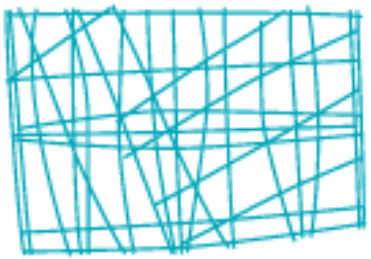

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Spatial Aspects of Trade Liberalization in Colombia: A General Equilibrium Approach

Eduardo Haddad Jaime Bonet Geoffrey Hewings Fernando Perobelli

Outline

- ✓ Motivation
- The CEER model
- Simulation results
- Final remarks

NEG models suggest that trade liberalization reduces regional inequality

Results from NEG models [Krugman and Elisondo (1996), Krugman (1994), Puga (1998), and Allonso-Vilar (2001)]:

Trade liberalization policies may reduce regional inequality in developing countries, especially by reducing the size of primate cities or at least reducing their relative growth.

Trade liberalization would also lead to more specialized regions.

Given the long-run nature of these models, a final result would be strongly related to population movements from the core region, which would ultimately increase welfare through reduction of congestion costs.

Empirical studies are not conclusive about NEG results

Ades and Glaeser (1995), using cross country data, did corroborate Krugman and Elisondo's predictions, showing that countries with high shares of trade in GDP or low tariff barriers (even holding trade levels constant) rarely have their population concentrated in a single city.

Hanson (1998) showed that trade reform appears to have contributed to the breakup of the Mexico City manufacturing belt and the formation of new industry centers in northern Mexico.

However, the reality of Brazil, another major Latin American country, seems to be more complex, as trade liberalization in the 1990s did not produce any relevant de-concentration from the core region (Haddad, 1999; Haddad and Azzoni, 2002). As Haddad and Hewings (2005) points out, one should consider some intermediate perspectives between a core-periphery model, on the one hand, and a perfectly competitive, homogeneous space model at the other extreme.

The Colombian case seems also to contradict the theory (Fernández, 1998)

One first attempt to test the Krugman and Elisondo model in Colombia was made by Fernández (1998). This author concludes that, contrary to the predictions of the theory, the empirical evidence suggests a **positive relationship between agglomeration and trade** for most sectors, excluding food, beverages and chemicals, which showed a negative association.

Fernández pointed out that further work should make a model more suitable for the Colombian case, and also **consider that the effects of changes in trade liberalization in agglomeration take longer to be seen**.

In this paper we try to reconcile theory and empirical work

The **short-term** growth consequences of a trade reform will depend on the structure of the reforming economy. From a spatial perspective, the short-run effects will also be heavily influenced by the respective regional structures. The first set of simulations in this paper will try to address some of these issues.

The second set of simulations is inspired by the work by Krugman and Elisondo (1996). We look at the Colombian case, from a **long-run** perspective.

We show the importance of different hypotheses on factor mobility and the role of price effects to better understand the consequences of trade opening in a developing economy.

Outline

Motivation

✓ The CEER model

Simulation results

Final remarks

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

Interstate 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

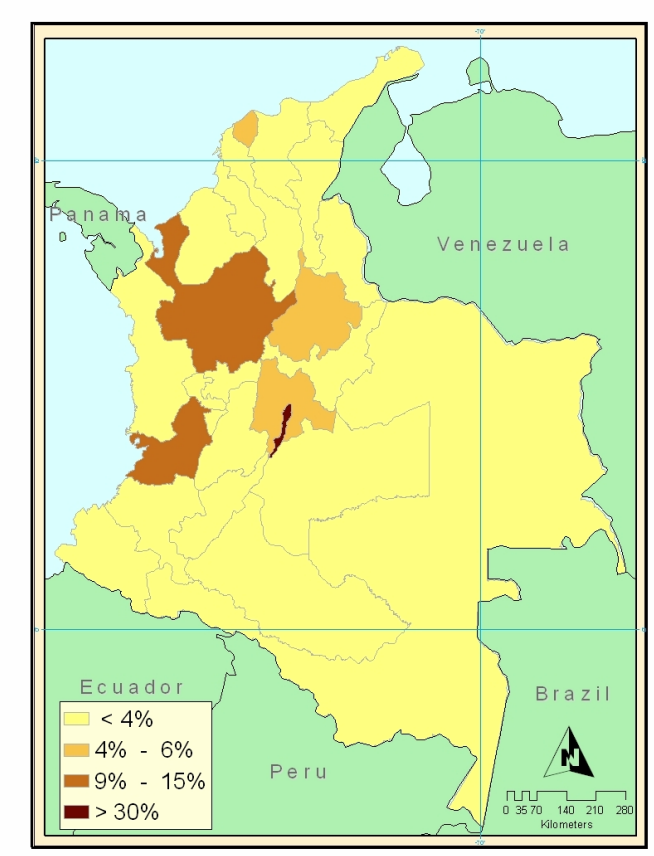
Regional and Central government

Regional labor markets

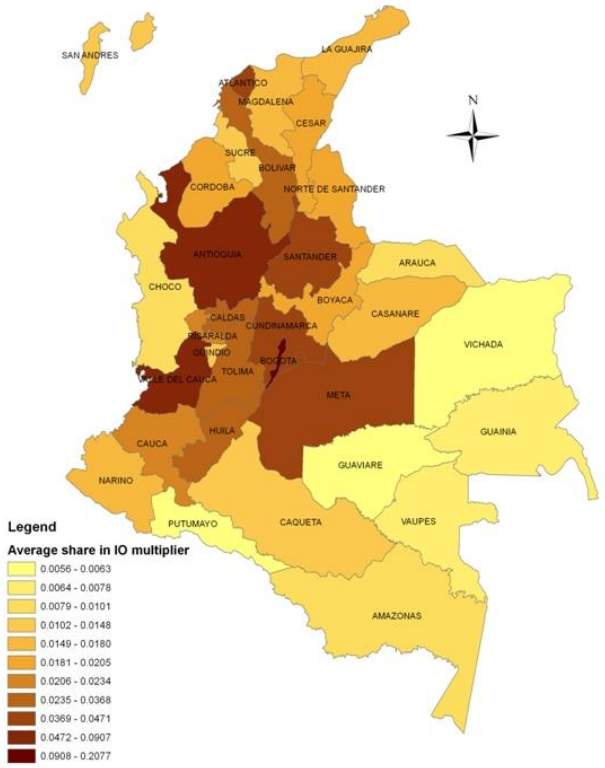
Non-constant returns to scale (agglomeration economies)

Regional setting

Departmental share in GNI, 2000



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



Source: Bonet and Meisel (2006)

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Motivation

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✓ Simulation results

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Simulations

The CEER model is used to simulate the impacts of tariff changes in the Colombian economy. The model is applied to analyze the effects of a **uniform 25% decrease in all tariff rates**. All exogenous variables are set equal to zero, except the changes in the power of tariffs, i.e., one plus the tariff rates, which were set such that the percentage change decrease in each tariff rate was 25%.

Results of the simulation computed via a four-step Euler procedure with extrapolation, under **short-run and long-run closures**.

The analysis is concentrated on the effects on spatial activity and welfare levels, and on some general macro variables.

Short-Run Effects on Selected Macro Variables

Real GDP	0.177
Real Household Consumption	0.483
Activity Level	0.149
Employment: Persons	0.264
Unemployment Rate (% point change)	-0.251
Nominal Wage Paid by Producers	-0.336
GDP Price Index	-0.380
Consumer Price Index	-0.336
Export Volume	0.380
Import Volume	1.017
Balance of Trade (percentage of GDP)	-0.174

Short-Run Effects on Selected Spatial Variables

		GRP	*Activity level*	*Equivalent variation*
D1	Antioquia	0.136	0.112	364,628
D2	Atlántico	0.147	0.135	112,651
D3	Bogotá D. C.	0.292	0.262	1,187,467
D4	Bolívar	0.113	0.093	86,795
D5	Boyacá	0.156	0.113	62,240
D6	Caldas	0.106	0.106	28,371
D7	Caquetá	0.052	0.053	3,184
D8	Cauca	0.064	0.053	19,940
D9	Cesar	0.115	0.110	30,169
D10	Córdoba	0.131	0.100	76,318
D11	Cundinamarca	0.275	0.258	214,639
D12	Chocó	0.046	0.042	3,805
D13	Huila	0.055	0.051	15,576
D14	La Guajira	0.110	0.100	33,038
D15	Magdalena	0.153	0.146	27,142
D16	Meta	0.121	0.115	26,222
D17	Nariño	0.119	0.090	33,091
D18	Norte Santander	0.105	0.097	24,256
D19	Quindío	0.087	0.086	8,416
D20	Risaralda	0.097	0.089	28,357
D21	Santander	0.198	0.132	286,486
D22	Sucre	0.084	0.083	7,527
D23	Tolima	0.101	0.090	33,516
D24	Valle	0.117	0.107	226,986
D25	Amazonas	0.064	0.065	533
D26	Arauca	0.274	0.139	11,584
D27	Casanare	0.060	0.061	28,015
D28	Guanía	0.054	0.053	301
D29	Guaviare	0.116	0.124	1,218
D30	Putumayo	0.092	0.092	2,811
D31	San Andrés y Providencia	0.181	0.174	4,878
D32	Vaupés	0.045	0.047	159
D33	Vichada	0.167	0.174	1,552

Short-run Spatial Results

Figure 5.1. Short-run Effects on GRP

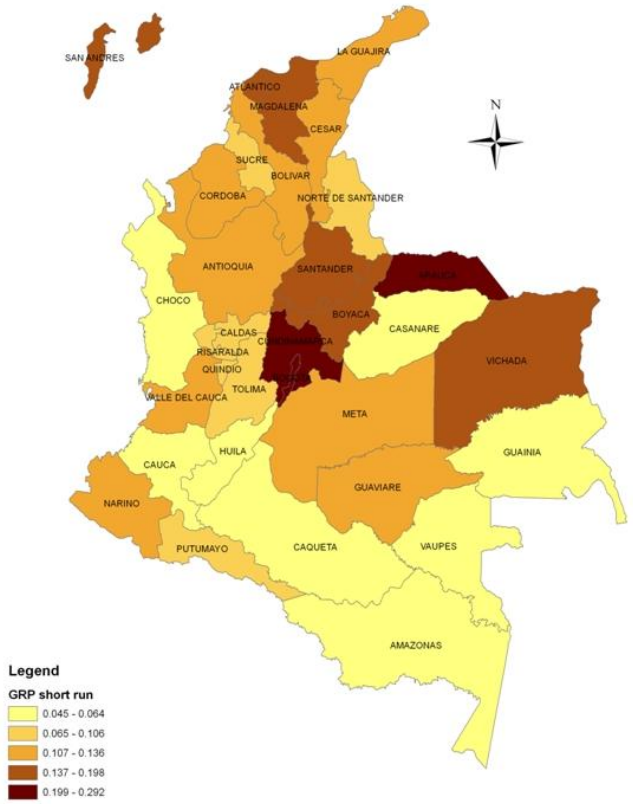
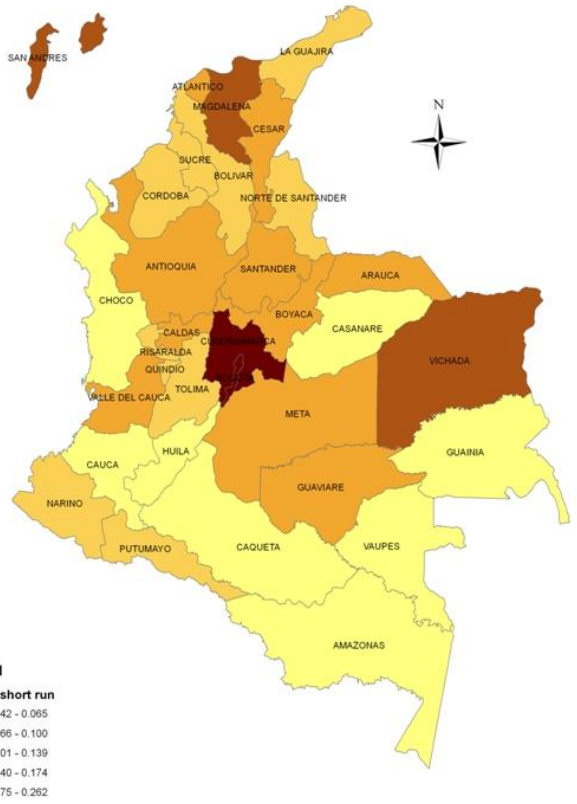


Figure 5.2. Short-run Effects on Activity Level



Short-run Spatial Results (Welfare)

Figure 5.3. Short-run Effects on Equivalent Variation

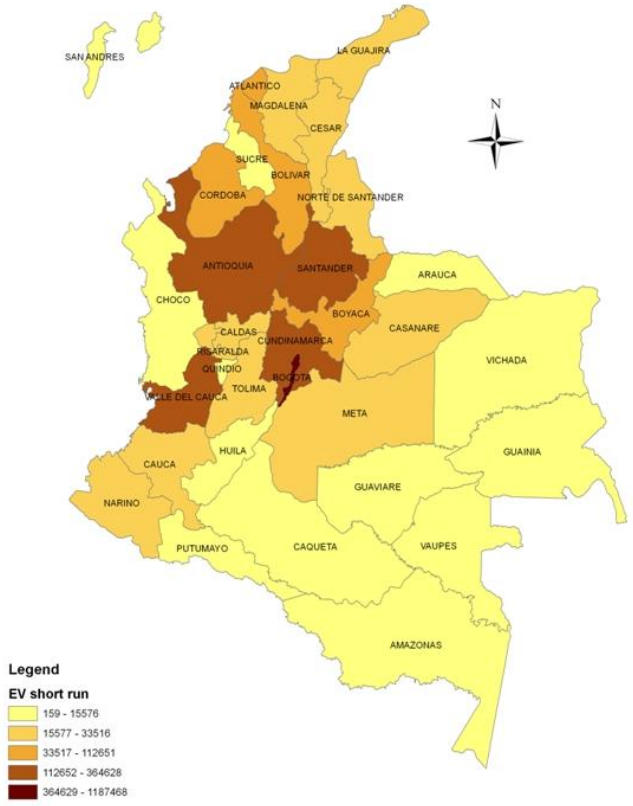
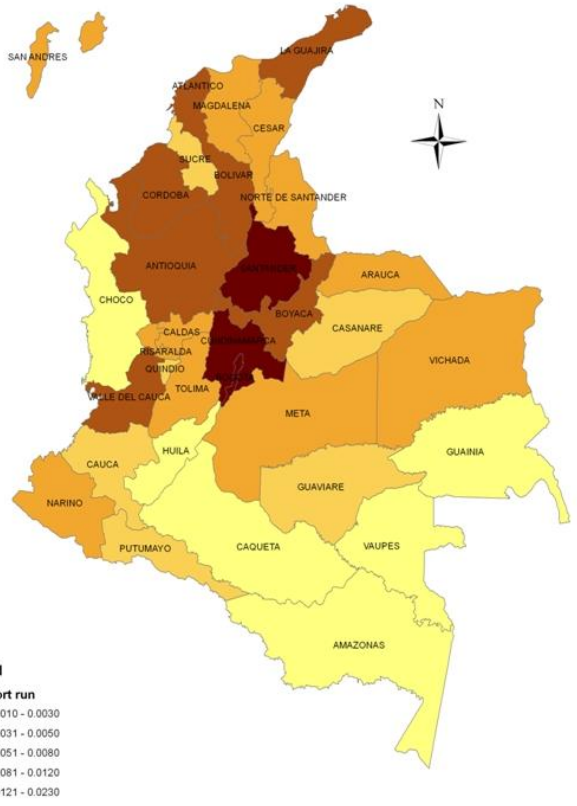


Figure 5.4. Short-run Effects on Relative Equivalent Variation



Structural Analysis of Short-run Activity Level Results

How important is the existing economic structure to explain short-run results associated with a trade liberalization policy in Colombia? Do backward and forward linkages matter?

Dependent Variable: ACT_SR
Method: Least Squares
Date: 02/08/08 Time: 11:24
Sample: 1 33
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.157437	0.083251	-1.891106	0.0698
IMPSH_3	-0.666530	0.342087	-1.948421	0.0622
IMPSHTOT	1.310548	0.430980	3.040852	0.0053
SH_1	0.390297	0.106954	3.649206	0.0012
SH_3	0.370619	0.124310	2.981411	0.0062
SH_4	0.407252	0.095772	4.252299	0.0002
KL	-0.064311	0.020033	-3.210213	0.0035

R-squared	0.758846	Mean dependent var	0.107636
Adjusted R-squared	0.703195	S.D. dependent var	0.051930
S.E. of regression	0.028291	Akaike info criterion	-4.106683
Sum squared resid	0.020811	Schwarz criterion	-3.789242
Log likelihood	74.76028	F-statistic	13.63581
Durbin-Watson stat	2.399898	Prob(F-statistic)	0.000001

ACT_SR = percentage change in regional activity level; **IMPSH_3** = import penetration in household consumption; **IMPSHTOT** = import penetration in total consumption; **SH_1** = intermediate inputs share in total sales; **SH_3** = household share in total sales; **SH_4** = export share in total sales; **KL** = capital to labor ratio.

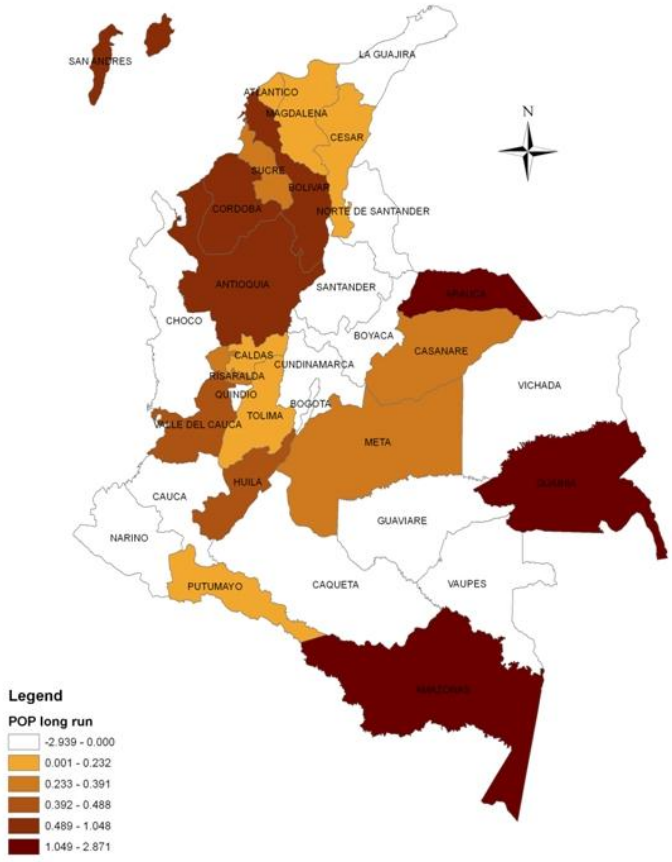
Long-Run Effects on Selected Macro Variables

Real GDP	0.027
Real Household Consumption	-0.269
Real Investment	0.937
Capital Stock	0.149
Activity Level	0.043
Regional Government Consumption	-0.168
Central Government Consumption	-0.269
Consumer Price Index	0.326
International Export Volume	0.704
International Import Volume	0.349
Balance of Trade (percentage of GDP)	-
Nominal Wage	-0.416
GDP Price Index	0.319

Long-Run Effects on Sectoral Activity

Sector	*%*
AGR	0.332
MNE	0.374
IND	0.140
CNT	0.849
TRN	-0.117
ADP	-0.244
OTS	-0.135

Long-run Effects on Population Growth



Short-run Spatial Results

Figure 5.6. Long-run Effects on GRP

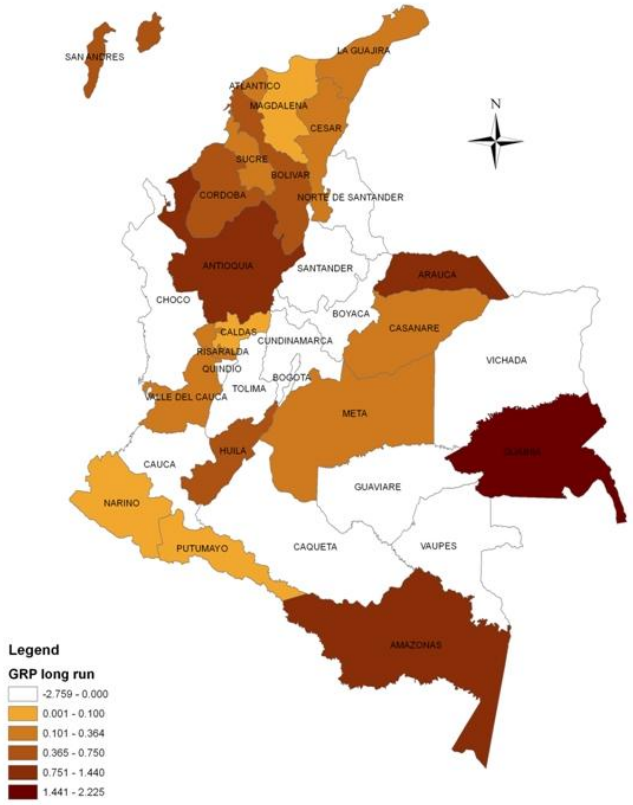
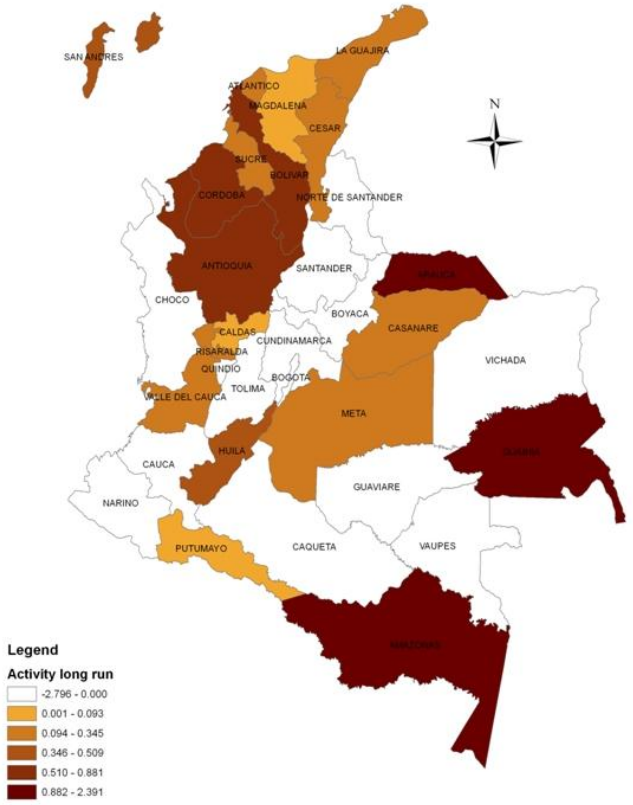


Figure 5.7. Long-run Effects on Activity Level



Short-run Spatial Results (Welfare)

Figure 5.8. Long-run Effects on Equivalent Variation

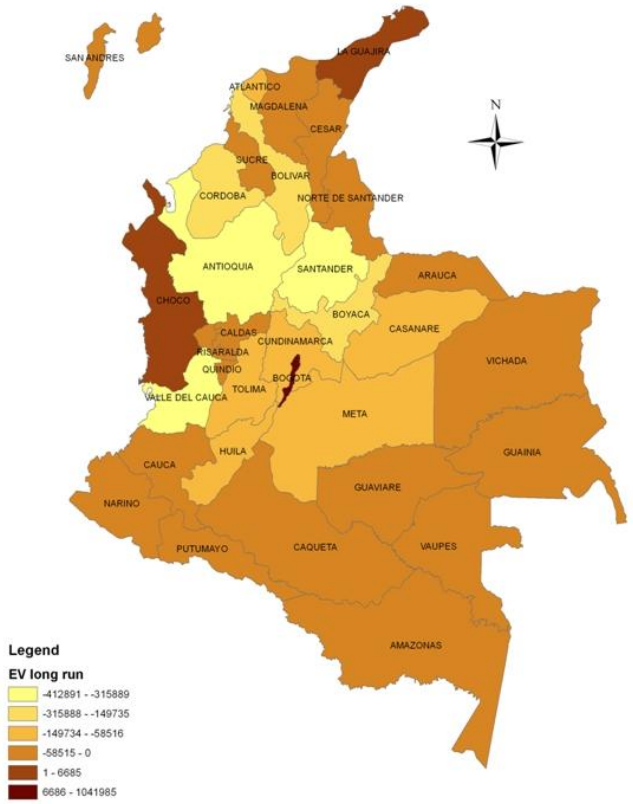
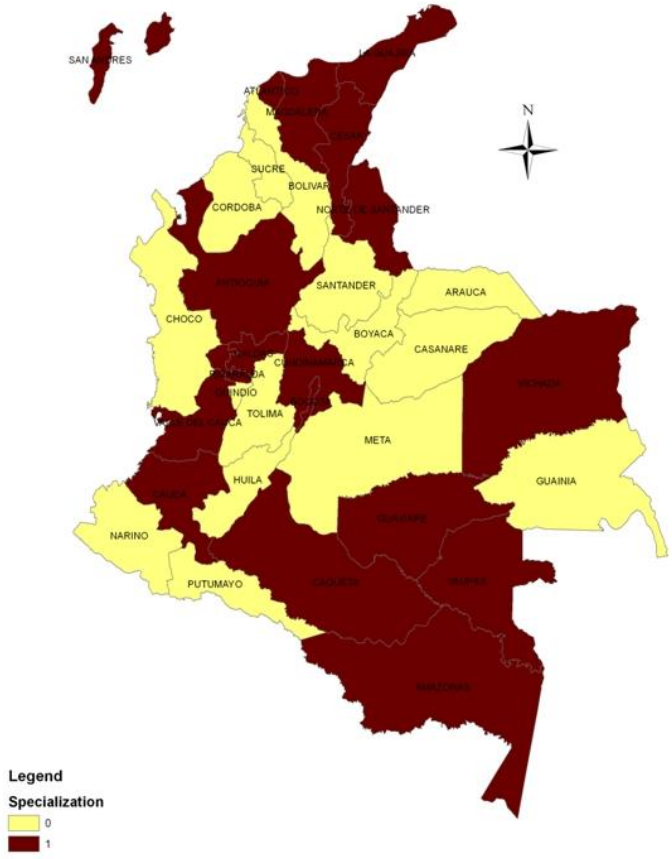


Figure 5.9. Long-run Effects on Relative Equivalent Variation

Long-run Effects on Regional Specialization (1 = more specialized)



Systematic Sensitivity Analysis

The scenarios related to the tariff cut experiments 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 three sets of parameters, namely the **export demand elasticities** for the various products, and **Armington elasticities of substitution** between goods from different domestic regions, and between imported and domestic goods.

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

Systematic Sensitivity Analysis: GRP/GDP changes (%)

	Trade elasticities				Scale economies parameters			
	Short run		Long run		Short run		Long run	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bour
Antioquia	0.13106	0.14167	0.84223	1.01114	0.13437	0.13836	0.90154	0.95183
Atlántico	0.14105	0.15212	0.17045	0.20303	0.14647	0.14670	0.17966	0.19381
Bogotá D. C.	0.27741	0.30735	-0.57592	-0.52666	0.29072	0.29404	-0.57735	-0.52523
Bolívar	0.10766	0.11905	0.56298	0.71104	0.11315	0.11355	0.62688	0.64713
Boyacá	0.14578	0.16566	-0.69320	-0.52807	0.15310	0.15834	-0.67065	-0.55061
Caldas	0.09895	0.11313	0.07267	0.12802	0.10589	0.10619	0.08606	0.11463
Caquetá	0.03958	0.06512	-0.86085	-0.67442	0.05115	0.05354	-0.78556	-0.74971
Cauca	0.05733	0.07111	**-1.61065**	**0.24679**	0.06420	0.06424	-0.87050	-0.49336
Cesar	0.11146	0.11908	0.22671	0.30767	0.11359	0.11694	0.24758	0.28680
Córdoba	0.12454	0.13707	0.68171	0.81830	0.12883	0.13279	0.71318	0.78683
Cundinamarca	0.25878	0.29208	-1.18673	-0.68512	0.25609	0.29476	-1.10418	-0.76767
Chocó	0.04031	0.05150	**-6.00005**	**2.06926**	0.04501	0.04680	-2.61918	-1.31161
Huila	0.04998	0.05944	0.17573	0.71194	0.05346	0.05596	0.38752	0.50015
La Guajira	0.10622	0.11351	0.19313	0.30085	0.10878	0.11095	0.22695	0.26703
Magdalena	0.14572	0.16117	**-0.00466**	**0.04203**	0.15193	0.15496	0.00193	0.03544
Meta	0.11400	0.12711	0.28130	0.36048	0.11892	0.12219	0.31226	0.32952
Nariño	0.11181	0.12708	**-0.05509**	**0.14726**	0.11424	0.12464	0.00651	0.08566
Norte Santander	0.09992	0.10949	-0.15220	-0.09168	0.10378	0.10563	-0.13748	-0.10640
Quindío	0.08089	0.09335	-0.19703	-0.10284	0.08606	0.08818	-0.18234	-0.11753
Risaralda	0.09273	0.10176	**-0.13238**	**0.77173**	0.09707	0.09743	0.20565	0.43371
Santander	0.18896	0.20755	-0.54192	-0.33773	0.19712	0.19939	-0.51375	-0.36591
Sucre	0.07751	0.09137	0.20091	0.31687	0.08304	0.08584	0.19209	0.32568
Tolima	0.09252	0.10932	**-0.67090**	**0.54223**	0.09921	0.10264	-0.07549	-0.05318
Valle	0.11063	0.12433	0.31131	0.41675	0.11678	0.11818	0.33682	0.39124
Amazonas	0.05964	0.06933	1.00127	1.63128	0.06380	0.06517	1.26571	1.36684
Arauca	0.21969	0.32812	1.26506	1.61526	0.26288	0.28493	1.39586	1.48445
Casanare	0.05409	0.06590	0.23381	0.28761	0.05865	0.06134	0.25952	0.26189
Guanía	0.04981	0.05777	**-11.80199**	**16.25231**	0.05312	0.05446	1.83696	2.61336
Guaviare	0.10619	0.12582	-3.12476	-2.39250	0.11438	0.11764	-2.76846	-2.74880
Putumayo	0.08807	0.09549	**-0.02026**	**0.12526**	0.09045	0.09311	0.04432	0.06068
San Andrés y Providencia	0.17729	0.18469	0.46830	0.60757	0.17999	0.18199	0.52974	0.54613
Vaupés	0.03808	0.05204	-0.77122	-0.50942	0.04377	0.04634	-0.71516	-0.56548
Vichada	0.15074	0.18322	-1.31811	-1.08386	0.16499	0.16897	-1.20236	-1.19960
National	0.17054	0.18302	0.01558	0.03743	0.17411	0.17944	0.01925	0.03376

Outline

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✓ Final remarks

Final remarks

The results of tariff cut simulations confirmed the asymmetric impacts that trade liberalization has on a spatial economy in which one region, Bogotá, is able to more fully exploit scale economies vis-à-vis the rest of Colombia.

The analysis also revealed the importance of different hypotheses on factor mobility and the role of price effects to better understand the consequences of trade opening in a developing economy. We found considerable differences from short-run and long-run impacts. While in the short-run structural constraints impose a spatial trap that leads to more concentration, in the long-run factor mobility enables spatial re-location of production in a way that regional disparities tend to diminish.

In summary, long-run results using the spatial CGE approach has shown to be able to reconcile theoretical predictions based on recent economic geography models with empirical applications to real economies.