary

relationship between j and k , so that when region j raises its GDP share, the region k also increases its share, again relative to the numeraire region.

In view of the fact that a system of equations is employed, the Seemingly Unrelated Regression (SUR) estimator is used. Data for the seven regions for the period 1960 – 1996 are used and the region that maintained the highest GDP per-capita during this period, Bogotá, is used as the numeraire.

IV. Results and Analysis

Our analysis will be carried out in two steps. First, the outcome of the Dendros-Sonis model is presented together with an analysis of the statistical properties. Secondly, attention is directed to the analysis of the signs of the coefficients in order to reflect the characteristics of the interactions among regions.

The initial estimates revealed that some variables were not significant in the model; the system was re-estimated by removing the insignificant explanatory variables. In this case, the SUR technique used generates higher efficiency of the estimates, and would also make sure that the solution achieves the maximum of the likelihood function.

Since there was an income polarization process in Colombia during the period 1960-1996, the expectation was that there would be a weak degree of interaction among the regions. Therefore, one would expect that most regions would exhibit a strong competitive evidence rather than complementary relationship with other regions.

Table 1. Results of the Dendrios-Sonis Model for Colombia Using All Variables

	Caribbean	West-Central	North-Central	South-Central	Pacific	Bogotá	New Depts.	R2
Caribbean	0.724 (1.23)	-0.415 (-0.63)	0.386 (0.82)	0.061 (0.08)	0.511 (0.73)	-0.478 (-0.66)	-0.039 (-0.30)	0.94
West-Central	-1.00*** (-1.67)	-0.749 (-1.11)	-0.095 (-0.19)	-0.44 (-0.60)	-1.21*** (-1.70)	-1.28*** (-1.75)	-0.26*** (-1.95)	0.83
North-Central	-0.699 (-1.038)	-0.852 (-1.12)	0.31 (0.57)	-0.808 (-0.99)	-0.711 (-0.88)	-1.523*** (-1.84)	-0.254*** (-1.68)	0.94
South-Central	-1.788* (-3.58)	-2.24* (-4.01)	-0.631 (-1.57)	-0.554 (-0.91)	-1.635* (-2.74)	-2.114* (-3.45)	-0.393* (-3.52)	0.88
Pacific	-1.004** (-2.19)	-1.49* (-2.90)	-0.363 (-0.98)	-0.23 (-0.41)	-0.776 (-1.41)	-1.297** (-2.30)	-0.353* (-3.44)	0.91
New Depts.	-0.715 (-0.71)	-0.527 (-0.47)	-0.268 (-0.33)	-0.162 (-0.13)	-0.569 (-0.47)	-0.847 (-0.69)	0.65* (2.90)	0.93

Numeraire: Bogotá. The equations are represented across the rows. t-statistic in parentheses. * significant at 1%. ** significant at 5%. *** significant at 10%.

The SUR estimates of the Dendrios-Sonis model for Colombia are shown in Table 1. Although just some coefficients turned out to be significant, the majority of the coefficients for the lag of the dependent variables have a negative sign as expected. The results provide the following interpretation; the fact that regions permanently compete to reach a higher share of the national GDP, and that when a region increase its share the others will decrease theirs, implies that the income polarization process will persist in the Colombian economy.

In addition, this interpretation is reinforced by the results showing a country with a low level of integration among the different regions. The non-significance in some coefficients presents evidence of poor regional interaction.

The data in Table 2 present some qualitative results of the Dendrios-Sonis model. In this table, actual values have been replaced by the signs of the coefficients. By ordering the regions according to their level of complementarity and competitiveness, this table attempts to establish a qualitative spatial dependence hierarchy. Again, the high competition among regions is revealed. The

regions that have the major proportion of national GDP - Bogotá, West-Central and Pacific – as well as the one with the highest growth rate – New Departments- exhibit a competitive relationship. This means that an increase in the share of the most dynamic economies will result in a decrease in the share of the others regions.

Table2: Qualitative Analysis of the Competitive and Complementary Relationships Using All Variables

(a) Qualitative Relationships

	Caribbean	West-Central	North-Central	South-Central	Pacific	Bogotá	New Depts.
Caribbean	+	-	+	+	+	-	-
West-Central	-	-	-	-	-	-	-
North-Central	-	-	+	-	-	-	-
South-Central	-	-	-	-	-	-	-
Pacific	-	-	-	-	-	-	-
New Depts.	-	-	-	-	-	-	+

(b) Qualitative Ordering

	North-Central	South-Central	Caribbean	Pacific	New Depts.	Bogotá	West-Central
Caribbean	+	+	+	+	-	-	-
North-Central	+	-	-	-	-	-	-
New Depts.	-	-	-	-	+	-	-
West-Central	-	-	-	-	-	-	-
South-Central	-	-	-	-	-	-	-
Pacific	-	-	-	-	-	-	-

Complementary ←————→ Competition

The outcome of the re-estimation of the model excluding the non-significant variables is shown in Table 3. The included explanatory variables still explain a high proportion of the variation in the dependent variable. In addition, the signs of the coefficients remain stable, the magnitude of the elasticity coefficients in general drops, and the coefficients continue to be statistically significant.

The fact that the New Departments exhibits only a significant relationship with itself (lagged once) reflects the poor integration of this region with the rest of

the country. This result is also similar to the conclusions obtained from the application of the analysis of shift-share to Colombian economic growth by Bonet (1999), who found that local endowment is the key factor in regional performance.

In addition, it is also important to note that the Caribbean region shows non-significant coefficients from the other regions while the effects of this region on others are negative when they are significant. The poor interaction of this region could be one of the reasons of its poor economic performance.

Table 3. Results of the Dendros-Sonis Model for Colombia Using Selected Variables

	Caribbean	West-Central	North-Central	South-Central	Pacific	Bogotá	New Depts.	R2
Caribbean	NS	NS	NS	NS	NS	NS	NS	-
West-Central	-0.454* (-3.47)	NS	NS	NS	-0.734* (-2.69)	-0.867* (-5.34)	-0.171* (-3.14)	0.82
North-Central	NS	NS	NS	NS	NS	-0.979* (-4.82)	-0.28* (-5.21)	0.90
South-Central	-1.446* (-6.47)	-2.037* (-5.60)	NS	NS	-0.942** (-2.35)	-1.389* (-8.24)	-0.268* (-4.01)	0.87
Pacific	-0.697* (-6.60)	-1.173* (-6.07)	NS	NS	NS	-0.831* (-6.99)	-0.241* (-5.52)	0.90
New Depts.	NS	NS	NS	NS	NS	NS	0.745* (20.4)	0.91

Numeraire: Bogotá. The equations are represented across the rows. t-statistic in parentheses. * significant at 1%. ** significant at 5%. *** significant at 10%. NS: not significant in the previous regression.

There is not a region with clear positive effects in the economy. The North Central is the only one with two positive coefficients whereas the other regions either have just one or do not have any. This evidence reveals the degree of regional competitiveness in the economy. It can be expected that that a positive shock in the GDP of any region at time t could not have a constructive impact on the other regions' GDP in time $t+1$.

Since the coefficients in the Dendrinos-Sonis Model represent regional growth elasticities, it is possible to identify which regions have a higher or lower impact on others. According to the results of Table 3, the South Central region receives the highest impact from the other regions because their coefficients with the regions Caribbean, West Central and Bogotá are greater than one in absolute value. While the West Central region shows the highest negative coefficients with other regions, the New Departments region exhibits the lowest ones with absolute values lower than one in absolute value.

Table 4: Qualitative Analysis of the Competitive and Complementary Relationships Using Selected Variables

(a) Qualitative Relationships							
	Caribbean	West-Central	North-Central	South-Central	Pacific	Bogotá	New Depts.
Caribbean	NS	NS	NS	NS	NS	NS	NS
West-Central	-	NS	NS	NS	-	-	-
North-Central	NS	NS	NS	NS	NS	-	-
South-Central	-	-	NS	NS	-	-	-
Pacific	-	-	NS	NS	NS	-	-
New Depts.	NS	NS	NS	NS	NS	NS	+

NS: not significant in the previous regression.

Bogotá is still a region that has a negative impact on the rest of the regions. The biggest impacts of Bogotá are in the South-Central region with an elasticity greater than one in absolute value (-1.38), and the North Central region with an elasticity close to minus one (-0.97).

When consideration is given to the factors that played an important role in the income polarization process (the consolidation of Bogotá as the main metropolis in the 1990's), the fact that Bogotá has negative coefficients indicates that the income disparity pattern will likely persist. Given that Bogotá concentrates

a high proportion of the national government expenditures, the public finance policy should take into consideration the spatial effects that an investment in Bogotá will have on the rest of the regions in order to consider some redistribution effects. Without access to interregional trade data, the results presented here suggest that the spillover effects are not expected to be large.

This type of bi-directional interaction is another significant piece of interregional competition and complementarity mentioned by Nazara, *et. al.* (2001). They stated three possible cases of interaction. First, they consider the situation in which two regions *i* and *j* may be in a (+,+) pair of impact signs making these two regions complements of one another. Secondly, they contemplate the case in which two regions may also be in a (-,-) pair of impact signs. In this case, both regions are mutually competing for economic growth. Finally, they consider the asymmetric case in which the two regions engage in a (+,-) pair of impact signs. Here *i* can have a positive impact in *j*, but *j* is negatively impacted by an economic growth in *i*.

Table 5: Regional Bi-Directional Interaction in Colombia

	Caribbean	West-Central	North-Central	South-Central	Pacific	Bogotá	New Depts.
Caribbean	(+,+)	(-, -)	(+, -)	(+, -)	(+, -)	(-, NU)	(-, -)
West-Central	(-, -)	(-, -)	(-, -)	(-, -)	(-, -)	(-, NU)	(-, -)
North-Central	(-, +)	(-, -)	(+,+)	(-, -)	(-, -)	(-, NU)	(-, -)
South-Central	(-, +)	(-, -)	(-, -)	(-, -)	(-, -)	(-, NU)	(-, -)
Pacific	(-, -)	(-, -)	(-, -)	(-, -)	(-, -)	(-, NU)	(-, -)
New Depts.	(-, -)	(-, -)	(-, -)	(-, -)	(-, -)	(-, NU)	(+,+)

NU means that this region is the numeraire and therefore, the model is not able to estimate the impact of the other regions in Bogotá.

Even though this issue was not addressed directly by the Dendros-Sonis model because it needs to develop an *nxn* interregional-impact matrix, a first

attempt to estimate a bi-directional interaction among Colombian regions is included in Table 5. The prevalence of the (-,-) pair in this matrix strengthens the earlier finding of a high degree of competition among Colombian regions. In addition, there are a couple of contrary signs of relationship which indicate an asymmetric impact between some regions.

V. Conclusions

The application of the Dendrinos-Sonis model to Colombia provides an overview about the form of competition and complementarity among the country's different regions. This first attempt shows a weak degree of regional integration which is consistent with the growth of income disparities between 1960 and 1996. These results reflect the low interaction among the Colombia's regional economies.

Policy makers have to take into account the competitive regional relationship in order to propose an adequate policy strategy. Given the set of region's economic behavior, the regions with rich natural endowment will have a greater probability of higher development, and consequently the income imbalances will increase. The policy recommendations should include the adoption of regional redistribution strategies, or other interventions (such as construction of infrastructure) that might enhance regional interaction and integration.

However, as noted by Nazara, *et. al.* (2001), competition is not always bad and complementarity is not always good. Interregional competition could encourage innovation and invention among regions. Competition among regions is a competition among the economic agents in each region (Poot, 2000). The government should create the necessary conditions to support the activities of the

local agents and, therefore, it plays an important role in regional economies. Some policy issues require further analysis to determine the circumstances where competition is bad and complementarity is good.

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