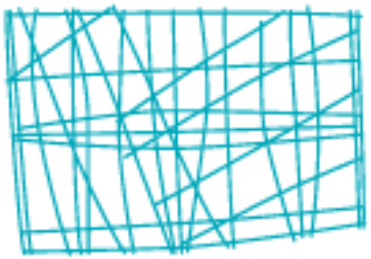


NEREUS

Núcleo de Economia Regional e Urbana da Universidade de São Paulo

fipe

Fundação Instituto de Pesquisas Econômicas

Regional Integration in Colombia: On Cournot's Problem and the New Economic Geography

Eduardo Haddad Ana Barufi Sílvio Costa

Outline

- ✓ Motivation
- The B-MARIA-27 and the CEER models
- Simulation results
- Final remarks

Motivation

This paper provides a complementary analysis to an earlier exploration of the short-run implications of adopting a more realistic representation of transportation costs and considering the impact of increasing returns to scale (Haddad and Hewings, 2005)

The paper addresses the issues in a long-run equilibrium solution which adopts usual hypotheses on factor mobility in new economic geography (NEG) models

Motivation

Theoretical inconsistencies between competitive regimes conceptualized in space-less and spatial economies

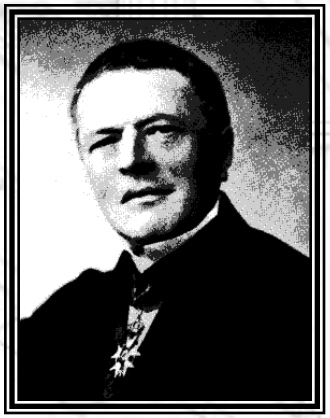
- Dominant result: spatial autarchy

New economic geography

- Role of increasing returns and transportation costs (Fujita *et al*., 1999; Fujita and Thisse, 2002)
- Dominant result: core-periphery (**spatial heterogeneity**)

Notion of some intermediate form of space?

- High transportation costs would enable firms to exploit increasing returns to scale within less than complete national markets
- Asymmetries in competitive advantage between regions (central position)



Antoine Augustin **Cournot**, 1801-1877

"So far we have studied how, for each commodity by itself, the law of demand in connection with the conditions of production of that commodity, determines the price of it and regulates the incomes of its producers. We considered as given and invariable the prices of other commodities and the incomes of other producers; **but in reality the economic system is a whole of which all the parts are connected and react on each other**. An increase in the income of the producers of commodity *A* will affect the demand for commodities *B*, *C*, etc., and the incomes of their producers, and, by its reaction, will involve a change in the demand for commodity *A*. **It seems, therefore, as if, for a complete and rigorous solution of the problems relative to some parts of the economic system, it were indispensable to take the entire system into consideration. <u>But this would surpass the powers of mathematical analysis and of our practical methods of calculation, even if the values of all the constants could be assigned to them numerically</u>**."

Cournot, Researches into the Mathematical Principles of the Theory of Wealth (1838), translated by Nathaniel T. Bacon (New York, 1929), p. 127.

Cournot's problem

Diagnostics:

(i) Development of economic analysis of **concrete problems** should pursue a "general equilibrium" framework

(ii) But existing mathematical, statistical and computational benchmarks, at the time of his writings, were far from sufficient for approaching the problem in a general equilibrium context

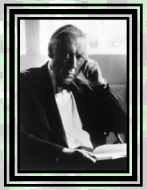
Solution:

Economics took different routes to (attempt) to solve the so-called Cournot's problem

From pure theory to applied theory and **practice**

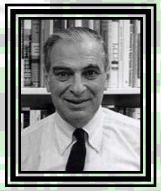
One route: development of Computable General Equilibrium models

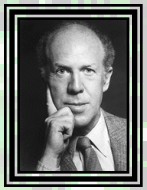
Regional Science

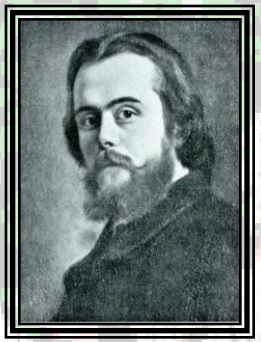


Norte-American School

Norweguian-Australian School







Marginalists

Proto-Marginalistas

Fisiocrats
Clássics

Cournot's problem in the context of the NEG

First pillar (pure theory):

It is relatively well acknowledged the intellectual background that influenced theorists of NEG

It is also recognized that the NEG approach deals properly with location and agglomeration: no other body of work explains agglomeration in a theoretical framework that is tractable, has solid micro foundations, and makes testable empirical predictions

It may be agreed that there are few major issues still to be resolved in the **realm of pure theory**.

Cournot's problem in the context of the NEG

Second pillar (applied theory):

As far as empirical relevance is concerned, we see a recent explosion of studies trying to test theoretical predictions of NEG models, which have been further developed to produce analytical insights to the policy debate

Thus, nowadays focus is on the **realm of applied theory**

Third pillar (practice):

Nonetheless, NEG applications have not reached the ground for fulfilling the policymakers' needs for analysis of **concrete** regional development policies

Krugman: development of "computable geographical equilibrium" models

Objectives

Develop a spatial CGE model that "mimics" NEG results

- Transportation costs
- (External) agglomeration economies – modeling "trick"
- Provide qualitatively similar results to displacements from the original equilibrium (Abdel-Rahman and Fujita, 1990)

Assess the role of transportation infrastructure to Colombian regions (illustrate analytical capability of the model)

- Equity and efficiency
- In this presentation: **the Colombian case**

Integration with a stylized transportation infrastructure model

- *Reach the planners*

Outline

Motivation

✓ The B-MARIA-27 and the CEER models

Simulation results

Final remarks

CRunGEM - CEER

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Picture | Text | Model/Data | Closure | Shocks | Output files | Solve | Results

CEER MODEL

Spatial CGE Model of Colombia

Centro de Estudios Económicos Regionales - CEER

Banco de la República de Colombia

The CEER model

The first fully operational spatial CGE model for Colombia

Similar approach to Haddad and Hewings (2005) to incorporate recent theoretical developments in the new economic geography

Experimentation with the introduction of scale economies, market imperfections, and transportation costs provide innovative ways of dealing explicitly with theoretical issues related to integrated regional systems

Regarding the regional setting, the main innovation in the CEER model is the detailed treatment of interregional trade flows in the Colombian economy, in which the markets of regional flows are fully specified for each origin and destination. The model recognizes the economies of the 32 Colombian Departments and the capital city, Bogotá

General features of the CEER model

Interregional bottom-up CGE model for Colombia

- 33 regions
- 7 sectors/goods

Interregional flows of goods and services

Interregional factor mobility

Explicit modeling of transportation costs based on origin-destination pairs, considering a stylized transportation network

Regional and Central government

Regional labor markets

Non-constant returns to scale (agglomeration economies)

Colombia: political division

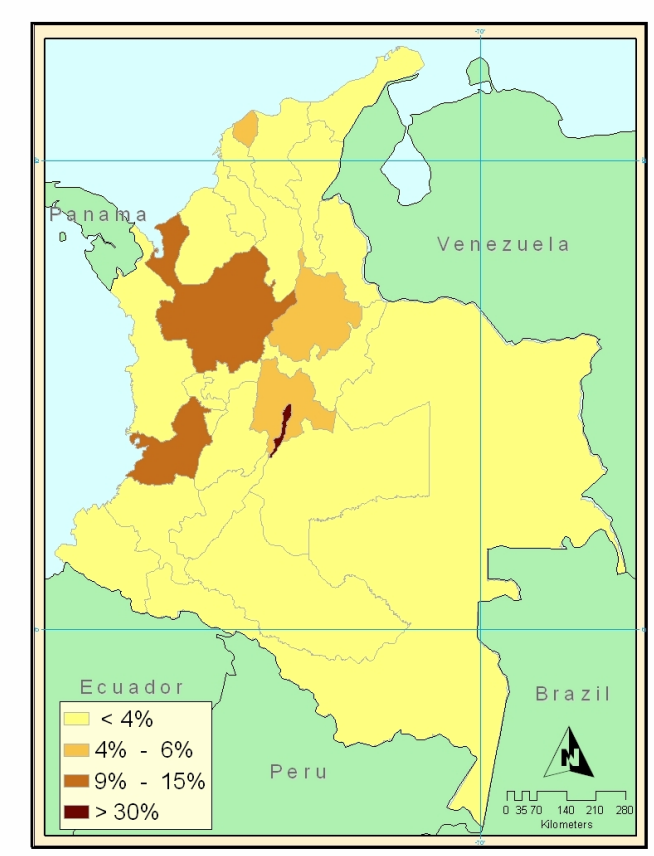
Colombia: geography

Aggregate domestic trade flows in Colombia

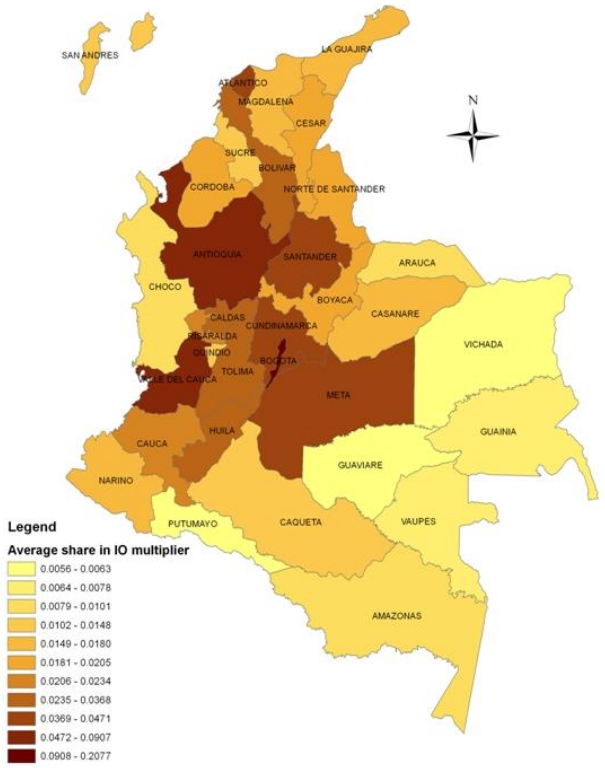
ORIGIN \ DESTINATION	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	Total
D1	0.6304	0.0409	0.0169	0.1059	0.0192	0.0554	0.0097	0.0346	0.0334	0.1107	0.0169	0.2930	0.0348	0.1149	0.0378	0.0197	0.0572	0.0257	0.0626	0.0703	0.0468	0.0837	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

Regional setting

Departmental share in GNI, 2000

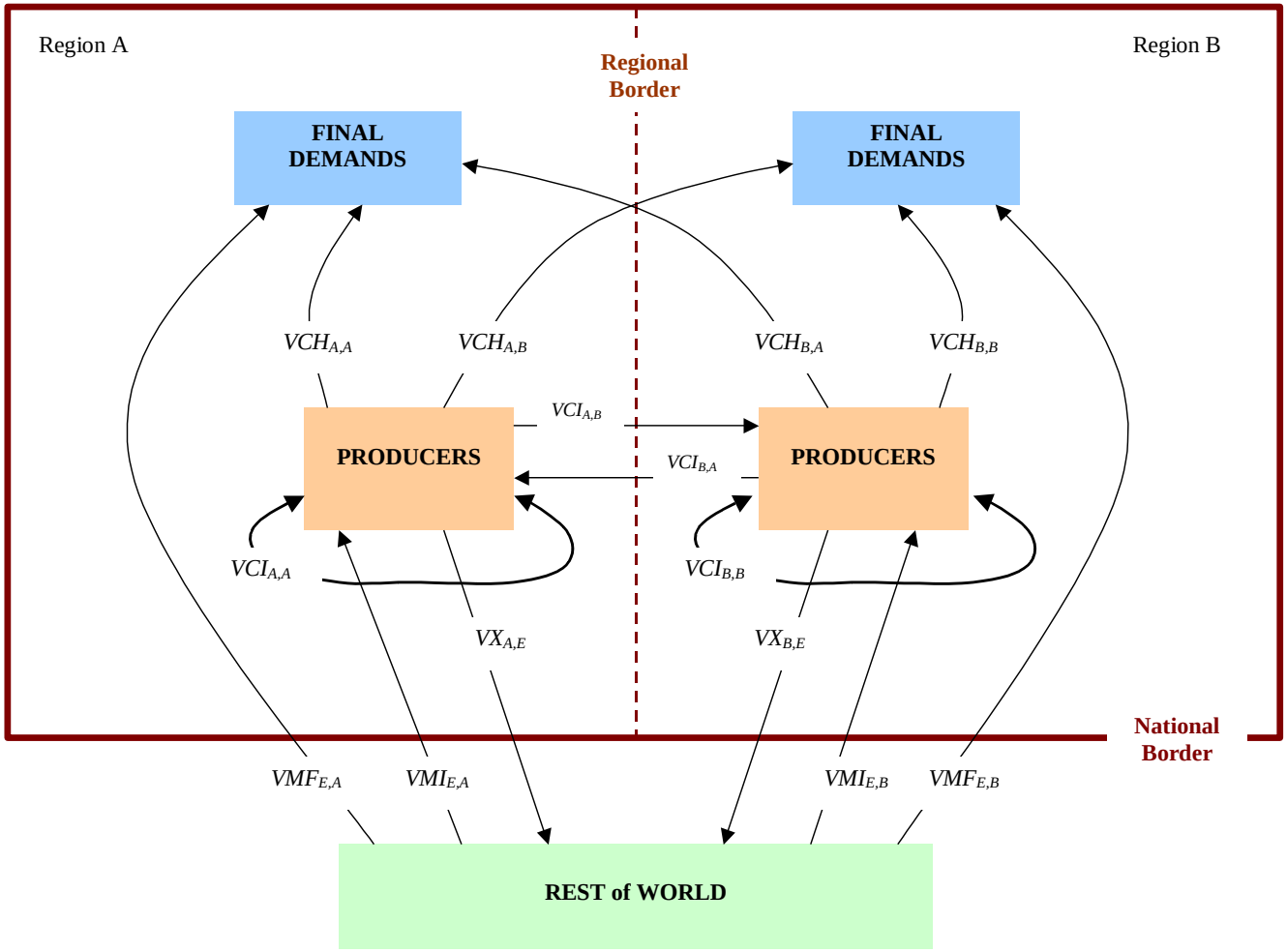


Linkages in Colombia
(Average % share in net I-O output multipliers)



Source: Bonet and Meisel (2006)

Stylized flows



Increasing returns

More generic specification of demand for primary factors

$$X1PRIM(j,q) = A1(j,q) * A1PRIM(j,q) * [\alpha(j,q)Z(j,q)]^{MRP(j,q)}$$

$MRP(j,q) < 1 \longrightarrow$ increasing returns

Manufacturing sector in Bogotá = 0.8

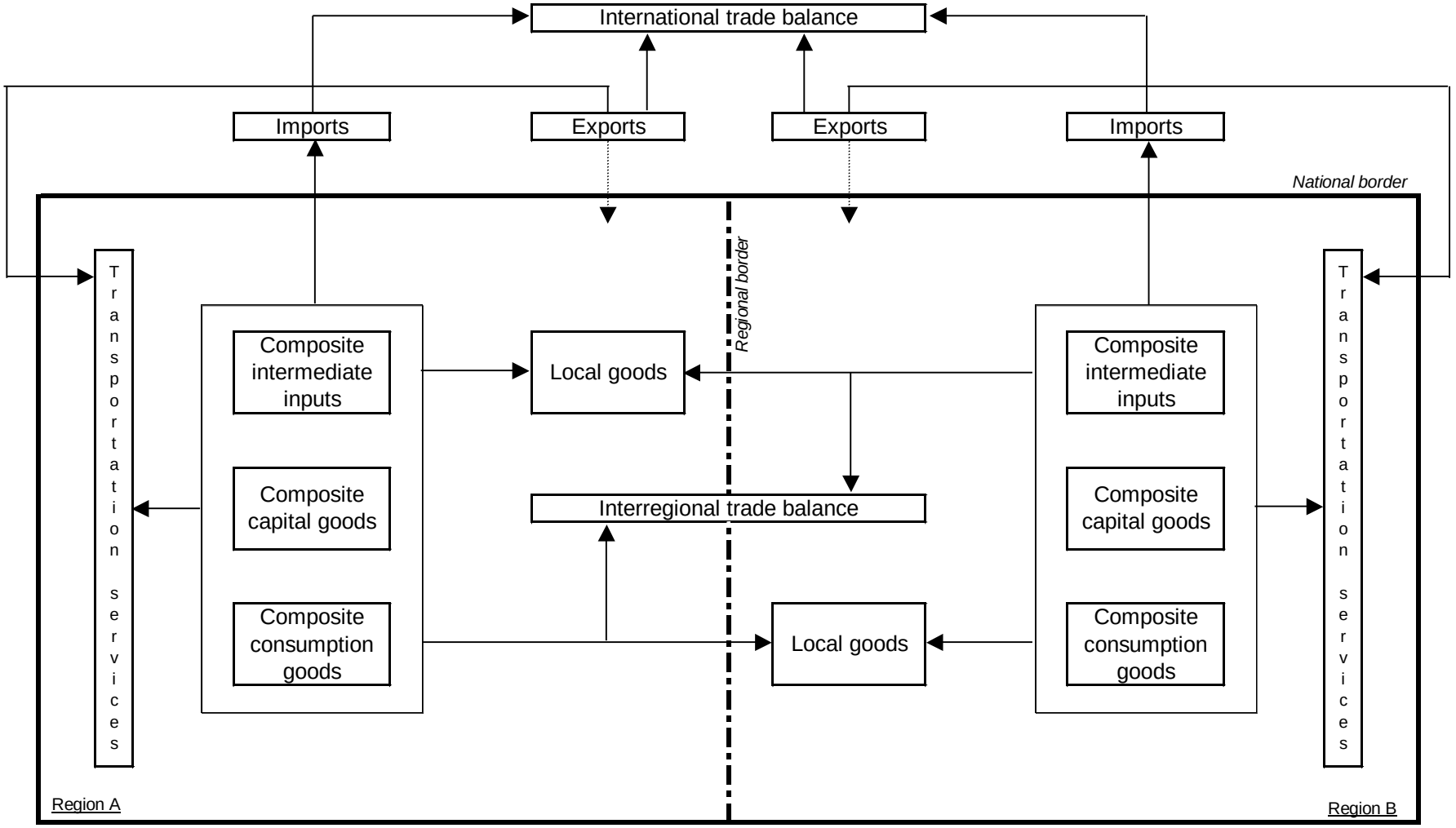
Transportation cost

Prices paid for commodity *i* from region *s* in region *q* by each user equate to the sum of its basic value and the costs of the relevant taxes and **transportation services**

Transportation services facilitate flows of goods from points of production or points of entry to either domestic users or ports of exit

$$XMARG(i,s,q,r) = AMARG\_I(s,q,r) * [\eta(i,s,q,r) * X(i,s,q,r)^{\theta(i,s,q,r)}]$$

The role of transportation services in the CEER model



Calibration

The calibration strategy adopted takes into account explicitly, for each origin-destination pair, key elements of the Colombian integrated interregional economic system, namely:

- Type of trade involved (transportation services vary according to specific commodity flows)
- Transportation network (distance matters!)
- Scale effects in transportation, in the form of long-haul economies
- Increasing returns to transportation

Outline

Motivation

The B-MARIA-27 and the CEER models

✓ Simulation results

Final remarks

Simulations

The CEER model is used to simulate the impacts of regional integration in Colombia

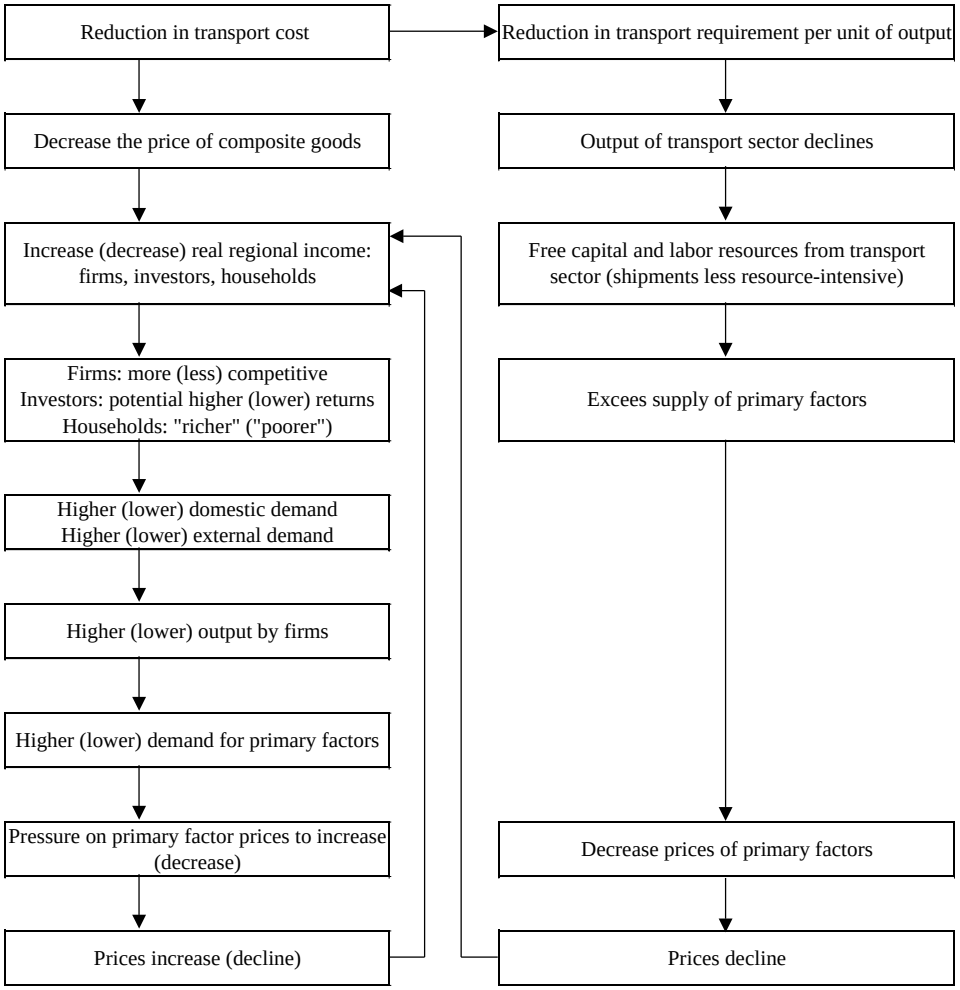
The model is applied to analyze the effects of an overall 1% reduction in transportation cost **within** the country. All exogenous variables are set equal to zero, except the changes in transport costs between each origin-destination pair

Results of the simulation computed via a four-step Euler procedure with extrapolation, under a **long-run closure**

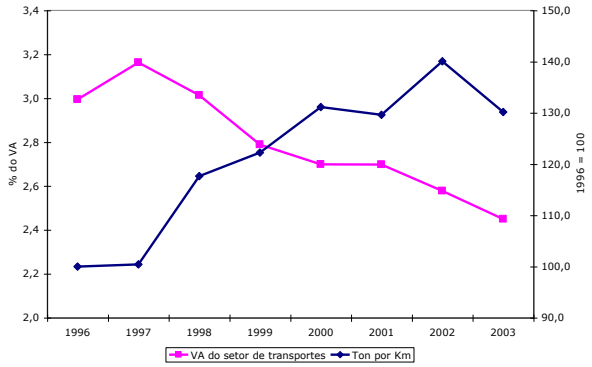
Analytically important transportation links

Role of increasing returns

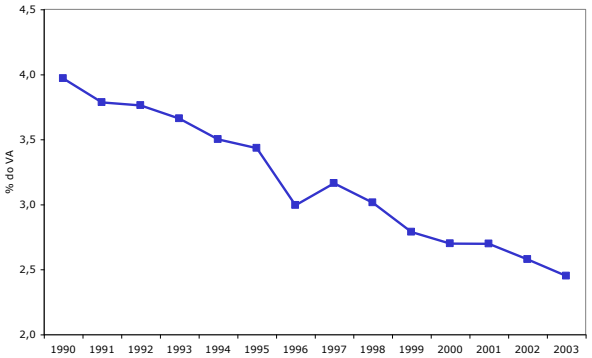
Functioning mechanisms of the simulations



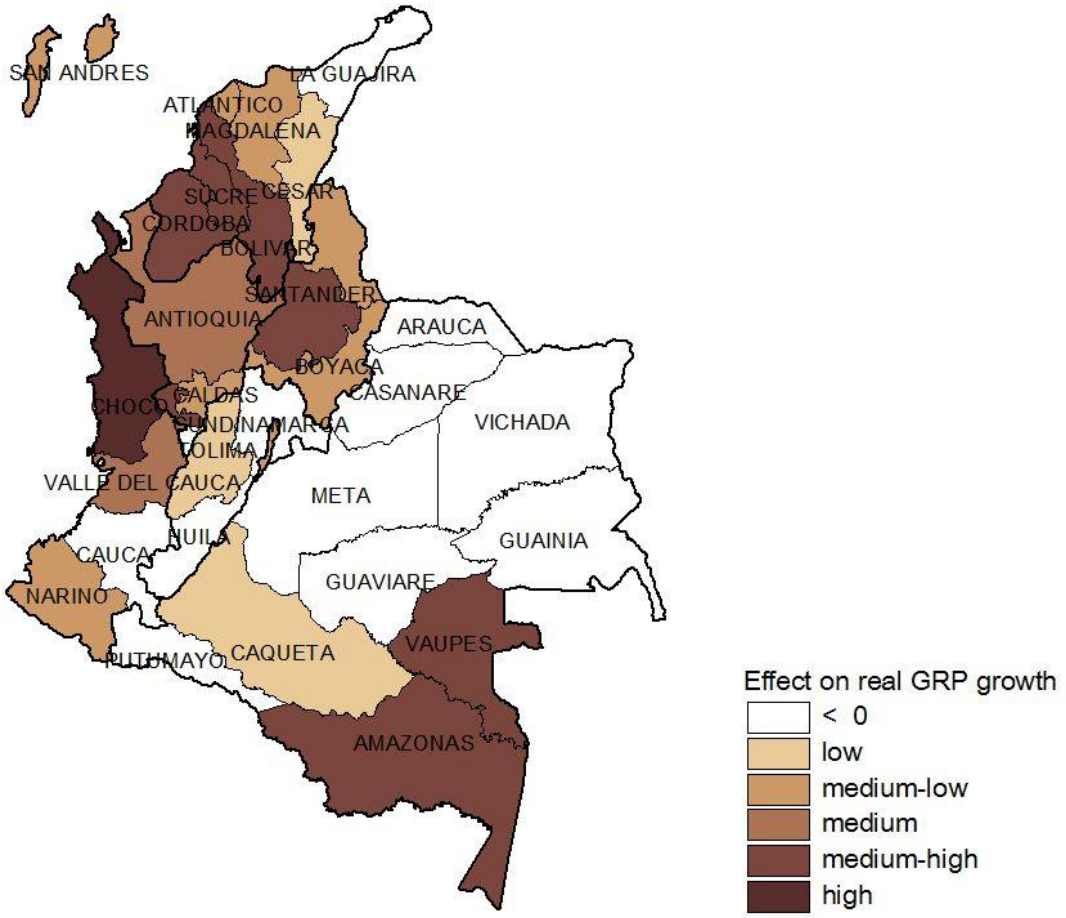
Recent evolution of transport sector



Share of transport sector in VA



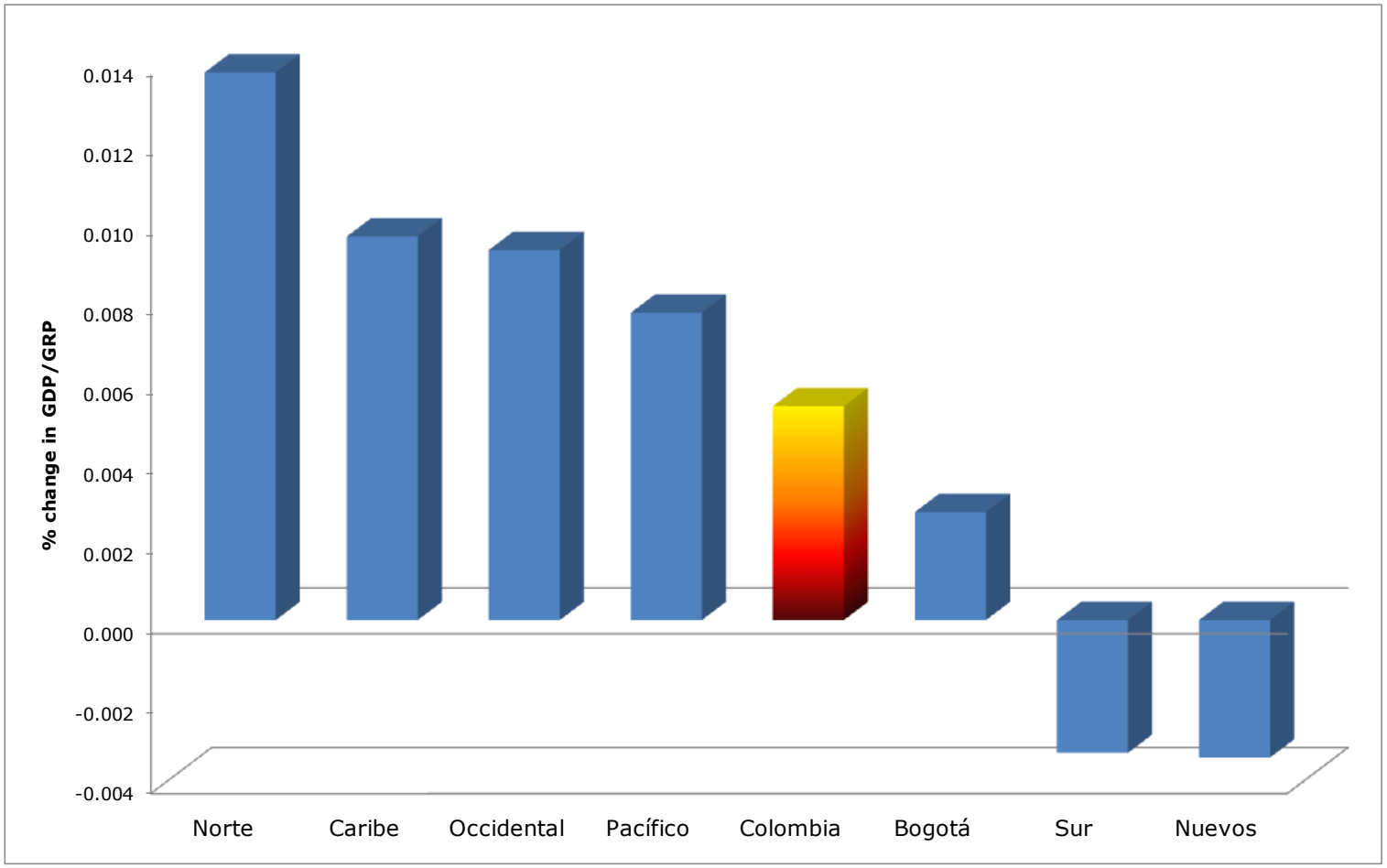
Spatial effects of regional integration on GRP growth



Colombian Regions

Colombian Departments

Macro-regional effects of regional integration



Model pre-selection and NEG

Pre-selection shapes the policy analysis in a way that one would expect the model to reproduce empirical regularities evidenced from tests of equilibrium equations derived from structural NEG models

We used the model results to capture the embedded relationship between regional wages and market access and supplier access in a context of regional integration

Wage equation considering displacements from the original equilibrium

Structural analysis of regional wages results

Dependent variable: Regional wage

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*P-value*
Constant	-0.0098	0.0004	-24.3539	0.0000
Interregional exports	0.1940	0.0425	4.5646	0.0001
International exports	0.2535	0.0207	12.2192	0.0000
Interregional imports	-0.1176	0.0321	-3.6591	0.0010
International imports	0.1636	0.0372	4.4013	0.0001

Obs.: Variables in percentage-change form

R-squared = 0.9613

Analytically important transportation links

For each transportation link, we can calculate its contribution to specific outcomes, considering different dimensions of regional policy

To obtain a finer perspective on the analytically most important transportation links for optimizing a given policy target (regional/national growth), we can decompose the results into region-to-region links

Key links based on their influence on each policy strategy are highlighted

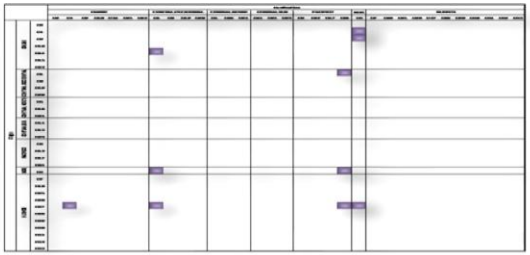
Row = market access

Column = supplier access

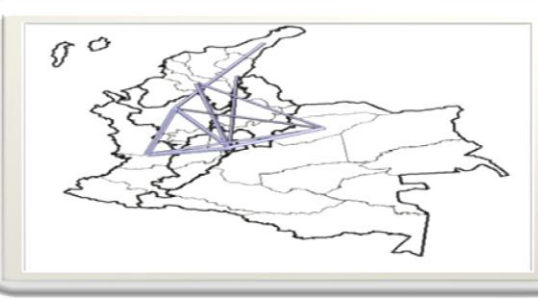
How do we read the following slides?

Real GDP– Colombia

- Policy target (real GDP, real GRP by region)

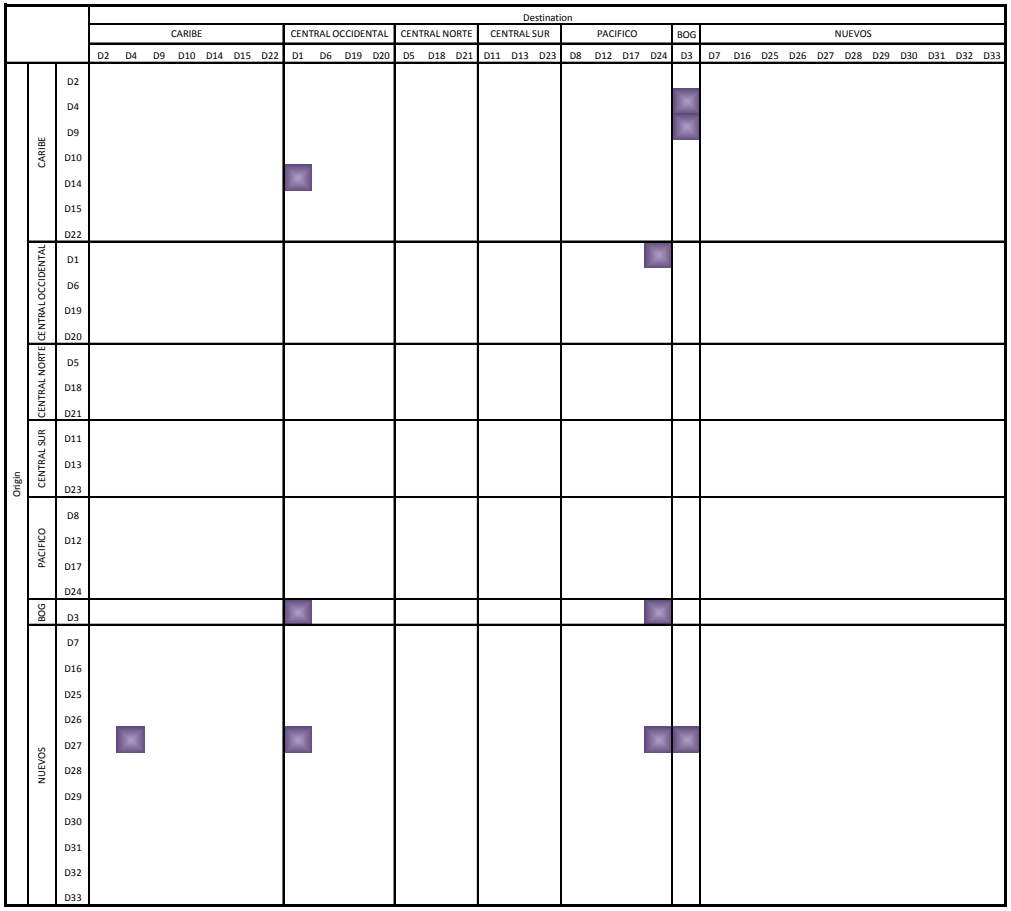


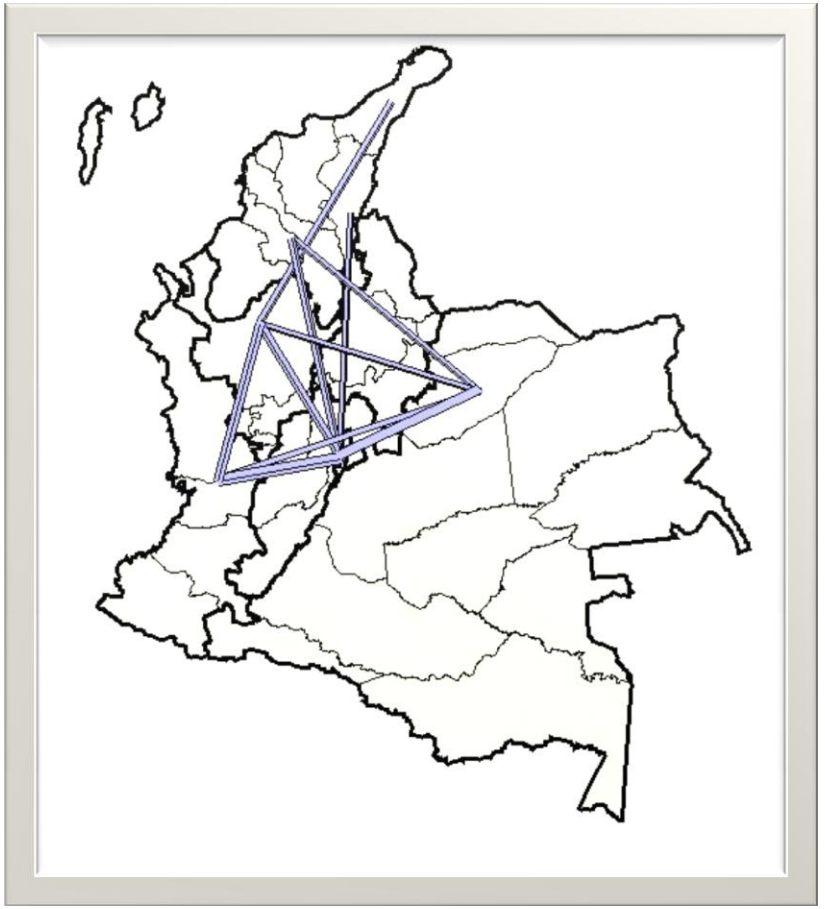
- Long-run analytically important transportation links (top 10)
- Highlighted cells indicate transportation links that contribute most for achieving the policy goal
- Rows (origin) represent forward linkages, and columns (destination) backward linkages



- Cartographical representation of the table, highlighting the desire lines related to the "top 10" links

Real GDP– Colombia





Real GRP – Bogotá

Origin		Destination																																
		CARIBE							CENTRAL OCCIDENTAL				CENTRAL NORTE			CENTRAL SUR			PACIFICO				BOG	NUEVOS											
		D2	D4	D9	D10	D14	D15	D22	D1	D6	D19	D20	D5	D18	D21	D11	D13	D23	D8	D12	D17	D24	D3	D7	D16	D25	D26	D27	D28	D29	D30	D31	D32	D33
CARIBE	D2																						■											
	D4																						■											
	D9																						■											
	D10																						■											
	D14																						■											
	D15																																	
	D22																																	
CENTRAL OCCIDENTAL	D1																						■											
	D6																																	
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	D20																																	
CENTRAL NORTE	D5																																	
	D18																																	
	D21																						■											
CENTRAL SUR	D11																																	
	D13																																	
	D23																																	
PACIFICO	D8																																	
	D12																																	
	D17																																	
	D24																						■											
BOG	D3																				■													
NUEVOS	D7																																	
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	D27																						■											
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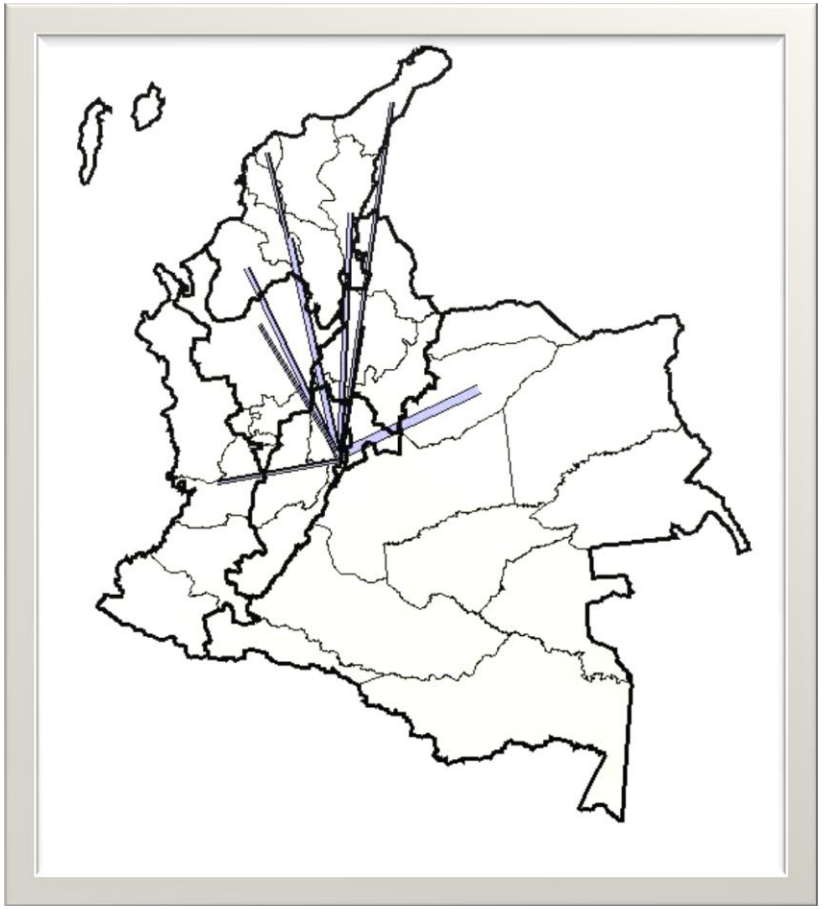
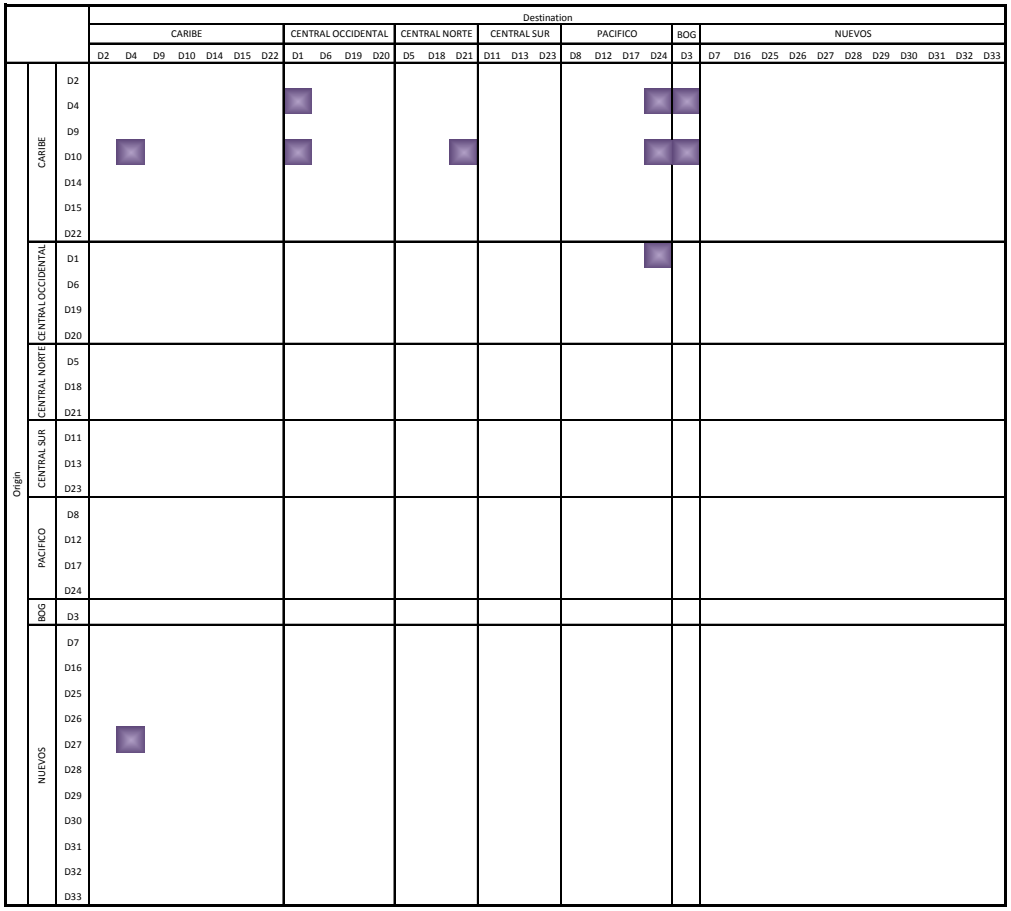
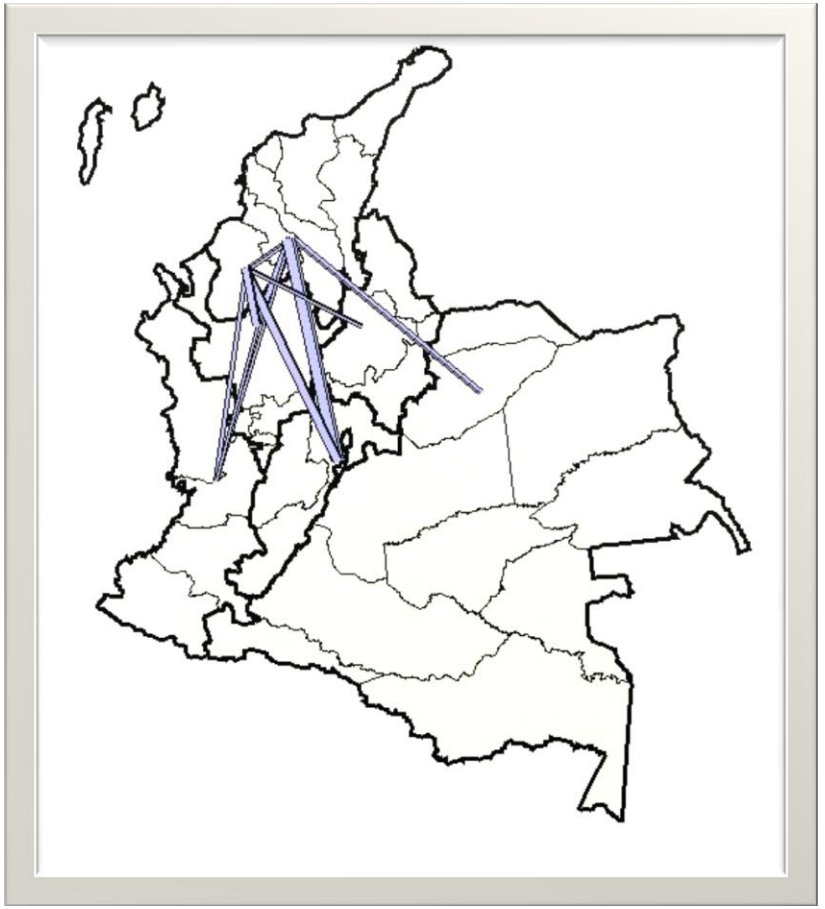


Real GRP – Caribe





Real GRP – Pacífico

Origin		Destination: CARIBE						
		D2	D4	D9	D10	D14	D15	D22
CARIBE	D2							
	D4							
	D9							
	D10							
	D14							
	D15							
	D22							
CENTRAL OCCIDENTAL	D1							
	D6							
	D19							
	D20							
CENTRAL NORTE	D5							
	D18							
	D21							
CENTRAL SUR	D11							
	D13							
	D23							
PACIFICO	D8							
	D12							
	D17							
	D24							
BOG	D3							
NUEVOS	D7							
	D16							
	D25							
	D26							
	D27							
	D28							
	D29							
	D30							
	D31							
	D32							
	D33							

Origin		Destination: CENTRAL OCCIDENTAL			
		D1	D6	D19	D20
CARIBE	D2				
	D4				
	D9				
	D10				
	D14				
	D15				
	D22				
CENTRAL OCCIDENTAL	D1				
	D6				
	D19				
	D20				
CENTRAL NORTE	D5				
	D18				
	D21				
CENTRAL SUR	D11				
	D13				
	D23				
PACIFICO	D8	■			
	D12				
	D17				
	D24	■			
BOG	D3				
NUEVOS	D7				
	D16				
	D25				
	D26				
	D27				
	D28				
	D29				
	D30				
	D31				
	D32				
	D33				

Origin		Destination: CENTRAL NORTE		
		D5	D18	D21
CARIBE	D2			
	D4			
	D9			
	D10			
	D14			
	D15			
	D22			
CENTRAL OCCIDENTAL	D1			
	D6			
	D19			
	D20			
CENTRAL NORTE	D5			
	D18			
	D21			
CENTRAL SUR	D11			
	D13			
	D23			
PACIFICO	D8	■		
	D12			
	D17			
	D24			
BOG	D3			
NUEVOS	D7			
	D16			
	D25			
	D26			
	D27			
	D28			
	D29			
	D30			
	D31			
	D32			
	D33			

Origin		Destination: CENTRAL SUR		
		D11	D13	D23
CARIBE	D2			
	D4			
	D9			
	D10			
	D14			
	D15			
	D22			
CENTRAL OCCIDENTAL	D1			
	D6			
	D19			
	D20			
CENTRAL NORTE	D5			
	D18			
	D21			
CENTRAL SUR	D11			
	D13			
	D23			
PACIFICO	D8			
	D12			
	D17			
	D24			
BOG	D3			
NUEVOS	D7			
	D16			
	D25			
	D26			
	D27			
	D28			
	D29			
	D30			
	D31			
	D32			
	D33			

Origin		Destination: PACIFICO			
		D8	D12	D17	D24
CARIBE	D2				
	D4				
	D9				
	D10				
	D14				
	D15				
	D22				
CENTRAL OCCIDENTAL	D1				
	D6				
	D19				
	D20				
CENTRAL NORTE	D5				
	D18				
	D21				
CENTRAL SUR	D11				
	D13				
	D23				
PACIFICO	D8				
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	D24				
BOG	D3				
NUEVOS	D7				
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	D25				
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	D27				
	D28				
	D29				
	D30				
	D31				
	D32				
	D33				

Origin		Destination: BOG	
		D3	
CARIBE	D2		
	D4		
	D9		
	D10		
	D14		
	D15		
	D22		
CENTRAL OCCIDENTAL	D1		
	D6		
	D19		
	D20		
CENTRAL NORTE	D5		
	D18		
	D21		
CENTRAL SUR	D11		
	D13		
	D23		
PACIFICO	D8	■	
	D12		
	D17		
	D24	■	
BOG	D3		
NUEVOS	D7		
	D16		
	D25		
	D26		
	D27	■	
	D28		
	D29		
	D30		
	D31		
	D32		
	D33		

Origin		Destination: NUEVOS										
		D7	D16	D25	D26	D27	D28	D29	D30	D31	D32	D33
CARIBE	D2											
	D4											
	D9											
	D10											
	D14											
	D15											
	D22											
CENTRAL OCCIDENTAL	D1											
	D6											
	D19											
	D20											
CENTRAL NORTE	D5											
	D18											
	D21											
CENTRAL SUR	D11											
	D13											
	D23											
PACIFICO	D8											
	D12											
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BOG	D3											
NUEVOS	D7											
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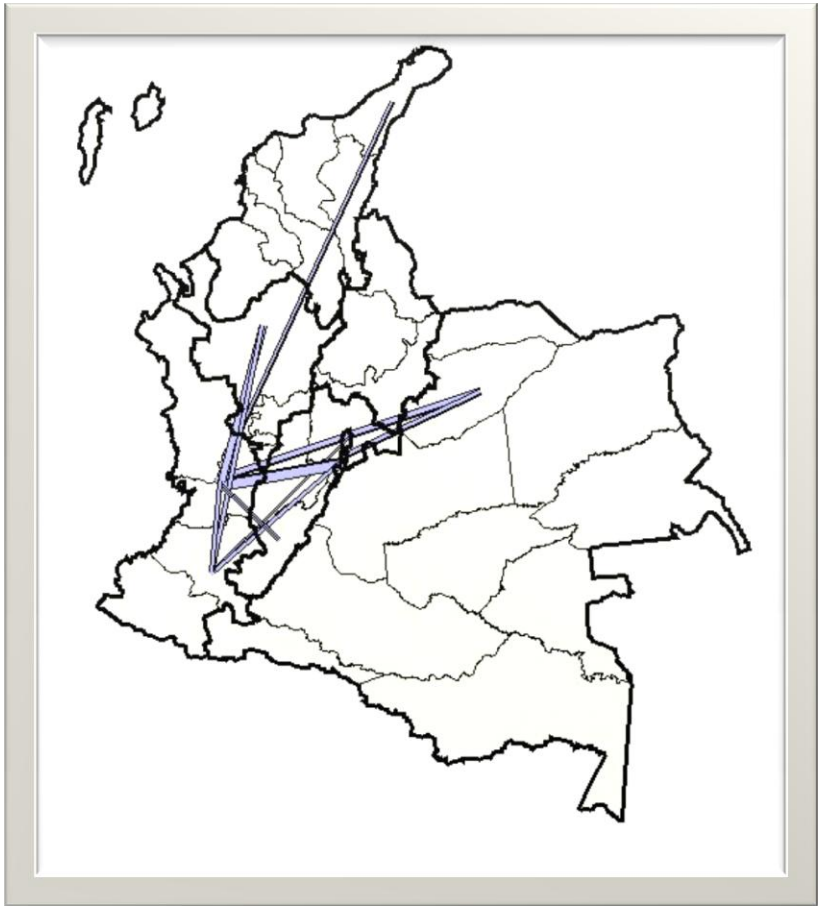
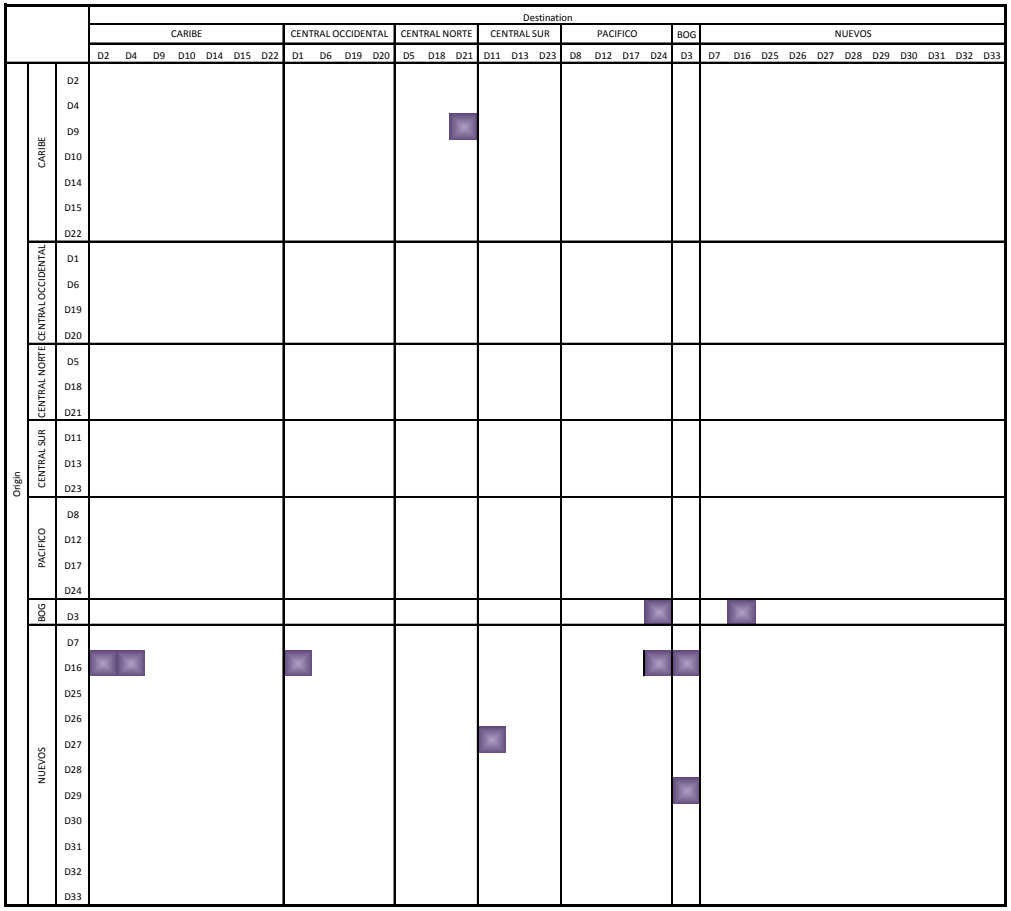
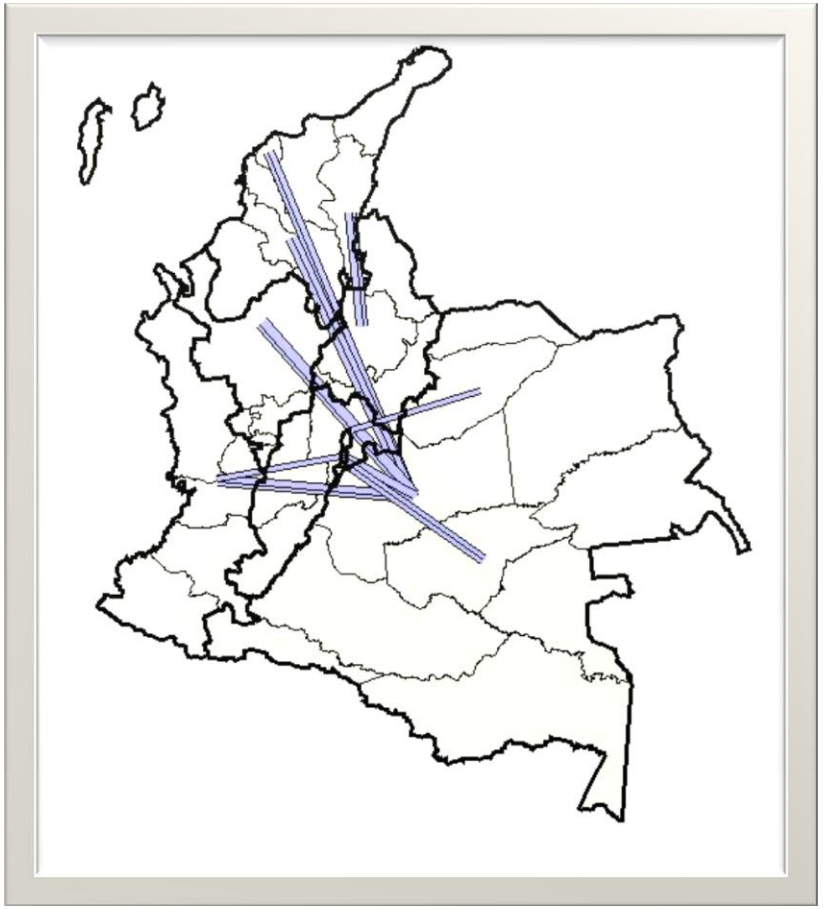


Real GRP – Nuevos





Real GRP – Central Sur

Origin		Destination																																		
		CARIBE							CENTRAL OCCIDENTAL				CENTRAL NORTE			CENTRAL SUR			PACIFICO				BOG	NUEVOS												
		D2	D4	D9	D10	D14	D15	D22	D1	D6	D19	D20	D5	D18	D21	D11	D13	D23	D8	D12	D17	D24	D3	D7	D16	D25	D26	D27	D28	D29	D30	D31	D32	D33
CARIBE	D2																																			
	D4																																			
	D9																																			
	D10																																			
	D14								■							■																					
	D15																																			
	D22																																			
CENTRAL OCCIDENTAL	D1																																			
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CENTRAL NORTE	D5																																			
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CENTRAL SUR	D11																																			
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PACIFICO	D8																																			
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BOG	D3																																			
NUEVOS	D7																																			
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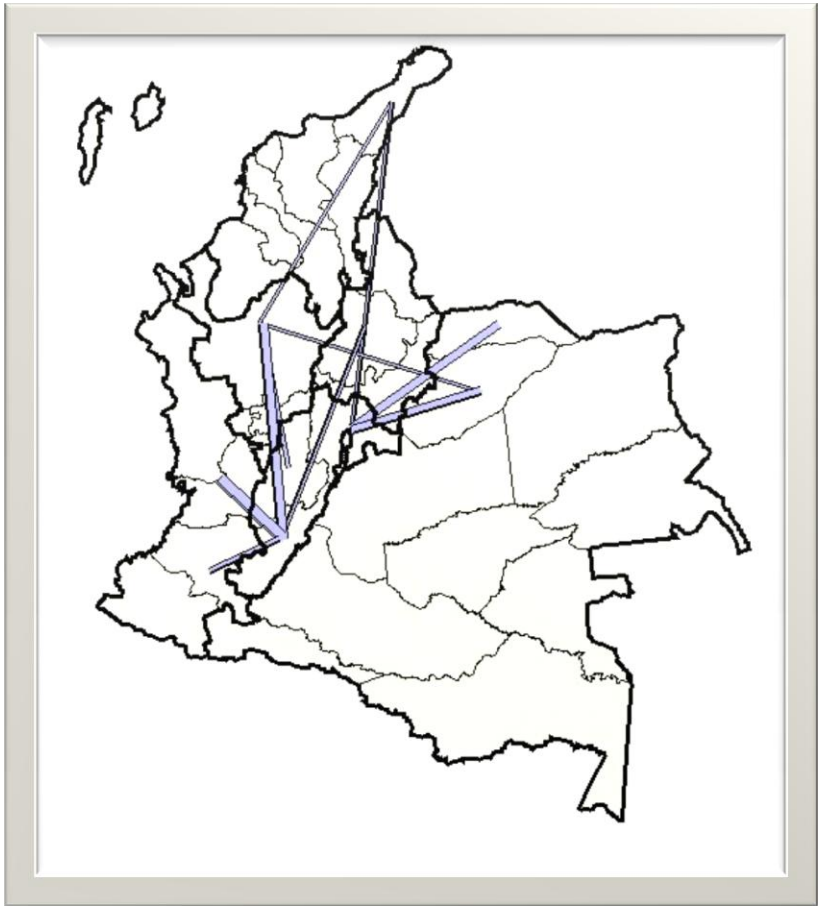

Real GRP – Central Occidental

Origin		Destination																																
		CARIBE							CENTRAL OCCIDENTAL				CENTRAL NORTE			CENTRAL SUR			PACIFICO				BOG	NUEVOS											
		D2	D4	D9	D10	D14	D15	D22	D1	D6	D19	D20	D5	D18	D21	D11	D13	D23	D8	D12	D17	D24	D3	D7	D16	D25	D26	D27	D28	D29	D30	D31	D32	D33
CARIBE	D2																																	
	D4								■																									
	D9																																	
	D10																																	
	D14																																	
	D15																																	
	D22																																	
CENTRAL OCCIDENTAL	D1		■																			■	■											
	D6																																	
	D19																																	
	D20																																	
CENTRAL NORTE	D5																																	
	D18																																	
	D21																																	
CENTRAL SUR	D11																																	
	D13																																	
	D23																																	
PACIFICO	D8																																	
	D12								■			■			■	■						■												
	D17																																	
	D24																																	
BOG	D3								■																									
NUEVOS	D7																																	
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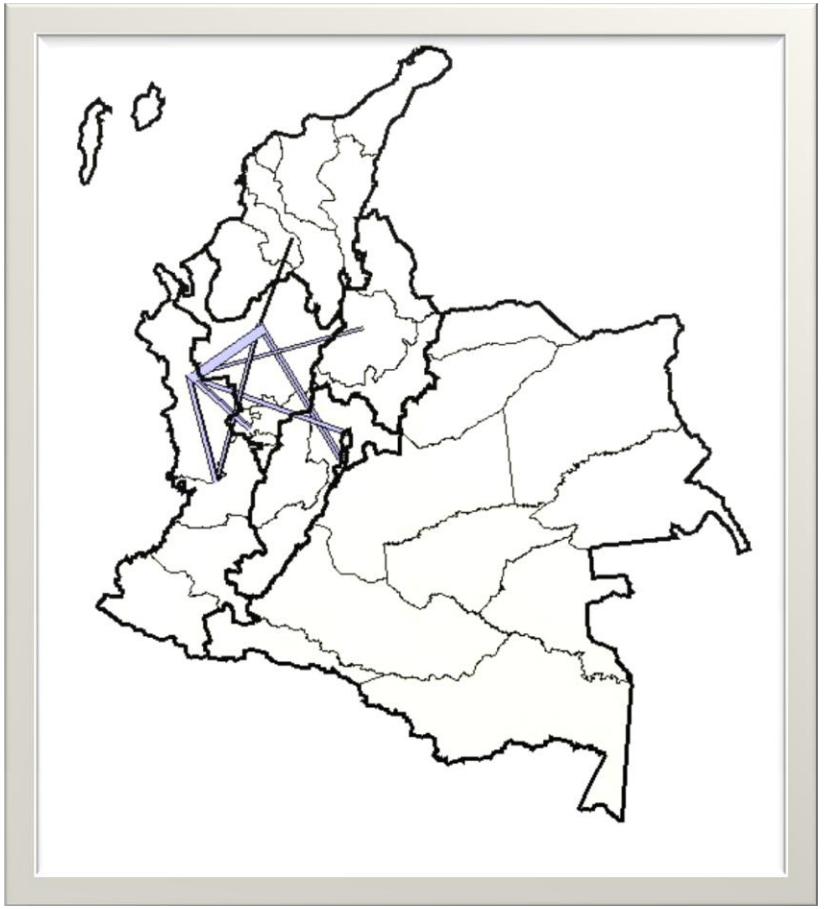
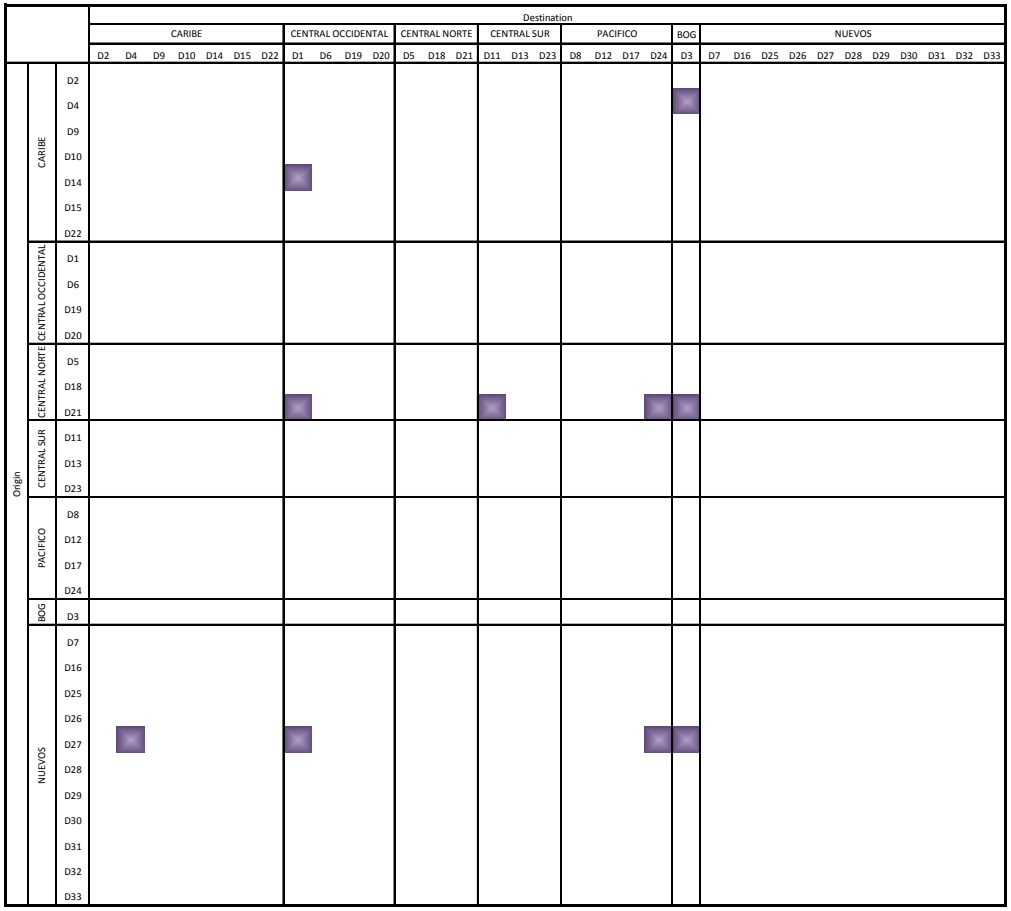
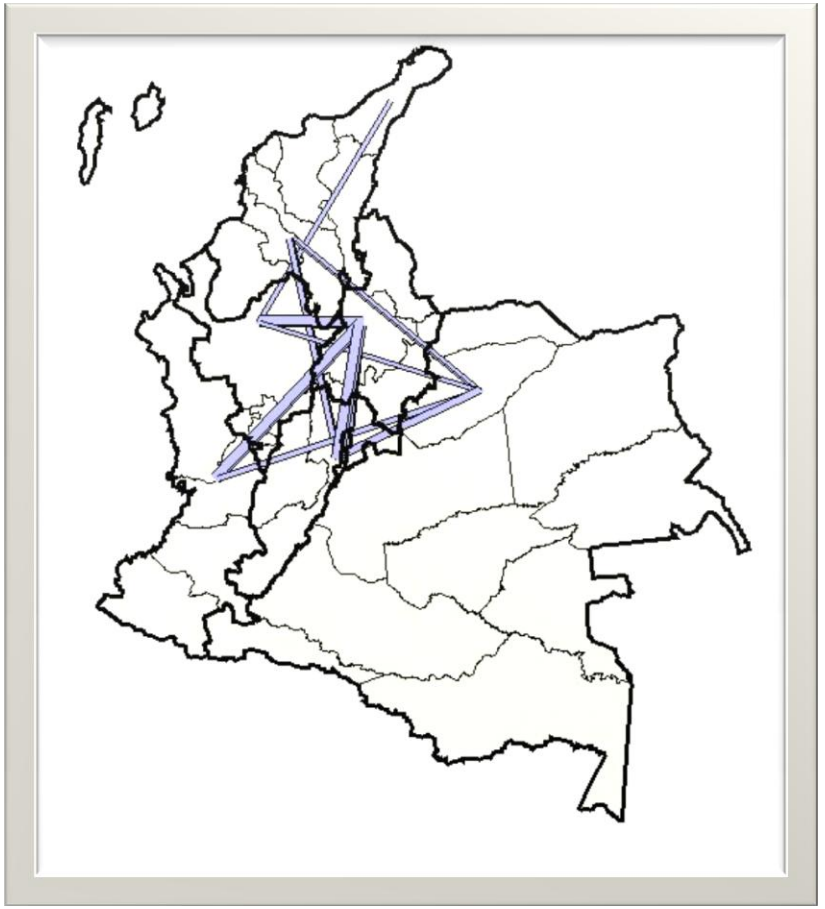


Real GRP – Norte





Implications of regional integration for regional growth

We present a visualization technique that provides an opportunity to explore regional characteristics of the Colombian economy, reflecting the spatial economic phenomena of backward and forward linkages specifications in a fully integrated interregional system

The results are presented in a way that helps identifying the different patterns of spatial integration from a **region's own perspective**

HBC figure

Basic information

The basic information used to build the HBC figure is drawn from matrices of results that contain, for each Departamento, the GRP effect of reductions in transportation costs for every origin-destination pair in the Colombian system.

A typical element of this matrix is the percentage change in GRP in region r, associated with a 1% reduction in transport costs from s to q

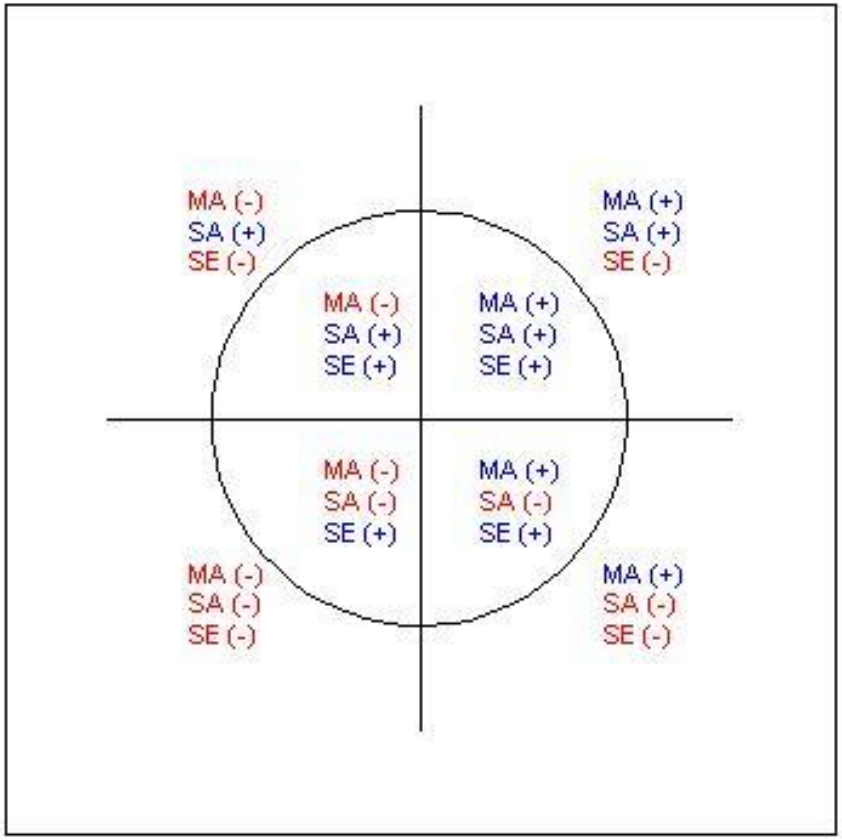
It is possible to aggregate this information in such a way that we obtain three summary measures reflecting the isolated effects of increasing the region's direct access to markets (MA_r); increasing direct access to suppliers (SA_r); as well as the indirect effects associated with transportation costs reductions outside the region (SE_r)

Summary matrix of results for GRP effects

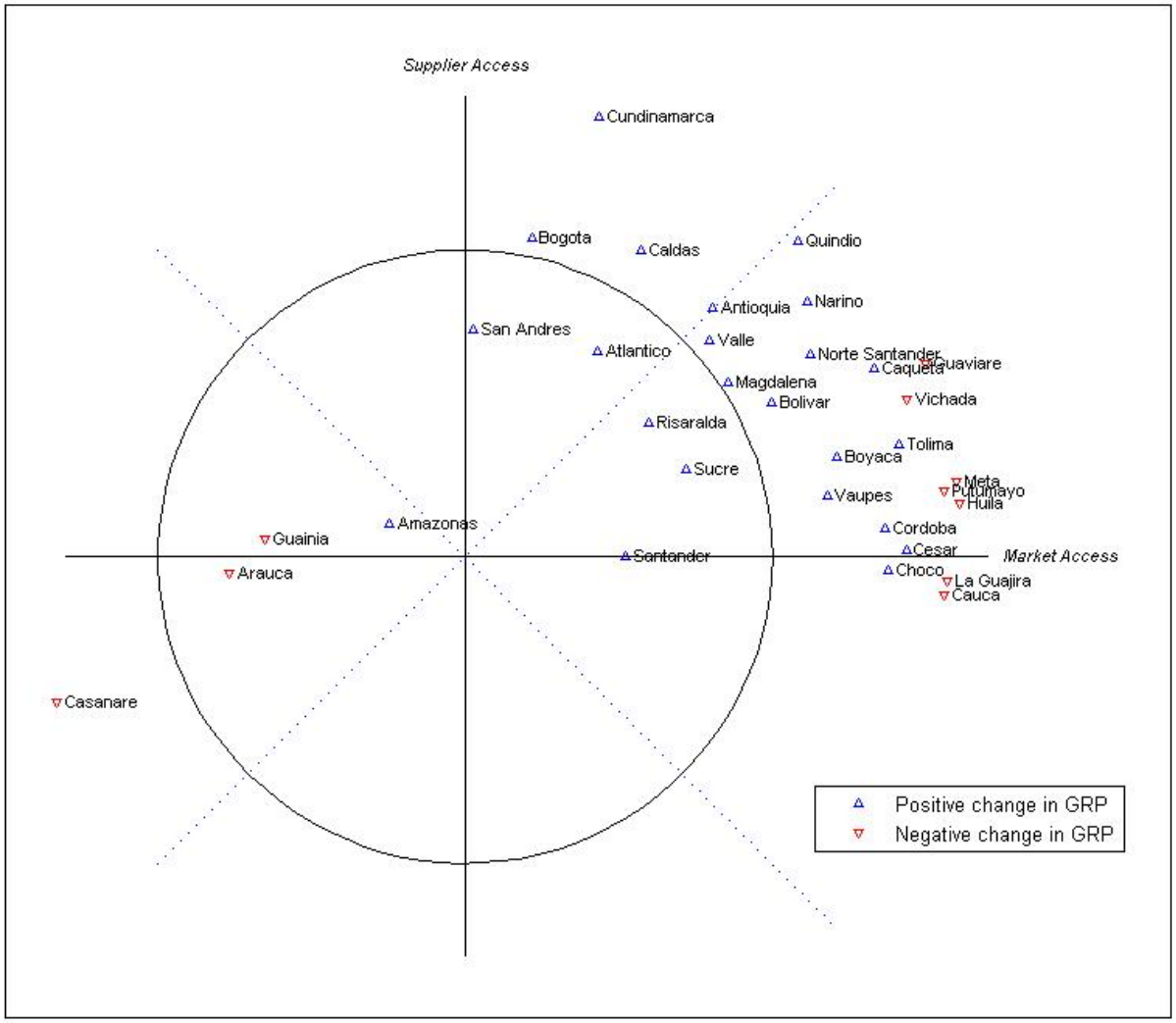
		Destination	
		r	R
Origin	r	0	$MA_r = \sum_q y_{sq}^r = y_{s\bullet}^r$, for $s = r$
	R	$SA_r = \sum_s y_{sq}^r = y_{\bullet q}^r$, for $q = r$	$SE_r = \sum_s \sum_q y_{sq}^r = y_{\bullet\bullet}^r$, for $s, q \neq r$

r = study region; R = rest of the country

Schematic representation of the HBC figure



Typology of regions according to their growth-orientation with increasing integration



Role of increasing returns

Qualitative sensitivity analysis

$$X1PRIM(j,q) = A1(j,q) * A1PRIM(j,q) * [\alpha(j,q)Z(j,q)]^{MRP(j,q)}$$

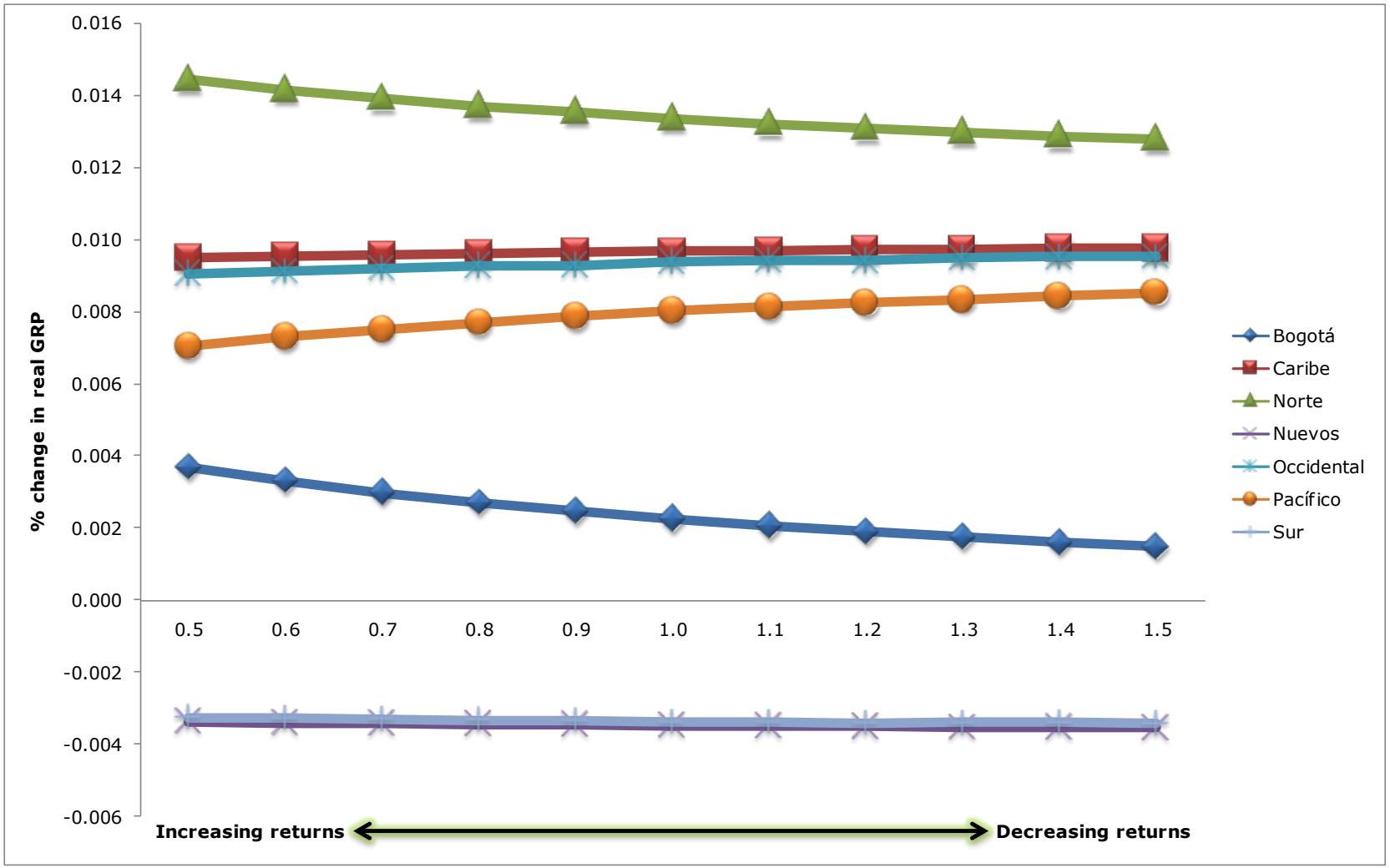
$$MRP \in [0.5, 1.5]$$

Increasing returns in manufacturing sector in Bogotá

- 31.5% of VA and 23.1 % of employment (2002-2005)

Working hypothesis: Bogotá (core region) could potentially further benefit from improvements in the transportation sector by exploiting scale economies

Effects of regional integration under different levels of agglomeration economies in Bogotá



Systematic Sensitivity Analysis

The scenarios related to the regional integration experiment discussed above were employed using the Gaussian quadrature approach to establish confidence intervals for the main results

The range for the parameters in the first group of sensitivity analyses was set to +/- 25% around the default values, with independent, symmetric, triangular distributions for the set of parameters related to the **trade elasticities**

The second group of sensitivity analyses was carried out in the **scale economies parameters** in the regional manufacturing sectors (+/- 25%)

Systematic Sensitivity Analysis: GDP/GRP changes (%)

	Trade elasticities		Scale economies parameters	
	Lower bound	Upper bound	Lower bound	Upper bound
D1	0.0041	0.0123	0.0092	0.0094
D2	0.0061	0.0071	0.0064	0.0066
D3	0.0012	0.0019	0.0011	0.0019
D4	0.0198	0.0284	0.0237	0.0240
D5	0.0023	0.0071	0.0039	0.0044
D6	0.0028	0.0039	0.0035	0.0036
D7	**-0.0026**	**0.0049**	**-0.0001**	**0.0004**
D8	**-0.0517**	**0.0265**	-0.0244	-0.0218
D9	0.0001	0.0016	0.0007	0.0007
D10	0.0145	0.0197	0.0165	0.0166
D11	**-0.0009**	**0.0023**	0.0002	0.0002
D12	**-0.1257**	**0.2372**	0.1024	0.1048
D13	-0.0289	-0.0045	-0.0205	-0.0202
D14	-0.0014	-0.0004	-0.0011	-0.0009
D15	0.0039	0.0059	0.0046	0.0048
D16	-0.0082	-0.0048	-0.0072	-0.0068
D17	0.0008	0.0070	0.0030	0.0031
D18	0.0011	0.0056	0.0027	0.0030
D19	**-0.0012**	**0.0025**	0.0002	0.0002
D20	**-0.0051**	**0.0407**	0.0236	0.0239
D21	0.0190	0.0266	0.0215	0.0221
D22	0.0125	0.0197	0.0157	0.0161
D23	**-0.0019**	**0.0064**	0.0011	0.0013
D24	0.0103	0.0119	0.0108	0.0112
D25	0.0060	0.0307	0.0210	0.0214
D26	-0.0050	-0.0035	-0.0047	-0.0044
D27	-0.0024	-0.0013	-0.0021	-0.0019
D28	**-0.1390**	**0.1005**	-0.0338	-0.0315
D29	-0.0201	-0.0102	-0.0181	-0.0142
D30	-0.0064	-0.0013	-0.0048	-0.0044
D31	0.0029	0.0053	0.0039	0.0039
D32	0.0120	0.0180	0.0155	0.0155
D33	-0.0047	-0.0006	-0.0037	-0.0025
Colombia	0.0051	0.0054	0.0051	0.0052

Outline

Motivation

The B-MARIA-27 and the CEER models

Simulation results

✓ Final remarks

Final remarks

We depart from Haddad and Hewings (2005) modeling approach, which offers some preliminary steps in the marriage of some of the theoretical foundations of NEG with spatial CGE models

Potential modeling strategy to be pursued in order to reinforce policy relevance of NEG-based models

Its ability to handle increasing returns to scale and transportation costs in an integrated spatial economic system with explicit forward and backward linkages places spatial CGE models as strong candidates for bridging the gap between theory and practice

Final remarks

Potential applications:

Impact analysis of transportation projects

- Road improvements, tolls, paving, ...

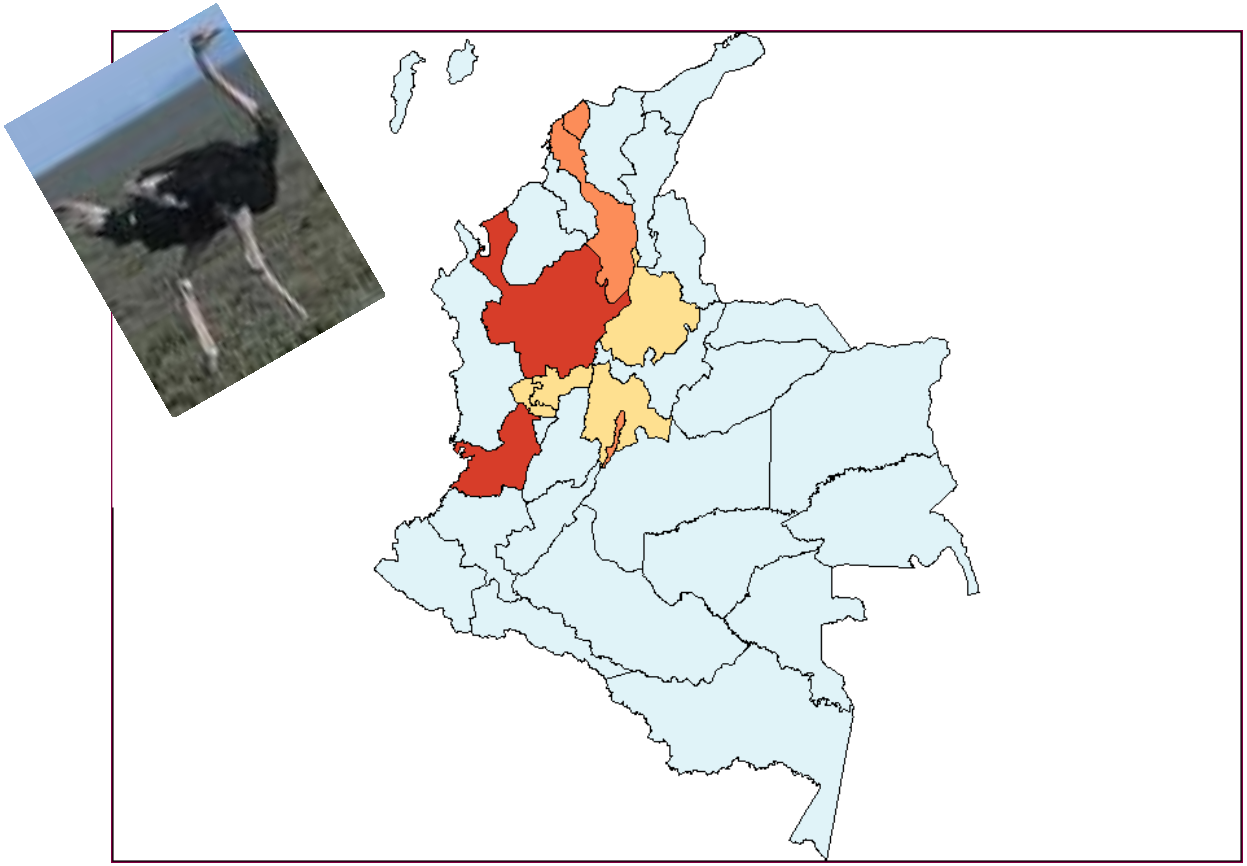
Adapt extraction method (I-O):

- Value of existence
- Unscheduled events

Treatment of spatial information and multimodal systems

(...)

What do you see in this picture?



Things about ostriches...

In Ancient Egypt mythology, usually, the feather was a symbol of Maat, the goddess of truth and order. The goddess was always shown wearing an **ostrich feather** in her hair. The feather by itself was her emblem.

In popular mythology, the Ostrich is famous for hiding its head in the sand at the first sign of danger.

Why the "Running Ostrich"?

Things to think about the "Colombian Running Ostrich":

- It is interesting to link the shape of such spatial cluster, very dynamic in economic terms, to the goddess of truth and justice – it gives a flavor of *efficiency*;
- The ostrich is running towards the north (Europe, USA): it is well known that Colombia has stronger economic ties with these areas – one may think also about *catch-up* (convergence);
- The cluster seems to be self-contained; spatial competition does not play a relevant role outside the cluster – "hiding the head" may be associated with *self-sufficiency*;
- The fact that the female ostrich may leave the nest unattended (because the eggs are too thick-shelled to be easily broken open by predators) was mentioned in the Bible as the reason why the bird was chastised as a bad parent in the Book of Job (Job 39:13-18); ostriches as proverbial examples of poor parenting may be a metaphor for the low HDI in the region.