Regulation, Competition and Income Distribution: Latin American Experiences

November 18-21, 2005 – Paraty, Brazil

Port Efficiency and Regional Development

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Outline

- Motivation
  - Methodology
  - Policy
- The Brazilian Case
- Modeling Strategy
- Simulations
- Final Remarks

Motivation

Integration of CGE models and transportation networks

- Modest but expanding literature
- Initial focus on spatial CGE models (e.g. Roson)
- Kim *et al* – Korea
  - Multi-regional CGE model
  - Examined optimal link construction strategies for major network expansion in highway network infrastructure
  - Considered link and system-wide (synergetic) interactions

Integration of CGE models and transportation networks

- Kim *et al*. – US
  - Integration of interregional commodity flow model and highway/rail transportation network to consider impacts of earthquake disruption
- Haddad and Hewings – Brazil
  - Explored role of market imperfections
  - Focused on role of scale economies and transportation costs
  - Latter much more important in terms of welfare impacts

Unresolved issues

- Integration focused on network structure
  - Modal choice
  - Congestion functions on links
  - Route choice and path identification (e.g. Lee, 2005)
- No consideration of nodal congestion
  - e.g. US railroads and Chicago (48 hours LA-Chicago, 18 hours Chicago-NY but 36-130 hours within Chicago)
  - Unlike highway link, congestion at port may have severe impacts spread over space and time whereas highway link congestion may be resolved within several hours

Unresolved issues

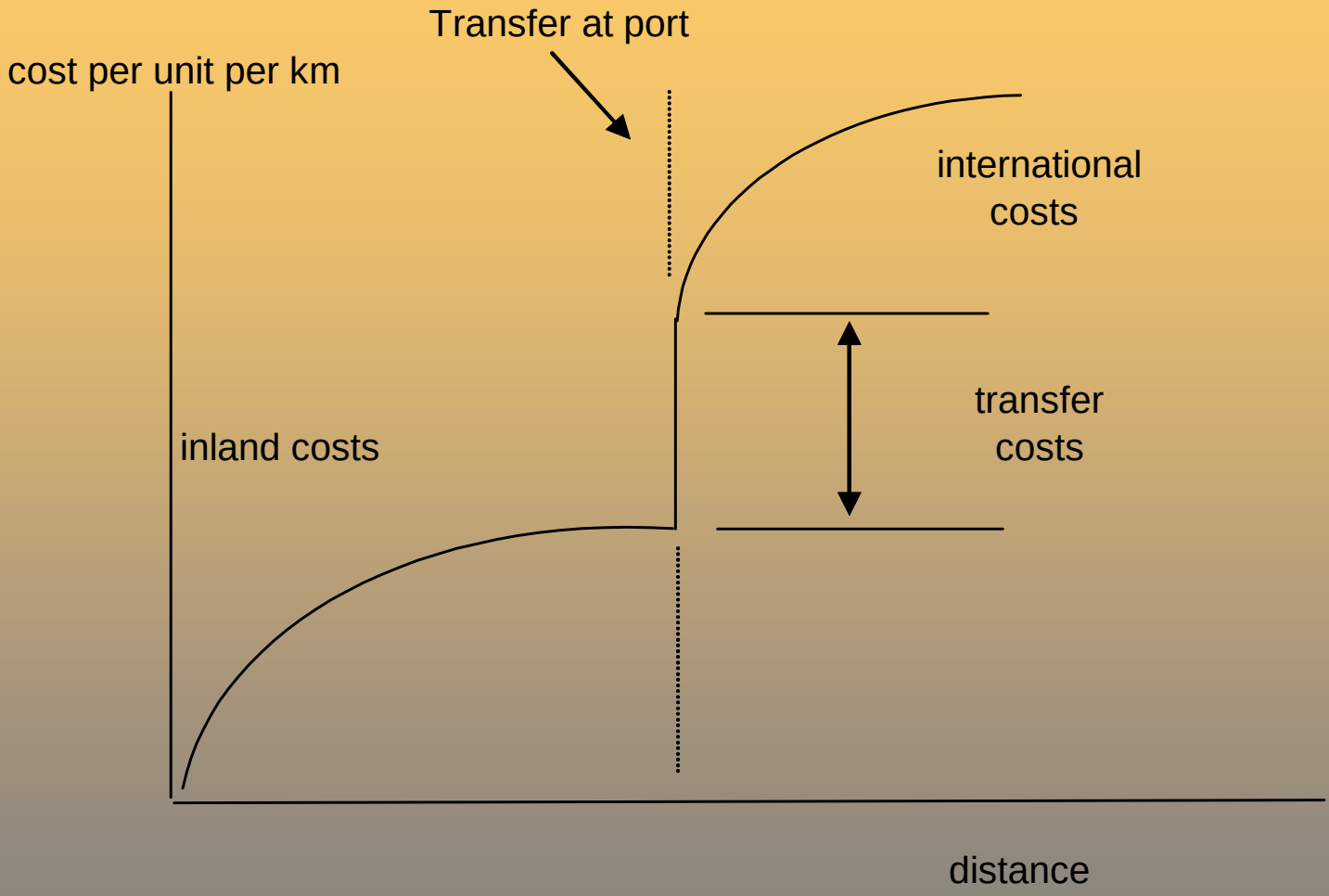
- Modeling issues
  - How to include a nodal congestion function
  - Consideration of regulation and spatial competition (competing destinations/origins/transfer)
  - Shipper/carrier/transfer agent issue
    - Shipper – minimize O-D transportation costs
    - Carrier – allocate shipper's goods to different modes or combination of modes
    - Transfer agent (port) – attracting different modes to use specific ports

Unresolved issues

- For port
  - How much investment to reduce transfer costs?
  - Specialize (e.g. in containers or handling particular cargoes)?
  - Dependency on links with the hinterland
  - Clark *et al*. (2004) found that in Latin American shipments to the US, moving from 25th to 75th percentile in port efficiency reduced total shipping costs by 12%

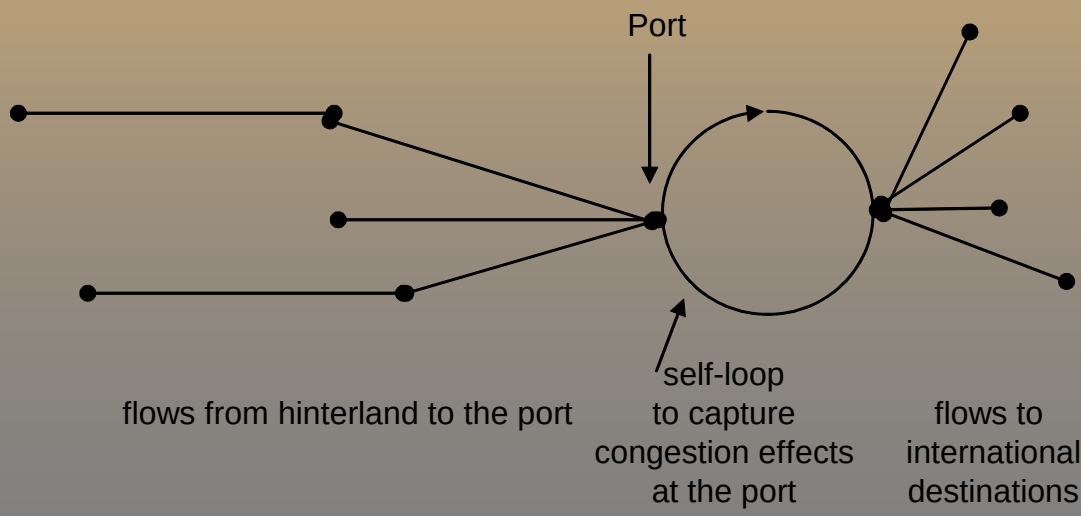
First steps

- Assume transportation costs for export/import include two components
  - Link costs (internally and externally)
  - Transfer costs at the port (function of volume and capacity)


Transfer at port
cost per unit per km
international
costs
transfer
costs
inland costs
distance

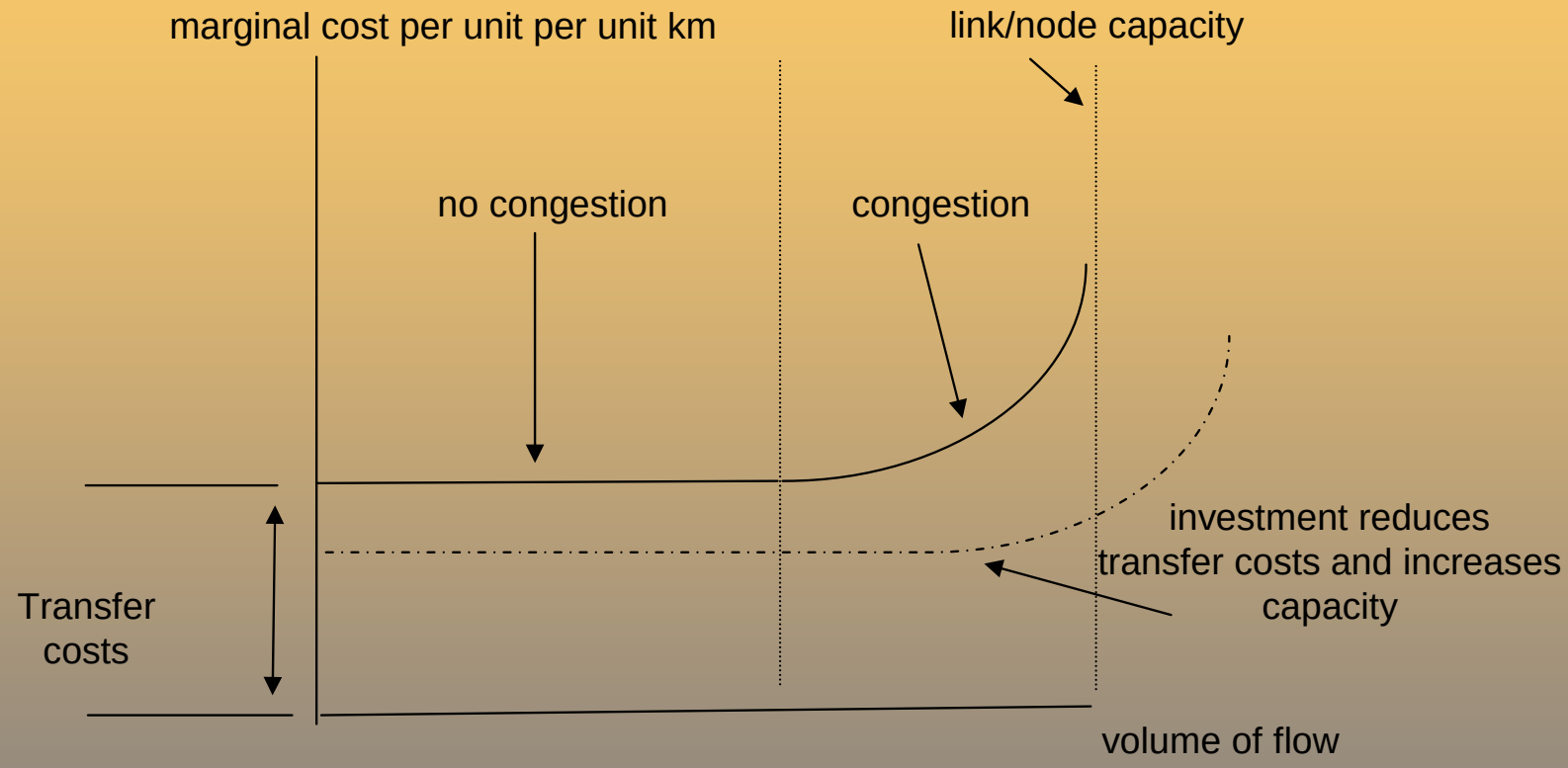
First steps

- Assume standard network with nodes and links
- At port, introduce a self-link to capture the transfer costs



First steps

- Adopt functional form similar to ones used for congestion function on links
- Assume there is a self link at port in which transfer costs are constant per unit up to a certain level and then rise exponentially until capacity is reached


marginal cost per unit per unit km
link/node capacity
no congestion
congestion
investment reduces
transfer costs and increases
capacity
Transfer
costs
volume of flow

First steps

- Need to formulate a model of imperfect competition among the ports
  - Different capacities
  - Different hinterland connectivities restrict the degree to which one port can serve as substitute for another – i.e., “trade areas” imperfectly overlap
- Since port is part of the transportation network, any congestion/disruptions likely to ripple throughout the hinterland

Port efficiency

- Port costs may be seen as an additional barrier to trade
- Determinants of port efficiency
  - Activities that depend on port infrastructure (e.g. pilotage, cargo handling, among others)
  - Activities related to customs requirements (e.g. legal restrictions, port management, etc.)
- Port efficiency varies widely from country to country

Table 1
Determinants of maritime transport costs, port efficiency variables

Region	Port efficiency (7—best, 1—worst)	Custom clearance (days)	Container handling charges in ports (US$/TEU)
North America	6.35	3.50	261.7
Europe (excl. East)	5.29	4.00	166.7
Middle East	4.93	NA	NA
East Asia and the Pacific	4.66	5.57	150.5
East and South Africa	4.63	12.00	NA
North Africa	3.72	5.50	NA
Former Soviet Union	3.37	5.42	NA
East Europe	3.28	2.38	NA
Latin America and the Caribbean	2.90	7.08	251.4
South Asia	2.79	NA	NA
West Africa	NA	11.70	NA

Sources: Global Competitiveness Report (1999), World Bank Surveys, Cámara Marítima y Portuaria de Chile. A.G. (1999), and LSU (1998). NA: data not available.

The Brazilian Case

Distribution of Brazilian Exports and Imports by Transport Modes

	Exports		*Imports*	
	1996	*2003*	*1996*	*2003*
Air	7.28	6.40	22.01	24.08
Road	12.37	6.67	9.03	6.19
Navigation	80.35	86.93	68.96	69.73
Total	100.00	100.00	100.00	100.00

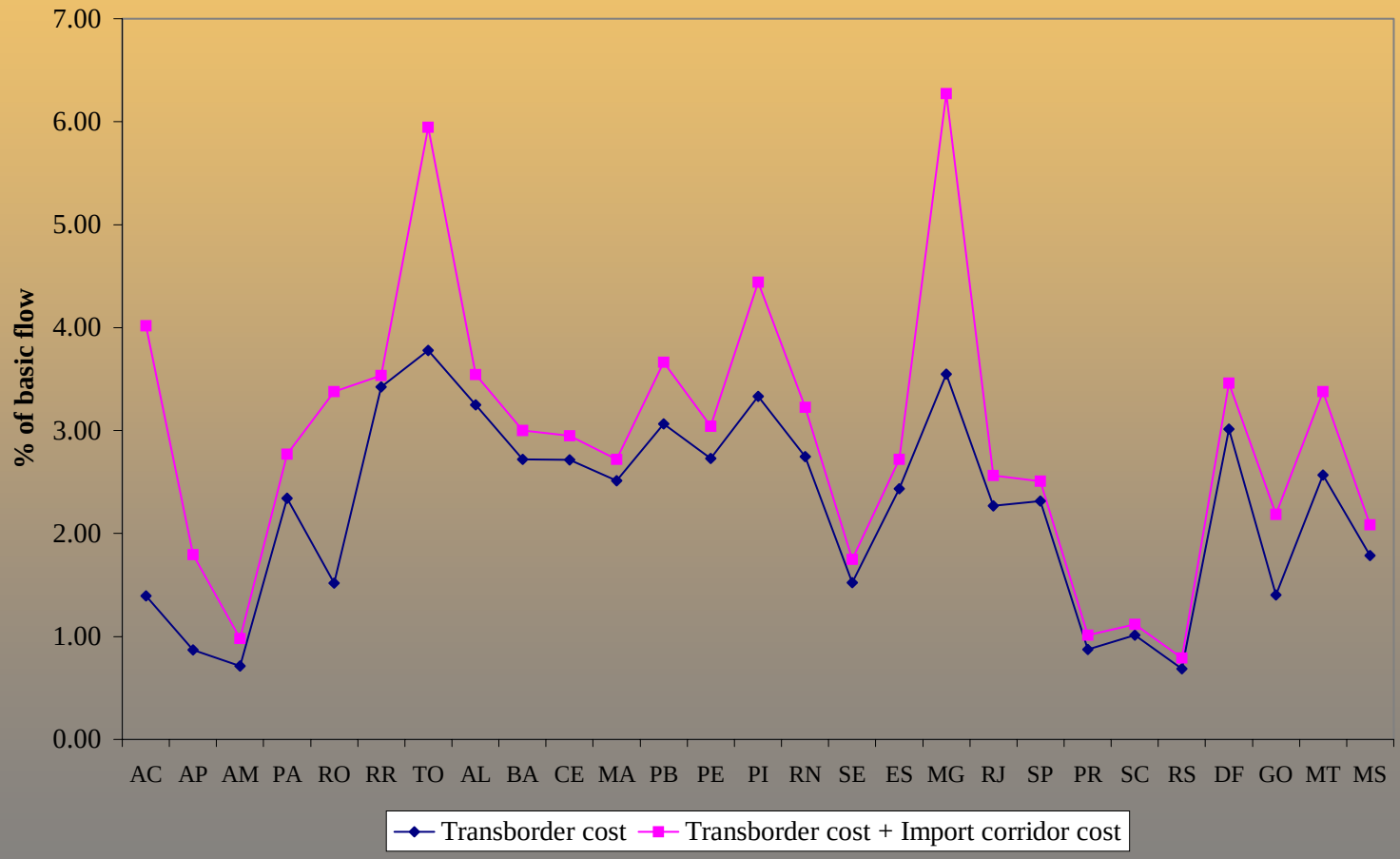

PRINCIPAIS PORTOS
Manaus
Santarém
Macapá
Belém
Vila do Conde
Itaqui
Luíz Corrêa (Planejado)
Pecém (Em Construção)
Fortaleza
Areia Branca
Natal
Cabedelo
Recife
Suape
Maceió
Barra dos Coqueiros
Salvador
Aratu
Ilhéus
Pirapora
Barra do Riacho
Vitória
Forno
Niterói
Rio de Janeiro
Sepetiba
Angra dos Reis
São Sebastião
Santos
Antonina
Paranaguá
São Francisco do Sul
Itajaí
Imbituba
Laguna
Estrela
Porto Alegre
Cachoeira do Sul
Pelotas
Rio Grande
Porto Velho
Cáceres
Ladário
Corumbá
Boa Vista
Rio Branco
Cuiabá
Goiânia
DF
Palmas
Campo Grande
Belo Horizonte
Curitiba
Florianópolis
São Paulo
Rio de Janeiro
Vitória
Aracaju
Maceió
João Pessoa
Natal
Recife
Teresina
Fortaleza
São Luis
Belém
Macapá
Manaus
Porto Velho
PORTOS FLUVIAIS E MARÍTIMOS
Portos Administrados Por Cia. Docas Controladas da União
Portos Administrados por Estados e Municípios
Portos Administrados por Empresas Privadas
Observação:
Não foram incluídos os terminais de uso exclusivo e misto.
MINISTÉRIO DOS TRANSPORTES
GOVERNO FEDERAL

Importação Estadual	Via Marítima	Porto de Entrada																						
	%	AC	AL	AP	AM	BA	CE	DF	ES	GO	MA	MT	MS	MG	PA	PB	PR	PE	PI	RJ	RN	RS	RO	RR	SC
ACRE	0.00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
ALAGOAS	94.04	0.0%	87.7%	0.0%	0.0%	3.4%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	4.8%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AMAPA	30.35	0.0%	0.0%	22.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	73.5%	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%
AMAZONAS	47.16	0.0%	0.0%	0.0%	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%
BAHIA	92.86	0.0%	0.0%	0.0%	0.0%	89.6%	0.1%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.1%	0.0%	1.0%	0.0%	0.1%	0.0%	0.0%	0.0%
CEARA	94.60	0.0%	0.0%	0.0%	0.0%	0.3%	89.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%	0.0%	2.1%	0.0%	1.3%	0.0%	0.0%	0.0%
DISTRITO FEDERAL	17.27	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	6.2%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%	32.8%	0.0%	0.0%	0.0%	0.0%	1.6%
ESPIRITO SANTO	79.51	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	73.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%	0.2%	0.0%	9.2%	0.0%	0.0%	0.0%	0.0%	0.3%
GOIAS	87.64	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	19.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	21.4%	0.1%	0.0%	5.2%	0.0%	0.0%	0.0%	0.0%	0.6%
MARANHAO	99.36	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%	0.0%	98.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
MATO GROSSO	88.18	0.0%	0.0%	0.0%	6.6%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	64.6%	0.0%	0.0%	0.1%	0.0%	0.3%	0.0%	0.0%	3.9%
MATO GROSSO DO SUL	17.52	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	36.7%	0.0%	0.0%	5.8%	0.0%	1.5%	0.0%	0.0%	5.7%
MINAS GERAIS	78.66	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	35.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%	0.1%	0.0%	34.1%	0.0%	0.0%	0.0%	0.0%	0.4%
PARA	93.45	0.0%	0.0%	0.0%	0.0%	0.5%	0.1%	0.0%	0.9%	0.0%	30.8%	0.0%	0.0%	0.0%	65.1%	0.4%	0.3%	0.1%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
PARAIBA	89.96	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.4%	0.1%	61.4%	0.0%	2.8%	0.0%	1.8%	0.0%	0.0%	1.1%
PARANA	74.56	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	78.1%	0.0%	0.0%	0.3%	0.0%	0.3%	0.0%	0.0%	15.2%
PERNAMBUCO	88.62	0.0%	0.3%	0.0%	0.0%	7.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	78.9%	0.0%	2.7%	0.0%	1.3%	0.0%	0.0%	0.0%
PIAUI	90.30	0.0%	0.0%	0.0%	0.0%	7.3%	46.3%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	0.9%	0.4%	0.0%	1.1%	0.0%	0.1%	0.0%	0.0%	0.0%
RIO DE JANEIRO	75.31	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	95.0%	0.0%	0.0%	0.0%	0.0%	0.1%
RIO GRANDE DO NORTE	85.87	0.0%	0.1%	0.0%	0.0%	2.2%	16.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	34.6%	0.0%	2.2%	31.4%	0.3%	0.0%	0.0%	0.0%
RIO GRANDE DO SUL	78.37	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.2%	0.0%	94.9%	0.0%	0.0%	0.5%
RONDONIA	55.37	0.0%	0.0%	0.0%	89.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RORAIMA	2.92	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SANTA CATARINA	72.2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.0%	0.0%	0.0%	1.0%	0.0%	1.6%	0.0%	0.0%	87.3%
SAO PAULO	60.75	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%	1.2%	0.0%	0.1%	0.0%	0.0%	0.3%
SERGIPE	67.81	0.0%	0.0%	0.0%	0.0%	30.4%	0.0%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	18.9%	0.0%	7.8%	0.0%	0.1%	0.0%	0.0%	0.0%
TOCANTINS	81.09	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	12.6%	0.0%	0.3%	0.0%	0.0%	0.9%

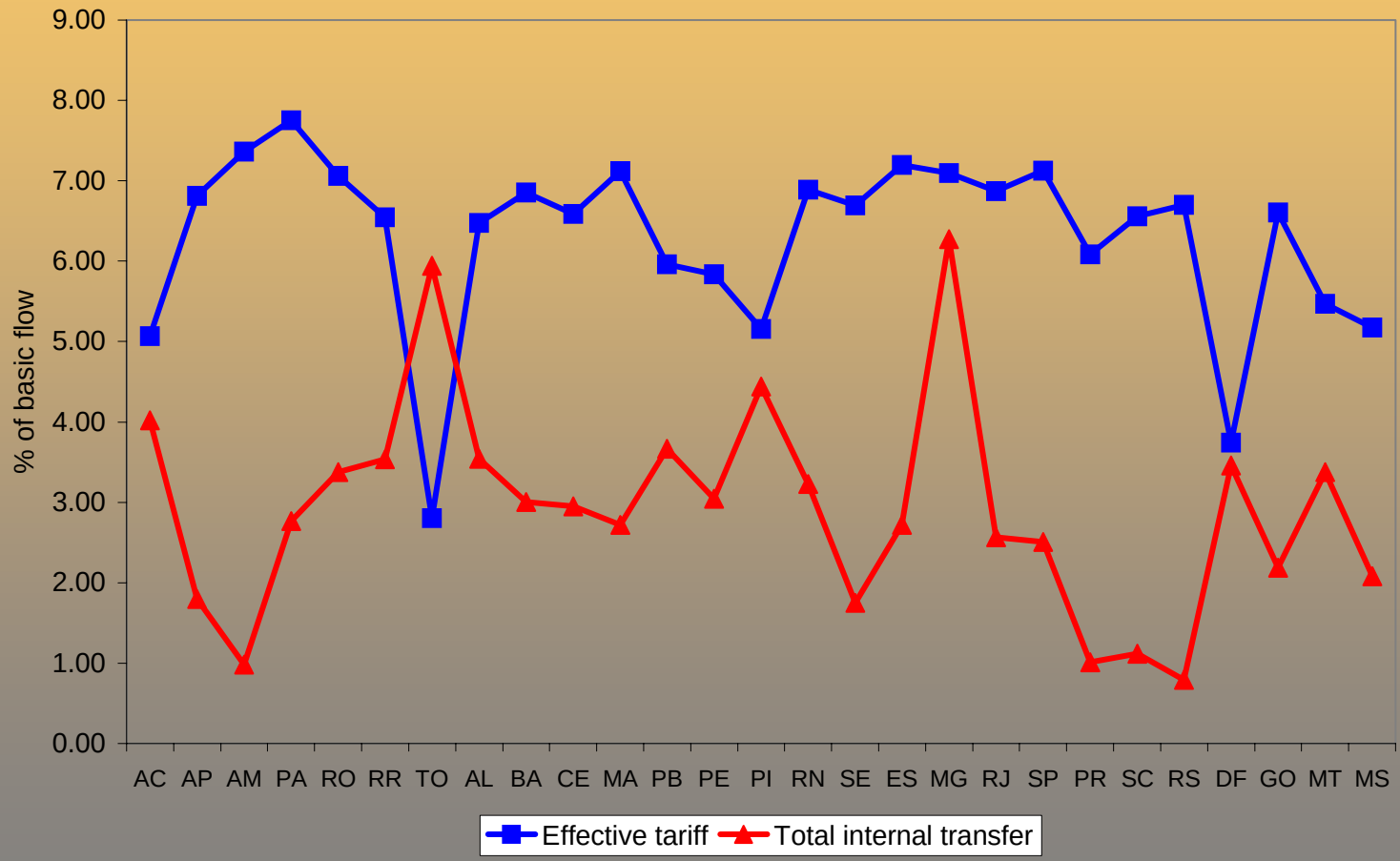
- **Minas Gerais**: 78.66% of total imports by navigation mode, from which 35.4% enter from ports in ES, 34.1% from RJ, 28.7% from SP, 1.4% from PR, 0.4% from SC and 0.1% from PE

- **Rio Grande do Sul**: 78.37% of total imports by navigation mode, from which 94.9% enter from ports within the state, 4.1% from SP, 0.5% from SC, 0.3% from PR, and 0.1% from RJ

Transborder and Import Corridor Costs: By State (In % of Total Value of Basic Flows of Imported Goods)



Internal Transfer Costs* as a Barrier to Trade



* Costs that accrue to import flows (port plus inland costs)

Modeling Strategy

Methodology

- Starting point: B-MARIA (Haddad, 1999) and its extensions
  - Well documented
  - Critical reviews
  - Various applications
- Need to undertake structural modifications to achieve the goal of this paper
  - Haddad and Hewings (QREF, 2005)

Methodology

- Haddad and Hewings (QREF, 2005)
  - Main modifications/extensions
    - Non-constant returns to scale
    - Integration with a geo-coded transportation network model
    - New measures of welfare
    - Micro-macro integration

Methodology

- Main modifications/extensions (cont.)
  - Estimates of scale parameters
  - Estimates of regional trade elasticities
  - New estimates of internatrional trade elasticities (IPEA/EFES)
  - New estimates of income elasticities (Asano e Fiúza, 2003)
  - New estimates of regional capital stocks

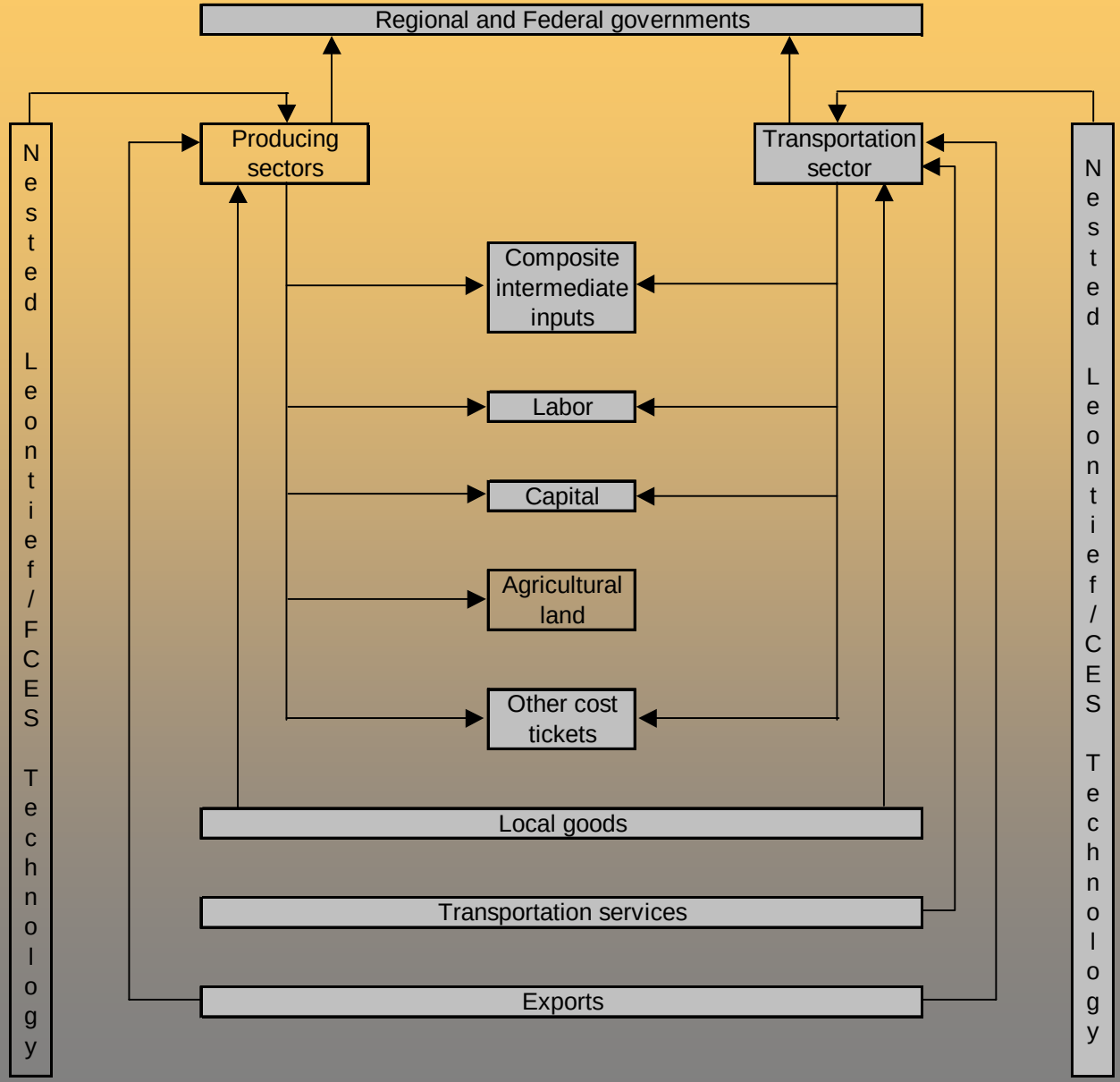
B-MARIA-27 model

- Interstate bottom-up CGE model for Brazil
  - 27 regions
  - 8 sectors/goods
- *Integrated with a geo-coded transportation model*
- Interregional flows of goods and services
- Interregional factor mobility

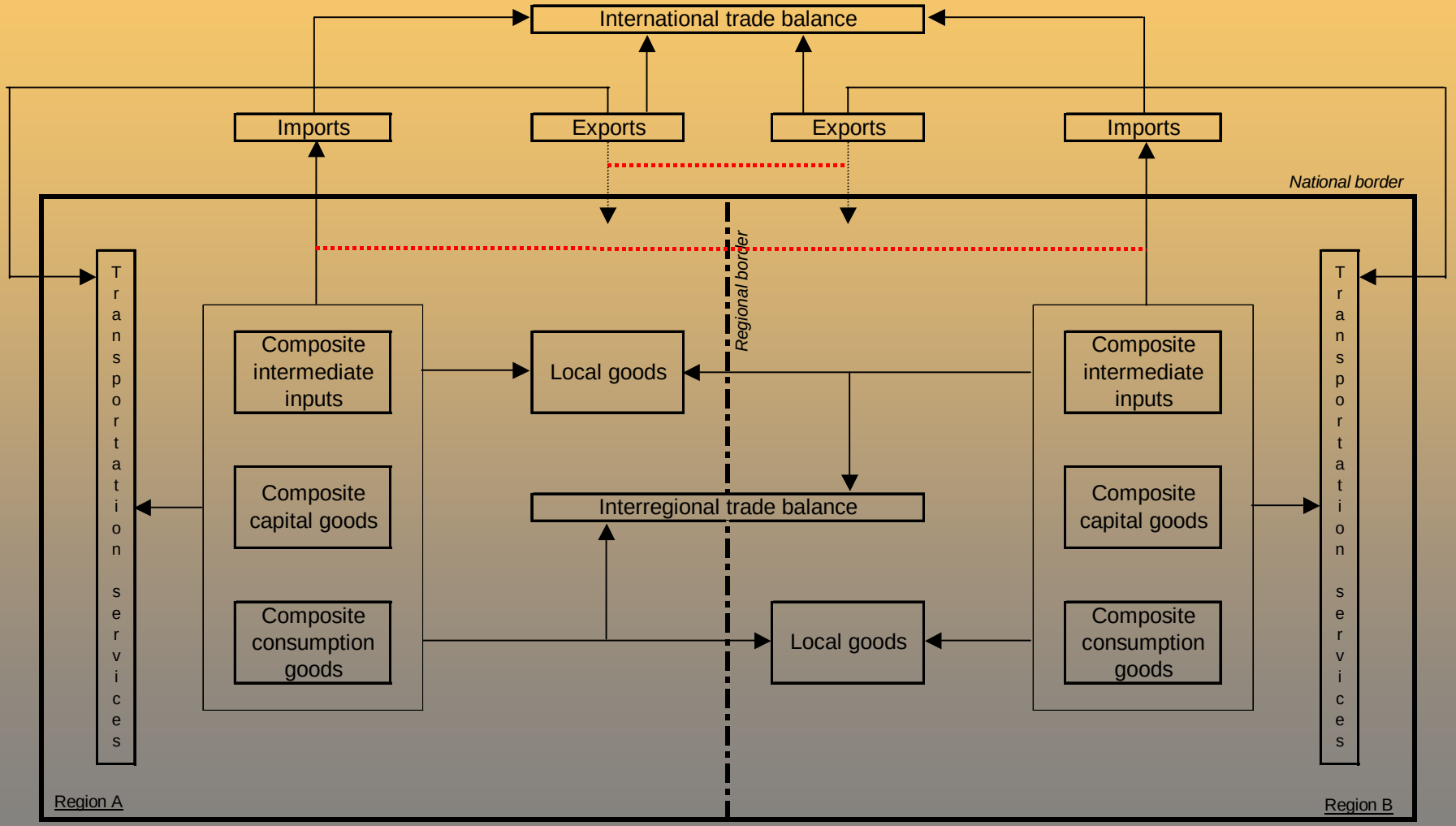
B-MARIA-27 model

- *Explicit modeling of transportation costs based on origin-destination pairs*
- Regional and Federal government
- Regional labor markets
- *Non-constant returns to scale (agglomeration economies)*

Flowchart with Regional Production Technology in B-MARIA-27: Highlighting the Transportation Sector



The Role of Transportation Services in B-MARIA-27: Illustrative Flowchart in a Two-Region Integrated Framework



Calibration

- The calibration strategy adopted takes into account explicitly, for each origin-destination pair, key elements of the Brazilian integrated interstate economic system, namely:
  - Type of trade involved (margins vary according to specific commodity flows)
  - Transportation network (distance matters!)
  - Distance effects in transportation, in the form of long-haul economies
  - Increasing returns to transportation
  - **Transborder costs**

Simulations

Simulations

- **Basic simulation**: uniform 25% decrease in all transborder rates (efficiency gains)
- "First-round" (short run) spatial effects
- **"Benchmark" simulation**: trade liberalization considering implicit transportation costs associated with hypothetical import/export corridors
  - Information on ports of entry (exit) of state imports (exports)
  - Effective cost (transborder cost and the cost of shipping the goods from the ports of entry to the place of consumption) *versus* transborder costs

“Benchmark” simulation

- Haddad and Perobelli (2005)
- It has been argued that there are still areas where further structural reforms are needed in Latin America, including **scaling back remaining high tariffs** (*World Economic Outlook*, April 2003)
- Changes in relative prices might have strong implications to the spatial allocation of resources
- How does the allocation of resources change throughout the adjustment process?
  - Winners and losers
  - Strong appeal to policymakers

“Benchmark” simulation

- Haddad and Perobelli were concerned with the spatial impediments for the internal transmission of the potential benefits of trade liberalization, in the form of high transportation costs that the more remote regions face (INLAND COSTS – **LINKS**)
- Explicit modeling of **space**
- **How about port efficiency issues (NODES)?**
  - Put them into perspective

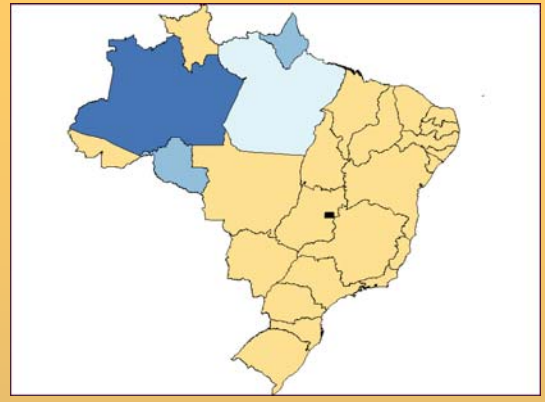
“Benchmark” simulation

- Main results:
  - Regarding regional performance in terms of real GSP growth, note the negative impact high transportation costs impose to the (more remote) regions.
  - Overall, states more remotely located – both in terms of distance from the central position or access to ports – are more adversely affected.
  - Two spatial regimes: coastal and hinterland

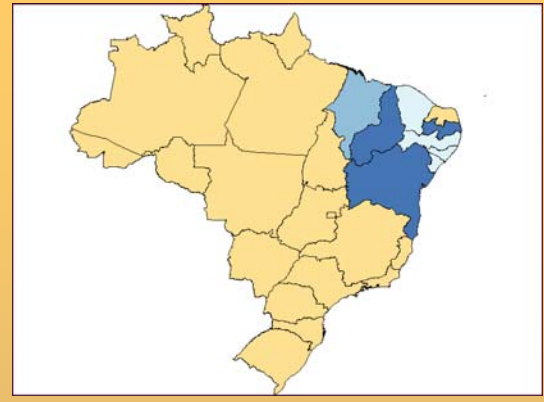
R E A L

Decomposition of Net Effects of Transportation Costs on the Impacts of Tariff Reductions on Regional Growth (Real GSP): By Import/Export Corridors (Haddad and Perobelli, 2005)

A. North



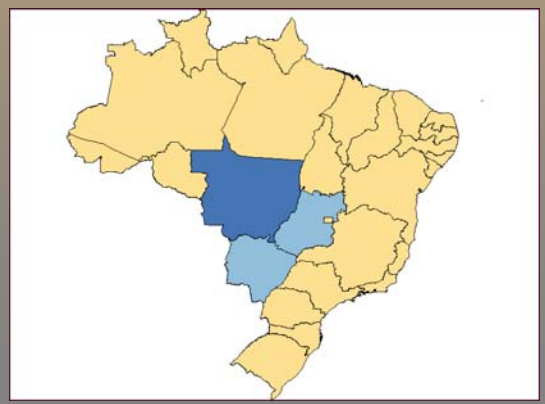
B. Northeast



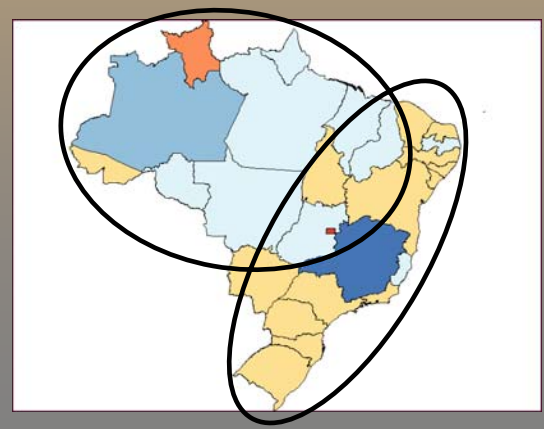
C. Southeast

D. South

E. Center-west



F. Total



Nereus
Núcleo de Economia Regional e Urbana da Universidade de São Paulo
The University of São Paulo Regional and Urban Economics Lab

Basic simulation

- Increase port efficiency (25%)

- Design of the shocks (import flows):

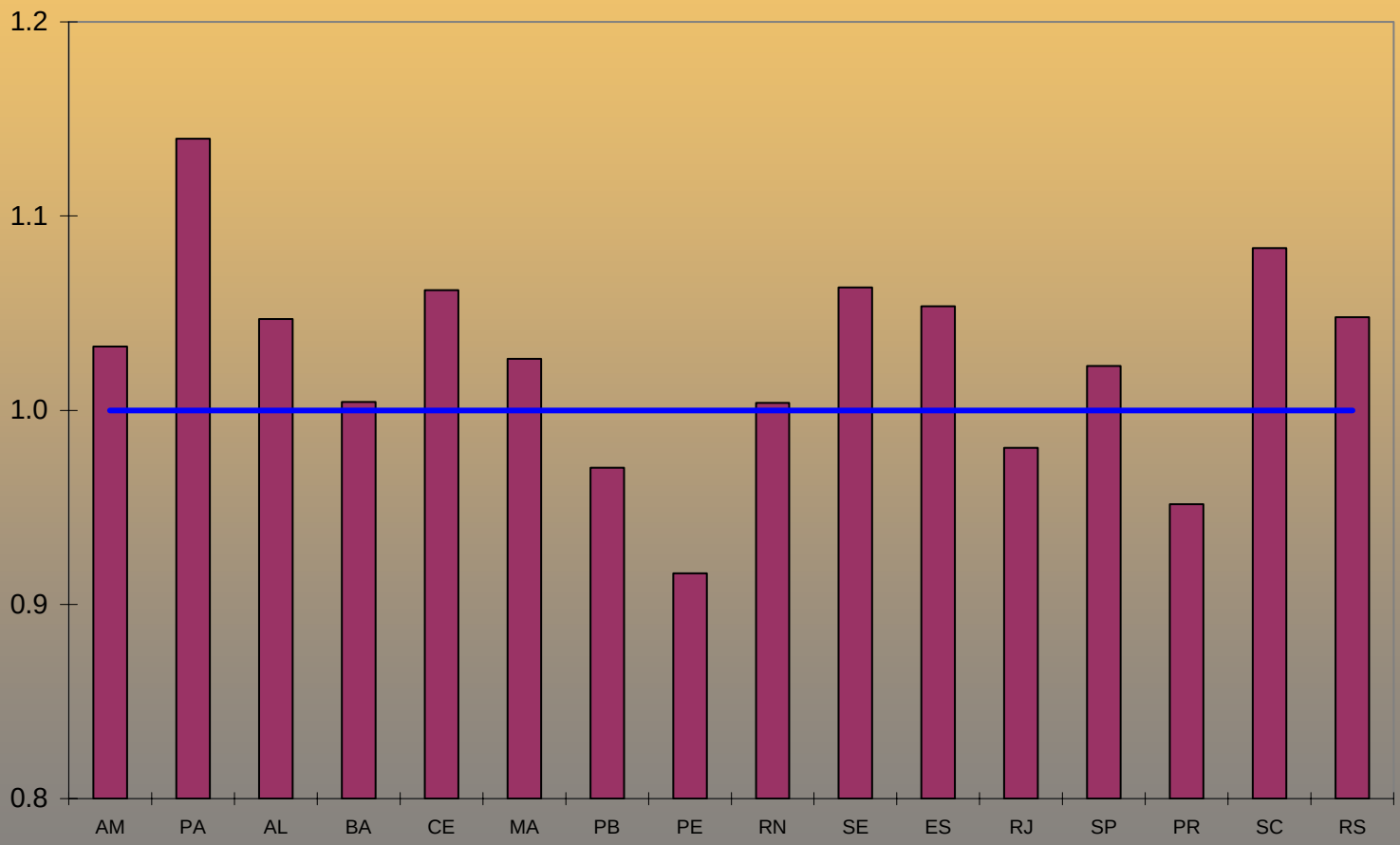
Shock amarg_i("foreign","state","OTS") =

f (share of state imports by navigation,

distribution of imports by ports of entry,

exisiting “relative efficiency” among ports)

“Relative Port Efficiency”

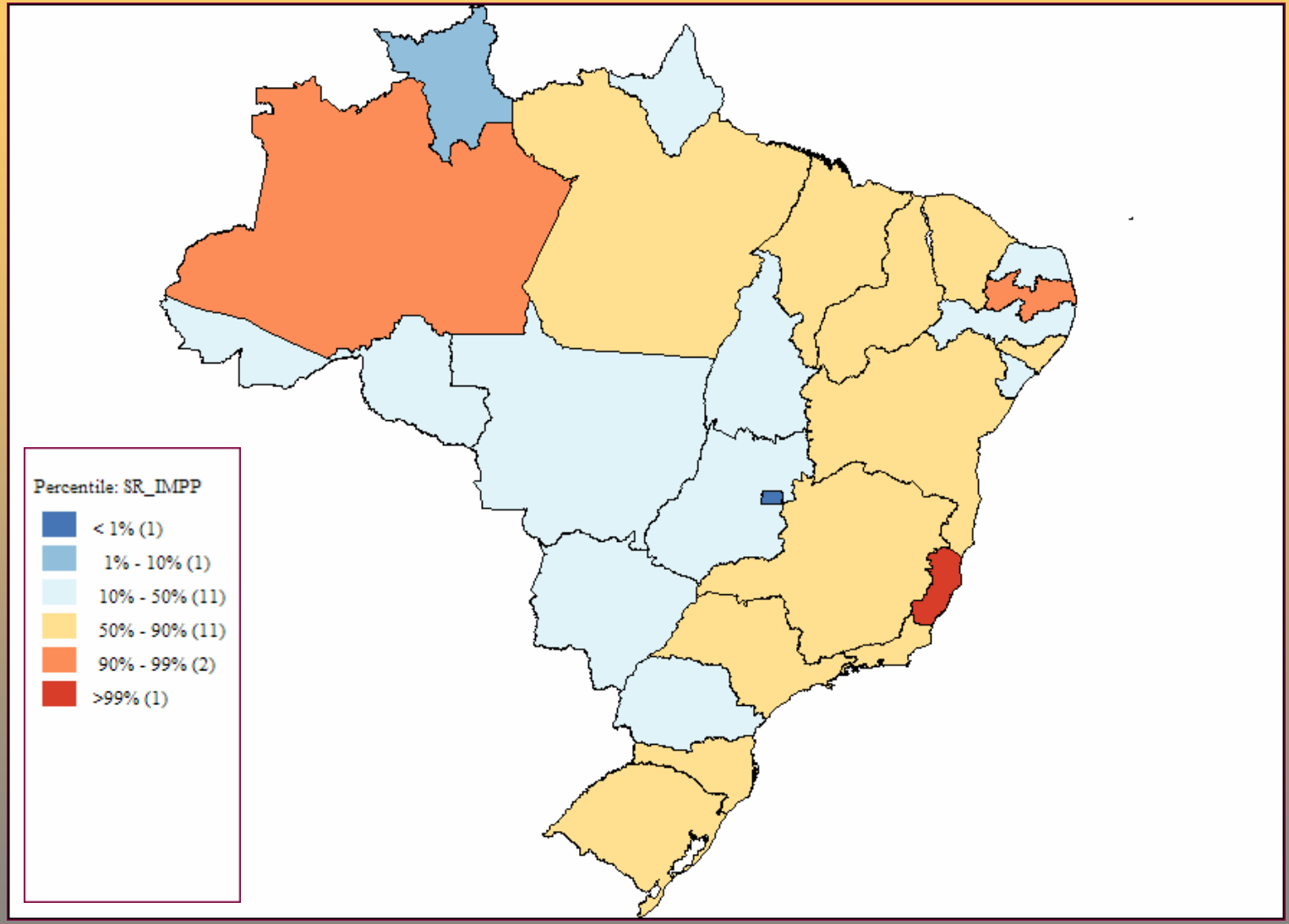


				Port efficiency		
	Import corridors costs			*Import corridors costs*		*Net effect*
	Non-included	*Included*		*Non-included*	*Included*	
Activity level						
Agriculture	0.0252	0.0195		0.0302	0.0245	0.0050
Manufacturing	-0.0112	-0.0224		-0.0006	-0.0118	0.0106
Utilities	0.0155	0.0156		0.0157	0.0158	0.0002
Construction	0.0017	0.0024		0.0010	0.0017	-0.0007
Trade	0.0419	0.0419		0.0408	0.0408	-0.0011
Financial institutions	0.0460	0.0426		0.0540	0.0506	0.0080
Public administration	0.0132	0.0123		0.0145	0.0136	0.0013
Transportation and other services	0.0597	0.0906		0.0286	0.0595	-0.0311
Prices						
Investment price index	-0.5836	-0.5157		-0.6813	-0.6134	-0.0977
Consumer price index	-0.4395	-0.3461		-0.5015	-0.4081	-0.0620
Exports price index	-0.4838	-0.4316		-0.5692	-0.5170	-0.0854
Regional government demand price index	-0.4472	-0.3597		-0.4969	-0.4094	-0.0497
Federal government demand price index	-0.4410	-0.3460		-0.5210	-0.4260	-0.0800
GDP price index, expenditure side	-0.4997	-0.4079		-0.5874	-0.4956	-0.0877
Primary factors						
Aggregate payments to capital	-0.3030	-0.2042		-0.3933	-0.2945	-0.0903
Aggregate payments to labor	-0.3817	-0.2766		-0.4794	-0.3743	-0.0977
Aggregate employment, wage bill weights	0.0580	0.0697		0.0457	0.0574	-0.0123
Aggregate demand						
Real household consumption	0.0521	0.0517		0.0526	0.0522	0.0005
Export volume	1.0028	0.8927		1.1064	0.9963	0.1036
Aggregate indicators						
Equivalent variation – total (change in $)	1670.7	1664.5		1689.8	1683.6	19.0631
Real GDP	0.0326	0.0215		0.0431	0.0320	0.0105

Effects on Real Gross Regional Product

	Import corridors costs		*Port efficiency*		
			Import corridors costs		*Net effect*
	Non-included	*Included*	*Non-included*	*Included*	
North	0.0291	-0.0372	0.0509	-0.0154	0.0218
Northeast	0.0128	0.0044	0.0237	0.0153	0.0109
Southeast	0.0235	0.0120	0.0367	0.0252	0.0132
South	0.0109	0.0033	0.0202	0.0126	0.0093
Center-West	0.0214	0.0193	0.0218	0.0197	0.0004

Spatial Results – GSP: Ports of Entry

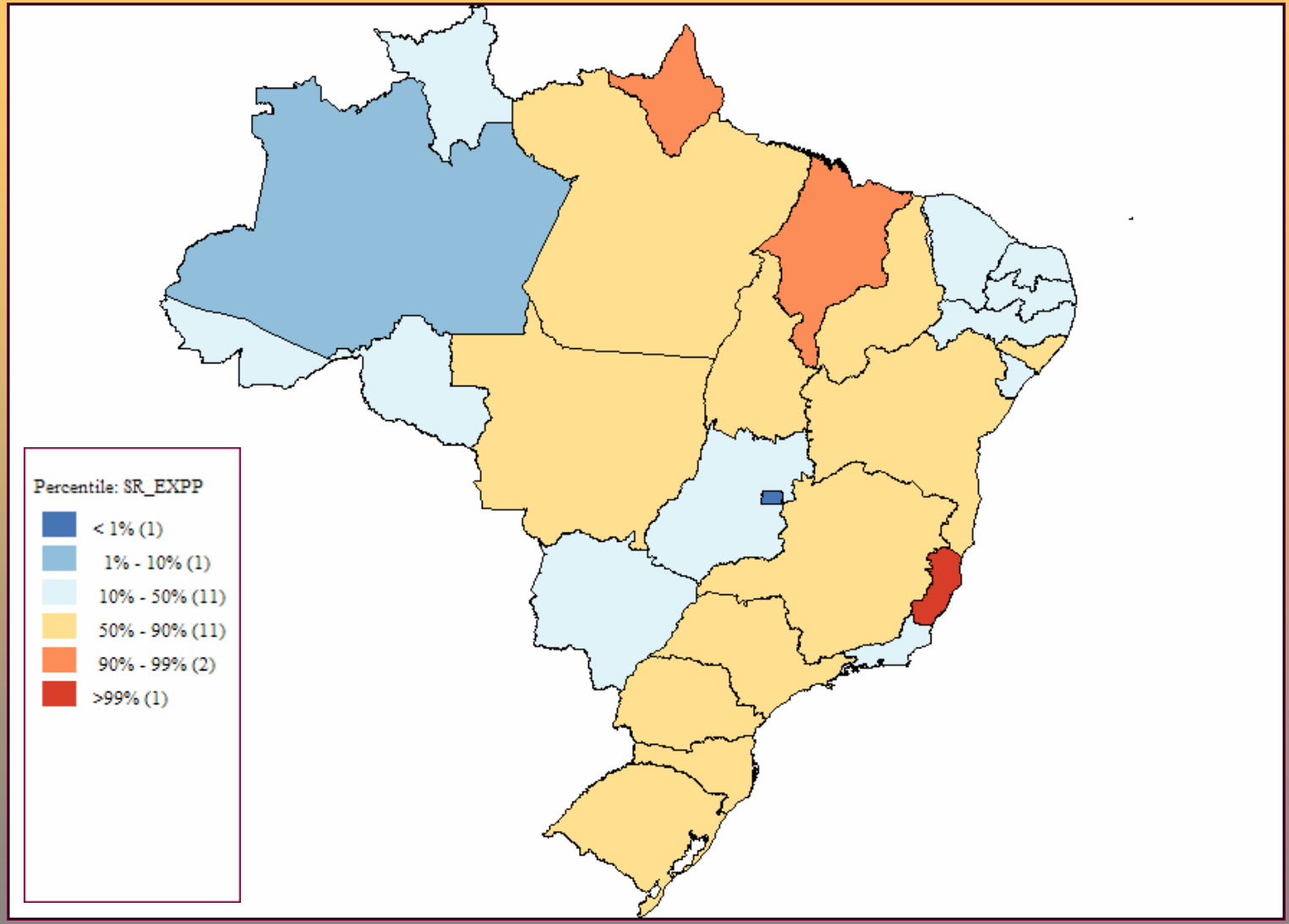


Final Remarks

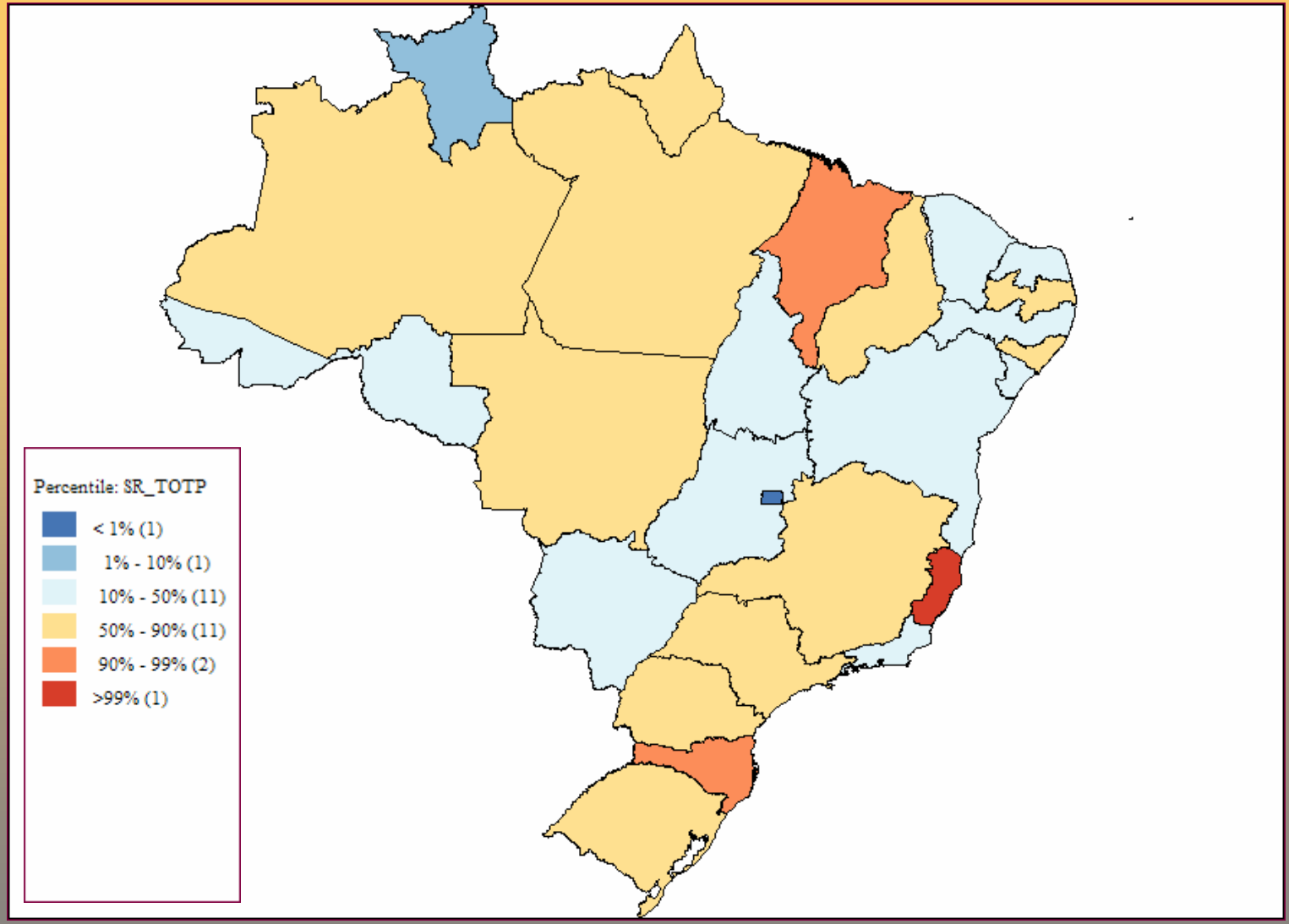
Final remarks

- Attempt to elucidate one of the mechanisms that link trade barriers (port efficiency) and subsequent growth and regional inequality
- Only one side of the coin
  - Constraints towards export expansion can also be perceived as a further barrier to link trade liberalization and growth
  - Investments in transportation appear to have been oriented towards supporting increased exports
  - Role of ports of exit must be considered in order to grasp the holistic picture

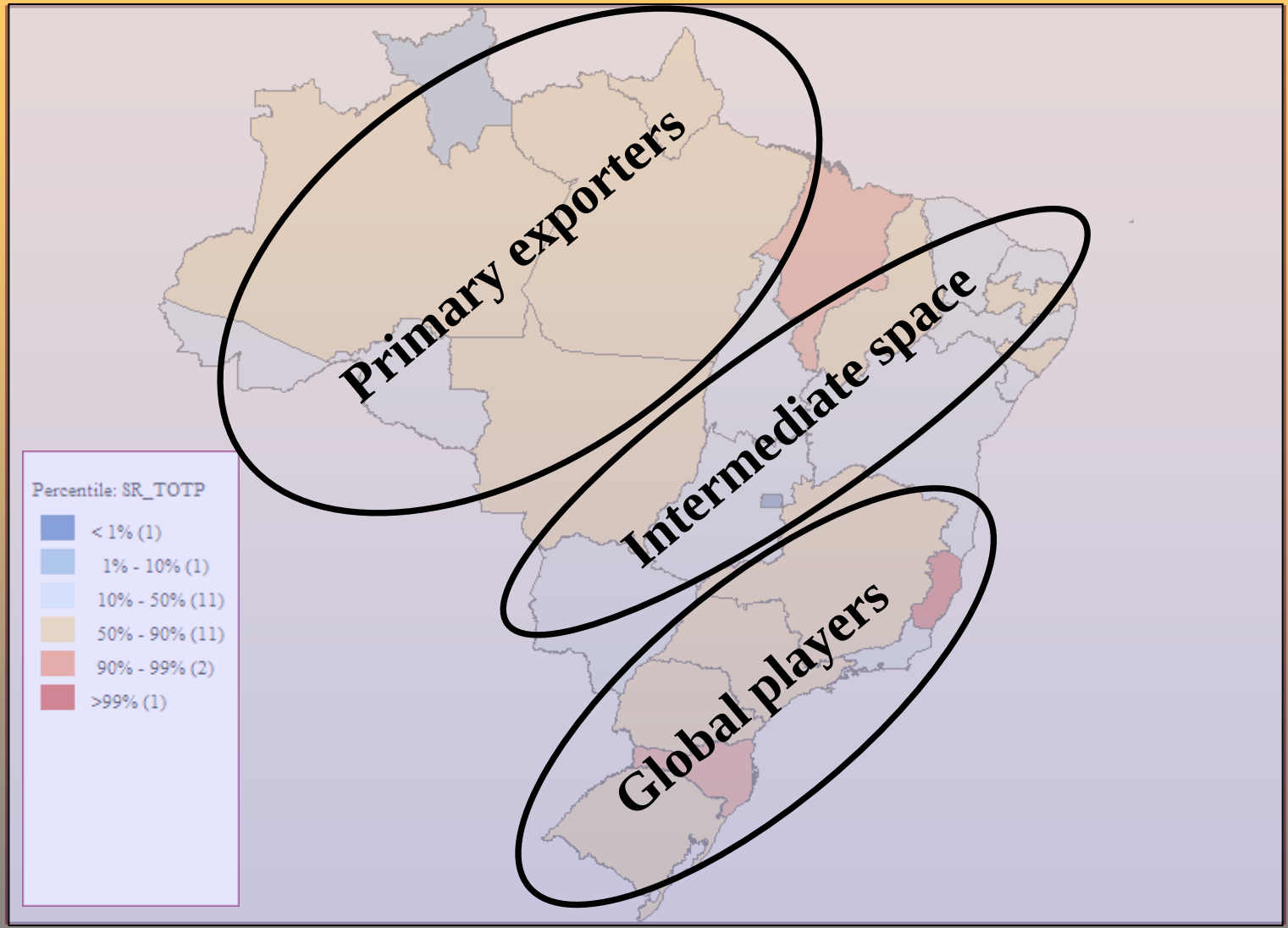
Spatial Results – GSP: Ports of Exit



Spatial Results – GSP: The "Whole" Picture



Spatial Results – GSP: The “Whole” Picture



Spatial regimes

- Primary exporters
  - Localized links/nodes
  - Specific/scattered economic space(s)
- Intermediate space
  - Transition
  - Role played: domestic markets
- Global players
  - Port efficency affects overall competitiveness
  - Dense economic space

Policy implications

- Enhance coastal effect: concentration!
- The role of transportation policies as compensatory regional policies
  - Investment in improving capacity of links needs to be complemented by improvements in nodal efficiency (break-even point in center-west is 12% higher than on southern farms beacuse of higher transportation costs)
  - Nodal bottlenecks present more important challenge because of the scale of the investment required
- Need to capture two-way impacts of improvement in port efficiency