REGIONAL STRUCTURAL CHANGES IN COLOMBIA: AN INPUT-OUTPUT APPROACH

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Abstract

No previous work has focused on the analysis of the regional and interregional structure and structural changes in Colombia. An initial exploration using a parsimonious approach to the measurement of interregional interaction suggested a country with limited spatial interdependency. These findings were evaluated by taking advantage of a newly constructed interregional input-output model to measure the interactions within and between the Colombian regions. The direct and indirect production linkages effects are captured through the evaluation of the Leontief inverse matrices. The results suggest that key sectors have moved from primary and secondary sectors to tertiary sectors, which is a movement observed in the economic development process. However, it can be argued that the regional economies do not have exactly the same linkage structures. These differences are the result of discrepancies in the dominant sectors in each economy. The interregional linkages reveal a country with self-sufficient sectors in most of the regions, which supports the idea of a country with relatively poor interregional dependences, results that were also found in previous studies. The fact that the powerful backward and forward linkages are identified in the most prosperous regions instead of the lagged ones implies that the regional inequalities are likely to be sustained.

1. Introduction

Some common points of view have guided the discussion about the relationship between economic growth and regional disparities. A consensus can be identified around the idea that regional inequalities are determined, at least at the beginning, by historical and geographical accidents. For instance, Myrdal (1957) states that the power of attraction of a center has its origin mainly in an historical accident that causes a place to be selected over other potential locations that could equally well have been chosen. Thereafter, the ever-increasing internal and external economies strengthened and sustained their

continuous growth at the expense of other localities and regions in which a relative stagnation became the pattern.

There is also an agreement about the existence of positive and negative factors affecting the regional inequalities once growth takes a firm hold in one part of the national territory. Mydal (1957) and Hirschman (1958) argue that there are forces in the market playing a role that usually tend to increase, instead of decrease, the inequalities across regions. In Mydal's words, these contrary effects are called *backwash* and *spread* effects whereas Hirschman calls them *polarization* and *trickling down* effects.

Some authors have also discussed the role played by backward and forward linkages in generating agglomeration around some places. For instance, Krugman (1991), refreshing the ideas of Mydal and Hirschman, argues that the externalities that sometimes lead to the emergence of a core-periphery pattern are pecuniary externalities associated with either demand or supply linkages rather than purely technological spillovers. Thus, the major reason for a manufacturing agglomeration in a specific place is the powerful backward and forward linkages that this location offers.

The final impact of backward and forward linkage patterns on regional inequalities will depend on the regional economic structures. How a local economy is connected to others would determine the impact of that territory upon other regions as well as the impact of those other regions on itself. The transformation of one economy from domination by some sectors to others as well as the concentration of the most dynamic or lagging sectors in specific regions will affect the regional convergence process.

No work has been devoted to the assembly and evaluation of the process of change associated with the interaction between sectors within and between the regional economies in Colombia. Previous studies have attempted to determine the level of spatial dependence in the economic activity at both the municipal and departmental levels by using spatial analysis techniques. Galvis (2001) analyzes the spatial dependence in economic activity at municipal level using two variables: the per capita banking deposits and the per capita local tax collection. The evidence of this work shows an heterogeneous country with a low level of spatial dependence. Later on, Baron (2003) shows that there is no evidence supporting a spatial dependence in the departmental per capita GDP.

The purpose of this paper is twofold. First, a comparative analysis of interindustry interactions within and between regions is undertaken. Secondly, the impacts of regional structural changes and sectoral interactions on the regional income polarization process are explored. Drawing on the limited empirical and theoretical contributions that are available, a set of hypothesis can be proposed. First, similar results to previous studies in which a low level of integration was observed can be anticipated and therefore, the inter-regional trade would be a small proportion of the total activity. Secondly, a degree of asymmetry in external relationships can be anticipated with less prosperous regions being far more dependent on the more prosperous than vice versa. Finally, the sector linkage patterns would be different among regions. This asymmetry would indicate that the national key sectors are relatively more concentrated in the wealthy regions than in the lagged ones.

The major contribution of this paper can be identified in three aspects. First, the paper introduces the input-output techniques to the analysis of regional economies in Colombia. Although there were some previous attempts to estimate single regional input-output tables, this is the first time that an interregional input-output model is estimated. Secondly, the interregional model estimates interregional trade flows for the first time in Colombia. Finally, the paper contributes to understand the Colombian interindustry interactions between and within regions by applying new techniques to analyze the Leontief inverse matrix .

This paper is composed of six sections. The next section makes a literature review about the techniques available to assess the degree of interdependence between regions with an emphasis in the Dendrinos-Sonis approach. Section 3 introduces the multi-regional input-output table estimation method. Section 4 describes the methods used to determine both the direct and indirect production linkages effects within and between regions. Section 5 presents the results of the estimations as well as their interpretation. Finally, section 6 offers some concluding comments.

2. Literature Review

One of the difficulties in evaluating the structure of sub-national economies in Colombia is the absence of data on interregional flows. A parsimonious approach was explored in an attempt to capture the essence of the regional interactions without access to a data set that would allow for formal testing of the results. The Dendrinos and Sonis (1988, 1990) approach (hereafter DS) draws on a view of development that envisages competition between regions. This competition is measured indirectly as competition for shares of

some national aggregate, such as gross product, income or employment. Thus, the DS model is from a class of models that may be referred to as nonlinear relative dynamics. Hewings, *et al.* (1996) claimed that this model captures the spatial effects without making use of any *a priori* weighting matrix, in contrast to the now standard approaches in spatial econometrics in which an adjacency matrix that signifies interaction only with the nearest neighbors is proposed. In addition, the DS model is capable of generating results for the structure of the spatial correlation among the regions within a country; it is also possible to examine the effects of any individual region on all 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 DS model, the first approach is taken. Hence, 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.

The basic model applied to the case of regional income is as follows. Denote x_{it} as the relative income of region i at the time t. If there are n regions in the economy, a vector X_t is defined as $X_t = [x_{1t}, x_{2t}, ..., x_{nt}] \qquad i = 1, ..., n \qquad t = 0,1, ..., T$

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

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

where $0 \le x_{i,t} \le 1$, $F_i[x_t] \ge 0$, 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:

$$G_j[x_t] = \frac{F_j[x_t]}{F_1[x_t]} \qquad \forall j = 2,3,.....,n \qquad t = 0,1,.....,T \tag{2}$$

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

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

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

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 DS Model can be seen as a working framework of the competitive model in terms of proportions (Nazara, *et al.*, 2001).

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

$$G_j[x_t] = A_j \prod_k x_{kt}^{a_{jt}} \qquad \text{where} \qquad j = 2,3,.....,n. \quad k = 1,2,.....,n. \tag{5}$$

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

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

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 numerarie, with respect to one percentage change of income in region *k*.

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

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

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 relate 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.

Bonet (2003) applied this model to the Colombian economy. This study considers seven regions into which the 33 Colombian territorial entities have been aggregated: Caribbean, West-Central, North-Central, Bogotá, South-Central, Pacific, and New Departments.[1] The period of analysis is 1960 – 1996 and the region that maintained the highest GDP per-capita during this period, Bogotá, is used as the numeraire.

Table 1. Results of the Dendrinos-Sonis Model for Colombia

	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%.

Although only 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 suggest 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, implying that the income polarization process persists in the Colombian economy. In addition, this

[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.

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 (see Table 1).

The data in Table 2 present some qualitative results of the application of the Dendrinos-Sonis model to Colombia. 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

(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 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. Moreover, it is also important to note that the Caribbean region reveals 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.

Since the coefficients in the DS Model represent regional growth elasticities, it is possible to identify which regions have a higher or lower impact on others. According to the results for Colombia, 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. Bogotá is still a region that has a negative impact on the rest of the regions. The biggest impacts from 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.

Two questions can arise from this prior work. First, to what extent are these results a reflection of reality and, secondly, can other empirical evidence be found suggesting that the Colombian regions are more competitors than complements? One way to deepen this analysis is to construct an alternate model such as an interregional input-output table that estimate the interindustry flows between and within regions. The methodology adopted to estimate this model is presented in the following section.

3. The Multi-Regional Input-Output Model

Based on the work in other developing economies, the construction of inter-regional input-output table uses the regional location quotient method and the RAS procedure.[2] Although there are more sophisticated mathematical methods, the data requirements limit their use in developing economies with poor regional data available. Since Colombia is not an exception in this regional data limitation, simple location quotient and RAS methods were selected for the estimation. According to Miller and Blair (1985), different empirical studies have revealed that in general the simple location quotient method is the best of the various location quotient techniques and is also generally better than the supply-demand pool approaches. Miller and Blair also point out that the RAS procedure

[2] Some previous works are Hulu and Hewings (1993) for Indonesia, and Stern (1992), Haddad and Hewings (1998) and Haddad (1999) for Brazil.

has been employed with some success for regionalization in countries with significant data constraints.

Assuming a four regions country, a *n*-sectors set of interregional accounts need to be estimated. The entire system looks like:

$$\begin{bmatrix} A_{11} & A_{12} & A_{13} & A_{14} \\ A_{21} & A_{22} & A_{23} & A_{24} \\ A_{31} & A_{32} & A_{33} & A_{34} \\ A_{41} & A_{42} & A_{43} & A_{44} \end{bmatrix} \tag{8}$$

The first step is the estimation of each region input-output table versus the rest of Colombia entries. Given the existence of a national input-output table, A_{11} is estimated using location quotients as follows:

$$a_{ij} = \begin{cases} lq_i a_{ij}^c & \text{if } \mathrm{lq_i} < 1 \\ a_{ij}^c & \text{if } \mathrm{lq_i} \geq 1 \end{cases} \tag{9}$$

where superscript, *c*, represents Colombian input-output coefficients

Then, it is possible to estimate $m_{ij} \in M^{rc,r}$, the interregional import matrix for the region *r* from the rest of Colombia. This matrix will be the sum of the non-main diagonal entries in (8) for each region (e.g., $A_{21} + A_{31} + A_{41}$ for the first region). It is estimated as follows:

$$m_{ij} = a_{ij}^c - a_{ij} \tag{10}$$

This matrix in the 2-region system (i.e. the region and the Rest of Colombia) appears as:

$$\begin{pmatrix} A^{r} & M^{r,rc} \\ M^{rc,r} & A^{rc} \end{pmatrix} \tag{11}$$

A similar analysis is conducted for the Rest of Colombia (RC). The regional total is extracted from RC and equation (9) is applied again, only this time for the Rest of Colombia. This provide estimates of $a_{ij}^{rc} \in A^{rc}$. Then, the imports from the region made by RC, $M^{r,rc}$, are estimated using an equation similar to (10):

$$m_{ij}^{r,rc} = a_{ij}^{c} - a_{ij}^{rc} \quad \text{for all } i \text{ and } j \tag{12}$$

Following the previous procedure, estimates for all the entries in (11) can be completed. After that, the method moves to region 2 and so on. Note that the Rest of Colombia is defined differently en each case and thus, the components in the entries of (11) are different. After this is done for all regions, the following system is completed:

$$\left(\begin{array}{cccc|c} A_{11} & & & & M^{1,rc} \\ & A_{22} & & & M^{2,rc} \\ & & A_{33} & & M^{3,rc} \\ & & & A_{44} & M^{4,rc} \\ \hline M^{rc,1} & M^{rc,2} & M^{rc,3} & M^{rc,4} & \end{array}\right) \tag{13}$$

However, since the system is dealing with coefficients, at this moment the estimation operate only on the $M^{rc,r}$ entries in the last row and on the $M^{r,rc}$ entries in the last column, where *r* is a representative region. These are the row and column totals for imports but not the specific region to region flows. Hence, it is necessary to allocate the $M^{rc,r}$ entries to regions.

The next step is completing the table. If there are R regions, divide each of the entries in the M matrices by R-1. In this case, $M^{rc,1}$ is divided by 3 because a four regions system has been considered. In this case, $\tilde{a}_{ij}$ would be the same in $\tilde{A}_{21,}, \tilde{A}_{31,}, \tilde{A}_{41,}$. This procedure is used to estimate all other entries for the other regions to complete the following system:

$$\begin{bmatrix} A_{11} & \tilde{A}_{12} & \tilde{A}_{13} & \tilde{A}_{14} \\ \tilde{A}_{21} & A_{22} & \tilde{A}_{23} & \tilde{A}_{24} \\ \tilde{A}_{31} & \tilde{A}_{32} & A_{33} & \tilde{A}_{34} \\ \tilde{A}_{41} & \tilde{A}_{42} & \tilde{A}_{43} & A_{44} \end{bmatrix} \tag{14}$$

So that a typical entry for the off-diagonal elements in system (14) would be:

$$\tilde{a}_{ij} \in \tilde{\tilde{A}}_{r1} = \tilde{\tilde{m}}_{ij} = M^{rc,1} / 3 \tag{15}$$

The final adjustment is carried out as follows. From (11), total intermediate flows can be estimated into and from each region and the RC, because total outputs are known. These values can be used to estimate total interregional flows into and from each region and therefore, system (11) can be converted to flows rather than coefficients:

$$\begin{pmatrix} A^{r} & M^{r,rc} \\ M^{rc,r} & A^{rc} \end{pmatrix} \begin{pmatrix} X^{r} & 0 \\ 0 & X^{rc} \end{pmatrix} = \begin{pmatrix} X^{r,r} & X^{r,rc} \\ X^{rc,r} & X^{rc,rc} \end{pmatrix} \tag{16}$$

Then, the off-diagonal elements of (16) can be used to convert the interregional coefficient matrices (14) to flows. The following system is estimated:

$$\begin{bmatrix} X_{1,1} & \tilde{\tilde{X}}_{1,2} & \tilde{\tilde{X}}_{1,3} & \tilde{\tilde{X}}_{1,4} \\ \tilde{\tilde{X}}_{2,1} & X_{2,2} & \tilde{\tilde{X}}_{2,3} & \tilde{\tilde{X}}_{2,4} \\ \tilde{\tilde{X}}_{3,1} & \tilde{\tilde{X}}_{3,2} & X_{3,3} & \tilde{\tilde{X}}_{3,4} \\ \tilde{\tilde{X}}_{4,1} & \tilde{\tilde{X}}_{4,2} & \tilde{\tilde{X}}_{4,3} & X_{4,4} \end{bmatrix} \begin{pmatrix} X^{1,rc} \\ X^{2,rc} \\ X^{3,rc} \\ X^{4,rc} \end{pmatrix} \qquad (17)$$
$$\begin{pmatrix} X^{rc,1} & X^{rc,2} & X^{rc,3} & X^{rc,4} \end{pmatrix}$$

System (17) has estimates that will be balanced column-wise (because of the way the interregional coefficients were estimated) but not by row. In order to get a balanced system, the bi-proportional RAS adjustment is used by re-balancing across rows. This procedure is continued until margins converge. Once convergence is reached, the full inter-regional input-output matrix (8) is completed.

A final concern of this procedure is the reliability of the estimates. The evidence in the literature suggests that the individual coefficients are reasonable estimates, and that the system is holistically accurate because the top-down approach makes the estimates conform to macro aggregates. However, in the absence of a benchmark set of accounts, it is impossible to undertake a formal evaluation. Further work must be oriented to overcome this limitation by constructing survey-based regional input-output tables in Colombia.

4. Analytical Methods for Comparison

The analysis will be carried out considering both intraregional and interregional sector linkages. The identification of key sectors in each region and the comparison of regional

and national structures will reveal particular regional production features within and between regions. The idea of a key sector is derived from the concept of backward and forward linkages associated with the works of both Rasmussen (1956) and Hirschman (1958). As has been pointed out by Hewings *et al.* (1998), these analytical techniques, as well as their subsequent modifications and extensions, try to identify the sector whose linkages structures are such that they generate an above-average impact on the rest of the economy when they expand or in response to changes elsewhere in the system. In addition to this analysis, the interregional linkages are analyzed by considering the estimated interregional trade flows.

Intraregional Linkages

There is an extended literature discussing the use of input-output tables in determining the production linkages between sectors within an economy.[3] Different methods based on the evaluation of the Leontief inverse matrices have been proposed in order to capture both the direct and indirect production linkages effects. For the purpose of this paper, three general approaches are adopted: the Rasmussen-Hirschman index, the pure linkage index, and the input-output multiplier product matrix (MPM). Following Sonis *et al.* (1995), these different kinds of analysis must be combined in order to have a complete picture of the structural changes in the economy. The following subsections present the analytical techniques in detail.

[3] See Cella (1984), Hewings *et al.* (1989), Clements (1990), Sonis *et al.* (1995, 1996, 1997, and 2000), among others.

Rasmussen-Hirschman Indices[4]

Rasmussen (1956) and Hirschman (1958) proposed two indices to determine the backward and forward effects in an economy using input-output tables. Define b_{ij} as the typical elements of the Leontief inverse matrix, *B*. If $b_{.j}$, $b_{i.}$, and $b..$ are considered as the column, row, and total sums of *B*, respectively, $B^*=b../n^2$ is the average value of all elements of *B* and *n* is the number of sectors in that matrix, then the backward linkage index, U_j, and the forward linkage index, U_i, can be estimated by:

$$U_j = \frac{b_{.j} / n}{B^*} \tag{18}$$

$$U_i = \frac{b_{i.} / n}{B^*} \tag{19}$$

While the numerator in U_j expresses the average value of the elements in column *j*, the numerator in U_i indicates the average value of the elements in row *i*. If the value of U_j is greater than one, we can say that a unit change in final demand of sector j generates above-average increase in the economy. On the other hand, a value of *Ui* greater than one indicates that a unit change in the final demand of all sectors creates an above-average increase in sector *i*. Those sectors with both backward and forward linkages greater than one are considered as key sectors in the economy.

Multiplier Product Matrix (MPM)

Following Hewings *et al.* (1998), the multiplier product matrix (MPM) is defined as follows: say $A = \|a_{ij}\|$ is the matrix of direct requirements in the input-output system,

[4] This section draws on Haddad (1999).

$B = (I - A)^{-1} = \|b_{ij}\|$ is the Leontief inverse matrix, b•j and bi• are the column and row multipliers of this Leontief inverse. These are defined as:

$$B_{\bullet j} = \sum_{i=1}^{n} b_{ij}, \quad B_{i\bullet} = \sum_{j=1}^{n} b_{ij} \tag{20}$$

Let V be the global intensity of the Leontief inverse matrix such as:

$$V = \sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij} \tag{21}$$

Then, the input-output multiplier product matrix (MPM) is defined as:

$$M = \frac{1}{V}\|B_{i\bullet}B_{\bullet j}\| = \frac{1}{V}\begin{pmatrix} B_{1\bullet} \\ B_{2\bullet} \\ . \\ . \\ B_{n\bullet} \end{pmatrix}\begin{pmatrix} B_{\bullet 1} & B_{\bullet 2} & . & . & . & B_{\bullet n} \end{pmatrix} = \|m_{ij}\| \tag{22}$$

The concept of a multiplier product matrix is used to reveal the general economic landscape of the Colombian regional economies. Basically, the MPM properties are analyzed in the context of the hierarchy of the backward and forward linkages and their economic landscape associated with the cross-structure of the MPM. The MPM has a cross structure such that the main cross (one row and one column) can be identified as the one with the larger backward and forward linkage. Arranging all the crosses in descending order from the larger to the smaller, one can obtain a descending economic landscape that can be used to determine visually the hierarchy of backward and forward linkages and can also be used to compare structural changes in the economy through the time horizon.

Pure Linkage Indices[5]

This method was introduced by Sonis *et al.* (1995), as an attempt to refine the work of Cella and Clements for backward and forward linkages.[6] The idea behind this technique is to introduce the level of production into each sector in the determination of key sectors in an economy. The Rasmussen-Hirschman approach considers only the linkages effects without any consideration as to the level of production in each sector. It could be the case that a sector can be identified as a key sector due to its forward and backward linkages but it may have a small volume of production and this may reduce its true importance in the economy. Conversely, sectors with less strong backward and forward linkages might have large volume of production and hence contribute more to the regional economy in absolute terms. The pure linkage method overcomes this limitation by incorporating the level of production in the determination of key sectors.

In order to summarize the pure linkage approach, consider the direct input coefficient matrix, A:

$$A = \begin{bmatrix} A_{jj} & A_{jr} \\ A_{rj} & A_{rr} \end{bmatrix} \tag{23}$$

where A_{jj} and A_{rr} are square matrices of direct input, respectively, within sector j and within the rest of the economy (economy less sector j); A_{jr} and A_{rj} are rectangular matrices showing the direct inputs purchased by sector j from the rest of the economy and the direct inputs purchased by the rest of the economy from sector j. The Leontief inverse matrix, B, is defined as:

$$B = (I - A)^{-1} \tag{24}$$

[5] This section draws on Haddad (1999).
[6] See Cella (1984) and Clements (1990).

In addition, the internal Leontief inverse matrix for the rest of the economy is defined as:

$$\Delta_r = \left(I - A_{rr}\right)^{-1} \tag{25}$$

The definition of the pure backward linkage (PBL) is expressed as:

$$PBL = i_{rr}^{'} \Delta_r A_{rj} q_j \tag{26}$$

where $i_{rr}^{'}$ is a unit row vector of the appropriate dimension, and q_j is the value of total production in sector *j*. The pure forward linkage (PFL) can be defined as:

$$PFL = A_{jr} \Delta_r q_r \tag{27}$$

where q_r is a column vector of total production in each sector in the rest of the economy.

The PBL can be interpreted as the pure impact on the economy of the value of the total production in sector *j*. In this sense, the impact does not include the effects generated by the demand of inputs that sector *j* makes from sector *j*, and the feedback from the economy to sector *j*, and vice-versa. The PFL measures the pure impact on sector *j* of the total production in the rest of the economy. In addition, the *pure total linkage* (PTL) is estimated by adding both the PBL and PFL. Under this approach, those sectors with the largest values of PTL are considered as key sectors.

Interregional Linkages

In addition to the intraregional linkage analysis, the interdependence among sectors in different regions is analyzed by using the complete interregional input-output model. To estimate the model, this study considers the same seven regions established by Bonet (2003): Caribbean, West-Central, North-Central, Bogotá, South-Central, Pacific, and New Departments. The model is of the form:

$$A = \begin{bmatrix} A_{11} & A_{12} & A_{13} & A_{14} & A_{15} & A_{16} & A_{17} \\ A_{21} & A_{22} & A_{23} & A_{24} & A_{25} & A_{26} & A_{27} \\ A_{31} & A_{32} & A_{33} & A_{34} & A_{35} & A_{36} & A_{37} \\ A_{41} & A_{42} & A_{43} & A_{44} & A_{45} & A_{46} & A_{47} \\ A_{51} & A_{52} & A_{53} & A_{54} & A_{55} & A_{56} & A_{57} \\ A_{61} & A_{62} & A_{63} & A_{64} & A_{65} & A_{66} & A_{67} \\ A_{71} & A_{72} & A_{73} & A_{74} & A_{75} & A_{76} & A_{77} \end{bmatrix} \quad (28)$$

where the main diagonal elements correspond to the intraregional inputs, and the off diagonal components capture the interregional inputs. This model includes only domestic inputs, while inputs from the rest of the world are considered as imports. The total flows of system (28) as well as the Leontief inverse matrices $B = (I - A)^{-1}$ will be considered to interpret the interregional linkages in the economy.

From *B*, output multipliers can be estimated for each sector *j* in each region *r*, as the total value of production in all sectors and in all regions of the economy that is necessary in order to produce sector *j´*s output. This multiplier effect can be decomposed into intraregional (internal multiplier) and interregional (external multiplier). According to Haddad (1999), the impacts on the outputs of sectors within the region where the final demand change was generated are represented by the former multiplier whereas the impacts on the other regions of the system (intraregional spillover effects) are shown by the latter.

The estimation of the interregional input-output model allows calculating the interregional feedback effects in the output multipliers. These effects were introduce by Miller (1966) and are defined as the increase in outputs necessary in the sectors of a particular region because of increased demands from sectors in the other regions, which

themselves result from an initial increase in outputs in the first region. Following Miller and Blair (1985), the output multipliers for each region are estimated from the multiregional input-output model (Leontief inverse matrix *B)*, and from the single model for region each region *r* (Leontief inverse matrix $B^r = (I - A_{rr})^{-1}$). The difference between the two output multipliers is calculated and divided by the multiregional output multiplier to estimate the amount by which output multipliers for sectors in each region would be underestimated if a single-region model were used instead of the interregional model.

5. Empirical Interpretation

For the empirical analysis, the inter-regional input-output model was estimated for three years: 1985, 1992 and 1997. Since the methodology used to estimate the model requires an appropriate national input-output table, these years were selected because the existence of suitable national tables for the same years.[7] The tables were estimated for the seven regions described in the previous section. Nine sectors were considered in the economy: agriculture (sector 1), mining (sector 2), non-durable manufacturing (sector 3), durable manufacturing (sector 4), construction (sector 5), wholesale and retail trade (sector 6), utilities (sector 7), private services (sector 8), and government (sector 9).[8]

[7] The sources for the national input-output tables are Cordi (1988), Valderrama and Gutierrez (1996), and Ministerio de Hacienda y Crédito Público – Dirección General de Política Macroeconómica (2001) for 1985, 1992 and 1997, respectively.

[8] The Rasmussen-Hirschman indices and the MPM matrices were estimated using the package PyIO. For more information about PyIO see Nazara et. al. (2003) and http://www2.uiuc.edu/unit/real/.

Table 3: Sector Classification Based on Rasmussen-Hirschman Indices, 1985

Region	Backward-Linkage-Oriented Sectors	Key Sectors
Caribbean	2, 3, 4, 5	2, 4
West Central	3, 4, 5	3, 4
South Central	3, 4	4
Bogotá	3, 4, 5	3, 4
North Central	2, 3, 4	2
Pacific	1, 3, 4, 5	1, 3, 4
New	1, 2, 3	1, 2
Colombia	2, 3, 4, 5	2, 3, 4
	Less Important Sectors	**Forward-Linkage-Oriented Sectors**
Caribbean	8, 9	1, 2, 4, 7
West Central	6, 9	1, 3, 4, 7, 8
South Central	2, 5, 8, 9	1, 4, 6, 7
Bogotá	2, 6, 9	3, 4, 7, 8
North Central	5, 6, 8, 9	1, 2, 7
Pacific	2, 6, 9	1, 3, 4, 7, 8
New	5, 8, 9	1, 2, 6, 7
Colombia	6, 9	1, 2, 3, 4, 7, 8

Based on the estimates of the Rasmussen-Hirschman indices, a classification of the sectors in the different regions and Colombia is carried out for the considered years. These results are presented in tables 3 to 5. Key sectors for each region are shown in the upper right corner of the table while the lower left section includes the less important ones. The two remaining quadrants (upper left corner and lower right corner) present the backward and forward linkage oriented sectors, respectively.

Table 4: Sector Classification Based on Rasmussen-Hirschman Indices, 1992

Region	Backward-Linkage-Oriented Sectors	Key Sectors
Caribbean	2, 3, 4, 5	2, 4
West Central	1, 3, 4	1, 3, 4
South Central	1, 2, 3, 4	1, 3, 4
Bogotá	3, 4, 5	3, 4
North Central	2, 3, 4	2, 4
Pacific	1, 3, 4, 5	1, 3, 4
New	2, 3, 4	2
Colombia	2, 3, 4	3, 4
	Less Important Sectors	**Forward-Linkage-Oriented Sectors**
Caribbean	6, 9	1, 2, 4, 7, 8
West Central	2, 5, 6, 9	1, 3, 4, 7, 8
South Central	5, 6, 9	1, 3, 4, 7, 8
Bogotá	2, 6, 9	3, 4, 7, 8
North Central	5, 6, 9	1, 2, 4, 7, 8
Pacific	2, 6, 9	1, 3, 4, 7, 8
New	5, 6, 9	1, 2, 7, 8
Colombia	5, 6, 9	1, 3, 4, 7, 8

As can be seen in tables 3 to 5, a transformation of the economies becomes evident during the 1990s. Between 1985 and 1992, with some minor exchanges, the key sectors are almost the same: sectors 1, 2, 3 and 4. However, the strategic sectors changed in 1997: sectors 1, 2 and 3 disappeared while sector 7 appeared joined with sector 4. Mining was a key sector in the North Central and New Departments regions, where the petroleum extraction and refinery activities have an important share in their economies. Agriculture reduced its role as a vital sector between the 1992 and 1997. In some regions, this sector was relatively important in 1985 and 1992 but it is not included as a key sector in any region in 1997.

The reduction in the significance of the primary sectors (1 and 2) and the non-durable manufacturing sector (3) is clearer in the forward linkage classification. In 1985 and 1997, these three sectors played an important role in almost all regions. Nevertheless, in 1997, sector 1 only had significant forward linkages in the South Central

and New Departments regions, sector 2 maintained its key role in North Central and New Departments regions, and sector 3 was displaced from the above average forward linkage ranking. Finally, the increasing importance of sector 8 among the forward linkage oriented sectors during all the years can be appreciated. While this sector was significant only in three regions in 1985, it appeared as a key forward oriented sector in all the seven regions during the following years.

Table 5: Sector Classification Based on Rasmussen-Hirschman Indices, 1997

Region	Backward-Linkage-Oriented Sectors	Key Sectors
Caribbean	3, 4, 5, 7	4, 7
West Central	3, 4, 5	4
South Central	3, 4, 5	4
Bogotá	3, 4, 5, 7	4, 7
North Central	2, 3, 4, 6, 7	2, 7
Pacific	3, 4, 5	4
New	2, 3, 7	2, 7
Colombia	3, 4, 5, 7	4, 7
	Less Important Sectors	**Forward-Linkage-Oriented Sectors**
Caribbean	1, 2, 6, 9	4, 7, 8
West Central	1, 2, 6, 9	4, 7, 8
South Central	2, 6, 9	1, 4, 7, 8
Bogotá	2, 6, 9	4, 7, 8
North Central	1, 5, 9	2, 7, 8
Pacific	1, 2, 6, 9	4, 7, 8
New	4, 5, 6, 9	1, 2, 7, 8
Colombia	1, 2, 6, 9	4, 7, 8

The backward linkage oriented sectors are relatively more stable that the forward classification. Sectors 3, 4 and 5 are maintained as key backward sectors in almost all regions during the years analyzed. Again, the most important feature is the reduction in the importance of primary sectors (agriculture and mining) in favor of a tertiary sector (utilities and private services). While the agricultural sector disappeared from the above

average backward linkage ranking in 1997, the mining sector only played an important role in North Central and New Departments regions.

Table 6: Sector Classification Based on Standardized Pure Linkage Indices, 1985

Region	Backward-Linkage-Oriented Sectors	Key Sectors
Caribbean	1, 3, 4, 5	1, 3, 4, 6, 7
West Central	3	1, 3, 4
South Central	1, 3	1, 3, 4, 6, 7
Bogotá	3, 4, 5, 8, 9	3, 4, 6, 7, 8
North Central	1, 3, 6, 7	1, 2, 6, 7
Pacific	1, 3, 4	1, 3, 4
New	1, 2, 3, 6	1, 6, 7
Colombia	3, 4	1, 3, 4, 7
	Less Important Sectors	**Forward-Linkage-Oriented Sectors**
Caribbean	2, 8, 9	1, 4, 6, 7
West Central	2, 8, 9	1, 4, 6, 7
South Central	2, 8, 9	1, 4, 6, 7
Bogotá	2	3, 4, 6, 7, 8
North Central	4, 8, 9	1, 2, 6, 7
Pacific	2, 5, 8, 9	1, 2, 6, 7
New	4, 8, 9	1, 5, 6, 7
Colombia	2, 8, 9	1, 4, 6, 7

As was mentioned, one of the criticisms of these Rasmussen-Hirschman indices is that they do not take into account the levels of production in each sector of the economy. To overcome this limitation, the pure linkage indices are estimated. Furthermore, these indices have been standardized by using the average pure linkage impact in each region. The idea is that for each region, the average impact is estimated for the pure backward, pure forward, and pure total linkages. Then, the standardized pure linkage indices are calculated dividing each pure linkage index by the estimated average index. Considering these standardized indices, a sector classification in the different regions and Colombia was carried out for 1985, 1992 and 1997. Those sectors with a standardized pure backward, pure forward or pure total linkage index greater than 1 are classified either as

backward linkage oriented sector or forward linkage oriented sector or key sector, respectively. If both the standardized pure backward index and the standardized pure forward index are less than 1, the sector is classified as a less important sector. These results are included in tables 6 to 8.

Table 7: Sector Classification Based on Standardized Pure Linkage Indices, 1992

Region	Backward-Linkage-Oriented Sectors	Key Sectors
Caribbean	1, 3, 4	1, 3, 4, 7, 8
West Central	3, 4	1, 3, 4, 8
South Central	1, 3	1, 3
Bogotá	3, 4, 5, 8, 9	3, 4, 7, 8
North Central	1, 3, 4, 7	1, 4, 6, 7, 8
Pacific	3, 4, 8	1, 3, 4, 8
New	1, 2, 3, 6, 7	1, 2, 5, 6, 7, 8
Colombia	3, 4	1, 3, 4, 7, 8
	Less Important Sectors	**Forward-Linkage-Oriented Sectors**
Caribbean	2, 5, 9	1, 4, 6, 7, 8
West Central	2, 5, 9	1, 4, 6, 7, 8
South Central	2, 5, 9	1, 4, 6, 7, 8
Bogotá	2	3, 4, 6, 7, 8
North Central	2, 5, 9	1, 4, 6, 7, 8
Pacific	2, 5, 9	1, 3, 4, 6, 7, 8
New	4, 9	2, 5, 6, 7, 8
Colombia	2, 5, 9	1, 4, 6, 7, 8

One of the main differences with the previous sector classification is the role played by agriculture. Under the Rasmussen-Hirschman indices, this sector disappeared as a key sector in both regional and national economies during the 1990s. When the production level is considered, different conclusion might be reached. Although there is a reduction in the interaction of agriculture with other sectors during the analyzed period, it kept some importance as a key sector and as forward linkage oriented sector in several regional economies in 1997.

Table 8: Sector Classification Based on Standardized Pure Linkage Indices, 1997

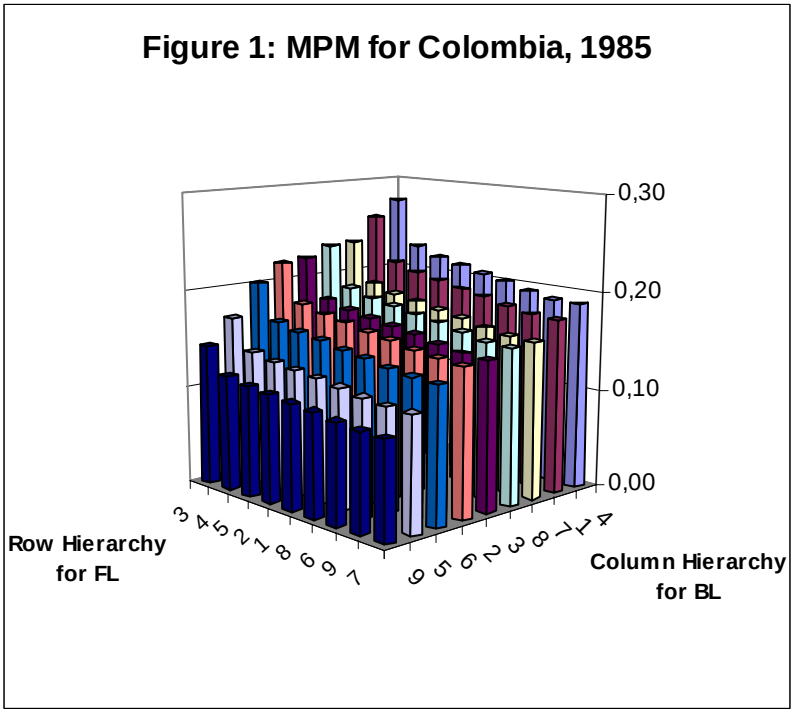
Region	Backward-Linkage-Oriented Sectors	Key Sectors
Caribbean	3, 4, 9	3, 4, 7, 8
West Central	3, 5, 9	1, 3, 4, 7, 8
South Central	3, 9	1, 3, 4, 8
Bogotá	3, 4, 5, 6, 7	4, 7, 8
North Central	3, 6, 7, 9	7, 8
Pacific	3, 9	3, 4, 7, 8
New	2, 3, 7, 9	1, 2, 7, 8
Colombia	3, 5, 9	3, 4, 7, 8
	Less Important Sectors	**Forward-Linkage-Oriented Sectors**
Caribbean	2, 5	1, 4, 7, 8
West Central	2, 6	1, 4, 7, 8
South Central	2, 5, 6	1, 4, 7, 8
Bogotá	2, 9	4, 7, 8
North Central	1, 4, 5	2, 7, 8
Pacific	2, 5, 6	1, 4, 7, 8
New	4, 5, 6	1, 2, 7, 8
Colombia	2, 6	1, 4, 7, 8

Another important difference is the reduced importance of mining under the pure linkage criteria. The Rasmussen-Hirschman indices identify this sector as a key one in some regions and at the national level. When the production level is taken into account, mining only maintained importance in the North Central and New Departments regions, which are zones where petroleum extraction and refinery industries are concentrated. In all other regions, this sector is identified as less important sector in 1997. This fact is particularly important when considering that one of most dynamic sectors in the Colombian economy during the last 10 years was the mining sector. Petroleum has been the leading exported product since 1995 while coal has been second since 2001. The economic growth in some lagging regions such as the Caribbean and New Departments regions has been associated with the exploitation of these products.

An additional difference between the different sector classifications is that the construction sector exhibited considerable backward linkages when the internal structure of the economy is analyzed using the Rasmussen-Hirschman indices but these linkages are not that clear when the level of production is included in the analysis through the pure linkage indices. It appears as if the construction sector has important interactions with the other sectors but the level of production is not large enough to generate a significant impact on the rest of the economy. On other words, the construction sector has important forward and backward linkages but its volume of production is not large enough to generate an important contribution in absolute terms. Finally, as in the Rasmussen-Hirschman approach, the increasing importance of the tertiary sectors is evident. Private services and utilities are important not only when the internal structure of the economy is taken into account but also when the volume of production is considered. Generally speaking, the pattern of transformation recognized using the Rasmussen-Hirschman indices, in which the primary and secondary sectors are declining in importance relative to the tertiary sector, is also identified with the pure linkage indices. This is a trend that is common in the development process observed around the word in the last years.

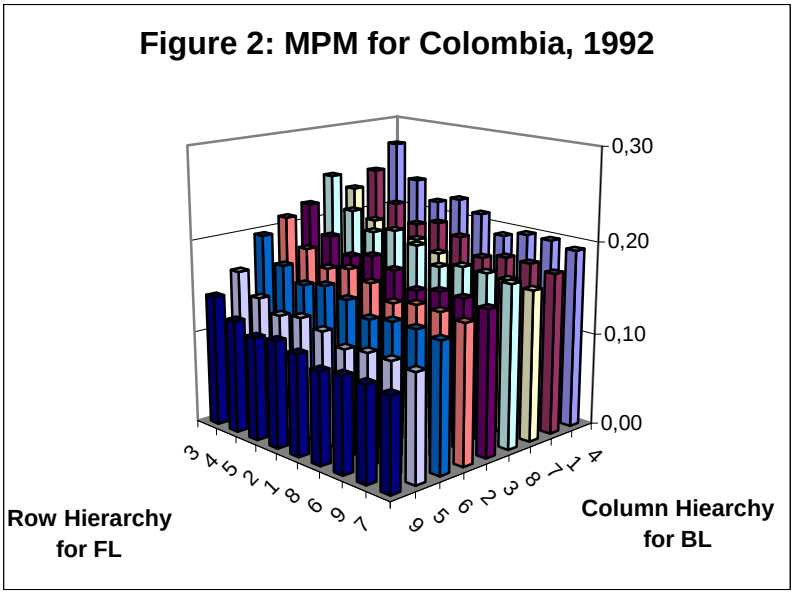
To continue with the intraregional linkages analysis, the multiplier product matrix – MPM – is estimated to reveal the cross structure for the country and each of the seven regions. The row represents the hierarchy of forward linkages while the columns provide similar details for backward linkages. For comparison purposes, the sectors in the regional economic landscapes were arranged in the same order as that for Colombia. Therefore, the sectors in the first columns of the matrix are those with the higher

backward linkages in the Colombian economy, whereas the sectors in the first rows of the matrix have the greater forward linkages.



According to the MPM results included in figures 1 to 3 and the Appendix, it can be argued that the regional economies do not have exactly the same linkage structure as the nation. In the case that all regions had identical interindustry structures, the regional economic landscapes would be as smooth as the one observed for Colombia. However, this is not the situation in the Colombian case where different economic landscapes can be identified. Some regions have arrangements that are more alike than others. Perhaps the most similar patterns are observed in the Caribbean, West Central and Pacific Regions, while Bogotá, South and North Central, and New Departments regions exhibit the most different landscapes.

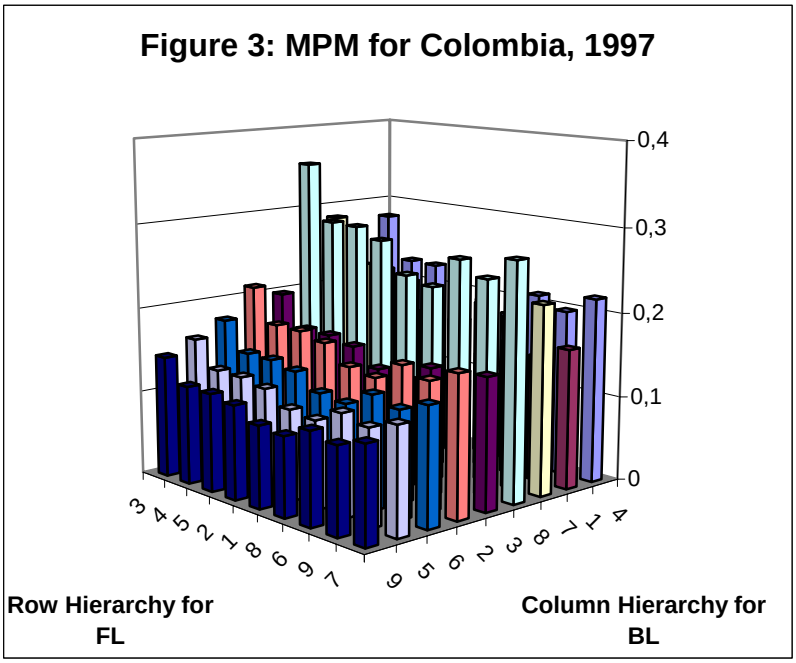
Figure 2: MPM for Colombia, 1992



What can be noted in the Colombian MPM is that significant structural changes occurred between 1992 and 1997 whereas relatively more stable structures are observed between 1985 and 1992. In addition, the observed tertiary transformation can also be detected by looking at the economic landscape associated with the cross structure of the MPM. At the national level, the MPM shows that the private services and utilities sectors became the dominant sectors in 1997, while the manufacturing and agriculture sectors were in this position in 1985 and 1992.

The regional discrepancies are the result of the differences in the dominant sectors in each economy. For instance, the dominance of the private services sector in the Bogotá's economy is clear since 1985. Even though there was a reduction in importance of the manufacturing sectors, the private services sectors had exhibited a relative higher dominance in Bogotá than in the other regions and in the country during the whole period. In the North Central region, the sectoral connections are more even than the country, suggesting that this region does not have a clear lead sector.

Figure 3: MPM for Colombia, 1997



Additionally, it can be argued that some regional economic landscapes are not as smooth as the one for the country as a whole, indicating that some regions have more dominant sectors than in the country as a whole. In the South Central regions, sectors such as agriculture, non-durable and durable industries, are as relevant as private services and utilities sectors in 1997. In the New Departments region, the primary sectors (agriculture and mining) still maintained an important role in the economy in 1997. These sectors exhibited interindustry linkages that were as significant as the tertiary sectors. In the Caribbean region, the durable manufacturing kept a key position during the three analyzed years. Although there are differences, one can argue, at a general level, that the regional structures looked more similar to the national one in 1997 that what they was the case in 1985.

After looking at the intraregional linkages, attention is focused on interdependence among sectors in the different regions through the analysis of the

complete intermediate input portion of the interregional input-output model. Looking at the intra and inter regional aggregate interindustry trade in each region included in Table 9, one observe a low degree of interregional input trade as was expected. Given the aggregation of the different Colombian territorial entities into regions, the intraregional interindustry flows contain trade between the departments within each region. The apparently low level of integration between regions could be a result of a high trade between the departments within each region that is captured as intraregional trade in the aggregate interregional model.

Table 9: Total Interindustry Trade Flow by Destination and Region, 1985 - 1992 - 1997 (Percentage)

Year	Destination	Caribbean	West Central	South Central	Bogotá	North Central	Pacific	New
1985	**Intra**	92,0	93,3	85,1	81,1	84,5	93,0	62,1
	Inter	8,0	6,7	14,9	18,9	15,5	7,0	37,9
1992	**Intra**	92,9	94,2	87,2	83,6	88,3	92,3	72,3
	Inter	7,1	5,8	12,8	16,4	11,7	7,7	27,7
1997	**Intra**	91,4	92,1	81,2	90,5	80,8	92,4	59,8
	Inter	8,6	7,9	18,8	9,5	19,2	7,6	40,2

The New Departments region exhibits the highest interregional interindustry trade, indicating that the inputs in the different sectors are mainly imported from other regions. This result makes sense due to the poor development and the lack of an adequate transportation infrastructure within this region. Other regions with a relatively high level of interregional interindustry trade were the South and North Central regions, especially in 1997. Some sectors, such as mining in the South Central Region and agriculture and construction in the North Central region, imported around 40% of their inputs from other regions. Finally, it is important to note that the mining and non-durable manufacturing sectors registered also a relatively high interregional trade in Bogotá.

Those sectors in Bogotá need to import a large part of their inputs given the urban character registered in the economy of the capital city.

The internal and external output multipliers by region for 1985, 1992 and 1997 are reported in the appendix. Following Haddad (1999), the results are reported in percentage with the purpose of determining the level of dependence of each sector in each region on the other regions. These results show the direct and indirect effects of a unit of change in final demand in each sector in each region net of the initial change. Similar to previous analysis, Colombian regions exhibit a low level of dependence. In general, the sectors seem to be self-sufficient in the different regions. The only region with a high level of dependence is the New Departments region. Some sectors such as mining and non-durable manufacturing in Bogotá, non-durable manufacturing in North Central Region, and mining in Pacific region show a relative high degree of dependence.

Although the low level of integration, it can be observed that the different regions usually generated their highest external output multiplier impacts on Bogotá and its surrounding neighbor: the North Central Region. This evidence supports the agglomeration process that has been taken place in these regions during the last forty years. While in 1960 Bogotá and its surrounding neighbor, Cundinamarca, contributed around 17% of the national GDP, they accounted for 30% in 2000. This region could have important relationships with the rest of the economy generating significant backward and forward linkages among sectors.

The analysis of the feedback effects in the output multipliers is included in Table 10. In general, the percent average errors in the regional output multipliers when interregional feedbacks were ignored are low. Only the New Departments region

exhibited an error greater than 1% in 1985. The regions with the highest errors are New Departments, Bogotá and North Central which are perhaps the more integrated regions in the Colombian economy. The low percent errors are consistent with the scarce level of integration detected among the Colombian regions.

Table 10: Average Error in Output Multipliers when Interregional Feedbacks Were Ignored (%)*

Year	Caribbean	West Central	South Central	Bogotá	North Central	Pacific	New
1985	0,07	0,04	0,10	0,15	0,17	0,05	1,15
1992	0,06	0,04	0,07	0,13	0,07	0,06	0,25
1997	0,04	0,05	0,08	0,15	0,10	0,06	0,24

* Averaged over all sectors in each region.

Finally, the analysis of the regional economic structure indicates an asymmetry in the key sectors concentration; the key sectors are relatively more concentrated in the most prosperous regions. In Colombia, the wealthy region is Bogotá whose per capita GDP was 1.7 times the national per capita GDP in 1997, while the poorest region is the Caribbean region whose per capita GDP was 0.7 times the national per capita GDP in 1997 (See Table 11).

Table 11: Portion of Colombia Per Capita GDP by Region

Region	1985	1992	1997
Caribbean	0,7	0,7	0,7
West Central	1,1	1,1	1,0
South Central	0,9	0,9	0,9
Bogotá	1,8	1,7	1,7
North Central	0,9	0,8	0,8
Pacific	0,9	0,9	0,9
New Departments	0,7	1,0	0,9

Source: CEGA (2004).

The distribution of the regional output production, included in the appendix, indicates that the Caribbean region exhibits a concentration in agriculture and mining

sectors, while Bogotá concentrates its output in durable manufacturing and private services. As was determined in the key sector analysis, the agriculture and mining sectors have relative low linkage effects whereas durable manufacturing and private services report significant intraregional linkage structures. Following Krugman and Livas (1996), one can argue that a major reason for the concentration of manufacturing in the metropolitan area of Bogotá is the powerful backward and forward linkages this location offers. These linkages played a major role in overcoming the disadvantages of high rents, wages, congestion and pollution.

Other dynamic regions such as the West Central and Pacific regions have an important participation of the non-durable and durable manufacturing sectors which also exhibit important intraregional backward and forward linkage effects. On the other hand, other lagging regions, like North Central and New Departments regions, are mainly concentrated in agriculture and mining sectors which have been identified as sectors with low levels of intraregional backward and forward linkage effects.

6. Conclusions

The initial exploration using a parsimonious approach to the measurement of interregional interaction suggested a country with limited spatial interdependency. These findings were evaluated by taking advantage of a newly constructed interregional input-output model to measure the interactions within and between the Colombian regions. The interregional linkages reveal a country with self-sufficient sectors in most of the regions, which supports the idea of a country with relatively poor interregional dependences, results that were also found in previous studies.

One explanation of this finding seems to be related to the poor transportation network existing in the country. Ramirez (2004) argues that the abrupt geographical conditions in Colombia restricted the development of the transportation infrastructure during the Twentieth Century. Making an analysis of convergence between the price of six products among the seven major cities in Colombia for the period 1928 - 1990, Ramirez concludes that the integration between the regional markets is limited and restricted by the inadequate infrastructure. This author claims that the high transportation costs, associated with the precarious transportation network, appear to explain the disparities between prices.

In addition, this paper provides evidence supporting a tertiary transformation in the Colombian economy during the 1990s. The structural change pattern indicates that the dominant sectoral interactions have moved from primary sectors (agricultural and mining) and secondary sectors (non-durable and durable manufacturing) to tertiary sectors (utilities and private sectors). Even though this is the general trend, some differences can be detected at the regional economies. These regional discrepancies are the result of the differences in the dominant sectors in each economy. Furthermore, it has been noted that the structural changes mainly occurred between 1992 and 1997, which is a period with profound structural reforms in Colombia. Further work should be focused on determining to what extent the changes in regional economies are a result of those reforms.

Given the low level of integration and the regional structural economies, it can be expected that the regional polarization would be perpetuated in Colombia. The powerful backward and forward linkages identified in the most prosperous regions and the weak

backward and forward linkages in the most lagging regions would indicate that there are little reasons to expect a change in this trend. The pecuniary externalities associated with the existing regional linkages suggest that current regional inequalities are likely to persist.

Notwithstanding the evidence accumulated through this input-output approach, a better understanding of the Colombian economy structure requires the study of the interconnection between changes in production, consumption and income distribution. To infer the degree to which changes in income distribution and consumption patterns provided further major impulses to changes in the economy demands the construction of regional social account matrices (SAM) and a more general equilibrium model. These areas must be the focus of a further research agenda in Colombia.

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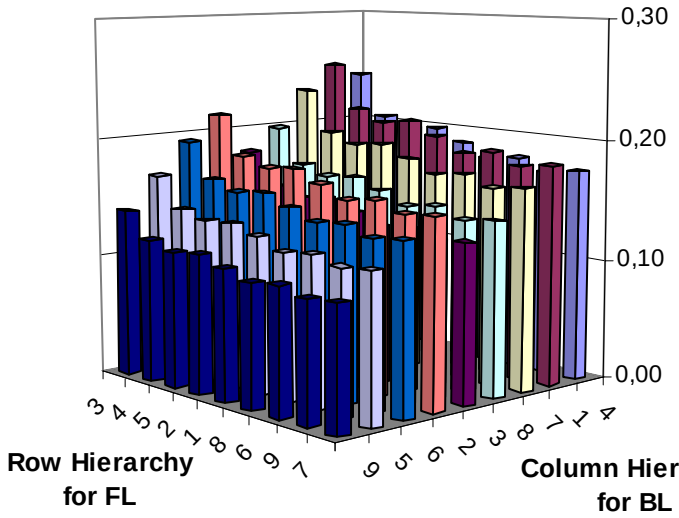
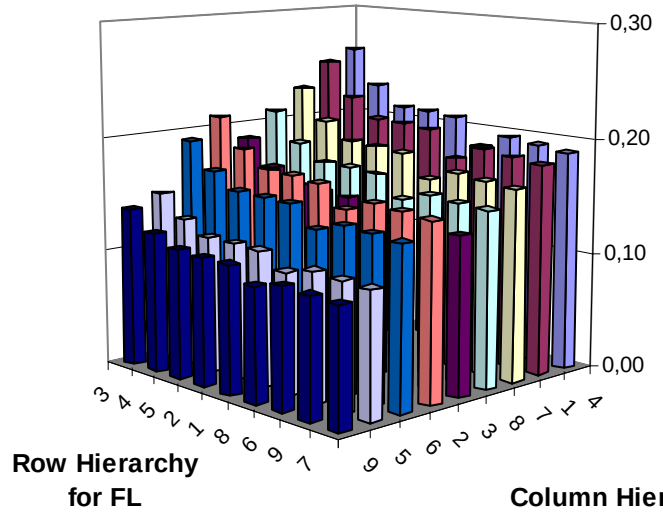
APPENDIX

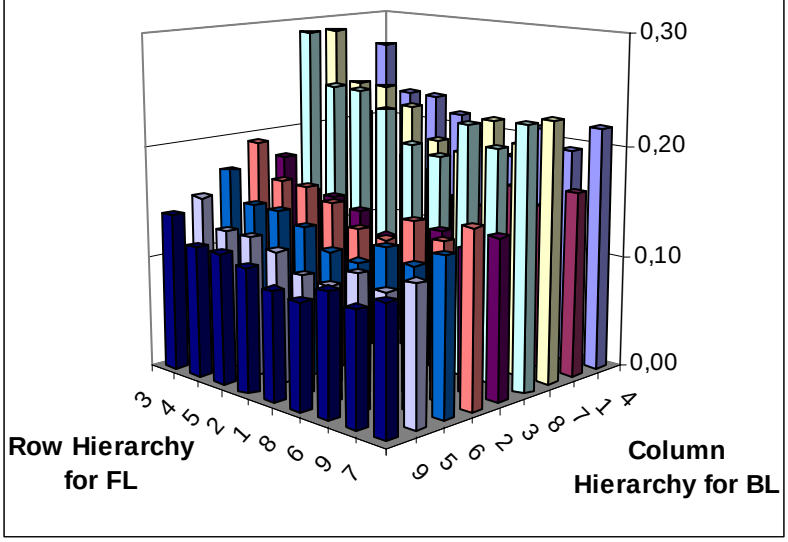
App-Figure 1: MPM for Caribbean Region using Colombia Imposed Hierarchy, 1985



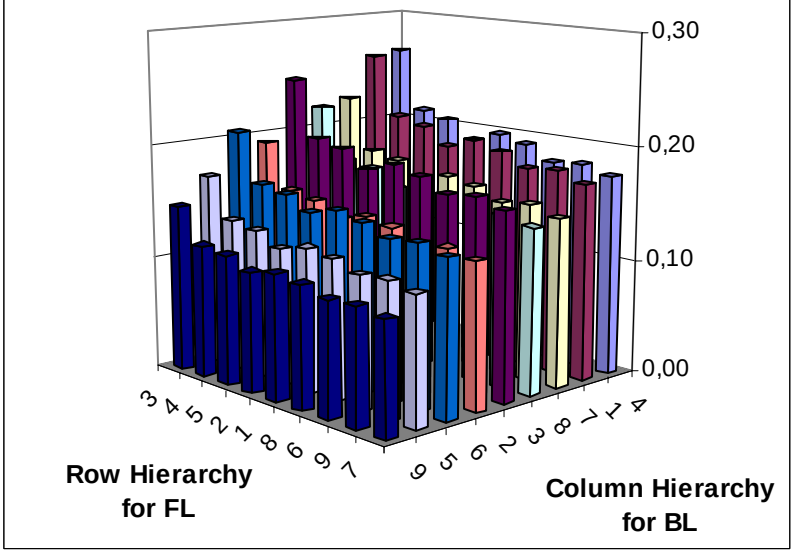
App-Figure 2: MPM for Caribbean Region using Colombia Imposed Hierarchy, 1992



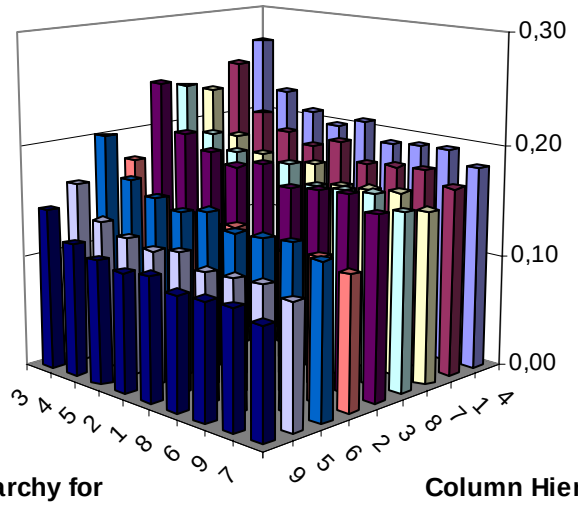
App-Figure 3: MPM for Caribbean Region using Colombia Imposed Hierarchy, 1997



App-Figure 4: MPM for West Central Region using Colombia Imposed Hierarchy, 1985



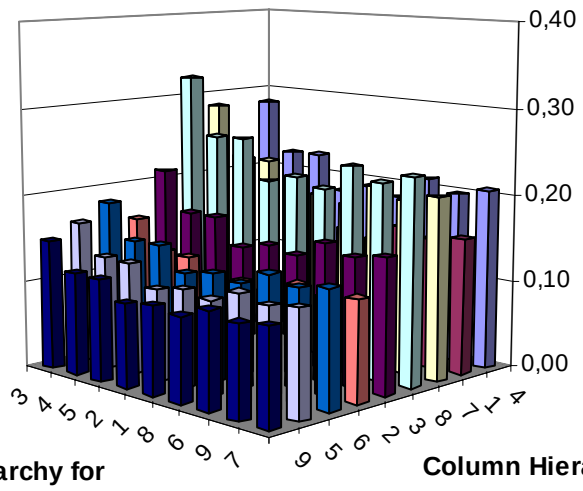
App-Figure 5: MPM for West Central Region using Colombia Imposed Hierarchy, 1992



Row Hierarchy for FL

Column Hierarchy for BL

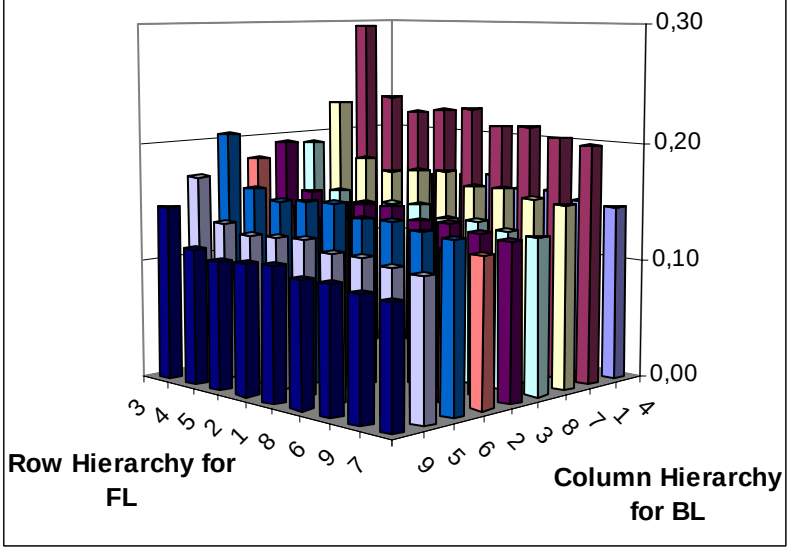
App-Figure 6: MPM for West Central Region using Colombia Imposed Hierarchy, 1997



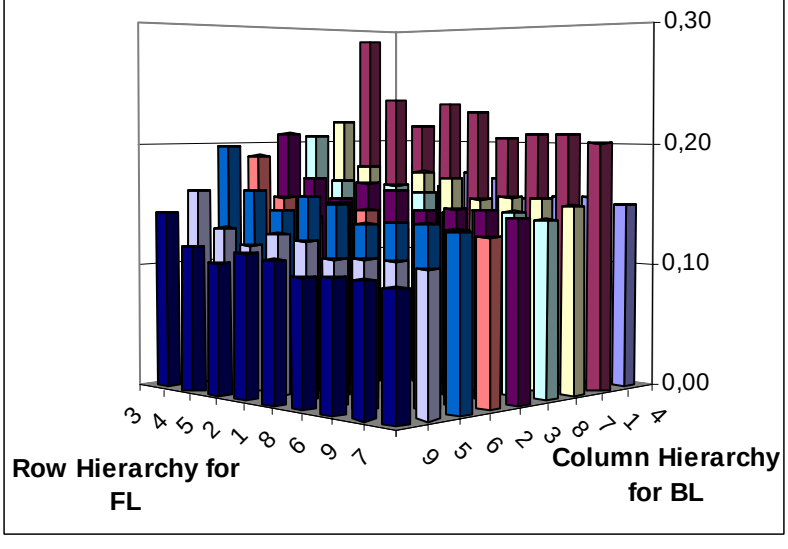
Row Hierarchy for FL

Column Hierarchy for BL

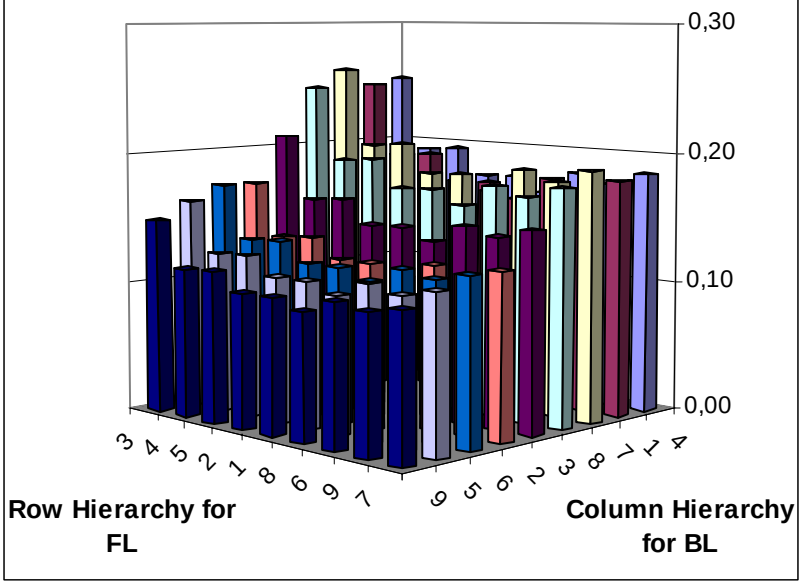
App-Figure 7: MPM for South Central Region using Colombia Imposed Hierarchy, 1985



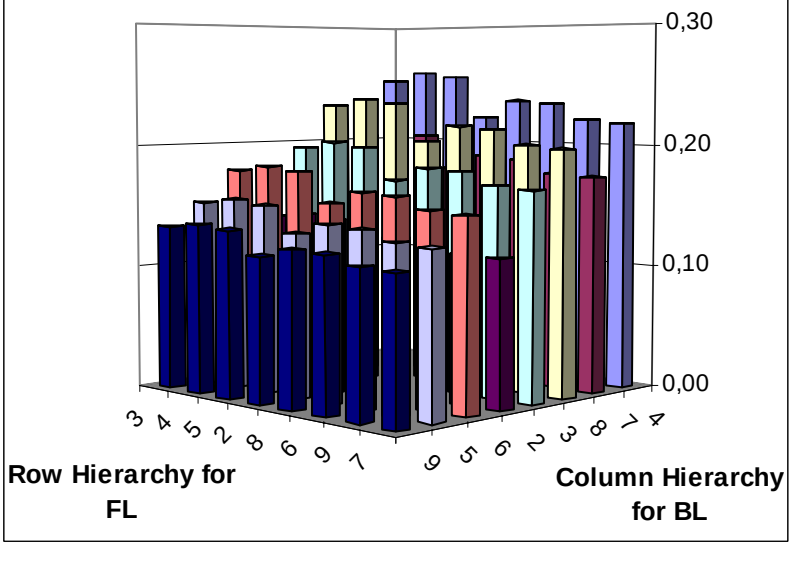
App-Figure 8: MPM for South Central Region using Colombia Imposed Hierarchy, 1992



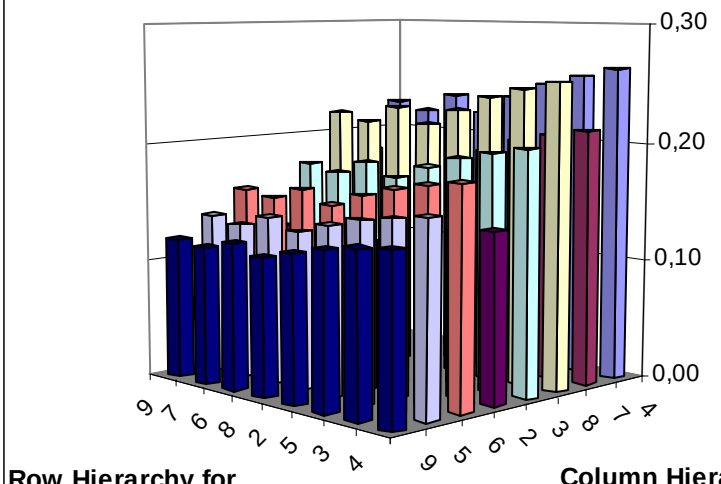
App-Figure 9: MPM for South Central Region using Colombia Imposed Hierarchy, 1997



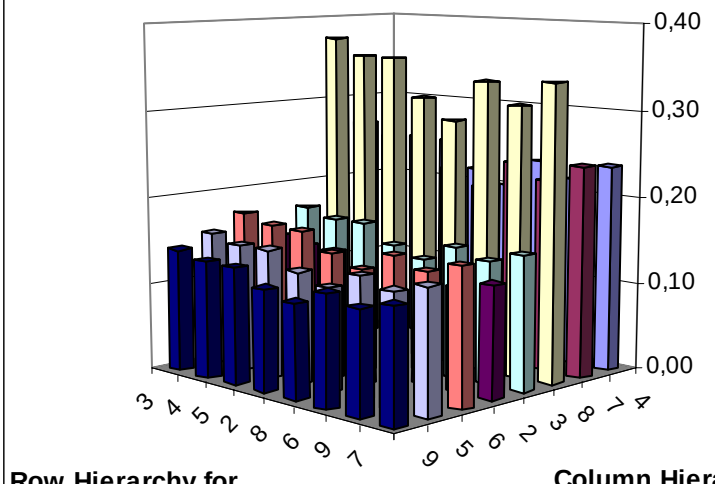
App-Figure 10: MPM for Bogotá using Colombia Imposed Hierarchy, 1985



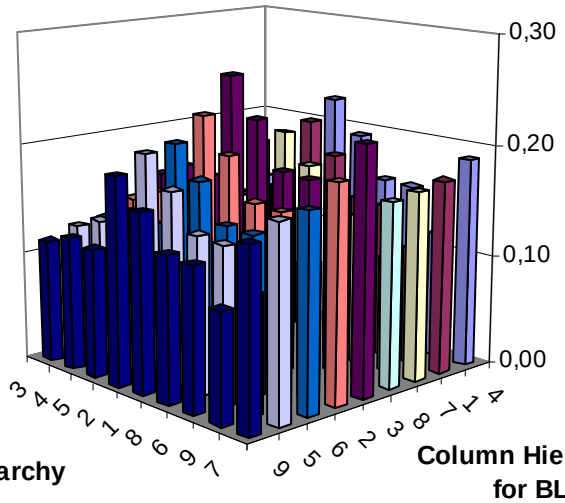
App-Figure 11: MPM for Bogotá using Colombia Imposed Hierarchy, 1992



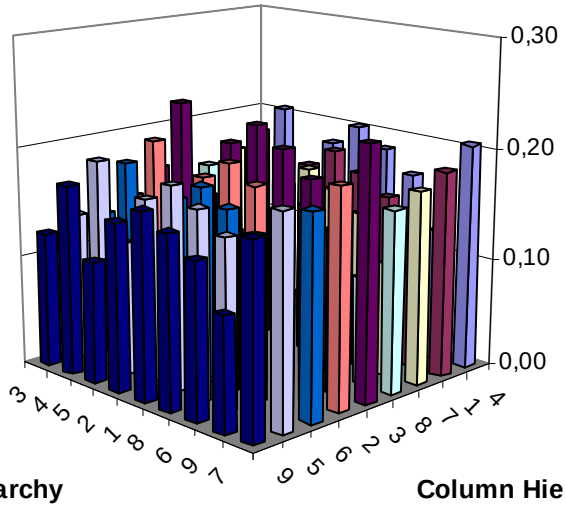
App-Figure 12: MPM for Bogotá using Colombia Imposed Hierarchy, 1997



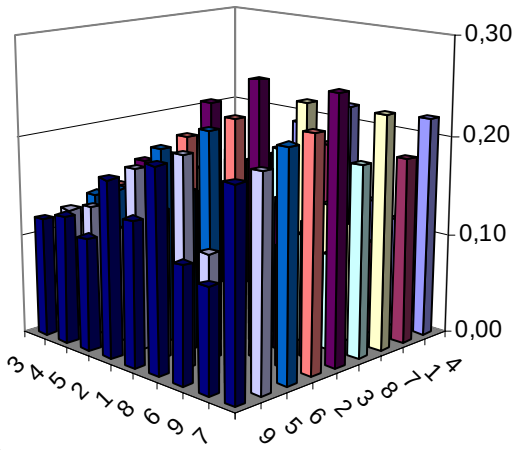
App-Figure 13: MPM for North Central Region using Colombia Imposed Hierarchy, 1985



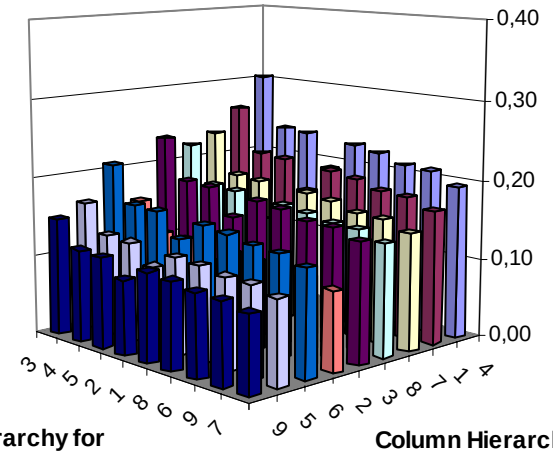
App-Figure 14: MPM for North Central Region using Colombia Imposed Hierarchy, 1992



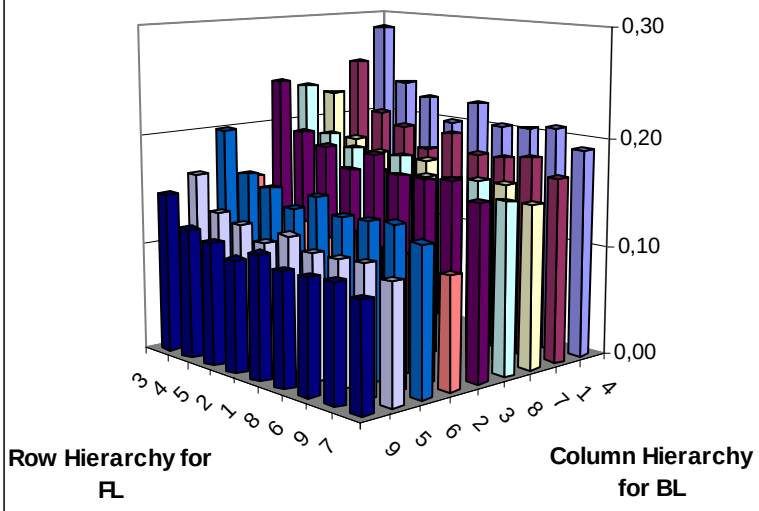
APP-Figure 15: MPM for North Central Region using Colombia Imposed Hierarchy, 1997



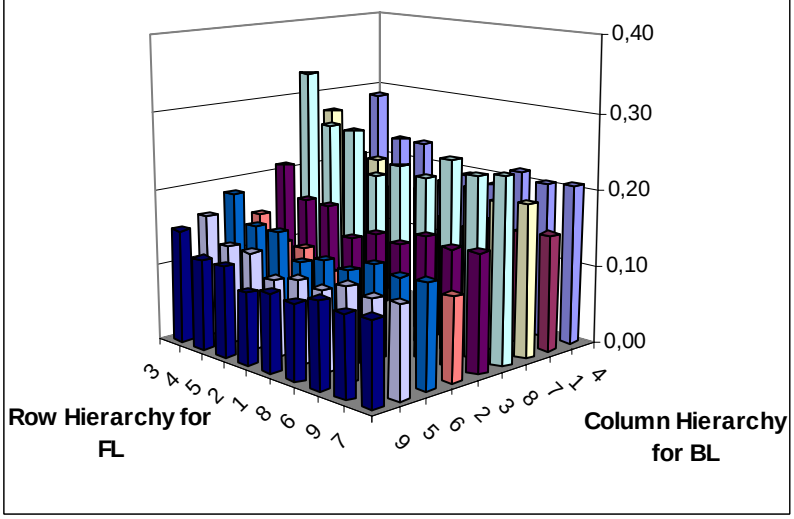
App-Figre 16: MPM for Pacific Region using Colombia Imposed Hierarchy, 1985



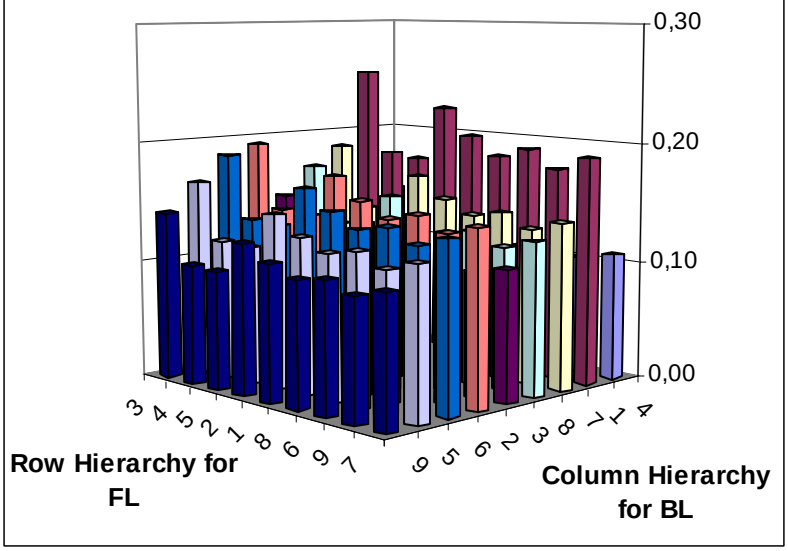
App-Figure 17: MPM for Pacific Region using Colombia Imposed Hierarchy, 1992



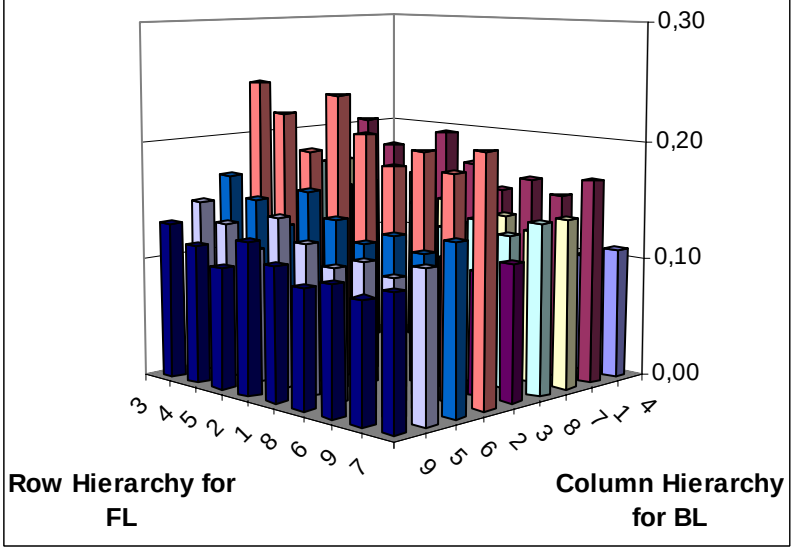
App-Figure 18: MPM for Pacific Region using Colombian Imposed Hierarchy, 1997



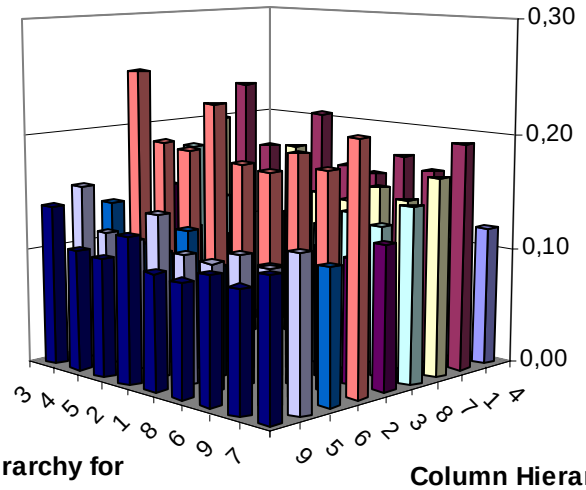
App-Figure 19: MPM for New Dpts Region using Colombia Imposed Hierarchy, 1985



App-Figure 20: MPM for New Dpts Region using Colombia Imposed Hierarchy, 1992



App-Figure 21: MPM for New Dpts Region using Colombia Imposed Hierarchy, 1997



App-Table 1 : Regional Percentage Distribution of Output Multipliers Effects by Sector, 1985

Region	Caribbean Region								
	1	2	3	4	5	6	7	8	9
Caribbean	96,7	98,9	93,3	95,9	95,5	97,9	97,9	92,9	95,6
West Central	0,6	0,2	1,3	0,7	0,7	0,3	0,3	1,2	0,8
South Central	0,5	0,2	1,2	0,6	0,7	0,3	0,3	1,1	0,7
Bogotá	0,9	0,3	1,6	1,2	1,4	0,7	0,7	2,1	1,2
North Central	0,5	0,2	0,9	0,6	0,6	0,3	0,3	1,0	0,6
Pacific	0,7	0,2	1,4	0,8	0,9	0,4	0,4	1,3	0,9
New Dpts	0,2	0,1	0,4	0,2	0,2	0,1	0,1	0,4	0,2
Region	**West Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,3	1,4	0,4	0,8	0,6	0,8	0,8	0,4	0,3
West Central	97,9	91,5	97,5	95,1	96,4	94,7	95,2	96,9	97,9
South Central	0,3	0,8	0,4	0,6	0,4	0,7	0,5	0,4	0,3
Bogotá	0,4	1,1	0,5	1,0	0,8	1,3	0,9	1,0	0,5
North Central	0,5	3,6	0,6	1,6	1,0	1,3	1,7	0,6	0,5
Pacific	0,3	0,7	0,4	0,6	0,5	0,7	0,5	0,5	0,3
New Dpts	0,2	0,9	0,3	0,4	0,3	0,5	0,5	0,2	0,2
Region	**South Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,7	1,4	0,9	1,7	1,9	0,8	1,2	1,3	1,0
West Central	0,7	1,0	1,0	1,6	1,8	0,7	1,0	1,4	1,0
South Central	95,1	91,0	94,3	88,9	87,6	94,5	92,3	91,0	93,6
Bogotá	1,5	1,4	1,6	3,2	4,0	1,7	2,0	2,9	2,0
North Central	0,8	3,4	0,9	2,2	2,1	1,0	1,9	1,3	1,0
Pacific	0,9	0,9	1,1	1,9	2,3	0,9	1,1	1,6	1,2
New Dpts	0,2	0,8	0,2	0,5	0,3	0,3	0,5	0,5	0,2
Region	**Bogotá**								
	2	3	4	5	6	7	8	9	
Caribbean	2,4	4,0	0,9	0,6	0,3	0,9	0,6	0,8	
West Central	1,5	3,0	0,6	0,4	0,2	0,6	0,5	0,6	
South Central	1,4	5,8	0,8	0,5	0,2	0,6	0,8	1,0	
Bogotá	85,7	75,4	94,3	96,5	98,3	94,8	96,3	95,4	
North Central	6,5	3,8	2,1	1,2	0,6	2,2	0,7	0,9	
Pacific	1,0	3,5	0,5	0,3	0,2	0,4	0,5	0,6	
New Dpts	1,6	4,4	0,8	0,5	0,2	0,6	0,6	0,8	
Region	**North Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	1,3	0,3	1,9	1,4	2,1	0,4	0,5	1,6	1,4
West Central	1,3	0,3	2,3	1,4	2,1	0,4	0,5	1,8	1,5
South Central	1,3	0,3	2,0	1,3	2,0	0,4	0,5	1,6	1,4
Bogotá	2,5	0,7	3,2	2,9	4,6	0,9	1,1	3,0	2,7
North Central	91,8	98,0	87,4	90,9	86,1	97,3	96,7	89,5	90,9
Pacific	1,7	0,4	2,5	1,8	2,8	0,5	0,6	2,0	1,8
New Dpts	0,2	0,1	0,5	0,2	0,2	0,1	0,1	0,5	0,3
Region	**Pacific Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,3	3,1	0,3	1,1	0,6	0,6	1,3	0,4	0,3
West Central	0,2	2,0	0,2	0,7	0,4	0,4	0,8	0,3	0,2
South Central	0,2	1,8	0,2	0,6	0,4	0,4	0,7	0,3	0,2
Bogotá	0,3	1,9	0,3	0,7	0,5	0,7	0,8	0,7	0,4
North Central	0,8	8,5	0,7	2,9	1,6	1,2	3,4	0,6	0,7
Pacific	98,0	80,6	98,2	93,2	96,1	96,3	92,0	97,5	97,9
New Dpts	0,2	2,0	0,2	0,7	0,4	0,4	0,8	0,2	0,2
Region	**New Departments Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	1,9	1,0	2,6	3,3	3,8	1,8	1,5	2,6	2,3
West Central	2,0	0,9	3,0	3,2	3,7	1,6	1,5	3,0	2,5
South Central	1,8	0,9	2,7	3,1	3,6	1,6	1,4	2,7	2,3
Bogotá	3,8	2,0	4,5	7,0	8,4	3,5	3,4	5,0	4,6
North Central	1,8	1,1	2,4	3,2	3,7	2,2	1,6	2,5	2,2
Pacific	2,5	1,2	3,4	4,3	5,1	1,9	2,0	3,3	3,1
New Dpts	86,3	93,0	81,6	75,9	71,8	87,4	88,6	80,9	82,9

App-Table 2 : Regional Percentage Distribution of Output Multipliers Effects by Sector, 1992

Region	Caribbean Region								
	1	2	3	4	5	6	7	8	9
Caribbean	97,7	93,5	95,4	96,5	97,2	97,6	97,5	95,3	96,5
West Central	0,4	0,9	0,8	0,5	0,4	0,3	0,3	0,8	0,6
South Central	0,4	0,7	0,8	0,5	0,4	0,3	0,3	0,8	0,6
Bogotá	0,6	2,1	1,1	1,0	0,8	0,8	0,8	1,3	0,9
North Central	0,3	0,8	0,6	0,4	0,3	0,3	0,3	0,6	0,4
Pacific	0,4	1,0	0,9	0,6	0,5	0,4	0,4	0,9	0,7
New Dpts	0,2	1,1	0,4	0,4	0,3	0,3	0,3	0,5	0,3
Region	**West Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,3	1,8	0,3	0,9	0,5	0,5	0,9	0,2	0,3
West Central	98,2	89,6	98,3	94,7	96,8	97,1	94,7	98,5	98,4
South Central	0,2	1,0	0,2	0,6	0,3	0,3	0,6	0,2	0,2
Bogotá	0,3	1,0	0,3	0,7	0,5	0,6	0,7	0,4	0,3
North Central	0,2	1,5	0,2	0,7	0,4	0,4	0,7	0,2	0,2
Pacific	0,2	0,8	0,2	0,5	0,3	0,3	0,5	0,2	0,2
New Dpts	0,5	4,2	0,5	1,9	1,0	0,7	1,9	0,3	0,5
Region	**South Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,8	1,2	0,8	1,9	2,2	1,2	1,2	0,9	1,1
West Central	0,6	0,9	0,6	1,4	1,6	0,9	0,9	0,7	0,9
South Central	95,6	93,4	95,4	89,6	88,6	93,1	93,3	94,8	93,9
Bogotá	1,3	1,9	1,4	3,2	3,6	2,0	2,1	1,6	1,9
North Central	0,6	0,9	0,6	1,4	1,5	0,9	0,9	0,6	0,8
Pacific	0,8	1,1	0,8	1,8	2,0	1,1	1,1	0,9	1,1
New Dpts	0,3	0,7	0,3	0,7	0,6	0,8	0,6	0,4	0,4
Region	**Bogotá**								
	2	3	4	5	6	7	8	9	
Caribbean	2,0	4,4	1,1	0,6	0,3	0,9	0,8	1,0	
West Central	1,1	2,6	0,7	0,4	0,2	0,5	0,5	0,6	
South Central	1,2	5,2	0,8	0,5	0,2	0,6	0,9	1,1	
Bogotá	88,7	78,7	93,8	96,5	98,3	94,9	96,0	95,1	
North Central	1,6	2,9	0,9	0,5	0,2	0,7	0,5	0,7	
Pacific	0,9	3,2	0,6	0,4	0,2	0,4	0,6	0,7	
New Dpts	4,7	3,1	2,1	1,1	0,6	2,0	0,6	1,0	
Region	**North Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,9	0,8	1,9	1,2	1,2	0,4	0,5	1,4	1,3
West Central	0,8	0,7	1,9	1,0	1,0	0,3	0,4	1,4	1,2
South Central	0,9	0,6	1,9	1,1	1,0	0,3	0,4	1,4	1,2
Bogotá	1,2	1,5	2,4	1,7	1,7	0,7	0,8	1,9	1,7
North Central	94,8	94,8	89,1	93,4	93,5	97,6	97,1	91,8	92,7
Pacific	1,0	0,8	2,2	1,2	1,2	0,4	0,5	1,6	1,4
New Dpts	0,3	0,7	0,7	0,4	0,4	0,2	0,3	0,6	0,5
Region	**Pacific Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,4	2,7	0,4	1,3	0,7	0,7	1,3	0,3	0,4
West Central	0,3	1,6	0,3	0,8	0,4	0,5	0,8	0,2	0,2
South Central	0,3	1,5	0,3	0,8	0,4	0,5	0,8	0,2	0,2
Bogotá	0,3	1,4	0,4	0,9	0,5	0,8	0,9	0,4	0,3
North Central	0,3	2,2	0,3	1,0	0,6	0,6	1,0	0,2	0,3
Pacific	97,6	84,0	97,7	92,5	95,8	95,8	92,4	98,4	97,8
New Dpts	0,8	6,5	0,7	2,8	1,5	1,1	2,8	0,4	0,7
Region	**New Departments Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	2,4	1,3	3,7	3,3	4,0	2,3	1,5	2,7	3,2
West Central	1,9	1,0	3,3	2,5	3,0	1,7	1,1	2,4	2,6
South Central	2,0	1,0	3,4	2,7	3,3	1,8	1,2	2,5	2,7
Bogotá	3,6	2,2	5,0	5,1	6,4	3,4	2,4	3,9	4,6
North Central	1,7	1,0	2,6	2,3	2,8	1,9	1,1	1,9	2,2
Pacific	2,4	1,2	3,9	3,2	3,9	2,0	1,4	2,9	3,2
New Dpts	85,9	92,2	78,2	80,8	76,6	86,9	91,5	83,7	81,5

App-Table 3: Regional Percentage Distribution of Output Multipliers Effects by Sector, 1997

Region	Caribbean Region								
	1	2	3	4	5	6	7	8	9
Caribbean	96,3	95,4	94,1	96,8	96,8	96,5	96,2	96,3	95,2
West Central	0,5	0,5	0,8	0,4	0,4	0,4	0,5	0,5	0,6
South Central	0,7	0,6	1,0	0,4	0,4	0,4	0,5	0,5	0,7
Bogotá	1,2	2,0	1,9	1,4	1,3	1,5	1,6	1,4	1,9
North Central	0,4	0,6	0,7	0,4	0,4	0,4	0,5	0,4	0,6
Pacific	0,5	0,5	0,8	0,4	0,4	0,4	0,4	0,5	0,6
New Dpts	0,3	0,5	0,6	0,3	0,3	0,3	0,4	0,4	0,5
Region	**West Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,2	2,2	0,4	0,6	0,6	0,5	1,1	0,3	0,4
West Central	98,3	81,5	97,0	94,9	95,4	96,2	91,3	97,6	96,4
South Central	0,2	1,4	0,3	0,5	0,4	0,4	0,7	0,3	0,4
Bogotá	0,5	1,9	0,9	1,2	0,9	1,0	1,3	0,8	1,0
North Central	0,3	5,0	0,5	1,1	1,1	0,7	2,2	0,4	0,7
Pacific	0,1	0,6	0,3	0,3	0,3	0,3	0,4	0,2	0,3
New Dpts	0,4	7,4	0,6	1,4	1,4	0,9	3,1	0,4	0,8
Region	**South Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,6	2,1	0,9	1,7	1,6	1,6	1,8	1,0	1,3
West Central	0,5	1,6	0,7	1,4	1,3	1,3	1,4	0,9	1,1
South Central	95,7	82,8	93,7	87,6	88,9	88,3	86,5	92,5	90,5
Bogotá	1,7	4,3	2,6	4,8	4,2	4,5	4,5	3,1	3,8
North Central	0,6	3,5	0,8	1,7	1,6	1,7	2,2	1,0	1,3
Pacific	0,5	1,2	0,7	1,4	1,3	1,3	1,3	0,8	1,1
New Dpts	0,4	4,6	0,6	1,3	1,1	1,4	2,3	0,7	1,0
Region	**Bogotá**								
	2	3	4	5	6	7	8	9	
Caribbean	1,1	2,2	0,2	0,2	0,1	0,4	0,2	0,2	
West Central	0,7	1,7	0,1	0,1	0,1	0,2	0,1	0,2	
South Central	0,7	3,7	0,2	0,2	0,1	0,3	0,2	0,3	
Bogotá	90,6	84,2	98,3	98,4	99,1	96,8	98,8	98,3	
North Central	2,6	1,8	0,4	0,4	0,2	0,9	0,2	0,3	
Pacific	0,3	1,7	0,1	0,1	0,0	0,1	0,1	0,1	
New Dpts	4,0	4,6	0,6	0,6	0,4	1,3	0,3	0,5	
Region	**North Central Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	1,7	0,7	2,2	2,0	2,7	0,8	0,8	0,9	1,3
West Central	1,6	0,6	2,1	1,7	2,3	0,7	0,7	0,8	1,2
South Central	1,9	0,6	2,7	1,7	2,3	0,7	0,7	1,0	1,3
Bogotá	3,9	2,1	5,1	5,5	7,3	2,2	2,2	2,3	3,4
North Central	88,5	95,0	84,5	86,7	82,1	94,7	94,6	93,7	91,1
Pacific	1,6	0,6	2,2	1,8	2,5	0,7	0,7	0,9	1,2
New Dpts	0,8	0,3	1,1	0,6	0,8	0,3	0,3	0,4	0,6
Region	**Pacific Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	0,2	2,5	0,6	0,6	0,6	0,6	1,3	0,2	0,4
West Central	0,2	1,5	0,4	0,4	0,4	0,4	0,8	0,2	0,3
South Central	0,2	1,6	0,7	0,4	0,4	0,4	0,8	0,2	0,3
Bogotá	0,2	1,7	0,4	0,6	0,6	0,8	1,2	0,3	0,5
North Central	0,3	5,7	0,7	1,1	1,2	0,9	2,6	0,4	0,7
Pacific	98,3	78,4	95,9	95,3	95,1	95,7	89,6	98,3	96,9
New Dpts	0,6	8,6	1,3	1,6	1,7	1,2	3,8	0,5	1,0
Region	**New Departments Region**								
	1	2	3	4	5	6	7	8	9
Caribbean	2,2	1,2	2,7	3,8	4,1	2,7	2,2	2,1	2,5
West Central	2,0	1,1	2,5	3,1	3,4	2,2	1,8	1,9	2,2
South Central	2,4	1,1	3,1	3,3	3,5	2,4	1,9	2,1	2,5
Bogotá	5,3	3,8	6,4	10,4	10,9	7,5	6,1	5,8	7,0
North Central	1,8	1,2	2,2	3,1	3,2	2,7	2,1	1,9	2,2
Pacific	2,1	1,1	2,6	3,3	3,6	2,3	1,8	1,9	2,3
New Dpts	84,2	90,4	80,6	72,9	71,3	80,1	84,1	84,2	81,3

App-Table 4: Distribution del Regional Output by Sectors, 1985 (Percentage)

Sectors	Caribbean Region	West central Region	South central Region	Bogotá	North central Region	Pacific Region	New Departs.	Total National
1Agriculture, forestry, fishery	20,8	15,8	29,3	0,0	20,0	17,3	37,0	16,0
2Mining	6,7	3,6	3,7	0,6	18,6	0,8	9,3	4,8
3Nondurable Manufacturing	10,6	22,6	12,7	17,8	7,2	19,3	4,0	15,8
4Durable Manufacturing	11,4	11,8	7,9	17,5	5,4	16,5	0,0	12,2
5Construction	9,7	7,5	8,7	7,0	7,4	6,5	9,8	7,8
6Wholesale and Retail Trade	9,3	9,2	9,8	8,7	9,0	9,1	9,9	9,1
7Utilities	12,1	9,0	10,2	10,3	12,8	9,9	8,4	10,4
8Private Services	14,1	15,0	11,7	26,8	13,9	15,3	12,8	16,9
9Government Services	5,4	5,5	5,9	11,3	5,8	5,2	8,7	6,9
TOTAL	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

App-Table 5: Distribution del Regional Output by Sectors, 1992 (Percentage)

Sector	Caribbean Region	West central Region	South central Region	Bogotá	North central Region	Pacific Region	New Departs.	Total National
1. Agriculture, forestry, fishery	19,8	14,2	26,9	0,0	17,9	15,3	19,8	14,1
2. Mining	9,3	3,8	6,2	0,7	10,1	1,4	37,8	6,3
3. Nondurable Manufacturing	11,3	19,8	14,4	15,2	7,8	19,6	3,6	14,9
4. Durable Manufacturing	14,2	13,1	8,2	17,0	12,0	15,4	0,3	13,1
5. Construction	2,8	6,4	6,1	8,1	4,5	6,4	4,7	5,9
6. Wholesale and Retail Trade	8,8	8,9	8,7	8,2	9,3	8,3	8,7	8,6
7. Utilities	13,8	11,9	11,0	12,3	15,6	11,2	7,0	12,1
8. Private Services	13,8	16,0	12,2	26,7	15,5	16,2	12,5	17,5
9. Government Services	6,1	6,1	6,3	11,8	7,3	6,2	5,6	7,5
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

App-Table 6: Distribution del Regional Output by Sectors, 1997 (Percentage)

Sectors	Caribbean Region	West central Region	South central Region	Bogotá	North central Region	Pacific Region	New Departs.	Total National
1Agriculture, forestry, fishery	11,2	8,9	18,6	0,0	10,8	8,4	22,9	9,0
2Mining	4,8	1,2	2,9	0,4	14,4	0,3	28,8	4,3
3Nondurable Manufacturing	11,1	17,1	17,9	12,2	8,0	17,5	3,9	13,6
4Durable Manufacturing	12,0	11,3	9,4	13,3	4,1	12,2	0,6	10,6
5Construction	6,0	8,7	6,8	8,3	7,6	7,0	10,3	7,8
6Wholesale and Retail Trade	8,5	7,0	5,5	8,6	7,1	7,5	4,5	7,4
7Utilities	13,2	11,6	10,1	11,7	13,4	10,9	7,3	11,5
8Private Services	19,2	21,1	14,0	35,3	20,2	23,2	9,7	23,1
9Government Services	14,1	13,1	14,8	10,2	14,5	13,0	11,8	12,8
TOTAL	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0