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Por: Eduardo A. Haddad, Fernando S.Perobelli
Jaime Bonet,Geoffrey. J. D. Hewings.

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Eduardo A. Haddad[♣]
Fernando S. Perobelli[♦]
Jaime Bonet[♥]
Geoffrey J. D. Hewings[♠]

Abstract

This paper advances on the analysis of the structural interdependence among Colombian departments. The results show that Bogotá has a large influence in the other regional economies through its purchasing power. Additionally, it can be observed a center-periphery pattern in the spatial concentration of the effects of the hypothetical extraction of any territory. From a policy point of view, the main findings reaffirm the role played by Bogotá in the polarization process observed in the regional economies in Colombia in the last years. Any policy action oriented to reduce these regional disparities should take into account that, given the structural interdependence among Colombian departments, new investment in the lagged regions would flow through Bogotá and the major regional economies.

Key-words: Input-output; extraction method, Colombia

JEL Classification: R12, R15.

1. Introduction

Colombia has been considered as a country characterized by relatively isolated regions. The geographical and topographical conditions have been mentioned as the main cause of the low integration due to the high costs of building communications infrastructure. As a result, transportation costs are high and accessibility is low, compared to European or North American standards.

Analyzing the evolution of the income estimated for the Colombian provinces, Bonet and Meisel (2006) find a clear hegemony of Bogotá, with an increasing share in the gross national income, which rose from 30% in 1975 to 36% in the year 2000. The importance of Bogotá becomes much clearer in the 1990´s, when a bimodal distribution is detected showing Bogotá very far up in one end of the scale, and the rest of the country on the other end, converging towards a lower per capita income. In fact, departments which formerly had per capita incomes above the national average, like Antioquia, Atlántico, and Valle, now approach it, while the other group of departments stays below it. Finally, these authors detected a persistent center-periphery pattern, in which Bogotá, located at the center of the country, stays at the top of per capita

[♣] Department of Economics – FEA/USP – Brazil. CNPq Scholar.
[♦] Department of Economics – FEA/UFJF – Brazil. CNPq Scholar.
[♥] Centro de Estudios Económicos, CEER, Banco de La República – Colombia.
[♠] University of Illinois, REAL – USA.

incomes, while the departments on the periphery remain in the last places: Caquetá, Cauca, Cesar, Córdoba, Chocó, Nariño, Norte de Santander, Magdalena, and Sucre.

The interdependence between regions has an impact in the regional inequalities evolution. 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 trade patterns between the dynamic or lagging regions will affect the regional convergence process. It could be developed some trade relationships between regions that reinforce the convergence trend.

In the Colombian case, Ramírez (2004) argues that the geographical conditions 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, Ramírez concludes that the integration between the regional markets is limited and restricted by the inadequate transportation network.

In spite of this reality, there exist few studies that focus on the analysis in the linkages between regions in Colombia. Some pioneer works use spatial analysis and econometric techniques to determine the level of spatial dependence in the economic activity within the country. Baron (2003) shows there is not evidence supporting a spatial dependence in the departmental per capita GDP. Bonet (2003) found a country with limited spatial interdependency through the use of a parsimonious approach to measure the interregional interaction. Finally, Galvis (2008) analyzes the spatial dependence at municipal level using two variables: the per capita banking deposits and the per capita local tax collection. The evidence of this work shows a heterogeneous country with a low level of spatial dependence.

Taking advantage of a multiregional input-output table, Bonet (2005) conclude that 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. However, one limitation of this work is imposed by the aggregation of the different Colombian territorial entities into regions.[1] 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.

The purpose of this paper is to move forward in the study of the interregional linkages in Colombia based on the multiregional input-output table for Colombia elaborated by Fipe-USP, REAL and Banco de la República. Using the extraction method proposed by Strassert (1968) and Schultz (1977), and modified by Dietzenbacher *et al.* (1993), we want to determine the structural interdependence among Colombian departments. The main objective is to detect the interdepartmental linkage to analyze the production structure of the regional economies.

The new multiregional input-output table is estimated considering the 32 departments and the capital district, Bogotá, instead of aggregate regions as was made in previous

[1] Colombia is politically divided into departments, districts and municipalities. Bonet (2005) aggregated the 32 Colombian departments and the capital district, Bogotá, into seven regions: Bogotá, Caribbean, West-Central, North-Central, South-Central, Pacific, and New Departments.

works. In addition, the interregional flows are calculated following the methodology proposed by Dixon and Rimmer (2004), which includes, among others variables, the distance between departments and the trade information available, making the estimated flows more reliable.

The paper is composed of four sections as follows: section 2 presents the regional extraction method; section 3 includes the results of our estimations and its analysis; finally, section 4 presents some concluding remarks.

2. Theoretical Framework

Input-output models are useful for analyzing the effects of changes in one sector upon other sectors. Hence, this framework seems to be very suitable to understand how important a sector (or region) is in a multi-regional context. In other words, which is the impact upon the rest of the economy of a slow down in the production of a specific sector (or region)? Moreover, input-output analysis can be useful in order to detect or describe sectoral dependences (or linkages) and to analyze the production structure of an economy.

To make a brief description about the interregional trade, the appendix presents the procedure used to estimate the trade matrices for the CEER model, a spatial CGE model of the Colombian economy. In addition, the appendix includes Table A1 and A2 in which we can see the basic structure of trade among the Colombian departments. In other words, those tables enable us to verify, in aggregated terms, the degree of the relationship between regional economies. Table A1 shows the interregional trade by the sales side and Table A2 by the purchase side. We can verify the importance of intra-regional trade both in terms of sales and purchases. It is also important to highlight the role played by Bogotá in the Colombian internal trade. For 21 departments, Bogotá represents more than 10% of their total purchases. On the sales side, Bogotá is one of the most important destiny for its sales for 12 departments.

The objective of this section is describing the method of hypothetical extraction used to examine the interdepartmental dependence.

2.1 Regional Extraction Method[2]

Consider the general case of an inter-regional input-output model with N regions and n productive sectors in each region[3]. The model is given by:

$$x = Ax + f \qquad (1)$$

where: x – the nN-element column output vector.
A – the nN x nN matrix of input coefficients.
f – the nN-element column vector of final demand.

[2] This section is based on Dietzenbacher, *et al* (1993).
[3] The regions will be represented by superscripts $I,J= 1,\dots,N$ and the products by subscripts $i, j= 1,\dots, n$.

The solution of equation (1) will be:

$$x = (I - A)^{-1} f \quad or \quad Lf$$

$$where\ \ L = (I - A)^{-1}\ \ is\ the\ Leontief\ Inverse$$

The output vector is partitioned as follows[4].

$$x = (x^{1'},..., x^{I'},..., x^{N'})$$

$$where\ x^{I} = (x_1^{I},...x_i^{I},...x_n^{I})'$$

The coefficient matrix is constructed as follows:

$$A = \begin{bmatrix} A^{11} & \cdots & A^{1N} \\ \vdots & \ddots & \vdots \\ A^{N1} & \cdots & A^{NN} \end{bmatrix} \tag{2}$$

The extraction method considers the effect of a hypothetically isolate region upon the output of the rest of the economy. Without loss of generality, let's assume that the first region was extracted. Thus, the remaining N-1 regions will represent the rest of the economy5. Hence, we can write $x = (x^{1'}, x^{R'})'\ with\ x^{R} = (x^{2'},..., x^{I'},..., x^{N'})'$ a n(N-1) element column vector.

In a similar way, we have:

$$A = \begin{bmatrix} A^{11} & A^{1R} \\ A^{R1} & A^{RR} \end{bmatrix} \tag{3}$$

Analogous to equation (3), the Leontief inverse in its partitioned form is given by:

$$L = (I - A)^{-1} = \begin{bmatrix} L^{11} & L^{1R} \\ L^{R1} & L^{RR} \end{bmatrix} \tag{4}$$

Based on the equation (4) we have:

$$x^{1} = L^{11} f^{1} + L^{1R} f^{R} \tag{5a}$$

$$x^{R} = L^{R1} f^{1} + L^{RR} f^{R} \tag{5b}$$

With the hypothetical extraction of region 1, the model in equation (1) will be reduced and will assume the form:

$$\bar{x}^{R} = A^{RR} \bar{x}^{R} + f^{R}$$

[4] The vector *f* can be partitioned in the same way.
[5] In order to represent these regions we will use the superscript *R*.

The vector $\bar{x}^R$ represents the product of the rest of the economy for the reduced model. The solution of the reduced equation is:

$$\bar{x}^R = (I - A^{RR})^{-1} f^R \tag{6}$$

The difference between x^R (equation 5b) and $\bar{x}^R$ (equation 6) will give the extraction effect of region 1 upon the product of the rest of the economy. In order to interpret the elements of vector $x^R - \bar{x}^R$, we have to calculate the matrix L as the inverse of partitioned matrix as follows:

$$L^{1R} = L^{11} A^{1R} (I - A^{RR})^{-1} \tag{7a}$$

$$L^{R1} = (I - A^{RR})^{-1} A^{R1} L^{11} \tag{7b}$$

$$L^{RR} = (I - A^{RR})^{-1} + (I - A^{RR})^{-1} A^{R1} L^{11} A^{1R} (I - A^{RR})^{-1} \tag{7c}$$

Hence we have:

$$x^R - \bar{x}^R = L^{R1} f^1 + \left[L^{RR} - (I - A^{RR})^{-1}\right] f^R \tag{8a}$$

$$= (I - A^{RR})^{-1} A^{R1} L^{11} \left[f^1 + A^{1R} (I - A^{RR})^{-1} f^R\right] \tag{8b}$$

The interpretation of the expression $x^R - \bar{x}^R$ can be divided into two parts: a) the first one $\left(L^{R1} f^1\right)$ describes the production in the rest of the economy that is necessary to satisfy the final demand f^1 in region 1 and b) the second part, $\left[L^{RR} - (I - A^{RR})^{-1}\right] f^R$, describes the production in the rest of the economy $L^{RR} f^R$ that is necessary to satisfy the final demand in the rest of the economy f^R.

We can observe that the elements of vector $x^R - \bar{x}^R$ show the interdependence between region 1 and the other regions. According to Dietzenbacher *et al.* (1993), these interdependencies are fundamentally backward in their nature. This can be demonstrated using the matrix A^{R1} (whose elements indicate the backward dependence of 1 on R) and A^{1R} (whose elements indicate the backward dependence of R on 1).

In order to better understand the expression $x^R - \bar{x}^R$, we will use the equation (8b) and examine this equation using the idea of interregional spillover effects and interregional feedback effects developed by Miller and Blair (1985).

To satisfy the final demand f^1 in region 1, this region must produce $L^{11} f^1$. Region 1 does not have all the inputs necessary to reach this level of production. So, with the aim of achieving this production, it is necessary that region 1 purchase inputs direct from the other regions. The amount of inputs purchased will be $A^{R1} L^{11} f^1$. To provide these inputs, the production in the rest of the economy is required to become $\left(I - A^{RR}\right)^{-1} A^{R1} L^{11} f^{1}$. The same analysis can be made for the demand in the rest of the economy f^{R}.

Applying the traditional idea of inter-regional feedbacks to region 1, it is possible to affirm that the feedbacks for this region will be obtained by comparing the outputs of region 1 within the inter-regional model to the outputs of region 1, within the single-region model. In a mathematical form we have:

$$x^{1} - \overline{x}^{1} = L^{11} f^{1} + L^{1R} f^{R} - \left(I - A^{11}\right)^{-1} f^{1} \qquad (9)$$

Taking the equations (7) and (8) and interchanging the superscripts 1 and R we will have:

$$x^{1} - \overline{x}^{1} = \left(I - A^{11}\right)^{-1} A^{1R} L^{RR} \left[f^{R} + A^{R1}\left(I - A^{11}\right)^{-1} f^{1}\right] \qquad (10)$$

Based on the regional extraction framework it is possible to affirm that the vector $x^{1} - \overline{x}^{1}$ measures the backward dependence of the rest of the economy on the region 1. In other words, the vector enables us to measure the impact of extracting, from the economy, all the N-1 regions in R upon the output of the remaining region 1.

3. Presentation and Analysis of Results

Some patterns of interdepartmental dependence can be gauged from the study of the linkages between the Colombian territorial entities. For the buying side, a first element is the fact that all departments have a net dependence on Bogotá. In other words, Bogotá has a large influence in the other regional economies through its purchasing power. This finding could be expected because of the high concentration of the national income in the capital city. According to CEGA (2006), around 36% of the national income was generated in Bogotá in 2000. This participation increases up to 41% when the income generated in Cundinamarca, the department surrounding the capital city, is added.

Another feature is the spatial concentration of the effects of a hypothetical extraction of any territory on the capital district, Bogotá, and the biggest departmental economies, Antioquia, Valle, Cundinamarca, Santander, and Atlántico. With the exception of Atlántico, which is located at the Caribbean regions, the other territories are located at the center of the country and belong to the Andean region. On the other side, the departments located at the periphery of the country exhibit weak impact as a consequence of the isolation of any departmental economy. Considering this spatial distribution of the effects of the extraction method, we can argue the existence of a center-periphery pattern.

From the selling side, the effects look more randomly distributed in space when they are compared to those observed on the buying side. However, the departments located at the south-east of the country still show the lowest effects, while those located in the center of the country, the Andean region, exhibited the highest impacts. In other words, we can also talk about a center-periphery pattern.

This section describes these findings in detailed. Initially, the backward effects are analyzed to evaluate the buying region side. In the second part, the selling region side is studied by paying attention to the forward effects.

3. 1. Backward Effects: Analysis Based on the Buying Side

The application of the extraction method enables us to construct a typology of the Colombian departments in terms of the degree of interdependence. The results presented in this section are based on the equations *8b* and *9*. The equations generate both the interdependence between region *1* on the other regions ($x^R - x^{-R}$) and the backward dependence of the rest of the economy on the region *1* ($x^1 - x^{-1}$). The first one is called the backward effects, BL, while the second one is identified as backward interdepartmental feedbacks, IF_b. The results are presented as maps of standard deviation from the mean.

Table 1 enables us to compare the BL (backward effects) and IF_b (backward inter-state feedbacks). If BL > IF_b we conclude that the backward dependence of each isolated department upon the rest of the Colombian economy is more important than the backward dependence of the rest of the economy upon each isolated department. The results show that all departments of Colombia are more dependent upon the rest of Colombian economy than the other way around.

It is interesting to highlight the differences among the departments in terms of this kind of dependence. Table 1 shows that Bogotá, Antioquia, Valle, Santander, Cundinamarca, and Atlántico present the lowest degree of dependence upon the rest of the Colombian economy. On the other hand, Guaviare, Vichada, Amazonas, Vaupés, and Guainía exhibit a higher degree of dependence upon the rest of the Colombian economy.

It can be noted that the BL effects show an inverse relationship with the level of development in each territory, while the IFb effects present a positive relationship with the development in each territorial entity. The correlation coefficient between BL effects and the income per capita of 2000 is -0.5, whereas the association between IFb effects and the income per capita of 2000 is 0.79.[6] In other words, we can say, as it was expected, that dependence is higher in small economies and lower in big ones.

Another important aspect in the study of interdependence is the spatial analysis. We present some maps to verify the impact is in spatial terms of the isolation of a specific Colombian department. The six major regional economies, Bogotá, Antioquia, Valle, Atlántico, Cundinamarca, and Santander, have been selected in this exercise.

[6] These correlation coefficients are statically significant at 1%.

Table 1: Backward effects (BL) and backward interdepartmental feedbacks (IFb), 2004

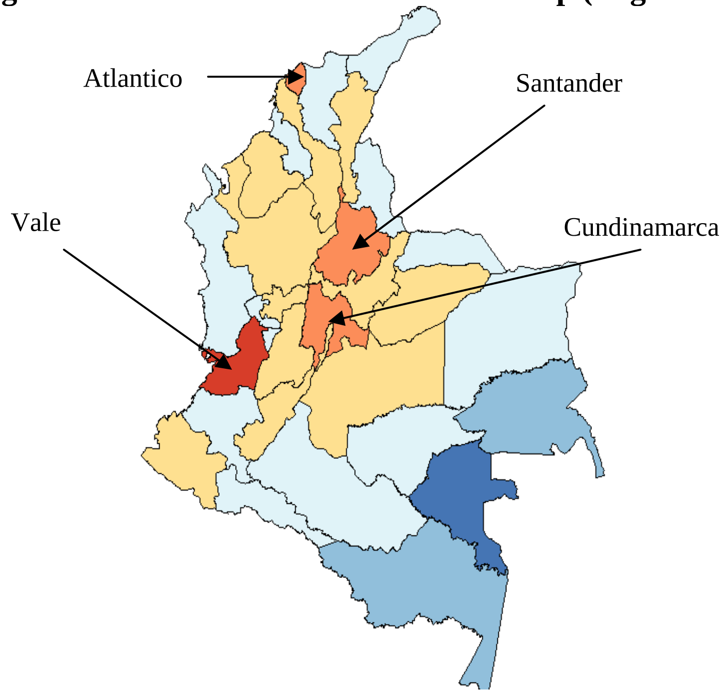
Department	BL	IFb
Bogotá	2,84	0,215
Antioquia	4,40	0,024
Valle	8,06	0,040
Santander	13,01	0,011
Cundinamarca	14,95	0,007
Atlántico	15,96	0,176
Bolívar	21,09	0,013
Casanare	32,34	0,006
Boyacá	34,96	0,006
Córdoba	36,49	0,007
Tolima	40,27	0,007
Caldas	45,50	0,006
Cesar	47,64	0,006
Huila	51,73	0,004
Meta	52,21	0,005
Cauca	54,85	0,003
Risaralda	56,26	0,004
Nariño	57,87	0,004
Norte	58,16	0,003
La Guajira	69,31	0,004
Magdalena	72,81	0,004
Quindío	128,08	0,002
Arauca	141,88	0,002
Sucre	144,99	0,002
Caquetá	219,13	0,001
Chocó	263,98	0,001
Putumayo	418,87	0,000
San Andrés	442,74	0,001
Guaviare	927,06	0,000
Vichada	1.121,16	0,000
Amazonas	1.491,20	0,000
Vaupés	2.539,93	0,000
Guainía	2.836,10	0,000

Source: elaborated by the authors.

Figure 1 show the percentile map when Bogotá was hypothetically extracted. We can verify that the highest impact occurs at Valle, Cundinamarca, Atlántico, and Santander, which means that those regions have Bogotá as an important market to their purchases. This indicates that the big regional economies trade between them. In addition, it is possible to affirm that sixteen departments have an impact above 50% percentile when Bogotá is hypothetically extracted. The majority of them are small economies with low share in the national income.[7]

[7] Bonet and Meisel (2006) classify the Colombian territories into four categories, according to their share in national income. Bogotá with a share above 30%, Antioquia and Valle with shares around 10-15%, Atlántico, Cundinamarca, and Santander with participations around 5%, and the remaining departments with shares less than 3%.

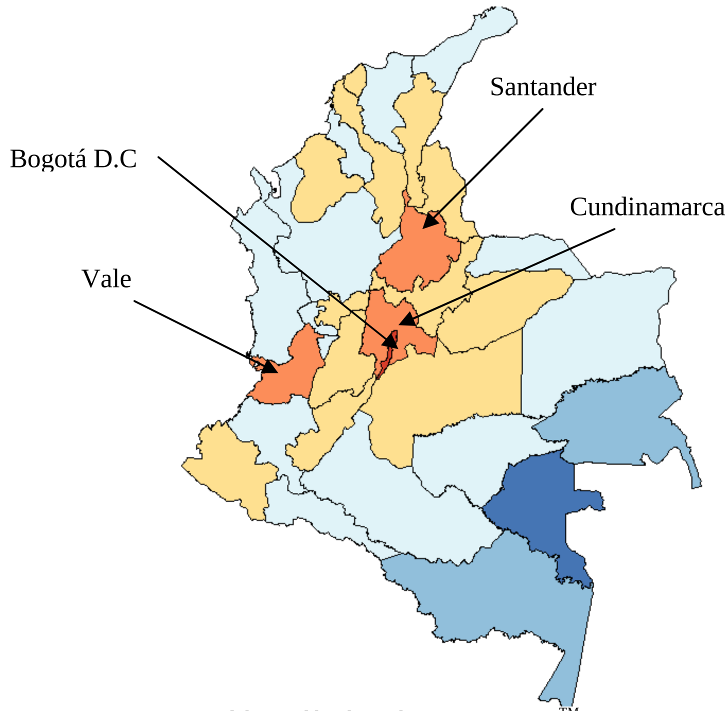
Figure 1. Backward Effects: Percentile Map (Bogotá D.C)



Source: Elaborated by the authors using GeoDA™.

Figure 2 shows the degree of backward interdependence when Antioquia was hypothetically extracted. We can observe that the departments which are more dependent on Antioquia's purchases are located mainly in the Central region of Colombia. As a matter of fact, we have that Bogotá presents the highest impact, while Santander, Cundinamarca, and Valle are located in percentile 90% to 99%. These departments belong to the Andean region.

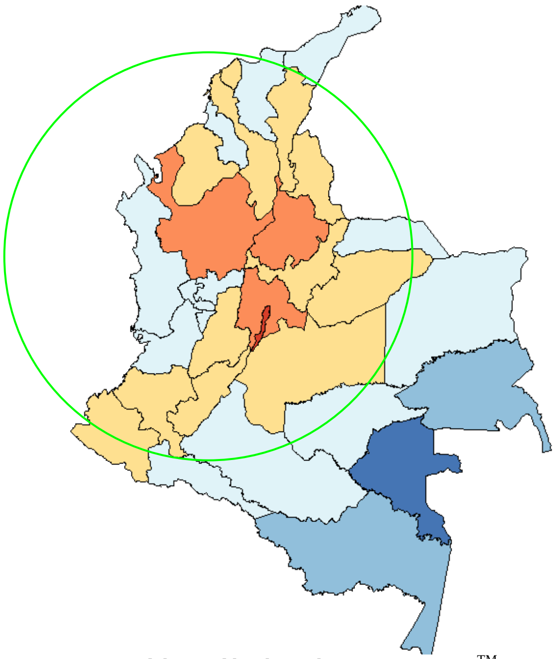
Figure 2. Backward Effects: Percentile Map (Antioquia)



Source: Elaborated by the authors using GeoDA™.

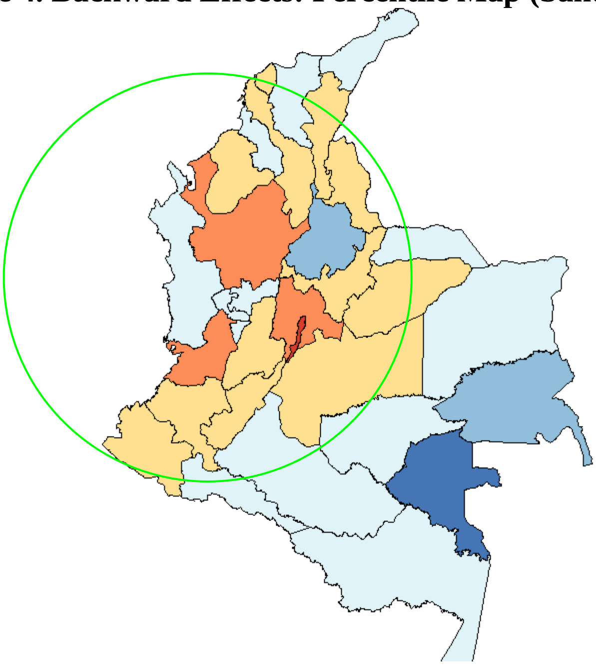
In Figure 3, we can observe that when Valle was hypothetically extracted the highest impact is upon Bogotá, followed by Antioquia, Valle, and Cundinamarca. This pattern shows a cluster located at the Central - North part of the country that concentrates the departments that have the highest impact in terms of purchase, which are inside the green circle in the figure.

Figure 3. Backward Effects: Percentile Map (Valle)



Source: Elaborated by the authors using GeoDA™.

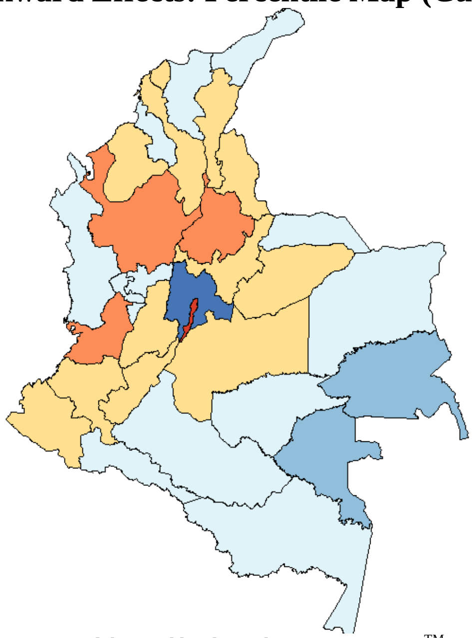
Figure 4. Backward Effects: Percentile Map (Santander)



Source: Elaborated by the authors using GeoDA™.

As can be seen in Figures 4 and 5, a similar pattern showing higher impacts on regions located at the Center-North (Caribbean and Andean regions), and lower impacts upon regions located at the periphery occurs when, respectively, the departments of Santander and Cundinamarca were hypothetically extracted. In both cases, Bogotá is the territory with the highest effect when these departments were removed.

Figure 5. Backward Effects: Percentile Map (Cundinamarca)



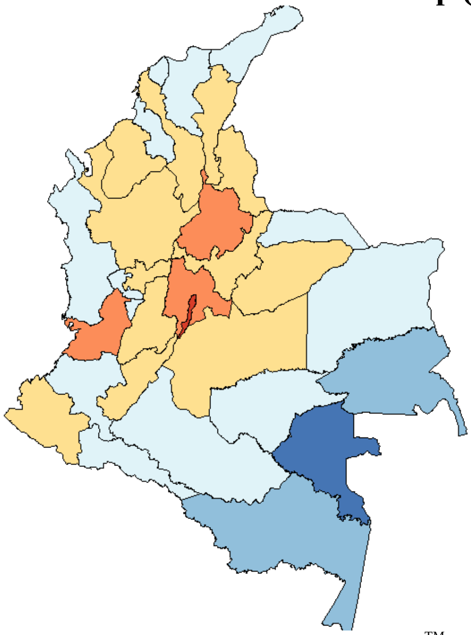
Source: Elaborated by the authors using GeoDA™.

An important result for the economy of Atlántico is one of backward dependence. As can be seen in Figure 6, the more important BL effects take place in Bogotá, Valle, Santander, and Cundinamarca. Again, a center-periphery pattern is obtained when Atlántico is extracted. In addition, there is a low degree of dependence of this department with its neighbors in the Caribbean region.

It is also relevant to consider the differences between the bilateral linkages of two departments. The literature argues that the effect on a small department (or region, or country) of isolating a large department is larger than the reverse effect. For example, if a department *F* depends more on department *I* than the other way round, it is possible to affirm that *F* shows a net dependence on *I*. The net dependence at Colombian economy is given in Table 2.

The results show that each department has a net dependence on Bogotá. We can also sustain that each department, except for Bogotá and Atlántico, also show a net dependence on Antioquia. It is also important to highlight that each department, except for Bogotá and Antioquia, also exhibit a net dependence on Valle. In contrast, Vaupés is at the other end, showing a net dependence on the other departments.

Figure 6. Backward Effects: Percentile Map (Atlántico)



Source: Elaborated by the authors using GeoDA[TM].

We can visualize in Table 2 that the departments with a higher degree of net dependence on the other departments are Vaupés, Guainía, Amazonas, Vichada, San Andrés, Guaviare, Putumayo, Chocó, Caquetá, Sucre, Arauca and Magdalena, which are departments with low shares on the national income and are located at the periphery of the country.

We can emphasize that this structure of bilateral dependencies is quite significant because the linkages show a clear hierarchical structure of net dependencies. There is a range of dependence in which the degree of dependence is increasing as the level of economic development decreases. This scale begins with Bogotá, the territory with the greatest economic performance, and finishes with some of the most lagged departments: Putumayo, Guaviare, Vichada, Amazonas, San Andrés, Guainía and Vaupés. In this scale, we can see that the departments with the highest share in the national income are dependent between them: Antioquia depends on Bogotá and Atlántico; Valle depends on Bogotá and Antioquia; Santander depends on Bogotá, Atlántico, and Valle; and Atlántico depends on Bogotá, Valle, Santander, and Cundinamarca.

The level of integration between the territories located at the center of Colombia can be expected due to the concentration of road infrastructure in this part of the country. According to Pachón and Ramirez (2006), the roads in the departments located at the central region represented around 80% of the national infrastructure in 1998.

Table 2. Net Backward Dependencies

(Continues….)

	Net Backward Dependencies of										
	BOGOTÁ D.C	ANTIOQUIA	VALLE	SANTANDER	CUNDINAMARCA	ATLANTICO	BOLIVAR	CASANARE	BOYACÁ	CORDOBA	TOLIMA
BOGOTÁ D.C	---	84875	62700	72274	73680	72575	82884	88036	88800	89109	90584
ANTIOQUIA	0	---	40733	51769	54431	0	62973	68073	68511	69963	70800
VALLE	0	0	---	8996	11075	20559	20373	24869	25346	26879	28085
SANTANDER	0	0	0	---	2432	11500	11750	16599	16958	18296	19428
CUNDINAMARCA	0	0	0	0	---	9163	8981	13871	14971	0	16901
ATLANTICO	0	10250	0	0	0	---	0	4599	4906	6569	7350
BOLIVAR	0	0	0	0	0	154	---	4718	5148	6423	7578
CASANARE	0	0	0	0	0	0	0	---	394	1887	3021
BOYACÁ	0	0	0	0	0	0	0	0	---	1501	2446
CORDOBA	0	0	0	0	0	0	0	0	0	---	1014
TOLIMA	0	0	0	0	0	0	0	0	0	0	---
CESAR	0	0	0	0	0	0	0	0	0	0	0
HUILA	0	0	0	0	0	0	0	0	0	0	0
CALDAS	0	0	0	0	0	0	0	0	0	0	0
NARINO	0	0	0	0	0	0	0	0	0	0	0
META	0	0	0	0	0	0	0	0	0	0	0
NORTE SANTANDER	0	0	0	0	0	0	0	0	0	0	0
CAUCÁ	0	0	0	0	0	0	0	0	0	0	0
RISARALDA	0	0	0	0	0	0	0	0	0	0	0
LA GUARIJA	0	0	0	0	0	0	0	0	0	0	0
MAGDALENA	0	0	0	0	0	0	0	0	0	0	0
ARAUCA	0	0	0	0	0	0	0	0	0	0	0
QUINDIO	0	0	0	0	0	0	0	0	0	0	0
SUCRE	0	0	0	0	0	0	0	0	0	0	0
CAQUETÁ	0	0	0	0	0	0	0	0	0	0	0
CHOCO	0	0	0	0	0	0	0	0	0	0	0
PUTUMAYO	0	0	0	0	0	0	0	0	0	0	0
GUAVIARE	0	0	0	0	0	0	0	0	0	0	0
SAN ANDRES	0	0	0	0	0	0	0	0	0	0	0
VICHADA	0	0	0	0	0	0	0	0	0	0	0
AMAZONAS	0	0	0	0	0	0	0	0	0	0	0
GUANIA	0	0	0	0	0	0	0	0	0	0	0
VAUPES	0	0	0	0	0	0	0	0	0	0	0

Source: Elaborated by the authors.

Table 2. Net Backward Dependencies

(Continues….)

	Net Backward Dependencies of										
	CESAR	**HUILA**	**CALDAS**	**NARINO**	**META**	**NORTE SANTANDER**	**CAUCÁ**	**RISARALDA**	**LA GUARIJA**	**MAGDALENA**	**ARAUCA**
BOGOTÁ D.C	91473	91965	92149	92881	92861	93248	93059	93388	94146	94419	97066
ANTIOQUIA	72224	72646	73307	73644	73682	73747	73920	74052	74890	75225	77623
VALLE	29105	29580	30202	30712	30584	30704	30763	31038	31719	32192	34389
SANTANDER	20490	20994	21709	22054	22140	22100	22275	22536	23347	23550	25818
CUNDINAMARCA	17839	18317	18896	19251	19345	19358	19478	19703	20510	20966	23177
ATLANTICO	8711	9015	9589	9959	10039	9991	10179	10438	11181	11659	13891
BOLIVAR	8825	9195	9747	10189	10271	10275	10438	10643	11475	11905	14117
CASANARE	4098	4462	5148	5511	5601	5576	5726	5988	6771	7199	9413
BOYACÁ	3748	4066	4743	5113	5155	5196	5337	5573	6384	6773	9019
CORDOBA	2246	2575	3277	3614	3676	3708	3848	4089	4903	5337	7558
TOLIMA	1221	1587	2274	2628	2664	2681	2820	3076	3882	4320	6539
CESAR	---	335	1060	1404	1470	1483	1611	1876	2663	3298	5334
HUILA	0	---	673	1057	1126	1133	1266	1541	2308	2773	5005
CALDAS	0	0	---	348	420	437	565	804	1636	2066	4283
NARINO	0	0	0	---	64	89	227	469	1272	1714	3932
META	0	0	0	0	---	7	148	394	1206	1642	3860
NORTE SANTANDER	0	0	0	0	0	---	138	373	1191	1637	3887
CAUCÁ	0	0	0	0	0	0	---	247	1072	1505	3718
RISARALDA	0	0	0	0	0	0	0	---	798	1253	3464
LA GUARIJA	0	0	0	0	0	0	0	0	---	726	2662
MAGDALENA	0	0	0	0	0	0	0	0	0	---	2217
ARAUCA	0	0	0	0	0	0	0	0	0	0	---
QUINDIO	0	0	0	0	0	0	0	0	0	0	0
SUCRE	0	0	0	0	0	0	0	0	0	0	0
CAQUETÁ	0	0	0	0	0	0	0	0	0	0	0
CHOCO	0	0	0	0	0	0	0	0	0	0	0
PUTUMAYO	0	0	0	0	0	0	0	0	0	0	0
GUAVIARE	0	0	0	0	0	0	0	0	0	0	0
SAN ANDRES	0	0	0	0	0	0	0	0	0	0	0
VICHADA	0	0	0	0	0	0	0	0	0	0	0
AMAZONAS	0	0	0	0	0	0	0	0	0	0	0
GUANIA	0	0	0	0	0	0	0	0	0	0	0
VAUPES	0	0	0	0	0	0	0	0	0	0	0

Source: Elaborated by the authors.

Table 2. Net Backward Dependencies

	Net Backward Dependencies of										
	QUINDIO	**SUCRE**	**CAQUETÁ**	**CHOCO**	**PUTUMAYO**	**GUAVIARE**	**SAN ANDRES**	**VICHADA**	**AMAZONAS**	**GUANIA**	**VAUPES**
BOGOTÁ D.C	96823	97239	98034	98162	98343	99290	99284	99393	99599	99692	99715
ANTIOQUIA	77686	77866	78881	79154	79042	80099	80093	80326	80395	80565	80587
VALLE	34527	34789	35640	35810	35830	36848	36920	37076	37153	37325	37349
SANTANDER	26058	26384	27282	27376	27429	28465	28527	28693	28772	28942	28964
CUNDINAMARCA	23248	23422	24456	24565	24589	25641	25704	25865	25945	26124	26138
ATLANTICO	13949	14292	15170	15280	15302	16352	16422	16594	16659	16829	16852
BOLIVAR	14199	14458	15389	15510	15538	16581	16644	16809	16889	17058	17081
CASANARE	9507	9799	10703	10832	10854	11903	11956	12130	12210	12380	12404
BOYACÁ	9103	9418	10295	10431	10453	11504	11566	11731	11811	11980	12002
CORDOBA	7615	7818	8831	8947	8971	10019	10082	10247	10326	10496	10520
TOLIMA	6588	6910	7803	7927	7964	9005	9068	9228	9304	9523	9500
CESAR	5385	5742	6598	6723	6746	7795	7855	8023	8101	8272	8295
HUILA	5049	5358	6322	6379	6533	7452	7516	7714	7759	7930	7953
CALDAS	4342	4652	5556	5670	5716	6743	6813	6971	7053	7221	7244
NARINO	3983	4301	5212	5320	5330	6393	6461	6621	6700	6870	6893
META	3915	4231	5134	5249	5276	6345	6389	6582	6628	6798	6868
NORTE SANTANDER	3909	4224	5129	5242	5267	6315	6384	6543	6623	6792	6814
CAUCÁ	3784	4091	4997	5107	5130	6179	6247	6407	6480	6657	6680
RISARALDA	3525	3836	4739	4894	4880	5929	5998	6157	6236	6406	6428
LA GUARIJA	2715	3040	3934	4051	4076	5122	5192	5350	5430	5599	5622
MAGDALENA	2272	2585	3490	3606	3631	4678	4747	4901	4987	5156	5179
ARAUCA	56	368	1273	1389	1412	2461	2530	2689	2768	2938	2962
QUINDIO	---	312	1220	1336	1356	2406	2475	2634	2713	2883	2906
SUCRE	0	---	904	1020	1044	2092	2161	2320	2399	2570	2593
CAQUETÁ	0	0	---	110	140	1198	1257	1416	1496	1666	1690
CHOCO	0	0	0	---	24	1072	1141	1300	1380	1550	1573
PUTUMAYO	0	0	0	0	---	1048	1117	1276	1355	1526	1550
GUAVIARE	0	0	0	0	0	---	69	228	307	477	501
SAN ANDRES	0	0	0	0	0	0	---	159	238	408	432
VICHADA	0	0	0	0	0	0	0	---	79	250	274
AMAZONAS	0	0	0	0	0	0	0	0	---	170	194
GUANIA	0	0	0	0	0	0	0	0	0	---	24
VAUPES	0	0	0	0	0	0	0	0	0	0	---

Source: Elaborated by the authors.

3.2 Forward effects: analysis based on the selling region side

The examination of the trend in the forward effects does not show as clear a pattern as it was observed in the backward effects. It seems that these effects are more randomly distributed in space. However, the departments located at the south-east of the country still show the lowest effects, as a result of the hypothetical extraction of any territorial entity, whereas those located at the center of the country exhibit the highest impacts. In other words, we can also talk about a center-periphery pattern.

Table 3: Forward effects (FL) and forward interdepartmental feedbacks (IF_f), 2004

Department	FL	IFf
Vichada	0,751	0,217
Vaupés	0,389	0,202
Valle	0,307	0,276
Tolima	0,425	0,262
Sucre	0,290	0,197
Santander	0,261	0,339
San Andrés	0,128	0,147
Risaralda	0,281	0,272
Quindío	0,321	0,240
Putumayo	0,348	0,266
Norte	0,266	0,212
Nariño	0,458	0,218
Meta	0,471	0,196
Magdalena	0,489	0,175
La Guajira	0,232	0,105
Huila	0,339	0,244
Guaviare	0,474	0,243
Guainía	0,313	0,223
Cundinamarca	0,375	0,191
Córdoba	0,394	0,201
Chocó	0,126	0,217
Cesar	0,277	0,231
Cauca	0,354	0,290
Casanare	0,302	0,228
Caquetá	0,463	0,212
Caldas	0,424	0,250
Boyacá	0,532	0,689
Bolívar	0,329	0,438
Bogotá	0,377	0,164
Atlántico	0,191	0,293
Arauca	0,288	0,209
Antioquia	0,144	0,314
Amazonas	0,265	0,194

Source: Elaborated by the authors.

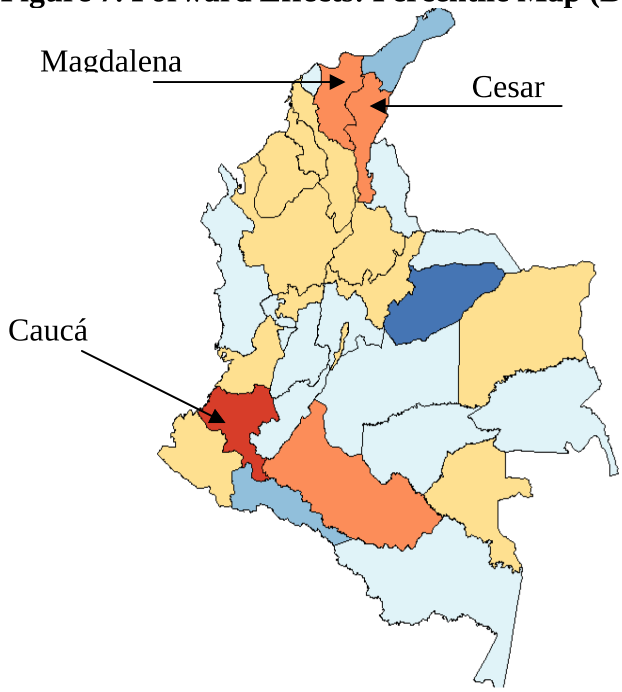
According to the forward effects (FL) and the forward interdepartmental feedback (IF_f), two clusters of territories can be singled out in Table 3. The first one is formed by regions that present ($FL>IF_f$), meaning that the forward dependence of the isolated region upon the rest of the economy is bigger than the forward dependence of the rest upon the isolated region. Most of the territories, 26 out of 33, are in this group, which means that these departments have a relative high dependency on the other ones as a market for the sale of their product.

The second cluster is formed by regions that presents ($IF_f > FL$) meaning that the rest of the economy has a high degree of forward dependence upon the isolated region. In other words the rest of the economy has a high degree of dependence on the isolated region as a market for the sale of its products. This is the case for Antioquia, Atlántico, Bolívar, Boyacá, Chocó, Santander, and San Andrés.

In order to show an example of the forward spatial interdependence among the Colombian departments, we present the results of extraction of the major regional economies in Colombia: Bogotá, Antioquia, Valle, Santander, Cundinamarca, and Atlántico. The forward effects in percentile maps of these departments can be observed, respectively, in Figures 7 to 12.

When Bogotá was hypothetically extracted, the highest impacts occur upon Caucá, followed by Cesar and Magdalena. Figure 7 shows that a cluster located at the north of Colombia is formed when the hypothetical extraction of Bogotá occurs. This cluster presents impacts above the mean. Thus we can affirm that there is a bi-directional trade. In other words, Bogotá is also an important market (buying side) for the departments located in this cluster and an important seller for those departments.

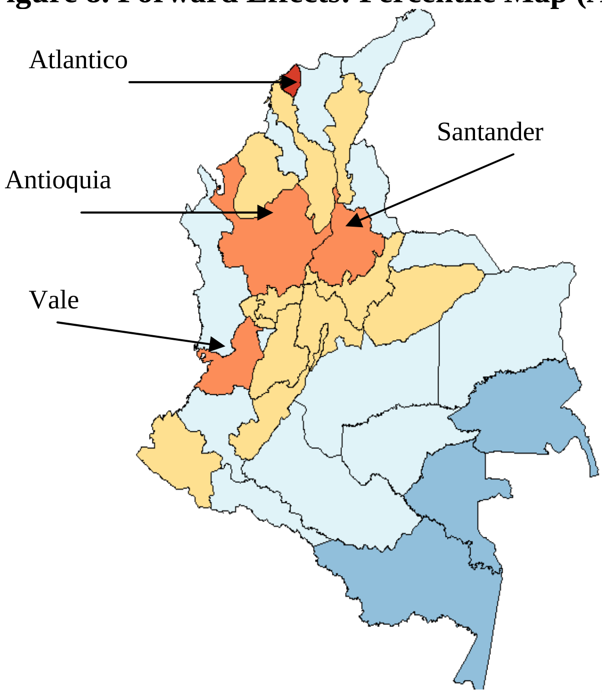
Figure 7. Forward Effects: Percentile Map (Bogotá D.C)



Source: Elaborated by the authors using GeoDA™.

The most important destiny for the sales of Antioquia are the departments of Atlántico, Valle, Antioquia, and Santander. We can observe that there is a high degree of concentration of high impacts in the region Central-North of the country. Thus we can argue that Antioquia has a small connection, in terms of its sales with the periphery of the country (Figure 8).

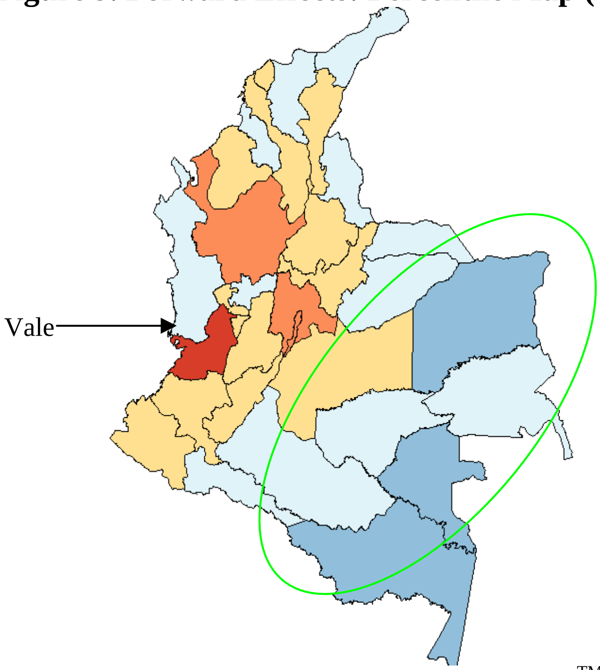
Figure 8. Forward Effects: Percentile Map (Antioquia)



Source: Elaborated by the authors using GeoDA™.

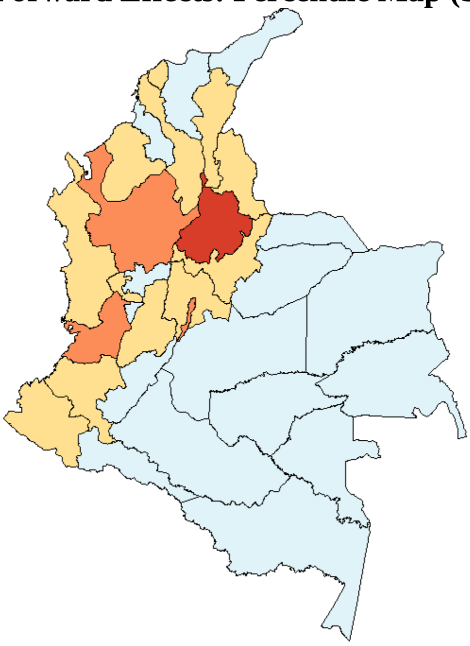
It is important to highlight the degree of internal sales that the department of Valle presents. The highest impact occurs at the region itself, followed by Cundinamarca, Bogotá, and Antioquia. It is also important to emphasize the small size of trade (in sales terms) between Valle and the south-east part of the country (in the green circle on the Figure 9).

Figure 9. Forward Effects: Percentile Map (Valle)



Source: Elaborated by the authors using GeoDA™.

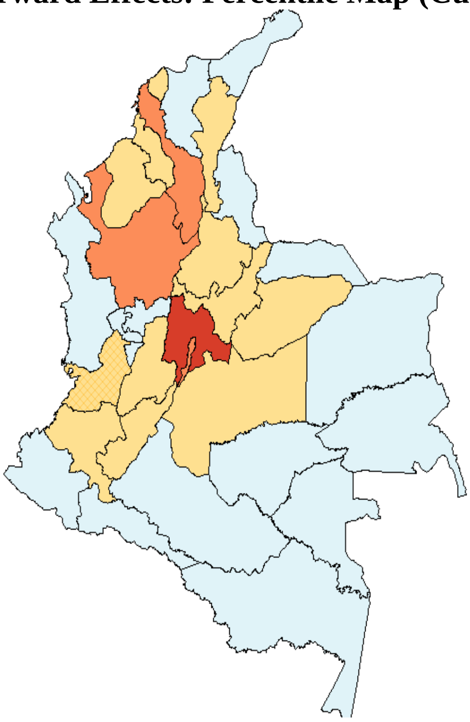
Figure 10. Forward Effects: Percentile Map (Santander)



Source: Elaborated by the authors using GeoDA™.

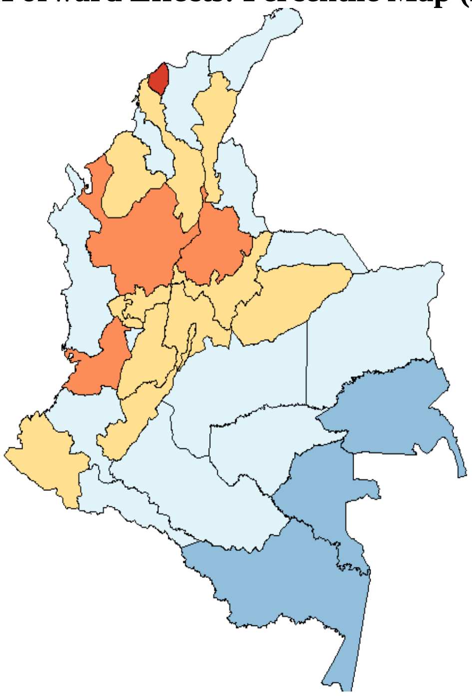
The results for Santander are very interesting. We can observe in Figure 10 a clear pattern North – South. The market for Santander's sales is located at some of the departments of the Caribbean region (Bolívar, Atlántico, Cesar, and Córdoba) and some of the Andean region (Bogotá, Santander, Antioquia, Valle, Boyacá, Cundinamarca, Tolima, Cauca, Risaralda, and Nariño).

Figure 11. Forward Effects: Percentile Map (Cundinamarca)



Source: Elaborated by the authors using GeoDA™.

Figure 12. Forward Effects: Percentile Map (Atlántico)



Source: Elaborated by the authors using GeoDA™.

Figures 11 and 12 present the results for hypothetically extracting the Cundinamarca and Atlántico departments. They have a similar pattern of impacts. Cundinamarca and Atlántico do not have the south east part of the country as an important destination for their sales and most of them are located at the interior of each one, some departments in the Caribbean region, and some additional ones in the Andean region. It is important to highlight the intra-department trade that Altántico presents (see Figure 12).

4. Conclusions

This paper advances on the analysis of the structural interdependence among Colombian departments. The study is based on a new input-output table estimated considering the 32 departments and the capital district, Bogotá, instead of aggregate regions as was done in previous works. This approach avoids the modifiable area unit problem that came from the aggregation of the different territorial units into regions. In addition, the interregional flows are calculated following the methodology proposed by Dixon and Rimmer (2004), which includes, among others variables, the distance between departments and the trade information available, making the estimated flows more reliable.

The results show that all departments have a net dependence on Bogotá. On other words, Bogotá has a large influence in the other regional economies through its purchasing power. Additionally, it can be observed that a spatial concentration of the effects of a hypothetical extraction of any territory on the capital district, Bogotá, and the biggest departmental economies, Antioquia, Valle, Cundinamarca, Santander, and Atlántico. With the exception of Atlántico, which is located at the Caribbean regions, the other territories are located at the center of the country. On the other hand, the effects of the isolation of any territory are relatively weak in those departments located at the Colombian periphery. Thus, we can say that there is a center-periphery pattern.

From a policy point of view, these findings reaffirm the role played by Bogotá in the polarization process observed in the regional economies in Colombia in the last years. Any policy action oriented to reduce these regional disparities should take into account that, given the structural interdependence among Colombian departments, new investment in the lagged regions would flow through Bogotá and the major regional economies. At the end, Colombian regional disparities could be perpetuated.

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Appendix 1: Estimation of Trade Matrices for the CEER Model

As part of the calibration of the CEER model, a fully specified interregional input-output database is needed. The model considers 7 different sectors (agriculture, mining, manufacturing, construction, transportation, public administration and other services) each one producing a single commodity, and 33 regions.

In order to estimate the whole set of tables, we have relied on an adapted version of the Chenery-Moses approach which assumes, in each, the same commodity mixes for the different users (producers, investors and households) as those presented in the national input-output tables for Colombia. For sectoral cost structure, value added generation may be different across regions. Trade matrices for each commodity are used to disaggregate the origin of each commodity in order to capture the structure of the spatial interaction in the Colombian economy. In order words, for a given user, say agriculture sector, the mix of intermediate inputs will be the same in terms of its composition, but it will differ from the regional sources of supply (considering the 33 regions of the model and imports).

The strategy for estimating the 7 trade matrices included the following steps.

1. We have initially estimated total supply (output) of each commodity by region, excluding exports to other countries. Thus, for each region, we obtained information for the total sales of each commodity for the domestic markets.

Supply(c,s) = supply for the domestic markets of commodity *c* by region *s*

2. Following that, we have estimated total demand, in each region, for the aforementioned 7 commodities. To do that, we have assumed the respective users' structure of demand followed the national pattern. With the regional levels of sectoral production, household demand and investment demand, we have estimated the initial values of total demand for each commodity in each region, from which the demand for imported commodities were deducted. The resulting estimates, which represent the regional total demand for Colombian goods, were then adjusted so that, for each commodity, demand across regions equals supply across regions.

Demand(c,d) = demand of commodity *c* by region *d*

3. With the information for *Supply(c,s)* and *Demand(c,d)*, the next step was to estimate, for each commodity c, matrices of trade (33x33) representing the transactions of each commodity between Colombian regions. For non-tradables, we have fully relied on the methodology described in Dixon e Rimmer (2004). The procedure considered the following steps:

a) For the diagonal cells, equation (1) was implemented, while for the off-diagonal elements, equation (2) is the relevant one:

$$SHIN(c,d,d) = Min\left\{\frac{Supply(c,d)}{Demand(c,d)},1\right\} * F(c) \qquad (1)$$

$$SHIN(c,o,d) = \left\{ \frac{1}{Dist(o,d)} \cdot \frac{Supply(c,o)}{\sum_{k=1}^{33} Supply(c,k)} \right\} * \left\{ \frac{1 - SHIN(c,d,d)}{\sum_{j=1, j\neq d}^{33} \left[\frac{1}{Dist(j,d)} \cdot \frac{Suply(c,j)}{\sum_{k=1}^{558} Suply(c,k)} \right]} \right\} \quad (2)$$

Where *c* refers to a given commodity, and *o* and *d* represent, respectively, origin and destination regions.

The variable *Dist(o,d)* refers to the distance between two trading regions. The factor *F(c)* gives the extent of tradability of a given commodity. As this procedure was adopted for the non-tradables (construction, transportation, public administration, and other services), typically assumed to be locally provided goods, we have used the value of 0.9 for *F(c)*, adopting a usual assumption.

It can be shown that the column sums in the resulting matrices add to one. What these matrices show are the supply-adjusted shares of each region in the specific commodity demand by each region of destination.

Once these share coefficients are calculated, we then distribute the demand of commodity *c* by region *d* (*Demand(c,d)*) across the corresponding columns of the SHIN matrices. Once we adopt this procedure, we have to further adjust the matrices to make sure that supply and demand balance. This is done through a RAS procedure.

4. The procedure adopted to generate the trade matrices for the tradable goods (agriculture, mining and manufacturing) made use of an estimated aggregated origin-destination matrix by tonnage, between Colombian regions. This information was used to substitute the estimates of equation (2), which provided a more appropriate structure of spatial interaction for tradables in Colombia.

To generate the aggregated origin-destination matrix by tonnage, we have relied in two main sources of information. We use the survey of origin and destiny of transport of load by highway published by the Ministry of Transport for 2001 and the survey of air cargo published by the Colombian aeronautical authority, *Aerocivil*. The second source was used in those cities, such as San Andrés and Leticia, that do not have a road connection.

We have the consolidate the two sets of information in a way that the resulting matrix (Figure 1) provided the initial solution for obtaining the off-diagonal coefficients of the SHIN matrices – *F(c)* was set to 0.5. We could then follow the next steps, described above, in which the demand was distributed across the respective columns and the matrices were adjusted through the RAS procedures.

Table A1. Interregional Trade in Colombia: Sales Shares, 2004

		DESTINATION																																	
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	Total
	D1	0.7601	0.0146	0.0273	0.0323	0.0036	0.0088	0.0003	0.0048	0.0034	0.0161	0.0044	0.0093	0.0046	0.0051	0.0038	0.0022	0.0074	0.0031	0.0041	0.0101	0.0202	0.0047	0.0056	0.0402	-	0.0002	0.0010	-	0.0005	0.0012	0.0007	-	0.0005	1.0000
	D2	0.0983	0.5850	0.0652	0.0226	0.0103	0.0046	0.0011	0.0019	0.0266	0.0322	0.0059	-	0.0145	0.0034	0.0030	0.0035	0.0033	0.0052	0.0007	0.0043	0.0557	0.0078	0.0054	0.0259	-	-	0.0113	-	-	-	0.0004	-	0.0018	1.0000
	D3	0.0496	0.0191	0.6674	0.0202	0.0245	0.0033	0.0028	0.0027	0.0066	0.0064	0.0084	0.0005	0.0063	0.0024	0.0047	0.0137	0.0070	0.0115	0.0024	0.0042	0.0285	0.0041	0.0143	0.0528	0.0019	0.0071	0.0180	-	0.0031	0.0051	0.0009	-	0.0007	1.0000
	D4	0.1521	0.0201	0.0921	0.5543	0.0161	0.0028	0.0012	0.0077	0.0121	0.0169	0.0014	0.0003	0.0132	0.0029	0.0026	0.0079	0.0027	0.0038	0.0045	0.0021	0.0259	0.0047	0.0069	0.0279	0.0001	-	0.0162	-	-	0.0007	0.0006	-	-	1.0000
	D5	0.0448	0.0230	0.0876	0.0242	0.5700	0.0019	0.0004	0.0047	0.0142	0.0054	0.0944	-	0.0054	0.0011	0.0022	0.0050	0.0027	0.0063	0.0033	0.0050	0.0278	0.0026	0.0051	0.0333	-	0.0028	0.0258	-	-	0.0001	0.0005	-	0.0002	1.0000
	D6	0.0376	0.0173	0.1281	0.0296	0.0041	0.6425	0.0004	0.0056	0.0010	0.0018	0.0081	0.0003	0.0107	0.0046	0.0012	0.0006	0.0044	0.0028	0.0055	0.0283	0.0049	0.0003	0.0184	0.0324	0.0006	0.0002	0.0027	-	-	0.0054	0.0005	-	-	1.0000
	D7	0.0234	0.0043	0.1297	0.0130	0.0144	0.0016	0.5597	0.0052	0.0106	-	0.0068	-	0.0317	-	-	-	-	0.0001	0.0022	0.0028	0.0073	-	0.0269	0.1343	-	-	0.0081	-	0.0177	-	-	-	-	1.0000
	D8	0.0225	0.0034	0.0271	0.0026	0.0002	0.0086	0.0037	0.7551	0.0015	0.0019	0.0062	-	0.0227	0.0039	0.0015	0.0020	0.0123	0.0009	0.0050	0.0044	0.0120	0.0015	0.0041	0.0954	-	-	0.0012	-	-	0.0001	0.0001	-	-	1.0000
	D9	0.0439	0.0593	0.1110	0.0233	0.0033	0.0056	0.0005	0.0002	0.4752	0.0018	0.0082	0.0002	0.0006	0.0104	0.0955	0.0001	0.0007	0.0074	0.0002	0.0064	0.1064	0.0184	0.0043	0.0131	-	0.0002	0.0030	-	-	-	0.0006	-	-	1.0000
	D10	0.0994	0.0236	0.1122	0.0792	0.0004	0.0025	-	0.0036	0.0071	0.5930	0.0063	0.0002	0.0023	0.0037	0.0006	0.0002	0.0004	0.0013	0.0004	0.0017	0.0265	0.0066	0.0011	0.0257	-	-	0.0013	-	-	-	0.0005	-	-	1.0000
	D11	0.0493	0.0361	0.0318	0.0069	0.0885	0.0021	0.0012	0.0044	0.0002	0.0015	0.5901	-	0.0175	0.0004	0.0021	0.0073	0.0033	0.0052	0.0029	0.0004	0.0387	0.0011	0.0385	0.0558	-	0.0001	0.0122	0.0012	0.0005	-	0.0009	-	-	1.0000
	D12	0.1245	-	0.0057	0.0022	-	0.0066	0.0135	-	-	0.0002	0.0267	0.7308	0.0007	-	-	-	-	0.0006	-	0.0300	0.0174	-	0.0026	0.0384	-	-	-	-	-	-	-	-	-	1.0000
	D13	0.0269	0.0105	0.0346	0.0116	0.0010	0.0036	0.0354	0.0230	0.0031	-	0.0074	-	0.6075	-	0.0001	0.0001	0.0096	0.0012	0.0048	0.0088	0.0086	0.0002	0.0161	0.1054	-	0.0047	0.0022	-	-	0.0591	0.0001	-	0.0144	1.0000
	D14	0.1105	0.0816	0.0550	0.0087	0.0008	0.0061	-	0.0003	0.0288	0.0057	0.0219	0.0004	0.0145	0.4390	0.1245	0.0004	0.0033	0.0015	-	0.0053	0.0188	0.0074	0.0085	0.0505	-	0.0002	0.0041	-	-	0.0016	0.0006	-	-	1.0000
	D15	0.0877	0.0217	0.1364	0.0057	0.0164	0.0017	-	-	0.0063	0.0023	0.0026	-	0.0002	0.0014	0.6127	0.0017	0.0005	0.0020	-	0.0003	0.0719	0.0005	0.0037	0.0168	0.0007	-	0.0061	-	-	0.0005	0.0001	-	-	1.0000
ORIGIN	D16	0.0340	0.0106	0.2274	0.0150	0.0089	0.0019	0.0007	0.0041	0.0014	0.0076	0.0080	-	0.0017	0.0022	0.0015	0.5785	0.0023	0.0008	-	0.0008	0.0052	0.0011	0.0092	0.0184	-	0.0006	0.0130	-	0.0115	0.0014	0.0001	0.0180	0.0140	1.0000
	D17	0.0620	0.0138	0.0900	0.0063	0.0016	0.0099	0.0036	0.0210	0.0004	0.0054	0.0063	-	0.0139	0.0030	0.0001	0.0004	0.6112	0.0046	0.0044	0.0091	0.0098	-	0.0055	0.1172	-	-	0.0006	-	-	-	0.0001	-	-	1.0000
	D18	0.0340	0.0546	0.0699	0.0081	0.0046	0.0017	0.0011	0.0024	0.0092	0.0009	0.0086	-	0.0036	0.0006	0.0030	0.0009	0.0009	0.6763	0.0013	0.0016	0.0485	0.0012	0.0040	0.0251	0.0002	0.0321	0.0051	-	-	0.0002	0.0005	-	-	1.0000
	D19	0.0474	0.0031	0.0625	0.0019	0.0028	0.0152	0.0042	0.0017	0.0036	-	0.0154	0.0018	0.0107	0.0008	0.0001	0.0001	0.0120	0.0024	0.6708	0.0010	0.0065	0.0002	0.0168	0.1186	-	-	0.0001	-	0.0002	-	-	-	-	1.0000
	D20	0.0833	0.0074	0.0159	0.0075	0.0041	0.0506	0.0002	0.0059	0.0020	0.0024	0.0012	0.0161	0.0019	0.0001	0.0010	0.0003	0.0061	0.0053	0.0011	0.7007	0.0048	-	0.0016	0.0801	-	0.0002	-	-	-	-	0.0002	-	-	1.0000
	D21	0.0562	0.0187	0.0433	0.0175	0.0128	0.0030	0.0024	0.0065	0.0342	0.0019	0.0184	-	0.0030	0.0050	0.0075	0.0029	0.0033	0.0154	0.0017	0.0032	0.6759	0.0017	0.0146	0.0304	-	0.0135	0.0043	-	-	0.0022	0.0004	-	-	1.0000
	D22	0.1395	0.0285	0.0300	0.0485	0.0006	0.0002	-	-	0.0037	0.1015	0.0166	-	0.0016	0.0010	0.0016	0.0003	-	0.0009	0.0017	0.0010	0.0006	0.6084	0.0005	0.0052	-	0.0005	0.0072	-	-	0.0001	0.0005	-	-	1.0000
	D23	0.0892	0.0181	0.0703	0.0141	0.0134	0.0338	0.0058	0.0039	0.0069	0.0025	0.0405	0.0002	0.0231	0.0035	0.0024	0.0037	0.0098	0.0013	0.0046	0.0032	0.0257	0.0011	0.5739	0.0281	-	0.0001	0.0028	0.0126	0.0014	0.0036	0.0003	-	-	1.0000
	D24	0.1320	0.0150	0.0694	0.0129	0.0029	0.0133	0.0028	0.0165	0.0033	0.0053	0.0083	0.0022	0.0173	0.0018	0.0029	0.0047	0.0244	0.0103	0.0111	0.0169	0.0254	0.0022	0.0152	0.5807	-	0.0001	0.0009	-	-	0.0018	0.0005	-	-	1.0000
	D25	-	-	-	-	-	-	-	0.0616	0.0060	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0172	0.0320	0.8807	-	-	-	-	0.0024	-	-	-	1.0000
	D26	0.0075	0.0011	0.0711	0.0040	0.0225	-	-	0.0007	-	-	0.1635	-	0.0006	-	-	0.0021	-	0.0430	0.0007	0.0061	0.1936	-	0.0004	0.0011	-	0.4505	0.0316	-	-	-	-	-	-	1.0000
	D27	0.0425	0.0190	0.2550	0.0681	0.0308	0.0032	-	0.0034	0.0008	0.0037	0.0381	0.0004	0.0067	0.0001	0.0003	0.0301	0.0008	0.0024	0.0024	0.0056	0.0056	0.0013	0.0428	0.0631	-	0.0049	0.3685	-	-	-	0.0005	-	-	1.0000
	D28	0.0077	0.0072	0.0064	0.0080	0.0071	0.0074	0.0006	0.0031	0.0033	0.0031	0.0049	0.0013	0.0010	0.0048	0.0029	0.0013	0.0047	0.0067	0.0048	0.0094	0.0051	0.0015	0.0034	0.0066	0.0011	0.0010	0.0018	0.8806	0.0002	0.0011	0.0020	-	0.0001	1.0000
	D29	0.0030	-	0.2786	-	-	-	0.0152	-	-	-	-	-	-	-	-	0.0478	-	-	-	-	-	0.0021	-	-	-	-	0.0005	-	0.6528	-	-	-	-	1.0000
	D30	0.0537	0.0051	0.1489	-	0.0043	-	-	0.0037	-	-	-	-	0.0821	0.0004	-	-	0.0280	-	0.0018	0.0016	0.0103	0.0003	0.0018	0.0249	-	-	-	-	-	0.6332	-	-	-	1.0000
	D31	0.1643	0.0069	0.1052	0.0294	0.0193	0.0025	0.0011	0.0067	0.0239	0.0187	0.0104	0.0001	0.0127	0.0009	0.0008	0.0041	0.0017	0.0035	0.0007	0.0015	0.0209	0.0026	0.0052	0.0160	0.0001	-	0.0219	-	-	0.0006	0.5174	-	0.0010	1.0000
	D32	0.0264	0.0253	0.0229	0.0288	0.0247	0.0224	0.0014	0.0083	0.0110	0.0110	0.0169	0.0045	0.0032	0.0172	0.0094	0.0045	0.0118	0.0229	0.0139	0.0316	0.0177	0.0048	0.0117	0.0223	0.0004	0.0030	0.0066	-	0.0004	0.0035	0.0064	0.6050	0.0003	1.0000
	D33	-	-	0.4923	-	0.0027	-	-	-	-	-	-	-	-	-	0.0292	0.0067	-	-	-	-	-	-	-	-	-	-	0.0039	-	-	-	-	-	0.4652	1.0000
	Total	0.1705	0.0504	0.2289	0.0431	0.0267	0.0224	0.0050	0.0194	0.0145	0.0206	0.0364	0.0045	0.0186	0.0062	0.0142	0.0159	0.0182	0.0171	0.0093	0.0203	0.0611	0.0079	0.0249	0.1140	0.0011	0.0053	0.0129	0.0006	0.0020	0.0043	0.0019	0.0005	0.0013	1.0000

Table A2. Interregional Trade in Colombia: Purchases Shares, 2004

	DESTINATION																																	
ORIGIN	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	Total
D1	0.6304	0.0409	0.0169	0.1059	0.0192	0.0554	0.0097	0.0346	0.0334	0.1107	0.0169	0.2930	0.0348	0.1149	0.0378	0.0197	0.0572	0.0257	0.0626	0.0703	0.0468	0.0837	0.0319	0.0499	-	0.0043	0.0109	-	0.0393	0.0385	0.0487	-	0.0549	0.1414
D2	0.0318	0.6408	0.0157	0.0290	0.0213	0.0113	0.0125	0.0055	0.1011	0.0863	0.0090	0.0003	0.0431	0.0299	0.0116	0.0121	0.0099	0.0169	0.0043	0.0117	0.0503	0.0541	0.0119	0.0125	-	-	0.0485	-	-	-	0.0106	-	0.0783	0.0552
D3	0.0779	0.1014	0.7815	0.1259	0.2459	0.0395	0.1501	0.0370	0.1227	0.0829	0.0619	0.0281	0.0906	0.1023	0.0891	0.2309	0.1034	0.1799	0.0681	0.0551	0.1251	0.1384	0.1538	0.1241	0.4484	0.3598	0.3747	-	0.4180	0.3179	0.1328	-	0.1489	0.2681
D4	0.0374	0.0167	0.0169	0.5396	0.0253	0.0053	0.0101	0.0167	0.0350	0.0343	0.0017	0.0024	0.0298	0.0196	0.0077	0.0207	0.0061	0.0094	0.0203	0.0043	0.0178	0.0249	0.0116	0.0102	0.0053	-	0.0526	-	-	0.0073	0.0125	-	-	0.0419
D5	0.0055	0.0095	0.0080	0.0117	0.4454	0.0018	0.0016	0.0051	0.0204	0.0054	0.0542	-	0.0060	0.0037	0.0033	0.0066	0.0031	0.0077	0.0074	0.0051	0.0095	0.0068	0.0043	0.0061	-	0.0112	0.0417	-	-	0.0006	0.0057	-	0.0026	0.0209
D6	0.0053	0.0082	0.0134	0.0164	0.0037	0.6848	0.0021	0.0069	0.0017	0.0021	0.0053	0.0017	0.0137	0.0175	0.0020	0.0009	0.0058	0.0039	0.0142	0.0334	0.0019	0.0009	0.0176	0.0068	0.0128	0.0008	0.0051	-	-	0.0301	0.0068	-	-	0.0239
D7	0.0006	0.0004	0.0026	0.0014	0.0025	0.0003	0.5176	0.0012	0.0034	-	0.0009	-	0.0079	-	-	-	-	-	0.0011	0.0006	0.0006	-	0.0050	0.0054	-	-	0.0029	-	0.0415	-	0.0001	-	-	0.0046
D8	0.0024	0.0012	0.0021	0.0011	0.0002	0.0068	0.0133	0.6946	0.0018	0.0016	0.0031	-	0.0218	0.0111	0.0019	0.0022	0.0121	0.0009	0.0095	0.0039	0.0035	0.0035	0.0030	0.0150	-	-	0.0017	-	-	0.0005	0.0008	-	-	0.0179
D9	0.0036	0.0166	0.0068	0.0076	0.0018	0.0035	0.0013	0.0001	0.4620	0.0013	0.0032	0.0007	0.0004	0.0236	0.0948	0.0001	0.0006	0.0061	0.0003	0.0044	0.0246	0.0328	0.0025	0.0016	-	0.0004	0.0033	-	-	-	0.0042	-	-	0.0141
D10	0.0116	0.0093	0.0098	0.0367	0.0003	0.0023	0.0001	0.0037	0.0097	0.5737	0.0034	0.0007	0.0025	0.0119	0.0009	0.0002	0.0005	0.0015	0.0007	0.0017	0.0086	0.0167	0.0009	0.0045	-	-	0.0021	-	-	-	0.0058	-	-	0.0199
D11	0.0124	0.0308	0.0060	0.0069	0.1426	0.0040	0.0101	0.0097	0.0007	0.0032	0.6985	-	0.0404	0.0025	0.0063	0.0198	0.0077	0.0131	0.0132	0.0009	0.0273	0.0058	0.0666	0.0211	-	0.0010	0.0407	0.0857	0.0115	-	0.0209	-	-	0.0430
D12	0.0024	-	0.0001	0.0002	-	0.0010	0.0089	-	-	-	0.0024	0.5357	0.0001	-	-	-	-	0.0001	-	0.0048	0.0009	-	0.0003	0.0011	-	-	-	-	-	-	-	-	-	0.0033
D13	0.0025	0.0032	0.0024	0.0042	0.0006	0.0025	0.1101	0.0184	0.0033	-	0.0032	-	0.5079	-	0.0001	0.0001	0.0082	0.0011	0.0081	0.0068	0.0022	0.0003	0.0100	0.0144	-	0.0137	0.0027	-	-	0.2129	0.0005	-	0.1773	0.0156
D14	0.0051	0.0126	0.0019	0.0016	0.0002	0.0021	-	0.0001	0.0155	0.0021	0.0047	0.0007	0.0061	0.5496	0.0682	0.0002	0.0014	0.0007	-	0.0020	0.0024	0.0073	0.0027	0.0035	-	0.0002	0.0025	-	-	0.0029	0.0025	-	-	0.0078
D15	0.0073	0.0061	0.0084	0.0019	0.0087	0.0011	-	-	0.0061	0.0016	0.0010	-	0.0002	0.0033	0.6102	0.0015	0.0004	0.0017	-	0.0002	0.0167	0.0009	0.0021	0.0021	0.0094	-	0.0068	-	-	0.0017	0.0009	-	-	0.0142
D16	0.0033	0.0035	0.0165	0.0058	0.0055	0.0014	0.0024	0.0035	0.0016	0.0061	0.0037	-	0.0015	0.0057	0.0018	0.6039	0.0021	0.0007	-	0.0007	0.0014	0.0023	0.0061	0.0027	-	0.0019	0.0167	-	0.0973	0.0052	0.0009	0.5596	0.1832	0.0166
D17	0.0062	0.0047	0.0067	0.0025	0.0010	0.0076	0.0122	0.0184	0.0004	0.0045	0.0030	-	0.0128	0.0083	0.0001	0.0004	0.5727	0.0046	0.0081	0.0076	0.0027	0.0001	0.0038	0.0176	-	-	0.0008	-	-	-	0.0012	-	-	0.0171
D18	0.0029	0.0159	0.0045	0.0028	0.0025	0.0011	0.0033	0.0018	0.0093	0.0006	0.0035	-	0.0028	0.0014	0.0031	0.0008	0.0007	0.5801	0.0020	0.0011	0.0117	0.0023	0.0024	0.0032	0.0025	0.0886	0.0058	-	-	0.0008	0.0039	-	-	0.0147
D19	0.0023	0.0005	0.0023	0.0004	0.0009	0.0057	0.0071	0.0007	0.0021	-	0.0035	0.0034	0.0048	0.0010	0.0001	-	0.0055	0.0012	0.5994	0.0004	0.0009	0.0002	0.0056	0.0087	-	-	0.0001	-	0.0009	-	0.0002	-	-	0.0083
D20	0.0094	0.0028	0.0013	0.0033	0.0030	0.0432	0.0008	0.0058	0.0026	0.0022	0.0006	0.0689	0.0019	0.0003	0.0014	0.0003	0.0064	0.0060	0.0022	0.6613	0.0015	-	0.0013	0.0135	-	0.0008	-	-	-	-	0.0019	-	-	0.0191
D21	0.0168	0.0189	0.0097	0.0208	0.0244	0.0067	0.0240	0.0171	0.1201	0.0047	0.0259	-	0.0083	0.0409	0.0267	0.0094	0.0091	0.0460	0.0095	0.0080	0.5645	0.0112	0.0299	0.0136	-	0.1298	0.0171	-	-	0.0265	0.0119	-	-	0.0510
D22	0.0060	0.0042	0.0010	0.0083	0.0002	0.0001	-	-	0.0019	0.0363	0.0034	-	0.0006	0.0012	0.0008	0.0001	-	0.0004	0.0013	0.0004	0.0001	0.5665	0.0001	0.0003	-	0.0006	0.0041	-	-	0.0001	0.0018	-	-	0.0074
D23	0.0120	0.0082	0.0070	0.0075	0.0114	0.0345	0.0265	0.0046	0.0108	0.0028	0.0255	0.0012	0.0284	0.0127	0.0039	0.0054	0.0123	0.0018	0.0113	0.0036	0.0096	0.0032	0.5274	0.0056	-	0.0006	0.0050	0.4621	0.0166	0.0189	0.0031	-	-	0.0229
D24	0.0987	0.0380	0.0386	0.0381	0.0137	0.0756	0.0723	0.1085	0.0288	0.0329	0.0289	0.0616	0.1188	0.0365	0.0256	0.0373	0.1708	0.0768	0.1516	0.1059	0.0531	0.0348	0.0780	0.6491	-	0.0025	0.0089	-	-	0.0533	0.0313	-	-	0.1274
D25	-	-	-	-	-	-	-	0.0021	0.0003	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0005	0.0002	0.5210	-	-	-	-	0.0004	-	-	-	0.0007
D26	0.0002	0.0001	0.0014	0.0004	0.0037	-	-	0.0002	-	-	0.0197	-	0.0002	-	-	0.0006	-	0.0110	0.0003	0.0013	0.0139	-	0.0001	-	-	0.3729	0.0108	-	-	-	-	-	-	0.0044
D27	0.0029	0.0043	0.0129	0.0183	0.0133	0.0017	-	0.0020	0.0007	0.0021	0.0121	0.0011	0.0042	0.0003	0.0002	0.0219	0.0005	0.0016	0.0029	0.0032	0.0011	0.0019	0.0199	0.0064	-	0.0106	0.3300	-	-	-	0.0031	-	-	0.0115
D28	-	-	-	0.0001	0.0001	0.0001	-	0.0001	0.0001	-	-	0.0001	-	0.0002	0.0001	-	0.0001	0.0001	0.0002	0.0001	-	0.0001	-	-	0.0003	0.0001	-	0.4523	-	0.0001	0.0003	-	-	0.0003
D29	-	-	0.0014	-	-	-	0.0034	-	-	-	-	-	-	-	-	0.0034	-	-	-	-	-	0.0003	-	-	-	-	-	-	0.3749	-	-	-	-	0.0011
D30	0.0006	0.0002	0.0012	-	0.0003	-	-	0.0004	-	-	-	-	0.0085	0.0001	-	-	0.0029	-	0.0004	0.0001	0.0003	0.0001	0.0001	0.0004	-	-	-	-	-	0.2817	-	-	-	0.0019
D31	0.0024	0.0003	0.0012	0.0017	0.0018	0.0003	0.0005	0.0009	0.0041	0.0023	0.0007	-	0.0017	0.0004	0.0001	0.0006	0.0002	0.0005	0.0002	0.0002	0.0009	0.0008	0.0005	0.0004	0.0002	-	0.0043	-	-	0.0003	0.6862	-	0.0020	0.0025
D32	0.0001	0.0002	-	0.0003	0.0004	0.0004	0.0001	0.0002	0.0003	0.0002	0.0002	0.0004	0.0001	0.0011	0.0003	0.0001	0.0003	0.0005	0.0006	0.0006	0.0001	0.0002	0.0002	0.0001	0.0001	0.0002	0.0002	-	0.0001	0.0003	0.0013	0.4404	0.0001	0.0004
D33	-	-	0.0021	-	0.0001	-	-	-	-	-	-	-	-	-	0.0020	0.0004	-	-	-	-	-	-	-	-	-	-	0.0003	-	-	-	-	-	0.3526	0.0010
Total	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table A3. Colombian Departments

Classification	Name
D1	ANTIOQUIA
D2	ATLÁNTICO
D3	BOGOTÁ D.C.
D4	BOLÍVAR
D5	BOYACÁ
D6	CALDAS
D7	CAQUETÁ
D8	CAUCÁ
D9	CESAR
D10	CÓRDOBA
D11	CUNDINAMARCA
D12	CHOCÓ
D13	HUILA
D14	LA GUAJIRA
D15	MAGDALENA
D16	META
D17	NARIÑO
D18	NORTE SANTANDER
D19	QUINDÍO
D20	RISARALDA
D21	SANTANDER
D22	SUCRE
D23	TOLIMA
D24	VALLE
D25	AMAZONAS
D26	ARAUCA
D27	CASANARE
D28	GUANÍA
D29	GUAVIARE
D30	PUTUMAYO
D31	SAN ANDRÉS
D32	VAUPÉS
D33	VICHADA

Source: Elaborated by the authors