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Location of economic activities within countries. The case of Argentina and MERCOSUR members

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Florencia … or just *Flo*

ABSTRACT

Motivated by the striking spatial reality of my country, Argentina, this thesis contributes to the body of research known as New Economic Geography (NEG) and to the underdeveloped study of economic geography in Argentina and MERCOSUR. The dissertation aims at understanding how location and agglomeration of economic activities have occurred within the country –and, in addition, inside the bloc– during the last decades of re-opening of the economy to international trade and regional integration.

The introductory chapter lays out the motivation and objectives of this thesis, and presents its plan.

Chapter 1 puts it into the perspective of the existing literature. It is a very complete and rather detailed revision of the NEG framework, focusing on theoretical and empirical contributions that address the impacts of trade costs changes on domestic economic landscapes.

Chapter 2 is a motivating chapter that studies location within Argentina trying to find out stylized facts describing its evolution during the last decades. Specifically, it carries out an explanatory spatial data analysis of the Argentinean economic landscape after MERCOSUR formation and shows that some spatial

concentration of manufacturing activities may have happened within border and initially more industrialised territories within the country.
Taking those stylized facts as an inspiration, Chapter 3 introduces a NEG model extended to deal with different 'pre-integration' scenarios in order to evaluate the spatial effects that regional integration may provoke within a member country. The main findings are that preferential trade liberalisation tends to foster domestic divergence favouring location within the region with access advantage to the bloc and to make trade liberalisation desirable in terms of location to some regions which would have been, however, against unilateral liberalisation.
Chapter 4 builds a model that, introducing some more realistic features such as comparative advantage differences across regions and intra-industry linkages, accounts for the role of transport costs and infrastructure in determining intra-country location and, hence, export performance. This setting contributes with the literature in allowing to separate the effects of transport infrastructure from those of production infrastructure and to split transport costs by edges, namely domestic transport costs *vis-à-vis* external ones.
Opening the empirical part of this thesis, Chapter 5 assesses whether regional export performance in Argentina, between 2003 and 2005, can be explained based on the theoretical framework developed in the previous chapter. In this regard, the chapter estimates a model-based gravity equation that highlights the role of transport costs and production infrastructure. The main finding suggests infrastructure enhancement and/or internal transport-costs reductions should be adequate policies in order to boost regional export performance.
Chapter 6 accomplishes a related assessment for MERCOSUR regions. Proposing a more policy-oriented exercise, it attemps to identify where the resources of the *Fondo de Convergencia Estructural del MERCOSUR* (FOCEM) for infrastructure investment should be directed to. The main conclusion is that improving physical infrastructure in less advantaged regions within Paraguay and Uruguay would help fostering exports of certain competitive products.
Finally, the concluding chapter sumarises the contributions of this thesis and presents potentially interesting topics related to the subject of the thesis that, having been put aside, will be among the objectives of future research.

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INTRODUCTION

This dissertation is motivated by the striking spatial reality of my country, Argentina. The fact that Argentina has a very heterogeneous landscape, not only in terms of physical geography but also as regards human and economic geography, is beyond doubt.

Argentina, the 7th largest country in the world, with an area of 3,749,400 squared kilometers –including claims on the Malvinas, South Georgia and the South Sandwich Islands and on Antarctica– is one of the countries with the roughest surfaces and the economic activity most spatially concentrated in the world.[1] As Ramcharan (2009) measures, Argentinean terrain undulation (1,02) is near the world's maximum (1,75 of Nepal) and very apart from the average (0,39 of Norway, Romania and Saudi Arabia).[2]

As regards economic disparities, Ramcharan's calculations show that Argentinean spatial Gini coefficient is 0,89, which stands above the world's average (0,63 of Switzerland and Italy) and just below the maximum values (0,92 of Australia and 0,91 of Canada).[3] Being even more illustrative, among the list of 153 countries considered by the author, Argentina has the third greatest spatial concentration and the 10th roughest surface in the world.

Indeed, as Figure 1 shows, Argentina together with other extensive countries – such as Australia, Brazil, Canada, Russia and the US– compose the group of nations that have the greatest spatial concentration of economic activity around the world. Figure 2 further shows how activity clusters within the country. The economic topographical map due to the G-Econ Project, which represents heights proportional to gross domestic product per area –known as 'gross cell product'– stresses the primacy of the city of Buenos Aires and its surrounding area, in opposition to the relative emptiness of the rest of the country.

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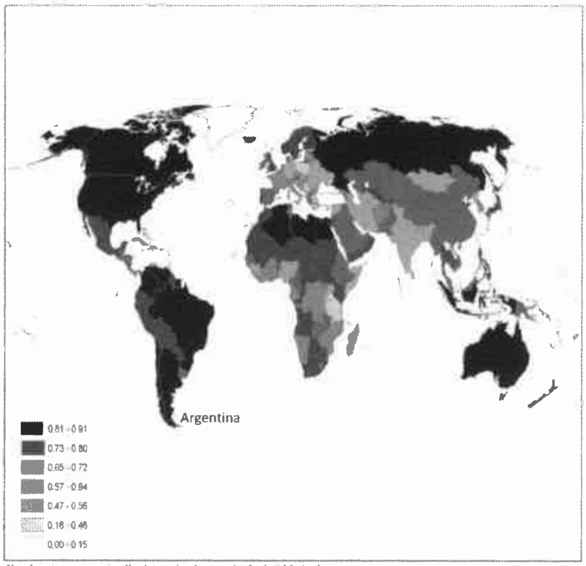
[1] Data on land area was obtained from United Nations (2007).

[2] To measure surface roughness, Ramcharan calculates the standard deviation of elevation at the 30s degree resolution for each country's land area. This, however, should be taken with some care since the standard deviation has important limitations as an inequality measure. Indeed, in the case of Argentina it is very likely that the high value of that measure is reflecting the constrast between the Andes and the very flat surface in the rest of the country.

[3] To measure spatial concentration, Ramcharan uses the 1990 (expressed in 1995 U.S. dollars) gross value added of economic activity at the 1º latitude by 1º longitude resolution –i.e. the gross cell product (GCP) available from G-Econ dataset (Nordhaus et al., 2006). Note, however, the use of the Gini coefficient could be somewhat arbitrary since this measure places an implicit relative value on changes that may occur in different parts of the distribution.

Figure 1: Spatial concentration around the world
Gini coefficient



Break points are optimally determined using the Jenks' Method.

Source: Ramcharan (2009, page 564) [label added]..

Figure 2: Economic map of Argentina

Source: G-Econ Project (2010) [labels added].

To complete the picture, it can be mentioned that the city of Buenos Aires and the homonymic province explained, in 2001, almost seventy percent (69,02%) of total manufacturing production and, together with the provinces of Córdoba and Santa Fe –

which main cities are Córdoba and Rosario, respectively– represented more than eighty percent (81,12%) of that production. As it may be imagined, the distribution of population across the Argentinean territory is in line with the geography of production. In 2001, more than thirty percent (31,6%) of Argentinean population lives in the area comprised by the city of Buenos Aires and Great Buenos Aires, which only represents the 14 per mill (14‰) of the national territory.[4]

I.1. Background

It is well known that the productive capacity of any territory and its evolution along time are at the genesis of a genuine and sustainable process of economic development. The productive characteristics of any region, its endowments and dynamic capacities, its access to buyers and suppliers, among others, are key elements that determine how its economic structure, living standards and welfare are today and would be in the future. In this regard, the chances of some Argentinean regions to achieve certain level of economic development, which fosters convergence at the country level, seem nowadays quite remote. But... should this be taken as an unchangeable truth?

Whether policy-makers or planners are concerned with the well-being of population across the extension of the country, they should be interested in understanding why some regions are more (less) developed and, more importantly, how the very unbalanced landscape could be change.[5] Moreover, it may be central for them to understand how economic activities locate within the territory, which are the main determinants of economic agglomeration (de-agglomeration) and what policy instruments can help to change that unequal reality.

In this respect, it is worth referring to some particularities that have traditionally influenced the productive profile and pattern of trade of the country. In territories like Argentina, where the domestic market is small in comparison with its productive capacity, the access to foreign markets and, for certain products, to suppliers has been decisive in determining its economic development and, further, the chances of its regions. Indeed, much of the circumstances under which the process of economic

[4] Regional data were obtained from the Ministry of Economy of Argentina and the last available population census (INDEC, 2001). We use 2001 data to unify the reference period. Notwithstanding, the last manufacturing statistics of the Economic Census for year 2005 show that the city of Buenos Aires together with the homonymic province explained more than sixty-five percent (66,61%) of that production and, adding Córdoba and Santa Fe, represented more than eighty percent (80,84%) (INDEC, 2011). A political map of Argentina is available in Appendix I (Figure 1).

[5] This intervention could be done in account of either efficiency or equity matters. Even if spatial concentration were economically efficient, it may not be equitable to allow the irrevocable emptiness of some populated territories.

development has historically and spatially taken place have been undeniably shaped by the relationships the country has maintained with the rest of the world.

The territory of Argentina, before obtaining its independency in 1816, was a Spanish colony which productive development was spatially concentrated in the Northwest, West and Centre of the country (see Figure 2 in Appendix I). By the end of the XIX century, the area known as '*Pampa húmeda*', composed by the city of Buenos Aires, the homonymic province and the provinces of Córdoba and Santa Fe, started to develop its potential for the production of cattle and agricultural goods.

Between 1920 and 1929, the country became the '*Granero del mundo*' ('World's barn'), being the biggest exporter of frozen meat, linseed, corn, oats and sorghum, and the second-biggest exporter of wheat and wool (Vaca and Cao, 2005). During the Two World Wars and for further 25 years after, Argentina closed its frontiers and followed a development strategy known as 'industrialisation through import substitution' (IIS). This strategy exacerbated its centre-periphery spatial configuration because of the concentration of population and industrial activity within the central region of the country or 'Pampa Húmeda'.[6] Finally, from late seventies on, the country has re-opened its frontiers to international trade and, almost simultaneously, has strengthened preferential trade relationships with countries in Latin America.

Since the early eighties, the country has exchanged tariff preferences as well as exceptions from non-tariff barriers with other Latin-American nations within the framework of the Latin American Integration Association (LAIA).[7] More recently, Argentina and Brazil started to exchange preferential trade treatment and to cooperate in industry programs; initiative that ends up with the enactment of the Common Market of the South (MERCOSUR) agreement by Argentina, Brazil, Paraguay and Uruguay on March 26, 1991. On that date, a custom union was created by means of both a gradual, automatic and linear reduction of tariffs and non-tariff barriers, and the implementation of the Common External Tariff (CET).[8]

[6] Notwithstanding, some prosperous agro-industrial activities oriented to local markets were developed during that period within provinces in the periphery (Vaca and Cao, 2005). Specifically, and because of particular policies introduced by the Federal government, 'regional' activities such as sugar and tobacco (in Tucumán, Salta and Jujuy), wine (in Mendoza and San Juan), cotton (in Chaco and Formosa) and *yerba mate* and tea (in Corrientes and Misiones) were strengthened.

[7] Even before, between 1960 and 1980, the predecessor of the LAIA –the Latin American Free Trade Association (LAFTA)– encouraged the exchange of trade preferences among Latin American countries.

[8] Very recently, to be more exact in 2008, Argentina, Bolivia, Brazil, Colombia, Chile, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela signed the Constitutive Treaty of the Union of South American Nations (UNASUR, in Spanish '*Unión de Naciones Suramericanas*') with the objective of constituting an extended area of cultural, social, economic and political integration and union (UNASUR, 2009).

Each of those historical periods has entailed a particular scenario for the country and across its regions that, in turn, has clearly defined specific patterns of production and international trade. Moreover, each implicit development strategy has relied on particular macro, micro, sectoral and regional policies, and tended to favour not only certain regions and sectors, but also specific infrastructure investments and the development of specialised factor markets.[9]

All this have irrevocably shaped a distinctive economic –as well as social, cultural and political– regional landscape within the Argentinean territory. Just to illustrate, let mention some examples. As it is well synthesized by Hernández (2000), during the period of IIS, profitable reduced-scale businesses flourished and, hence, complete sectorial structures developed to supply regional markets. More recently, however, the re-opening of the Argentinean economy to international trade has promoted a reconfiguration of its production structure more reliant on large-scale units.[10]

With this picture of the Argentinean reality in mind, an obvious question is that already mentioned as a central policy-makers' concern, namely: which are the chances the country has to achieve a seamless economic development across her/his nowadays very unbalanced territory. In this regard, this dissertation aims at understanding or explaining how location and agglomeration of economic activities have occurred within the country and inside MERCOSUR during the last decades of re-opening of the economy to international trade.

More specifically, the objective of this dissertation is twofold:

a) To study, from the perspective of mainstream economics, how location is determined inside countries and, indeed, how the distribution of economic activity –mainly manufacture– across domestic regions is affected by changes in trade costs.

b) To provide for theoretically-grounded explanations about spatial disparities within Argentina –and inside other MERCOSUR members– during the last decades in terms of regional location and trade performance.

[9] That is the case, for instance, of the construction of the basic railway network. The design of that network was the direct result of the United Kingdom's pre-eminence as external market for Argentinean goods between the end of the XIX century and the first decades of the XX century.

[10] Indeed, authors such as Terra and Vaillant (1997), Calfat and Flôres (2001), Bouzas (2003) and Heyman (2004) agree about MERCOSUR's great influence on investment and location decisions inside its member countries.

I.2. Plan of the dissertation and contributions

This dissertation, which is entitled Location of economic activities within countries. The case of Argentina and MERCOSUR members, contributes to the body of research known as New Economic Geography (NEG). It introduces amendments and extensions in the sub-area of research that studies economic agglomeration at intra-country level, which is referred from now on as 'Regional NEG'. More purposefully, this thesis significantly contributes with the underdeveloped study of economic geography in Argentina and MERCOSUR.11

The central discussion proposed focuses on the spatial effects of broadly defined trade policy on the distribution of economic activity across interior regions from the perspective of the NEG paradigm. Specifically, following Combes et al. (2008), Lafourcade and Thisse (2011), Redding (2011) and Spulber (2007) among others, we define trade costs as every spatial friction that economic agents face in the exchange of goods and services. In other words, the concept comprises what Spulber refers to as 'the four Ts': transport costs, tariff and non-tariff barriers, transaction costs and time costs; nonetheless, the thesis concentrates on the former two components.

As regards the term 'region', instead of categorically defining it, we decide to take a more pragmatic approach. Most authors within NEG work with a homogeneous definition of region, or at least with one that is sufficiently ample to encompass many diverse cases. They tend to "… focus on the spatial distribution of agglomerations (...) while abstracting from the internal spatial structure of agglomeration (...)" (Fujita and Mori, 2005a, page 381 [emphasis added]). Hence, following the 'standard' approach, in what it follows regions are mostly regarded as dimensionless points.12

Chapters 1, 3 and 4 of the thesis contribute to mainstream theoretical literature on economic geography by carefully reviewing specific studies that deal with intra-country matters and extending the ability of this paradigm to address properly the regional question. Whilst Chapters 2, 5 and 6 make empirical contributions concerning regional disparities within Argentina and other MERCOSUR member countries. In Chapter 2, the thesis applies an ad-hoc approach, while in the last two chapters it proposes an analysis inspired on the theoretical work of Chapter 4.

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[11] Though there is a longstanding tradition in regional studies in Argentina, the contribution of economic geography to the understanding of the national reality is scarce and very recent.

[12] Whether or not regions have been philosophically envisaged as non-spatial points by authors within this literature, they are indeed treated as if they were dimensionless. For instance, consider a model that assumes the existence of regional commuting costs –like in Krugman and Livas Elizondo (1996), where people travel inside regions paying for this– though it implies regions are not dimensionless, the analysis does not go over the internal spatial structure of those territories. Other example is Martin and Rogers' (1995) paper that assumes there are transport costs within regions but disregards studying the internal geography of those territories.

The above paragraphs shortly present the principal aims and scope of the thesis. Let me now refer in more detail to the content of each chapter, leaving the reference to previous works to the introductory section of each chapter itself.

Chapter 1 is a complete survey of the literature focusing on the spatial effects of trade policy within countries. After a brief review of the main features of NEG models, the chapter examines which settings and methodologies theory and applied research, respectively, have proposed to address those intra-country spatial effects. The main message of this first chapter is that Regional NEG research has been tipically characterised by a gap between applied investigations and theory, which has imposed important limitations to the progress of the research agenda. Only very recently, those limitations are being surpassed thanks to the introduction of theoretical refinements – such as more-than-two regions, intial assymetries, etc.– and innovative empirical strategies –namely, structural specifications, natural experiments, simulations, etc.

Chapter 2 aims to shed light on the changes occurred in manufacturing location in Argentina after MERCOSUR formation. In accomplishing that, the analysis relates to the works of Brülhart and Traeger (2005), Cutrini (2005) and Combes et al. (2011) among others. Specifically, it relies on well-known indicators of industrial concentration and specialisation, such as the Gini coefficient and dissimilarity entropy indices, in order to derive stylized facts describing the evolution of location in Argentina between 1993 and 2005. The spatial data analysis brings some illustrative evidence suggesting that spatial concentration of manufacturing activities may have happened within border and initially more industrialised territories, spoiling the remotest provinces within the country.

The subsequent four chapters attempt to both develop theoretical settings that add geography and realism to the regional research agenda and propose empirical applications that aim to connect a bit more closely empirics with theory. Specifically, Chapters 3 and 4 propose interesting extensions of well-known NEG models to deal with intra-country issues, in particular addressing the Argentinean reality. In due course, Chapters 5 and 6 attempts to apply those settings to study regional disparities within Argentina and MERCOSUR respectively.

Motivated by the situation of Argentinean regions at the time of MERCOSUR enactment –as it is apparent from the stylized facts derived in Chapter 2– and inspired by Henderson's (1996, p.33) suggestion regarding that the final spatial outcome is 'situation-specific', the main purpose of Chapter 3 is to develop a setting which allows examining how first nature differences across regions interact with preferential trade liberalisation to jointly shape the domestic geography of production and welfare. Hence, the chapter extends a very tractable model due to Martin and Rogers (1995) to set up a world economy with three countries or large territories –i.e. two preferential partners and the rest of the world– where one of them comprises two domestic locations that can differ in terms of both accessibility and size.

In other words, and a bit differently from related articles, the challenge of this third chapter is to introduce appealing extensions that both take account of different geographical scenarios and address the distinctive effects of discriminatory, instead of unilateral, trade liberalisation. The main findings are that preferential trade liberalisation tends to: foster domestic divergence and deepen initial imbalances, favouring location within the region with access advantage to the bloc; make trade liberalisation desirable in terms of location to some regions which would have been against unilateral liberalisation; and only induce a welfare reduction within the integrated territory in very specific scenarios.

Continuing with the theoretical part of this dissertation, Chapter 4 moves from the setting of Chapter 3 to other where many regions, vertical linkages among firms, comparative advantage and more realistic trade costs are assumed. Building on Robert-Nicoud's (2002) refinement of Martin and Rogers' (1995) model, this second setting acknowledges for infrastructure in a double role: affecting transport and production costs.13 Hence, deepening the line of research proposed, this chapter adds more geography and incorporates classical determinants of production and trade together with infrastructure issues.

As regards previous articles within the literature, our contribution is in line with the most recent approaches that consider real road distances or travel costs. Further, it allows to separate the effects of transport infrastructure (or export corridors) from those of production infrastructure, effects which were somewhat mixed up in earlier studies; and to split transport costs by edges, hence e.g. to address the different role domestic transport costs and external ones may play.

The last two chapters of this thesis attempt to provide theoretically grounded explanations, based on the settings developed in the previous chapter, for spatial disparities within Argentina and inside other MERCOSUR members in terms of both regional location of productive activities and trade performance. Taking a novel approach to analyse intra-country location, Chapters 5 and 6 concentrate on trade flows to investigate whether regional export performance depends on market access, infrastructure, market size and other localised features. Though our initial idea had been to structurally estimate the equilibrium expressions of Chapter 4 for the case of

[13] The published version of Robert-Nicoud's work is in *Spatial Economic Analysis*, 2006.

Argentinean and MERCOSUR regions, we faced severe data limitations that disappointingly restrict the scope of our study.14

In the case of Chapter 5, the main finding is that production infrastructure and transport costs seem to affect export performance across Argentinean regions. This suggests infrastructure enhancement and/or internal transport-costs reduction should be adequate policies in order to boost regional export performance. Finally, Chapter 6 goes beyond Argentinean national boundaries to deal with MERCOSUR economic geography. Its purpose is twofold: to study how location across regions is affected by key location determinants, such as transport costs and physical infrastructure, and how infrastructure improvements could benefit the bloc's most backward regions and countries. The main conclusion is that enhancing structural convergence of physical infrastructure across member countries, by improving the situation of less advantaged regions within Paraguay and Uruguay, would help fostering exports of certain competitive products.

[14] Argentinean and MERCOSUR regional databases are virtually inexistent; indeed, researchers just have access to incomplete, unsystematic, discontinous and very dispersed statistical information.

Chapter 1:

LOCATION WITHIN COUNTRIES AND TRADE COSTS: A SURVEY ON NEW ECONOMIC GEOGRAPHY[15]

1.1. Introduction

During the last century there has been an important reduction in trade costs at almost every spatial scale impulsed not only by technological advances applied to transport and communication systems, but also by the spread of regional trade agreements and other related schemes. This sizeable fall has provoked an explosion of physical, trade and investment integration and, hence, important and lasting effects on the economy at different dimensions –*i.e.* macro and microeconomic, sectoral, firm-specific, etc. Among them, one that has received special attention from economic literature during the last twenty years is the spatial dimension, which indeed is the conceptual focus of this thesis.

It is well-established that trade integration affects the location of economic activities across space through their direct and indirect impacts on production and trade. Nontheless, the manner in which this happens in a given territory is nor unique neither inocuous. From the point of view of Trade theory, this is an issue that can be addressed from the perspective of three alternative frameworks. In the case of Traditional Trade theory (TTT), models propose industrial location and, hence, trade flows are determined by comparative advantage. Thus, the underlying differences among territories provide the only explanation for spatial agglomeration.

New Trade theory (NTT) enriches the latter explanation by acknowledging for the presence of a centripetal force that affects the distribution of economic activities, namely the access to large markets. Since firms exhibit internal increasing returns and face trade costs, they are more profitable producing for and locating near larger markets. Indeed, the NTT predicts that there is a more than proportional relationship between a territory's share of world production and its share of world demand, namely the well-known 'home-market effect' coined by Krugman (1980). More recently, the so-

[15] This chapter is a revised and extended version of a paper presented at the XLIV Annual Conference of the Argentine Association of Political Economy (Granato, 2009). We thank very much María Cecilia Gáname, Elisenda Paluzie and three anonymous referees for their very helpful comments and suggestions.

called New New Trade theory (NNTT), which assumes heterogeneity across firms, predicts regions with the most productive firms would increase their aggregate productivity; in other words, would tend to concentrate production and the best firms.[16]

Spatial economics is another area of study that provides an alternative fruitful framework for analysing how territories respond to changes in trade costs.[17] With different assumptions about externalities, the two canonical models that nowadays dominate the field help to understand the formation of economic agglomerations at different geographical scales (Combes *et al.*, 2005).[18] On the one hand and relying on the trade-off between local agglomeration and either congestion effects or commuting costs, the Urban Systems theory appears to be of relevance at reduced spatial scales – namely, cities and industrial and scientific districts– where technological externalities (or direct physical contact) are expected to play a major role.[19] On the other hand, New Economic Geography relying on market-mediated forces seems to be relatively useful for explaining trends at large spatial scales, such as ample regions, countries or groups of them.[20]

Since the emphasis of this dissertation is put on countries or large areas, where the type of externalities that more likely operates is neither localisation nor urban economies but pecuniary external effects (market interactions); this chapter concentrates on NEG models.[21] More specifically, it surveys the NEG literature on the spatial effects that changes in trade costs tend to provoke on the distribution of economic activity within countries.

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[16] These are insights that can be derived, for instance, from Jean's (2002) and Melitz's (2003) models.

[17] This field, which quoting Duranton (2008, page 1) "*... is concerned with the allocation of (scarce) resources over space and the location of economic activity*", has developed on the basis of several intellectual contributions coming from location theory and urban-regional economics –such as those due to von Thünen (1826), Marshall (1890), Weber (1909), Hotelling (1929), Christaller (1933), Lösch (1940), Isard (1956), Myrdal (1957), Hoover (1963) and Alonso (1964).

[18] Following Scitovsky (1954), extenalities can be of two types: 'techonological' (or spillovers) and 'pecuniary'. While the former refers to the effects of nonmarket interactions, namely those directly affecting utility levels or production functions; pecuniary externalities affect firms, consumers or workers involved in market exchanges.

[19] Technological externalities can be classified, following Hoover (1936), as: localisation economies, which relate to the proximity of firms producing similar goods, and urbanisation economies associated with the overall level of activity prevailing in a limited area.

[20] For instance, the well-known 'Core-Periphery' model due to Krugman (1991a,b) predicts that a reduction in trade costs across two symmetric countries ends up with a stable spatial equilibrium characterised by complete agglomeration of economic activity.

[21] As Fujita and Thisse (2002, ch.8) put forward, several reasons can explain the choice of studying pecuniary externalities instead of technological ones. It can be reasonably argued that pecuniary externalities arising from imperfect competition provide a stronger explanation of agglomeration than face-to-face interactions when considering large geographical areas –where sources of agglomeration seem more to do with vertical linkages or market-interactions between firms and population.

The remainder of the chapter is laid out as follows. Next section briefly examines the main characteristics of the NEG framework highlighting the progresses it has had, leaving a more detailed discussion of some contributions to the following sections. The section does it adopting a 'historical' perspective, hence, selectively focusing on the evolution of this framework. Sections 3 and 4 review what theory and applied research respectively have proposed to address the impacts of trade costs changes on domestic economic landscapes. As regard the empirical review, it does not only revise papers that formally and explicitly relies on NEG models, but also papers that, adopting a different theoretical perspective or taking an ad-hoc strategy, make interesting contributions related with main interests of this dissertation. Finally, section 5 concludes.

1.2. NEG Models: Main Features

NEG is a pretty new strand of the literature, pioneerded by Krugman (1991a,b) that can be defined as the study of where economic agglomeration takes place and why.[22] Specifically, it is an approach that provides a general-equilibrium framework where market-mediated mechanisms give rise to agglomeration and dispersion forces and, hence, explain where and why the clustering of economic activity takes place modifying an otherwise more seamless economic landscape.[23]

Although the nature of both agglomeration and dispersion forces vary across different NEG settings, the very essential ingredients behind these models are common.[24] First, there are two key assumptions that allow having a location problem, namely: mobility costs and non-perfectly divisible activities. More specifically, a standard NEG setting assumes firms face internal increasing returns and operate under imperfect competition, trade is costly and production factors and demand move across space.

As regards the latter, factor mobility guarantees that the spatial distribution of production activities is endogenously determined. Specifically, the spatial equilibrium is achieved as firms re-locate towards, or the stock of firms increases within, larger markets. This phenomenon, known as 'backward' or 'demand' linkage, is enabled by either mobility of capital services (or delocation of firms), labour (entrepreneur) migration or local accumulation of capital. Regarding the spatial movement of demand, it is assumed that expenditure locates along with production due to the existence of feedbacks mechanisms that operate from the latter to the former, known as 'forward' or 'cost' linkage.

Models assume the connection production-demand takes any of the following forms: embodied factor migration explained by the 'cost-of-living' effect (Krugman, 1991a,b); local vertical linkages induced by the 'cost-of-producing' effect (Venables, 1994, 1996; Krugman and Venables, 1995); or factor accumulation driven by the

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[22] In fact, as some authors point out, Fujita (1988) is previous and presents a more general model than Krugman, though he has not reached the level of visibility and 'popularity' achieved by Krugman.

[23] For very good reviews of the theoretical literature on NEG, see *e.g.*: Behrens and Robert-Nicoud (2009), Candau (2008b), Fujita and Krugman (2004), Fujita and Mori (2005a), Fujita and Thisse (2009), Krugman (1998), Ottaviano and Puga (1998), Ottaviano and Thisse (2005) and Redding (2009).

[24] Throughout NEG literature, different expressions are used to refer to agglomeration and dispersion forces or effects. In the case of the former, one can find the use of terms as 'centripetal' or 'pulling' forces or, alternativelly, the use of 'home-market' and 'cost-of- living' (or 'price index') effects. On the other hand, authors refer to dispersion forces/effects using expressions such as 'centrifugal' or'pushing' forces or, alternativelly, like 'market-crowding' and 'immobile demand' effects.

depreciation of capital (Baldwin, 1999; Martin and Ottaviano, 1999; Baldwin *et al.*, 2001).[25] Any of these mechanisms explains how pecuniary externalities reinforce the home market effect and, thus, prompts the attraction of even more firms to large markets; inducing, as a result, a process of cumulative causation also known as 'circular' or 'cumulative' causality.

On the opposite side, dispersion forces operate discouraging backward and forward linkages. The presence of immobile resources –more commonly, workers and/or land– and/or positive transport costs for the homogeneous-constant returns to scale (CRS) good put into motion either local demand pull, since consumers are inevitable spatially dispersed, or factor price pull as concentration of increasing returns to scale (IRS) activity augments the prices of immobile resources. Therefore, these two pull preasures discourage the home market effect and its reinforcement, limiting the spatial concentrarion of production and demand.

Micro-founded interactions among those entire ingredients yield, as mentioned, agglomeration and dispersion forces to emerge; and the tension between them turns out to be decisive in determining the spatial structure of the economy. If agglomeration forces are stronger than dispersion ones, an agglomerative shock may trigger a self-reinforcing process that could result in an extremely unbalanced landscape, the 'Core-Periphery' (CP) equilibrium. The other way around, if dispersion forces dominate, the same shock could be partially or totally counterbalanced, leaving the landscape almost unaltered.

Moreover, there is a two-way relationship between those forces and trade costs. On the one hand, the level of trade costs critically influences the balance between aglomeration and dispersion forces[26]; on the other hand, the spatial effects of changes in these costs crucially depend on the nature and extent of the forces involved.[27] Among alternative settings, the pattern for this two-way interaction is not unique, and its richness allows for very special and appealing spatial results, such as catastrophic agglomeration, locational hysteresis, overlap of stable long-run equilibria, inverted-U relationship between the level of trade costs and the degree of agglomeration, etc. In addition, that interplay allows for the existence of stable and unstable long-run

[25] When workers migrate in order to obtain higher real wages, they shift their demand for final goods raising incentives for production shifting. In the case of input-output linkages, when a firm changes location there is a simultaneous movement of demand for intermediate inputs that further boosts agglomeration. Finally, the assumption that firms must replace capital –hence purchase new one– implies that expenditure shifts together with production encouraging additional concentration.

[26] Indeed, as Picard and Tabuchi (2008) clearly demonstrate, not only the level but also the specific shape of trade costs is central for determining the spatial equilibrium and its particular characteristics.

[27] Fujita and Mori (2005b) carry out a comprehensive analysis of this important feature of NEG models.

equilibria and the presence of multiple ones –issue that has been at the centre of an interesting debate within the literature.[28]

To begin describing the evolution of NEG theoretical models let schematically present Krugman's (1991a,b) model. The author develops a two-factor (sectoral-specific), two-sector, and two-region setting that relies, beyond the set 'IRS-trade costs', on three main assumptions: Dixit-Stiglitz (DS) monopolistically competitive modern sector[29] and perfectly competitive traditional one; iceberg trade costs in the modern sector[30] and costless trade in the other; and inter-regional mobility of the modern-sector specific factor. This setting, which logic is intuitively layed out by Krugman (2009, pages 567-568), yields many of those novel and persuasive results already mentioned.[31] More importantly, this contribution gives rise to a very prolific research programme that extends the spatial analysis in many directions and addresses novel concerns.[32] In the following paragraphs we summarise the follow-up models and extensions that Krugman's contribution has triggered.

1.2.a- Market structure

As regards the market structure assumed for the modern sector, some authors depart from the DS approach, relying instead on either a linear model of monopolistic competition or an oligopoly *à la* Cournot.[33]

Put forth by Ottaviano *et al.* (2002), quadratic utility functions and additive trade costs give rise to linear and, hence, more tractable settings. This type of models, which displays similar results as the CP but allowing for clearer comparative static results, exhibits some features that are closer to well-known results in spatial price theory, namely: 'pro-competitive' effects and the 'competitive limit', which in turn give rise to additional dispersion forces.[34] On the other hand, linear settings have a partial

[28] For a very recent discussion on it see Behrens and Robert-Nicoud (2011). Note Robert-Nicoud (2005) and Ottaviano and Robert-Nicoud (2006) carefully analyse the properties of NEG long-run equilibria.

[29] Dixit and Stiglitz (1977) develop a version of the Chamberlinian model of monopolistic competition in which consumers love variety and each firm has no impact on overall market conditions.

[30] Iceberg trade costs imply transportation is a costly activity that uses the transported good; hence, certain fraction of the good melts on the way.

[31] For a short but vey didactic presentation of the CP model see Redding (2009); and for a summarised formal version see Brakman and Garretsen (2009).

[32] Simultaneously, some authors have criticised the new paradigm from different flanks. For a schematic review of some of those critiques, see Behrens and Robert-Nicoud (2009, page 475).

[33] For a comprehensive analysis of the implications of the DS model, see for instance Matsuyama (1995) and Baldwin *et al.* (2003, chapter 2).

[34] Within the non-linear framework, the comparative static analysis is more obscure because the number of independent parameters is smaller than the number of exogenous variables. As regards price elasticities of

equilibrium flavour due to the absence of income effects. This feature abolishes the overlap of agglomerated and dispersed stable equilibria, and makes the mass of firms to be fixed regardless of regional income distribution.[35]

In the case of oligopoly, Combes (1997) proposes a two-region model that yields similar results as DS settings. Namely, firms agglomerate if transport costs are low or economies of scale are high, and production shifting prompts expenditure shifting, giving rise to cumulative causation.[36] Compared with monopolistically competitive settings, this oligopolistic model does not display a CP outcome as stringent, and the adjustment process seems smoother and finishes with firms more evenly distributed across space.

1.2.b- Trade costs

With respect to the form trade costs assume, there has also been an interesting debate within NEG literature wich remains until now (Behrens and Robert-Nicoud, 2011). One of the issues initially raised was whether Samuelson's iceberg costs are more or less realistic (or crucial) than additive trade costs in terms of spatial outcomes.[37] In this regard numerous objections about the analytical and empirical adequacy of iceberg costs have been put forward –see, for instance Matsuyama (2007), McCann (2005) and Neary (2001).[38]

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demand, while non-linear models display constant ones –so equilibrium mark-ups are independent of how crowded is the market– linear setups display demands with elasticities that vary with distance, and profits that change with both demand and competition.

[35] Note neither non-linear nor linear setups are general models of monopolistic competition. Indeed, as Behrens and Thisse (2007, page 461) conclude, "*... NEG models have so far the scientific status of examples.*" Nevertheless, there is place for optimism since, for instance, Behrens and Murata (2007) have proposed a more general monopolistic competition setting displaying both price competition and income effects.

[36] Firms have incentives to locate in the region where they are less numerous, so they can put a higher price and hold a larger domestic market share. However, IRS or lower trade costs tend to reduce those incentives since either the home-market effect is greater or external competition is fiercer.

[37] For some interesting discussions on these issues, see Behrens (2004a, 2005), Fujita and Thisse (2009) and Ottaviano *et al.* (2002). Just as an illustration, Ottaviano *et al.* (2002) consider that assuming trade costs rise proportionally with the increase in prices is unrealistic. Quite in opposition, Picard and Tabuchi (2008, page 20) point out that Samuelson's iceberg cost "*... are considered to be fair approximations of actual transport costs when distance-related shipping costs are low and fixed costs (insurance, loading and unloading) are high.*" Moreover, Picard and Tabuchi (2008) find that: more concave costs, such as the iceberg type, make firms spread to a larger number of cities; whereas less concave transport costs –as the linear ones assumed by Ottaviano *et al.* (2002)– imply firms and workers tend to spread into a small number of cities.

[38] For an updated survey of NEG main contributions as regards transport analysis see Lafourcade and Thisse (2011).

As a result, different authors have proposed extensions to first-generation NEG models aiming to introduce more realism to the transport sector and/or trying to overcome the limitations imposed when assuming exogenously given and spatially independent levels of trade costs. In this vein, Behrens *et al.* (2007a) model the transport system as a network along which shipping of goods occurs, and make a distinction between two types of trade costs or frictions: transport and non-transport ones. Their results show that changes in the latter do not allow for clear predictions with respect to location, while changes in transport frictions do it. Specifically, the authors find that changes in transport costs have mainly localised effects since the spatial interactions across non-bordering regions –*i.e.* those that do not share any frontier– is weaken due to the interposition of third regions.

Making trade costs partially endogenous, Behrens *et al.* (2006b) and Behrens and Gaigné (2006) introduce density economies (diseconomies) in transportation. With unit transport costs that positively (negatively) depend on the volume of trade, they find that agglomeration within a certain region may be induced (deterred) by the geography of the other region. Moreover, depending on the type and scope of those externalities, agglomeration would be catastrophic or smoother, and the resultant spatial equilibria would be multiple or unique, stable or not, etc.

Very recently and taking a step forward, Behrens *et al.* (2009a) follow Takahashi's (2006) idea and provide for a setting that makes trade costs completely endogenous.[39] In their paper, a profit-maximizing transport sector sets freight rates within a flexible market structure, ranging from constant returns and perfect competition to increasing returns and imperfect competition. Within this setting, spatial agglomeration increases carriers' market power and hence freight rates; this interaction puts into movement stabilizing spatial forces that paradoxically end up defeating agglomeration.

1.2.c- Number of regions

Since two-region settings offer a very restricted geographical scenario when compared against the real world and its multiple spatial interactions –in particular, for contributions in the empirical-and-policy front– a valuable and convenient refinement of the standard NEG framework, pioneered by Krugman (1993), has been to augment the number of regions considered.

[39] Takahashi (2006) studies the interdependence among economic geography and the transport sector. More specifically, the author makes endogenous the determination of transport technology –*i.e.* modern *versus* traditional– focusing upon a transport sector that earns no profit.

As it was already commented with respect to Behrens *et al.*'s (2007a) multi-region model, working with many regions implies spatial feedbacks across regions are less straightforward because of the interposition of third regions –*i.e.* Krugman's (1993) 'three-ness' or 'hub' effect. Regions interact both directly and indirectly; hence, any change in parameters tends to generate complex spatial interactions that may unlikely leave any region unaffected. Within multi-region settings, accessibility becomes fundamental. The relative position of each region within the entire spatial system –*i.e.* the facility to access each market from every region– ends determining how a location responds to both direct and indirect shocks.[40]

Puga and Venables (1997, 1998) were one of the pioneers who propose more-than-two-region settings for analysing the locational effects of discriminatory trade policy and, in particular, the spatial implications of hub-and-spoke trade agreements. More recent exponents of this line of research are: Behrens *et al.* (2006c, 2007b, 2009c) who develop a DS trade model with potential asymmetric trade costs; Bosker *et al.* (2010), presenting a multi-region Puga (1999) setting with pair specific trade costs and asymmetrically sized regions; and Combes and Lafourcade (2011) who propose a model under Cournot competition.[41]

Though each of these settings has its particularities, in general terms they entail a hierarchy of regional markets that can be seen as the extension of the two-region home market effect to a multi-regional set up –*i.e.* the 'market access effect'. In other words, both the size of regions and their relative spatial position end determining the geography of industrial location.

1.2.d- Ex-ante regional asymmetries

Another interesting extension of the standard NEG set-up has been the incorporation of asymmetries across regions to allow for more diversified spatial interactions. That is, with the intention of bringing together underlying theory and empirical findings, numerous authors have added geography to their settings by introducing market access, economic size or comparative advantage regional asymmetries.

[40] Indeed, as Behrens and Thisse (2007, page 462) and Fujita and Thisse (2009, page 117) clearly claim: "*... spatial frictions between any two regions are likely to be different, which means that the relative position of the region within the whole network of interactions matters*".

[41] The fourth chapter of this thesis, based on Granato (2008), is also an exponent of this approach. It re-dimensions Robert-Nicoud's (2002, ch.1) original model into a multi-region setting, adding also regional asymmetries and features related with trade and production costs.

Referring to the former, it is widespread in the literature the application of set ups with asymmetric trade costs. Beyond well-known two-region settings that introduce this type of asymmetry, there are more recent contributions that assume it within more-than-two-region models.[42] The initial contributions in this line are those of Crozet and Koenig (2004a), Brülhart *et al.* (2004) and Behrens *et al.* (2006a), which build a three or (at most) four-region setting and assume one region, at least, is 'gated' or 'border' –*i.e.* it has an advantage in terms of access to foreign markets.[43] Within this type of settings and depending on the relative size and accessibility of regions, the 'border' may be benefited or, in contrast, damaged as a result of trade liberalisation.

More vanguard contributions, such as those of Bosker *et al.* (2010), Combes and Lafourcade (2011) and García Pires (2005), propose multi-region models and, hence, a complete transport-network setting where hubs and gates are multiple and diverse in terms of their relative spatial scope and hierarchy. Relaying on simulations, these papers find that spatial agglomeration dramatically change with increasing integration, contrary to what happens in settings with less geographical structure.

With respect to comparative advantage, some NEG settings introduce this type of asymmetry under the Ricardian form, while others adopt the Heckscher-Ohlin's (HO) scheme. Working with one production factor and exogenous technology-driven differences across regions, Ricci (1999), Venables (1999) and Forslid and Wooton (2003) find there is a tension between comparative advantage specialisation and agglomeration forces.[44] Moreover, they show that economic integration could lead to either dispersion of production when industrial location become more dependent on comparative advantage –Forslid and Wooton's (2003) bell-shaped prediction– or agglomeration of industries completely at odds with comparative advantage –Ricci (1999) and Venables' (1999) prediction.

Within the second group, Amiti (2005) and Epifani (2005) –who assume both H-O inter-industry factor-intensity differentials and endowment-based comparative advantage across regions– find that spatial effects of trade liberalisation on industry location and international specialisation are closely related with the allocation of endowments. Moreover, they notice that both a non-linear relation between comparative advantage and specialisation and the bell-shaped prediction characterise their outcomes.

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[42] For two-region settings see, for instance, Baldwin *et al.* (2003).

[43] Note the third chapter of this dissertation, based on Granato (2005), pertains to this group of contributions.

[44] In the case of Forslid and Wooton (2003), Ricardian comparative advantage is introduced in Krugman's (1991a) model through fixed costs, whereas Ricci (1999) and Venables (1999) do it by assuming different marginal labour requirements within Krugman and Venables' (1996) model. Making a synthesis, Baldwin *et al.* (2003, chapter 12) apply both assumptions to extend their 'Footloose Capital' model.

1.2.e- More recent extensions

More recent NEG contributions deal with many other interesting issues such as the spatial fragmentation of production, knowledge and information externalities, the relationship between agglomeration and growth and micro-heterogeneity across workers and firms.[45]

Fujita and Thisse's (2006) pioneer paper and Fujita and Gokan's (2005) extension are the first to assume firms break down their production process into geographically spread stages in order to exploit locational asymmetries in terms of technology, endowments or factor prices. Those models, which assume the presence of intra-firm communication costs, predict that trade and communication costs interact to determine the location of production unites across space.

The inclusion of knowledge externalities and information spillovers ('K-linkages') within NEG research agenda extends the scope of the framework beyond the boundary imposed by pecuniary externalities ('E-linkages'). Indeed, since it is applicable to any geographic scale, represents a step toward the synthesis between the two canonical models that dominate the field of spatial economics (Fujita, 2007; Fujita and Thisse, 2009). Moreover, this extension is useful to analytically enrich the relationship between agglomeration and growth, in particular as regards spatially circumscribed growth processes –like in Walz (1996) and Martin and Ottaviano (1999).[46]

The third extension has been introduced as a natural by product of Melitz's (2003) and subsequent contributions to the NNTT. For instance, the research accomplished by Ottaviano (2005), Baldwin and Okubo (2005, 2006) and Nocke (2006), which assumes firm-level productivity differences, shows how trade cost reductions impact on industry location, not only through classic NEG channels but also as a result of competitive selection processes that take place both across domestic firms and between domestic and foreign firms. While a standard Melitz's selection effect fosters the elimination of the least efficient firms within a region, a spatial selection effect fosters the relative agglomeration of most efficient firms within the large region.

With respect to heterogeneity across workers, either under the form of tastes (Murata, 2003; Tabuchi and Thisse, 2002), innate skills (Mori and Turrini, 2005) or matching externalities (Amiti and Pissarides, 2005), its incorporation to NEG settings

[45] For a survey on these contributions see Fujita and Mori (2005a).

[46] Other related contributions are, *e.g.*: Baldwin *et al.* (2001), Baldwin *et al.* (2003, ch. 7), Basevi and Ottaviano (2002), Dupont (2007) and Yamamoto (2003).

adds other sources of dispersion and agglomeration forces, which change the spatial equilibria and its features. For instance, Amiti and Pissarides show that matching externalities give rise to an additional agglomeration force, making the agglomerated equilibrium even more likely.[47]

1.2.f- To sum up…

As previous paragraphs summarise, multiple extensions have been proposed for first-generation NEG models. Quoting Krugman (2009, page 568): "*... the new economic geography created a style of work that reached well beyond the specifics of the initial models...*" whose essence was "*... a willigness to focus on tractable special cases*".

Beyond the success of those numerous contributions, new theoretical and methodological challenges keep on emerging within the NEG paradigm both regarding elder issues –such as trade costs and multiple equilibria among others (Behrens and Robert-Nicoud, 2011)– and more novel ones.[48] Just as examples one can mention the concern some authors have put on a deeper analysis of 'micro-heterogeneity' across people and firms (Ottaviano, 2011), the two-way interaction between endogenous policy and economic geography (Fratesi, 2008; Gáname, 2005; Ottaviano and Thisse, 2002; Robert-Nicoud and Sbergami, 2001, 2004), the locational relevance of institutions (Bosker and Garretsen, 2009a; Candau, 2008a) and the philosophical and methodological enquiries Nijkamp (2007) puts forward as regards the 'legitimacy' of the *ceteris paribus* postulate for the analysis of spatial-economic interactions and those Fowler (2011) introduces with reference to NEG's standard practice of assuming 'a priori' equilibrium.[49]

[47] For updated reviews of NEG contributions assuming 'micro-heterogeneity' see Ottaviano (2011) and Behrens and Robert-Nicoud (2011).

[48] In the same vein, an up-to-the-minute paper by Behrens and Robert-Nicoud (2011) suggests that theoretical NEG needs to make progress, stepping outside of the canonical 'Cobb-Douglas-DS-Samuelson' setup, by extending the approach into various directions, namely: heterogeneity, cities, transportation, public policy and calibration.

[49] Even more, some authors such as Rafiqui (2009) highlight the importance New Institutional Economics has for economic geography.

1.3. Theoretical Research in Regional NEG

Having summarised the main lines of research within NEG, the objective of the following two sections is to survey theoretical and empirical contributions that focus on intra-country spatial effects of changes in trade costs. Specifically, this section intends to portray what theory has proposed to analyse how those types of changes may impact on domestic landscapes; while the following section aims at reviewing how empirical literature has addressed this issue and, hence, what conclusions can be drawn from it. Worth is to mention that, though some of the settings this third section reviews have already been formerly sketched out, the intention here is to emphasize on their key assumptions and main predictions as regards intra-country economic geography.

Within NEG theoretical literature, the link between international trade policy and domestic location seems to have been satisfactorily studied. Many papers have analysed how location across two (more usually) or multiple (less frequently and more recently) domestic regions may be modified when countries multilaterally reduce tariff and non-tariff barriers to trade.[50] In contrast, just few studies have taken into account the locational effects of other schemes such as preferential liberalisation and regional integration, and even less have addressed the spatial impacts of changes in transport, transaction and time costs.[51]

As it has been advanced in the Introduction of this thesis, next paragraphs survey a selection of papers focusing on tariff, non-tariff and transport costs, hence disregarding transaction and time costs. Moreover, the selected papers are reviewed following an order that allows associating each article to relevant works preceding it and, where appropriate, mentioning other related papers. Specifically, the contributions have been grouped into three different and more-or-less successive generations of research; an ordering that attempts to systematize both progress done and main findings obtained by the literature. Table 1 in Appendix C1 presents a summary of the articles surveyed.

Before starting with the survey itself, let summarise some main characteristics of Regional NEG models. To begin with, it may be noticed that these models introduce the spatial distinction between national and sub-national territories through differences in trade costs, factor mobility or both. Some authors assume trade of goods entails

[50] For an updated survey of this literature, see Brülhart (2010).

[51] It is due to mention that, this survey categorizes the type of trade policy each model analyses accordingly to what is explicitly expressed (or implicitly assumed) by its authors, albeit some set-ups could be used for addressing other trade policy schemes, too.

differentiated costs according to the nature of flows, namely: tariff, non-tariff and other barriers at the frontier when international flows are considered, and transport costs for intra-national flows. Regarding factor mobility, it is commonly assumed that one production factor, generally labour, is perfectly mobile across regions within the same country, but immobile between countries. In other words, the model endogenously determines the spatial distribution of expenditure, and how cumulative causation takes place only within countries, but not across them.

These two fundamental assumptions together with the market structure proposed and the incorporation or not of other features like vertical linkages (VL) and regional asymmetries determine the type and scope of agglomeration and dispersion forces in each model. These characteristics together with other issues introduced in some settings –namely, number of regions, type of trade costs, etc.– help to distinguish across alternative regional models in the following paragraphs.

1.3.a- First generation

Krugman and Livas Elizondo (1996) and Krugman (1996) are the first researchers within NEG tradition who explicitly take into account the spatial distribution of domestic or sub-national agglomerations. Nonetheless, it is due to recognise that the paper by Martin and Rogers (1995) is a significant antecedent of this area of research. Indeed, their two-region model allows concluding that lower transport costs –*i.e.* better domestic infrastructure– promote domestic concentration and that a higher degree of international integration magnifies this effect.[52]

Specifically, Krugman and Livas Elizondo propose a three-region model –*i.e.* acknowledging for two domestic territories and a foreign one, or 'Rest of the World'– where the distinction among spatial scales are both labour migration and trade costs. Assuming DS monopolistic competition and congestion costs –explained by the trade-off between commuting costs and land rents– they find that reciprocal trade liberalisation between the two countries tends to foster dispersion of economic activity across domestic regions; a result at odds with Martin and Rogers' finding.[53]

Moreover, Krugman –who extends the analysis to consider the locational impacts of transport infrastructure– highlights both the interrelation exists between transport and tariff and non-tariff costs and the effects that changes in each of these costs have on

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[52] Their seeting acknowledges for both intra and inter-national trade costs, but disregards circular causality.

[53] Being precise, Krugman and Livas study the effects of unilateral trade liberalisation when export goods are freely traded.

regional disparities. In particular, with respect to transport costs he concludes that the higher they are, the stronger the advantages of locating production near an established metropolitan area.

Within this first generation of regional models, successive contributions deal with alternative assumptions regarding dispersion forces and include some regional asymmetries. Every model assumes, in addition to the triad 'DS-IRS-iceberg costs', foreign immobile demand and takes one out of two alternative approaches to handle dispersion forces within countries, namely: one that involves either congestion diseconomies *à la* Krugman and Livas Elizondo (1996), dispersed and immobile supply of housing *à la* Helpman (1998), or any other costs associated with agglomerated locations; and other that entails the pull of a dispersed market by assuming a partially (most usually) or totally (less frequently) immobile demand at intra-country level.

Following the former approach and assuming labour migration within countries, Alonso Villar (1999, 2001), Fujita *et al.* (1999) and Moncarz and Bleaney (2007) obtain the same result as their predecessors: international trade liberalisation tends to increase dispersion within countries.[54] On the contrary, applying the second approach Andres (2004), Brülhart *et al.* (2004), Crozet and Koenig (2004a), Granato (2005), Montfort and Nicolini (2000) and Paluzie (2001) find that trade liberalisation favours the emergence of agglomerated national landscapes.[55]

The discrepancy between both groups of studies is explained by the manner in which dispersion forces are affected by trade costs reductions. Specifically, whereas the pull of a dispersed market is weakened as international trade is liberalised; the push pressure delivered by congestion costs, that characterise the former models, remains unaltered.[56] At the very end of the liberalisation process, when international trade costs are null, the pull pressure from foreign markets disappears and the only force operating comes either from congestion costs or regional immobile demand. As a result, domestic dispersion remains being fostered by the former, while international agglomeration tends to emerge thanks to the latter.

Following the second approach, some articles introduce extensions and address novel issues within the literature. Andres (2004) presents an original setting that supposes *à la* Martin and Rogers (1995) there is not labour migration across domestic regions but there do are size asymmetries or, alternatively, Ricardian comparative

[54] Nevertheless, when additional agglomeration forces are introduced –such as those generated by VL as in Fujita *et al.* (1999), or those fostered by asymmetries in terms of size and accessibility like in Alonso Villar (2001)– domestic spatial agglomeration may be fostered instead. Note that the model by Fujita *et al.* (1999) addressed is that presented in pages 331-335, which is directly comparable with the rest of studies since it assumes only one industrial good.

[55] Granato's (2005) contribution is presented in detail in Chapter 3.

[56] For a detailed argumentation on the latter, see Crozet and Koenig (2004a) and Behrens *et al.* (2007b).

advantage at the regional level. The author concludes that a decrease in international trade costs creates incentives for firms to agglomerate in the largest or most advantaged region.[57] Among the models that assume instead intra-national expenditure mobility, Monfort and Nicolini (2000) find that international integration leads to domestic polarisation when there are initial asymmetries in the distribution of economic activity and the portion of immobile population is not sufficiently large.

In the case of Brülhart *et al*. (2004), Crozet and Koenig (2004a) and Granato (2005), who additionally assume accessibility asymmetries across domestic regions, the findings are even richer. Though international trade liberalisation generally fosters spatial concentration in the border region, economic activity may concentrate in the remote region if competitive pressure from foreign firms is relatively high or if there is sufficient concentration in that region before liberalisation. As Crozet and Koenig interestingly conclude, and Brülhart *et al*. adhere to, the presence of a 'gate' effect makes the difference.[58] This assumption introduces two opposing forces in the model: a pull pressure towards the border region –*i.e.* a locational attraction of that region– and a push pressure outside it, which balance is shaped by international trade costs levels. As Brülhart (2010, page 11) well synthesises: "*A relocation towards the border region becomes more probable (a) the larger is the share of mobile activity in the border region prior to liberalisation, (b) the stronger is the degree of liberalisation, (c) the larger is the size of the foreign market, and (d) the more complementary is the sectoral composition of the foreign market (such that the demand pull towards the border is strong, and the competition effect is weak)*".[59]

As it may be apparent from the above exposition, much of the focus within the first-generation of regional models is related with whether alternative assumptions about dispersion forces could imply either opposing intra-country spatial effects of trade liberalisation or more complex impacts on the geographical structure of the country. While models assuming congestion costs *vis-à-vis* those supposing an immobile regional demand yield opposing results; settings acknowledging for access heterogeneity across domestic regions tend to provide richer insights on regional spatial effects.

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[57] Similarly, Haaparanta's (1998) model predicts trade liberalisation leads to intra-country spatial concentration in the region producing the good for which the country enjoys comparative advantage.

[58] A 'gate' effect implies regions are asymmetric in terms of accessibility. As it has been already referred to, the region with better access to trade partners is usually called 'border' or 'gate' region.

[59] The result obtained by Brülhart *et al*. and Crozet and Koenig is further reinforced by the one we get in the third chapter of this dissertation. In a setting that introduces both size asymmetries and border effects within a setting that disregards inter-regional forward linkages, it is found that heterogeneity between domestic regions – in terms of either access to preferential partners or market size– plays a major role in shaping industrial location inside a country.

Apart from that, it is worth noting that some of these contributions can be seen as 'the transition' towards the second generation of models that, taking one step towards realism, allow for inherently different regions. Namely, Alonso Villar (1999, 2001), Brülhart *et al.* (2004), Crozet and Koenig (2004a) and Granato (2005) –pioneers of the 'geographic approach' as we called from now on– are the first researchers we are aware of to explicitly and formally interrelate the spatial structure of countries. Their models, by assuming asymmetries in terms of accessibility, help to explain how the location of a foreign centre may prevent agglomeration in a border region –due to competition effects– while may facilitate concentration of firms within a remote location.

1.3.b- Second generation

The second generation of regional models, though supposing dispersion force entails partially immobile demand across regions, finds international trade liberalisation may foster a dispersed national landscape –in the fashion of Krugman (1996) and Krugman and Livas (1996)– when 'pro-competitive' effects are introduced.

The approach, which is put forward by Behrens *et al.* (2007b), entails adopting *à la* Ottaviano *et al.* (2002) a quasi-linear utility function with quadratic and symmetric sub-utility together with additive transaction costs, instead of the standard CES framework with iceberg trade costs. This new specification entails intensified endogenous competition *vis-à-vis* the DS setting, which acts as an additional dispersion force in the form of lower markups in denser regions.

As a result, one of its predictions is that "*... lower intranational transport costs foster regional divergence when international trade costs are high enough, whereas* ***lower international trade costs promote regional convergence*** *when intranational transport costs are high enough*" (Behrens *et al.*, 2007b, page 1297 [emphasis added]). In other words, the authors stress the interrelation may exist between international trade and intra-national transport costs levels –an issue already raised by Krugman (1996)– when price competition is introduced.

Other contributions of this second generation follow more closely the 'geographic approach' broadening it within a linear NEG framework; thus obtaining renewed results on the link between the spatial structures of countries. To start with, Behrens *et al.* (2006a) –who extend Behrens *et al.*'s (2007b) setting acknowledging access heterogeneity across regions– find that: the 'gate-less' country is likely to be agglomerated; the gated country tend to be dispersed (agglomerated) when its partner is agglomerated (dispersed); and agglomeration occurs in the gate region when the country is well integrated, but in the landlocked one when it is poorly integrated –*i.e.* high intra-national transport costs act as a barrier to competition from abroad.[60]

In another paper that adds density economies in international transportation to the same basic linear setting, Behrens *et al.* (2006b) also find that national spatial structures are interconnected.[61] In particular, the model predicts international trade liberalisation may promote agglomeration in one country as a corollary of its partner's agglomerated geography. The authors find that an increased volume of international trade gives rise, through density economies, to 'trade-mediated' transport externalities, which may trigger domestic agglomeration.

To sum up, within this second generation of regional models the introduction of additional spatial forces and the analysis of the interconnection across national geographical structures –which can indeed be thought as spatial forces themselves– are the main contributions. In the first case, the introduction of pro-competitive effects make it possible to ease agglomerative pressures, and thus to give rise to less extreme results. With respect to the latter, the broadening of the 'geographic approach' towards linear settings represents another step in the way of extending the scope of Regional NEG. In addition, the introduction of density economies shows up as another manner, complementary to the all-or-nothing former modellisation, to think on access heterogeneity across regions.

1.3.c- Third generation

The last generation of Regional NEG models deals with multiple regions and allows for a richer geographical structure by assuming either asymmetric spatial relations or unequal initial endowments across regions.[62]

[60] In Behrens *et al.* (2007b), the impact of domestic transport costs on the economic geography of the other country is disregarded since, as the authors themselves explain, the setting assumes all firms in a country have the same access to the other country. On the contrary, in Behrens *et al.* (2006a), one country is modeled with a gate region, whereas the two regions of the other country have homogeneous accessibility.

[61] It is worth noting that this is another way of introducing access heterogeneity across regions. Instead of adopting an 'all-or-nothing' assumption –*i.e.* supposing the presence of border (gate) regions together non-border (gate-less) ones– the introduction of density economies implies each location is characterised by a particular degree of accessibility. Mansori (2003) also presents another way to model access heterogeneity.

[62] Behrens *et al.*'s (2006c, 2009c) and Behrens *et al.*'s (2007a) multi-country trade models should be considered as close antecedents of the formers since they extend Krugman's (1980) setting to account for both multiple countries and accessibility asymmetries.

The first contribution within this strand is García Pires' (2005) multi-regional setting that, emulating Fujita *et al.*'s (1999, chapter 18, pages 335-338) setting adds cumulative causation operating across both regions and countries, *i.e.* VL in the manufacturing sector. This assumption allows for expenditure shifting not only within a country, as it takes place in models that suppose domestic labour mobility, but also at the international level. Hence, it widens the spatial extent for circular causation from being domestically bounded to be of international scope. Relying on numerical simulations, the author finds that international trade liberalisation may foster dispersion of economic activity within countries.[63]

Another exponent of this strand is Bosker *et al.* (2010) who extend Puga's (1999) DS-VL model for the case in which trade costs are pair specific and regions can be heterogeneous in terms of both accessibility and initial endowments. In every simulated scenario, increased integration across European regions leads to higher agglomeration; nonetheless, whether labour mobility is allowed or not ends determining if increased agglomeration occurs catastrophically or steadily.[64]

Other related article is due to Combes and Lafourcade (2011) who aim to study France's economic geography. The authors propose a Cournot competition multi-industry model that assumes pair specific trade costs. Their prediction is that a fall in France's inter-regional trade costs tends to foster domestic agglomeration, as well as intra-regional inequality.[65]

By supposing intra and international VL, these third-generation settings acknowledge for internationally mobile (intermediate) demand. Hence, they spread within the literature –which standard practice is to assume an internationally immobile demand– a curious feature due to Fujita *et al.* (1999) that gives rise to strengthened outward oriented agglomeration forces *vis-à-vis* previous models.[66] The introduction of international demand-shifting –and, hence, expenditure-shifting– tends to modify the path towards the long-run spatial equilibrium. Indeed, at intermediate trade-costs levels, agglomeration and dispersion forces may act quite differently than when there is not such purchasing mobility. For instance, take Krugman and Livas Elizondo's (1996) model and suddenly permit for some form of expenditure-shifting across

[63] Referring to his case of study, the author concludes that "*... a scenario of complete integration between the Portuguese and the Spanish economy is favourable to the most laggard regions. On the contrary, the most advanced regions of each country loose a little*" (page 107).

[64] In the first case, agglomeration could be too extreme; while in the second one, the likelihood of a reversed result –*i.e.* a dispersed outcome– increases.

[65] Intra-regional inequality has not been referred to before in this survey because, as it was mentioned, the dissertation regards regions as dimensionless points.

[66] The fourth chapter of this thesis makes a contribution to this strand of the literature. Based on Granato (2008), it presents a multi-region model that assumes VL, regional comparative advantage and trade costs *à la* Behrens *et al.* (2007a).

countries. Intuitively, this new agglomeration pressure tends to counterbalance the centrifugal force explained by congestion costs, re-shaping the economic landscape as long as some trade costs remain. As a result, a less dispersed geography seems more likely.[67]

Summing up, the novel features introduced by third-generation models, namely the combination of multiple regions with cumulative causation at international level, give rise to more complex and richer geographical outcomes, thus, to appealing spatial results. Notwithstanding, these new settings do not allow for unambiguous predictions on how changes in parameters could finally affect the economic landscape. Indeed, in order to get some predictions, authors have to rely on numerical simulations and estimation exercises over particular cases.

1.3.d- To sum up…

The review of Regional NEG theoretical literature about the spatial effects of trade costs changes on the distribution of economic activity within nations has showed that abundant work has been done, and notorious progresses have taken place. Improvements have been achieved in understanding how labor mobility and VL – either global or spatially restricted– on the one hand, and accessibility, on the other, may affect the spatial equilibrium of an economy. In other words, alternative agglomeration and dispersion forces were introduced –within both the traditional DS approach and the linear one– in order to find out whether international trade liberalisation (mostly) and intra-national trade liberalisation (less) may increase concentration within a given country or, on the contrary, may foster dispersion of economic activities.

Based on the election made by authors for accomplishing their works and on the manner in which settings have evolved, it appears that 'the chosen' approach is the combination of the DS framework with a pull of dispersed final-consumption markets and VL. Anyhow, as it may be clear from the above exposition, there is not a unanimously elected and definitively preferred approach. Furthermore, as many authors conclude, the alternative theoretical settings have not reached a consensus on the effects of trade costs changes. Hence, there are not unambiguous predictions on

[67] Indeed, the final outcome depends on how sensitive the results are to a robustness issue: the importance of immobile demand for determining market-potentials and, thus, dispersion forces.

how trade costs impact on the internal economic geography of a given country.[68] Under these circumstances, empirical analysis shows up as crucial. Indeed, many area-based studies, surveyed in the following section, have appeared trying to disentangle these issues.

To conclude, let briefly discuss three interesting remarks reckon authors have made about this literature. First, some authors as Behrens *et al.* (2007b) and Lafourcade and Thisse (2011) have pointed out that a main theoretical difficulty within Regional NEG has been to characterise the spatial equilibrium when both many locations and a 'genuine' distinction between domestic regions and countries –which they conceptualise as a differentiation in terms of both trade costs and factor mobility– are simultaneously considered. As it may be clear from the previous survey, there is no consensus among NEG researchers on whether one (and which one) or both distinctions among spatial scales should be considered, neither on which type of cumulative causation mechanism may be assumed –*i.e.* labour mobility, vertical linkages or factor accumulation– nor even on the geographical scope at which the latter should operate.[69] Moreover, the argumentation seems to draw attention again towards empirical studies; indeed, it appears to be an issue to be disentangled for each particular case of study.[70]

Second, from a methodological point of view, an important issue that has been raised is about the adequacy of relaying on numerical solutions instead of obtaining definite algebraic solutions. Though some could argue that the former may be misleading in providing definite results as base for policy analysis; the tendency to apply numerical simulations and other quantitative methods seems to be quite inexorable. Multiple regions and countries, different kinds of asymmetries and alternative market structures are very likely considered in order to find out reliable and close-to-reality answers from which to derive appealing policy suggestions. The complexity of the models combining all these features seems to leave no many other alternatives to deal with rather than particular econometric estimations, numerical simulations and computable general equilibrium (CGE) conterfactuals, as it will be clearer from the following section.[71]

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[68] Quoting Brülhart (2010, page 10 [parenthesis added]), "*Which type of model is better? Both approaches* (with stronger or weaker dispersion forces) *rely on specific functional forms, and no a priori reasoning will be able to adjudicate between the two. The only viable solution would appear to be empirical*".

[69] Indeed, there is a need for debating whether each expenditure-shifting mechanism may have a global, national, regional or none extent at all.

[70] For a discussion on this issue and some suggestions on how to deal with the multilicity of equilibria see Behrens and Robert-Nicoud (2011).

[71] For instance, a decade ago authors such as Bröcker (1998), Forslid *et al.* (2002a) and Forslid *et al.* (2002b) proposed to study the multi-regional (and multi-sector) effects of trade costs reductions by means of

The final remark on this literature is about policy issues. As many authors point out, NEG lacks definite policy implications –*e.g.* Behrens and Robert-Nicoud (2011), Combes (2011).[72] Though research on regional policy is one of the vacancies most frequently advertised by NEG literature, many central questions remain unanswered. In addition, NEG explanations and policy suggestions tend to differ from those provided by geographers (Rodríguez-Pose, 2011). With different methodological approaches, both areas of study –*i.e.* (economic) geography and NEG– have tried to give answers to many of those questions, though arriving to almost opposite results. This fact, however, could be taken as an opportunity. As Martin and Sunley (2011) and Rodríguez-Pose (2011) claim, both frameworks should be combined in the research arena (theoretical and empirical) in order to achive better policy analyses and, hence, more comprehensive advices.

1.4. Empirical Research 'Inspired' on Regional NEG

The question of how location reacts to falling trade costs is a longstanding issue that has been increasingly addressed by empirical researchers. During the last fifteen years, the broad issue 'how could location be affected by changes in trade costs?' together with other more recently risen questions –namely, 'how schemes fostering physical integration, *e.g.* transport and infrastructure projects, cohesion policy, etc. may affect location?'– have received renewed interest from researchers studying regional integration processes such as the EU and the North American Free Trade Area (henceforth, NAFTA).

Addressing those types of questions, the research enterprise has attempted both to identify and measure the evolution of agglomeration and specialisation patterns across territories, and to disentangle the extent to which different determinants of location could explain the spatial changes that follow policy changes.[73] This has been accomplished mainly at cross-country level; nevertheless, in the last ten years within-country studies have been increasingly conducted.

general equilibrium simulations instead of deriving analytical solutions from a full-fledge theoretical model.

[72] The exception to that is the area of tax competition, with studies such as Andersson and Forslid (2003), Baldwin and Krugman (2004), Borck and Pfluger (2006) and Ludema and Wooton (2000) among others.

[73] For comprehensive reviews of this empirical literature, see *e.g.* Combes (2011), Combes and Overman (2004), Head and Mayer (2004), Overman *et al.* (2003) and Redding (2010).

In view of which is the focus of this review, this section concentrates on empirical articles that specifically refer to the spatial effects of trade costs changes on domestic economic landscapes.[74] In other words, it surveys papers addressing the spatial effects of inter- and intra-national trade liberalisation or integration –*i.e.* including those relating to transport and communication infrastructure. Nonetheless, it is due to mention that since the within-country issue has not received so much attention until recent years and because many advances in empirical research have been achieved for EU studies, some of the most outstanding cross-country contributions are also reviewed.[75]

In presenting the papers selected, it would have been preferable to mimick the ordering developed to survey the theoretical contributions –*i.e.* grouping articles into three generations– in order to facilitate the appraisal between both areas of study. However, the strict circumscription to the NEG approach in the empirical arena is somewhat difficult and pretty restrictive. As it will be clear from the following exposition, within applied literature there is not a definite and specific analytical background adopted. Therefore, the review does not only survey what could be called 'empirical NEG', but also other closely related spatial studies. In other words, it follows a more pragmatic approach and considers the diversity of methods that have been proposed with the intention of enhancing the analysis and widening the perspective of the survey –by reviewing complementary approaches. Thus, this survey does not only revise empirical research that formally and explicitly relies on NEG models, but also papers that, though adopting a different theoretical perspective or taking a more ad-hoc strategy, make interesting contributions as regards main interests of this dissertation.

This section is organized as follow: first, it refers to descriptive works, to afterwards surveying papers that propose either more analytical or theoretically-grounded methodologies. Specifically, the empirical contributions are classified into four big groups or, better to say, 'phases' –since they are roughly consecutive– which are characterised along the section. Tables 2 and 3 in Appendix C1 present a summary of the articles reviewed.

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[74] It is due to mention that many empirical papers, related with location issues but focusing on aspects different from my main interests, are disregarded in this survey. For example, studies applying discrete choice models to explain why a firm or plant chose to locate in a particular place –namely, the location-choice approach– and those using count data models to examine how *ceteris paribus* changes in location characteristics could affect industrial location decisions are not included. For a survey on recent papers applying those methodologies, see *e.g.* Arauzo-Carod *et al.* (2010).

[75] Mainly, those accomplished during the first years of empirical research on economic geography.

1.4.a- First phase

In a first phase, which can be said begins with the publication of Kim's (1995) and Ades and Glaeser's (1995) papers, authors study the location issue and its determinants mainly at cross-country level, by applying ad-hoc approaches based on a mixed theoretical framework with some prevalence of Trade theory and, in a lesser extent, NEG. More specifically, most of them try to describe the evolution along time of agglomeration and specialisation patterns –quantified and described by specific indices– and to corroborate whether those observed patterns are consistent with the predictions coming from different traditions.

While some authors construct concentration and specialisation indices and just analyse their evolution over different industries and time periods;[76] others intend to check whether the distribution patterns described by those indices can be explained by some plausible explanatory variables proposed by theory. In doing this, most authors regress a particular industry specific index –usually a Gini, Krugman or Ellison & Glaeser index– on proxies accounting for trade costs, the degree of economies of scale and variables intending to capture endowments, technology or locational features. These studies find, in general terms, that comparative advantage, intra-industry linkages and economies of scale play an important role explaining concentration of economic activity. In addition, the results obtained show there seems to be not a definite or obvious relationship between increasing integration and concentration.[77]

The validity of these contributions has been, nonetheless, questioned. The weak relationship between theory and the specifications used tends to undermine the reliability of their results. At the centre of this appraisal are matters as: type of index used, right-hand-side variables considered, and relationship assumed between left and right-hand-side variables. With respect to the former issue, and as several authors have pointed out, though the Gini index has been the main tool used, it suffers from methodological shortcomings that make it not a proper left-hand-side variable. On the contrary, the Ellison and Glaeser's (1997) index and the very sophisticated measure developed by Duranton and Overman (2005) –which construction is demanding in

[76] That is the case *e.g.* of Brülhart and Torstensson (1996), Ellison and Glaeser (1997) and Hallet (2002).

[77] Articles in this line are, for instance: Ades and Glaeser (1995), Amiti (1999), Brun and Renard (2000), Ellison and Glaeser (1999), Kim (1995, 1999), Midelfart-Knarvik *et al.* (2000a), Pernia and Quising (2003), Ramcharan (2009) and Tirado *et al.* (2002).

terms of data and computing-power requirements– satisfy many of the properties one would expect from a meaningful concentration index.[78]

Regarding the econometric specification, the main concern has been on its functional form and, more generally, on its connection with the theoretical frameworks. The linear specifications have been usually proposed without tidily justifying how this would match with the functional form implied by theoretical predictions.[79] Therefore, paraphrasing Combes and Overman's (2004) words, the studies within this first phase are useful for generating stylised facts about location but can tell very little about what is causing the observed spatial patterns.

1.4.b- Second phase

In a second phase, applied economists have more specifically attempted to evaluate the extent to which hypotheses derived from NEG models are supported or not by evidence. Applying renewed empirical specifications, these works tend to focus on within-countries geography and to address how changes in trade costs affect the evolution of market size or industrial location measured in terms of value added, employment, etc.

Likewise papers belonging to the first phase, some studies describe the spatial concentration of economic activities and try to check whether it is or not consistent with theoretical predictions. Among them, a first group undertakes explanatory spatial data analysis; namely, it analyses location patterns across domestic regions as international trade is liberalised.[80] Interesting examples within this set are the contributions made by Brülhart and Traeger (2005), Combes *et al.* (2011) and Granato (2007), among others, which spread the use of novel indices to measure agglomeration.[81] These authors propose the use of entropy indices, which have distinct advantages over the standard concentration measures. The most relevant one is their decomposability; this feature allows authors to decompose the inequality analysis across either different spatial scale (sectors) in order to identify the contributions of

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[78] Head and Mayer (2004) make a complete exposition about the shortcomings of the Gini index and the advantages of both Ellison & Glaeser and Duranton & Overman indices. For a comprehensive discussion on the properties of these indices see Combes and Overman (2004) and Duranton and Overman (2005).

[79] For additional discussions on this issue, see for instance Head and Mayer (2004), Brakman and Garretsen (2006) and Behrens and Thisse (2007).

[80] Other articles in this line *e.g.* are Overman and Winters (2005, 2006), Pons *et al.* (2002) and Sjöberg and Sjöholm (2004).

[81] Other papers in this line are, for instance, Cutrini (2005), Das and Barua (1996) and Kanbur and Zhang (2005). Note Granato (2007) is the base for the second chapter of this thesis.

individual regions (sectors) to the overall geographic concentration of economic activity.[82]

Other interesting contribution is that due to Hanson (1998a), which is a close antecedent of a prolific line of research in the following phase. The author is the first we are aware of to look at regional wage differentials as an explanation for location within countries. Applying a descriptive methodology to study the spatial structure of US, Canada and Mexico before and after NAFTA, the author finds the integration agreement seems to be associated with an expansion of production in border regions.

A second group of articles, in the spirit of first-phase studies, proposes to more explicitly derive testable hypothesis from NEG models and to check whether they are supported or not by evidence. In this regard, authors such as Chiquiar (2005), Crozet and Koenig (2004b) and Daumal (2008) regress specifications aiming to disentagle how trade liberalisation, both at intra- and inter-country level, changes location patterns.[83] Other authors build on an approach due to Midelfart-Knarvik and co-authors. In few words, Midelfart-Knarvik *et al.* (2000b, 2002) propose to econometrically estimate a specification that attempts to represent testable hypotheses about concentration and specialisation patterns derived from NEG and Trade theories.[84] Thus, their articles, which regress a concentration index on variables capturing country and industry characterictics together with interaction terms between them, find that the availability of skilled workers and forward and backward linkages seem to be robust determinants of location across EU countries.[85]

Among the authors who apply this methodology one can mention Wen's (2004) study of the Chinese economy, Volpe Martincus' (2009) study of Brazil and Sanguinetti and Volpe Martincus' (2009) analysis of Argentina; papers that look for disentangling whether alternative determinants of location can explain domestic location patterns. Wen (2004), who estimates a system of two equations, finds that after market-oriented economic reforms a more agglomerated landscape was delineated. Concerning South America, Volpe Martincus (2009) finds that, between 1990 and 1998, external trade liberalization may have favoured the location of manufacturing in Brazilian states closer to Argentina. Finally, Sanguinetti and Volpe Martincus' (2009) results suggest

[82] As Cutrini (2006, 2009) shows, the Theil index responds to the necessity –already recognised by spatial economists– to disentangle the relative importance of intra-country dissimilarity from cross-country divergence in order to analyse both the spread of economic activities across space and the structural differences between geographical units.

[83] Within this set of papers one can also include the already mentioned articles by Brülhart and Traeger (2005), Combes *et al.* (2011), Das and Barua (1996) and Kanbur and Zhang (2005).

[84] Midelfart-Knarvik *et al.* (2000a) is a close antecedent of that pair of papers. Other related contributions are those due to Brülhart (2001) and Haaland *et al.* (1999).

[85] At the aggregate level, this approach is also applied by Sanguinetti *et al.* (2004) to study location within MERCOSUR.

that lower trade protection may have fostered dispersion from the main domestic market, Buenos Aires, towards interior provinces.

Finally, another (the third) group of articles within this second phase proposes the estimation of gravity equations to disentagle whether trade performance across domestic regions can be reasonably explained by NEG and Trade theories.[86] This is the case, for instance, of: Coughlin and Wall's (2003) research of the states in the USA that evaluates the role played by the NAFTA; Benedictis *et al.* (2006) study of Ecuadorian provinces trade focusing on the role played by infrastructure; and Porto (2005) and Castro and Saslavsky's (2009, ch. 3) who assesses the impact of MERCOSUR on intra-country trade performance in Brazil and Argentina, respectively.

1.4.c- Third phase

In the third phase, authors propose innovative approaches for addressing questions not as different as before. Specifically, this literature tries to assess what are the characteristics of a region that are optimal for location by applying either reduced-form or structural approaches.[87]

Within the reduced-form group, the typical strategies are either to estimate a standard wage equation –or a variation of it in the spirit of Hanson (1996, 1997)– or, alternatively, to work with either productivity growth or the determinants of local employment.[88] A very interesting study within this group is the paper by Fingleton (2005) that compares the explanatory power of a neoclassical growth model and a NEG setting for explaining regional wage variations. Studying 408 districts of Great Britain, the author finds that, though the reduced-forms derived from both theories mirror the data reasonably accurately, there is some piece of evidence that turns the balance in favor of NEG.

The group of studies applying instead a sturctural approach derives specifications directly from NEG models to afterwards estimating them. In doing this, most authors follow one of two alternative strategies, namely the one put forward by Hanson (2005) and the other due to Redding and Venables (2004), to evalute the role play by real market access in determining regional wages. While the former author

[86] Among authors applying this approach for studying national trade patterns, it is due referring to Egger and Pfaffermayr (2002), Feenstra *et al.* (2001), Hanson and Xiang (2004) and Weder (2003).

[87] For a complete methodological survey on these two empirical strategies see Combes (2011).

[88] Among those studies we can mention for instance: Chiquiar (2008), Egger *et al.* (2005), Faber (2007), Gonzáles Rivas (2007), Hanson (1998b) and Tomiura (2002).

suggets to estimate augmented market potential functions on wages; Redding and Venables propose a two-stage strategy, namely: first, to regress a trade equation in order to obtain estimates of bilateral transport costs and market/supply capacities and, then, to estimate a wage equation.

In line with Hanson, Roos (2001) studies West-German counties between 1992 and 1996, concluding that market potential is important for determining salaries and wages of skilled workers.[89] Similarly, Tirado *et al.* (2009), who test the existence of regional nominal wage gradients, find support for a gradient centered on Barcelona before 1922, which is weakened afterwards when protectionist policies are put into place.[90] The authors conclude that: "*The progressive closeness of the Spanish economy tended to weaken the privileged position of the coastal regions* (like Barcelona) *and favor the rise of central regions* (like Madrid)" (page 33 [parentheses added]).

Applying instead the methodology proposed by Redding and Venables, various investigations have being completed. That is the case of Breinlich (2006), Head and Mayer (2006), Knaap (2006) and Paillacar (2007), who conclude that real market access is an important determinant of wage (income) spatial disparities.[91] For instance, Head and Mayer, who conduct a study for 57 European regions between 1985 and 2000, conclude that real market potential is not equalized as predicted by the model with factor price equalization and, indeed, differentials across regional market potentials explain how wages and employment spatially diverge.

Finally and in the spirit of second-phase intra-country gravitational studies, a third group of articles estimates structural specifications which resemble the standard gravity equation in order to corroborate the 'trade-induced agglomeration' hypothesis. In this fashion, Lafourcade and Paluzie (2011) investigate whether the European integration process has changed the geography of trade within France. The authors, who assume trade costs are composed of two elements, transport costs and specific cross-border costs, and that the formers depend on the existence (or not) of cross-border infrastructures, find that French border regions: trade on average 72% more with neighbour countries than do interior regions, perform better if they have good

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[89] Brakman *et al.* (2004) coincide with Roos' conclusion. They find strong support for the spatial wage structure across German districts in 1995.

[90] Note that the authors combine two reduced form estimations of the market access effect, one proposed by Hanson (2005) and the other put forward by Hanson (1996, 1997).

[91] Worth is to mention that most of these studies use trade flows at the country level instead of intra-country ones because of availability.

cross-border transport connections and are not so benefited with respect to other border regions if they are located at the periphery (western and southern) of Europe.[92]

1.4.d- Fourth phase

The fourth phase, which includes papers mostly written from 2006 on, is characterised by three main lines of research with different degree of development. A first strand continues Hanson's and Redding and Venables' tradition but introducing simulation excersises. A second line of work proposes, in the spirit of Forslid *et al.* (2002a,b), CGE-model simulations to address the effects of changes in trade costs on location, trade and welfare. The third line is, in fact, just an embryonic approach.

As regards the spreaded former approach, most of the papers address the relationship between market access levels and degree of agglomeration by means of numerical simulations based on multi-region NEG models. Within this strand one can mention several papers, such as Bosker *et al.* (2010), Brakman *et al.* (2006), Brülhart *et al.* (2004), Brülhart *et al.* (2009), García Pires (2005), Huber *et al.* (2006) and Niebuhr (2006, 2008).[93] These studies apply the following research strategy: first, they estimate a theoretical relationship like the predicted correlation between market potential and wages; second, they employ the estimated coefficients to simulate changes in regional market potentials; and finally, some of them confront the simulation results with additional empirical evidence.

In the same line of research but somewhat differently, Redding and Sturm (2008) propose a natural experiment that simulates the impact of German post-war division with a calibrated model, to next testing the results by means of parametric and non-parametric estimates.[94] Also with an original strategy, Combes and Lafourcade (2011) and Teixeira (2006) try to validate a NEG model already in the first step by structurally estimating it, to afterwards run simulations.

The second group of studies, as it has been pointed out, applies CGE models to evaluate the potential effects of reductions in different types of trade costs on the internal geography of countries. With theoretical roots in NTT, Bröcker (1998) finds

[92] Fairly in line with Lafourcade and Paluzie's research, Chapters 5 and 6 of this thesis proposes to study how regional trade performance in Argentina and other MERCOSUR member countries is affected by transport costs and infrastructure.

[93] Worth is to note that Huber and co-authors are one of the first, at least to my knowledge, to introduce the use of spatial econometric techniques in this literature.

[94] This is the published version of Redding and Sturm's (2005) *Political Economy and Public Policy Series* paper.

very small variations of integration effects due to location. On the contrary, recent few studies related with the NEG framework support the hypothesis that geographic location does modify integration effects across regions. Ferraz and Haddad (2009) and Haddad and Perobelli (2005) conclude this for Brazil; while Melchior (2008b, 2009) do the proper as regrads Europe.

Finally, the underdeveloped but very promising third approach suggests the application of structural spatial econometrics in NEG empirical studies.[95] In the spirit of studies addressing either the location of foreign direct investment (FDI) –*e.g.* Castro *et al.* (2007) and Coughlin and Segev (1999)– or the patterns of trade as in Behrens *et al.* (2009b, see Box 1) within other theoretical frameworks; Huber *et al.* (2006) and Mion (2004) assess the role of market potential in shaping regional wage structures trying to corroborate NEG predictions.

Box 1: A digression on the gravity equation and its application within the NEG research

Besides some well-known empirical shortcomings researchers affront when estimating the gravity equation, nowadays another issue appears frequently addressed in the literature concerning spatial economics. As several authors argue, taking into account the interdependence between trade flows is important in order to obtain consistent estimates.[96]

As we have pointed out in the theoretical section of this chapter, when multiple regions are considered spatial feedbacks across regions are at the centre of the scene. In other words, the relative position of each region within the entire system ends determining the complete location map and, hence, the pattern of trade across regions. Accordingly, an equation aiming to explain bilateral trade flows should include spatial feedbacks among regions for the consistency of the results.

However, the proper inclusion of those interactions is an issue that has been largely neglected. In fact, some applied work in trade that aim at controlling for such interdependence has included in the gravity equation either, on the one hand, origin- and destination-specific importer-exporter fixed effects or, on the other hand, measures of remoteness *à la* Wolf (1997) or multilateral resistance indices *à la* Anderson and van Wincoop (2003) that permit the effect of bilateral distance to vary with the proximity of third trading partners.[97]

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[95] For an updated overview of the spatial econometrics literature, its problems and suggestions for future research see Pinkse and Slade (2009).

[96] See, for instance Anderson and van Wincoop (2003), Behrens and Thisse (2007) and Behrens *et al.* (2009b).

[97] More recently, a group of authors have attempted to improve Anderson and van Wincoop's approach conducting structural estimations or, at least, proposing approaches to compute general equilibrium

Nonetheless, as some authors point out, both methods reduce the control of that interdependence to a scalar measure, which implies assuming bilateral trade flows are independent from the rest of trade flows. Therefore, these approaches seem quite unlikely to comprehensively account for the entire system of interactions.

As a response, Behrens *et al.* (2009b) have very recently made a compelling contribution within the New Trade theory. The authors, after deriving a 'dual' version of the gravity equation, estimate it using spatial econometrics for US-Canada bilateral sub-national trade. Not surprisingly, the results they get suggest that controlling for spatial feedbacks seems relevant to properly measure border effects and to determine the scope of different agglomeration forces.

Hence, one should expect a growing literature applying theoretically-grounded spatial econometrics in this fashion to empirical NEG research.

These three lines of research will in the near future very likely provide for a better understanding of how trade costs affect location across domestic regions, which policy recommendations can be prescribed, among others.

1.4.e- To sum up…

During the last fifteen years the number of empirical papers studying the spatial effects of falling trade costs has multiplied; and within the last ten years, the 'intra-country' issue has started to receive relatively more attention. As it can be grasped from previous sections, there is not a unified corpus of literature that can be considered to unambiguously address those effects on the distribution of economic activity within nations. Indeed, and rather at odds with the theoretical literature, empirical studies apply a diversity of approaches.

By way of contrast, in the last five years empirical works have started to take NEG theory more seriously, almost in simultaneity with the emergence of Regional NEG settings. Thus, many studies commence both to apply structural specifications in order to evaluate NEG predictions and, more recently, to exploit natural experiments for analysing spatial phenomena.[98] In addition, renewed methodologies and strategies

comparative statics that accurately acknowledge for the border effect with symmetric or asymmetric trade costs –*i.e.* Baier and Bergstrand (2009), Balistreri and Hillberry (2006 and 2007) and Bergstrand *et al.* (2007).

[98] 'Natural experiments' –defined by Meyer (1995, page 151 [example added]) as studies "*in which there is a transparent exogenous source of variation in the explanatory variables* (*e.g.* policy changes) *that determine the*

have been proposed, showing notable improvements. Research tools such as CGE simulations and, more incipiently, spatial econometric techniques are applied to address old and new questions.

As regards findings, and beyond the fact that few papers have tested NEG models, empirical research seems to mirror the luck of the theoretical agenda: there is not certainty. Whether a fall in trade costs promotes dispersion or agglomeration of economic activity across interior regions hinges on the specific geography of each territory (Henderson, 1996). However, the promising news are that empirical papers do support the existence of statistically significant spatial impacts within countries, in particular in border regions or locations with better accessibility to large markets. Hence, all the above is indeed an invitation for further developments, both theoretically and empirically, in order to arrive to more realistic depictions of geography and to develop enhanced empirical tools.

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treatment assignment" – provide for otherwise difficult-to-isolate exogenous variations in main explanatory variables, especially when estimates in spatial economics are biased because of selection problems or omitted variables. Examples of natural experiments are those studied by Bosker *et al.* (2007, 2008), Combes *et al.* (2011), Davis and Weinstein (2008), Redding and Sturm (2008), Redding *et al.* (2007), Tirado *et al.* (2009) and Wolf (2007) among others.

1.5. Concluding Remarks

Since NEG pioneering works, there has been a revival of research on the geographical distribution of economic activity, in general, and regarding domestic landscapes in particular. The present review of the theoretical and empirical literature on the domestic spatial effects of trade costs changes shows that very much progress has been done and, indeed, much work is likely to be accomplished as regrads empirics and, moreover, policy-oriented regional issues. In what it follows we synthesize the findings.

The NEG framework has successfully evolved thanks to many fruitful contributions and extensions. As a result, there is by now an extensive and rich theoretical literature that examines the role of trade costs in determining the distribution of economic activity across countries and, more recently, across domestic regions. Despite the considerable advances that have been made, to date theoretical research still has some limitations regarding relevant issues, such as the application of a general model of monopolistic competition, the appropriate treatment of alternative cumulative causation processes at different spatial scales, the finer incorporation of 'micro-heterogeneity' features and the proper inclusion of the transport sector, which is central for thereafter carrying out insightful applied work.

As regards Regional NEG models, features as spatially fragmented production, interaction between agglomeration and growth, heterogeneous firms and/or agents, endogenous policy decisions, and institutions remain to be studied more deeply. Refinements like these might favour an even deepener and more insightful treatment of issues which, from a regional perspective, are central. With reference to empirical literature, this chapter finds that the number of papers studying intra-country spatial effects of trade policy has multiplied during the last ten years. Indeed, not only tariff and non-tariff barriers effects have been addressed but also, and more recently, those implied by inter- and intra-national transport costs.

Apart from the specific challenges theoretical and applied literature face –and perhaps because of these overdues– there is ambiguity within NEG regarding the final spatial effects of trade costs changes. The main challenge hence is, taking theory more seriously, to apply structural specifications, to exploit natural experiments and to use innovative research tools –such as spatial econometric techniques and CGE simulations– for analysing spatial phenomena. Moreover, the invitation is to further advance in useful policy-oriented analyses which, so far, has been very scarce and mostly restricted to the area of tax competition.

As it has been advanced in the Introduction, this thesis aims at contributing to Regional NEG in order to study the Argentinean and MERCOSUR's spatial reality. While the following chapter derives stylized facts describing the evolution of location in Argentina; the next two make theoretical contributions extending well-known settings to account for features that characterise those realities. In due course, the last two chapters intend to contribute with empirical Regional NEG by studying location and trade performance within Argentina and MERCOSUR member countries at the light of predictions derived from our models –in spite of limitations data (un)availability imposes– with the ultimate aim to propose some interesting policy-related suggestions.

Chapter 2:

THE ARGENTINEAN MANUFACTURING LANDSCAPE DURING MERCOSUR DAYS[99]

2.1. Introduction

As it has been advanced in the Introduction, Argentina suffers from a considerable sin as regards regional disparities. During the last decades, this unbalanced pattern might have been deepened or, perhaps, lessened as the country re-opened to international trade and became a MERCOSUR member. This ambiguity regarding the final spatial effects is explained by the inconcluding results the specialised literature brings, as reviewed in the previous chapter. Namely, regional integration agreements tend to affect location of economic activities and the spatial distribution of factors of production and demand. However, there is not certainty on the final outcome. As Henderson (1996) clearly concluded, whether a fall in trade costs promotes dispersion or agglomeration of economic activity is an open story that hinges on the specific geography of each territory.

The formation of MERCOSUR has reduced trade costs among the members and, thus, provoked well-known effects on both volumes and patterns of trade, and a noticeable influence on investment and location decisions inside its territory.[100] Moreover, the process of regional integration may have impacted asymmetrically across regions within member countries. For instance, in the case of Brazil, while more industrialised or developed locations may have attracted firms due to market access and spillovers effects; other ones might have suffered due to comparative disadvantages and relative remoteness from (or closeness to) partners (Haddad *et al.*, 2002; Porto, 2005; Volpe Martincus, 2009).

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[99] This chapter is a revised version of a paper presented at the Fourth Annual Conference of the Euro-Latin Study Network on Integration and Trade (2006) and the XLII Annual Meeting of the Argentine Association of Political Economy (2007). We would like to thank the very valuable comments and suggestions received from María Cecilia Gáname, Matthieu Crozet, Marcelo Garriga and other participants. We also thank María Cecilia Ganame, Gabriela de Aduriz and Ariel Barraud for supplying raw statistical information used here.

[100] As a result of the latter, for instance, Brazil appears as the net winner inside the bloc capturing the majority of foreign direct investment flows (Bittencourt *et al.*, 2006). Indeed, between 1995 and 2005 Brazil has received an average annual share of 75 percent of those flows (CEI, 2010; Crespo Armengol *et al.*, 2004).

Hence, one may wonder how interior regions within Argentina might have been affected by the formation of MERCOSUR, which spatial units may have been benefited and which could have suffered a negative net effect in terms of manufacturing location, etc. One could conjecture that the geographical position of different sub-national territories, together with their pre-integration industrial profile may have played role in determining their luck during the relocation process.

In an attempt to give some *prima facie* answers for Argentina, this chapter analyses how the distribution of manufacturing activities inside Argentina has evolved during MERCOSUR days. Neither testing nor estimating NEG postulates, the objective is to derive stylised facts describing the evolution of location in Argentina between 1993 and 2005.[101] Departing as less as possible from the spirit of the New Empirics of Agglomeration and Trade (Head and Mayer, 2004) and applying a strategy similar to that proposed for instance by Brülhart and Sbergami (2009)[102], Brülhart and Traeger (2005) and Cutrini (2005), the chapter try to find out which changes in manufacturing location across Argentinean regions occurred during those years. Indeed, to our knowledge the chapter is one of the first works on regional disparities in Argentina inspired on NEG ideas.

Most of the articles mentioned above, pertaining to the second phase of empirical research on Regional NEG reviewed in Chapter 1, accomplish explanatory data analysis attempting to provide for empirically well-founded stylised facts on predictions about the relation between integration and manufacturing spatial concentration. By the use of dissimilarity entropy indices, they assess the evolution of these measures and their decomposition during a period of increasing market integration across European countries. Similarly, though relying on locational Gini indices, Pons *et al.* (2002) analyse over time –between 1856 and 1907– whether internal and external Spanish integration played a role in shaping industrial agglomeration.[103]

Following them, this chapter proposes an explanatory spatial data scrutiny of the evolution that regional gross manufacturing product and other well-known indicators of industrial concentration and specialisation showed insofar as MERCOSUR trade liberalisation was perceptible. In addition, the analysis relies on entropy measures and

[101] Note we were not able to choose the period of analysis because the best data we had been able to obtain was only available for those years.

[102] The authors, who study the impact of within-country spatial concentration of economic activity on country-level growth, measure aggregate and sectoral geographic concentration using Theil indices.

[103] Indeed, there are many papers that analyse location patterns during periods characterised by trade integration, instead of relying on explicit measures of intra- and inter-national trade openness. We can mention, for instance, the papers by Chiquiar (2005), Das and Barua (1996), Hanson (1996, 1997), Kanbur and Zhang (2005) and Midelfart-Knarvik *et al.* (2002) among others.

their geographical decomposition in order to disentangle whether manufacturing disparities have grown or not across Argentinean regions and provinces.

The remainder of the chapter is organised as follows. Next section describes very briefly the story of Argentina within MERCOSUR and describes main features of disparities within the bloc. Section 3 presents the data used and methodological issues regarding the empirical strategy adopted. The fourth section derives stylised facts of the spatial effects that might have taken place within the Argentinean landscape between 1993 and 2005. Finally, section 5 presents concluding remarks and draws some lines of research, which we attempt to address in the following chapters.

2.2. Main Features about MERCOSUR

2.2.a- A brief story

Prior to MERCOSUR enactment, there was already some, though limited in its extent, preferential trade among many Latin American nations. Since the early eighties, these countries had exchanged tariff preferences as well as exceptions for non-tariff barriers within the framework of the Latin American Integration Association (LAIA).[104] In addition to that, from 1986 on, Argentina and Brazil were implementing what can be regarded as the basis of the MERCOSUR agreement. Within the Economic Integration and Cooperation Program, both countries agreed on lists of negotiated products that were to receive preferential treatment, and designed industry cooperation programs to perform (Estevadeordal *et al.*, 2000).

MERCOSUR was officially launched on March 26, 1991 when the four founder members –Argentina, Brazil, Paraguay and Uruguay– signed the Treaty of Asunción which creates a common market by December 31, 1994. More precisely, on that date a custom union was created by means of both a gradual, automatic and linear reduction of tariffs and non-tariff barriers, and the implementation of the common external tariff. The process of integration was intended to evolve towards a common market, characterised by: free movement of goods, services and factors, common trade policy, coordinated macroeconomic and sectoral policies and harmonised legislation.

[104] In 1980 eleven countries signed the Montevideo Treaty, nalemy: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela. Afterwards, Cuba (1999) and Panama (2009) adhered to the agreement. Even before, between 1960 and 1980, the Latin American Free Trade Association (LAFTA) encouraged the exchange of trade preferences among the eleven former member countries of the LAIA.

Nowadays, MERCOSUR trade policy can be described as a combination of features which are common to all members –*i.e.* intra-bloc unfinished free trade[105], around 80 percent of external tariffs lines, and some preferences to third countries– and several issues which remain within each member country's national jurisdiction. This second subset includes those policy aspects such as antidumping and countervailing measures, non-tariff instruments, export policies, and other preferences to third parties, that have not hitherto been harmonised.

A regards MERCOSUR enlargement, from 1996 on several Latin American countries have been incorporated into the agreement as associated members; specifically: Chile in 1996, Bolivia in 1997, Peru in 2003, and Ecuador, Colombia and Venezuela in 2004 (MERCOSUR Secretariat, 2009). Finally, in July 2006, Venezuela signed a Protocol of Adhesion to MERCOSUR as a full member. In addition, several agreements have been being negotiated by the bloc with both third countries and other integration schemes –*e.g.* the Free Trade Area of the Americas (FTAA), the EU, India, South Africa Custom Union (SACU), Canada, Egypt, Morocco, Israel and the Cooperation Council for the Arab States of the Gulf (INTAL, 2009).

Apart from that preferential liberalisation, from early nineties Argentina –almost in simultaneity with the other MERCOSUR members– unilaterally liberalised its external trade by means of tariff reductions and the elimination of quantitative restrictions.[106] This opening process led to significantly lower import tariffs, reduced dispersion of protection rates and the scrapping of most non-tariff barriers for imports from third countries (Estevadeordal *et al.*, 2000).

Though it is not straightforward to disentangle MERCOSUR effects from the overall effects of trade liberalisation, authors agree about the bloc's great influence on investment and location decisions inside the member countries.[107] They argue that there are several noticeable features which must be taken as evidence of MERCOSUR geographical impacts; and they conclude those impacts will be greater as the integrating process moves forwards and progress with common policies is made.

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[105] In fact, some intra-bloc trade barriers remain (MERCOSUR Secretariat, 2006). One of the most notorious one is the 'double payment' of the Common External Tariff (CET); this means that when external goods successively cross the frontier of two or more member countries, the CET has to be paid twice or even more times.

[106] For a detailed analysis of the evolution of tariff barriers in MERCOSUR's member countries during the nineties see, for instance, Estevadeordal *et al.* (2000) and Sanguinetti *et al.* (2004a).

[107] One can mention the works by Terra and Vaillant (1997), Calfat and Flôres (2001), Bouzas (2003) and Heyman (2004), among others.

2.2.b- Disparities within MERCOSUR

MERCOSUR suffers from an original sin as regards disparity across its member countries. From the Brazilian giant to the tiny Uruguay, differences from nearly every viewpoint are impressive. To have a shallow notion of this, Table 1 shows some rough records that describe macro disparities across the members. Briefly, one renders with a strange taste in the mouth: though Brazil has become the regional power, Uruguay seems to be a better place for living, and Paraguay shows up as the less 'gifted' member country.[108]

In addition, the bloc is characterised by no minor locational discrepancies that, in due course, are likely to confine some expectations as regards trade and economic performance at the national level. As it can be grasped from Figure 1 in Appendix C2, besides the restrictive land-locked position of Paraguay, it is unquestionable the favourable location of Brazil, and even Uruguay, to reach the developed markets of North America and Europe together with the no so advantageous situation of Argentina.[109] Nevertheless, quite in opposition, Argentina and Uruguay seem to be located in a better position to arrive at emerging markets like China, India and other Asiatic countries.

Table 1: MERCOSUR macro data, 1991 and 2008

MERCOSUR country	Area	Population		GDP		Per capita GDP	
	(squared kms)	1991	2008	1991	2008	1991	2008
Argentina	3.749.400	33,0	39,7	189.594	326.474	5.751	8.214
Brazil	8.514.877	149,1	191,9	445.242	1.572.840	2.986	8.197
Paraguay	406.752	4,4	6,2	5.919	16.006	1.359	2.601
Uruguay	176.215	3,1	3,2	11.206	32.262	3.601	10.082

Source: Author's construction based on the dataset of CEI (2010) and United Nations (2007).

Note: Population expressed in millions of inhabitants, GDP in millions of current US dollars and per capita GDP in current US dollars.

[108] In order to alleviate somehow discrepancies among member countries, MERCOSUR created in 2004 a Structural Convergence Fund (FOCEM) with four areas of action, namely: structural convergence, development of competitiveness, social cohesion, and strengthening of the institutional structure and the integration process. Chapter 6 will deepen our knowledge on FOCEM and its potential effects within the bloc.

[109] Though this is not the case for the main Argentinean ports –*i.e.* Buenos Aires and Rosario– it is indeed for the majority of the Argentinean territory.

To close this section, let refer to another disparity across members that, though is not new-found, did take place during the period this chapter analyses. Between the second half of 2001 and the end of 2002, Argentina experienced a huge economic crisis that followed the devaluation of its national currency. The crisis had a tremendous impact on the Argentinean economy –where the annual variation of quarterly GDP was -7,6 in average between 2001 and 2002 and the unemployment rate was 18,5 (CEI, 2010)[110]– and shocked unevenly the other MERCOSUR member countries. While the country that reacted more similarly to Argentina was Uruguay, with an average variation in quarterly GDP of -7,2 and an unemployment rate of 15,9; Brazil was the less shocked (CEI, 2010).[111] Its huge domestic market and its consolidated exporter profile helped the country to be apart such a macroeconomic catastrophe.

2.3. *Data and Methodology*

As it has been explained in the introductory section, this chapter attempts to get some stylised facts of the Argentinean economic geography after MERCOSUR formation. In doing this, it follows Brülhart and Traeger (2005) and Pons *et al.* (2002) among others; nonetheless, it is due to clarify that the accomplishment and design of the empirical exercise confronted important data limitations. Contrary to other countries such as the members of the European Union, Argentina has an enormous deficit as regards regional data. Indeed, if some official statistics can be found at the level of provinces, they are very likely discontinuous, sporadic and dispersed.

The regional data used has been taken from the annually gross geographic product 1993-2005 database provided by the Ministry of Economy of Argentina; which is, in fact, the result of estimations the Ministry conducted.[112] The available data, expressed in thousands of current pesos, was deflated and re-expressed in constant pesos of 1993 using the price index implicit in the gross domestic value added, which is also provided in the database.

[110] Before that period –between 1998 and 2000– the annual variation of GDP was -0,1 and the unemployment rate was 14. The recovery strated in 2003, when the GDP grew constantly at successive rates of 5,4, 7,7, 10,2 and 11,7.

[111] In the case of Brazil, the annual variation of GDP between 2001 and 2002 was 1,6 and the unemployment rate was 11,4 –very similar to the averages between 1998 and 2000, 1,8 and 11,6, respectively. Paraguay, on the other hand, experienced a smooth recovery during those years and a brief recession in the third quarter of 2002 and the first of 2003.

[112] This is, to my knowledge, the most updated and complete database of regional –better to say provincial– productive structure in Argentina; nonetheless, its characteristics do not allow performing accurate sectoral analyses.

2.3.a- Methodological issues

As it has been mentioned, the idea of the following section is to give some illustrative evidence on the changes in the distribution of manufacturing across Argentinean regions occurred as preferential trade liberalisation has taken place.

Before that, let clarify what MERCOSUR has meant in terms of the reduction of intra-bloc trade policy barriers.[113] As it has been mentioned, intra-bloc trade liberalisation and the implementation of the Common External tariff (CET) have progressed during the period under study. In addition, the net effect of the simultaneous, unilateral and preferential, trade reforms have implied an unrelenting increase of preferential margins among MERCOSUR member countries; *i.e.* internal trade preferences have advanced over MFN or extra-bloc tariff reductions (Estevadeordal *et al.*, 2000; MERCOSUR Secretariat, 2006).

Data on gross regional manufacturing product (GMP_r), which is available for Argentinean provinces, is considered to give a broad idea of changes in industrial location within the country. Nevertheless, it should be noted that the evolution of Argentinean gross manufacturing product may be notoriously affected by the 2001-2002 macroeconomic crisis. Therefore, section 4 additionally analyses the evolution of a normalised indicator for regional manufacture, *i.e.* the ratio between gross regional manufacturing product and an index of the non-tradable domestic product: $RGMP_r \equiv GMP_r / INTP_A$. This ratio seeks to correct GMP_r for issues that do impact on the level of national economic activity but are not directly related with the integration process.[114]

To complete the analysis, that section also presents three well-known indicators which try to summarise how concentrated are manufacturing activities within the country and how specialised are domestic regions in manufacturing. One of those indicators is the ratio between gross regional manufacturing product and gross domestic manufacturing product, $z_r^I \equiv GMP_r / GMP_A$, which measures manufacturing concentration in r. An increase of this ratio represents an improvement in the industrialisation of location r compared with the national average; on the contrary, a decline describes a worsening of r manufacturing position.

The second indicator is a specialisation index, defined as the ratio between gross regional manufacturing product and gross regional total product, $z_r^{II} \equiv GMP_r / Y_r$. This ratio aims to highlight the industrial profile of location r. Finally, the section reports an

[113] Note it was not possible to access to a complete tariff database for Agrentina and MERCOSUR.
[114] Subscript 'A' denotes it is an aggregate variable; that is, it is measured for Argentina as a whole.

index of relative specialisation, $z_r^{III} \equiv \frac{GMP_r/Y_r}{GMP_A/Y_A} = z_r^{II}/z_A^{II}$, that describes how the level of industrial development in location r has evolved *vis-à-vis* the industrial profile of the country.[115]

Apart from analysing the evolution of those indicators, section 4 studies location for two different spatial partitions of Argentina, first dividing the country into two large locations and afterwards splitting the national territory into five more homogeneous regions –as it is explained in the following sub-section.

2.3.b- The exercise proposed

As mentioned, the empirical analysis is first presented for Argentina divided into two large locations: *A1*, which comprises natural regions adjacent to other MERCOSUR countries, *i.e.* the Pampean region and the Northeast; and *A2*, a remote territory that is formed by the natural regions of Northwest, Cuyo and Patagonia.[116] This division distinguishes across domestic regions in terms of both, size asymmetries and accessibility. Location *A1* is situated next to Uruguay, Paraguay and Brazil, comprises the North-eastern and Central-eastern part of the country and, before MERCOSUR enactment, explained 82,37 percent of domestic manufacturing product and congregated near 77,35 percent of Argentinean population (INDEC, 2001).

Nevertheless, none of these two broad Argentinean regions exhibit a homogeneous interior landscape. For instance in 1990, the Pampean region alone explained over 95 percent of *A1* manufacturing activity. Inside *A2*, the most industrially developed region is Cuyo, which accounts for around 49 percent of *A2* manufacturing product and is situated in the Central-western part of the country, exactly on the opposite side to MERCOSUR. Therefore, the analysis is enhanced by studying whether spatial impacts have been asymmetrical or symmetrical inside each broad location. We study whether manufacturing disparities have grown or not across Argentinean provinces, and how important are those divergences within and between

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115 This index can alternatively be viewed as a 'normalised' version of z_r^{I}, $z_r^{III} = \frac{z_r^{I}}{Y_r/Y_A}$, which controls for those features that make each location different –such as first nature issues and other spatially reliant features.

116 *A1* includes the provinces of: Misiones, Corrientes, Entre Ríos, Chaco, Formosa (located in the Northeast), Santa Fé, Buenos Aires, Córdoba, La Pampa, the city of Buenos Aires (in the Pampean region). *A2* comprises: Salta, Jujuy, Santiago del Estero, Tucumán, La Rioja, Catamarca (in the Northwest), San Luis, Mendoza, San Juan (in Cuyo), Neuquén, Río Negro, Chubut, Santa Cruz and Tierra del Fuego (in Patagonia). See Figure 2 in Appendix C2.

A1 and *A2*. In doing this, some dispersion measures –*i.e.* the squared variation coefficient, the Gini coefficient and Theil indexes– are calculated and their evolution is analysed.

Moreover, we accomplish the decomposition of Theil indexes in order to know how much of total provincial disparity is due to each, divergences across provinces within *A1* and *A2* and provincial disparities between both locations. Finally, and as a result of this last analysis, an alternative division of provinces, different from '*A1-A2*', is proposed, which seems to be preferable since groups together less dissimilar provinces.

At this point it is worth mentioning that defining a regional system for an assessment may not be innocuous from the point of view of the statistical results one expects to get. The main challenge of this definition lies on the empirical application one has in mind, which is restricted, as it is obvious, by the nature of available data. In the case under study, the aggregation of provincial data –and even the work with provincial data– may give rise to the modifiable areal unit problem (MAUP), see Box 1.

Box 1: The Modifiable Areal Unit Problem (MAUP)… An empirical problem?

An issue especially relevant for empirical research is the definition of the regional system and, hence, the determination of the shape and number of regions to be considered.

The definition of the geographical unit of analysis is a task that should be accomplished when carrying out applied research. Nonetheless, most empirical works within economic geography disregard this issue and, as a result, the spatial scale of analysis is determined according to available data and its classification – which is generally administrative.

This way-of-doing seems to underestimate the sensitivity of statistical results to the choice of a particular regional system, commonly known as the Modifiable Areal Unit Problem (MAUP).[117] In other words, to take standardized regions as representative geographical units –thus, economically functional– could imply some misleading interpretation of the results obtained.

Notwithstanding, a recent paper by Briant *et al.* (2010) gives some appealing clues with respect to the actual magnitude of the MAUP. In the context of economic geography estimates for France, the authors find that specification issues provides

[117] This problem of varying statistical results whilst regional boundaries change –which initial study is, following Briant *et al.* (2010), due to Gehlke and Biehl (1934) and Openshaw and Taylor (1979)– has two determinants, namely: a size or scale component that involves the aggregation of smaller units into larger ones, and a shape component regarding the alternative allocation of spatial units to regions.

a clearer explanation of the variation in the estimated coefficients across specifications, in comparison with the size and shape components of the MAUP.

Therefore, though from a theoretical point of view it would be welcomed that empirical researchers take care about the MAUP, from an empirical point of view Briant *et al.* (2010, page 300) suggest that researchers must "... *pay attention to choosing the relevant specification for the question they want to tackle*", instead of worrying too much if they are left with not-so-representative spatial units. Thus, the standard way-of-doing in the literature seems hitherto supported.

Nevertheless, and following Brülhart and Traeger's (2005) argument, since the focus of this study is on changes in concentration over time, the absolute magnitude of biases due to the MAUP will not distort the findings one can get as long as they are intertemporally stable.

2.4. Spatial Effects within Argentina after MERCOSUR

The review of Chapter 1 has shown that alternative Regional NEG settings have not reached a consensus on the effects trade costs changes could foster on the internal geography of a given country. Moreover, to the extent we are aware of, there are not models and, thus, conclusions regarding regional integration particular spatial impacts.[118] Nonetheless, there are some theoretical results that could help to hypothesise how Argentinean opening up to MERCOSUR may have impacted on its economic landscape.

From the point of view of a country like Argentina, which launched a preferential trade agreement with Brazil –a fairly big country– Paraguay and Uruguay and whose regions are very heterogeneous in terms of international accessibility, MERCOSUR might have favoured the emergence of a more agglomerated national landscape –as predicted, for instance, by Andres (2004), Montfort and Nicolini (2000) and Paluzie (2001). Moreover, though trade liberalisation could have fostered spatial concentration in border regions of Argentina –namely, the Northeast and Centre-East– economic activity might have, perhaps, also tended to augment within remote regions if competitive pressure from foreign firms were relatively high or if there were sufficient concentration in those regions before liberalisation (Brülhart *et al*, 2004; Crozet and Koenig, 2004a; Granato, 2005).

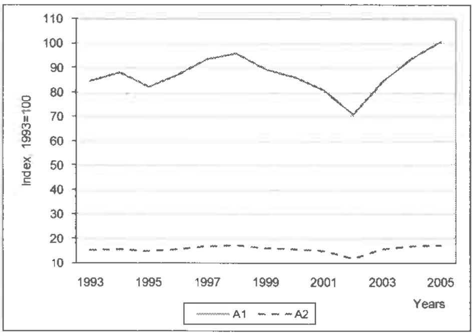
[118] Chapter 3 presents an attempt to contribute in this respect.

2.4.a- Location effects across large Argentinean regions

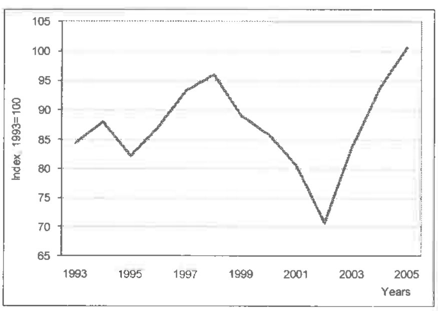
The above are the type of hypotheses one can derive from some Regional NEG models. Let now examine whether they are, to some extent, supported or not by Argentinean data. Figures 1 show the evolution GMP_{A1} and GMP_{A2} displayed, suggesting that regional disparities may have slightly increased since 1993.[119] Moving from the origin of each diagram to the right, it can be observed that some industry relocation may have happened inside both locations –though the difference in behaviour between the two territories seems to be statistically significant.[120] That positive average evolution is nevertheless slight and barely illustrative of the very fluctuating behaviour exposed by the indicator.

Figures 1: Location effects inside large Argentinean regions

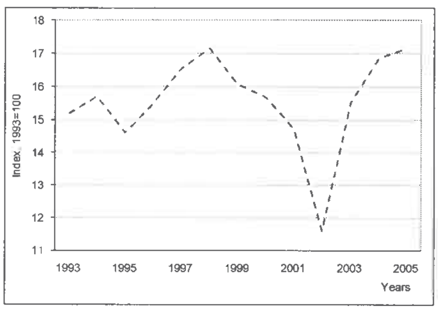
Gross manufacturing product, Index 1993=100



Gross manufacturing product, location A1



Gross manufacturing product, location A2



Source: Author's calculation based on the database of the Ministry of Economy.

[119] The 20-percent fall experienced between 1999 and 2002, and exacerbated in 2001 and 2002, is a very likely outcome of the economic crisis suffered by the country during those years.

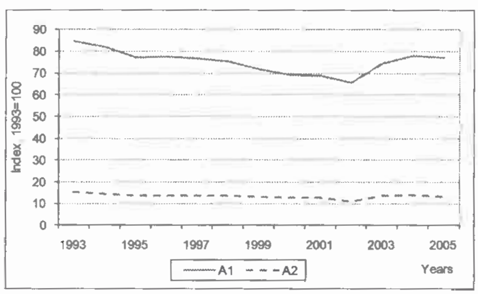
[120] Appendix C2.1 presents some descriptive and inferential statistics on these two series.

Inside *A1* and *A2*, the effect was not homogeneous; whilst the Pampean region moved together the entire *A1*, the less-developed border region (the Northeast) evolved more stably without showing such a reduction in 2002. Inside *A2*, industry seems to have expanded in Cuyo –thought facing a pronounced reduction in 2002– and to have relocated away from the Northwest and, even more, from Patagonia.[121]

Figures 2 complement the above description. While the index of the gross non-tradable product almost continuously grew between 1993 and 1998, fell subsequently reaching its lowest level in 2002, and grew again afterwards; manufacturing in every location, first grew more slowly, showed a bigger decline, and recovered more rapidly than the former. This steeper recovery shown by manufacturing *vis-à-vis* non-tradable activities could be due to the increased external competitiveness of Argentinean goods after the devaluation of the peso on January 2002. Across locations, the responses were not identical: normalised location effects were less severe in *A1* than within the remote location; the fall was smaller, as well as the rise.

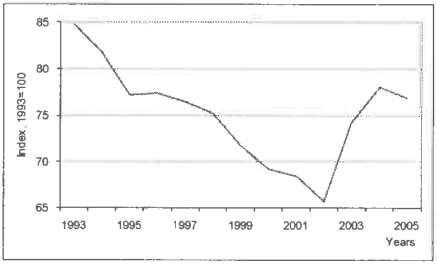
Figures 2: Normalised location effects across Argentina

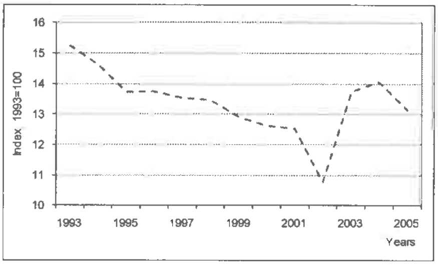
$$RGMP \equiv \frac{GMP}{INTP}, \text{ Index 1993=100}$$



$$RGMP_{A1} \equiv \frac{GMP_{A1}}{INTP}, A1 \qquad RGMP_{A2} \equiv \frac{GMP_{A2}}{INTP}, A2$$

[121] The results corresponding to the five Argentinean natural regions –*i.e.* Pampean, Northwest, Northeast, Cuyo and Patagonia– are represented in Figures 3, Appendix C2.2.



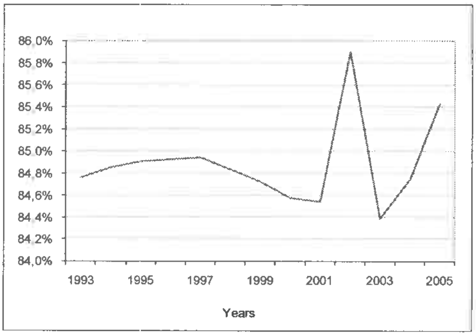


Source: Author's calculation based on the database of the Ministry of Economy.

Analysing now changes in the level of manufacturing concentration, it can be observed that manufacturing has slightly tended to agglomerate in *A1* (see Figure 3). The index of concentration, z^{I}_{A1}, has grown but only 0,78 percent between 1993 and 2005, at an average annual growth rate of 0,07 percent. Moreover, during the first eight years, the participation of location *A1* in the domestic manufacturing product had a negative tendency; only reverted in 2001-2002 and after 2003, when the border region appears to be the less damaged territory.

Figure 3: Evolution of absolute concentration

Manufacturing concentration in region A1, $z^{I}_{A1} \equiv \frac{GMP_{A1}}{GMP_{A}}$



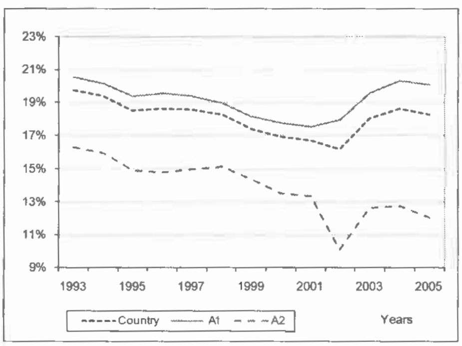
Source: Author's calculation based on the database of the Ministry of Economy.

Inside each broad region, there are important differences concerning manufacturing concentration. The most defined and less oscillating evolution of the indicator is shown by Patagonia and the Northwest; regions that have continuously lost participation in the domestic manufacturing product. A similar shape is described by z^{I} for the North-eastern region. On the opposite side, for Cuyo and the Pampean region –territories where manufacturing firms have tended to agglomerate– the evolution of the indicator has been very fluctuating.

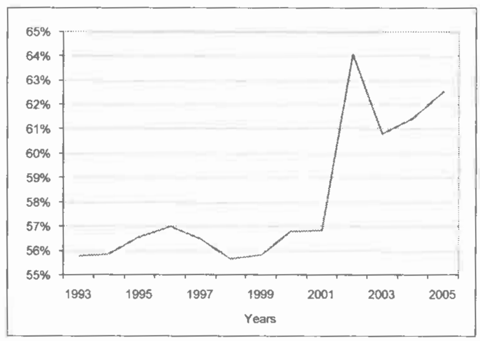
Figures 4 add other details to the analysis. First, it is clear from the graph on the left that in every location –like in the country as a whole– manufacturing has almost continuously lost importance *vis-à-vis* total production. While the decline of *A2* manufacturing specialisation seems to be permanent, the country and every region in *A1* may be recovering some of their initial industrial profile. Second, the graph on the right seems to confirm that pattern; both *A1* 'manufacturing bias' with regard to national average and *A2* 'non-manufacturing bias' have grown together with MERCOSUR.

Figures 4: Evolution of specialisation measures

Absolute specialisation in each region, $z_r^{II} \equiv GMP_r/Y$,



Relative specialisation of region A1, $z_{A1}^{III} = z_{A1}^{II}/z_A^{II}$



Source: Author's calculation based on the database of the Ministry of Economy.

Note: For the relative specialisation measure, normalised values are reported ($z_{A1}^{III} + z_{A2}^{III} = 100$).

Inside *A1*, the Northeast and the Pampean region show very similar behaviours; relative industry specialisation grows, though softly. Thus, it can be inferred that relative industry inequalities may have not increased inside the border region. In *A2*, on the contrary, disparities might have risen; the Northwest seems to be the less damaged sub-region, whilst Cuyo and, even more, Patagonia seem to have notably suffered industrial de-specialisation.

Hence, what can be concluded from such a collection of results, tendencies, paths and shapes? Trying to synthesise the main findings connected with the MERCOSUR initiative, it can be stated that:

- Both Argentinean regions experienced industrial growth, though likely affected by macroeconomic instability.[122]
- Industry appears to be less concentrated in 2000 *vis-à-vis* 1993; nonetheless, its spatial agglomeration may have increased during and after the crisis, favouring region *A1*.
- Industrial specialisation declined in both regions between 1993 and 2002, and strengthened after 2002.
- Region *A1* has relatively specialised in manufacturing over the period. Its industrial specialisation first decreased the less, growing the most afterwards. Thus, the border region seems to have recovered its pre-integration industrial profile.

To conclude, there are some indications of the unbalanced spatial impacts within the country during MERCOSUR days. Though *A1* and *A2* attracted firms, industrial concentration and relative industrial specialisation tended to favour the border region. Thus, whilst the less developed and remote region is relatively damaged, *A1* is benefited in terms of industry relocation.

2.4.b- Provincial disparities during MERCOSUR days

As it has been mentioned, spatial impacts inside the two broad regions were not neutral. Neither *A1* nor *A2* exhibits a uniform territory, and these heterogeneities may be introducing important biases to the previous analysis. Therefore, in this sub-section the investigation is complemented by studying manufacturing disparities inside each region.

To begin with, let examine various dispersion measures calculated for provincial gross manufacturing product, namely: the squared variation coefficient, the Gini coefficient, and *T(0)* and *T(1)* Theil indexes.[123] Figures 5 resume the evolution of these indicators. As it can be observed, manufacturing disparities across provinces increased. Though every dispersion measure was noticeably affected by the 2001-2002 crisis, its evolution is clearly ascendant between 1993 and 2001, and also after 2003.

Additionally, the decomposition of Theil indexes for the two broad regions, presented in Table 2, shows that internal disparity is constantly greater than external one.[124] More than 60 percent of total disparity across provinces is explained by

[122] Nevertheless, it is worth to remember that this is not evidence of industry de-location inside other MERCOSUR member countries or in the Rest of the World.

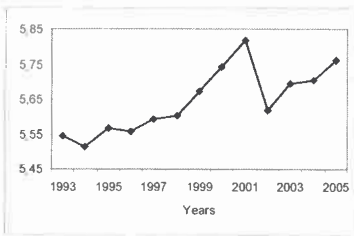
[123] For details on the definitions and values of these measures, see Appendix C2.3.

[124] The complete decomposition is presented in Table 4, Appendix C2.4.

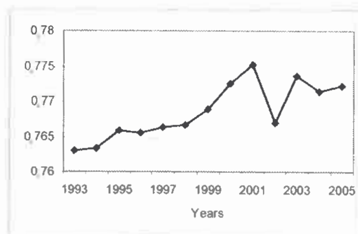
divergences inside the two broad regions instead of disparities across provinces pertaining to different regions. This can be interpreted as a shortcoming of the partition '*A1-A2*', since it appears gathering very dissimilar territories or, at least, spaces with uneven industrial performance.

Figures 5: Dispersion of Provincial Gross Manufacturing Product

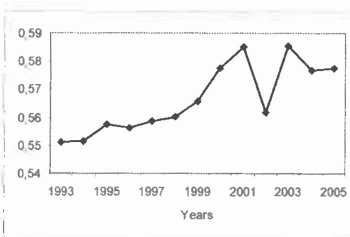
Squared variation coefficient



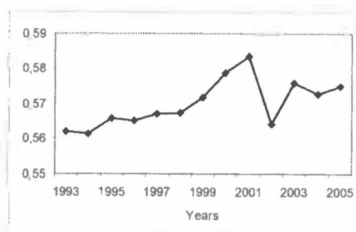
Gini coefficient



Theil(0) index



Theil(1) index



Source: Author's calculation based on the database of the Ministry of Economy.

Table 2: Spatial Decomposition of Theil Indexes - Partition 'A1-A2'

Components	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Theil(0)	0,551	0,552	0,558	0,556	0,559	0,560	0,566	0,578	0,585	0,562	0,586	0,577	0,578
Intra-groups	61,6%	61,4%	61,7%	61,5%	61,6%	62,0%	62,7%	63,8%	64,4%	59,3%	64,8%	63,4%	61,7%
Inter-groups	38,4%	38,6%	38,3%	38,4%	38,4%	37,9%	37,3%	36,2%	35,6%	40,7%	35,2%	36,6%	38,3%
Theil(1)	0,562	0,561	0,566	0,565	0,567	0,568	0,572	0,579	0,584	0,564	0,576	0,573	0,575
Intra-groups	69,3%	69,1%	69,3%	69,2%	69,3%	69,5%	69,9%	70,5%	70,8%	67,6%	70,6%	69,9%	68,9%
Inter-groups	30,7%	30,9%	30,7%	30,8%	30,7%	30,5%	30,1%	29,5%	29,2%	32,4%	29,4%	30,1%	31,0%

Source: Author's calculation based on the database of the Ministry of Economy.

Taking advantage of that difficulty, let intend to search for another partition that allows to more accurately studying the Argentinean spatial reality. Thus, trying to improve the analysis, let look for an alternative partition of Argentina that acknowledges for the prevalence of market-access and market-crowding effects in the location process. In other words, we search for a spatial division that, acknowledging for trade costs, geographical distance and size matters, puts together more homogeneous territories.[125] From that scrutiny, an alternative division of provinces is uncovered, which is called '5-Group' and comprises:

- 'G1': Misiones, Corrientes, Chaco and Formosa.
- 'G2', formed by: 'G2a': Santa Fe, city of Buenos Aires, Buenos Aires and Córdoba.
  'G2b': Entre Ríos, Tucumán, Santiago del Estero, Catamarca, Salta and Jujuy.
- 'G3': La Pampa, San Luis, Mendoza, San Juan and La Rioja.
- 'G4': Neuquén, Río Negro, Chubut, Santa Cruz and Tierra del Fuego.

From the top to the bottom, these groups are ordered in terms of the distance between them and MERCOSUR largest member country, Brazil.[126] Namely, while 'G1' gathers provinces located at the frontier with Brazil or Paraguay, 'G4' ends up congregating the most remote and Southern Argentinean territories. With respect to 'G2', its sub-division separates the more industrialised provinces from less industrialised ones –gathering them into 'G2a' and 'G2b', respectively.

[125] Thus, a partition that has a very robust response to the Theil decomposition, with a sufficiently low internal divergence, is looked for. Appendix C2.4 presents the details on how this task was accomplished and the results we get.
[126] For a complete description on how these groups were formed see Appendix C2.4.

Table 3 presents the results of the Theil decomposition for this novel spatial partition. External or inter-group divergence explains more than 75 percent of total manufacturing disparity across provinces in all the period. In other words, this partition of Argentina seems to congregate more similar manufacturing structures. Among the five regions, 'G3' followed by 'G2a' are the most internally dissimilar territories. The explanation for this is that these regions include both, highly developed industrial provinces –Mendoza in 'G3' and Buenos Aires in 'G2a'– together with other less industrialised.[127]

Table 3: Alternative Spatial Decomposition - '5-Group'

Components	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Theil(0)	0,551	0,552	0,558	0,556	0,559	0,560	0,566	0,578	0,585	0,562	0,586	0,577	0,578
Intra-group	20,4%	19,7%	19,6%	19,6%	19,6%	20,0%	20,6%	20,9%	21,7%	20,9%	22,0%	21,8%	21,4%
Inter-group	79,6%	80,3%	80,4%	80,4%	80,4%	80,0%	79,4%	79,1%	78,3%	79,1%	78,0%	78,2%	78,6%
Theil(1)	0,562	0,561	0,566	0,565	0,567	0,568	0,572	0,579	0,584	0,564	0,576	0,573	0,575
Intra-group	23,2%	22,8%	23,0%	22,9%	23,0%	23,3%	24,1%	24,6%	25,3%	22,7%	24,5%	24,0%	23,3%
Inter-group	76,8%	77,2%	77,0%	77,1%	77,0%	76,7%	75,9%	75,4%	74,7%	77,3%	75,5%	76,0%	76,7%

Source: Author's calculation based on the database of the Ministry of Economy.

2.4.c- Location effects across large Argentinean regions, reconsidered

Applying to this new partition the initial empirical approach, and regarding the evolution of gross manufacturing product in each group g, GMP_g, during MERCOSUR days (see Figures 6) one finds that:

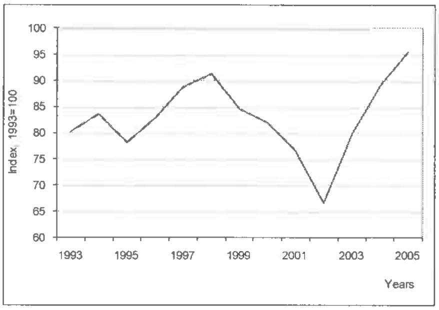
- 'G2a', the industrialised big border location resembles *A1*; some firms may have been attracted towards its territory;
- in 'G1', 'G2b' and 'G3', manufacturing product also increased, with the North-western provinces displaying the less fluctuating behaviour;[128] and
- in the remotest territory ('G4' or Patagonia) de-industrialisation seems to be the definite tendency.

[127] See Table 7 in Appendix C2.4.

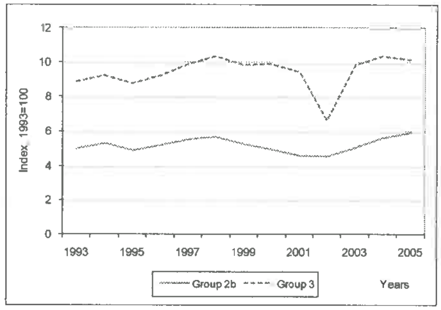
[128] Note that 'G2b' is composed by four North-western provinces together with Entre Ríos.

Figures 6 Location effects within '5-Group'

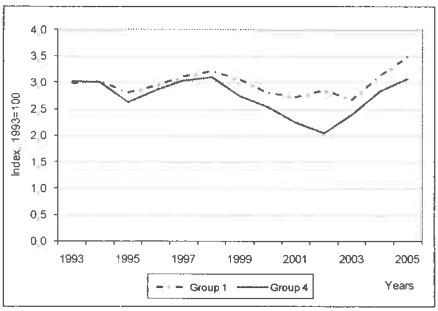
Gross manufacturing product of 'G2a', Index 1993=100



Gross manufacturing product of 'G2b' and 'G3', Index 1993=100



Gross manufacturing product of 'G1' and 'G4', Index 1993=100

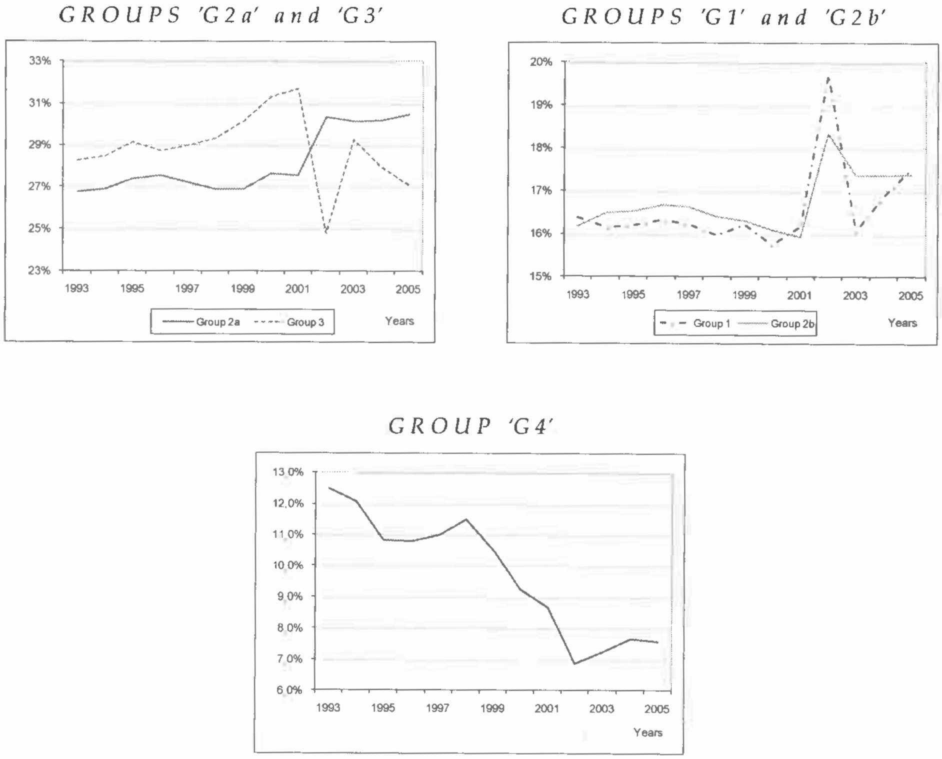


Source: Author's calculation based on the database of the Ministry of Economy.

Between 1993 and 1999, most of these territories experienced a positive industrial performance; being the exception the provinces located in the South of the country. After that, the crisis seems to hit the country causing important losses in both, the remotest territories and those specialised in manufacturing –*i.e.* 'G2a' and 'G3', look at Figure 5 in Appendix C2.5– which, even so, recovered later on.

Figures 7 complete the picture showing some interesting facts. With MERCOSUR, 'G2a' increased its manufacturing bias as regards national average; while 'G4' definitely strengthened its non-manufacturing bias. In a different fashion, the small border region, 'G1', and 'G2b' seem to have relatively specialised in manufacturing, though suffering a notorious instability. Finally, the territory situated in the Central-western part of the country, exactly on the opposite side to MERCOSUR, first increased its manufacturing bias to afterwards fairly loosing it.

Figures 7: Relative specialisation in '5-Group'



Source: Author's calculation based on the database of the Ministry of Economy.

Note: Normalised values are reported ($z^{III}_{G1}+z^{III}_{G2a}+z^{III}_{G2b}+z^{III}_{G3}+z^{III}_{G4}=100$).

Returning to the findings derived from the analysis of locations *A1* and *A2*, they can be re-formulated as follows:

- Though some industry attraction towards Argentinean territories occurred, Patagonia was definitely not the benefited region.
- Spatial agglomeration seems to have favoured 'G2a' and 'G3', manly during and after the crisis. On the contrary, absolute manufacturing de-concentration occurred in the remote 'G4' –see Figures 4 in Appendix C2.5.
- Industrial specialisation declined in every territory; showing after 2002 some recovery for groups located near MERCOSUR partners –namely 'G2a', 'G1' and 'G2b' (see Figure 5 in Appendix C2.5).

- These border groups also tended to relatively specialise in manufacturing; while the remote ones markedly lost their industrial profile.

Summing up, relative manufacturing specialisation together with absolute specialisation and some industrial concentration seem to have favoured provinces located near MERCOSUR members, in the Northeast and Centre-East of Argentina; while the unambiguously damaged territories have been those at the very South, very far from the rest of the bloc.

Thus, one might infer that the formation of MERCOSUR could have provoked uneven spatial effects within the domestic economic landscape. These unbalanced spatial impacts could be explained by both, regional differences in terms of accessibility to the bloc and relative market-size, namely pre-integration level of industrial development. Hence, regional integration might have fostered spatial concentration, deepening pre-existent regional imbalances and even creating new ones.

Related with this result, Hernández (2000) –who undertakes a historical analysis from the first decade of the XX century to 1994– finds that between 1985 and 1994, a period of slightly external liberalisation, there is evidence of concentration of production and employment within large regions in Argentina. Quite at odds, Sanguinetti and Volpe Martincus (2009) find that, for the same period, trade policy does seem to matter for the geography of the Argentinean industries; but in the opposite direction. Indeed, they conclude "*everything else equal, sectors facing less protection tend to be located at a larger distance from the main domestic market, i.e. Buenos Aires*" (page 165).

2.5. Concluding Remarks

The empirical assessment carried out, which should be taken as an attempt to analyse Argentinean regional data during a period of regional integration, gives some rough but illustrative evidence. Indeed, the location effects that seem to have taken place in the manufacturing sector during MERCOSUR days appear to consolidate the spatial concentration of manufacturing activities within border and initially more industrialised territories and to spoil remotest provinces of Patagonia. In other words, market-access and market-crowding effects, directly affected by trade costs, could have played a role shaping the Argentinean industrial landscape during those years.

The methodology applied and, in particular, the analysis relying on spatial decomposition measures shows as a useful method for describing location when the availability of spatially disaggregated data is not so good. Indeed, it seems as a proper tool to find out stylised facts describing the evolution of location within a heterogeneous and vast territory as Argentina. Nonetheless, it is not a tool to derive neither correlations between variables nor, even less, causality relationships. Therefore, the findings, which should be taken as suggestions at best, are an incentive for further research.

In the following chapters, the aim is to asses how increased economic integration could define opportunities and constraints for different Argentinean and MERCOSUR regions in terms of location and trade. Specifically, Chapters 3 and 4 propose interesting extensions of well-known NEG models to deal with intra-country issues, in particular addressing the Argentinean and MERCOSUR realities. Chapters 5 and 6, in due course, make empirical contributions concerning regional disparities within Argentina and other MERCOSUR member countries drawing on the theoretical work of Chapter 4.

Chapter 3:

SPATIAL EFFECTS OF REGIONAL INTEGRATION. WHAT HAPPENS TO NATIONAL LANDSCAPES?[129]

3.1. Introduction

As Chapter 2 has helped to figure out, after MERCOSUR enactment some industry relocation seems to have taken place within Argentina, spawning unequal effects across Argentinean regions. Relative manufacturing specialisation, absolute specialisation and some industrial concentration seem to have favoured provinces located near MERCOSUR members –*i.e.* in the Northeast and Centre-East of the country– while those located at the very South, very far from the rest of the bloc, appear to have been unambiguously damaged.

One can hypothesize that the formation of MERCOSUR might have act as a force inducing those uneven spatial effects. Regional integration could have fostered spatial concentration of manufacturing activities within border and initially more industrialised territories, spoiling the remotest provinces of Patagonia. In other words, regional asymmetries in terms of both accessibility to the bloc and relative market-size may have shaped the Argentinean industrial landscape. Hence, one can conjecture that the geographical position of different sub-national territories, together with their pre-integration industrial profile may play a role in determining the luck of each region during regional integration processes.

Regional integration (henceforth, RI), as it is well-known, tend to affect location of economic activities and the spatial distribution of factors of production, demand, and thus the level of welfare both within and outside the integrated bloc. Understanding how economic activities can potentially relocate within the bloc; whether some more (less) developed regions or border (remote) zones may attract (deter) capital inflows and labour migration; and, consequently, how their well-being could be modified are issues of much concern for policy-makers and interested agents.

[129] This chapter is a revised version of a paper presented under different versions in various Conferences and Worshops, which were organised, respectively, by the Euro-Latin Study Network on Integration and Trade (ELSNIT, 2006), the VI Arnoldshian Seminar (2005), the Economic Council of Sweden and the Swedish Institute for European Policy Studies (2004), the Argentine Association of Political Economy (2004) and the University of Antwerp (2004). We would like to thank Nora Balzarotti, Matthieu Crozet, Alberto Díaz Cafferata, Frédéric Robert-Nicoud, Gianmarco Ottaviano and Christian Volpe Martincus for their very valuable comments and suggestions.

However, to uncover how those impacts may occur seems to be quite a puzzling task, since there are not unanimous or general answers, neither from theory nor from the empirical arena –as it has been reviewed in Chapter 1. Although spatial economics has received renewed attention during the last fifteen years –and within it, NEG models have boomed– no comprehensive framework can give yet a complete explanation for those RI spatial effects. On the other hand, applied work has not been conclusive in finding definite evidence in that respect –mainly due to methodological difficulties– thus slowing down empirics-to-theory feedback.

In spite of that, empirical papers aiming to address the relevance of trade-induced agglomeration –*i.e.*, one of NEG's most renowned predictions– show that RI may deepen initial production and income imbalances across territories, and that the precise dimension and direction of those spatial effects seem to rely on each region's relative geographic position inside the bloc (Brakman *et al.*, 2006; Brülhart *et al.*, 2004; Niebuhr, 2006; and Traistaru *et al.*, 2002). So, even there is not an agreed test for RI spatial effects, several authors have found persuasive evidence of their significance and have revealed some of their main characteristics.

This chapter proposes a theoretical discussion about RI impacts on industrial location, both within the bloc and particularly inside a member country from the perspective of NEG. The objective of this first theoretical chapter is to present an illustrative framework that can deal with different 'pre-integration' scenarios, thus allowing getting a broad picture of the spatial effects that RI can originate in terms of both location and welfare.

Within the theoretical literature, different authors have already studied the link between trade liberalisation and industrial location inside countries within the NEG paradigm. Some of them find international trade liberalisation tends to increase dispersion within countries (Alonso Villar, 1999, 2001; Fujita *et al.*, 1999; Krugman, 1996; Krugman and Livas Elizondo, 1996; Moncarz and Bleaney, 2007) while others conclude trade liberalisation favours the emergence of agglomerated national landscapes (Andres, 2004; Brülhart *et al.*, 2004; Crozet and Koenig, 2004a; Montfort and Nicolini, 2000; Paluzie, 2001).[130] All these papers analyse within a particular geographical scenario, how industrial location across two domestic regions may be modified when a country unilaterally opens to trade.

The challenge of this chapter is, then, to introduce some appealing extensions to a NEG model that both take account of different geographical scenarios and address the distinctive effects of preferential or discriminatory trade liberalisation. Following Henderson's (1996, page 33) suggestion, who points out that the final spatial outcome

[130] Contributions already reviewed in Chapter 1.

of any policy is 'situation-specific' –or, in other words, it may crucially depend on the pre-integration distribution of agents and factors– this chapter departs from previous studies that deal with a more restricting landscape. In particular, it builds a model where different pre-integration geographical scenarios are allowed, feature that makes the model more suitable for studying different cases that could come out.

On the other hand, it also departs from previous works since extends the number of regions and redesign the manner in which they are interconnected through trade. Specifically, the chapter models a world economy with three countries or larger territories: two preferential partners that may differ in terms of size and the Rest of the World (RoW).[131] In addition, one member country is assumed to comprise two domestic regions that can differ in terms of both market size and access to the preferential partner. With respect to the latter, this chapter concentrates in analysing two particular scenarios, namely: the 'Gateless' setting, where all domestic firms regardless of their location have equal access to the preferential partner; and the 'Gated' scenario, where instead one domestic region has better access to the partner's market. Hence, with this extension the aim is to contribute to the study of integration effects in border regions.[132]

Those two main departures from previous models are, nonetheless, not costless. The chapter adopts an extended version of a very tractable NEG model due to Martin and Rogers (1995), which due to its simplicity permits to more easily handle the particular issues we aim to address.[133] However, this particular framework –*i.e.*, a 4x2x2 Footloose Capital (FC) setting– leaves us with a world where demand and thus income spatial distribution remains unaltered, even though firms do change location endogenously.[134] So, the model loses one of NEG key mechanisms, *i.e.* circular causality, that is at the heart of the catastrophic-agglomeration phenomena.

The remainder of the chapter is organised as follows. Next section sets up the formal model and section 3 characterises the spatial equilibrium and illustrates how dispersion and agglomeration forces can support a long-run location pattern. Section 4 shows, through numerical simulations, how regional integration may modify the geographical landscape of a member country. More specifically, this section provides a set of examples for specific asymmetries among regions, which are therefore indicative

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131 The incorporation of a third country for studying preferential trade liberalisation is the approach introduced by Puga and Venables (1997) and followed by Baldwin *et al.* (2003, ch.14) and Melitz and Ottaviano (2008), among others.

132 Note, 'border' and 'gate' are used interchangeably.

133 More precisely, our framework is based on posterior versions of Martin and Rogers' model, which were put forth by Baldwin *et al.* (2003, chs.3 and 14) and Ottaviano and Thisse (2004).

134 'Footloose Capital' is the name given by Baldwin *et al.* (2003, ch.3) to their 2x2x2 version of Martin and Rogers' (1995) model.

of general conclusions about the relocation process provoked by regional integration. In addition, some main welfare implications of regional integration are analysed. Finally, section 5 presents some concluding remarks and draws some lines of research that are addressed in Chapter 4.

3.2. *The Model*

3.2.a- *Assumptions*

- Four regions *r,s*={*A1,A2,B,C*}. More specifically, there are three countries: a country, let say *A*, divided in two domestic locations (*A1* and *A2*), and two foreign countries *B* and *C* –the prospective preferential partner and the RoW, respectively. Let call *O*={*B,C*} the set of Oustide or foreign countries.
- Two productive sectors: the traditional sector *Z* and the modern sector *Q*.
- Two production factors: physical capital *H* and labour *L*.

Regions

- Regions (*i.e. r* and *s*) are distinguished from each other in terms of trade costs, t_{rs}.[135]

While every exchange of goods across any two regions –countries or domestic locations– has a cost related with transport infrastructure, distance and communication (or transport costs), d_{rs}; the exchange across countries is also costly due to tariff and non-tariff barriers to trade, τ_{rs}.

In other words, trade costs are: $t_{rs} = 1 + d_{rs} + \tau_{rs} \quad \forall r \neq s$ between countries

$t_{rs} = 1 + d_{rs} \quad \forall r \neq s$ connecting domestic locations,

where $d_{rs} \in [\varepsilon, \infty[\; \forall r \neq s, \varepsilon > 0$ and $\tau_{rs} \in [0, \infty[\; \forall r \neq s$.[136,137]

In addition, the following simplifying assumption is taken to hold: $t_{rs} = t_{sr} \; \forall s \neq r$, which means trade costs are symmetric.

- Regions are assumed to be either: equidistant among them or *partially* heterogeneous.

In the first case or 'Gateless' scenario, transport costs are assumed to be the same between any two regions, *i.e.*:

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[135] So, as it has been mentioned in Chapter 1, this model distinguishes between domestic locations and countries only by assuming different trade costs –other papers, instead, make an additional distinction in terms of factor mobility.

[136] A linear specification like this –similar to related studies– implies that changes in both transport costs and tariff/non-tariff barriers have the same impact on both trade costs and destination prices and, in addition, that there is not cross-effect among different trade-costs components.

[137] Assuming $d_{rs} > 0 \, \forall r \neq s$ implies that some distance and 'natural' barriers exist between any two regions and, hence, some transport costs –or 'natural transportation costs', as Krugman and Livas (1996) called them– must be paid to exchange goods. Finally, the simplifying assumption $\tau_{rs} \geq 0 \, \forall r \neq s$ means that negative trade protection is disregarded in the following analysis.

$$d_{rs} = d \qquad \forall r \neq s$$

The other scenario (called 'Gated') supposes, instead, that one domestic location, let assume *A1*, has better access to country *B* than the other region, *A2*:

$$d_{A2B} = d_{A2A1} + d_{A1B} = 2d$$

Thus, shipments from *A2* arrive in *B* after passing through region *A1*, while country *C* remains equidistant from every region.[138]

Figures 1, in Appendix C3, show a schematic representation of each of these scenarios.

- Regions are symmetric in terms of tastes and technology.[139] With respect to regional endowments, the model allows to analyse different cases as it is explained later on.

To sum up, we define various trade costs asymmetries in order to give rise to three spatial distinctions, namely: among countries and domestic locations, across preferential and non-preferential trade partners and, finally, between gate (or border) regions and remote ones.

<u>Sectors</u>

- The traditional sector is kept as simple as possible. It is assumed that: it produces a homogeneous good under CRS and perfect competition, uses one unit of *L* per unit of output and its output is exchanged across regions without cost.

- The modern sector produces a continuous of horizontally differentiated varieties under IRS and monopolistic competition with free entry –the number (mass) of varieties is *N*, being n_r the sub-set produced in region *r*. Exchange of its output across regions is costly, as it has been explained; and regional markets are segmented.

- Production of $x(i)$ units of variety *i* requires a fixed amount *F* of physical capital and a variable amount $\beta x(i)$ of labour. Then, the total cost of firm producing variety *i* in region *r* is given by:

$$TC_r(i) = \pi_r F + w_r \beta x_r(i) \quad \forall r$$

where w_r is nominal wage and π_r is both rental rate of capital in region *r* and firm's operating profit under free entry. For simplicity, it is assumed each firm requires one

[138] Since parameter *d* may be viewed as a policy instrument, the model could be extended to allow for a richer analysis. For instance, different transport costs (*d* and d^*) might be introduced for shipments inside the domestic country and those across countries, intending to distinguish between national and international transport infrastructure and technology. Indeed, this distinction is introduced in Chapert 5.

[139] Namely, all individuals have the same utility function and technology is identical for every variety and in every location.

unit of capital ($F = 1$); thus the fixed cost equals the equilibrium rental rate. Hence, total cost is:

$$TC_r(i) = \pi_r + w_r \beta x_r(i) \quad \forall r$$

<u>Market structure in the modern sector</u>

• Monopolistic competition takes Dixit-Stiglitz (DS) form. The representative consumer in each region has preferences given by a two-tier utility function: the upper tier determines consumer's division of expenditure between the homogeneous good and all differentiated industrial varieties, and the lower tier dictates his/her preferences over those varieties.

More specifically, the utility function of a representative consumer living in region r is given by:[140]

$$U_r = Q_r^{\mu} Z_r^{1-\mu} \quad \forall r \qquad (1)$$

where $Q_r = \left[\int_0^N q_r(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}$ is consumption of modern good, $q_r(i)$ is consumption of variety $i \in [0,\mathrm{N}]$ and Z_r is consumption of traditional good.[141] With respect to parameters, $\mu \in]0,1]$ is the weight of good Q in utility, and $\sigma \in]1,\infty]$ is the elasticity of substitution between any two industrial varieties.

• Trade costs are modelled as iceberg costs *à la* Samuelson. That is, for one unit of the modern good produced in region r to reach region s, $t_{rs} \in [1+\varepsilon, \infty[\; \forall r \neq s$ units must be shipped. As it has been stated: $t_{rs} = 1 + d_{rs} + \tau_{rs} \; \forall r \neq s$; thus, $t_{rs} - 1$ units of the good 'melt' in transit.

<u>Production factors</u>

• The world economy is endowed with H units of capital and L units of labour, which are distributed across regions as follows:

$$H_{r \in O} = \theta H \quad , \quad H_{A1} = \rho(1-2\theta)H \quad \text{and} \quad H_{A2} = (1-\rho)(1-2\theta)H$$
$$L_{r \in O} = \theta L \quad , \quad L_{A1} = \rho(1-2\theta)L \quad \text{and} \quad L_{A2} = (1-\rho)(1-2\theta)L$$

where $\theta \in]0,1/2[$ is the share of world capital (labour) that resides in each foreign country, and $\rho \in]0,1[$ is the share of domestic capitalists (workers) who live in *A1*. Therefore, Oustide or foreign countries are assumed to be equally endowed and

[140] Since preferences are identical for all individuals in the world economy, the subscript r could be readily omitted; nonetheless, it is maintained for the sake of illustration.

[141] Formally, we should also include the constant $\mu^{\mu}(1-\mu)^{(1-\mu)}$ in the utility function, but this plays no role in the analysis.

relative endowments are the same across regions –there is no place for comparative advantage à la Heckscher-Ohlin.[142]

• Endowments are uniformly owned and inelastically supplied by the population. That is, every individual is assumed to supply one unit of labour and a fixed amount of capital regardless of the payment he/she receives.[143]

• Labour is immobile across regions and capital is perfectly mobile, though capital owners stay put. In other words, they reside and expend money in their region of origin but their capital can be hired in any region.

• Distribution of capital across regions is endogenously determined; physical capital moves in search of the highest nominal reward. Let define λ_r as the share of firms located in region r or, what is the same since F = 1, the share of world capital H employed in region r.[144] Since $\pi_r(\Gamma)$ is the rental rate in region r when capital's spatial distribution is $\Gamma=\{\lambda_{A1},\lambda_{A2},\lambda_B,\lambda_C\}$, a spatial equilibrium arises at $\lambda_r^\circ \in]0,1[\ \forall r$ (*i.e.* is interior) when:

$$\Delta\pi(\Gamma)\equiv\pi_r(\Gamma)-\pi_s(\Gamma)=0 \quad \forall r\neq s$$

because perfect capital mobility equalises equilibrium rewards to capitalists. A long-run spatial equilibrium could also arise at $\lambda_r=0$ for some r when $\Delta\pi(\Gamma)\leq 0$.[145] However, from now on it is assumed that parameters allow for $\lambda_{r\in O}>0$ and $\min\{\lambda_{A1},\lambda_{A2}\}>0$. Thus, their values ensure some firms are in fact operating in every region.

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[142] A more general framework, which allows for asymmetric-sized foreign countries, international and intra-national H-O comparative advantage, etc. may assume: 1) $H^W=H^*+H$ and $L^W=L^*+L$, where superscript W denotes world endowments, * represents foreign ones and none subscript denotes domestic endowments; 2) $\theta_{II}H^*$ and $\theta_I L^*$ for B's endowments and $(1-\theta_{II})H^*$ and $(1-\theta_I)L^*$ for C's resources; 3) for domestic regions: $\rho_{II}H$ and $\rho_I L$ representing $A1$'s endowments and $(1-\rho_{II})H$ and $(1-\rho_I)L$ $A2$'s endowments.

[143] Assuming endowments are 'uniformly owned' means that this interpretation of the model does not permit studying income differences across individuals –hence, poverty or income distribution. Nonetheless, for instance, Robert-Nicoud (2002, ch.1) takes a different interpretation –namely, assuming each individual owes either one unit of labor or one of capital– that gives rise to 'class conflicts' into FC and 'Footloose Capital and Vertical Linkages' (FCVL) models.

[144] If N represents the number of firms in the world economy and n_r is the number located in region r, hence $\lambda_r\equiv {n_r}/{N}={n_r}/{H}$ and $\sum_r\lambda_r=1$.

[145] For values of t_{rs} or Γ that would imply a share λ_r for some r either below zero or above unity, it is assumed that either all industry is clustered in the remaining regions or, conversely, it is agglomerated inside those r regions.

- Both labour and capital are fully employed:

$$L_r = \int_{i\in n_r} \beta x_r(i)di + L_r^Z \quad \forall r \quad (\textit{local} \text{ full employment of labour})$$

$$H = N \quad (\textit{global} \text{ full usage of physical capital})$$

where L_r^Z is the number of workers in r employed in the traditional sector.

3.2.b- Short-run equilibrium

Traditional sector

In each region, the traditional sector maximises its profits:

$$Max_{Z_r \geq 0} Z_r p_r^Z - Z_r w_r$$

The homogeneous good, which price is the same everywhere due to its zero trade costs, is chosen as numeraire. Therefore, under CRS and perfect competition, the first order conditions imply $p_r^{Z*} = 1 = w_r$. Furthermore, as long as some homogeneous good is produced in every region, wages equalise across them:[146]

$$w_r = w_s = 1 \quad \forall r,s$$

Consumers

The representative consumer in each region maximises his/her two-tier utility function. First, she/he decides the amounts of both homogeneous and differentiated goods that he/she will optimally consume.

$$Max_{Q_r, Z_r \geq 0} U_r = Q_r^{\mu} Z_r^{1-\mu}$$
$$s.t. \quad Y_r = Z_r + P_r Q_r$$

Where Y_r is income (expenditure) in region r.[147]

Optimal quantities are: $Z_r^* = (1-\mu)Y_r$ and $P_r Q_r^* = \mu Y_r$, where P_r is the CES price index in region r. Explicitly:

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146 The traditional good is produced in every region when any three regions (or less) together have not enough labour to satisfy world demand for this good. The exact condition is that total world spending on Z, (1-μ)Y, is greater than the maximum value of Z's production attainable by any three regions together. After operating, the condition can be written as: $\mu < 1 + \left(\frac{\mu}{\sigma} - 1\right)(\max\{[2\theta + \rho(1-2\theta)],[2\theta + (1-\rho)(1-2\theta)],(1-\theta)\}L)$. This condition, which is assumed to hold from now on, applies when the modern good has a small weight in utility and product variety is so highly valued by consumers –*i.e.* σ is small– that a large amount of labour is employed in the modern sector.

147 By assuming the equivalence between income and expenditure the model rules out investment and, in turn, growth. Thus, it precludes 'real' dynamics.

$$P_r = \left[\int_{i \in n_r} p_{rr}(i)^{1-\sigma} di + \sum_{s \neq r} \int_{i \in n_s} p_{sr}(i)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} \qquad (2)$$

being $p_{sr}(i)$ the price of variety *i* produced in region *s* and consumed in region *r*.

After that, the representative consumer determines her/his demands for each variety of the industrial good by solving the following problem:

$$Max_{q_{sr}(i), q_{rr}(i) \geq 0} Q_r = \left[\int_{i \in n_r} q_{rr}(i)^{\frac{\sigma-1}{\sigma}} di + \sum_{s \neq r} \int_{i \in n_s} q_{sr}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}$$

$$s.t. \quad \int_{i \in n_r} p_{rr}(i) q_{rr}(i) di + \sum_{s \neq r} \int_{i \in n_s} p_{sr}(i) q_{sr}(i) di = \mu Y_r$$

where $q_{sr}(i)$ is consumption of variety *i*, produced in region *s*, by a consumer who resides in region *r*.

The optimal direct demands are:

$$q^*_{sr}(i) = \frac{p_{sr}(i)^{-\sigma}}{P_r^{1-\sigma}} \mu Y_r \qquad (3)$$

Finally, the indirect utility function in region *r* can be written as:[148]

$$V_r = \frac{Y_r}{P_r^{\mu}} \qquad (4)$$

Modern sector

A typical firm located in region *r* and producing variety *i* maximises its profits, which are given by:

$$\Pi_r(i) = p_{rr}(i) q_{rr}(i) + \sum_{s \neq r} p_{rs}(i) q_{rs}(i) - \beta \left[q_{rr}(i) + \sum_{s \neq r} t_{rs} q_{rs}(i) \right] - \pi_r$$

The resulting optimal prices for that firm are:

$$p^*_{rr}(i) = \beta \frac{\sigma}{\sigma - 1} \quad \text{for sales in region } r \text{, and}$$

$$p^*_{rs}(i) = \beta t_{rs} \frac{\sigma}{\sigma - 1} \quad \text{for sales in region } s. \qquad (5)$$

Introducing these prices into the CES price index (2), one gets:

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[148] To find this short expression, we first plug the optimal direct demands for homogeneous and modern goods (3) into utility function (1), getting:

$$V_r = \left\{ \int_{i \in n_r} \left[\frac{p_{rr}(i)^{-\sigma}}{P_r^{1-\sigma}} \mu Y_r \right]^{\frac{\sigma-1}{\sigma}} di + \sum_{s \neq r} \int_{i \in n_s} \left[\frac{p_{sr}(i)^{-\sigma}}{P_r^{1-\sigma}} \mu Y_r \right]^{\frac{\sigma-1}{\sigma}} di \right\}^{\mu\left(\frac{\sigma}{\sigma-1}\right)} \left[(1-\mu) Y_r \right]^{1-\mu}$$

$$P_r = \frac{\beta\sigma}{\sigma - 1}\left(n_r + \sum_{s \neq r} t_{sr}{}^{1-\sigma} n_s\right)^{\frac{1}{1-\sigma}} \qquad (6)$$

Market clearing in the modern sector

Market clearing conditions say that total production by a typical firm in region r must equal, in equilibrium, world consumption of the variety produced by that firm, plus real trade costs paid to ship goods from r to other regions:

$$x_r(i) = q_{rr}(i) + \sum_{s \neq r} t_{rs} q_{rs}(i) \qquad (7)$$

Replacing optimal direct demands (3) into (7), and using equation (5) one finds that market clearing conditions imply:

$$x_r^*(i) = \frac{\sigma - 1}{\beta\sigma}\left[\frac{\mu Y_r}{n_r + \sum_{s \neq r} t_{sr}{}^{1-\sigma} n_s} + \sum_{s \neq r} \frac{t_{rs}{}^{1-\sigma} \mu Y_s}{n_s + \sum_{r \neq s} t_{rs}{}^{1-\sigma} n_r}\right] \qquad (8)$$

Free entry in the modern sector

Due to the free entry assumption, scale of production of any firm is such that pure profits $\Pi_r(i)$ are zero. In other words, a bidding process for H determines the fixed cost paid in terms of capital, which ends when no firm can earn a positive profit at equilibrium market prices.

By market clearing condition (7), the free-entry assumption and given that $p_{rs}^*(i) = t_{rs} p_{rr}^*(i)$, operating profits for every firm are:

$$\pi_r^* = \frac{\beta x_r(i)}{\sigma - 1}$$

Replacing $x_r(i)$ by its equilibrium value (8), a final expression for the equilibrium reward to capital in region r is found, namely:

$$\pi_r^* = \frac{\mu}{\sigma}\left[\frac{Y_r}{n_r + \sum_{s \neq r} t_{sr}{}^{1-\sigma} n_s} + \sum_{s \neq r} \frac{t_{rs}{}^{1-\sigma} Y_s}{n_s + \sum_{r \neq s} t_{rs}{}^{1-\sigma} n_r}\right] \qquad (9)$$

The last expression can alternatively be written as:

$$\pi_r^* = \frac{\mu Y}{\sigma}\left[\frac{\Xi_r}{n_r + \sum_{s \neq r} t_{sr}{}^{1-\sigma} n_s} + \sum_{s \neq r} \frac{t_{rs}{}^{1-\sigma} \Xi_s}{n_s + \sum_{r \neq s} t_{rs}{}^{1-\sigma} n_r}\right] \qquad (9')$$

where Ξ_r and Ξ_s are the share of world income/expenditure located in regions r and s, respectively.

3.2.c- Long-run spatial equilibrium

The model presented is a 4x2x2 FC setting, which allows for: uneven trade costs levels, size asymmetries and market-access heterogeneity. Expression (9') together with the fact that n_r can be replaced by $\lambda_r H$ allows writing down the following system of equations:

$$\begin{aligned}
\pi^*_{A1} &= \frac{\mu Y}{\sigma H}\left[\frac{\Xi_{A1}}{DA1}+\frac{t_{A1A2}{}^{1-\sigma}\Xi_{A2}}{DA2}+\frac{t_{A1B}{}^{1-\sigma}\Xi_{B}}{DB}+\frac{t_{A1C}{}^{1-\sigma}\Xi_{C}}{DC}\right]\\
\pi^*_{A2} &= \frac{\mu Y}{\sigma H}\left[\frac{t_{A2A1}{}^{1-\sigma}\Xi_{A1}}{DA1}+\frac{\Xi_{A2}}{DA2}+\frac{t_{A2B}{}^{1-\sigma}\Xi_{B}}{DB}+\frac{t_{A2C}{}^{1-\sigma}\Xi_{C}}{DC}\right]\\
\pi^*_{B} &= \frac{\mu Y}{\sigma H}\left[\frac{t_{BA1}{}^{1-\sigma}\Xi_{A1}}{DA1}+\frac{t_{BA2}{}^{1-\sigma}\Xi_{A2}}{DA2}+\frac{\Xi_{B}}{DB}+\frac{t_{BC}{}^{1-\sigma}\Xi_{C}}{DC}\right]\\
\pi^*_{C} &= \frac{\mu Y}{\sigma H}\left[\frac{t_{CA1}{}^{1-\sigma}\Xi_{A1}}{DA1}+\frac{t_{CA2}{}^{1-\sigma}\Xi_{A2}}{DA2}+\frac{t_{CB}{}^{1-\sigma}\Xi_{B}}{DB}+\frac{\Xi_{C}}{DC}\right]
\end{aligned}\qquad (10)$$

where: Ξ_r is the share of world income/expenditure located in region r, $DA1 \equiv \lambda_{A1} + t_{A2A1}{}^{1-\sigma}\lambda_{A2} + t_{BA1}{}^{1-\sigma}\lambda_B + t_{CA1}{}^{1-\sigma}\lambda_C$, $DA2 \equiv t_{A1A2}{}^{1-\sigma}\lambda_{A1} + \lambda_{A2} + t_{BA2}{}^{1-\sigma}\lambda_B + t_{CA2}{}^{1-\sigma}\lambda_C$, $DB \equiv t_{A1B}{}^{1-\sigma}\lambda_{A1} + t_{A2B}{}^{1-\sigma}\lambda_{A2} + \lambda_B + t_{CB}{}^{1-\sigma}\lambda_C$ and $DC \equiv t_{A1C}{}^{1-\sigma}\lambda_{A1} + t_{A2C}{}^{1-\sigma}\lambda_{A2} + t_{BC}{}^{1-\sigma}\lambda_B + \lambda_C$.[149]

For an interior equilibrium, $\lambda_r^\circ \in]0,1[\ \forall r$, the distribution of firms equates rental rates across every region –*i.e.* solves $\pi^*_{A1} = \pi^*_{A2} = \pi^*_B = \pi^*_C = \pi^\circ$, the so-called 'location condition'.[150] In particular, a set of functions of every trade cost and the full distribution of expenditure portrays the economically-relevant equilibrium location pattern $\Gamma^\circ = \{\lambda^\circ_{A1}, \lambda^\circ_{A2}, \lambda^\circ_B, \lambda^\circ_C\}$.[151]

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[149] Being the fifth equation of system (10): $\lambda_r = 1 - \sum_{s \neq r} \lambda_s$ for any $r \neq s$.

[150] We keep the distinction between π^*_r, π°, and an additional variable π^* –though they are equalised in the long-run equilibrium– in order to gain some insights from the analysis of the 'ad-hoc' adjustment process that should take place from any short-run equilibrium to the final or long-run spatial equilibrium. Although there are not real dynamics in the model, for analytical purposes the short-run is understood as a situation in which capital hired in each region is given and immobile. Capitalists (everywhere) earn the world average reward π^* although rental rates π^*_r can differ. Specifically, it is assumed that: a share θ of capital hired in each region belongs to capital owners residing in C, another share θ belongs to those living in *B*, a share $\rho(1\text{-}2\theta)$ corresponds to assets of capitalists in *A1* and the remaining assets belong to capitalists from *A2*.

[151] In this model, since capital ownership is fixed and labour is immobile, when physical capital relocates and reduces the incentive for further relocation, no agglomeration force is set into motion –differently from other NEG models. In other words, there are no destabilising forces operating. Hence, the equilibrium is always stable –for a formal analysis of this under symmetry see Appendix C3.1.

In order to characterise interior equilibria, one must solve the operating profit equalisation for the spatial distribution of capital Γ°. However, the expressions for equilibrium shares λ_r° become cumbersome under the assumptions taken; indeed, more than three regions and completely uneven trade costs make algebra unwieldy.

Therefore, aiming to provide some examples suggestive of general conclusions, section 4 presents numerical simulations on the spatial scenarios this chapter proposes. In other words, the analysis of how distribution of firms among the three countries and within domestic locations may change with RI is deferred to that section. Even so, the following sub-section analyses a useful parsimonious benchmark that, being a simplification of the original setting, allows characterising the equilibrium and grasping interesting economic insights.

3.3. Characterisation of the Spatial Equilibrium

First of all, let characterise the spatial equilibrium for a three-region model where both size asymmetries and a distinction between countries and domestic locations are introduced, though the gate effect *–i.e.* the market-access advantage of a particular region– is not. Second, within the same setting, the latter effect is introduced but disregarding the spatial distinction 'countries *vs.* internal regions'.[152] Finally, some intuition over the full model's dynamics *–i.e.* how capital tends to move across regions when every assumption is considered– is presented for the 'Gateless' and 'Gated' scenarios.

3.3.a- A 3-region setting with domestic locations

Let start with a rather general three-region model that allows for trade costs asymmetries. Specifically, it is assumed that there are two countries, *A* and *B*, and the former is divided into two locations, *A1* and *A2*. As regards trade costs, let consider

[152] The final step of this exercise should have been to analyse the equilibrium for a model merging that two settings –thus, a model where both spatial distiction between countries and domestic locations and a gate effect were introduced. This idea was disregarded, however, because no conclusive results could be obtained from the cumbersome expressions involved.

they are t_A between domestic regions and t_B between countries; hence, $t_B = t_{A1B} = t_{A2B}$. In line with assumptions in section 2, $t_A \leq t_B$ and is strictly lower if tariff and non-tariff barriers to international trade do exist. Let assume this holds, so $t_A < t_B$.

Solving location conditions $\pi^*_{A1} = \pi^*_{A2}$ and $\pi^*_{A2} = \pi^*_B$ one gets:

$$\lambda^\circ_{A1} = \frac{1}{1-2t_B{}^{1-\sigma} + t_A{}^{1-\sigma}} \left\{ \frac{1-2t_B{}^{2(1-\sigma)} + t_A{}^{1-\sigma}}{1-t_B{}^{1-\sigma}} \left[\Xi_{A1} + \frac{t_A{}^{1-\sigma} - t_B{}^{1-\sigma}}{1-t_A{}^{1-\sigma}} (\Xi_{A1} - \Xi_{A2}) \right] - t_B{}^{1-\sigma} \right\} \quad (11)$$

an expression with the same structure for λ°_{A2} –because domestic locations are symmetric regarding trade interconnections– and the following for country *B*:

$$\lambda^\circ_B = 1 + \frac{1}{1-2t_B{}^{1-\sigma} + t_A{}^{1-\sigma}} \left[\frac{1-2t_B{}^{2(1-\sigma)} + t_A{}^{1-\sigma}}{1-t_B{}^{1-\sigma}} (\Xi_B - 1) + 2t_B{}^{1-\sigma} \right] \quad (12)$$

which characterise the long-run equilibrium for parameter values that yield $\lambda^\circ_r \in]0,1[$ for every region.

All these expressions are increasing in region's own size, since all parentheses are positive as long as $t_A < t_B$ –remember, by assumption, $t_A{}^{1-\sigma}, t_B{}^{1-\sigma} < 1$.[153] In addition, location of capital within each domestic region is increasing in the relative size of that local market inside the country.

Both, the well-known home-market effect and the home-market magnification effect are in operation. Consider, for instance, expression (11): if home-market size (Ξ_{A1}) augments, location increases more than proportionally since first term's coefficient is greater than one and second one's is, at least, positive.[154] Moreover, as external trade costs diminish, first and second terms' coefficients may tend to increase; thus, magnifying the former effect –for details on how coefficients change with a reduction in t_B see Appendix C3.2.

Nonetheless, there are also counterbalancing forces operating. One of them comes from market *B* –see expression (12). The larger it is the greater is agglomeration inside that territory. Another comes from external openness, which gives incentives for further agglomeration in *B*. Finally, a third pro-dispersion force may emerge from domestic geography itself; namely, as internal trade costs are higher ($t_A \to \infty$), agglomeration in *B* is more likely.

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[153] Indeed, for $1-2t_B{}^{2(1-\sigma)} + t_A{}^{1-\sigma}$ and $1-2t_B{}^{1-\sigma} + t_A{}^{1-\sigma}$ to be positive, $t_B > \left(\frac{1+t_A{}^{1-\sigma}}{2} \right)^{\frac{1}{1-\sigma}}$ is a sufficient condition, which is satisfied when $t_A < t_B$.

[154] As $t_A < t_B$ guarantees $t_A{}^{1-\sigma} > 4t_B{}^{1-\sigma} - 3$, first term's coefficient is greater than one.

When internal or external trade liberalisation takes place, firms' agglomeration is likely to increase within domestic locations; while the opposite is true for *B*. Let consider expression (11) disregarding domestic size asymmetries ($\Xi_{A1}-\Xi_{A2}$): external trade liberalisation tends to foster agglomeration within domestic locations through both improved accession to the foreign market –*i.e.* the last term– and the home-market magnification effect. Domestic size asymmetries, in due course, tend to reinforce that pattern –at least when the margin $t_A < t_B$ is large enough– strengthening agglomeration within the biggest location. This process, nevertheless, may not be permanent. As trade openness increases exceeding a threshold level and some internal barriers remain, there might be incentives for domestic de-agglomeration and relocation within *B* due to the persistence of internal market segmentation –for details see Appendix C3.2.

As it has been mentioned in the Introduction of this chapter, one of the motivations for extending the FC model is to understand how within-country disparities evolve when trade liberalisation takes place. The following expression represents those disparities:

$$\lambda^{\circ}_{A1}-\lambda^{\circ}_{A2}=\frac{\left(1-2t_B^{\,2(1-\sigma)}+t_A^{\,1-\sigma}\right)\left(\Xi_{A1}-\Xi_{A2}\right)}{\left(1-t_B^{\,1-\sigma}\right)\left(1-t_A^{\,1-\sigma}\right)} \tag{13}$$

which is positive (negative) whenever the largest domestic location is *A1* (*A2*) as long as $t_A < t_B$.

As it can be grasped, both external and internal liberalisation may increase existing spatial disparities benefiting the biggest location. Intuitively, domestic size asymmetries determine firm's location within the country because the trade cost margin ($t_A < t_B$) softens competition from abroad and reinforces the home-market effect. Nonetheless, at some level of external openness for which the margin $t_A < t_B$ is not so big, further liberalisation could foster spatial convergence within *A* since domestic market segmentation may discourage further agglomeration.

3.3.b- A 3-region setting with a gate effect

Let introduce into the three-region setting a gate effect within country *A*, instead of assuming a trade-cost distiction between countries and domestic locations. That is, it is now assumed that t_D represents trade costs between the 'distant' (or remote) location *A2* and country *B* ($t_D = t_{A2B}$), while t_N are trade costs between the 'nearby' (or gate) location *A1* and both *B* and *A2* –*i.e.* $t_N = t_{A1B} = t_{A1A2} < t_D$.[155] Thus, trade costs between each domestic location and country *B* differ: $t_{A1B} < t_{A2B}$.[156]

Solving location conditions $\pi^*_{A1} = \pi^*_{A2}$ and $\pi^*_{A2} = \pi^*_B$ for parameter values that yield $\lambda^\circ_r \in]0,1[\ \forall r$:

$$\lambda^\circ_{A1} = 1 + \frac{1}{1-2t_N^{1-\sigma}+t_D^{1-\sigma}}\left[\frac{1-2t_N^{2(1-\sigma)}+t_D^{1-\sigma}}{1-t_N^{1-\sigma}}(\Xi_{A1}-1)+2t_N^{1-\sigma}\right] \qquad (14)$$

$$\lambda^\circ_{A2} = \frac{1}{1-2t_N^{1-\sigma}+t_D^{1-\sigma}}\left\{\frac{1-2t_N^{2(1-\sigma)}+t_D^{1-\sigma}}{1-t_N^{1-\sigma}}\left[\Xi_{A2}+\frac{t_N^{1-\sigma}-t_D^{1-\sigma}}{1-t_D^{1-\sigma}}(\Xi_B-\Xi_{A2})\right]-t_N^{1-\sigma}\right\} \qquad (15)$$

together with an expression for λ°_B that has the same structure as (15) but depends positively on $(\Xi_{A2}-\Xi_B)$ and Ξ_B instead of $(\Xi_B-\Xi_{A2})$ and Ξ_{A2}.

As in the previous analysis, these expressions are increasing in local-market size.[157] In addition, the size of the foreign market plays also a role. The bigger it is, the more likely is location within *A2* because, though local and foreign firms are equalised as regards access to *A1*, firms in *A2* are more protected against competition coming from market *B*. Finally, note that the level of t_N impacts differently on location within each domestic region. While higher *A1*'s openness benefits agglomeration in that gated market because of better access to both *B* and *A2*, it impacts negatively on location within the remote region.

As regards the home-market effect, it is in operation in both domestic regions for trade-costs pairs $t_D^{1-\sigma} > 4t_N^{1-\sigma} - 3$.[158] On the other hand, the home-market magnification effect is not a general characteristic of this setting. It may only operate within the 'nearby' location when t_N is not so low –for details see Appendix C3.3. Intuitively, domestic market-size may lose relative importance as location determinant when the gate effect tends to disappear.

In this second setting, domestic disparities are represented by:

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[155] So, internal transport costs are as high as the lowest external trade cost.

[156] Note there is a sort of paralelism between this model and the previous one. In 3.3.a, firms located in country *B* 'pay' t_B to sell in both domestic locations; while firms in those regions 'pay' either t_A to trade domestically or t_B to do it internationally. In the present sub-section, domestic location *A1* is playing a similar but not identical role as *B*: firms in *A1* 'pay' t_N to sell in the other regions (*B* and *A2*), while firms within these two regions 'pay' t_D to trade with each other (internationally).

[157] Here parentheses are positive if condition $\left(\frac{1+t_D^{1-\sigma}}{2}\right)^{\frac{1}{1-\sigma}} \le t_N < t_D$ is satisfied.

[158] That condition is satisfied for all pairs $1{,}33^{\frac{1}{\sigma-1}} \le t_N < t_D$ and only for some pairs when $t_N < 1{,}33^{\frac{1}{\sigma-1}} \le t_D$.

$$\lambda^{\circ}_{A1}-\lambda^{\circ}_{A2}=\frac{1}{1-2t_N^{\,1-\sigma}+t_D^{\,1-\sigma}}\left\{\frac{1-2t_N^{\,2(1-\sigma)}+t_D^{\,1-\sigma}}{1-t_N^{\,1-\sigma}}\left[(\Xi_{A1}-\Xi_{A2})+\frac{t_N^{\,1-\sigma}-t_D^{\,1-\sigma}}{1-t_D^{\,1-\sigma}}(\Xi_{A2}-\Xi_{B})\right]\right\}+$$
$$+\frac{t_N^{\,1-\sigma}-4t_D^{\,1-\sigma}}{1-t_N^{\,1-\sigma}}t_N^{\,1-\sigma}$$

(16)

As it is shown in Appendix C3.3, we cannot derive definite conclusions about domestic disparities when t_N diminishes since different combinations of spatial forces are possible. Nonetheless, we can claim that an intensification of domestic disparities is more likely when they are yet not so relevant, t_N is not very high, the foreign market is larger than domestic ones and the elasticity of substitution between varieties is higher. With respect to changes in location as t_D decreases, it seems more likely that λ°_{A1} increases and λ°_{A2} diminishes; in other words, that domestic disparities augment as a result.

3.3.c- *Brief comparison between the two 3-region settings*

Let first compare equilibrium location across the two previous settings. In region *A1*, under the assumption $t_A < t_B = t_N < t_D$, one can observe that due to both the home-market effect and the gate effect agglomeration is likely to be stronger in the second model, $\lambda^{\circ\text{Gate}}_{A1} > \lambda^{\circ\text{NoGate}}_{A1}$ –look at expressions (11) and (14). In other words, the greater access advantages *A1* has to reach consumers in every region, the larger the number of firms choosing that location. On the other hand, the size of *A2* and *B* –not only of the former as in the previous scenario– negatively affects location in the gate region. This stronger dispersion force might relatively decrease $\lambda^{\circ\text{Gate}}_{A1}$ with respect to $\lambda^{\circ\text{NoGate}}_{A1}$, counterbalancing to some extent the pattern previously mentioned.

To complete the analysis, let see how the gate effect may modify domestic disparities, *i.e.* comparing expression (13) and (16) under the assumption that $t_A < t_B = t_N < t_D$.[159] First, note that while domestic size asymmetries explain all location disparities in the 'Gateless' scenario, they are not the only responsible for them in the 'Gated' one. As it is well known, the FC model assumes no circular causality; hence, 'near' catastrophic-agglomeration phenomena could only emerge when some heterogeneity is introduced. In the 'Gateless' scenario domestic size asymmetries play that role, while in the 'Gated' one both accessibility and size do it. As a result, the latter setting opens the door to novel spatial forces and, thus, different spatial equilibria. For

[159] Note those expressions do not only differ due to the gate effect, but also because in the second setting there is not a distinction between domestic locations and countries.

$$\pi_s^* - \pi_r^* = \frac{\mu(\pi^* H + L)}{\sigma H}(\Omega_s^* - \Omega_r^*)$$

Since the initial ratio is positive: $\text{sgn}(\pi_s^* - \pi_r^*) = \text{sgn}(\Omega_s^* - \Omega_r^*)$. Plugging expressions Ω_s^* and Ω_r^* for the special case of domestic firms:

$$\text{sgn}(\pi_{A1}^* - \pi_{A2}^*) = \frac{(1-2\theta)(1-t_A^{1-\sigma})}{\Lambda}\text{sgn}[\rho DA2'' - (1-\rho)DA1''] \quad (19)$$

where Λ, $DA1''$ and $DA2''$ are positive functions of trade openness and industry shares (λ_r).[162]

Thus, when domestic and international shipments are not perfectly free, pressure for firms to move across domestic regions is driven by the interaction of opposing forces: market-access and market-crowding or competition effects –see Appendix C3.5 for a formal isolation of those effects. That is, producing in the largest domestic market –*A1* when ρ>1/2– gives profit-advantage to local firms and promote domestic agglomeration in *A1*.[163] On the other hand, the market-crowding effect operates; *i.e.* a larger number of firms in *A1* tend to reduce that profit-advantage, thus pushing firms towards *A2*. Intuitively, starting from a symmetric domestic equilibrium ($\lambda_{A1} = \lambda_{A2}$) an exogenous movement of firms from *A2* to *A1* tends to generate a market-crowding disadvantage for firms in *A1* –operating profits of *A1*'s firms tend to diminish due to fiercer local competition.

In the case of capital flows from/to country *B* to/from any domestic region, for instance *A1*, they respond to the following forces:[164]

$$\text{sgn}(\pi_{A1}^* - \pi_B^*) = \text{sgn}\left\{\frac{(1-2\theta)}{\Lambda}\left[\rho(1-t_{FTA}^{1-\sigma})DA2'' + (1-\rho)(t_A^{1-\sigma} - t_{FTA}^{1-\sigma})DA1''\right] - \theta\frac{(1-t_{FTA}^{1-\sigma})}{DB''}\right\}$$

(20)

where DB'' is a positive function of λ's and the levels of openness.[165]

Hence, a larger local market gives incentives for firms to stay put in their own region, while a bigger *A2*'s market is more advantageous for national firms rather than for firms located in *B* due to accessibility differences ($t_A < t_{FTA}$). On the other hand,

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[162] Explicitly: $DA1'' \equiv \lambda_{A1} + t_A^{1-\sigma}\lambda_{A2} + t_{FTA}^{1-\sigma}\lambda_B + t_{GE}^{1-\sigma}\lambda_C$, $DA2'' \equiv t_A^{1-\sigma}\lambda_{A1} + \lambda_{A2} + t_{FTA}^{1-\sigma}\lambda_B + t_{GE}^{1-\sigma}\lambda_C$ and $\Lambda \equiv t_A^{1-\sigma}(\lambda_{A1}^2 + \lambda_{A2}^2) + (1 + t_A^{2(1-\sigma)})\lambda_{A1}\lambda_{A2} + (1 + t_A^{1-\sigma})(\lambda_{A1} + \lambda_{A2})t_{GE}^{1-\sigma}\lambda_C + (1 + t_A^{1-\sigma})(\lambda_{A1} + \lambda_{A2})t_{FTA}^{1-\sigma}\lambda_B + t_{FTA}^{2(1-\sigma)}\lambda_B^2 +$ $+ t_{GE}^{2(1-\sigma)}\lambda_C^2 + 2(t_{FTA}t_{GE})^{1-\sigma}\lambda_C\lambda_B$.

[163] It is worth noting that within this setting, it is not possible to definitely derive the home-market effect as in the 3-region benchmark analysed. As it has been shown by authors such as Baldwin *et al.* (2003, ch.14) and Behrens *et al.* (2006c) among others, in a *multi-country* setting the interplay between trade costs and expenditure puts accessibility and attraction effects, rather than the unambiguous home-market effect, at the heart of industry relocation.

[164] In the Appendix, expression (C3.7) shows how industry relocation between C and *A1* is driven.

[165] Explicitly, $DB'' \equiv t_{FTA}^{1-\sigma}(\lambda_{A1} + \lambda_{A2}) + \lambda_B + t_{GE}^{1-\sigma}\lambda_C$.

dispersion forces that act through the interaction of industry shares and trade costs tend to foster capital relocation towards less crowded markets.

'Gated' scenario

Let analyse the case in which regions *A1* and *A2* are assumed to be heterogeneous in terms of access to *B*. This implies that:

$$t_{FTA1} \neq t_{FTA2} \quad \text{where}$$
$$t_{FTA1} = t_{A1B} = t_{BA1} \equiv 1 + d + \tau_{FTA} \quad \text{and}$$
$$t_{FTA2} = t_{A2B} = t_{BA2} \equiv 1 + 2d + \tau_{FTA}$$

while the rest of assumptions remain as before. For the new system of equations –written down in Appendix C3.6– the equilibrium distribution of industry can be expressed as another set of functions of trade costs and expenditure.

As in the previous scenario, let proceed to get some insights from the analysis of the system's 'dynamics'. In the case of domestic regions, the sign of capital reward differential is given by that of the right hand side in this expression:

$$\text{sgn}\left(\pi^*_{A1} - \pi^*_{A2}\right) = \text{sgn}\left\{ \frac{(1-2\theta)\left(1 - t_A{}^{1-\sigma}\right)}{\Phi}\left[\rho DA2''' - (1-\rho) DA1'''\right] + \theta \frac{\left(t_{FTA1}{}^{1-\sigma} - t_{FTA2}{}^{1-\sigma}\right)}{DB'''} \right\} \tag{21}$$

where Φ, $DA1'''$, $DA2'''$ and DB''' are positive functions of trade openness and λ's.[166]

The first term between curly brackets is very similar to the whole expression obtained for the 'Gateless' case. In other words, it reveals the interaction between two opposing forces governing firms' incentives to relocate: market-access and market-crowding effects –see Appendix C3.7 for a formal analysis on those effects. As a subtle difference from that case, supposing $t_{FTA1} < t_{FTA} = t_{FTA2}$ –hence, $DA1''' > DA1''$ while $DA2''' = DA2''$– one can notice that firms in *A1* suffer higher competition from firms located in *B* than before and benefit from a lower market-access differential. Thus, incentives to relocate in *A1* may be lower. Nevertheless, since $\Lambda < \Phi$ both market-access and market-crowding effects are smoother in the 'Gated' scenario –point already raised at the end of sub-section 3.3.c.[167]

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[166] Where $DA1''' \equiv \lambda_{A1} + t_A{}^{1-\sigma}\lambda_{A2} + t_{FTA1}{}^{1-\sigma}\lambda_B + t_{GE}{}^{1-\sigma}\lambda_C$, $DA2''' \equiv t_A{}^{1-\sigma}\lambda_{A1} + \lambda_{A2} + t_{FTA2}{}^{1-\sigma}\lambda_B + t_{GE}{}^{1-\sigma}\lambda_C$, $DB''' \equiv t_{FTA1}{}^{1-\sigma}\lambda_{A1} + t_{FTA2}{}^{1-\sigma}\lambda_{A2} + \lambda_B + t_{GE}{}^{1-\sigma}\lambda_C$ and $\Phi \equiv t_A{}^{1-\sigma}\left(\lambda_{A1}^2 + \lambda_{A2}^2\right) + \left(1 + t_A{}^{2(1-\sigma)}\right)\lambda_{A1}\lambda_{A2} + \left(1 + t_A{}^{1-\sigma}\right)\left(\lambda_{A1} + \lambda_{A2}\right)t_{GE}{}^{1-\sigma}\lambda_C + \left(\lambda_{A1} + t_A{}^{1-\sigma}\lambda_{A2}\right)\left(t_{FTA1}{}^{1-\sigma} + t_{FTA2}{}^{1-\sigma}\right)\lambda_B + t_{FTA2}{}^{2(1-\sigma)}\lambda_B^2 + t_{GE}{}^{2(1-\sigma)}\lambda_C^2 + 2\left(t_{FTA2}t_{GE}\right)^{1-\sigma}\lambda_B\lambda_C$.

[167] The difference between Φ and Λ is given by the fourth term, which is very likely to be lager in Φ – this certainly occurs when $\lambda_{A1} = \lambda_{A2}$ or $\lambda_{A1} > \lambda_{A2}$.

However, the presence of a gate effect introduces one more noticeable difference. A new term, the last one appears in the reward differential; it is again a combination of opposing forces –which are closely related to those analysed in sub-section 3.3.c. Domestic firms are attracted towards the border region in order to gain better access to *B* –the larger this market (higher θ), the stronger this force. On the other hand, the more crowded is this market (higher λ_B) the stronger is competition from *B*'s firms and, hence, the lower is the positive impact of the gate effect ($t_{FTA1} < t_{FTA2}$) on the rental rate differential.[168]

With respect to international capital movements, relocation from the preferential partner to *A1* is driven by:

$$\operatorname{sgn}(\pi^*_{A1} - \pi^*_B) = \operatorname{sgn}\left\{\frac{(1-2\theta)}{\Phi}\left[\rho(1 - t_{FTA1}{}^{1-\sigma})DA2''' + (1-\rho)(t_A{}^{1-\sigma} - t_{FTA2}{}^{1-\sigma})DA1'''\right] - \theta\frac{(1 - t_{FTA1}{}^{1-\sigma})}{DB'''}\right\} \tag{22}$$

Thus, incentives for foreign firms to enter market *A1* are similar to those in the 'Gateless' case; however, there is one interesting difference that deserves some attention. When a gate effect is introduced, the impact of *A2*'s market-size on capital flows from *B* to *A1* changes. Specifically, accessibility advantage of *A1*'s firms toward market *A2* does remain even after all trade barriers have been removed $-t_A$ is always lower than t_{FTA2}. Consequently, even after complete intra-bloc liberalisation, the gate effect continues stimulating industry dispersion from *B* towards *A1*.

Apart from that, the gate effect also changes the incentives for capital flows to move from *B* towards each particular domestic region –compare expression (22) with (C3.10) in the Appendix. The negative impact of *B*'s market-size on those capital outflows –represented by the last term between curly brackets– is always lower for the border region. That is, capitalists in *B* have stronger incentives to move towards *A1* rather than towards *A2* due to accessibility.

The role of the RoW within both scenarios

As regards the role of country *C* in shaping market-access and market-crowding forces across domestic regions, two main issues should be noticed. First, in the two scenarios, each the size of market *C* and the magnitude of firms' agglomeration there tend to soften those spatial forces –see (C3.8), (C3.9), (C3.13) and (C3.14) in the Appendix. In other words, the existence of a third market lessens domestic effects since there is other market to supply, other location option, and additional competition; note

[168] These effects seem to be directly associated with the pull and push effects discussed by Crozet and Koening (2004a) within a Core-Periphery model.

this influence of country C takes also place for capital flows between *A1* and country *B* –see expressions (20) and (22).

Second, the 'Gated' scenario delivers again particularities that involve country C. On the one hand, firms' migration between domestic regions –compare (21) and (19)– is lessen by *B*'s size (θ) but this dispersion force is soften by the share of firms located in *C*. In other words, to have a third non-preferential partner softens spatial forces within the bloc. On the other hand, capital relocation from the RoW to each domestic region changes with the gate effect. Flows from *C* to *A1* tend to be more abundant than those towards *A2* because of *A1*'s relative access advantage towards *B* –see expressions (C3.11) and (C3.12) in the Appendix.

Summing up, this sub-section has shown that most of the corollaries for the 3-region benchmark hold for the full 4-region model. Briefly: regions' own size promotes agglomeration and access/protection asymmetries tend to foster agglomeration in the gate location as long as market-crowding effects are not so important. Nonetheless, the 4-region model also underlines that the presence of a third non-preferential partner is not innocuous; indeed, it provides for a spatial *status quo* as it tends to weaken spatial forces in the model.

The task is now to analyse how regional integration (RI) can affect modern-sector's location within the bloc and, in particular, across domestic regions. From sub-sections 3.3.a and 3.3.b we could expect that, under certain conditions, external trade liberalisation first increases domestic disparities to afterwards fostering convergence. Moreover, in the presence of a gate effect, the former impact might be sustained because the influence of the trade-costs margin could persist and even be reinforced with trade liberalisation. Let analyse whether those effects take place or, instead, change with RI.

3.4. Regional Integration

Within this section, the aim is to obtain some insights about how symmetric trade liberalisation between *B* and the domestic country can modify the national economic landscape. As mentioned, the model's characteristics –*i.e.* unevenness of trade costs, size-asymmetries and market-access heterogeneity– make the explicit solution of the model unattainable. Therefore, instead, we propose an analysis that relies on numerical simulations, trying to relate (to some extent) the simulations' results to conclusions derived in section 3 with respect to the spatial effects of trade liberalisation.[169]

Simulations were run using Maple 8 for a marginal and continuous reduction of τ_{FTA} from infinity –or complete intra-bloc autarky– to zero within each of the two benchmark scenarios, *i.e.* 'Gateless' and 'Gated', and for parameter values close to those employed by other authors.[170] The use of data –namely, estimates that fit in real data– that could discipline the choices of parameter values would have been desired. Nonetheless, in order to illustrate a general case instead of a particular one and since the only particular case of interest in this dissertation is Argentina within MERCOSUR for which there are not reliable and updated data, we have to decide using parameter values close to those employed by other authors in the literature.

In addition, and aiming to find specific predictions for diverse hypothetical cases, different factor-endowment settings –*i.e.* values of θ and ρ– were considered. In the case of ρ, levels used were: 0,6, 0,5 and 0,4; so two domestic landscapes were simulated, a symmetric and an asymmetric one –where the gate region could be either the largest (ρ=0,6) or the smallest (ρ=0,4). With respect to θ, three different cases were considered. When foreign countries were assumed to be larger than domestic country, θ could take values between 1/2 and 1/3.[171] When complete symmetry among countries was assumed, this parameter was set equal to 1/3. Finally, when all regions were supposed to be symmetric, θ was set equal to 1/4, and ρ equal to 0,5; thus implying a domestic country larger than *B* and *C*.

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[169] The main drawback of performing simulations is that one is never 100% certain whether or not the results found are due to the model itself or the particular parameter values used –in addition, but not necessarily a drawback, many different effects take place together. Nonetheless, analysing simulation's outcomes at the light of corollaries in section 3 may bring some indication of formers' reliability. As regard the latter, note 'Gated' 4-region scenario cannot be directly compared with the 3-region setting in 3.3.b. Instead of the paralelism that one can make between the 'Gateless' scenario and setting in 3.3.a, the 'Gated' case should correspond to a combination of the two 3-region settings analysed.

[170] With respect to robustness, a modest analysis was carried out in order to get insights of how the results were modified when some key parameters, such as *d*, ρ, θ and τ_{GE} were altered; the results were the expected ones.

[171] In fact, θ was set equal to 3/8. In the case of the other parameters, the following values were applied: σ=4, τ_{GE} =0,5 and *d*=0,5.

Just as illustrations, some possible interpretations of the resulting factor-endowment settings may be the following ones. Under the first setting one can imagine the case of hypothetical RI between the EU, or *more likely* the ASEAN with the US or the NAFTA. Secondly, a scenario with $1/2>\theta>1/3$ seems the most accurate for the case of Argentina –or Uruguay or Paraguay– within the MERCOSUR, with Brazil as the largest member country. Finally, the case of $\theta=1/4$ might be a scenario where a very big country –for instance the US, Canada, or both together– comprising two main inner locations forms a bloc with a smaller country –namely Mexico.

3.4.a- Regional integration in the 'Gateless' case

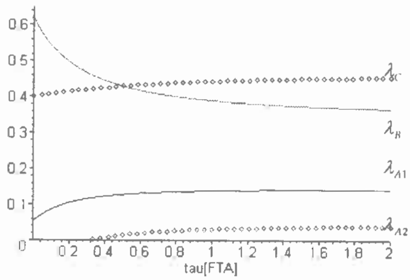
The results of the 'Gateless' case, which are summarised by Figures 1 (moving from the right of the diagrams to the origin), show that for every factor-endowment scenario considered there is a 'production shifting' effect from RoW to the bloc as a whole.[172] That is, *C*'s industry share always diminishes when preferential trade liberalisation takes place, and, thus, the bloc is benefited (see Table 1). Additionally, country *B* always receives new entrants; *B*'s relative market size and its freer access to (and from) the domestic country may explain this result. In fact, as figures reveal, spatial impacts on *B* diminish as its market size decrease and, simultaneously, competition from firms in *A1* and *A2* becomes fiercer.[173]

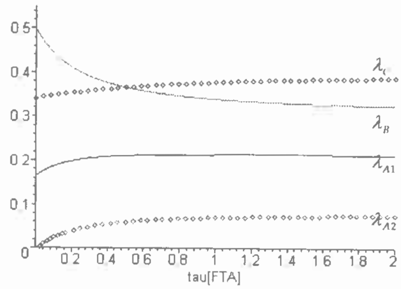
Figures 1: 'Gateless' case when domestic regions are asymmetric (ρ=0,6)

Case of large foreign countries (θ=3/8) **Case of symmetrically sized countries (θ=1/3)**

[172] The name 'production shifting' given for that effect is due to Baldwin and Venables (1995). This effect is like a 'nephew' of the classical trade-diversion effect. Pure trade theory states that preferential trade liberalisation can drive less-efficient preferential partners to replace world more-efficient producers when supplying the bloc's market. In the present case, the rest of the world (country *C*) is also damaged by preferential liberalisation. The bloc's market is bigger after preferential liberalisation; therefore, firms relocate towards larger markets in order to exploit their internal economies of scale. Hence, preferential liberalisation provokes what Baldwin *et al.* (1996) called 'investment diversion'.

[173] When ρ=0,4 the results are identical for *B* and *C*, and symmetrically inverted for *A1* and *A2*. Finally, when ρ=0,5 both domestic regions suffer exactly the same delocation process, and *B* and *C* are affected in the same way as in the asymmetric case (ρ=0,6).





Case of a big domestic country (θ=1/4)

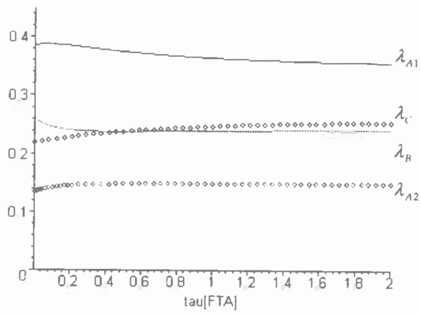


Table 1: The 'Gateless' case. Location effects outside domestic country

Relative changes

Countries' relative size (θ)	$\Delta\lambda_B/\lambda_{B0}$	$\Delta\lambda_C/\lambda_{C0}$
Big foreigners (3/8)	65%	-17%
Symmetric (1/3)	56%	-13%
Big domestic (1/4)	8%	-15%

Note: Since λ_{A2} takes negative values for some parameters' configurations, the values of λ's were adjusted to be between 0 and 1 and sum one –in particular, this explains the first line of values.

Size-asymmetries between *A1* and *A2*, do not have any impact on foreign countries' industry shares. More clearly, the spatial effects that RI has on those markets is unaffected by domestic internal geography. This, which is in line with equilibrium location in country *B* as derived for the 3-region benchmark –see expression (12)– occurs because capital owners in *B* and *C* do not find any advantage in hiring their factor inside any particular domestic region –since the model does not display cumulative agglomeration.

Considering now the domestic landscape, in general terms there is a displacement of national firms towards foreign regions. Indeed, the only case in which delocation does not happen and, instead, the country receives new entrants is when it is the largest country in the world (θ=1/4). In this case, the country is benefited since its relative market size is large enough to overcome its disadvantage in terms of internal transport costs (market segmentation). That is, during the process of RI, capitalists from *B* and *C* may have incentives to employ their capital inside that large market.[174]

Inside the domestic country, relative distribution of industry between *A1* and *A2* remains unchanged when both regions are totally homogeneous (ρ=0,5) –cristal-clear from expressions (13) and (C3.3) in the 3-region benchmark when $\Xi_{A1} = \Xi_{A2}$. On the contrary, when domestic regions are asymmetric, RI tends to increase pre-existent internal disparities. The largest location is either less damaged in terms of firms' outflow or the only one that receives new entrants. Again, expressions (13) and (C3.3) help to clarify this result.

3.4.b- Regional integration in the 'Gated' case

Results for the 'Gated' scenario reveals that 'production shifting' effect from RoW towards integrating countries is again present in every factor-endowment setting considered (see Table 2). That is, *C*'s industry share or the fraction of world's capital employed in *C* (λ_C) always diminishes when preferential trade liberalisation takes place. As before, domestic geography do not have any impact on location within the RoW; on the contrary, it do affect *B*'s industry shares.

[174] However, no relocation from *B* to domestic country would have happened with a big-bang liberalisation.

Table 2: The 'Gated' case. Location effects outside domestic country

Relative changes

Countries' relative size (θ)	**$\Delta\lambda_B/\lambda_{B0}$**			**$\Delta\lambda_C/\lambda_{C0}$**
	when ρ=0,4	**when ρ=0,5**	**when ρ=0,6**	
Big foreigners (3/8)	38%	38%	34%	-11%
Symmetric (1/3)	31%	25%	19%	-10%
Big domestic (1/4)	0%	-8%	-29%	-20%

Note. Since λ_{A1} and λ_{A2} take null or negative values for some parameters' configurations, the values of λ's were adjusted to be between 0 and 1 and sum one. In addition, $\Delta\lambda_C$ does not vary with ρ unless θ=3/8 and ρ=0,4 –thus λ_{A1} becomes negative. In this last case, the simple average of $\Delta\lambda_C$ values is reported.

Indeed, though country *B* is generally benefited by firms' relocation, it suffers some delocation when domestic country is the biggest in the world and its gate region is relatively large (ρ=0,6). During the liberalisation process, firms located in *A1* have the advantage of accessing *A2* more easily; then, firms located in *B* have an incentive to move towards *A1* in order to supply the common market.

In general terms, there is a displacement of firms from the domestic country towards the partner's market. Figures 2, moving from the right of the diagrams to the origin, shows that the share of world's capital employed in *A1* and *A2* almost always diminishes when intra-bloc trade barriers fall. This is the direct outcome of both, market-size asymmetries within the bloc and the unequal accessibility from/to domestic regions. When *B* is large or as big as the domestic country (θ≥1/3), firms located in C or in the domestic country prefer to locate within *B*'s territory because of its relative market size.

On the other hand, internal size asymmetries (ρ≠0,5) tend to improve the balance of capital flows for the domestic country, unless its border region is small and the domestic country is big enough (θ≤1/3).[175] These asymmetries, though do not affect investment decisions taken by *C*'s capital owners, do modify the way in which firms tend to move from/to country *B*.[176] Indeed, as it has been explained above, the larger the gate region, the smaller *B*'s industry share after trade liberalisation. Hence, for the domestic country as a whole, the gate effect plays a favourable role in reducing the

[175] In this last case, *A2* loses capital; while *A1* is not big enough to retain or attract firms.

[176] If these asymmetries mean that *A2* is the bigger domestic region, *C*'s capitalists prefer to invest in their home country. Only in the case in which *A1* is the larger region, those capitalists take advantage of the bloc's market entering into *A1*.

negative impacts of RI; differently from the 'Gateless' case, even with a big-bang liberalisation, some capital would still relocate from *B*.

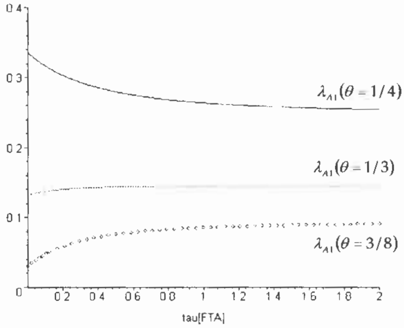
Inside the domestic country, and in the case of symmetrically sized regions (ρ=0,5), RI tends to promote the emergence of an uneven economic landscape –look at the first pair of graphs in Figures 2. To be the gate region is an advantage when the country is large enough (θ=1/4) because *A1*'s better external accessibility concurs with its competitive strength; as a consequence, this region is benefited due to 'investment creation'. On the other hand, *A1* may be the most seriously damaged region when foreign locations are very large (θ=3/8) because competition from abroad is too high. In this case, to be remote is the less precarious condition; indeed, *A2*'s market is relatively more protected from foreign competitors.

When domestic regions are heterogeneous in terms of expenditure –*i.e.* ρ=0,4 or ρ=0,6– inequalities tend to be deepened after RI. The only case in which size asymmetries are likely to diminish, but not to disappear, is when the domestic country is the biggest (θ=1/4) and its remote region is the richest or most developed one (ρ=0,4). Within this setting, the gate region gradually receives capital flows due to its access advantage; and *A2* loses very few firms thanks to its relative size and isolated position. For every other parameterisation, the initially most developed domestic region is the most favoured (or less damaged) one after preferential trade liberalisation. Hence, domestic asymmetries increase.

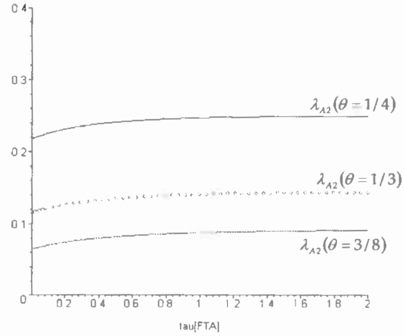
Figures 2: 'Gated' case. Location effects inside domestic country

Case of symmetrically sized locations (ρ=0,5)

Share of world's capital employed in *A1*, λ_{A1}

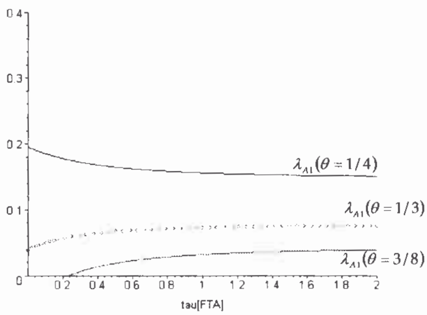


Share of world's capital employed in *A2*, λ_{A2}

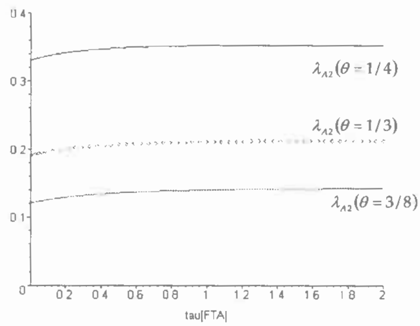


Case of a big remote location (ρ=0,4)

Share of world's capital employed in *A1*, λ_{A1}

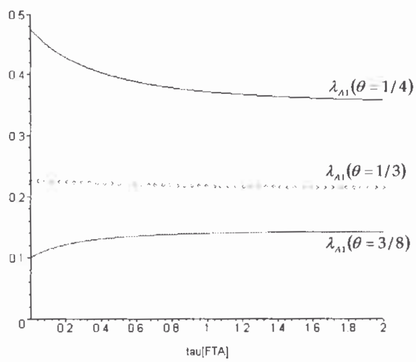


Share of world's capital employed in *A2*, λ_{A2}

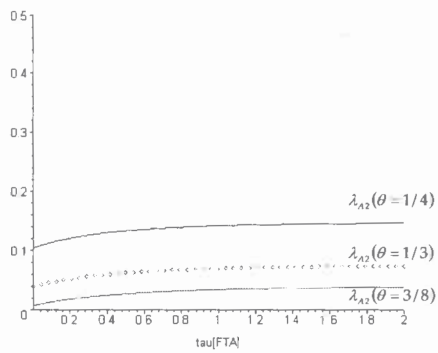


Case of a large border location (ρ=0,6)

Share of world's capital employed in *A1*, λ_{A1}



Share of world's capital employed in *A2*, λ_{A2}



To sum up, the collection of examples provided by simulations are suggestive of the following propositions:

- RoW may be harmed by industrial relocation when there is a process of RI, while the bloc and its largest member may be benefited by capital inflows.[177]
- The presence of a non-preferential partner tends to lessen intra-bloc and domestic spatial forces –issue already raised in Section 3. Moreover, it could likely make *B* receive capital flows and domestic country also receive them or, at least, retain some firms when its market is big and integrated enough –hence, to compete in location with the preferential partner.
- Within a member country, RI seems to foster spatial concentration, either creating an uneven national landscape in the 'Gated' case or deepening pre-existent imbalances –*i.e.* favouring the initially more developed or big region –conclusions also brought up for the 3-region settings.
- In addition, the domestic region with better access to the preferential partner may be more favoured or less damaged by industry agglomeration than the land-locked region –issue already raised in the Appendix when comparing expressions (C3.4) and (C3.5).

Some of these results are close to those reported by previous research. 'Inside-outside' effects and intra-bloc spatial impacts of preferential trade liberalisation –*i.e.* the two first propositions– have already been put forth by Baldwin *et al.* (2003, ch.14), within a similar framework to ours, and by Puga and Venables (1997) using a 'Core-Periphery' setting.

With respect to the impact of trade openness on the internal geography of a country, our findings appear to coincide, to some extent, with those obtained for unilateral liberalisation by Alonso-Villar (1999, 2001), Andres (2004), Brülhart *et al.* (2004), Crozet and Koening (2004a), Monfort and Nicolini (2000) and Paluzie (2001).[178] In particular, our results under the 'Gateless' scenario are in line with those of Andres, Monfort and Nicolini and Paluzie. Nonetheless, differently from them, this chapter also shows domestic dispersion might, instead, take place in some 'pre-integration' scenarios. Specifically, as section 3 helps understanding, the level of internal trade costs with respect to external ones (or margin) conditions the balance between market-access

[177] When preferential partners are equally sized, *B*'s more integrated market is benefited to the detriment of the segmented domestic country.

[178] As it has been already pointed out in Chapter 1 and the Introduction of this chapter, other studies conclude instead that trade liberalisation tends to foster dispersion of economic activity within the country.

and market-crowding effects, both domestically and internationally. Thus, allowing domestic disparities to decrease –see expressions (C3.3) and (19).

In addition, our results seem to support Crozet and Koening's and Brülhart *et al.*'s findings in relation with the spatial impacts of trade liberalisation in the presence of a gate effect. As they conclude, that effect introduces two opposing forces: a pull pressure towards border regions and a push force inside remote ones, which balance is shaped by the strength of both external market-access and market-crowding effects. This chapter extends these findings to a preferential liberalisation context.

Moreover, we find discriminatory liberalisation, rather than unilateral one, also modifies the spatial outcome, making trade liberalisation desirable in terms of firms' concentration for some regions which would have been against a unilateral process. Indeed, the model underlines location outcomes are highly dependent on size imbalances, both inside the domestic country and across countries. When the domestic country is big enough, it grasps all the gains in terms of location and welfare, as it will be clear from the following paragraphs.

3.4.c- Welfare effects of regional integration

This sub-section proceeds to analyse some welfare implications of RI.[179] To do this, and for the case of region *r*, let first differentiate indirect utility function (4) with respect to τ_{FTA}, which yields:[180]

$$\frac{\partial V_r}{\partial \tau_{FTA}} = \Theta_r \left[\sum_{s \neq r} \frac{\partial t_{sr}{}^{1-\sigma}}{\partial \tau_{FTA}} \lambda_s + \left(\frac{\partial \lambda_r}{\partial \tau_{FTA}} + \sum_{s \neq r} t_{sr}{}^{1-\sigma} \frac{\partial \lambda_s}{\partial \tau_{FTA}} \right) \right] \tag{23}$$

where Θ_r is a positive function of λ's and openness parameters.[181]

Since nominal incomes remain constant across spatial equilibria, welfare in region *r* increases with trade liberalisation if and only if location effects imply a reduction in consumer prices –*i.e.* an increase in real income.[182] The first summation

[179] For simplicity, in doing this we neglect the proceeds that governments obtain through tariffs on imports. In addition, note that the interpretation given to the model in section 2 is not proper for studying 'class conflicts'.

[180] In doing this, we use expression (6) and the fact that $n_r = \lambda_r H$. Additionally, since *Z* is the numeraire we choose units such that: *H*=1, *Y*=1 and $\beta = \frac{\sigma - 1}{\sigma}$, thus $L = \frac{\sigma - \mu}{\sigma}$.

[181] Specifically: $\Theta_r \equiv \Xi_r \frac{\mu}{\sigma - 1} \left(\lambda_r + \sum_{s \neq r} t_{sr}{}^{1-\sigma} \lambda_s \right)^{\frac{\mu - \sigma + 1}{\sigma - 1}}$, where for each region: $\Xi_{A1} \equiv \rho(1 - 2\theta)$, $\Xi_{A2} \equiv (1-\rho)(1 - 2\theta)$, $\Xi_B \equiv \theta$ and $\Xi_C \equiv \theta$.

[182] The name 'location effects' is used as in Baldwin *et al.* (2003, ch.12).

inside brackets shows the direct effect of preferential trade liberalisation on local prices, while the expression between parentheses accounts for indirect price effects, which operate through industry relocation.

To be more illustrative, in the case of domestic region *A1*:[183]

$$\frac{\partial V_{A1}}{\partial \tau_{FTA}} = \Theta_{A1}\left\{\frac{\partial t_{FTA1}{}^{1-\sigma}}{\partial \tau_{FTA}}\lambda_B + \left[\left(1 - t_{GE}{}^{1-\sigma}\right)\frac{\partial \lambda_{A1}}{\partial \tau_{FTA}} + \left(t_A{}^{1-\sigma} - t_{GE}{}^{1-\sigma}\right)\frac{\partial \lambda_{A2}}{\partial \tau_{FTA}} + \left(t_{FTA1}{}^{1-\sigma} - t_{GE}{}^{1-\sigma}\right)\frac{\partial \lambda_B}{\partial \tau_{FTA}}\right]\right\} \quad (24)$$

The first term inside curly brackets shows the welfare-improving effect that a fall in prices of goods imported from *B* provokes. The second expression (between brackets) reveals that production shifting has three indirect effects that depend on exchange-costs differentials across regions. Specifically, if firms located inside the bloc have higher accessibility to *A1*'s market than firms located in RoW, relocation towards (beyond) the bloc may benefit (harm) consumers in region *A1*.

In order to determine what the welfare effects of RI are within the multiple scenarios, we proceed to run numerical simulations, which results are summarised by Figures 2 and 3 in Appendix C3.8. As one could expect from the results in previous sub-sections, while RoW's welfare level tends to diminish within every scenario due to industry delocation; *B*'s consumers are very likely better off since capital inflows are the most probable ones, and because industry relocation towards domestic country becomes less welfare-reducing for *B*'s residents as intra-bloc liberalisation takes place.

In the case of domestic regions, *A1* tends to gain in terms of well-being, and *A2* seems to be unlikely damaged. *A2*'s welfare may decrease when the following holds: the domestic country is very large, there is a gate effect and *A2* is small (under-industrialised). Furthermore, in this peculiar scenario, both the domestic country and the bloc as a whole tend to suffer a reduction in welfare levels after intra-bloc trade barriers fall below certain critical value.[184]

This result, which is not general but very specific, can be taken as a counterexample to the one found by Baldwin *et al.* (2003, ch.14); namely, that in the FC model the degree of delocation within the bloc is small enough to ensure that all member countries are better off after any level of preferential liberalisation. The presence of a gate effect in the model presented here reinforces agglomeration, making

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[183] Welfare impacts in *A2* are very similar to those of *A1* residents. In Appendix C3.8, we present the derivatives of V_B and V_C.

[184] Total welfare for each of those territories was defined as the simple sum of the indirect utility levels of their component regions.

delocation stronger than in the standard FC; as a consequence, welfare in the more disadvantaged region can decrease.

To sum up, while RoW is in general terms 'the loser' in this story; for member countries and the bloc as a whole preferential trade liberalisation tends to be a welfare-improving policy. Moreover, even though domestic delocation may take place and regional inequalities tend to be deepened; domestic welfare may increase, and every region is very likely better off in terms of real income.

3.5. Concluding Remarks

Following Henderson's (1996, page 33) suggestion, the focus of this chapter is to analyse the spatial effects of preferential trade liberalisation on the internal geography of a member country when different geographical scenarios are considered. Coinciding with the conjecture expressed in the Introduction, this chapter finds that the geographical position of different sub-national territories together with their pre-integration industrial profile determines the luck of each region during and after a RI process.

The theoretical analysis proposed helps to understand how economic activities may relocate within the bloc, whether some more (less) developed regions or border (remote) zones may attract (deter) capital inflows and, consequently, how well-being could be modified. As a result, it also makes evident there could be place for regional policy interventions attempting to, for instance, lessen some undesirable RI effects –*e.g.* internal trade costs and, at least, some portion of external ones are areas where domestic authorities could conveniently intervene in this regard.

The chapter contributes to the literature in three main ways. First, it finds preferential trade liberalisation tends to fosters domestic divergence –and to deepen initial imbalances– favouring location within the region with access advantage to the bloc; though it also shows this result may be reversed in particular 'pre-integration' scenarios. Second, since spatial outcomes are highly dependent on size imbalances and accessibility disparities, it points out preferential liberalisation could be desirable in terms of location for some regions that might have been against unilateral liberalisation. Finally, the chapter finds that though the most likely outcome is every territory inside the bloc –*i.e.* every domestic region, the domestic country and the bloc as a whole– gaining in terms of well-being, in some peculiar scenarios the integrated territory could suffer a reduction in welfare.

Coming back to the MERCOSUR example presented in the Introduction, but being very careful in deriving conclusions from our theoretical analysis, the results seem to suggest that from the point of view of Argentina within MERCOSUR –in a scenario where θ equals 3/8 since Argentina is small in comparison with the RoW and its preferential partner Brazil– the picture seems no very promising since firms would tend to move towards that partner. However, if central-eastern regions of Argentina take advantage of their better access to the bloc and of their pre-integration higher level of industrialisation –as shown in Chapter 2– that capital outflow may be considerably lessened and those border regions can be greatly benefited –in particular, as a result of capital inflows from the RoW. On the other hand, less developed and more remote regions –such as Patagonia and some western areas– would be very likely damaged.

Indeed, from the explanatory spatial data analysis of Chapter 2 we know location within Argentina has changed after MERCOSUR enactment. The pattern of location effects seems to show that, during MERCOSUR days, manufacturing activities have spatially concentrated within border and initially more industrialised territories. On the other hand, the remotest provinces of Patagonia seem to have lost manufacturing activity. Therefore, we could hypothesise that market-access and market-crowding effects may have played a role shaping the Argentinean industrial landscape between 1993 and 2005 in the manner our model predicts.

As regard the model, some of its stark (or hopeless) predictions may be however eased by the introduction of some more realistic features, such as comparative advantage differences across regions and intra-industry linkages, among others. Indeed, in the case of Argentina within MERCOSUR the role of both features might be decisive in shaping relocation inside the bloc. Taking into consideration the Argentinean geographical and infrastructure reality, accessibility differences across domestic regions seem to be not a binary characteristic, *i.e.* 'to be or not to be' a gate region, but a gradual feature. Therefore, it does not seem appropriate to model market accessibility through an all-or-nothing assumption as in this model; on the contrary, it is desirable to assume more close-to-reality trade costs.

The challenge for the next chapter is, then, to move from the setting presented here to other that introduces more realistic trade costs, assumes vertical linkages among firms and encompasses comparative advantage. The idea is to take advantage of the greatest asset of the FC model, its simplicity, to introduce these new assumptions without losing analytical parsimony.

Chapter 4:

REGIONAL EXPORT PERFORMANCE. FIRST NATURE, AGGLOMERATION ... AND DESTINY? THE ROLE OF INFRASTRUCTURE[185]

4.1. Introduction

Within large and internally dissimilar countries, regional export performance is, at first sight, a matter of destiny. A highly varying geographical landscape (topography, climate, environment, etc.), big internal distances, and huge regional differences in terms of physical accessibility tend to constrain regional production and consumption profiles inside them. In addition to these first nature characteristics, both market and non-pecuniary interactions tend to delineate the spatial distribution of economic activities within their territory. Flows of ideas and knowledge, movement of factors, vertical linkages, trade flows and factor accumulation likely stimulate agglomeration and dispersion processes, which ultimately shape the economic landscape of the countries. To sum up, the interplay between first nature and second nature tend to determine the pattern of production and consumption in each region and, hence, their exporting capabilities.

But... is it just a matter of destiny? In fact, the way in which that interplay occurs and the chances for agglomeration forces to emerge ultimately depend on the extent of interconnection within and across countries –namely, the spatial scope of market accessibility, migration, knowledge diffusion, etc. Indeed, which of these phenomena explains relatively more of the resulting pattern of production and trade ultimately depends on their relative strength within each particular geographical area, along with regional first nature characteristics and history.[186] Therefore, location and export performance is not a matter of irreversible destiny, but one that can be altered or even shaped by accurately intervening at its basis in account of either efficiency or equity matters.

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[185] This chapter is an updated part of a paper published in *Perspectivas* –the journal of the Corporación Andina de Fomento (CAF)– on June 2008, and presented at the IX Latin American Meeting on Economic Theory (2008) and the XLIV Annual Conference of the Argentine Association of Political Economy (2008). We thank very much Alberto Díaz Cafferata, Germán González, Jorge Streb, Valentina Viego and other participants for their very helpful comments and suggestions. We are also grateful to Gianmarco Ottaviano for his early suggestions.

[186] History matters; processes occurred in the past may restrict others in progress.

In the last thirty years, NTT and NEG have stressed the role played by market accessibility in determining the distribution of increasing returns to scale activities across countries and interior regions. Further, recent theoretical extensions have proposed that regional export performance is driven by that basic force, which assumes a dual dimension when firms are vertically linked, namely: the real access to purchasers for products local firms sell, and the real availability of suppliers for intermediates goods those firms use.[187] Within this framework two elements appear as principal targets when attempting to shape destiny: trade costs and localised assets. As it has been defined in the Introduction of this thesis, the former comprises all those features that limit or even preclude trade flows; whilst the latter corresponds to those modifiable assets that make local agents particularly efficient, and thus more competitive, for producing and exporting certain goods. This is precisely the case of physical infrastructure, specially related to local transport, energy, communication and so on.

As McCann and Shefer (2004) point out in their discussion the relationship between transport infrastructure and location are nowadays central for understanding and, hence, designing policies and projects to foster regional development. Indeed, a clear evidence of the popularity infrastructure issues have nowadays is given by the multiplication of studies on infrastructure impacts and the proliferation of regional initiatives intended to develop infrastructure projects. We can mention, for instance, the contributions of Estache and Fay (2007) reviewing current debates on infrastructure policy, Mu and van de Walle (2007), Grigoriou (2007), Iimi and Smith (2007) and Hallaert *et al.* (2011) assessing the impacts of infrastructure investments in Asian, African and developing countries and the broad report of the World Bank (2009). As regards those initiatives, we can refer to the World Bank's and the African Development Bank's projects (Buys *et al.*, 2006) and, more close to Argentinean interests, the Fund for Structural Convergence of MERCOSUR (*Fondo de Convergencia Estructural*, FOCEM) and the Initiative for the Integration of the South American Regional Infrastructure (Vega Alvear, 2002; IIRSA, 2007).

Within the academia, as it is reviewed in the following section, many works have already studied the interaction between, on the one hand, localised assets –such as infrastructure– and trade costs and, on the other, the levels and patterns of trade. Specifically, two different strands of theoretical literature have considered either,

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[187] The adjective 'real' indicates that both concepts, demand and supply access, acknowledge for the fact that the mass of customers/suppliers improve market access (market size effect), while the number of competitors (competition or market-crowding effect) and the level of trade costs across regions (hub effect) worsen it.

infrastructure only affects trade costs –mostly within the NTT and NEG tradition– or, instead, it directly influences production by reducing its costs –*i.e.* growth literature.[188]

The present chapter makes a theoretical contribution to this literature. Specifically, it syntheses the previous positions by addressing the role played by both transport costs and production infrastructure on intra-country export performance. In other words, differently from previous models, this chapter makes a theoretical distinction among the effects of infrastructure on each firms' production functions and on transport costs, which may help to more properly explain location of firms and, hence, regional export performance. In doing this, as it has been anticipated in Chapter 3, it builds on the FC model introducing vertical linkages, comparative advantage across regions and more realistic trade costs. Further, a second version of this setting is presented, which assumes a multi-industry tradable sector though disregarding vertical linkages. Both models provide for empirically estimable specifications that will be used in Chapters 5 and 6 to study sub-national units' external trade in Argentina and MERCOSUR member countries, respectively.

The remainder of the paper is organised as follows, section 2 reviews theoretical antecedents and explains how this chapter intends to contribute with this literature. The next section sets up the general model that specifically addresses the role played by transport costs and regional infrastructure; and section 4 presents a second version of this setting. Finally, section 5 presents some concluding remarks.

4.2. Background

From the theoretical perspective, traditional answers to the above concerns have come from Traditional Trade theory, Location theory and Regional science. More recently, NTT and NEG have complemented those answers. Within this strand, some authors have explicitly introduced assumptions related with either the functional form of trade costs or infrastructure issues.[189]

In this respect, Martin and Rogers (1995) pioneer introducing public infrastructure in a setting where infrastructure is assumed to impose lower costs on

[188] Some empirical papers, measuring the actual impact of those features on bilateral flows, seem to have confirmed the theoretical predictions.

[189] Previously, though the importance of infrastructure for productivity and economic growth had been widely documented, very few studies explored the link between infrastructure and trade. One of those exceptions is Bougheas *et al.* (1999) who, within a Dornbusch-Fischer-Samuelson (1977) Ricardian model, assume transport costs inversely depend on the level of infrastructure.

trade and to comprise *"any facility, good, or institution provided by the state which facilitates the juncture between production and consumption"* (page 336). The authors, who examine the impact of infrastructure on industrial location when trade integration takes place, find that firms tend to locate in countries with better domestic infrastructure; in addition, they uncover high levels of international infrastructure and strong increasing returns to scale magnify industrial relocation.[190] Within a multi-country set up, Behrens *et al.* (2007a) explicitly model a transport-cost function that acknowledges for the fact that firms choose among roads aiming to minimise transport costs. The authors conclude that improvements in transport infrastructure, which reduce trade costs, have spatially limited impacts.

Within the NEG approach, Baldwin *et al.* (2003, ch. 17) present a growth model that assumes infrastructure can affect both domestic and international trade costs. They find results for relocation which are in line with those of Martin and Rogers, though exacerbated due to market size endogeneity. In the same vein, with a linear model that allows for domestic inequalities and labour mobility, Behrens (2004b) concludes that whereas trade combined with poor domestic infrastructure may exacerbate spatial inequalities, better local infrastructure may favour a more balanced development.

To sum up, these models implicitly or explicitly assume infrastructure improvements are trade-cost reducing, and thus affect location, export performance and disparities across regions. They disregard, however, the role infrastructure may play like an incentive (or a constraint) to the production process itself.

On the contrary, authors in other areas of study do have highlighted this role. For instance, Arrow and Kurz (1970) and Barro (1990) stress the substitutability of public infrastructure and private capital in the production function. The authors consider public capital generates a flow of services comparable to productive services; that is the case of transportation, water, electric power, etc. Other studies, like Bougheas *et al.* (2000), Brakman *et al.* (2002), Dembour and Wauthy (2009), Egger and Falkinger (2006), Holtz-Eakin and Lovely (1996) and Justman *et al.* (2005), acknowledging that public infrastructure is an important aspect of competitive location policy, sustain that it directly affects firms' production costs or profits.

Trying to make a synthesis of both positions, which consider either, infrastructure only affects trade costs or, instead, it directly influences production, the present chapter proposes a theoretical distinction among the effects of infrastructure,

[190] Lanaspa and Sanz (2004) propose an extension of Martin and Rogers' setting to acknowledge for, besides domestic and international communication and transport infrastructure, both specific export and import infrastructure. The authors, who analyse the effects of infrastructure improvements on location and welfare, find that the better domestic and export infrastructure, the greater industrial concentration and the higher welfare.

dividing them between those concerning firms' production functions and those directly connected with trade across locations.

Thus, the main contribution is building a general equilibrium model that can be applied for empirical studies to uncover which of those forces are important in shaping the spatial economy and, in particular, that addresses transport costs in the line of authors who stress their role in NEG –such as Behrens *et al.* (2007a), Bosker *et al.* (2008, 2009b) and Combes and Lafourcade (2005). Moreover, though this setting cannot be 'structurally' applied (as it would be desired) to study Argentinean and MERCOSUR reality because of severe data limitations –as it will be clear from Chapters 5 and 6– it is developed in such a way that can be applied for structural-form estimations or calibrations in order to conduct counterfactual analyses.

4.3. The Model

We build on Robert-Nicoud's (2002) refinement of Martin and Rogers' (1995) model extending the setting to acknowledge for both infrastructure in a double role and trade costs *à la* Behrens *et al.* (2007a). Specifically, as it has been mentioned, the main contribution of this chapter is that theoretical split of infrastructure. Hence, the most important departure from Robert-Nicoud's FCVL model is related with the introduction of both: a) regional infrastructure within variable production costs, which in turn relies on endowment differences across regions –*i.e.* H-O comparative advantage– and b) transport infrastructure, which rests on a trade cost specification amenable to deal with different frictions hampering trade –which are almost indispensable when accomplishing empirical studies.[191]

The model displays the two mechanisms for profit equalisation across regions that characterised alternative NEG models, namely: re-localisation of firms –which relays on disembodied capital mobility, like in the previous chapter– and adjustments through costs of production. That is, two simultaneous processes endogenously determine the distribution of production across the space: firms relocate into those regions with higher operating profits, while production costs increase in more agglomerated areas reducing profits.

[191] Moreover, the setting also re-dimensions Robert-Nicoud's model into a multi-region setting. Nonetheless, these extensions are not costless. The framework has many regions and endogenous market sizes; therefore, equilibria may be multiple. This, in turn, limits aspirations to completely characterise spatial equilibria.

The world consists of R regions, $r=1,2,...,R$, symmetric in terms of tastes and technology; each hosting exogenously given masses of a labour (L_r), physical capital (H_r) and infrastructure services (M_r, or production infrastructure).[192] The former, $L_r > 0$, also represents the number of consumers in region r. The three types of endowments are uniformly owned and inelastically supplied by the population; all but capital is perfectly mobile across sectors and the only inter-regionally mobile factor (though disembodied) is H_r –as assumed and clarified in Chapter 3.[193]

There are two productive sectors: the modern or tradable sector Q which is assumed to provide one good as a continuum of horizontally differentiated N varieties –being n_r the sub-set of varieties produced in region r– and the traditional or non-tradable sector Z producing a homogeneous good.[194]

4.3.a- *Preferences and consumption demand*

Preferences of a typical resident of region r, defined over the two goods Q and Z, are represented by the following utility function, where Q_r and Z_r are consumption of the tradable and non-tradable good, respectively.[195]

$$U_r = Q_r{}^{\mu} Z_r{}^{1-\mu} \qquad (1)$$

Consumption of Q can be expressed as:

$$Q_r = \left[\sum_{s \in R} \int_{i \in n_s} q_{sr}^{Qfin}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \qquad (2)$$

where $q_{sr}^{Qfin}(i)$ is the quantity of tradable variety $i \in [0, n_s]$ produced in region s and consumed in r, $\mu \in]0,1[$ is the weight of good Q in utility and $\sigma \in]1, \infty]$ is the elasticity of substitution between any two varieties. Since the sector of interest in this work is Q, we continue our exposition focusing on it, confining the treatment of sector Z to Appendix C4.1.

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[192] Public infrastructure services account for energy (*i.e.* gas and electricity), telecommunications, provincial roads, national airports, among others. That is, they represent those localised assets that directly influence production costs, profits and thus incentives to locate in different regions.

[193] As in the previous chapter, we assume capital owners reside and expend money in their region of origin, while they offer their factor services in any region.

[194] This sector can be thought as delivering commercial services and local goods.

[195] As mentioned in Chapter 3, we should also include the constant $\mu^{\mu}(1-\mu)^{(1-\mu)}$ in the utility function, but this plays no role in the analysis.

The representative consumer in each region maximises its two-tier utility function. First, she/he decides the amounts of goods Q and Z that he/she will optimally consume; and after that, determines her/his demands for each variety.[196] As usual in the DS setting, optimal direct demands are:

$$q_{sr}^{Qfin}(i) = \frac{p_{sr}(i)^{-\sigma}}{P_r^{1-\sigma}} \mu Y_r \qquad (3)$$

where $p_{sr}(i)$ is the price of variety i produced in region s and consumed in region r, and P_r is the price index in region r.[197] Thus, the quantity demanded for any variety produced in s by the representative consumer of region r depends: positively on the price index in his/her region and on her/his income and negatively on the price of this variety in r.[198]

Let express the price index as:

$$P_r = \left[\sum_{s \in R} \int_{i \in n_s} p_{sr}(i)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} \qquad (4)$$

Finally, the indirect utility function of region r representative consumer can be written as:

$$V_r = \frac{Y_r}{P_r^{\mu} p_r^{1-\mu}} \qquad (5)$$

4.3.b- Technology and intermediate demand

It is assumed that every variety of good Q is produced with the same technology in every region, under IRS and monopolistic competition with free entry. The production of $x(i)$ units of variety i requires a fixed amount F of capital and a variable amount $\beta x(i)$ of a Cobb-Douglas composite input.

This composite input combines labour with price w_r and share α, infrastructure services with price m_r and input share γ, and a combination of intermediate varieties

[196] Optimal expenditure in goods Z and Q are: $p_r^Z Z_r = (1-\mu)Y_r$ and $P_r Q_r = \mu Y_r$. P_r is the CES price index in r for the tradable good.

[197] Since the model rules out savings, regional income is totally expended in final consumption, that is: $Y_r = E_r^{Qfin} + E_r^Z$, where $E_r^{Qfin} = \mu Y_r$ denotes final expenditure in the manufacturing good and $E_r^Z = (1-\mu)Y_r$ stands for expenditure in the homogeneous good.

[198] As it can be noticed, σ is the perceived elasticity of demand; therefore condition $\sigma > 1$ is in fact imposed as a regularity condition.

with price P_r and input share ρ. It is also assumed $\alpha + \gamma + \rho = 1$.[199] Thus, the implicit cost function of a firm producing variety i in region r is given by:

$$TC_r^Q(i) = \pi_r F + \beta x_r(i) w_r^{\alpha} m_r^{\gamma} P_r^{\rho}$$

where π_r is both rental rate of capital in region r and firm's operating profit under free entry.[200] For simplicity, it is assumed each firm requires one unit of capital ($F = 1$); thus the fixed cost equals the equilibrium rental rate. Hence, total cost is:

$$TC_r^Q(i) = \pi_r + \beta x_r(i) w_r^{\alpha} m_r^{\gamma} P_r^{\rho} \qquad (6)$$

From now on, let $\Psi_r \equiv w_r^{\alpha} m_r^{\gamma} P_r^{\rho}$ denotes the price of the Cobb-Douglas composite input. Note that due to the form fixed costs assume $N = H$ and $n_r = h^r$, with H denoting world capital endowment and h^r standing for the amount of capital employed in region r.[201]

Since firms' optimisation programme is formally equivalent to that of consumers within DS setting, a typical firm in region r demands the following amount of intermediates:[202]

$$q_{sr}^{Q\,\text{int}}(i) = \frac{p_{sr}(i)^{-\sigma}}{P_r^{1-\sigma}} \rho\beta\Psi_r x_r(i) \qquad (7)$$

Thus, the n_r firms located in region r require $n_r q_{sr}^{Q\,\text{int}}(i)$ units of each variety. Further, making a parallel with consumer's optimal demands (3), the expenditure those n_r firms devote to purchase intermediate inputs can be denoted by $E_r^{Q\,\text{int}} = n_r \rho\beta\Psi_r x_r(i)$.[203]

Finally, the quantities of other factors of production that a typical firm in region r requires can be expressed as follows:

$$l_r^Q(i) = \frac{\alpha}{w_r} \beta\Psi_r x_r(i) \qquad (8) \qquad \text{and} \qquad M_r^Q(i) = \frac{\gamma}{m_r} \beta\Psi_r x_r(i)$$

(9)

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[199] The composite of intermediate varieties has exactly the same form as the combination of varieties consumed by individuals. Indeed, $Q_r^{\text{int}} = \left[\sum_{s \in R} \int_{i \in n_s} q_{sr}^{Q\,\text{int}}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}$ where the elasticity of substitution between varieties is the same for consumption and production.

[200] The free entry-exit assumption precludes pure profits in sector Q; then, operating profits just cover capital reward.

[201] Thus, $H \equiv \sum_r H_r = \sum_r h^r$.

[202] By Sheppard's lemma and Roy's identity.

[203] Note that intermediate expenditure in region r is defined as: $E_r^{Q\,\text{int}} \equiv n_r \sum_{s \in R} \int_{i \in n_s} p_{sr}(i) q_{sr}^{Q\,\text{int}}(i) di$.

4.3.c- *Trade costs*

As usual in NEG models, we assume trade of each variety of good Q is subject to Samuelson's iceberg costs. This means that for one unity of differentiated good produced in region r to reach region s, $t_{rs} \in [1+\varepsilon, \infty[$ units must be shipped. Nonetheless, differently from many NEG settings, we enhance the structure of trade costs –specifically, transport costs– following Behrens *et al.* (2007a).

Our setting intends to address the issue many authors have already raised about the importance of accurately modelling and measuring the ample spectrum of frictions that hamper trade, such as physical trade barriers, policy measures and cultural differences across regions that limit trade flows.[204] Therefore, we assume trade costs from region r to region s are a multiplicative combination of policy barriers to trade (τ_{rs}), transport costs (δ_{rs}) and other cultural and spatial k determinants of trade (λ_{rs}^{k}) such as contiguity, common language, etc. That is:

$$t_{rs} = e^{\tau_{rs}} \delta_{rs}{}^{\phi} e^{\sum_k \varphi_k \lambda_{rs}^k} \qquad (10)$$

with: $\tau_{rr} = 0$, $\lambda_{rr}^{k} = 0$, and τ_{rs} that can differ from τ_{sr}. Thus, t_{sr} may differ from t_{rs}, while $t_{rr} = \delta_{rr}{}^{\phi}$.[205] Note that region-specific proxies can also be present since the following may hold: $\lambda_{rs}^{1} = \lambda_{rq}^{1} = ... = \lambda_{r}^{1}$ or, alternatively, $\lambda_{rs}^{2} = \lambda_{qs}^{2} = ... = \lambda_{s}^{2}$.

Let explain equation (10) a bit more. Instead of maintaining the specification of Chapter 3, we opt for an expression that could be more directly applied for empirical studies.[206] As Bosker and Garretsen (2008, 2009b) argue, in empirical NEG papers the unavailability of trade costs data requires the approximation of trade costs through a trade cost function; and the multiplicative form is by far the most commonly used in that literature and international trade one.[207]

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[204] The list of authors includes: Combes and Lafourcade (2005), Eaton and Kortum (2002), Hummels (2001), Lafourcade and Thisse (2011) and Spulber (2007), among others.

[205] We could further assume that δ and τ can vary across varieties and that δ has a domestic portion and an external one. While we prefer to simplify our specification leaving the former issue for the extension in section 4 where J tradable goods are assumed, the second feature is indeed allowed by adopting Behrens *et al.*'s (2007a) arithmetic as we explain below –and introduced in Chapter 5.

[206] Note that the additive trade cost function due to its non-linearity imposes estimation difficulties, limiting its usefulness.

[207] Though this functional form could be regarded as somewhat arbitrary –indeed, virtually every empirical study in NEG uses arbitrary trade cost functions– the intention here is to link trade costs to the most relevant observable cost proxies when accomplishing empirical work. Note this function, differently from the additive one, implies that the marginal effect of a change in each trade cost component depends on the magnitude of all other components; namely: $\frac{\partial t_{rs}}{\partial \delta_{rs}} = \frac{t_{rs}\phi}{\delta_{rs}}$, $\frac{\partial t_{rs}}{\partial \tau_{rs}} = t_{rs}$ and $\frac{\partial t_{rs}}{\partial \lambda_{rs}^{i}} = t_{rs}\varphi_i$.

Expression (10) also proposes a power distance function, which is the standard choice in the empirical trade literature and exponent functions in the case of policy barriers and cultural and spatial features. As Fingleton and McCann (2007) argue, the power distance function –*i.e.* standard in transport and logistic literature– implies transport costs are concave in distance; the alternative functional form (the exponential) implies, instead, transport costs are convex in distance and imposes a very strong distance decay.

Finally, we introduce a particular specification of transport costs. They are modelled in a simple but illustrative way that tries to introduce the effect physical infrastructure triggers on transportation (transport infrastructure). Following Combes and Lafourcade (2005), it can be specified that the cost of shipping commodities across space depends on the network of roads, railways and waterways available, the taxation system in force, the ease of access to ports, airports and border crossings and the prevailing market structure in the transport industry, among other related issues. This is the second effect of infrastructure in our model. First, we referred to those effects concerning the production functions of firms; here, we introduce those affecting interregional trade.

Hence, and adopting Behrens *et al.*'s arithmetic, we assume all regions contain one node of a transportation network –denoted by s if located in region s– which is connected to other nodes around the world by a set of edges E; and we denote by $(r,s) \in E$ the edge linking nodes r and s. We called path P to a sub-set of edges needed to be 'hiked' in order to joint two particular nodes; and we imagine there is place for both types of paths: single-edge ones between neighbour nodes, and multiple-edge paths linking any other pair of nodes.

As it ca be inferred, more than one potential path connecting two particular nodes might exist; $P \in P_{rs}$ where P_{rs} denotes the set of paths connecting r and s. Let stand $c_{oq}>1$ for the 'iceberg coefficient' of edge (o,q), which measures transport costs that arise due to the existence of physical trade barriers –such as geographic accidents (mountains, lakes, etc.), distance, etc.– between nodes o and q. Since transport costs of connecting any two particular nodes may add up to different totals, let assume arbitrage by profit-maximising firms ensures transportation always occurs along the lowest cost path. Moreover, since alternative modes of transport may exist –which indeed interact and have interfaces among them– let further assume that arbitrage ensures transportation is always done using the cheapest mode. Formally, the transport cost between nodes r and s is the overall iceberg cost calculated for the cheapest mode of transport along the minimum cost path:

$$\delta_{rs} \equiv \min_{P \in P_{rs}} \prod_{(o,q) \in P} c_{oq} \quad \text{with} \quad \prod_{(o,q) \in P} c_{oq} \equiv c_{rp_1} c_{p_1 p_2} \ldots c_{p_n s} \qquad (11)$$

where $\delta_{rs} = \delta_{sr}$. We additionally allow for internal distance and other physical barriers within any region, so $\delta_{rr} \geq 1$. Intuition on this transport cost function is given in sub-section 4.3.g.

4.3.d- Equilibrium in regional factor markets

As it is standard in the NEG literature, every factor of production is assumed to be fully employed. For the case of immobile factors, regional supply must equal the sum of input demands that stem from both the competitive sector Z and monopolistic firms located in the region.[208]

Applying expressions (8) and (9) together with sector Z's input demands –see (C4.1) and (C4.2) in the Appendix– and using the regional income equation $Y_r = L_r w_r + M_r m_r + H_r \pi$, we can express equilibrium factor prices as follows:[209]

$$\begin{aligned} w_r &= \frac{\alpha}{\alpha+\gamma}\frac{(\mu Y_r - H_r \pi)}{L_r} + \eta \frac{(1-\mu)Y_r}{L_r} \\ m_r &= \frac{\gamma}{\alpha+\gamma}\frac{(\mu Y_r - H_r \pi)}{M_r} + (1-\eta)\frac{(1-\mu)Y_r}{M_r} \end{aligned} \qquad (12)$$

4.3.e- Optimal scale of production

As it is well-known, within DS setting it is optimal for firms to apply a fixed mark-up over its marginal cost, being purchasers who pay all the costs of trade. Thus equilibrium demand prices are:

$$p_{rs}(i) = \frac{\sigma}{\sigma-1} t_{rs} \beta \Psi_r \qquad (13)$$

Introducing these expressions into CES price index formula (4), we get:

$$P_r = \frac{\sigma}{\sigma-1}\beta\left[\sum_{s\in R} n_s t_{sr}{}^{1-\sigma} \Psi_s{}^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \qquad (14)$$

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[208] Therefore, $L_r = n_r l_r^Q + l_r^Z$ and $M_r = n_r M_r^Q + M_r^Z$.

[209] Note that capital services, unlike other factor services, receive a non-regional specific return. The model assumes the reward of capital services always equals world's weighted-average operating profits, $\pi = \sum_{s\in R} \frac{n_s}{N} \pi_s$.

Hence, price indices are inverse functions of competition coming from firms located everywhere; that is, price indices are smaller the smaller are trade and production costs in the own region, and the larger is the number of firms everywhere.[210]

Each firm's production will equalise the sum of intermediate and final demand –both, local and external– of the variety it produces, plus the volume 'melted' in transit:

$$x_r(i) = \sum_{s\in R} x_{rs}(i) = \sum_{s\in R} t_{rs}\left[n_s q_{rs}^{Q\,\text{int}}(i) + q_{rs}^{Qfin}(i)\right] \qquad (15)$$

Due to the free entry-exit assumption, this optimal scale of production must ensure zero pure profits. Consequently, operating profits can be expressed as a function of the optimal scale $x_r^*(i)$ as $\pi_r = \frac{\beta\Psi_r}{(\sigma-1)} x_r^*(i)$.[211] Replacing the optimal scale of production (15) into this last expression, we just re-express equilibrium operating profits of any firm in region r as:[212]

$$\pi_r = \frac{\Psi_r^{\;1-\sigma}}{\sigma} RMP_r \quad (16) \qquad \text{with} \qquad RMP_r \equiv \sum_{s\in R} RMP_{rs} = \sum_{s\in R}\left[\frac{t_{rs}^{\;1-\sigma}\left(E_s^{Qfin} + E_s^{Q\,\text{int}}\right)}{\sum_{q\in R} n_q t_{qs}^{\;1-\sigma} \Psi_q^{\;1-\sigma}}\right]$$

(17)

which represents the sum of region r Real Market Potential in every region. Thus, profitability of any region essentially depends on two elements: the prevailing cost of production and its *RPM*, which can be interpreted as a generalised measure of accessibility from that region towards all the existent markets, included its own.

Indeed, expression (17) denotes the Real Market Potential of region r, which resembles the idea of Harris (1954). This measure weighs up the positive effect of accessing any market s from region r –in the numerator, that positively depends on expenditure in good Q in market s, and negatively on trade costs– and the negative

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[210] That is why manufacturing price indices are regarded as 'multilateral trade resistance' variables by Anderson and van Wincoop (2003). In Brakman *et al.*'s (2004, page 447) words: "*A low price index reflects that many varieties are produced in nearby regions and are therefore not subject to high transportation costs and this reduces the level of demand for local manufacturing varieties*".

[211] Using final and intermediate demands (3) and (7), together with equations (13) and (14), the optimal scale of production can be expressed as: $x_r^*(i) = \frac{\sigma-1}{\sigma\beta}\Psi_r^{\;-\sigma}\sum_{s\in R}\left[\frac{t_{rs}^{\;1-\sigma}\left(E_s^{Qfin}+E_s^{Q\,\text{int}}\right)}{\sum_{q\in R} n_q t_{qs}^{\;1-\sigma}\Psi_q^{\;1-\sigma}}\right]$, with E_s^{Qfin} and $E_s^{Q\,\text{int}}$ denoting final and intermediate expenditure in region s, respectively.

[212] And the optimal scale of production can, hence, be re-expressed as $x_r^*(i) = \frac{(\sigma-1)}{\sigma\beta}\frac{RMP_r}{\Psi_r^{\;\sigma}}$.

effect of competition coming from firms located in every region, which is greater the smaller are trade costs, the larger is the number of firms and the smaller are production costs in that region.

4.3.f- Regional trade balances and global market clearing

To close the model we introduce R additional trade balances, which state that the value of sales from region r to all other regions including itself (exports plus domestic sales) –or, what is the same, the total value of production in region r– must equal the value of purchases that agents in region r make (imports and domestic consumption), *i.e.*:

$$n_r \sum_{s\in R} p_{rs}\left[n_s q_{rs}^{Q\text{int}}(i) + q_{rs}^{Qfin}(i)\right] = \sum_{s\in R} p_{sr} n_s \left[n_r q_{sr}^{Q\text{int}}(i) + q_{sr}^{Qfin}(i)\right]$$

If we first re-express (3) and (7) in terms of final and intermediate expenditure in sector Q, replace them into our trade-balance expression, then plug (13) and (14), and operate, we get:

$$n_r \Psi_r^{\,1-\sigma} RMP_r = \sum_{s\in R} n_s \Psi_s^{\,1-\sigma} RMP_{sr} \qquad (18)$$

Therefore, the total value of production in region r –the right hand-side of (18), denoted as G_r – directly depends on the number of firms located there and the *RMP* that benefits them, and it is inversely related with regional costs of production.

Finally, note that the value of world output in sector Q must equal the value of world expenditure in sector Q; formally, $\sum_{r\in R} n_r \sum_{s\in R} p_{rs}\left[n_s q_{rs}^{Q\text{int}}(i) + q_{rs}^{Qfin}(i)\right] = \sum_{r\in R}\left(E_r^{Qfin} + E_r^{Q\text{int}}\right)$. Following similar steps as before we find that the world value of Q production can be expressed as:

$$G \equiv \sum_{r\in R} G_r = \sum_{r\in R}\left(E_r^{Qfin} + E_r^{Q\text{int}}\right) \qquad (19)$$

4.3.g- Instantaneous and spatial equilibria

As it is standard in NEG models, though there are no real dynamics, the equilibrium is analysed at two different moments; namely, the short-run and the long-run. The first one is understood as a circumstance in which: capital hired in each region are given and immobile and capital owners everywhere earn the world average reward while regional operating profits can differ.[213] Therefore, the instantaneous equilibrium is characterised by consumers maximising their utility, firms maximising their profits and all market clearing for an exogenously given distribution of firms, n_r.

On the other hand, the long-run spatial equilibrium implies that operating profits are indeed equalised across regions. During this period, capital is perfectly mobile and capital owners seek the higher nominal return. Therefore, inter-regional distribution of capital and, hence, n_r adjust so that $\pi_r = \pi$ for any active firm. Formally, if $\pi_r(\Gamma)$ denotes operating profits in region r when the spatial distribution of firms is $\Gamma = \{n_1, n_2, ..., n_R\}$, a spatial equilibrium arises at $n_r \in]0, N[\; \forall r$ (*i.e.*, is interior) when optimal rewards are equalised across regions, $\Delta\pi(\Gamma) \equiv \pi_r(\Gamma) - \pi_s(\Gamma) = 0 \quad \forall s \neq r$.[214]

Expressions (12), (14) and (16) together with profit equalisation define 4*R*+1 equations in the unknown variables –namely w_r, m_r, P_r, n_r and π– that characterise the model interior equilibrium.[215,216] The solution of this system, which defines the spatial distribution of industry $\Gamma^\circ = \{n_1^\circ, n_2^\circ, ..., n_R^\circ\}$, is a synthesis of the interaction between ensuing accessibility and attraction forces.[217]

Let give some intuition on how the latter occurs applying a heuristic analysis around interior equilibrium –related algebra is presented in Appendix C4.2.[218] When capital relocates, in response to profit differentials and due to the presence of vertical linkages, capital relocation simultaneously reduces the local price index of intermediates (the forward or cost linkage) and increases local firms' intermediate expenditure (the backward or demand linkage) fostering further agglomeration. On the other hand, competition across varieties increases (the market-crowding effect) and the price of some productive factors rises (the factor-price effect) hence, production

[213] In other words, as it has been stated in footnote 25, it is assumed that capital owners hold a perfectly diversified portfolio; each of them has the same share of each firm around the world.

[214] Nonetheless, it is worth noting that a spatial equilibrium could also arise at $n_r = 0$ for some $r \neq s$ when $\Delta\pi(\Gamma) \leq 0$.

[215] More precisely, these equations together with those corresponding to the competitive sector Z define a set of 6*R*+1 equations in the unknowns – w_r, m_r, P_r, π, n_r, p_r^Z and Z_r.

[216] Many NEG and NTT models allow for factor price equalisation (FPE) across regions by assuming costless trade of good Z. This paper precludes FPE for labour and infrastructure services by assuming the non-tradability of Z. Thus, our model is in the vein of Hanson (2005), Hanson and Xiang (2004) and Redding and Venables (2004).

[217] As Robert-Nicoud (2006) shows, the FCVL model is isomorphic to models that rely on other mechanisms such as skilled labour migration and capital accumulation; so it exhibits the same dynamic properties.

[218] This analysis is in line with the tradition in the NEG literature that typically resorts on informal methods when discussing the stability properties of models –methods which validity has been formally assessed by Baldwin (2001).

costs tend to rise in the region where new firms arrive.[219] Therefore, incentives for further agglomeration fall.

Which of these offsetting forces will prevail depends on the parameters values in the model. For instance, if trade costs and the share of varieties in production (with high elasticity of substitution) are low, tradable production may be distributed proportional to population size. On the contrary, if trade costs are high and intermediate varieties (with low elasticity of substitution) are an important input; then production can agglomerate in one or few regions. Thus, the spatial equilibrium is the result of complex relationships where accessibility and attraction forces together with initial conditions are determinant.

Throughout the relocation process, the role of infrastructure is twofold. On the one hand, availability of lower-cost infrastructure services in a certain region, M_r, creates profit differentials and thus, *ceteris paribus*, fosters spatial concentration of firms within that region. More intuitively, firms' access to cheaper sources of gas and electricity, paved and inter-connected roads, and competitive telecommunication systems reduces variable operating costs, amplifies capital reward (π_r) and, thus, fosters agglomeration.

On the other hand, infrastructure also affects the level of trade costs; it determines how intensely firms react to changes in surrounding stimulus, *i.e.* market access and competition effects. Other things been equal, the lower transport costs and the far-reaching spatial accessibility, the less spatially concentrated should be tradable production. In other words, upgraded transportation networks –such as roads, railways, waterways and their interfaces– improved border crossings, ports and airports and enhanced competition in the transport industry multiply the number and increase the quality of alternative paths connecting regions, P_{rs}. This, lastly, reduces the costs of available paths, and thus diminishes effective transport cost, δ_{rs}, modifying the *RMP* or real opportunities of firms located at region *r*.

[219] Our setting displays two dispersion forces: the local demand pull and the factor price pull.

4.3.h- Specification for exports

The theoretical expression for bilateral exports is given by:

$$X_{rs} = \frac{p_{rs}}{t_{rs}} n_r t_{rs} \left[n_s q_{rs}^{Q\text{int}}(i) + q_{rs}^{Qfin}(i) \right] \qquad (20)$$

First, $\frac{p_{rs}}{t_{rs}} n_r$ is replaced by the total value of production in region r, G_r.[220] Next, we replace (3) and (7) and consecutively (13) into the expression for bilateral exports. Using expenditure notation and arranging terms we get:

$$X_{rs} = aG_r t_{rs}{}^{1-\sigma} \Psi_r{}^{-\sigma} \left(E_s^{Qfin} + E_s^{Q\text{int}} \right) P_s{}^{\sigma-1} \qquad (21)$$

with $a \equiv \left(\frac{\sigma - 1}{\sigma\beta} \right)^{\sigma}$.

Further, we replace Ψ_r and t_{rs} into (21) and thus express bilateral exports as a function of factor prices, price indices, level of expenditure at destination, size of the region of origin (G_r) and trade costs:

$$X_{rs} = aG_r e^{(1-\sigma)\tau_{rs}} \delta_{rs}{}^{(1-\sigma)\phi} e^{(1-\sigma)\sum_k \varphi_k \lambda_{rs}^k} \left(w_r{}^{\alpha} m_r{}^{\gamma} \right)^{-\sigma} \left(E_s^{Qfin} + E_s^{Q\text{int}} \right) P_r{}^{-\rho\sigma} P_s{}^{\sigma-1} \qquad (22)$$

As it can be regarded, this equation is a reminiscence of the well-known gravity equation, where G_r and E_s are indicative of economic size. Intuitively, region *r* has a better export performance the higher are: local production of *Q* goods, partner's expenditure and partner's price index of the tradable good; and the smaller are: local prices of L_r and infrastructure services, local price index and trade costs with *s*.[221]

Besides considering some elements that are not present in the standard gravity equation –*i.e.* different kinds of trade cost apart from distance, comparative-advantage features and multilateral resistance terms *à la* Anderson and van Wincoop (2003), for details see Appendix C4.3– our specification accounts for the impact of vertical linkages, the role of production infrastructure and the specific effect of transportation (across its edges) on trade flows, each of which has particular comparative static effects on prices and trade flows. Even more, since production and transport infrastructure

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[220] Following Combes *et al.* (2008, ch.5), since preferences and technology are assumed identical in every region, every firm has the same optimal volume of production ($x_r^* = x^*$), thus expression $G_r = n_r p_r x_r^*$ can be written as $G_r = n_r p_r x^*$. Therefore, $\frac{p_{rs}}{t_{rs}} n_r = \frac{G_r}{x^*}$ can be approximated by G_r when x^* is just a very small fraction of G_r.

[221] P_s should be seen as a proxy for what Wolf (1997) calls remoteness; namely, two regions will trade more if they are relatively far from all other regions –*i.e.* they have relatively high price indices.

affect agglomeration and dispersion forces, the general-equilibrium outcome may differ with them –for an illustration see Appendix C4.4.

More importantly, since this specification is part of a system of equations that characterise the general equilibrium, there are relationships among variables –such as income, factor prices, etc.– that can be exploited. Therefore, differently from other 'gravity-related' approaches, the model can be applied for structural-form estimations or general equilibrium numerical calibrations in order to conduct counterfactual analyses, as it is suggested in recent papers –*i.e.* Balistreri and Hillberry (2006 and 2008), Balistreri *et al.* (2011), Behrens *et al.* (2010) and Corcos *et al.* (2010). Thus, apart from explaining location of firms and thus export performance across regions –which is the main objective of the following chapters– this framework can be used to evaluate policies, in particular transport and production infrastructure, since general equilibrium conditions are taken into account.

4.4. Another Related Model

In this section we briefly present a second version of the model that both introduces some simplifying assumptions as regards production process and structure of endowments and accounts for a multi-industry modern or tradable sector, instead of assuming vertical linkages.

The assumption made by the first setting –following the tradition in NEG– that every firm uses all the varieties produced as intermediate inputs including its own variety, seems not so unrealistic when one consider a sector including a vast range of commodities –*e.g* industial products. Nevertheless, when a large number of different goods –each offered as a continuum of horizontally differentiated varieties– are considered; then, to suppose that the production of every variety applies in its production process all the varieties of the wide range of goods seems not so plausible.

4.4.a- Main assumptions

<u>*Regions and endowments*</u>

As before, the world consists of R regions, $r=1,2,...,R$, symmetric in terms of tastes and technology. Each region hosts exogenously given masses of labour (L_r), physical capital (H_r) and infrastructure services (M_r). The former, $L_r > 0$, also represents the number of consumers in region *r*. The three endowments are uniformly owned and inelastically supplied by the population, all but capital is perfectly mobile across sectors and the only inter-regionally mobile factor (though disembodied) is H_r.

Sectors

There are two productive sectors: the non-tradable sector *Z* that produces a homogeneous good and the tradable sector *Q* which is assumed to provide a set of differentiated goods, *j*=1,...,*J*, each of them supplied as a continuum of horizontally differentiated Ω varieties –being denoted as ω=1,..., Ω.[222] We denote by Ω_r^j the set of varieties of good *j* produced in region *r* and n_r^j the mass of firms producing good *j* in region *r*.[223]

Production

It is assumed that every variety of good *j* is produced with the same technology in every region, under IRS and monopolistic competition with free entry. The production of $x^j(\omega)$ units of variety ω requires a fixed amount F^j of capital and a variable amount $\beta^j x^j(\omega)$ of a Cobb-Douglas composite input. This composite combines labour with price w_r and share α and infrastructure services with price m_r and input share γ, and it is assumed α + γ = 1. Thus, the implicit cost function of a firm producing variety ω of good *j* in region *r* is given by:

$$TC_r^j(\omega) = \pi_r F^j + \beta^j x_r^j(\omega) w_r{}^{\alpha} m_r{}^{\gamma} \qquad (23)$$

where π_r is both rental rate of capital in region *r* and firm's operating profit under free entry. For simplicity, it is assumed each firm requires one unit of capital ($F^j = 1$); thus the fixed cost equals the equilibrium rental rate. Hence, total cost is:

$$TC_r^j(\omega) = \pi_r + \beta^j x_r^j(\omega) w_r{}^{\alpha} m_r{}^{\gamma} \qquad (24)$$

The quantities of production factors that a typical firm in industry *j* and region *r* requires can be expressed as follows:

$$l_r^j = \frac{\alpha}{w_r} \beta^j w_r{}^{\alpha} m_r{}^{\gamma} x_r^j(\omega) \qquad (25) \qquad \text{and} \qquad M_r^j = \frac{\gamma}{m_r} \beta^j w_r{}^{\alpha} m_r{}^{\gamma} x_r^j(\omega) \qquad (26)$$

The non-tradable sector produces a homogeneous good under constant returns to scale (CRS) and perfect competition, requiring a variable amount ζZ_r of labour with share $\eta \in]0,1[$, and infrastructure services with input share $(1-\eta)$.

[222] The treatment of sector Z is, in general terms, the same as in the first model, see Appendix C4.1.

[223] Besides: $n_r = \sum_j n_r^j$ is the mass of firms producing tradable goods localised in region *r*; $N^j = \sum_r n_r^j$ represents the mass of firms producing good *j* around the world; and $N = \sum_r n_r$ the total mass of firms of sector *Q*.

Preferences and optimal demands:

The preferences of a typical resident of region r, are given by:

$$U_r = Z_r^{1-\mu} \prod_j \left(Q_r^j\right)^{\mu^j} \qquad (27)$$

where Q_r^j and Z_r are consumption of tradable good j and non-tradable good, respectively.[224]

Consumption of Q_r^j can be expressed as the CES sub-utility function:

$$Q_r^j = \left[\sum_{s \in R} \int_{\omega \in \Omega_s^j} d_{sr}^j(\omega)^{\frac{\sigma^j - 1}{\sigma^j}} d\omega \right]^{\frac{\sigma^j}{\sigma^j - 1}} \qquad (28)$$

where $d_{sr}^j(\omega)$ is the quantity of variety $\omega \in [0, \Omega_r^j]$ produced in region s and consumed in r, $\mu^j \in]0,1[$ is the weight of good j in utility, and $\sigma^j \in]1,\infty]$ is the elasticity of substitution between any two varieties of good j.[225]

Optimal direct demands are:

$$d_{sr}^j(\omega) = \frac{p_{sr}^j(\omega)^{-\sigma^j}}{\left(P_r^j\right)^{1-\sigma^j}} \mu^j Y_r \qquad (29)$$

where $p_{sr}^j(\omega)$ is the price of variety ω of good j produced in region s and consumed in region r, and P_r^j is the price index of good j in region r.[226]

The price index can be expressed as:

$$P_r^j = \left[\sum_{s \in R} \int_{\omega \in \Omega_s^j} p_{sr}^j(\omega)^{1-\sigma^j} d\omega \right]^{\frac{1}{1-\sigma^j}} \qquad (30)$$

Or alternatively as:[227]

$$P_r^j = \left[\sum_{s \in R} n_s^j \left(p_{sr}^j\right)^{1-\sigma^j} \right]^{\frac{1}{1-\sigma^j}}$$

Finally, the indirect utility function can be written as:

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[224] Remember, we should include constant $C_\mu \equiv \prod_j \mu^{j^{-\mu^j}} (1-\mu)^{\mu-1}$ in the utility function. In addition, $\sum_j \mu^j = \mu$, with $\mu \in]0,1[$.

[225] σ^j measures both price-elasticity and cross-elasticity of demand of any variety of good j.

[226] Regional income is totally expended in final consumption, that is: $Y_r = E_r^Q + E_r^Z$, where $E_r^Q = \sum_j \mu^j Y_r \equiv \sum_j E_r^j$. $E_r^Q = \mu Y_r$ denotes total expenditure in tradable goods and $E_r^Z \equiv (1-\mu) Y_r = p_r^Z Z_r$ stands for expenditure in the homogeneous good.

[227] From now on, we simplify notation disregarding varieties, ω.

$$V_r = \frac{Y_r}{\prod_j \left(P_r^j\right)^{\mu^j} p_r^{1-\mu}} \qquad (31)$$

<u>Trade costs</u>

As in the previous model, we assume trade of each variety is subject to Samuelson's iceberg costs, $t_{sr}^j \in [1+\varepsilon,\infty[$ and that Behrens *et al.*'s (2007a) function holds. Hence:

$$t_{rs}^j = e^{\tau_{rs}^j} \delta_{rs}^{j\,\phi} e^{\sum_k \varphi_k \lambda_{rs}^k} \qquad (32)$$

with: $\tau_{rr}^j = 0$, $\lambda_{rr}^k = 0$, and τ_{rs}^j that can differ from τ_{sr}^j. Thus, t_{sr}^j may differ from t_{rs}^j, while $t_{rr}^j = \delta_{rs}^{j\,\phi}$.

And where $\delta_{rs}^j \equiv \min_{P \in P_{rs}}{}^j \prod_{(o,q)\in P} c_{oq}$ with $\prod_{(o,q)\in P} c_{oq} \equiv c_{rp_1} c_{p_1p_2} \ldots c_{p_n s}$, $\delta_{rs}^j = \delta_{sr}^j$ and $\delta_{rr}^j \geq 1$.

4.4.b- Equilibrium in regional factor markets

For the case of immobile factors, regional supply must equal the sum of input demands that stem from both the competitive sector Z and the monopolistic firms located in the region. Thus:

$$\begin{aligned} w_r &= \frac{\alpha}{\alpha+\gamma} \frac{\mu Y_r - H_r \pi}{L_r} + \eta \frac{(1-\mu) Y_r}{L_r} \\ m_r &= \frac{\gamma}{\alpha+\gamma} \frac{\mu Y_r - H_r \pi}{M_r} + (1-\eta) \frac{(1-\mu) Y_r}{M_r} \end{aligned} \qquad (33)$$

4.4.c- Optimal scale of production

Equilibrium consumer prices are:

$$p_{rs}^j = \frac{\sigma^j}{\sigma^j - 1} t_{rs}^j \beta^j w_r^{\alpha} m_r^{\gamma} \qquad (34)$$

Hence, using expression (28') the CES price index can be expressed as:

$$P_r^j = \frac{\sigma^j}{\sigma^j - 1} \beta^j \left[\sum_{s \in R} n_s^j \left(t_{rs}^j\right)^{1-\sigma^j} \left(w_s^{\alpha} m_s^{\gamma}\right)^{1-\sigma^j} \right]^{\frac{1}{1-\sigma^j}} \qquad (35)$$

And the equilibrium operating profits of any firm in region *r* as:

$$\pi_r^j = \frac{\left(w_r^{\alpha} m_r^{\gamma}\right)^{1-\sigma^j}}{\sigma^j F^j} RMP_r^j \qquad (36)$$

where
$$RMP_r^j \equiv \sum_{s\in R} RMP_{rs}^j = \sum_{s\in R}\left[\frac{\left(t_{rs}^j\right)^{1-\sigma^j} E_s^j}{\sum_{q\in R} n_q^j {t_{qs}^j}^{1-\sigma^j}\left(w_q^{\alpha} m_q^{\gamma}\right)^{1-\sigma^j}}\right] \qquad (37)$$

4.4.d- Regional trade balances and global market clearing

To close the model we introduce *jR* trade balances, *i.e.*: $\sum_j n_r^j \sum_{s\in R} p_{rs}^j d_{rs}^j = \sum_{s\in R}\sum_i p_{sr}^i n_s^i d_{sr}^i$.

Re-expressing (29) in terms of expenditure, replacing this expression into the trade-balance expression then, plugging (34) and (35) and operating, we get:

$$\sum_j n_r^j \left(w_r^{\alpha} m_r^{\gamma}\right)^{1-\sigma^j} RMP_r^j = \sum_{s\in R}\sum_i n_s^i \left(w_s^{\alpha} m_s^{\gamma}\right)^{1-\sigma^i} RMP_{sr}^i \qquad (38)$$

Note that the value of world output in tradable sector must equal the value of world expenditure in the sector. Formally, $\sum_{r\in R}\sum_j n_r^j \sum_{s\in R} p_{rs}^j d_{rs}^j = \sum_{r\in R}\sum_j E_r^j$. Therefore, the world value of tradable production can be expressed as:

$$G \equiv \sum_{r\in R} G_r \equiv \sum_{r\in R}\sum_j n_r^j \left(w_r^{\alpha} m_r^{\gamma}\right)^{1-\sigma^j} RMP_r^j = \sum_{r\in R} E_r \quad (39)$$

4.4.e- Instantaneous and spatial equilibria

As it has been explained for the previous model, the instantaneous equilibrium is characterised by consumers maximising their utility, firms maximising their profits and all markets clearing for an exogenously given distribution of firms, n_r. On the other hand, the long-run spatial equilibrium implies that, formally: if $\pi_r(\Gamma)$ denotes operating profits in region *r* when the spatial distribution of firms is $\Gamma = \{n_1, n_2, ..., n_R\}$, a spatial equilibrium arises at $n_r \in \left]0, N\right[\ \forall r$ (*i.e.* is interior) when optimal rewards are equalised across regions, $\Delta\pi(\Gamma) \equiv \pi_r(\Gamma) - \pi_s(\Gamma) = 0 \quad \forall s \neq r$.

Expressions (35) and (36) define $2jR$ equations and expression (33) together with profit equalisation define $2R$+1 equations in the unknown variables $-w_r$, m_r, π and the jR dimensional ones P_r^j and n_r^j – that characterise the model interior equilibrium. The solution of this system, $\Gamma^\circ = \{n_1^\circ, n_2^\circ, ..., n_R^\circ\}$, is a synthesis of the interaction between ensuing accessibility and attraction forces.

4.4.f- Specification for exports

In this model, the theoretical expression for bilateral exports is given by:

$$X_{rs}^j = \frac{p_{rs}^j}{t_{rs}^j} n_r^j t_{rs}^j d_{rs}^j \qquad (40)$$

As for the previous setting we can re-express them as:

$$X_{rs}^j = a^j G_r^j \left(t_{rs}^j\right)^{1-\sigma^j} \left(w_r{}^\alpha m_r{}^\gamma\right)^{-\sigma^j} E_s^j \left(P_s^j\right)^{\sigma^j-1} \qquad (41)$$

with $a^j \equiv \left(\dfrac{\sigma^j - 1}{\sigma^j \beta^j}\right)^{\sigma^j}$.

Further, replacing τ_{rs}^j we get:

$$X_{rs}^j = a^j G_r^j e^{\left(1-\sigma^j\right)\tau_{rs}^j} \delta_{rs}^{j\,\left(1-\sigma^j\right)\phi} e^{\left(1-\sigma^j\right)\sum_k \varphi_k \lambda_{rs}^k} \left(w_r{}^\alpha m_r{}^\gamma\right)^{-\sigma^j} E_s^j \left(P_s^j\right)^{\sigma^j-1} \qquad (42)$$

As in the first model, we get an expression that accounts for the impact of vertical linkages, the role of production infrastructure and the specific effect of transportation (across its edges) on trade flows, which can be exploited for counterfactual general-equilibrium analyses.

4.5. Concluding Remarks

After carefully reviewing theoretical and empirical antecedents, we have set up a theoretical model that concentrates on transport costs and regional infrastructure as determinants of location and introduce those extensions proposed at the end of Chapter 3 –*i.e.* vertical linkages and comparative advantage.

As regards previous articles within the literature, our contribution is in line with the most recent approach that considers real road distances or travel costs. Further, it allows to separate the effects of transport infrastructure –more related to export corridors– from those of production infrastructure, effects which were somewhat mixed up in earlier studies; and permits to divide transport costs by edges, hence, for instance, to address the different role domestic transport costs and external ones may play.

Export equations derived from our settings are a synthesis of ensuing agglomeration and dispersion forces driving location. Reminiscences of the well-known gravity equation, these equations show that a better export performance is achieved the higher are: local production of the tradable good, partner's expenditure and price index for that good; and the smaller are: prices of local production factors and/or infrastructure services, local price index for the tradable good and trade costs with the partner. Moreover, the settings can be the basis for structural-form estimations or calibrations from which to calculate general equilibrium comparative statics, including potential welfare effects. In other words, they allow for proper regional policy evaluation, in particular as regard transport and production infrastructure.

Chapters 5 and 6 of this dissertation, limited in their scope due to data availability, present applications of those model-based gravity equations for Argentina and MERCOSUR member countries, respectively, aiming to verify whether intra-country export performance can be explained in terms of our frameworks. Specifically, the chapters aim at contributing to understand the Argentinean and MERCOSUR regional reality by answering (at least some of) the following questions: To what extent transport costs and regional infrastructure condition regional export performance? May infrastructure enhancement or the reduction of transport costs effectively help for changing regional competitiveness and market accessibility? Thus, could these policies help to turn the destiny of less developed regions?

Chapter 5:

REGIONAL EXPORT PERFORMANCE IN ARGENTINA. THE ROLE OF INFRASTRUCTURE[228]

5.1. Introduction

Within the academia, as it has been referred to in Chapter 4, many theoretical papers have studied the interaction between, on the one hand, localised assets and transport costs and, on the other, the levels and patterns of trade. Moreover, as it is surveyed in the following section, during the last decade many empirical articles have addressed this relationship finding evidence that seems to support some theoretical predictions.

The present chapter belongs to this strand of the literature. Specifically, it addresses regional export performance focusing on the role played by transport costs and localised infrastructure –related to local transportation, energy, etc. The objective is to assess whether regional export performance in Argentina, between 2003 and 2005, can be explained by means of a gravity specification inspired by the theoretical framework developed in Chapter 4. In other words, this chapter aims at answering the following question: To what extent transport costs and localised infrastructure may condition regional export performance in Argentina?

Though, as we mentioned in the Introduction of this dissertation, our initial idea had been to structurally estimate the equilibrium expressions of Chapter 4 for the case of Argentinean regions, we faced severe data limitations –already alluded to in Chapter 2– that disappointingly restrict the scope of our study. Therefore, and as it will be clear from the following exposition, this chapter just intends to give an initial answer to the above question; indeed, not a minor challenge under these conditions.

The contribution of this chapter is twofold. First, it contributes in studying the Argentinean spatial reality aiming to disentangle whether some policies could help to

[228] This chapter is a shorter and improved version of a paper published in *Perspectivas* –the journal of the Corporación Andina de Fomento (CAF)– on June 2008, and presented at the IX Latin American Meeting on Economic Theory (2008) and the XLIV Annual Conference of the Argentine Association of Political Economy (2008). We thank very much Alberto Díaz Cafferata, Germán González, Jorge Streb, Valentina Viego and other participants for their very helpful comments and suggestions. The author gratefully acknowledges the valuable collaboration of Ana Rivas with statistical work.

foster export performance across her/his territory. Specifically, it tries to bring light on the link between infrastructure and exports in Argentina, an issue recently raised by Castro and Saslavsky (2009). The manner to do it is building an empirical strategy on the framework developed in Chapter 4 in order to arrive at: more accurate selection, construction and measurement of the variables considered, the selection of an appropriate estimation procedure and, hence, a more proper interpretation of the results.

Second, the chapter contributes in gathering a rather systematic and comprehensive collection of statistical information at regional (and provincial) level which was obtained from very incomplete, discontinuous and dispersed sources. This activity, which was one of the most time-consuming and dreary tasks the chapter demanded, helps also in the compendium of MERCOSUR regional data used in Chapter 6.

The remainder of the chapter is laid out as follows. Section 2 reviews close antecedents of the assessment we propose. The following section presents the specification applied and gives details on data and methodological issues. In the fourth section we present the results of the estimation and discuss them looking to answer the above question. Finally, section 5 presents some concluding remarks.

5.2. Background

Within the empirical arena, during the last decade many studies have addressed the role played by infrastructure and transport costs as determinants of bilateral trade. Let review some of those contributions, both at country and regional level. Table 1 in Appendix C5 presents a summary of those papers.

To begin with, Bougheas *et al.* (1999), using an augmented gravity model and data from European countries, find their two alternative infrastructure variables –*i.e.* the stock of public capital and the length of the motorway network– have a positive impact on the volume of bilateral trade. Based on stylised facts, Limão and Venables (2001) propose a transport-cost specification that relies on transport and communication infrastructure inside both trade partners and transit countries, together with other country characteristics. The authors estimate a gravity equation for world bilateral trade, where transport costs are represented by the inverse of an average of four infrastructure indicators, namely: road and paved road network, rail network and telephone lines. They find international support for the importance of infrastructure as a determinant of trade, especially for landlocked countries.

Nordås and Piermartini (2004) follow a similar approach, but extend it to acknowledge for bilateral tariff rates, Anderson & van Wincoop multilateral resistance indices and bilateral quality-of-infrastructure dummy variables.[229] The authors conclude that the quality of infrastructure has a significant impact on world bilateral flows, and that bilateral tariffs have a large and negative impact on them. Also looking for cross-country evidence on the effects of infrastructure on trade flows, Carrère and Grigoriu (2008) assess the case of internal infrastructure –measured as in Limão and Venables (2001)– and landlockedness in Central Asia. Evidence shows that an improvement in both own infrastructure and transit-country infrastructure raises exports –though more hugely due to the latter.[230]

Somewhat related with the last paper, Overman and Winters (2005, 2006) address the role played by the geography of ports in the UK. They find that the resultant change operated across ports due to the accession to the EEC modified market access and external competition across regions, hence asymmetrically affecting employment across regions. Also focusing on intra-country spatial effects of infrastructure, Benedictis *et al.* (2006) apply the gravity approach and conclude infrastructure, which is measured using the principal component analysis methodology, emerges as an important determinant of provincial export performance in Ecuador.

Studying the Argentinean reality, Castro *et al.* (2007) analyse the geographical distribution of foreign direct investment across Argentinean provinces and find paved roads –both inside a province and in neighbouring regions– favour FDI location. On the other hand, Castro and Saslavsky (2009) applying the gravity approach find the supply of infrastructure at provincial level has have positive impacts on Argentinean export performance between 1994 and 2007.

Some contributions within this literature address more carefully on the spatial effects of intra- and inter-national transport costs. In this vein, Shepherd and Wilson (2006), following Buys *et al.* (2006), examine the quality of the road network across a group of neighbouring countries. The authors estimate an extended gravity equation along the lines of Anderson and van Wincoop (2003) and, differently from previous works, use actual road distances and road quality indicators to account for infrastructure. They conclude that better roads are strongly associated with larger trade

[229] Specifically, their infrastructure index is an average of the indicators considered by Limão and Venables plus ports, airports and the time spent for customs clearance.

[230] Reviewing applied studies carried out for Latin America at the country level, one finds they are scarce, *e.g.* Martinez-Zarzoso and Nowak-Lehmann (2003) and Acosta Rojas *et al.* (2005).

flows within Eastern Europe and Central Asia, and that cross-country spillovers are important.

Relying on simulations, Ferraz and Haddad (2009) implements an interstate CGE model for Brazil aiming to examine how the distribution of the economic activity may change as the country opens up to international trade. The authors, who explicitly model regional transport sectors, maritime transport costs and regional port costs, find that reductions in maritime transport costs and improvements in port efficiency are both important for regional trade performance.[231] Further, they conclude that those infrastructure improvements seem to reinforce the centrality of the main industrial core in the country, the city of São Paulo.

Another recent contribution, due to Combes and Lafourcade (2011), estimates a structural linear specification for France in order to assess the impact of better intra-national integration on location. Related with Shepherd and Wilson's and Buys *et al.*'s proposal, these authors use a more sophisticated measure of transport costs that accounts for both distance and time charges.[232] They conclude that decreasing intra-national transport costs entail changes in inequality and that Paris should attract an increasingly large number of firms.

Using the same structural framework as Combes and Lafourcade for Portuguese regions, Teixeira (2006) finds that the expansion of the road network has not resulted in greater spatial equity; nonetheless, a further expansion is likely to foster manufacturing dispersion. Finally, Lafourcade and Paluzie (2011) run an augmented gravity equation to explain the geography of trade within France, between 1978 and 2000. Accounting for transport costs that depend on both, the existence of cross-border infrastructures and physical distance, the authors find that French border regions have better trade performance if they have cross-border transport connections.

Summarising, though diverse empirical strategies have been applied, the gravity equation seems to prevail for assessing the relationship between trade flows and both, infrastructure and transport costs. In addition, there seems to be a movement from using comprehensive infrastructure indices to proxy (inverse) transport costs to, instead, relying on measures of real road distances and/or monetary road transport costs as suggested by Combes and Lafourcade (2005).

In this regard, this chapter applies the gravity approach based on the framework developed in Chapter 4. Hence, it focus on how transport costs and production infrastructure affect Argentinean regional export performance, taking into account the

[231] Nevertheless, they find that import tariffs are yet the most important determinants of trade.
[232] They use the cost for a truck to connect any pair of employment areas through the cheapest route on the real road transport network in 1993.

particularities of the territory, the characteristics of its transport system, etc. In doing this, we incorporate suggestions just revised such the use of real road distances to proxy internal transport costs, the distinction between intra- and inter-national transport costs and the consideration of infrastructure issues, among others.

5.3. *Argentinean Regions: Data and Methodological Issues*

Since this chapter tries to make a synthesis of the above positions drawing on the first model presented in Chapter 4, let succinctly present the specification we applied, describe the data used and explain how key variables are measured and/or calculated. With regard to the coherence between the model's assumptions and our case of study, see Box 1.

As regards the specification, we start with expression (22) in Chapter 4.

$$X_{rs} = aG_r e^{(1-\sigma)\tau_{rs}} \delta_{rs}^{(1-\sigma)\phi} e^{(1-\sigma)\sum_k \varphi_k \lambda_{rs}^k} \left(w_r^{\alpha} m_r^{\gamma}\right)^{-\sigma} \left(E_s^{Qfin} + E_s^{Q\text{int}}\right) P_r^{-\rho\sigma} P_s^{\sigma-1} \tag{1}$$

Taking logarithms, we find a linear specification for bilateral exports:

$$\begin{aligned} \ln X_{rs} = {} & a' + \ln G_r - (\sigma-1)\tau_{rs} - (\sigma-1)\phi \ln \delta_{rs} - (\sigma-1)\sum_k \varphi_k \lambda_{rs}^k - \sigma\alpha \ln w_r - \sigma\gamma \ln m_r + \ln\left(E_s^{Qfin} + E_s^{Q\text{int}}\right) \\ & - \sigma\rho \ln P_r + (\sigma-1)\ln P_s \end{aligned} \tag{2}$$

where $a' \equiv \ln\left(\dfrac{\sigma-1}{\sigma\beta}\right)^{\sigma}$.

Re-writing this equation:

$$\ln X_{rs} = b_0 + b_1 \ln G_r + b_2 \ln\left(E_s^{Qfin} + E_s^{Q\text{int}}\right) + b_3 \ln \delta_{rs} + b_4 \ln m_r + b_5 \tau_{rs} + b_6 \ln w_r + b_7 \sum_k \varphi_k \lambda_{rs}^k + b_8 \ln P_r + b_9 \ln P_s + \varepsilon_{rs} \tag{3}$$

where: $b_1 = b_2 = 1$, $b_3 < 0$, $b_4 < 0$, $b_5 = b_7 < 0$, $b_6 < 0$, $b_8 < 0$, $b_9 > 0$, ε_{rs} is the error term and b_0 can be positive, negative or zero.

Box 1: A digression on our modelling assumptions and the case of Argentina

At this point it is worth referring to some issues that must be considered in order to clarify this study's results. Apart from measurement and definitional issues that are addressed in a while, we would like to make a brief comment on the coherence between two particular assumptions, namely factor mobility and market segmentation, and our case of study.

As regards the former, the model of Chapter 4 assumes labour does not move across locations, neither among countries nor across domestic regions, and that disembodied capital moves freely across space. Whereas labour mobility is commonly disregarded in cross-country studies, it is instead assumed for many intra-country analyses. In the case of Argentina, however, disregarding it seems quite realistic; indeed, though population migration has been not a negligible characteristic along Argentinean history, the phenomenon seems not so relevant for the period under study (Rodríguez and Busso, 2009).

The other assumption, which means that each firm can set a price specific to the location in which it sells its output, seems to be not so restrictive for the Argentinean case. Whereas it is common to assume –based on a vast amount of evidence– that international markets are segmented, it is not so evident to suppose the existence of spatial price discrimination within countries. However, in the case of countries like Argentina with an important continental dimension and underdeveloped transport and communication systems, this supposition seems not so restrictive.

Finally, it is worth thinking about whether our theoretical outcomes could be weighed against Argentinean reality. Whether the Argentinean (and world) economy is in its long-run or short-run spatial equilibrium during the particular period we analyse is not clear. Indeed, it depends on the satisfaction of the operational-profit spatial equalisation that, at least at the national level, perhaps could be ratified; but, this is a supposition because there are no data to verify it.

5.3.a- Data

As it has been already mentioned in Chapter 2, Argentina is divided into 23 political-administrative districts called 'provinces' and an Autonomus City –see Map 1 in Appendix I or Map 2 in Appendix C2. These districts are commonly grouped into five 'natural' regions, namely: the Pampean region, the Northwest, the Northeast, Cuyo and Patagonia.

In terms of both production and export performance, the former region can be considered the richest and most productive territory within the country, while the Northwest and the Northeast are the less developed ones. To have a rough idea, in 2005 the Pampean region concentrated around 70 percent of aggregate GDP and 80 percent of the manufacturing product, contrasting with the 6 and 4 percent that correspond to each of those two peripheral regions. Further, a bit more than 70 percent of total exports and 80 percent of manufacturing exports were originated in the national centre; whilst a total of 5 and 7 percent, respectively, came from that periphery.[233]

This chapter studies Argentinean export performance during a pretty recent period for which many relevant variables have statistical coverage.[234] Nonetheless, it is due to mention that we are, unfortunately, confronted with a no minor difficulty that many empirical researchers face: the discrepancy between data-availability and data-requirements. As it will be clear throughout this section, the complete and careful data scrutiny accomplished has not precluded from taken some arbitrary decisions.

Let consider a time-varying version of expression (3) as a starting point for describing the variables analysed:[235]

$$\ln X_{rst} = b_0 + b_1 \ln G_{rt} + b_2 \ln\left(E_{st}^{Qfin} + E_{st}^{Q\text{int}}\right) + b_3 \ln \delta_{rst} + b_4 \ln m_{rt} + b_5 \tau_{rst} + b_6 \ln w_{rt} + b_7 \sum_k \varphi_k \lambda_{rs}^k + \\ + b_8 \ln P_{rt} + b_9 \ln P_{st} + \varepsilon_{rst} \quad (4)$$

<u>Variables</u>

X_{rst} is the value of aggregated manufacturing exports from region r to partner country s in year t. For this variable, we use a dataset developed by the National Institute of Statistics and Census (INDEC) of Argentina, disaggregated at four-digit level of the ISIC rev.2 and nine-digit level of MERCOSUR nomenclature.[236]

G_{rt} is the value of total manufacturing production in region r in year t. This study employs information offered by the Ministry of the Economy of Argentina on the annual gross geographic product of every province disaggregated at two-digit level of the ISIC rev.2.

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233 This paragraph refers to manufacturing exports of industrial origin, which is the notion normally employed by the INDEC and other areas of the Ministry of the Economy in Argentina.

234 This is not the case for some previous years, for which data on infrastructure and resources is not available. And is neither the case for subsequent years, for which data on provincial GDP cannot be obtained.

235 For details on the definition of variables, measurement, sources, *etc.* see Table 2 in Appendix C5.

236 This dataset, which provides for annual provincial exports (values and physical quantities) distinguishing country of destination and type of product, is constructed on the basis of the 'Maria' System, applied by the Directorate-General of Customs, together with additional information on firms' geographical location. On the methodology applied by the INDEC, refer to http://www.indec.gov.ar/nuevaweb/cuadros/19/comext_metod.pdf.

t_{rst}, which comprises τ_{rst}, δ_{rst}, and λ_{rs}^{k}, are the ad-valorem trade costs for shipments from region *r* to partner country *s* in year *t*. As it has been already portrayed in Chapter 4, the trade cost function is replaced into export equation; hence, we directly deal with transport costs and other barriers to trade.[237]

There is not a unified approach within the empirical literature to measure these trade-cost components; while some authors just use one or two variables such as distance and a 'border' dummy or ad-valorem tariffs (Behrens *et al.*, 2010; Balistreri *et al.*, 2011), others include several determinants trying to acknowledge for geographical and cultural differences (Corcos *et al.*, 2010; Castro and Saslavsky, 2009). In addition, the chances this study has to incorporate τ_{rst}, δ_{rst}, and λ_{rs}^{k} –or at least some proxies– are restricted by data availability. Let see what we have to resolve in each case:

1) τ_{rst} denotes policy barriers to trade between region *r* and partner country *s* in year *t*. It is supposed to comprise at least two policy features: a) trade policy barriers imposed by the partner to Argentinean exports, and b) the negative of national and regional incentives to export and/or to produce manufactures. However, the lack of systematic information on domestic policies, together with the absence of complete and updated time series on partners' barriers to trade –*i.e.* tariff, non-tariff and technical barriers– make the inclusion of this variable impracticable.[238] Therefore, we must rely on a very imperfect option that some authors made: to proxy τ_{rst} by Regional-Trade-Agreement (RTA) dummy variables.

2) δ_{rst} represents transport costs to ship goods from region *r* to country *s* in year *t*, or transport infrastructure. Trying to depart as less as possible from the model, and hanging upon some information about transport modes and border offices in the country, we create an original proxy variable. In the following sub-section we give details about this.

3) λ_{rs}^{k} are usually represented in the gravity literature by time-invariant 0-1 dummies that acknowledge for cultural and geographical *k* determinants of bilateral trade – such as contiguity, common language and landlockedness. Though these variables may be relevant determinants of trade in multilateral studies, they are very likely not pertinent within a setting like this where: origin regions and trade partners are so

[237] The decision of introducing the trade cost function into export equation, instead of estimating trade costs as it was suggested by Head and Mayer (2004) and accomplished for instance by Bosker and Garretsen (2008, 2009b), is mainly due to lack of data. Data on internal trade flows both across Argentinean regions and within partner countries that should be used for that estimation is not available.

[238] In the case of domestic (regional) promotion policies, we reviewed two main sources: FIEL's (2003) study on business atmosphere in Argentinean provinces and the WTO's (2007a,b) trade policy review of the country. Nonetheless, it was not possible to find an indicator or a set of them that could be used to proxy that variable.

few, contiguity is very correlated with external transport costs and its effects seem to mix up with RTA dummies' ones, and the lack of maritime coastline may not be an adequate indicator of regional inaccessibility when various landlocked argentinean regions are indeed directly connected through road- or fluvial-ways.

w_{rt} is the price of labour in region r in year t. Since the prices of factor services are not available at spatially disaggregated level, we could either rest on a proxy variable as the one suggested and used by Hanson and Xiang (2004) –namely, regional factor supply of these resources– or indicators such as the skill-intensity of workforce as proxy of human capital, etc. However, since available regional data is not accurate at all, we have to disregard this variable.

m_{rt} is the price of infrastructure services, or production infrastructure, in r during year t. Again, because these prices are not available for each Argentinean region, we rely on a proxy like the one proposed by Hanson and Xiang (2004).[239] In this case, we control for the length of the paved road network (in kilometres per hundred of square kilometres) and electricity consumption (MW) per inhabitant.[240] This solution is in line with studies reviewed in section 2; thus, the focus of this chapter does not seem threatened. As regards electricity, some authors suggest it might not be its availability but its reliability or its cost which affect trade performance (Hallaert *et al.*, 2011); however, we were not able to get information on these variables.

$\left(E_{st}^{Qfin} + E_{st}^{Q\,\text{int}}\right)$ denotes the sum of final (or consumers') and intermediate (or firms') expenditure in Q within region s in year t. Since we were not able to find data on this variable for every partner and every year, national GDP was taken as a proxy.

P_{rt} and P_{st} are the manufacturing price indices in each region in year t. To represent them in the gravity equation, well-known authors –Anderson and van Wincoop (2003), Baier and Bergstrand (2001), Baldwin and Taglioni (2006), Combes *et al.* (2008, ch.5), Redding and Venables (2004) and Shepherd and Wilson (2006) among others– suggest different alternatives: 1) to separately estimate the non-linear price indices, 2) to use direct measures of that indices, which, however, might crucially differ from their theoretical definition, and 3) to replace them by time varying nation dummies. In this study, however, we have to omit including the price indices into the export equation. While alternatives one and two were disregarded due to lack of detailed regional data; the third one was ignored in order to preserve one of our key

[239] The authors argue that: *"In general equilibrium, national factor supplies map into national factor prices and these factor prices map into industry production costs. (...). This is clearly a reduced-form treatment of production costs, but one that is necessitated by a lack of detailed cross-national cost data..."* (page 1114).

[240] The measurement of production infrastructure differs between the present chapter and the following one. For the case of Argentinean regions, we do not find high correlations among infrastructure variables such as telecoms, electricity and roads; so we disregard building an infrastructure index as we indeed do in Chapter 6.

variables: regional production infrastructure, which is represented by a time varying regional variable as well.[241]

To sum up, the computation of every variable attempts to depart as less as possible from the spirit of the model in Chapter 4; however, as reported above, many difficulties appear. In case available data do not exactly coincide with the theoretical definitions of our variables, we look for selecting proxy variables over which there seems to be consensus within the literature. In the absence of any reliable data, we just omit the variable.

It is due to note that the omission and/or the erroneous measurement of some variables, such as τ_{rst}, w_{rt}, P_{rt} and P_{st}, may bring biased estimates. Specifically, the effect of some variables included in the regression can be over- or under-estimated since they are capturing effects not directly reflecting their own stimulus. For instance, the omission of τ_{rst} may imply that the effect of δ_{rst} may be over-estimated since it captures effects not directly reflecting their specific influence. Moreover, those omissions and measurement errors, together with the potential presence of simultaneity between exports and some explanatory variable might give rise to endogeneity problems, which are referred latter on.

5.3.b- Measuring transport costs

To complete this section, let consider the construction of the variable that represents transport costs, δ_{rst}, or transport infrastructure. One alternative, perhaps the most accurate, would have been to calculate expression (11) in Chapter 4 that defines transport cost between nodes *r* and *s* as the overall iceberg cost calculated for the cheapest mode of transport along the minimum cost path.[242] Nevertheless, the lack of detailed data and the highly time-and-resource-consuming computations required preclude us from this possibility.

Therefore, trying to depart as less as possible from our setting, we create a proxy variable that divides total transport costs into two spatial portions. Specifically, we assume only two edges must be hiked to joint nodes *r* and *s*, namely: an interior edge

[241] Other suggestions as that of Brakman *et al.* (2004, 2006) were also disregarded because of lack of regional data.

[242] Remember, expression (11) is: $\delta_{rs} \equiv \min_{P \in P_{rs}} \prod_{(o,q) \in P} c_{oq}$ with $\prod_{(o,q) \in P} c_{oq} \equiv c_{rp_1} c_{p_1 p_2} \dots c_{p_n s}$.

connecting node r with exit-node q, and an exterior or extra-territorial edge joining q with final destination s. Intuitively, shipping goods from, for instance, Cuyo to Asunción (Paraguay) implies travelling inside the country from Cuyo to the border crossing of Clorinda, and then from Clorinda to Asunción. This formally implies that total transport costs between r and s are the minimal product between internal and external transport costs, $\delta_{rs} = min(c_{rq}c_{qs})$.[243]

This strategy has, from our point of view, at least two advantages with respect to the alternative option of measuring total transport costs –combining internal and external ones– by the standard geodesic (great-circle) distance. First, it allows distinguishing between an issue that can be affected by national policy authorities, namely the internal segment of transportation, and other which is quite outside their ambit. Hence, c_{rq} should be viewed as a policy instrument that can be shaped in order to trigger regional export performance. Second, it seems easier to adjust to Combes and Lafourcade's (2005) suggestion since real distances and/or monetary transport costs likely differ within domestic context *vis-à-vis* international one.

Relying on some information about modes of transport more frequently used to ship goods, both inside Argentina and abroad (Cristini *et al.*, 2002; Hoffman *et al.*, 2002; Sánchez and Cipoletta, 2003; CEP, 2004; Ministry of Federal Planification, Public Investment and Services, 2007, 2010), main road corridors of South America and MERCOSUR (Cristini *et al.*, 2002; Sánchez and Cipoletta, 2003), and more important border crossings in each Argentinean region (Sánchez and Cipoletta, 2003; Bolsa de Comercio de Córdoba, 2003; Gendarmería Nacional, 2007), we create a measure for internal transport costs, c_{rq}.

The procedure to construct our proxy seems to be in line with studies on country trading capabilities, such as Brun *et al.* (2006), Grigoriou (2007) and Dennis and Shepherd (2007), among others. Specifically, our measure of c_{rq} stands for *the minimal road distance from the most distant provincial capital city*, inside each region, *to the closest and most transited exit-node* to reach final destination s –*i.e.* port or road border crossing which is the most relevant exporting gate more closely located to the majority of provincial capital cities in that region.[244] Hence, internal transport costs represent the distance (kilometres) travelled to ship goods along export corridors within the

[243] Recall that $c_{oq} > 1$ is the 'iceberg coefficient' of edge (o,q), which joints node o with node q.

[244] This is done to take into account accessibility difficulties faced by the most disadvantageously located cities inside each region. Note the present study does not consider rail and airborne modes of transport. They are disregarded because their participation is marginal –either railways for internal/external transit or planes for external one– as it can be corroborated going through references above. Even so, it is worth noting that some high-priced manufacturing items, mainly some sold to USA or EU, are actually transported by plane and the virtually unique airport that operates international cargo is Ezeiza, in Buenos Aires.

country.[245] Since this variable is quite relevant for this work, we also consider an alternative to this measure, namely the *average minimal road distance from every provincial capital city to that closest exit node*. The list of chosen exit-nodes for every region and every foreign destiny is presented in Table 3 in Appendix C5.1.

Finally, to compute external transport costs, c_{qs}, we opt for applying the most commonly used strategy within the gravity literature: to calculate great-circle distance between the exit node and each partner's capital city.[246]

5.3.c- Estimation procedure

The model is estimated for period 2003-2005 using a dataset of 360 bilateral export flows, which took place between 5 Argentinean regions and 24 partner countries.[247] Since the dataset contains 35 zero bilateral export flows, following Santos Silva and Tenreyro's (2006) suggestion we apply Poisson pseudo-maximum likelihood (PPML) estimators to the non-linear form of the gravity equation, *i.e.* prior to taking logarithms:[248]

$$Exp_{rst} = \exp\begin{bmatrix} b_0 + b_1 \ln GMP_{rt} + b_2 \ln GDP_{st} + b_{31} \ln dist_{rq} + b_{32} \ln dist_{qs} + b_{41} \ln roads_{rt} + b_{42} \ln elect_{rt} + b_{51} MERCO_s + \\ + b_{52} ASOMER_s + b_{53} NAFTA_s + b_{54} EU_s \end{bmatrix} + v_{rst} \tag{5}$$

where: $b_1 = b_2 = 1$, $b_{31}, b_{32} < 0$, $b_{41}, b_{42} > 0$, $b_{51}, b_{52} > 0$, $b_{53}, b_{54} < 0$, v_{rst} is the error term and b_0 can be positive, negative or zero.[249] As regard variables: Exp_{rst} stands for regional exports, GMP_{rt} is gross manufacturing product, GDP_{st} stands for gross domestic

[245] Instead of applying a monetary indicator for c_{rq} as it is proposed in the model, we have to rely on a 'physical' or 'real' measure quantified in terms of kilometres. Data that, for instance, the application of Combes and Lafourcade's (2005) methodology would have demanded were not available.

[246] The geodesic distance was obtained from the Web site "Great Circle Calculator (GUI)" (http://216.147.18.102/dist/) using the latitude and longitude of each exit node. Note we cannot use, for instance, the very well-known CEPII distance database (Mayer and Zignago, 2006) because it is developed for country pairs, instead of region-country pairs.

[247] As it is common in trade studies, the analysis is limited to a set of foreign trade partners that explain around 75 and 80 percent of national manufacturing exports. These countries are: Brazil, Uruguay, Paraguay, Bolivia, Chile, Mexico, the United States, Canada, China and the 15 European Union members of 1995 –Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, the Netherlands and the United Kingdom.

[248] That is the same one obtains re-writting expression (1) as a time-varying empirical specification: $X_{rst} = b_0 G_{rt}^{b_1} \left(E_{st}^{Qfin} + E_{st}^{Q\text{int}}\right)^{b_2} \delta_{rst}^{\;b_3} m_{rt}^{\;b_4} e^{b_5 \tau_{rst}} w_{rt}^{\;b_6} e^{b_7 \sum_k \varphi_k \lambda_{rs}^k} P_{rt}^{\;b_8} P_{st}^{\;b_9} + v_{rst}$.

[249] Note those signs of coefficients are the ones that we expect from what gravity literature claims and what the model of Chapter 4 predicts. The subscripts maintain the first digit used in expression (4) in orden to facilitate the link between both expressions.

product of partner countries, $dist_{rq}$ are internal transport costs (c_{rq}), $dist_{qs}$ represents external transport costs (c_{qs}), $roads_{rt}$ is length of the paved road network, $elect_{rt}$ is electricity consumption, $MERCO_s$ is a RTA dummy that takes the value of 1 for those partners that are members of MERCOSUR, $ASOMER_s$ is a RTA dummy which equals 1 for those partners which are just 'associated' members of MERCOSUR, $NAFTA_s$ is a RTA dummy which takes the value of 1 for the members of NAFTA, EU_s is a dummy that equals 1 for the members of the European Union.[250]

PPML estimation strategy does not only allow including zero trade flows, but also dealing with the heteroscedasticity that is inherently present in trade flow data (Santos Silva and Tenreyro, 2006).[251] In this regard, Siliverstovs and Schumacher (2009) find out supporting evidence for the PPML estimation approach over the OLS one when applying the gravity equation.[252]

We run three different versions of the above specification, namely: I) with internal transport cost ($dist_{rq}$) measured as the *minimal road distance from the most distant provincial capital city* to the closest exit node ($dist_{rq}^{I}$); II) with $dist_{rq}$ measured as the *average minimal road distance from every provincial capital city* ($dist_{rq}^{II}$); and III) with internal and external transport costs combined and represented by total great-circle distance ($GCdist_{rs}$) from the more populated city within each Argentinean region and the capital city of each trade partner.[253]

5.4. Regional Export Performance: Estimation Results

PPML regressions are carried out using pooled data and with standard errors that allow for intragroup correlation. Table 3 summarises the results, showing estimated coefficients, t-statistics, pseudo R^2 and number of observations.

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[250] Specifically, MERCOSUR members are Brazil, Uruguay and Paraguay; 'associated' members of MERCOSUR are Bolivia and Chile; NAFTA members are Mexico, the United States and Canada; and EU_s represents the 15 members of the European Union in 1995.

[251] Following Helble *et al.*'s (2009, footnote 12) suggestion –and in the same fashion as Corcos *et al.* (2010) and Bosker and Garretsen (2009b)– we opt for Poisson instead of Heckman's sample selection estimator.

[252] As Bosker and Garretsen (2009b, footnote 7) point out, note PPML itself requires the same process drives the zero and the non-zero observations.

[253] Those cities are: Corrientes in the Northeast, Tucumán in the Northwest, Mendoza in Cuyo, Neuquén in Patagonia and Buenos Aires in the Pampean region.

Table 3: Argentinean Regional Export Performance

Period 2003-2005

Estimator / Expl. Vars	I (baseline)	II (baseline)	III
$\ln GMP_{rt}$	0,819*** (7,81)	0,831*** (7,17)	0,953*** (7,65)
$\ln GDP_{st}$	0,523*** (5,08)	0,528*** (5,10)	0,550*** (4,83)
$\ln dist^{I}_{rq}$	-0,846** (-2,88)	-	-
$\ln dist^{II}_{rq}$	-	-0,638** (-2,94)	-
$\ln dist_{qs}$	-0,064 (-0,49)	-0,092 (-0,70)	-
$\ln GCdist_{rs}$	-	-	-0,245 (-1,19)
$\ln roads_{rt}$	0,924*** (3,53)	0,873** (3,01)	0,921** (2,68)
$\ln elect_{rt}$	0,556* (2,08)	0,347 (1,49)	0,001 (0,00)
$MERCO_s$	1,750*** (6,45)	1,746*** (6,67)	1,028** (2,87)
$ASOMER_s$	1,820*** (3,93)	1,855*** (4,08)	1,067** (3,02)
$NAFTA_s$	-0,866 (-1,62)	-0,899 (-1,68)	-1,029 (-1,77)
EU_s	-1,027** (-3,19)	-1,043** (-3,26)	-1,085** (-3,37)
Const	-6,737** (-2,90)	-6,459** (-2,90)	-8,283*** (-3,69)
RESET test p-value	0,104	0,08	0,045

GNR test p-value	0,098	0,096	0,097
Pseudo R^2	0,864	0,864	0,861
N° obs.	360	360	360
Wald chi² (#)	1636,42	1506,16	1543,59

Note: Dependent variable is exports. Standard errors adjusted for clustering by region-partner-pair. z-statistics under the point estimates. * for p-values < 0,05, ** for p-values < 0,01 and *** for p-values < 0,001. Estimation method is PPML.

Pseudo R^2 of every regression takes values around 86%, hence confirming the ability of the gravity model to explain regional manufacturing exports from Argentina towards selected partners. The Ramsey RESET test and the Gauss-Newton Regression GNR test for the type of heteroskedasticity support the PPML estimator.[254] Coefficients have, in general terms, the expected signs and are statistically significant.

Specifically, let begin by analysing the first column of baseline results, I. Internal transport costs measured as the *minimal road distance from the most distant provincial capital city* to the closest exit node ($dist^{l}_{rq}$) behave as it was expected: negatively affecting export performance; specifically, a 10% reduction implies a boost of 8,5% in regional exports. On the other hand, external transport costs ($dist_{qs}$) have the expected sign but their coefficient is not significantly different from zero. With regard to their combined effect, the average distance elasticity is around -0,9, which is indeed the central tendency of the gravity literature (Disdier and Head, 2008).

The other policy-relevant variables, representing production infrastructure ($roads_{rt}$ and $elect_{rt}$) have also the expected sign though dissimilar statistical significance. A 10% improvement in paved roads is associated with a 9% increase in exports; while a 10% increase in the availability of electricity seems to be related with a 5,5% rise in exports.

Economic mass variables, GMP_{rt} and GDP_{st}, have the expected signs and their coefficients are significantly different from zero. As it is expected, the economic size of both partner and origin region boosts manufacturing exports. Indeed, the impact of the former is around 1,6 the impact of the latter.

[254] Though p-values are not so high –as it may be expected due to the omission and measurement errors our study faces– they are close to the ones reported by Santos Silva and Tenreyro (2006) for the Anderson and van Wincoop's (2003) gravity equation and by Martínez-Zarsoso *et al.* (2007). Moreover, note alternative estimators we run, such as OLS, TOBIT and FGLS, failed the RESET test and Park test checking on the adequacy of the log linear model.

Finally, the behaviour of RTA dummies is reasonable. Whether the foreign partner is a member country of the enlarged MERCOSUR –namely, Brazil, Paraguay, Uruguay, Chile and Bolivia– tends to boost regional exports of manufacturing goods. On the contrary, if the partner is a member of either NAFTA or EU, trade flows are spoiled –*i.e.* exports towards those blocs are roughly between 58 and 64 percent lower than exports to the other partners.[255] In other words, trade preferences among similarly developed countries, like MERCOSUR members, tend to facilitate trade of manufacturing varieties, while preferences among more developed countries –from Europe and US and Canada in North-American[256]– tend to favour their own exchange, reducing the chances of Argentina to export there.

The second column of baseline results (II) shows almost similar results. Specifically, while the impact of internal transport costs –measured as the *average minimal road distance from every provincial capital city* within the respective Argentinean region ($dist^{II}_{rq}$)– is lower than the previous one and production infrastructure variables reduce a bit their importance, the inverse tends to occur for market sizes and preferential frameworks.

Notoriously, baseline results (I and II) seem to be rather conclusive with respect to the relative importance of internal distance *vis-à-vis* external one. This should not be a surprise if one knows the spatial reality of Argentina, the location of most customs offices, the characteristics of its transport system, etc. While the majority of international shipments leave the country through not so many customs offices located at the borders –mostly at the Central eastern portion of the maritime and river coastline– domestic supply is dispersed (though not so balanced) across the country. Moreover, Argentina is a country in which road distance play a decisive role because both other transport modes are not as well developed and extended as road transport and overland distances are not irrelevant at all.

As regard the third column (III), which could be viewed as a robustness check to the measurement of transport costs, we can notice that the sign of the relationships between regional exports and independent variables remain stable though the statistical significance of some of them diminishes. While estimated coefficients of economic size variables increases –particularly that of GMP_{rt}– as well as the coefficients of $roads_{rt}$ and NAFTA, distance elasticity is much smaller than in the two previous specifications and it is not significantly different from zero. Therefore, it seems that the improvement on the measure of distance we propose in the baseline

[255] The formula to compute this effect is $(e^{b_i} - 1) * 100\%$, where b_i is the estimated coefficient.

[256] The participation of Mexico in NAFTA, a country more similar to Argentina than US and Canada, helps perhaps to explain the weaker and statistically insignificant impact of that bloc in the estimations.

models goes in line with established results, at least for trade flows disaggregated at regional level.

5.4.a- Sensitivity analysis

There are two additional dimensions in which we examine the robustness of the estimates.[257] First, we run different regressions for specification I, namely by year and on the average. The results, presented in Table 4 in Appendix C5.2, are largely robust to these changes. Indeed, every coefficient maintains its sign and the statistical significance of the regressors is almost unaltered. More importantly, the two policy-relevant variables –*i.e.* internal transport costs and production infrastructure, $roads_{rt}$ and $elect_{rt}$ – remain as relevant as before, though the statistical significance of the latter diminishes.

Second, as anticipated, we intend to take into account the probable endogeneity in our regression models. Though endogeneity might also arise in two other ways – namely, omitted variables and measurement error– we just try to provide a solution to the problem arising from the potential simultaneity between exports and regional income. A well-known solution for endogeneity problems is to instrument the explanatory variables that are correlated with the residuals; thus, replacing them by other variables that though correlated with them are not correlated with the formers.

As it is also common knowledge, the principal difficulty with that solution lies in identifying an appropriate set of instruments; difficulty that becomes even greater in this study because of the lack of regional data we face. In spite of this, we try to correct for that possible problem instrumenting gross manufacturing product in each region (GMP_{rt}) by population and land area.[258] In doing this, we apply the approach suggested by Helble *et al.* (2009), who follow Wooldridge (2002), for instrumental variables (IV) estimation of Poisson models. That is: in the first stage, the probable endogenous explanatory variable (GMP_{rt}) is regressed by OLS on the exogenous explanatory variables and the two instruments (population and land area). The residuals from the first stage regression are then included as additional regressors in the final PPML regression.

[257] In addition, we run PPML panel data models –see Table 7 in Appendix C5.2. While the RE estimator is inconsistent; the FE estimator seems to reveal time-invariant heterogeneity –either observable or non observable– is present.

[258] The specialised literature proposes different instruments for GDP such as land area, physical or human capital, labor or its accumulation rate (Cyrus, 2002; Martínez-Zarzoso and Márquez-Ramos, 2005).

The results in Table 5 in Appendix C5.2 shows all estimated coefficients, but that on $elect_{rt}$, retain their expected signs and, in general, are as statistically significant as in the baseline specifications –for first stage regression results see Table 6.[259] Note, however, that while the coefficient of GMP_{rt} increases under the IV estimation, the coefficients of production infrastructure variables tend to diminish as well as their statistical significance –note these variables are indeed highly correlated with the instruments. On the other hand, internal transport costs retain their explicative value. Therefore we can conclude that while endogeneity does seem to exist, instrumenting for GMP_{rt} solely tends to alter (slightly) the effect of income and infrastructure variables on regional exports.

5.4.b- Discussion of the results

To sum up, since most estimated PPML coefficients are stable across specifications and have the expected signs, we claim that: lower internal transport costs, improved production infrastructure –particularly, road infrastructure– greater local market-size, higher trade preferences and lower trade indifferences –especially from European countries– seem to be associated with higher regional export flows.[260]

Even so, we insist our results need to be interpreted with a dose of caution. As it has been pointed out, the omission and the imperfect measurement of some variables may have brought biased estimates. Moreover, the lack of data on within-Argentina-shipments could very likely affect the results and their proper interpretation since many Argentinean regions are indeed relatively more engaged in internal trade rather than in external one.

Partially because of that, our study has two additional limitations that condition the potential utility of its results. As many other gravity studies, ours has not been able to control for the interdependence between export flows across regions –issue already commented on in Chapter 1 (Box 1). On the other hand, it does not accomplish the estimation of structural forms or general equilibrium (GE) numerical calibrations, attempts that would allow for conducting posterior counterfactual analyses in order to evaluate particular policies –as mentioned in Chapter 4.[261]

[259] Note that the estimated standard errors have not been adjusted to take account of the use of first stage residuals; thus, they tend to understate reality.

[260] Regardless of data problems, in Appendix C5.3 we make a pretty 'irresponsible' attempt to recover the parameter values of the model developed in Chapter 4.

[261] As regard the latter, note there is no generally agreed-upon methodology to deal with those GE estimations, to the best of our knowledge. While some authors propose to accomplish an iterative

When comparing with other related studies, however, we conclude our research seems indeed relevant. To begin with, the results we obtain are in line with Granato and Moncarz's (2010) findings. The authors, who carry on an empirical study trying to measure whether a reduction in internal transport costs can trigger provincial export competitiveness in Argentina, conclude that a ten percent reduction in freight costs may diminish total exporting transport costs: in 13-14 percent points for provinces far from exit nodes and in 6-8 percent points for provinces located near those nodes. Thus, transport costs reduction seems to be beneficial, especially for provinces located far from customs offices.

As regard Castro and Saslavsky's (2009) study, though our results are not directly comparable with theirs due to several reasons –namely, they apply an extensive gravity equation including too many regressors[262] and choose a different estimation strategy (Heckman's selection model) within a larger time-period (1994-2007) and for provinces instead of regions– we consider there are certain issues that should be noticed. First, they find the main determinants of provincial exports are distance, economic size of partners and local size –with elasticities around -0,68, 1,15 and 0,40, respectively. With respect to distance, the authors express they use CEPII's great-circle measure; as regard economic sizes, while foreign GDP has a greater coefficient than the one we obtain, domestic size has lower impact than in our estimation.

From our point of view, some of these differences could be explained by: a) the use of a distance measure that does not vary by origin, issue we consider central for the case of Argentina as explained; b) the introduction of provincial population as additional control variable, which coefficient is indeed high (around 0,92); c) the manner in which the authors measure each province's market-size, including not only the production of the good analysed, but also the production of other goods and services; and d) some endogeneity bias that could be present in their regression –as the one we account for.

Finally, with respect to production infrastructure variables, the results Castro and Saslavsky get are, in general terms, in line with ours. They find per capita paved roads and production of electricity are positively related with provincial exports, though their impacts are smaller than the ones we find –with coefficients around 0,25 and 0,16, respectively.

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estimation (Behrens *et al.*, 2010), others suggest applying routines of computable general equilibrium models Balistreri *et al.* (2011) and a third group proposes to develop estrategies based on 'more standard' estimation methods–namely, Baier and Bergstrand (2009), Bosker *et al.* (2010) and Corcos *et al.* (2010).

[262] In fact, they include almost the same regressors we use together with various additional ones such as population, unemployment rate, level of education, number of fixed phone-lines, fiscal result, FDI per capita and dummy variables for contiguity, language and landlockedness.

Coming back to the strict objective this chapter has proposed, remember: to answer "To what extent transport costs and localised infrastructure condition regional export performance in Argentina?", we can initially reply "yes, both variables seem to affect regional export flows". Thus, infrastructure enhancement (road infrastructure) and the reduction of internal transport costs may help for changing regional competitiveness and market accessibility. Policies in this regard could be designed in order to turn the destiny of some less developed or relatively disadvantaged Argentinean regions –already identified in Chapter 2.

5.5. *Concluding Remarks*

This chapter addresses regional export performance focusing on the role played by transport and production infrastructure in the competitiveness and interconnection of different geographical spaces. Our study contributes in deepening and enriching the study of Argentinean regional export performance drawing on a NEG model developed in Chapter 4. The latter permits to more accurately select, construct and measure the variables considered, selecting an appropriate estimation procedure and, hence, to properly interpret our results. Indeed, our strategy seems to pay for when comparing our results with those of Castro and Saslavsky (2009).

The results found, albeit should be taken at best as suggestive, allow answering both transport costs and localised infrastructure seem to affect regional export flows. They suggest some interesting considerations for policy, namely: the importance of infrastructure enhancement and/or internal transport-costs reduction for boosting regional export performance. A second important policy implication is that regional trade preferences (or 'indifferences') may also be important in determining exports from Argentinean regions towards foreign markets.

This chapter reveals there is scope for future work in several directions. First, to assemble and process high quality and sufficiently disaggregated primary and secondary regional data in Argentina is central. Second, having good datasets, to structurally estimate models as the one in Chapter 4 and, hence, to conduct counterfactual analyses may give additional answers to questions as the one we raised.

Complementarily, to get even more comprehensive answers through case studies or other place-based approaches seems advisable. This type of investigations should help to properly analyse and evaluate specific aspects related with infrastructure and transport policies, namely: which type of infrastructure, a reduction in transport costs through what means –namely, developing other transport modes, investing in highways, etc.– addressing the development of which region and focusing in which particular goods, among others.

Working out on this line of research, Chapter 6 attempts to accomplish an assessment for MERCOSUR regions proposing a more comprehensive exercise, which is closely related to the suggested 'case-study' methodology. Specifically, the chapter aims at identifying a set of goods for which, and of provinces where, the resources of the *Fondo de Convergencia Estructural del MERCOSUR* (FOCEM) for infrastructure investment should be directed to.

Chapter 6:

REGIONAL EXPORT PERFORMANCE IN MERCOSUR.
WHETHER AN INFRASTRUCTURE UPGRADE CAN HELP DISADVANTAGED REGIONS?[263]

6.1. *Introduction*

Asymmetries are a serious problem in regional integrations. The asymmetries rhetoric mixes however in the same bowl ingredients from distinct sources. Policies to deal with a given bloc's asymmetries should aim at those aspects of the problem related to the existence, functioning and deepening of the bloc itself, especially in what regards its strictest purpose; usually the building up of a customs union or a common market. Acceptance of this point allows for consideration of two kinds of asymmetries, relevant to the integration process: a) the ones related to public policies and b) structural asymmetries.

The mere announcement of common trade policies, for the future establishment of a unified market, for instance, is not immediately translated into benefits. Its realization requires the implementation of complementary measures to coordinate and harmonize individual, domestic public policies of member countries. The implicit application of measures for the treatment of asymmetries, through the implementation of differentiated periods of convergence, lists of exceptions and the operation of different regimes of origin for the smaller partners does not usually achieve the expected results.

As known, MERCOSUR suffers from an original sin as regards asymmetries: from the Brazilian giant to the tiny Uruguay, size differences –from nearly every viewpoint as sketched out in Chapter 2– are impressive, making even more difficult

[263] This chapter presents a version of a paper authored by Germán Calfat, Renato G. Flôres, Ana Rivas and myself (Calfat *et al.*, 2009), which is based on a report prepared for the MERCOSUR Secretariat in 2008. The authors gratefully acknowledge the valuable collaboration of Geovanna Benedictis who carried out the simulations and thank participants at workshops and seminars in Europe and South America, notably those organized by the MERCOSUR Secretariat (Uruguay, 2008) and by the ELSNIT (Germany, 2009), as well as Elisenda Paluzie, Rolf Langhammer, Christian Volpe Martincus and Marcel Vaillant, for helpful comments and suggestions.

the already slow and winding path of integration, and turning the bloc into an example of the problem. If Paraguay and Uruguay are very small and, to a certain extent, poor economies with respect to Brazil; they are not, on the other hand, the poorest spots in the integrated space. Continental Brazil, with its huge income disparities, is the country where the poorest areas of the bloc are found; the size and complexity of the Brazilian social problem largely overtaking those of its fellow members.

This has two important consequences. The first is that, though hoping that MERCOSUR will enhance growth and improve convergence prospects among its members, it is unwise to expect the bloc to solve internal, deep structural problems that existed before its creation. Poverty alleviation, as a national strategy, will have to continue to be a national issue, reasonably independent of the common policies. Secondly, the acute Brazilian problem renders senseless any global asymmetries' strategy focusing purely on income disparities.

In MERCOSUR, the implementation of common public policies aimed at reducing inequalities in the less developed partners has been treated implicitly and constitutes an unsolved issue. Concerning structural asymmetries, one important tool is the Structural Convergence Fund of MERCOSUR (*Fondo de Convergencia Estructural del MERCOSUR*, FOCEM), created in 2004 by the Council of the Common Market's Decision (CMC/Dec.) N° 45/04, which aims at alleviating somehow the discrepancies among the four members by way of target regional investments, projects and works that would improve the socio-economic conditions of less-favoured areas (MERCOSUR Secretariat, 2004).[264]

FOCEM is operative since 2006 and has approved duration of, at least, ten years (CMC/Dec. N°18/05, art. 22).[265] The Fund receives a total amount of one hundred millon dollars per year from member countries according to their historial participation in regional GDP, namely: 70% Brazil, 27% Argentina, 2% Uruguay and 1% Paraguay (art. 6); an amount that represents less than 0,01 percent of MERCOSUR 2006 GDP –which totals almost 1.333 hundred millon dollars (CEI, 2010).[266] These resources are distributed among projects presented by the members in the following manner: 48% to finance Paraguayan projects, 32% for Uruguayan ones and 10% for

[264] As it is established by the Protocol of Ouro Preto (arts. 1-4), the Council of the Common Market is the highest organ of MERCOSUR inter-governmental organs with decision-making powers (MERCOSUR Secretariat, 2010). In 2005, the CMC/Dec. N° 18/05 established which resources should and can integrate the fund and which expenditures can be done with it, and the CMC/Dec. N° 24/05 aproved FOCEM's reglament (MERCOSUR Secretariat, 2005a,b).

[265] In fact, the first projects were aproved on May 2007, and until the beginning of 2011 none of them has been finished (FOCEM, 2011).

[266] Note FOCEM can also receive financial resources from third countries, international institutions and organisms (art. 8).

each set of projects, Argentinean and Brazilian one (art. 10).[267] Thus, FOCEM is essentially an instrument that redistributes resources from the big partners towards the small ones.

As regards FOCEM's objectives, the Council of the Common Market has defined four programatic areas, namely: I- Structural Convergence, II- Development of Competitiveness, III- Social Cohesion, and IV- Strengthening of the Institutional Structure and the Integration Process (art. 2). Projects of Program I aim at contributing to development and structural adjustment of small economies and less developed regions; those of Program II attempt to promote competitiveness across productive sectors; Program III aims at contributing to social development; while projects of Program IV attempt to improve the institutional infrastructure of MERCOSUR (art. 3).

Nonetheless, as it is stated by article 12 of CMC/Dec. N° 18/05, during the first four years of operation, FOCEM's resources must be destinated to Program I. Moreover, during that period, resources assigned to that Program have to be employed, also with priority, to increase physical infrastructure in order to facilitate the integration process (art. 13). This means that, as it is clarified by article 12 of CMC/Dec. N° 24/05, MERCOSUR's main concern is for: a) construction, modernisation and recuperation of modal and multimodal transport roads to optimise the movement of production and promote physical integration, b) exploration, transportation and distribution of fossil fuel and bio-fuel, c) generation, transport and distribution of electricity, and d) development of hydric infrastructure.

Just as an illustrative parallelism, let us briefly refer to the Structural Funds (SF) Program of the European Union (EU), which goes back to the 1950s and nowadays comprehends three main funds: the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF) (Molle, 2007).[268] Each of these frameworks, in general terms, establishes three mutually exclusive schemes for SF transfers, namely: Objective 1 to promote the development and structural adjustment of regions whose development is lagging behind; Objective 2 to support the economic and social conversion of areas experiencing structural difficulties; and

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[267] In fact, FOCEM co-finances the projects that are aproved since member countries are obligued to finance, at least, 15% of the total amount of their own projects (art. 11).

[268] From a historical perspective, the ESF is the pioneer fund. Created in 1952, it can be considered the first step towards regional development at the European level (Molle, 2007). As Hoste (2003, chapter 7) expresses, the 'take-off' period of Structural Funds was between 1970 and 1985, when the first enlargement of the EU took place. As a result, in 1975, the largest of the EU funds (ERDF) was created. From 1986 to 1992, when three less developed new member states entered the EU, the Structural Funds were substantially modified. During 1993-1999, the Maastricht Treaty introduced changes in the Funds. The EU increased the size of the Structural Funds and created the CF in 1994. More recently, the eastern enlargement of the EU boosts a further steping up of cohesion efforts.

Objective 3 to support the adaptation and modernisation of education, training and employment policies and systems (European Union, 2010a).[269]

As regards resources, the Structural Funds average around 1,5 percent of EU GDP (Varga and in't Veld, 2009), which represents about 35% of the EU's budget (European Union, 2010c). Within the overall Funds Program budget, Objective 1 expenditures represent the largest part; indeed, they have accounted for more than two thirds of that budget in every period –70% in 1988-93, 68% in the 1994-99 period and 72% in 2000-06 (Becker *et al.*, 2010). This means that, during those periods, there has been in fact a focus on three categories of projects, namely: infrastructures, mainly transport ones (28% of Objective 1 funds), human resources (30%) and productive sectors (42%) (European Union, 2010d).

Having the European situation in mind, it can be concluded that, though MERCOSUR objectives as regards structural funds are, more or less, in line with (and inspired on) EU's ones; the status of FOCEM is yet embryonic. No precise and proper evaluation can be done since FOCEM is a very recent common policy; indeed no project has been finished yet. Nonetheless, the very poor budget of the Fund and the somewhat capricious territorial distribution of its global aid may limit the degree of financial solidarity and, more importantly, the accurate targeting of economic, social and territorial disparities within the bloc.

Related with the latter, it must also be said that changes and improvements about FOCEM should be expected in the following years. Article 13 of CMC/Dec. N° 18/05 establishes that, after the first four years of FOCEM's efective operation, MERCOSUR members must accomplish a general evaluation of the Fund and a review of its priorities, which results will be applied from the fifth year on. In addition, article 22 states that after 10 years of operation, member countries will assess the effectivity of the Programs and the advisability of their continuity. So, the learning-by-doing process may occur within the bloc and an imporvement of this policy instrument would presumably take place.

Coming back to nowadays MERCOSUR situation, once such a Structural Convergence Fund exists and its main features have been defined, a key problem is how to allocate its (scarce, in the case) resources according to the guidelines already in force. The issue is less simple than one might think because, as said, the poorest areas are found in the biggest member, Brazil. This naturally raises the question of internally versus externally induced structural policies. Moreover, policies may also bear a

[269] Note that for the programing period 2007-13, the main objectives of the Structural Funds Program have been re-defined as: Convergence Objective, Regional Competitiveness and Employment Objective, and European Territorial Cooperation Objective (European Union, 2010b).

predominant micro or macro character. Flôres (2008) and Baruj *et al.* (2008) have addressed part of these issues from a predominantly micro perspective. In this chapter, taking instead a *regional* perspective, we outline how external policies would help in reducing asymmetries.

It is for the above reasons –in particular as regards FOCEM's priorities– that we have chosen to analyse regional disparities in terms of physical infrastructure. The proposal is to build a range of priorities at the sub-regional level, where the degree of impact of improvements in physical infrastructure would be measured by enhancements in export performance.

Several works have already studied the interaction between, on the one hand, localised assets and transport costs and, on the other, the levels and patterns of trade, as it has been referred to in Chapters 4 and 5. Empirical papers, measuring the actual impact those features could provoke on bilateral flows, seem to have confirmed various theoretical predictions. The present chapter belongs to this strand of the literature; its applied exercise addresses MERCOSUR regions' export performance, focusing on the role played by transport costs and regional infrastructure.

Specifically, our analysis focuses on a raking of spatial units with relative backwardness in terms of infrastructure, as well as the identification of sectors/products that could improve their export position through an intervention or financial support investments programs in specific infrastructure. Ideally, a combination of both identifications (units/product), based on an exercise of 'mapping' the concentration of economic activities in disadvantaged areas in terms of infrastructure, can set priorities for the efficient allocation of funds for structural convergence.

In other words, the chapter addresses the link between external competitiveness and investment in physical infrastructure as prioritized by FOCEM. Bearing in mind the balance between equity and efficiency, the paper attempts to find those regions, which being relatively underdeveloped in terms of infrastructure, can gain competitiveness in potentially-successful exporting sectors –*i.e.* very dynamic and destinated to big or growing markets– thanks to improvements in physical infrastructure.

Therefore, the main contributions of this chapter are three. The first is the construction of a compound infrastructure index at MERCOSUR regional level, which entailed the compilation of a systematic and comprehensive collection of provincial, state or departmental level information on infrastructure indicators. The second contribution is the ranking of MERCOSUR regions in terms of that index, which offers a rather fair representation of physical infrastructure asymmetries across them. Finally, there is a methodological contribution. We propose an intuitive exercise for identifying products/sectors as potential recipients of FOCEM's aid. Indeed, this methodology is comprehensive enough and can be applied at different national and sub-national spaces to derive useful policy suggestions.

In a broader sense, the chapter contributes to understanding MERCOSUR regional reality by answering the following questions: To what extent transport costs and regional infrastructure condition regional export performance? May infrastructure enhancement or the reduction of transport costs effectively help in changing regional competitiveness and market accessibility? And, under the event of solving bottlenecks to improve competitiveness, could regional common policies turn the otherwise irreversible destiny of less developed or disadvantaged MERCOSUR regions?

The rest of the chapter is organized as follows. Section 2 presents a brief review of the relationship between export performance and infrastructure drawing on what has been addressed in Chapters 4 and 5. In section 3 the methodological steps of the proposal are outlined. Regional data as well as methodological issues, which are at the basis for identifying MERCOSUR units with relatively less developed physical infrastructure, are the subject of section 4. The next one goes deep into the application; it details the selection and estimation of the gravity equations to model the export performance of a selected number of products exported by Paraguay and Uruguay, the ensuing simulations and the guidelines for identifying products/sectors as potential recipients of funds. Finally, section 6 presents some concluding remarks and a suggestion on further data initiatives.

6.2. Export Performance and Infrastructure: Conceptual Framework

As it has been reviewed in Chapter 4, within NTT and NEG two elements appear as principal targets when attempting to boost regional export performance: trade costs –all those features that limit or even preclude trade flows– and locally assets or settled advantages that make agents particularly efficient and competitive for producing and exporting certain goods. This is precisely the case of physical infrastructure; needless to say, the lack of adequate physical infrastructure is at the origin of inefficient trade exchanges, affecting, consequently, the firms' competitive position.

Moreover, as Chapter 5 has surveyed, during the last decade many empirical trade studies have addressed the role played by infrastructure and trade costs as determinants of bilateral trade. Moreover, almost every study finds infrastructure has a significant role explaining location and trade performance, and various of them highlight some infrastructure improvements could exacerbate historical agglomeration instead of fostering greater spatial equity. Similarly, applied studies carried out for Latin American countries as well as our contribution in Chapter 5, find infrastructure and transport costs seem to be fundamental determinants for trade flows.

In the macroeconomic literature, likewise, numerous studies have assessed the impact a particular type of infrastructure has on economic growth. For example, Röller and Waverman (2001) analyse the impact of telecommunications in economic development. Fernald (1999) finds a positive effect on productivity due to changes in road infrastructure. Likewise, Hulten (1997) combines indicators of the effectiveness of various infrastructure systems to investigate its impact on economic growth, finding that the inefficient use of infrastructure pays a growth penalty, namely a smaller benefit from infrastructure investments.

The macroeconomic study of Calderon and Serven (2004) pointed out, however, a high degree of correlation between various types of infrastructure –*e.g.* roads, electricity and telephones– may make almost impossible the identification of the degree of contribution each type of infrastructure has in the econometric estimation. In this regard, the authors adopted a different methodology based on principal component analysis for the purpose of capturing in a single index the likely effect of each infrastructure variable on growth.

Lastly, those empirical studies that have examined the impact of the use of European Structural Funds –*i.e.* the only respectable example given the time intervals for the analysis– conclude that they have been influential in its goal of helping to convergence between nations, but agree they have not achieved one of its main objectives: reducing intraregional disparities. In this regard, a review of the literature on the topic of the effectiveness of European regional policies –see, among others, Bijvoet and Koopmans (2004), Ederveen *et al.* (2002), Molle (2007) and Rodriguez-Pose and Fratesi (2004)– seem to indicate that the implementation of cohesion policy has failed to diminish, in a significant manner, the asymmetries within the European regions.

The explanations advanced by the literature on this topic suggest that regional policies designed to attract economic activity in so-called peripheries or to reduce the circularity of agglomeration effects in centres –as it follows from NGE– are complex processes in some cases marked by failure. The reason given is that the peripheral regions lack a critical mass capable of retaining economic activities. Within this context, the improvement of infrastructure in remote regions might facilitate trade between the periphery and a centre next door, making the first to lose competitiveness and inducing a reorientation of economic activity towards the centre.[270]

6.3. The Methodological Proposal

Trying to make a synthesis of the above positions, the present chapter draws on the second setting proposed in Chapter 4, which makes a theoretical distinction among infrastructure effects, dividing them between those concerning firms' production functions and those directly connected with inter-regional trade, and introduces a transport-cost function *à la* Behrens *et al*. (2007a).

In the inevitable comparison with the European reality, the experience of MERCOSUR integration presents potential risks of desertification, a phenomenon clearly due to the Brazilian asymmetries and the existence of a limited number of powerful centripetal agglomerations –mainly São Paulo, and to a lesser extent Porto Alegre, Rio de Janeiro and Buenos Aires, the only agglomeration of magnitude outside Brazil. This disparity in terms of concentration of economic activity, which has no parallel in Europe –with a more equal distribution of economic activities– renders impractical the application of criteria for the allocation of funds for individual eligible regions exhibiting, for instance, development indicators below 75% of the average values. In such event, it would take several FOCEMs to meet the needs of the poorer or less developed regions.

On the threshold of the creation of FOCEM, Hoste (2003) analysed the likelihood of applying a criteria, similar to the one implemented by the European Structural Funds, to assist the less developed regions in MERCOSUR. In his attempt to classify MERCOSUR regions, the author focuses on the identification of three kinds of gaps (economic, infrastructure and social) in development indicators and ends up computing twelve indicators. This effort, worthy and valuable in its parts, lends itself to complex interpretation as a whole due to methodological difficulties, as well as to the nature of the reality of MERCOSUR and its peculiar differences with the European experience.

[270] Examples of these developments, relating to the impact of regional policies at the expense of the periphery, have been noted by Forslid (2004), Lafourcade and Thisse (2011) and Puga (2002), among other papers we have surveyed in Chapters 1 and 4.

An alternative solution would be the use of synthetic indices, able to condense different indicators. This is precisely the idea implemented in this chapter, where a characterization of the spatial units builds on an infrastructure index, summarizing in a single indicator the total physical infrastructure endowment. The rationality of focusing on traditional indicators of physical infrastructure, apart from FOCEM's priorities, is based on the fact that these are directly linked to what might be recognized as an integration effect: enhanced exports. The inclusion of other types of capital would have provided a valuable input in the analysis, making however the judgment of the cause-effect links an extremely complex exercise.

The first step then is a ranking of regions in the bloc, according to the values of the synthetic infrastructure index. The bottom regions are the potential candidates for help. This result is combined with information on export potential at the product level (5-digits), in order to provide additional information to be used as a valid criterion for allocating the Fund resources. As regard the latter, the starting point is to select a range of products with sustainable export potential for those regions (or countries) relatively disadvantaged regarding infrastructure.[271]

Next, we estimate an extended gravity equation –along the lines of Chapter 5– for each of the correspondingly chosen exports. Finally, each models' coefficients are used to predict the increase in exports of these very products as a result of improved physical infrastructure or a reduction in transport costs; task that gives us a clue to identify a sub-group of products where the impact is more notorious –as sugar cane, the example considered in sub-section 6.5.b– which, in due course, must be analysed more carefully and in detail in order to design specific policy interventions. This last exercise, nonetheless, faces a no minor constraint. Since we were not able to obtain the necessary data to accomplish the structural estimation of our general-equilibrium expressions in Chapter 4 –as it is clear below– the 'counterfactual analysis' we do is limited in scope as referred to in Chapters 4 and 5 –see our references to Balistreri *et al.* (2011) and Corcos *et al.* (2010) among others. Hence, the results should be taken with caution and, at best, as starting point for accomplishing deeper case studies, specific project evaluations and proper cost-benefit analyses.

[271] The criteria applied to select products with export potential for Uruguay and Paraguay is as follows. In a first step, we used trade data for both countries and their major trade partners (MERCOSUR partners, Mexico, USA, China and members of the EU-15) to construct a trade complementarity index (TCI). Trade data used in this step was collected from COMTRADE-2005 –coded up to five digits of the SITC, rev.3 classification extracted through the WITS-system. In a second step, products having a TCI>1 and a representative share within the total exports of the respective country were selected. Additionally, to complement these criteria, selected products were analyzed by stage of production to evaluate their dynamism into global chains of production (see Calfat *et al.*, 2008b).

The estimation of our extended gravity model is undertaken at a product level using panel data between 2003 and 2005. For the case of Argentina and Brazil trade data was available at a provincial and state level. This was not the case for Uruguay and Paraguay for which trade flows are recorded at national level only. Nevertheless, since both countries are relatively small, with industrial activity highly concentrated into their capital cities and considering that most of their trade is shipped through specific gateways, we have attempted to circumvent these data constraints by considering them as big regions of MERCOSUR.

Hence, observations of 53 MERCOSUR regions and their main trading partners (21) were taken into account for the selected products.[272] It is worth to notice that sample size for each product varies as not all MERCOSUR regions exhibit the same trade pattern. Moreover, even though a total of 30 products were selected, estimations were only performed for those cases in which the number of observations was representative.

Furthermore, for estimation purposes and to account for changes on the stocks of infrastructure through time, infrastructure indices were computed for each of the 53 units of MERCOSUR in an annual base. In this respect, annual observations for each one of the stocks of infrastructure considered (paved roads, electricity consumption and phone lines) jointly with the coefficients obtained from the principal component analysis were used.

The estimation of gravity models by product allows to arrive at a kind of counterfactual result to figure out what would had been the export performance of a 'without asymmetries' or an 'average'-integration, had no changes occurred in physical infrastructure or transportation costs. The results of the simulations, thus, set an indicative ranking of products able to further expand exports as a result of a 20% improvement in physical infrastructure of the exporting region. Hence, the simultaneous identification of regions and products with export potential provides the input for determining the final allocations.

[272] Selected partner countries are: Brazil, Uruguay, Paraguay, Bolivia, Chile, Mexico, the United States, China and the 15 European Union members of 1995 – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, the Netherlands and the United Kingdom.

6.4. Data and Background Results

6.4.a- Regional data

The establishment of a database of spatial/regional statistics within the MERCOSUR, similar to the NUTS system (Nomenclature of Territorial Units for Statistics) used by EUROSTAT, is still a dream to come true. Because of this 'statistical' reality, data collection of comparable indicators of infrastructure for cross-regions is a daunting, frustrating and sometimes tortuous endeavour. In an attempt to fix this 'bug' in the official statistical landscape, we have compiled a systematic and fairly comprehensive collection of provincial, state or departmental level information at the regional level, in the hope to set up the basis for further work on the subject.[273]

6.4.b- Measurement of infrastructure

Adopting the definition of physical infrastructure cited by the MERCOSUR Secretariat (2005c), as being related to transport, energy and communications, and depending on the availability of statistics for the countries studied, three have been the infrastructure variables considered: electricity consumption per capita (MW), number of telephones (fixed and mobile) per 1000 inhabitants and the length of paved roads (km) normalized by total surface (km^2) of the region.

Since those variables are highly correlated within the regional context of MERCOSUR, we adopt the methodology suggested by Serven and Calderon (2004).[274] Hence, following Sanchez-Robles (1998) and posterior studies –such as Benedictis *et al.* (2006) and Francois and Manchin (2007)– we construct an index of infrastructure for each of the regional units (provinces, states, departments) of MERCOSUR making use of principal components analysis.

Data availability obliged us to work with 87 regions, which roughly correspond to the Brazilian states (27 regions), the Argentine provinces (24 regions), and 17 and 19 spatial divisions in Paraguay and Uruguay, respectively. The observations refer to

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[273] For detailed information on the sources and data used in the construction of our regional infrastructure data base, we refer the reader to the Annexes of the report prepared for the MERCOSUR Secretariat (Calfat *et al.*, 2008a). For the case of Argentinean data, the sources are the same as those used for Chapter 5.

[274] Note that high correlation was not present when exclusively studying Argentinean regions in Chapter 5.

average indicators (2003-2005) for each infrastructure variables described above. The results of the principal component analysis give the weights with which the three variables enter the index, namely:

$$PC(Z)_{it} = 0{,}53 \times proad + 0{,}56 \times elecper + 0{,}64 \times phones \qquad (1)$$

where $PC(Z)_{it}$ represents the first principal component; *proad* stands for the length of paved roads normalized by surface; *elecper* corresponds to electricity consumption per capita; and *phones* symbolises number of telephones per 1000 inhabitants.

After carrying out the calculation of the infrastructure index, and in order to establish a comparative analysis of the existing asymmetries between the various regions, a ranking was prepared. Tables 1 in Appendix C6 give the overall result, where regions that occupy the top places are those that, in addition to improved physical infrastructure, have a relatively high per capita income.

The outcome of the ranking is compelling and offers a rather fair representation of the regional state of physical infrastructure in MERCOSUR. The Brazilian states of the South and Southeast, characterised with relatively high-income levels, are represented in the upper section of the ranking. In Argentina, as expected, the top positions include the Autonomous City of Buenos Aires and the provinces of the South –Chubut, Santa Cruz, Neuquén and Tierra del Fuego– characterized by production structures based on intensive use of natural non-renewable resources. Interestingly, the heading group also includes Catamarca, which along with San Luis –located in an overall twenty-second place– are typical cases of new economic developments with the support of policies aimed at attracting investments in the region.

Furthermore, it is interesting to observe the location of the province of Buenos Aires in Argentina, which appears relatively far from the top. Two main reasons explain this position in the ranking: a) a clear abandonment of the physical infrastructure in the last twenty years, b) the heterogeneity of this province, characterised by a wide geographical discrepancy in terms of basic infrastructure. The latter points out the necessity of further improvements in the regional database for MERCOSUR, similar to the European NUTS system.

The southern provinces of Uruguay, which concentrate the highest levels of economic activity, belong to the top ten of the MERCOSUR regions, with the exception of Colonia that lies at the nineteenth position. The best Paraguayan region, in terms of the infrastructure index, is represented by Asunción and the Central Department, which were merged as one region for the purposes of calculating the index.

The contrasting situation of Uruguay and Paraguay in terms of physical infrastructure leaves little doubt in the event of identifying less favoured regions. A fragmentation of the global ranking into five sections would result in the inclusion of 11 Paraguayan departments in the lowest section. In other words, 60% of all its departments, excluding the zone of Asuncion, come out as the MERCOSUR regions with the most limited physical infrastructure.

The analysis of the Paraguayan departments in the bottom of the ranking does not allow a clear-cut distinction between border and interior regions. It is only the Alto Paraná department –known for its great dynamism and as a major producer of soybeans, corn, wheat and other oilseeds– as well as Misiones the ones that escape from the border regions of the latter group –the central department was already mentioned as among the top regions. In general, based on the rates of infrastructure for Paraguay, it may be inferred, unequivocally, that most of their departments suffer from inadequate physical infrastructure in relation to its MERCOSUR partners.

This statistical finding is consistent with the Paraguayan official perception on the asymmetries in MERCOSUR. In the document "Las Asimetrías en el MERCOSUR desde la Perspectiva de Paraguay" (MERCOSUR/LXIV GMC/DT N° 16/06), Paraguay argues for the implementation of "*aggressive and sustainable common market policies*" as the only way out to resolve, in their opinion, their most important structural hindrance: "*being a land-locked nation*", ending its status as relatively less developed country. Clearly, a weak physical infrastructure can only further exacerbate the cost of being landlocked. The high toll resulting from the absence of coastline is further aggravated as a result of poor land routes connections from centres of economic activity to gateways to foreign markets. Paraguay exports are mainly carried by truck to Argentina (66%) and Brazil (95%), while transportation to Uruguay is mainly made by waterway (88%) (Sánchez and Cipoletta Tomassian, 2003).

Compared with the Paraguayan situation, and based on our principal component analysis, physical infrastructure in Uruguay does not appear as a crucial disadvantage. Indeed, and as it is observed in the ranking, Uruguay counts only two departments (Cerro Largo and Rivera), in the group of regions with the most underprivileged physical infrastructure.

This preliminary conclusion is, to a certain extent, confirmed in the light of an official document produced by the Uruguayan government under the name "Uruguay and MERCOSUR" (MERCOSUR/LXV GMC/DI Nº 16/06). In this document, Uruguay unveils its interpretation and proposals to address the asymmetries and improve market access. With the exception of only one point of coincidence with the Paraguayan document –which stresses the small size of the domestic market as a major source of asymmetry– the Uruguayan perception of the notion of asymmetry outlines other causes of weight and it is in essence quite distant from the Paraguayan vision.

In a small economy like Uruguay, the achievement of efficient scales of production is closely linked to access to export markets; in other words, any sustainable growth strategy for Uruguay is doomed to failure if not accompanied, at the same time, by a competitive insertion in both intra and extra MERCOSUR markets.

In the Uruguayan view the main cause of its asymmetry is not fuelled by the classic shortcomings of the physical infrastructure but come, above all, from the high degree of uncertainty that characterises MERCOSUR policies. Uruguayan aspirations do not go beyond merely requiring compliance with agreed targets and measures to address the institutional deficit, to deal with the problem of non-tariff restrictions, to eliminate policies that distort trade and investment location, to achive coordination of financial and macroeconomic policies and to develop an agenda of productive complementarities among MERCOSUR partners.

Returning to asymmetries based on physical infrastructure inequalities, and from a national perspective, in no one of the cases the indicators of infrastructure of the two sub-regions described for Paraguay as Border and Interior outperform their less developed peers in each of the other members –the Northeast in Argentina (NEA), the North and Northeast in Brazil ('Norte' and 'Nordeste') and the relatively less developed region in Uruguay. Building upon the results revealed by the principal component analysis, everything thus seems to indicate that the vast majority of regions in Paraguay would be in a condition to qualify for financial aid from the FOCEM, while a less developed criterion in terms of physical infrastructure, in view of the same results, can be regarded as a fragile argument to address the issue of asymmetries in the Uruguayan case.

The identification of regions in Paraguay, with a clear infrastructural deficit, should be dealt with even greater refinement. In this regard, and because of the dual economies existing in various Paraguayan departments, it would be possible to identify departments within sub-regions with distinct development characteristics. For example, the Alto Paraná region, characterised by a disintegrated development, has both agricultural areas that produce commodities and subsistence crops. At the same time, re-exporting activities can be observed, as well as parallel economies without production chains. This dualism is a structural feature of the Paraguayan economy and society, almost equally divided in terms of inhabitants between the rural and urban areas.

Finally, the analysis in this section enables to advance some major ideas regarding the criteria to apply for the allocation of funds:

a) The annual amount of net transfers established by FOCEM for Paraguay (48 million dollars) and Uruguay (32 million dollars) does not seem to find support in the principal component analysis for the physical infrastructure. The balance should be tilted sharply toward the Paraguayan side.

b) Since the allocation criteria of the European Cohesion Funds are not immediately applicable to the MERCOSUR framework, in the case of Paraguay it would not be reasonable to allocate funds to the most backward regions, with reduced levels of economic activity and without export potential. This would be a mere 'ugliness contest' to attract funds and produce a negligible return. Rather, the objective of a sound regional development policy should be to help the regional development of wealth-creating areas (*e.g.* the most dynamic areas in the Paraguayan border) and not to try to divert economic activity from a relatively prosperous region to another less developed, isolated and with a tiny chance of generating sustainable exports.

6.4.c- Helping the poor, supporting advanced regions?

The preceding statement seems, at first glance, to contradict the widely held view regarding the expected destination of the funds for convergence between regions. This theme, related to increased channelling of funds to regions that concentrate more economic activity ('local cores') in relation to those with less advanced economic development ('local peripheries') has been subject to treatment in the literature and do not contradict, in any way, the principal objective of the fund, that is to say, to help to reduce imbalances between MERCOSUR regions.

This would indicate that regions cannot be interpreted as islands in itself but as belonging to a system of cores and peripheries. In this sense the location of activities in centres entails a trickle down effect as a result of so-called externalities of agglomeration, which could result in benefit of the areas adjacent to centres and located in the peripheries. In other words, the recognition of the existence of centre-periphery structures within regions is an important element in the decision to allocate funds to stimulate regional growth poles, while allowing, at the same time, an improvement in the development of poorer regions.

The logic of the exposed reasoning reinforces the choice of the methodology used in our attempt to arrive at objective criteria for the allocation of funds. The choice between equity and efficiency is addressed through our analysis in two stages. Having identified priority regions –relatively disadvantaged regarding infrastructure– the next step is the identification of sectors/products with opportunities within each region. The main idea is to select products exported by Paraguay and Uruguay that show sustainable opportunities in partners' markets and determine the extent to which interventions with a direct impact on competitiveness –in the case, improvements in physical infrastructure, or a reduction in transport costs– would be able to improve their export position and, thus, contribute to the development of the region in which they are produced.

6.5. Export Performance and Infrastructure: Estimation Results

Using the latest available data, we study export performance of MERCOSUR regions between 2003 and 2005, a period for which most of the relevant variables have statistical coverage.[275] Let consider the following expression as a starting point to describe the variables analysed:[276]

$$\ln X_{rst}^{j} = b_0 + b_1 \ln G_{rt} + b_2 \tau_{rst}^{j} + b_3 \ln \delta_{rst}^{j} + b_4 \sum_k \varphi_k \lambda_{rs}^{k} + b_5 \ln m_{rt} + b_6 \ln E_{st}^{j} + b_7 \ln P_{st}^{j} + \varepsilon_{rst}^{j} \tag{2}$$

Variables

X_{rst}^{j} is the value of exports of commodity *j* shipped from the region *r* to partner *s* in year *t*. Bilateral exports were obtained from various sources. In the case of Argentina, the data was provided by the National Institute of Statistics and Censuses (INDEC) of Argentina, in the case of Brazil the database is from the Secretary of Foreign Trade (SECEX) of the Ministério do Desenvolvimento, Indústria e Comércio (MDIC) of Brazil.[277] In the case of Paraguay and Uruguay, since it was not possible to obtain detailed information of exports by departments, aggregate exports are considered and were obtained from COMTRADE. In this context, countries/regions considered as 'reporting units' in estimating our gravity

[275] This is not the case for either previous or following years, for which a lot of statistical information is not available.

[276] This specification results from taking logarithms to a time-varying version of expression (42) in Chapter 4, namely: $X_{rs}^{j} = a^{j} G_r^{j} e^{(1-\sigma^{j})\tau_{rs}^{j}} \delta_{rs}^{j\,(1-\sigma^{j})\phi} e^{(1-\sigma^{j})\sum_k \varphi_k \lambda_{rs}^{k}} \left(w_r^{\alpha} m_r^{\gamma}\right)^{-\sigma^{j}} E_s^{j} \left(P_s^{j}\right)^{\sigma^{j}-1}$. Note, additionally, that price of labour is disregarded due to absence of accurate data at regional level.

[277] The Secretariat of Foreign Trade has an integrated system called ALICEWEB, which allows querying detailed but limited exports. For that reason it was necessary to request special access to additional information.

model amounted to 53 (24 provinces in Argentina, 27 states in Brazil, Paraguay and Uruguay).

G_{rt} is the Gross Domestic Product (GDP) of each regional exporting unit (province, state, country) considered in this study.[278] The data was provided by the Ministry of Economy in the case of Argentina; the Brazilian Institute of Geography and Statistics (IBGE) in the case of Brazil. For Paraguay and Uruguay, the data was gathered from international statistics published by the World Bank.

τ_{rst}^{j} accounts for policy barriers measures (*e.g.* tariff barriers, non-tariff and technical barriers). Because of the lack of systematic information about domestic policies, together with the absence of a complete and updated time series of the commercial impediments levied by the partners, the inclusion of this variable for estimation purposes was impracticable.

δ_{rst}^{j} represents transportation costs to ship the product *j* from region *r* in country *s* in year *t*, or 'transport infrastructure'. Trying to depart as little as possible from our model, and relying on some information about modes of transportation and border crossings in the country, we created an original proxy variable. We considered the construction of a variable representing transportation costs, δ_{rs}, or 'transport infrastructure', including both the notion of internal and external distance. This means that, beyond the common distance from export port to destination, distance within the country –from the producing region to the export gateway– was included. This is crucial not only for a landlocked member as Paraguay, but also for vast territories like Argentina and Brazil for which internal distances are not negligible at all –as referred to in Chapter 5.

To compute internal distance we relied on the basis of information collected in identifying the point-to-point paths up to the exporting gateways for different types of commodities. Accordingly, information on both latitude and longitude of output nodes as well as capital cities of the economic units under consideration was used. In the case of Brazil, the identification of gateways for product by destination did not pose problems because export databases containing such information were available. In the case of Argentina, we made use of a complementary database, which was provided by the Centre of Studies on Production. Information on the exit gateways per product depending on destination was not available in the export datasets for the cases of Uruguay and Paraguay. To deal with this issue we made a thorough and detailed analysis to identify the exit points of the products selected for this study. In the case of Paraguay, we used an additional database provided by the

[278] Note there is a deviation from the theoretical definition. While this variable should have been measured by regional production of commodity *j* (G_{rt}^{j}), the lack of data impedes it.

Central Bank of Paraguay that facilitated the mapping of exports by product according to mode of transportation used. This information was combined with information from production areas, roads, airports and ports available from different sources. Similarly, in the case of Uruguay, we used basically export information from ports collected by the National Ports Administration. Moreover, for the purpose of correcting any biases in the calculation of the internal distance for the cases of Paraguay and Uruguay, only those departments concentrating most of the economic activity were considered.

λ_{rs}^{k} are other geographical and cultural determinants of bilateral trade, such as contiguity, common language and isolation. These variables are represented by two dummy variables, '*Locked*' and '*Border*'.

m_{rt} is the price of infrastructure services. As these prices are not available at the required level of geographical disaggregation, we adopt a 'proxy' variable as suggested and implemented by Hanson and Xiang (2004), *e.g.* factorial supply of these resources in the region. It is further noted that this 'solution' is in line with those studies that have attempted to measure the impacts of infrastructure improvements on trade, reviewed in Chapter 5. For our gravity regressions we use the infrastructure indices constructed.

E_{st}^{j} is expenditure on good j in region s during year t. Since it is not possible to find information on this variable for each partner and year, the national GDP is taken as proxy. Accordingly, GDP data from the international statistics published by the World Bank is used.

P_{st}^{j} is the price index of the commodity j. To represent this variable in gravity equation, several authors different alternatives as reviewed in Chapter 5. In this work, however, we are forced to omit this variable because of lack of information.

To conclude, the computation of each variable, albeit many difficulties, tries to deviate as less as possible from the essence of model (2). In the event that available information does not exactly match theoretical definitions, we tried to select 'proxy' variables for which a consensus has been reached in the literature. In the absence of any consistent or reliable information, the omission of the variable was decided. Thus, it should be noted that both the omission as well as the imprecise measurement of some variables, such as t_{rst}^{j} and P_{st}^{j}, may affect the obtained estimates, introducing some biases.

The final specification estimated is:

$$\ln Exp\_ij = b_0 + b_1 lgdp\_i + b_2 lgdp\_j + b_3 ldist\_ii + b_4 ldist\_ij + b_5 lINFRA + b_6 Bord + b_7 Locked\_i + \varepsilon_{rst} \quad (3)$$

where: $\ln Exp\_ij$ stands for the logarithm of regional exports, $lgdp\_i$ is the logarithm of gross regional product, $lgdp\_j$ stands for the logarithm of gross domestic product of partner countries, $ldist\_ii$ is the logarithm of internal (transport) distance, $ldist\_ij$ represents the logarithm of external (transport) distance, $lINFRA$ is the logarithm of the infrastructure index, $Bord$ is a dummy variable that takes the value of 1 for contiguous region-country pairs, $Locked\_i$ is a dummy that equals 1 for landlocked MERCOSUR regions.

6.5.a- Results of the simulations

Table 1 shows the selected products with export potential for Paraguay and Uruguay. The regression results for ten of them are presented in Table 2 in Appendix C6. The signs and the value of the coefficients, obtained by OLS for a classic pool and panel data with random errors, are generally acceptable; especially considering that these are not traditional gravity equations where exports are aggregated in a total with no product distinction at all. The regressions by product imply a more refined construction of variables where it is not always possible to collect information at compatible and uniform levels of classification and characteristics for products and industries, resulting in a complex interpretation of the results.

As an example of the interpretation of the results, we select a particular product, sugar cane -06111, and proceed with the comments on the coefficients to explain the degree of variability of exports (see Table 2 in Appendix C6). The variable that captures the purchasing power or market size of the trading partner ($lgdp\_j$) has the expected sign and a high significance level. Sugar cane has an important input market in developed countries with temperate climates and is an alternative to the more traditional sugar beet, as in the case of Europe.

The variable that captures the size of the producing region ($lgdp\_i$) has a negative sign and a high significance. This result could indicate that regions concentrating the production of sugar cane are often not the most economically developed, but those characterised by a weak level of economic activity with a production mode typical of a rural setting. The same interpretation could be made of the variable that captures the fact of being a landlocked exporting region, which seems to be a feature of regions that export sugar cane in our sample.

Table 1: List of selected products

Cod Prod	Description
01122	Meat of bovine animals, frozen....boneless
08131	Oilcake and other solid residues (except dregs), whether or not ground or i
01112	Meat of bovine animals, fresh or chilled....boneless
61142	Other bovine leather and equine leather, without hair on ... parchment-dres
42111	Crude oil, whether or not degummed
61141	Other bovine leather and equine leather, without hair on ...tanned or retan
04231	Rice, semi-milled or wholly milled, whether or not polished, glazed, parboi
89319	Articles for the conveyance or packing of goods, n.e.s.; stoppers, lids, ca
26873	Wool tops and other combed wool
02499	Other cheese
02222	Milk and cream, in solid form, of a fat content, by weight, exceeding 1.5%
65771	Wadding of textile materials and articles thereof; textile fibres not excee
06111	Cane sugar, raw
29193	Guts, bladders and stomachs of animals (other than fish), whole and pieces
82119	Parts of the seats of subgroup 821.1
01212	Meat of sheep, frozen
55421	Organic surface-active agents, whether or not put up for retail sale
42171	Crude oil of Rape, colza or mustard
63431	Plywood consisting solely of sheets of wood...with at least one outer ply o
28239	Ferrous waste and scrap, n.e.s.
24615	Wood in chips or particles....non-coniferous
03428	Other fish, frozen (excluding livers and roes)
62111	Compounded rubber, unvulcanized,...compounded with carbon black or silica
24752	wood....of other non-coniferous species
42151	Crude oil of Sunflower seed
55132	Other essential oils
05711	Oranges, fresh or dried
65422	Fabrics, woven, containing 85% or more..of combed wool or of combed fine a
78435	Drive-axles with differential, whether or not provided with other transmiss
24502	Wood charcoal (including shell or nut charcoal), whether or not agglomerate

Note: This list based on a selection criteria outlined by the authors
Product codes refer to SITC rev.3, COMTRADE-databases extracted from WITS system

As regard infrastructure, its expected positive impact on exports is, in general, verified. In other words, being well endowed with roads, electricity and telecoms seems to favour external competitiveness. The variables which capture the importance of distance (the internal $ldist\_ii$ and external $ldist\_ij$) as a proxy for transport costs are significant and with the expected sign. This would indicate that poor access to export gateways is equally important, when compared to classical distances between the export gateway and the final destination, and acts as a brake on export potential.

Simulations where then performed, for each good selected for Paraguay and Uruguay, supposing an improvement of 20% in the value of the infrastructure index. The results of the simulations are presented in Tables 2 and 3, which contain a ranking of the most benefited exports as a result of that improvement in physical infrastructure.

The difference observed between the results for Paraguay (Table 2) and Uruguay (Table 3) seems to be due to both a greater diversification by country of destination and a less pronounced effect on exports (absolute and relative increases set out in columns 8 and 10) in the case of Uruguay. The latter would indicate that the larger relative increases in Paraguayan exports are explained by the existence of weaker infrastructure as compared to Uruguay.

Table 2: Paraguay

Impact on exports derived from changes in the index of regional infrastructure

Main selected products

Prod. Code	Product	Year	Trade partner	Exports	Estimated exports	Exports increase	Absolute increase (%)	Share of exports	Relative increase (%)
04231	Rice, semi-milled	2004	Brasil	1355,35	3504,90	2149,54	159%	100%	159%
06111	Cane sugar, raw	2005	USA	13899,11	29700,23	15801,12	114%	82%	93%
55132	Other essential oils	2004	Brasil	3763,02	7436,92	3673,90	98%	79%	77%
02499	Other cheese	2004	Bolivia	477,19	635,31	158,12	33%	100%	33%
55132	Other essential oils	2004	France	396,52	785,42	388,90	98%	8%	8%
55132	Other essential oils	2004	USA	278,25	551,74	273,49	98%	6%	6%
06111	Cane sugar, raw	2005	Italy	778,90	1666,39	887,50	114%	5%	5%
06111	Cane sugar, raw	2005	Belgium	693,22	1483,32	790,10	114%	4%	5%
06111	Cane sugar, raw	2005	Netherlands	523,97	1121,69	597,72	114%	3%	4%
06111	Cane sugar, raw	2005	Germany	513,99	1100,36	586,37	114%	3%	3%
55132	Other essential oils	2004	Germany	163,28	324,58	161,30	99%	3%	3%
55132	Other essential oils	2004	Belgium	163,08	324,18	161,10	99%	3%	3%
06111	Cane sugar, raw	2005	United Kindom	395,65	847,51	451,86	114%	2%	3%
06111	Cane sugar, raw	2005	Denmark	134,00	288,45	154,45	115%	1%	1%

Note: 5th column: exports recorded by year and trade partner, thousands of U.S. dollars. 6th column: estimated exports by product per year and trading partner due to 20% improvement in infrastructure index (thousands US $). 7th column: gross increase in exports due to infrastructure improvement. 8th column: percentage increase in exports due to infrastructure improvement. 9th column: participation of the respective partner in total trade with selected markets. 10th column: relative increase in exports due to infrastructure improvement.

Table 3: Uruguay

Impact on exports derived from changes in the index of regional infrastructure

Main selected products

Prod. Code	Product	Year	Trade partner	Exports	Estimated exports	Exports increase	Absolute increase (%)	Share of exports	Relative increase (%)
01112	Meat bovine animals	2004	USA	45760,01	63095,20	17335,19	38%	37%	14%
01122	Meat bovine animals, froz. b-less	2004	USA	316066,20	324100,85	8034,65	3%	90%	2%
01112	Meat bovine animals	2004	Brasil	9113,73	11595,84	2482,12	27%	7%	2%
61142	Other bovine leather	2004	Germany	39835,45	41972,08	2136,63	5%	34%	2%
61142	Other bovine leather	2004	USA	32467,66	34209,55	1741,89	5%	28%	2%
61142	Other bovine leather	2004	China	18738,82	19744,53	1005,71	5%	16%	1%
29193	Guts, bladders	2004	Italy	4557,26	4651,60	94,33	2%	35%	1%
29193	Guts, bladders	2004	Germany	3164,93	3230,75	65,83	2%	24%	0%
61142	Other bovine leather	2004	Mexico	8434,04	8887,29	453,25	5%	7%	0%
29193	Guts, bladders	2004	Spain	2324,93	2373,55	48,63	2%	18%	0%
29193	Guts, bladders	2004	France	1390,68	1420,17	29,50	2%	11%	0%
61142	Other bovine leather	2004	Paraguay	4456,11	4696,07	239,96	5%	4%	0%
61142	Other bovine leather	2004	Argentina	3930,45	4142,23	211,78	5%	3%	0%
61142	Other bovine leather	2004	France	3813,91	4019,44	205,53	5%	3%	0%
61142	Other bovine leather	2004	Sweden	2193,17	2311,81	118,64	5%	2%	0%
29193	Guts, bladders	2004	USA	539,71	551,78	12,07	2%	4%	0%
29193	Guts, bladders	2004	China	470,97	481,63	10,66	2%	4%	0%

Note: 5th column: exports recorded by year and trade partner, thousands of U.S. dollars. 6th column: estimated exports by product per year and trading partner due to 20% improvement in infrastructure index (thousands US $). 7th column: gross increase in exports due to infrastructure improvement. 8th column: percentage increase in exports due to infrastructure improvement. 9th column: participation of the respective partner in total trade with selected markets. 10th column: relative increase in exports due to infrastructure improvement.

In the case of Paraguay, the main products are: unrefined sugar cane (06111), semi-processed or prepared rice, polished or not, glazed (04231), other types of cheese (02499) and other essential oils (55132), among which we can find peppermint and the 'Japanese' variety –being the Brazilian market the main destination. The largest Uruguayan export increments are observed in the following products: meat and frozen boneless bovine (01122), bovine meat not frozen, boneless (01112), other bovine and equine leather parchment (61142) and guts, bladders and stomachs of animals except fish (29193).

To complement the simulations on the effects derived from infrastructure improvements, an equivalent measure of this impact expressed under the form of a reduction in internal transport costs (distance) of the selected goods to its export gateways can be computed (see Table 4).

It should be noted that these results ought to be interpreted with caution because the calculation of internal distances for both the Paraguayan and Uruguayan case requires still refinement. The database for export gateways has not yet been formalized, and in most cases is still missing. In this regard, although the work to identify point-to-point paths was extremely dense, we believe that the assembly of these databases is crucial in the analysis of transportation costs, and constitute a research project in itself.

Having made this provision, the results for Paraguay suggest the 20 percent increase in infrastructure is equivalent to an important reduction in internal distance, near to the elimination of the latter. This confirms the importance that cargo volume has as a crucial determinant in final transportation cost, considering the natural geographic barriers faced by this landlocked country for shipping goods.

Table 4: Paraguay

Impact on exports derived from equivalent changes in internal transport costs (distance)

Some selected products

Prod. Code	Product	Year	Trade partner	Exports	Decrease internal distance (%)	Decrease internal distance (Kms)
06111	Cane sugar, raw	2005	USA	13899,11	-99%	-153
55132	Other essential oils	2004	Brasil	3763,02	-100%	-210
02499	Other cheese	2004	Bolivia	477,19	-98%	-152
55132	Other essential oils	2004	France	396,52	-100%	-155
55132	Other essential oils	2004	USA	278,25	-99%	-154
55132	Other essential oils	2004	Belgium	163,08	-100%	-154
06111	Cane sugar, raw	2005	Belgium	940	-87%	-134
06111	Cane sugar, raw	2005	Italy	976	-72%	-112
06111	Cane sugar, raw	2005	Netherlands	465,09	-72%	-111

Note: 5th column shows: exports recorded by year and trade partner, thousands of U.S. dollars. 6th column: estimated internal distance reduction (equivalent to 20% improvement in infrastructure). 7th column: estimated internal distance reduction, in kilometers (equivalent to 20% improvement in infrastructure).

In the case of Uruguay, due to greater diversification of their exports and increased availability of air cargo and seaport facilities, the effects of infrastructure improvements are less influenced by the size of exports. The results in the case of Uruguay (not shown) tend to favour products whose main customers are in MERCOSUR, the USA and Germany.

6.5.b- The case of sugar cane

Further dealing with the example of sugar cane, and due to the importance of this product among the list of sectors with greater export potential for Paraguay, we carried out a deeper analysis on the characteristics of its production in Paraguay. The basic idea is to determine a regional mapping as reliable as possible in order to match sectors/products with regions.

The emergence of sugar cane in a privileged position in our ranking is not accidental. The product is not the traditional sugar cane but the ecological variety of this product. Paraguay is the first nation in the industrial production of organic sugar and a leader in the worldwide market for this product. The organic sugar is exported to the major centres of global consumption, in North America and Europe, where its price is higher –a ton of organic sugar is priced at about $ 330, while $ 260 is the price paid for common sugar.

A glance back at Tables 1 in Appendix C6 identifies the department of Guairá –heart of the production of sugar cane in Paraguay– as ranked in the 61st place out of a total of 87 regions. When compared to the whole of the MERCOSUR region, this department can be considered as relatively disadvantaged in terms of physical infrastructure. However, with the exception of the region that combines both the department of Asuncion Central and Misiones (near Guairá in the ranking), within the context of Paraguay, it comes out as one of those enjoying a better position in terms of physical infrastructure.

The department of Guairá, with a population of more than 180.000 inhabitants, is part of the corridor that traverses the country from East to West, which concentrates two-thirds of the Paraguayan population and is considered as the most economically dynamic region of the country. It has been estimated that more than half the population of Guairá is related directly or indirectly to the sugar cane sector.

The acreage of sugar cane cultivation amounted to 23.000 hectares, with districts in which the area of cultivated land reached 60% or more, such as Mauricio Jose Troche, Borja, Itapé, Iturbe, Félix Pérez Cardozo and Mbocayaty. The sugar cane mills not only receive and collect the raw material of its own department, but of neighbouring or nearby departments too –as is the case of Paraguari, Caazapa, Caaguazú and Cordillera– fact that extends the benefits of improved export performance in the sector beyond the borders of Guairá.

In line with the above reasoning and following the recent evolution in terms of regional policies, the mapping 'Guairá-organic sugar' provides a valuable clue that achieves a balance between the concepts of fairness (equity) and efficiency (competitiveness). It is important to stress that though relatively well endowed in terms of infrastructure, Guairá exhibits relatively high poverty records (45% of its population considered poor).

In this regard, the strengthening of the agro-organic sugar cane system as a development strategy in the region (extended to neighbouring departments as mentioned above) deserves consideration. The last ten years have witnessed in Paraguay the shift from a traditional/marginal agricultural system and labour to an organic and sustainable system –comprising approximately 1200 *cañicultores*– that is globalised and with established and solid international partnerships, a key element to guarantee access to markets and technology. In this sense, the role that physical infrastructure plays in regional development and, indirectly, in improving the competitiveness of sectors with export potential is far beyond doubt.

Although everything seems to indicate that the boom of sugar cane would naturally spill over all involved stakeholders in the sector, the analysis of the distributional impact of potential benefits deserves special consideration. An agricultural sector such the sugar cane, located in Eastern Paraguay, is characterized by very small production family units, with a significant share of subsistence agricultural production –*i.e.* using limited technological means and being basically labour intensive. The transmission of favourable international prices down to households will not materialise unless appropriate complementary measures are implemented.

That is why, having identified sector and region, and in light of a clear diagnosis of the situation, a criterion of convergence fund allocation should take into account an identification of bottlenecks in the price transmission mechanism, in order to encourage, through the implementation of complementary policies, improvements in physical infrastructure, provision of technical assistance and training to farmers, and upgrading of marketing systems, among others. This will smooth the pass-through of the positive shocks, allowing for a better distribution of the benefits of trade integration and liberalization, also to the most disadvantaged sectors of society.

From this new angle, asymmetries derived by processes of deeper integration or trade liberalisation that result in less desired poverty effects, albeit the difficulties in establishing clear causalities, are certainly an important element to be considered at the time of allocating Fund resources.[279]

[279] Among the various authors who have developed the theme of the relationship between trade liberalization and poverty in the framework of MERCOSUR we find Porto (2003 and 2006), Barraud and Calfat (2008) and Castro and Saslavsky (2006).

6.6. Concluding Remarks and Recommendations

We have put forward a proposal with two well-defined steps. In the first one, and to produce a global idea of target sectors in the bloc at stake, spatial units are ranked according to an infrastructure index. Then, for one or two most disfavoured members –*i.e.* hosting the greatest number of backwards units– the most competitive exports are identified. Gravity models are estimated for each of the correspondingly chosen exports. In each regression, observations are composed by *all members in the bloc exporting the selected good* acting as reporting units.

In a second step, simulations are performed for each selected good, supposing an improvement of 20% in the value of the infrastructure index of the exporting regions/provinces in each country. This allows the identification of sectors/products where investment in the related infrastructure would be more rewarding in terms of enhancing exports revenues. Though exports data are not usually disaggregated by provinces for the small members at stake, the location of production centres for each key good can be found. This amounts in turn to identify provinces, whose infrastructure has been assessed in the first step. This closes the logic of the exercise, producing a set of goods/provinces where investment in infrastructure should be directed to.

In the early years of its existence, FOCEM (our focus) has been mainly concentrated in financing activities within the framework of a structural convergence notion, aimed at improving the physical infrastructure of MERCOSUR members, with less relative economic development. Our conclusions point to the added insight in combining regional information with trade performance parameters. Priorities become, thus, assigned not only in a more encompassing but also in a more realistic way.

The analysis of the infrastructure complex clearly showed that in 60% of Paraguayan *departamentos* the worst infrastructure conditions in MERCOSUR are found. Uruguay, on the other hand, presents a better overall situation in this aspect, more in the lines of the bigger members. This is indirectly confirmed by the simulations based on the gravity parameters, for products with sustainable export potential both in Paraguay and Uruguay, which indicate that improvements in infrastructure have much more impact on the export performance of the former rather than on that of the latter. Indeed, the poor Paraguayan conditions seem to amplify the negative effect of its locked-in situation and related difficulties in reaching extra-bloc markets.

The applied policy conclusion is that FOCEM resources, under the global objective of fostering convergence of the members' physical infrastructure, should be directed in their totality to Paraguay, and not be dispersed among all backward regions in MERCOSUR. Behind this conclusion lies the belief that a regional development policy should aim at helping potential welfare-creating zones and not diverting economic activities from prosperous or better areas to zones with no growth perspectives at all.

A side result of the work is the clear need to create spatial units similar to the NUTS system used by the EU, maintaining and regularly updating a socio-economic and physical infrastructure database at each unit level.

CONCLUSION

This dissertation, mainly motivated by the strikingly heterogeneous spatial reality of Argentina, has contributed to the body of research known as the New Economic Geography (NEG) –more specifically, 'regional' NEG– and to the underdeveloped study of economic geography in Argentina and MERCOSUR.

The thesis aimed at explaining how location and agglomeration of economic activities –in particular export-oriented ones– have occurred within the country and MERCOSUR during the last decades. In this regard, first, it studied how location is determined inside countries and how changes in trade costs affect the distribution of economic activity; secondly, it looked for theory-based explanations about spatial disparities within Argentina and other MERCOSUR member countries.

Chapter 1 was the starting point for our research. It proposed a complete and rather detailed revision of the NEG framework, focusing on theoretical and empirical contributions that address the impacts of trade costs changes on domestic economic landscapes. Our revision showed that very much progress has been done and, indeed, much work is likely to be accomplished as regards both areas of study and, in particular, as regard regional policy issues.

Features as spatially fragmented production, the agglomeration-growth interaction, micro-heterogeneity, endogenous policy decisions, among others, deserve much work within regional studies. With respect to empirical research, the application of structural specifications, the use of research tools such as spatial econometric techniques and CGE simulations together with the development of complete spatially disaggregated datasets should be the basis for a promising research program oriented to policy issues.

In an attempt to provide some elements to characterise the Argentinean spatial reality during MERCOSUR days, Chapter 2 studied location within Argentina. Specifically, the explanatory spatial data analysis carried out suggests that between 1993 and 2005 manufacturing activities have concentrated inside the territory within border and initially more industrialised territories, unambiguously spoiling the remotest provinces of Patagonia.

The theoretical contributions of this thesis started with Chapter 3, which proposed a theoretical discussion about the impacts of regional integration on industrial location. In doing this, the chapter presented a very simple but illustrative framework that can deal with different 'pre-integration' scenarios in order to evaluate the spatial effects that a regional integration agreement may provoke.

The chapter showed that regional integration tends to foster agglomeration inside the country, and to deepen initial imbalances. In addition, and extending the results obtained by other authors, the chapter highlighted that location outcomes are highly dependent on size imbalances, both inside the domestic country and across countries. Indeed, preferential liberalisation could be desirable in terms of location for some regions that might have been against unilateral liberalisation and, under peculiar scenarios, might be welfare decreasing for the integrated territory.

Since some of the theoretical predictions derived from Chapter 3 seem somewhat stark in terms of industry relocation, the second theoretical chapter built a model that introduces some more realistic features such as comparative advantage differences and intra-industry linkages together with transport costs and infrastructure.

Export equations derived in Chapter 4 are a synthesis of ensuing agglomeration and dispersion forces driving location. Indeed, they show that a better export performance is achieved the higher are: local production of the tradable good, partner's expenditure and price index for that good; and the smaller are: prices of local production factors and infrastructure services, local price index for the tradable good and trade costs with the partner.

The settings of Chapter 4 provide for the empirically testable specifications used in Chapters 5 and 6 to study trade across Argentinean and MERCOSUR member countries'regions, respectively. After completing not a minor task, namely gathering a systematic and comprehensive collection of statistical information at regional (and provincial) level for Argentina, the fifth chapter estimated a theory-based gravity equation. The results found suggest the importance of infrastructure enhancement and/or internal transport-costs reduction for boosting regional export performance.

Finally, Chapter 6 accomplished a related assessment for MERCOSUR regions. Proposing a more policy-oriented exercise, it attemped to identify a set of goods for which, and of provinces where, the resources of the *Fondo de Convergencia Estructural del MERCOSUR* (FOCEM) for infrastructure investment should be directed to. The analysis focused on a raking of spatial units with relative backwardness in terms of infrastructure, as well as on the identification of sectors/products that could improve their export position through an intervention or financial support investments programmes in specific infrastructure.

The analysis of the infrastructure complex together with the simulations based on gravity parameters indicated that improvements in infrastructure might have a great impact on the export performance of Paraguay. Therefore, the applied policy conclusion was that FOCEM resources should be directed totally to Paraguay, instead of being dispersed among all backward regions in MERCOSUR.

Lines for future research

Many potentially interesting topics related to the subject of this thesis have been put aside. Various are the extensions of the NEG framework that should be work out within regional economics, as mentioned, and many are the empirical challenges to be tackled.

As regard the latter, two areas are of relative importance, namely: the proper estimation of NEG models, which is still a debt (Combes, 2011), and their application to draw relevant policy implications that is just in an embryonic state (Behrens and Robert-Nicoud, 2011). Availability of high quality and sufficiently disaggregated datasets, structural estimations, GE simulations and the correct inclusion of spatial interactions across regions are central in order to achieve both goals.

With respect to our particular 'geographical' concern, future work should address three main issues. First, the development of comprehensive regional databases for Argentina (and MERCOSUR), similar to the European NUTS system, will allow to accomplish such empirical research looking at estimating models and applying the results for relevant policy discussions.

Second, the accomplishment of place-based approaches may give clues, help to sketch hypotheses and bring specific information to be combined and enriched with NEG central features and predictions in order to give answers about the striking spatial reality of Argentina (and MERCOSUR). Indeed, one can reasonably expect that this associated research may offer more complete interpretations and, hence, more precise policy suggestions.

For instance, as previous chapters suggested, improvements of transport infrastructure might help regions to overcome their disadvantages. Nonetheless, upgrading specific transport modes or investing within particular regions might also pull out more productive firms from the small region towards the core (Baldwin and Okubo, 2006; Nocke, 2006). Hence, there is place for case studies and/or cost-benefit analyses that give essential information for designing proper policy interventions. Moreover, for regional policies to attract firms inside small regions there are additional issues such as micro-heterogeneities and technological externalities that should be introduced into the framework –as pointed out above.

Finally, from that economic-policy perspective, it would be especially interesting to deepen the analysis on the design of effective and efficient policy instruments that can change stringent unequal realities as those present in Argentina and MERCOSUR. As it is argued for instance by Van Der Ploeg and Poelhekke (2008), the process of development can and should be aided with public policies, such as public infrastructures and public education. Nonetheless, as many authors point out, this is an area of study where no concluding answers have yet been given.

Samenvatting in het Nederlands

Vanuit de opvallende ruimtelijke situatie van Argentinië, mijn vaderland, wil dit artikel een bijdrage leveren aan het bestaande onderzoek, bekend als Nieuwe Economische Geografie (NEG), en aan de onderontwikkelde studie van de economische geografie in Argentinië en de MERCOSUR. Het artikel beoogt een beter inzicht in de manier waarop locatie en agglomeratie van de economische activiteit hebben plaatsgevonden in dit land – en in de unie – gedurende de laatste decennia sinds de heropening van de economie voor de internationale handel en regionale integratie. Het inleidende hoofdstuk schetst de uitgangspunten en doelstellingen van deze verhandeling en stelt de aanpak voor.

Hoofdstuk 1 benadert het onderwerp vanuit de bestaande literatuur. Het gaat hier om een complete en veeleer gedetailleerde herziening van het NEG-kader, gericht op de theoretische en empirische bijdragen die de gevolgen van de wijzigende handelskosten op het binnenlandse economische landschap behandelen.

Hoofdstuk 2 is een verklarend hoofdstuk dat locatie in Argentinië bestudeert, waarbij getracht wordt 'stylized facts' te vinden die de evolutie van de voorbije decennia beschrijven. Meer in het bijzonder geeft het een verklarende ruimtelijke data-analyse van het Argentijnse economische landschap na de vorming van de MERCOSUR en toont het aan dat een zekere ruimtelijke concentratie van industriële activiteiten kon plaatsvinden binnen de grenzen en aanvankelijk binnen meer geïndustrialiseerde gebieden in het land.

Met deze 'stylized facts' als inspiratiebron, introduceert hoofdstuk 3 een NEG-model dat uitgebreid werd met de bedoeling verschillende "pre-integratiescenario's" uit te werken om de ruimtelijke gevolgen die regionale integratie kan veroorzaken binnen een lidstaat te evalueren. De belangrijkste bevindingen zijn dat bevoorrechte handelsliberalisering de binnenlandse divergentie binnen de regio met bevoorrechte toegang tot de unie lijkt te bevorderen en handelsliberalisering wenselijk lijkt te maken met betrekking tot locatie voor bepaalde regio's die gekant zouden kunnen zijn tegen unilaterale liberalisering.

Hoofdstuk 4 werkt een model uit dat, via de invoering van een aantal meer realistische eigenschappen zoals verschillende comparatieve voordelen van de regio's en intra-industriële verbanden, rekening houdt met de invloed van transportkosten en infrastructuur bij het bepalen van intra-landelijke locatie en bijgevolg met exportprestaties. Deze omkadering levert een bijdrage aan de literatuur omdat het zo mogelijk wordt om de gevolgen van de transportinfrastuctuur te scheiden van die van de productie-infrastructuur en de transportkosten op te splitsen vanuit diverse hoeken, met name binnenlands transport versus buitenlands transport.

Het empirische deel van dit artikel start bij hoofdstuk 5, dat beoordeelt of de regionale exportprestaties in Argentinië tussen 2003 en 2005 verklaard kunnen worden vanuit het theoretische kader dat ontwikkeld werd in het vorige hoofdstuk. In dit verband maakt dit hoofdstuk een schatting van een modelgebaseerde graviteitsvergelijking die de impact van de transportkosten en productie-infrastructuur benadrukt. In het algemeen zou men kunnen stellen dat een verbetering van de infrastructuur en/of reductie van de interne transportkosten doeltreffende strategieën zijn om de regionale exportprestaties te stimuleren.

Hoofdstuk 6 komt tot een vergelijkbare evaluatie voor de MERCOSUR-regio's. Het stelt een meer beleidsgerichte uitoefening voor en tracht de koers te bepalen voor het aanwenden van de middelen van de *Fondo de Convergencia Estructural del MERCOSUR* (FOCEM) voor infrastructuurinvesteringen. De belangrijkste conclusie is dat een verbetering van de fysieke infrastructuur in minder ontwikkelde regio's in Paraguay en Uruguay de export van bepaalde concurrerende producten bevordert.

Tot slot vat het afsluitende hoofdstuk de bijdragen samen van deze verhandeling en reikt het een aantal potentieel interessante onderwerpen aan voor verder onderzoek, die in het kader van deze verhandeling terzijde geschoven werden.

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APPENDIX I

Figure 1: Political map of Argentina

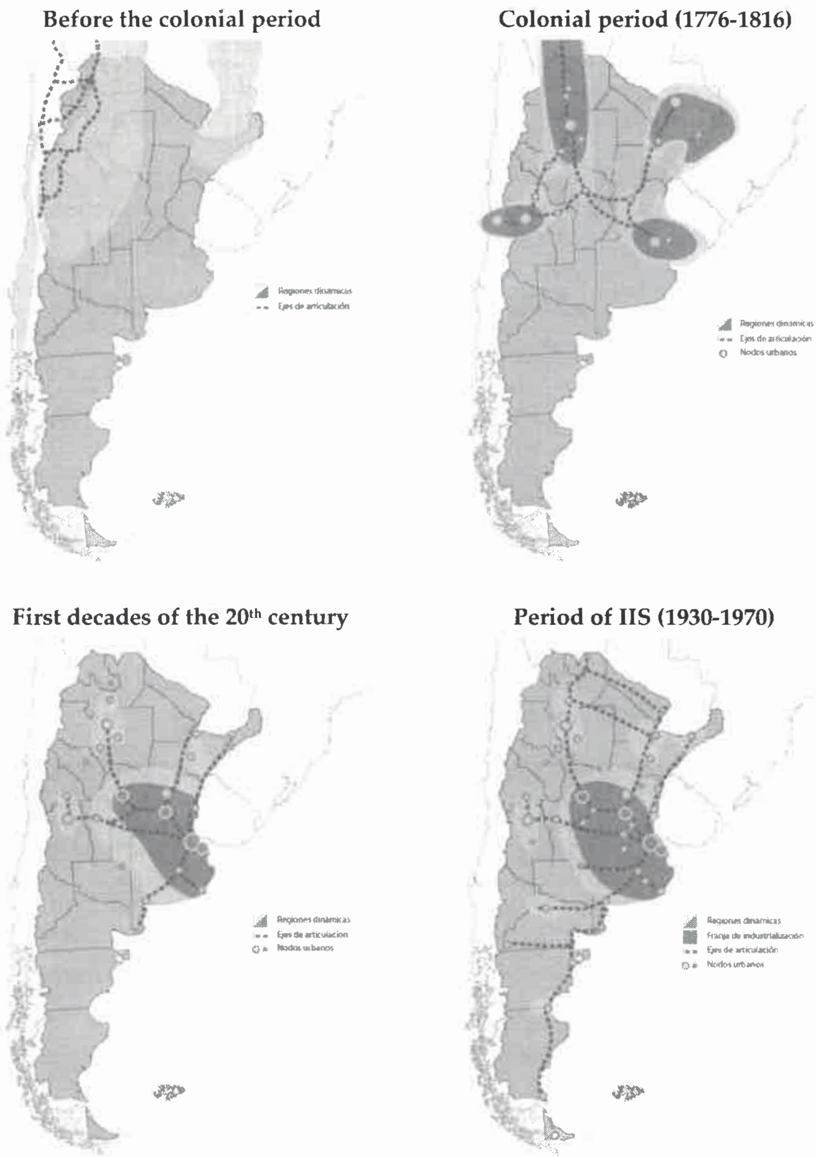
Provinces:

1- Buenos Aires
2- Córdoba
3- Santa Fe
4- Mendoza
5- Tucumán
6- Entre Ríos
7- Salta
8- Misiones
9- Chaco
10- Corrientes
11- Santiago del Estero
12- Jujuy
13- San Juan
14- Río Negro
15- Formosa
16- Neuquén
17- Chubut
18- San Luis
19- Catamarca
20- La Rioja
21- La Pampa
22- Santa Cruz
23- Tierra del Fuego

Source of the image: http://www.eleccionargentina.org/wiki/images/6/62/363px-Argentina_-_Pol%C3%ADtico-N-.png [label added]

Note: Argentina is politically divided in 23 provinces and an Autonomus City, the city of Buenos Aires.

Figure 2: Maps of the territorial developmet in Argentina along history.



Source: Ministry of Federal Planification, Public Investment and Services (2007), pages 31 to 33.
Note: Brown areas correspond to dynamic regions; darker ones represent more dynamic territories. Dotted lines show the axes of communication inside the country. Brown circles represent urban nodes; bigger and darker ones correspond to more developed urban areas. In the last map, dark grey regions are those more industrialised.

APPENDIX C1

Table 1: Regional NEG theoretical models

Author/s	Year/ Publ	Number of regions	Market struct.	Trade costs	Regional asymmetries	Spatial distinction	Disp. force		Agglom. force		Analysed change	Prediction
							Internat.	Inter-reg.	Internat.	Inter-reg.		
Martin & Rogers	1995/ JIE	2 not dimensionless countries	DS	Iceberg	NO	Trade costs	Totally immobile demand		IRS/TC		Internat. + intra-nat. liberalis.	Agglomerat.
Krugman & Livas	1996/ JDE	2 countries, 2 regions in one	DS	Iceberg	NO	Labour mob Trade costs	Totally immobile demand	Aggl. costs (congest.)	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic dispersion
Krugman	1996/ IRSR	2 countries, 2 regions in one	DS	Iceberg	NO	Labour mob Trade costs	Totally immobile demand	Aggl. costs (congest.)	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic dispersion
Fujita, Krugman & Venables	1999/ MIT, p. 331-335	2 countries, 2 regions in one	DS	Iceberg	NO	Labour mob Trade costs	Totally immobile demand	Aggl. costs (congest.)	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic dispersion
Alonso Villar	1999/ RSUE	3 countries, 3 regions in one	DS	Iceberg	Accessibility asymmetries	Labour mob	Totally immobile demand	Aggl. costs (congest.)	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic dispersion
Alonso Villar	2001/ US	3 countries, 2 regions in one	DS	Iceberg	Accessibility asymmetries	Labour mob	Totally immobile demand	Aggl. costs (congest.)	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic dispersion
Moncarz & Bleaney	2007/ GEP RP	2 countries, 2 regions in one	DS	Iceberg	NO	Labour mob Trade costs	Totally immobile demand	Aggl. costs (housing)	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic dispersion
Haaparanta	1998/ RSUE	2 countries, 2 regions in each	DS	Iceberg	CA asymmetries	Labour mob Trade costs	Totally immobile demand	Partially immobile demand	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic agglom.

Author/s	Year/ Publ	Number of regions	Market struct.	Trade costs	Regional asymmetries	Spatial distinction	Disp. force		Agglom. force		Analysed change	Prediction
							Internat.	Inter-reg.	Internat.	Inter-reg.		
Monfort & Nicolini	2000/ JUE	2 countries, 2 regions in each	DS	Iceberg	NO	Labour mob Trade costs	Totally immobile demand	Partially immobile demand	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic agglom.
Paluzie	2001/ PRS	2 countries, 2 regions in one	DS	Iceberg	NO	Labour mob Trade costs	Totally immobile demand	Partially immobile demand	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic agglom.
Mansori	2003/ JRS	2 countries, 2 regions in one	DS	Iceberg	Accessibility asymmetries	Labour mob Trade costs	Totally immobile demand	Aggl. costs (congest.)	IRS/TC	IRS/TC + LM	- Internat. liberalis. - Intra-nat. liberalis.	- Domestic agglom. - Possibly dom. disper.
Crozet & Koenig	2004/ E. Elgar	2 countries, 2 regions in one	DS	Iceberg	Accessibility asymmetries	Labour mob Trade costs	Totally immobile demand	Partially immobile demand	IRS/TC	IRS/TC + LM	Internat. liberalis.	Domestic agglom.
Brülhart, Crozet & Koenig	2004/ WE	3 regions, 2 more integrated	DS	Iceberg	Accessibility asymmetries	Human K migration Trade costs	Totally immobile demand	Partially immobile demand	IRS/TC	IRS/TC + HKM	Internat. liberalis.	Domestic agglom.
Andres	2004/ *Mimeo*	2 countries, 2 regions in each	DS	Iceberg	Size & alternatively CA asymmetries	Trade costs	Totally immobile demand		IRS/TC		Internat. liberalis.	Domestic agglom.
Granato (*Chapter 3*)	**2005/ IOB WP**	**3 countries, 2 regions in one**	**DS**	**Iceberg**	**Accessibility + size asymmetries**	**Trade costs**	**Totally immobile demand**		**IRS/TC**		**Preferent. liberalis.**	**Domestic agglom.**
Behrens, Gaigné, Ottaviano & Thisse	2007/ EER	2 countries, 2 regions in each	Quasi-linear	Additive	NO	Labour mob Trade costs	Totally immobile demand Pro-comp. effects	Partially immobile demand Pro-comp. effects	IRS/TC	IRS/TC + LM	Internat. + intra-nat. liberalis.	Ambiguous (interrelation between both trade costs)

Author/s	Year/ Publ	Number of regions	Market struct.	Trade costs	Regional asymmetries	Spatial distinction	Disp. force		Agglom. force		Analysed change	Prediction
							Internat.	Inter-reg.	Internat.	Inter-reg.		
Behrens, Gaigné, Ottaviano & Thisse	2006/ JEG	2 countries, 2 regions in each	Quasi-linear	Additive	Accessibility asymmetries	Labour mob Trade costs	Totally immobile demand Pro-comp. effects	Partially immobile demand Pro-comp. effects	IRS/TC	IRS/TC + LM	Internat. + intra-nat. liberalis.	Ambiguous
Behrens, Gaigné, Ottaviano & Thisse	2006/ JUE	2 countries, 2 regions in each	Quasi-linear	Density economie s	NO	Labour mob Trade costs	Totally immobile demand Pro-comp. effects	Partially immobile demand Pro-comp. effects	IRS/TC	IRS/TC + LM	Internat. + intra-nat. liberalis.	Ambiguous
Fujita, Krugman & Venables	1999/ MIT, 335-338	2 countries, 2 regions in one	DS	Iceberg	NO	Trade costs Case labour mobility	Partially immobile demand	Aggl. costs (congest.) &/or partially immobile demand	IRS/TC + VL	IRS/TC + VL + LM	Internat. liberalis.	Agglom. costs → dispersion Partially immobile demand → agglom.
García Pires	2005/ PEJ	Many	DS	Iceberg	Accessibility & size asymmetries	Trade costs	Partially immobile demand		IRS/TC + VL		Inter-regional. liberalis.	Ambiguous (simulation = domestic dispersion)
Granato (*Chapter 4*)	**2008/ CAF**	**Many**	**DS**	**Iceberg**	**Accessibility & CA asymmetries**	**Trade costs**	**Partially immobile demand**		**IRS/TC + VL**		**Intra-nat. liberalis.**	**Ambiguous**
Bosker, Brakman, Garretsen & Schramm	2010 JEG	Many	DS	Iceberg	Alternatively accessibility & size asymmetries	Trade costs Case labour mobility	Partially immobile demand		IRS/TC + VL	IRS/TC + LM + VL	Reciprocal trade liberalis.	Ambiguous (simulation = domestic agglom.)

Author/s	Year/ Publ	Number of regions	Market struct.	Trade costs	Regional asymmetries	Spatial distinction	Disp. force		Agglom. force		Analysed change	Prediction
							Internat.	Inter-reg.	Internat.	Inter-reg.		
Combes & Lafourcade	2011 RSUE	Many	Cournot	Iceberg	Accessibility, size & CA asymmetries	Trade costs	Partially immobile demand		IRS/TC + VL + LM		Intra-nat. liberalis.	Ambiguous (simulation = domestic agglom.)

Note: The acronyms used are: DS = Dixit-Stiglitz, CA = comparative advantage, IRS = indreasing returns to scale, TC = trade costs, VL = vertical linkages and LM = labour mobility.

Table 2: Regional empirical studies at cross-country level

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
FIRST PHASE									
Ades & Glaeser	1995/ QJE	FIRST	Alternative explanations for urban primacy	85 countries	Average 1970-85	Average population in main city	Urbanised & nonurb. pop., per capita GDP, trade/GDP share, import duties, government transp+communic. expenditure, roads, dummy variables	Econometric analysis (OLS & instrument variables)	High tariffs, high costs of internal trade, and low levels of international trade increase concentration.
Brülhart & Torstensson	1996/ CEPR	FIRST	NTT's predictions	11 EU countries (& regions of 9 EU countries)	1980 & 1990, 18 sectors	Krugman's local. index & centrality index for employmt and trade	Internal scale economies	Correlation analysis	Empirical support for some predictions. But concentration of IRS industries in central countries does not seem to increase during 80s.
Amiti	1999/ WA	FIRST	Trade theories' predictions	5 European countries	1976-89, 65 manuf. indust.	Krugman's local. index for industry prod. and employmt	Factor intensities, plant-specific scale economies, intermediate-goods intensity	Econometric analysis (OLS with time and industry dummies)	More geographically concentrated industries characterized by scale economies and high intermediate-input intensity

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Midelfart-Knarvik, Overman & Venables	2000/ CEPR	FIRST	TTT model with trade costs' predictions, period of increasing integration	14 EU countries	1980-97 (4-year intervals) 33 indust.	Value of output relative to the size of industry and country	Country characteristics, industry characteristics, interaction variables	Econometric analysis (OLS with standardised variables, for the pool and each interval)	CA variables more significant than economic geography variables, though the latter play a part. Mixed results on interaction between transport intensity and distribution of demand.
SECOND PHASE									
Haaland, Kind, Midelfart-Knarvik & Torstensson	1999/ CEPR	FIRST	TTT, NTT & NEG's predictions	13 European countries	1985 & 1992, 35 indust.	Relative & absolute concent. for production (also employ. & VA)	Factor intensities, labour productivity, expenditure concentration, internal scale economies, I/O linkages, NTBs	Econometric analysis (OLS & 2SLS with instrument variables).	Most important determinant of localisation is demand. Evidence of cumulative causation. CA and intra-industry linkages impact on concentration. The higher NTBs, the more concentrated production
Midelfart-Knarvik, Overman, Redding & Venables	2000/ EE EP	SECOND	TTT, NTT & NEG's predictions, period of increasing integration	14 EU countries	Pction: 1970-97, 36 indust. Trade: 1970-96, 104 indust.	Share of each industry for output	Population share, total manufacturing share, country characteristics, industry intensities, interaction variables	Econometric analysis (OLS, pooling across industries)	Increasing importance of forward and backward linkages and of availability of skilled labour and researchers in determining location. High increasing returns industries better able to serve markets from less central locations.
Brülhart	2001/ WA	SECOND	Trade theories and NEG's predictions, completion of Single Market	13 Western European countries	1972-96, 32 manuf. indust.	Locational Gini indices for employmt and exports	Factor-intensity classification, scale economies, NTBs	Econometric analysis: a) OLS on time trend, b) Multivariate OLS with year fixed-effects	Industrial specialization increases steadily, accelerated with Single Market. Neither concentration in core countries nor movement towards peripheral ones.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Midelfart-Knarvik, Overman, Redding & Venables	2002/ RE	SECOND	TTT, NTT & NEG's predictions, period of increasing integration	14 EU countries	1970-1997 (4-year intervals), 36 indust.	Krugman index of special. & Gini index of concent. for industry production	Time period (comparing intervals), industry and country characteristics	Econometric analysis (OLS over concent., pooling across industries)	EU integration → increasing national specialisation. Some industries more concentrated, others dispersed. CA and economic geography are driving changes
Sanguinetti, Traistaru & Volpe Martincus	2004/ ESSS IADB	SECOND	TTT, NTT & NEG's predictions	4 MERCOSUR countries	1971-98 & 1985-98, 27 indust.	Relat. & abs. special., concent. & country's share for manuf. production value	Size, openness, preferential openness, various industry & country characteristics, interaction terms. Time period (preparation, transition, CU)	Econometric analysis: a) OLS on time trends for specialisation; b) OLS over concent. with industry, country & time fixed effects and lagged variables	Increased economic integration → stronger interactions between IRS & market potential, intensity in intermediate inputs & large industrial market, transport intensity & infrastructure. Low intra-bloc tariffs → increased intensity of NTT interactions; CA interactions weakened.
THIRD PHASE									
Redding & Venables	2004/ JIE	THIRD	NEG's predictions for regional wages	101 countries	1994	1st: Bilateral exports 2nd: Per capita GDP as a proxy for wages	1st: Bilateral distance, border, country/partner dummies (alternativelly, GDP & openness). 2nd: Predicted MA & SA and controls for different characteristics.	Econometric analysis: 1st: OLS & Tobit on trade equation → estimates of bilateral transport costs & market/supply capacities. 2nd: OLS & IV on wage equation.	Geography of access to markets and sources of supply is important explaining variation in per capita income. Geography matters through mechanisms emphasized by the theory. Estimated coefficients are consistent with plausible values for the model's structural parameters

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
FOURTH PHASE									
Forslid, Haaland, Midelfart-Knarvik & Maestad	2002/ ET	FOURTH	TTT, NTT & NEG (VL)'s predictions	10 world regions (5 European)	1992, 14 indust.	Real income, manuf. exports & imports, sectoral production, wages, etc.	Productivity, risk premium and tariff equivalents	CGE-model simulations	Non-linear response to trade liberalisation. It improves market access, boosts productivity and affects magnitude of agglomeration forces for Eastern Europe. Neighbouring countries are the more negatively affected
Forslid, Haaland & Midelfart-Knarvik	2002/ JIE	FOURTH	TTT, NTT & NEG's predictions	10 world regions (5 European)	1992, 14 indust.	Production patterns, geographical concent. for production, factor prices and welfare.	Three types of trade costs (transport costs, tariffs and export taxes)	CGE-model simulations	Locational effects highly region- and sector-specific. Inverted U-shaped relation between trade liberalisation and concentration.

Table 3: Regional empirical studies at intra-country level

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
FIRST PHASE									
Kim	1995/ QJE	FIRST	Alternative explanations for trends in localization, integration period	9 regions of U.S.	1860-1987, 2 and 3-digit SIC indust.	Hoover's coefficient of localisation for employmt	Internal scale economies and resource intensity variable	Econometric analysis (panel with 20 industries & 5 years, with industry & year fixed effects)	Scale economies explain industry localization over time, resource intensity explains localization patterns across industries.
Ellison & Glaeser	1997/ JPE	FIRST	Whether real concent. is greater than random one	50 states of US plus District of Columbia	1987, 459 manuf. indust.	Own index of geog. concent. for employmt	-	Descriptive evidence, correlation analysis	Some of the most extreme concentrations likely due to natural advantages. Industries with strong upstream-downstream ties have a tendency to coagglomerate.
Bröcker	1998/ ARS	FIRST	NTT's predictions	97 regions of Europe and RoW	1994	Welfare	Impediments to international trade	Spatial CGE-model simulations	Very small variations of integration effects due to geographic location (distance) within respective nations.
Kim	1999/ RSUE	FIRST	TTT's predictions	States of U.S.	1880, 1900, 67 & 1987, 20 SIC manuf. indust.	Regional value added	Endowments	Econometric analysis (OLS on the Rybczynski equation matrix adjusted for heteroscedasticity)	Factor endowments explain a significant amount of geographic distribution of manufacturing over time.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Ellison & Glaeser	1999/ AER	FIRST	Alternative explanations of spatial concentration	50 states of US plus District of Columbia	1987, 459 manuf. indust.	Ellison & Glaeser's (1997) index for employmt	Costs of inputs, labour inputs, relative prices of labour types, transport costs (interactions with coastal dummy & consumer location)	Econometric analysis (NLS with interactions)	Differences in concentration expalained by: natural advantages and intra industry spillovers. Importance of locating closer to customers.
Brun & Renard	2000/ CERDI WP	FIRST	NTT's predictions	30 regions of China	1988-94, 30 sectors	Isard coefficient of regional special. for value added	International openness (X/VA), internal scale economies, GDPP, CONSP, FDI	Econometric analysis	Positive effect of openness and consumption on the degree of industrial specialisation
Hallet	2002/ Springer	FIRST	Localisation effects of Single Market, EU enlargement & opening up of Eastern Europe	119 regions of Europe	1980-95, 17 branches	Regional special. & measures of concent. for gross value added	-	Descriptive	Manufacturing with high scale economies concentrated in fewer locations. Clustering prevails in traditional manufacturing. Most branches tend to follow the centre-periphery pattern of GDP
Tirado, Paluzie & Pons	2002/ JEG	FIRST	Trade theories' predictions	45 provinces of Spain	1856 & 1893, 9 sectors	Index of industrial intensity for indust. production	Time period (1856: pior construction of railways, 1893: basic network established), human capital, tax payment & centrality or consumption tax	Econometric analysis (OLS & ML-SER)	Spain became an integrated economy → industrial activity concentrated in limited number of territories characterised by human-capital CA, favourable position and initial specialisation in scale-economies sectors.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Pernia & Quising	2003/ ARS	FIRST	Alternative explanations on effects of openness, period of significant liberalisation	14 regions of Philippines	1988, 91, 94, 97 & 2000	Per capita gross regional domestic product, openness & welfare	Lagged variables, local factors & initial conditions	Econometric analysis (3SLS on a system of equations)	Regional development driven by trade openness, but also by local factors and initial conditions
Ramcharan	2009/ JEG	FIRST	Whether physical geography or transport costs determines location	World: 1º by 1º (longitude/latitude) cells within 128 countries	World: 1990 US: 1900-1930	Spatial Gini coefficient for Gross Cell Product	Surface roughness and controls, density of road and rail networks, controls (such as Export/GDP)	Econometric analysis (OLS, also instrumenting road density)	Openness not statistically significant. Rougher surface → less developed transport networks → greater spatial concentration
SECOND PHASE									
Das & Barua	1996/ JDS	SECOND	Krugman and Livas' (1996) and Kuznets' (1955) & Williamson's (1965) predictions, period of trade liberalisation	23 states of India	1970-92	Dissimilarity entropy measures of inequality for different output variables	Time period	Econometric analysis a) OLS on non-linear time trends. b) OLS on per capita income at different-degree polynomials	Inter-state inequality rise, agreeing with Krugman and Livas' hypothesis. Incomplete support for Kuznets and Williamson' hypothesis.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Hanson	1998/ OREP	SECOND	NEG's predictions, period of regional integration	8 regions of US, 6 regions of Canada & 5 regions of Mexico	1850-1990 US, 1926-95 Canada & 1930-93 Mexico	Shares of manuf. employmt	Regional wage differentials, Mexico-US trade, Mexican regional employment	Descriptive	Economic integration associated with expansion of production in border regions. No correlation between Mexican export production and employment in cities located in US border states
Pons, Tirado & Paluzie	2002/ AEL	SECOND	NEG's predictions, period of changing internal & external integration	45 provinces of Spain	1856, 1893 & 1907	Locational Gini indices for industrial product	Time period (1856: prior integration, 1893: external integration & concluded internal integration, 1907: reduced internat. integration), economies of scale, centrality	Descriptive, correlation analysis	Positive relationships between degree of scale economies & industrial concent. and between degree of proximity to economic centre & industrial concent. Industrial agglomeration along with trade liberalization.
Coughlin & Wall	2003/ PRS	SECOND	NEG & TT's predictions, during NAFTA trade liberalisation	50 states of US and the District of Columbia	1988-97	Exports	GDP, gross state product, consumer price index, contiguity, common language, etc.	Econometric analysis (OLS on gravity equation with states & partners fixed effects).	NAFTA affects pattern of state exports by altering origin and destination. States in the NE of USA have seen the smallest increases in exports.
Sjöberg & Sjöholm	2004/ EG	SECOND	NEG's predictions, period of substantial trade liberalisation	27 provinces and 298 districts of Indonesia	1980, 91 & 1996, 3-digit ISIC level	Herfindahl & E-G indices of spatial concent. for employmt and VA	-	Descriptive	High concentration has not decreased. Not obvious relation between concentration and protection.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Wen	2004/ JDE	SECOND	4 hypotheses derived from NEG, after market-oriented economic reforms	30 provinces of China	1993	Regional share in industrial GDP	Share in GDP, per capita GDP, population, investment of foreign units, number of cities, share in paved highways & railways, price index, wage.	Econometric analysis (OLS-system regression)	Chinese industry more geographically concentrated. Regional share in GDP positively related to regional market size, foreign investment, and lower intra-regional transaction & transport costs. Wage and price levels, no negative effect on regional industry
Crozet & Koenig	2004/ JCE	SECOND	NEG's predictions, period of trade liberalization with EU	41 regions of Romania	1991-1997	Annual growth rate of urban population share	Nominal wage, various MPs, unemployment rate & dummies for Bucharest and maritime regions	Econometric analysis (Panel with years fixed effects and IV).	Access to Romanian market has no significant influence on urban growth. Access to CEE and EU markets is more important in driving industrial reallocations.
Overman & Winters	2005/ EP	SECOND	NEG & TT's predictions, after accession of the UK to EEC (1973)	9 regions (ports or local groups of ports) of UK	1970-92, 54 indust.	Five-port concent. ratio, Herfindhal index & port shares for imports & exports	Distance between each port and Dover, weighted by shares of particular flow passing through each port.	Descriptive: pre- and post-accession	Trade reorientated in favour of ports located nearer to continent. Changes in trade consistent with NEG models.
Brulhart & Traeger	2005/ RSUE	SECOND	To provide for empirically well-founded stylised facts	236 regions of Western European countries, 8 sectors	1975-2000 (1980-1995)	Dissimilarity entropy indices for employmt (value added)	Time period	Descriptive: measurement and decomposition	Concentration of employment has not changed. Manufacturing more concentrated relative to employment and less concentrated relative to physical space

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Cutrini	2005/ QR WP	SECOND	Whether manuf. location is explained by regional localisation or A	145 regions of 10 European countries	1985, 93 & 2001, 12 manuf. indust.	Dissimilarity entropy indices for employmt	Time period (pre- and post-Single Market trend)	Descriptive measurement and decomposition	Overall declining entropy. Spatial organisation driven by external economies or intra-firm IRS. Internal regional agglomeration decreases after Single-Market, international component slightly increases.
Porto	2005/ SSRN	SECOND	NEG & TT's predictions, during MERCOSUR trade liberalisation	5 regions of Brazil	1990, 94 & 98	Exports	GDP, population, distance & contiguity.	Econometric analysis (OLS on gravity equation with region and blocs fixed effects).	Most significant impacts of MERCOSUR on Southern and Southeastern regions.
Kanbur & Zhang	2005/ RDE	SECOND	Openness → greater inequality in spatially large countries	28 provinces of China	1952-2000	Dissimilarity entropy indices for per capita consumpt	Trade/GDP, time periods (pre/post rural reform 79), descentralisation & heavy-industry ratio	Econometric analysis (time-series OLS)	Regional inequality explained in the long-run by the degree of openness Increase in trade openness → increases in concentration
Chiquiar	2005/ JDE	SECOND	Alternative explanations on effects of openness	30 states of Mexico	1970-2001 and sub-periods	Per capita regional output	Time periods (pre/post 85)	Econometric analysis: a) NLS of beta convergence, b) GLS of sigma convergence	Absolute and conditional convergence up to 1985, divergence between 1985 and 2001.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Overman & Winters	2006/ CEPR	SECOND	NEG's predictions, after accession of UK to EEC	11 port regions of UK	1970-92, 80 sectors & 54 commds	1st: Employmt 2nd: Share of port group in total trade of each good	1st: Import competition, access to intermediates, export markets & idiosyncratic shock 2nd: Share each destination in trade, time trend, dummies for destination.	Econometric analysis 1st: Panel with establishment specific fixed effect, & year dummies 2nd: OLS and IV	Better access to export markets & intermediate goods increase employment, increased import competition decreases employment. Accession changed country-composition trade. Changes in spatial distribution of manuf. consistent with predictions.
Granato	2007/ AAEP	SECOND	NEG's predictions, period of regional integration	24 provinces of Argentina	1993-2005	Dissimilarity entropy indices for gross manuf. product	Time period (pre- and post-Single Market trend)	Descriptive: measurement and decomposition	Manufacturing disparities increased. MERCOSUR fosters agglomeration in most developed border locations.
Daumal	2008/ ETSG Conf.	SECOND	NEG's predictions	19 states of India & 26 states of Brazil	1980-2004 (India) & 1985-2004 (Brazil)	Gini index for income per capita	Trade openness (M+X/GDP), net inflows of FDI as GDP%, GDP per capita.	Econometric analysis (cointegration technique & Granger causality tests)	Brazil's trade openness contributeS to reduction in regional inequalities. The opposite is found for India.
Volpe Martincus	2009/ JRS	SECOND	TTT, NTT and NEG predictions	27 states of Brazil	1990 & 1998, 21 manuf. sectors	Share in sector employmt	Industry & region characteristics, interaction terms & interplay between sectoral trade policy & proximity to Argentina	Econometric analysis (OLS and robustness regressions)	More open industries locate in states nearer to the largest neighbor trading partner. Openness strengthened tendency to locate in states with better infrastructure and weakened demand linkages.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Sanguinetti & Volpe Martincus	2009/ RSUE	SECOND	NEG's predictions	24 provinces of Argentina	1985 & 1994, 125 manuf. indust.	Share in sector employmt	Industry & region characteristics, interaction terms & interplay between distance to traditional centre & sectoral tariffs	Econometric analysis (ML with region, industry and year fixed effects; LS & sample selection models)	Trade policy has had significant impact on manufacturing location. Lower sectoral tariffs → de-concentration of industries out of the area surrounding Buenos Aires.
Castro & Saslavsky	2009/ Fund. CIPPE C	SECOND	NEG & TT's predictions	24 provinces of Argentina	1994-2004	Exports	Gross geographic product, GDP, population, distance, dummy variables, unemployment, paved roads, skilled labour, electricity & phones.	Econometric analysis (Panel on gravity equation with origin, destination & year fixed effects)	Importance of distance as impediment for provincial trade. Especially important for provinces in the North East and North West. Infrastructure = major determinant of export performance.
Combes, Lafourcade, Thisse & Toutain	2011 EEH	SECOND	NEG's long-run predictions, period of uninterrupted fall in freight costs	26 regions and 88 departms. of France	1860, 1930 & 2000. 3 sectors	Dissimilarity entropy indices for population, employmt and value-added	Time period	Econometric analysis (simple & multivariate to check magnitude of agglomeration economies and role of human capital)	Bell-shaped evolution of spatial concentration. Labour productivity converges. Inequality across regions stable since 1930s, concentration across departments increases until 2000. Existence of strong agglomeration economies.
THIRD PHASE									
Hanson	1996/ AER	THIRD	Model production networks (external economies)'s predictions	32 states of Mexico	1970, 75, 80, 85 & 1988, apparel industry	Regional wage differentials of the industry	Distance, border dummy, distance interacted with border & year 1988 ('open economy') dummies	Econometric analysis (OLS for levels and first differences)	Existence of regional wage contour in Mexican apparel industry, under closed economy; and partial break down of this contour in transition to open economy. Border states have high wages, relocation to the North.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Hanson	1997/ EJ	THIRD	NEG's predictions for regional wages	32 states of Mexico	1965, 70, 75, 80, 85 & 1988, 9 two-digit indust.	Regional manuf. wage differentials with the center	Time period dummy variable (pre/post 1985 trade liberalisation), distance to centre & to US, & interaction terms with dummy variables	Econometric analysis (panel with year fixed effects and other with state dummy variables)	No evidence of structural break in the relationship between distance & relative wages. Falling regional wage differentials. Distance effects differ between border (weaker) and interior states (stronger)
Hanson	1998/ RSUE	THIRD	NEG's predictions for regional employment, period of change in trade policy	32 states of Mexico	1980, 85, 88 & 1993, 54 indust.	Growth of regional labour employmt	Time period (pre/post 1985 trade liberalisation), wages, distance to US, establishment size, resource concentrations, industrial diversity, etc.	Econometric analysis (panel by period, with region and industry fixed effects)	Post-trade employment growth higher in regions close to US & near upstream & downstream industries. No evidence of positive correlation between agglom. economies & employment growth. Trade reform contributes to breakup of the Mexico City manufacturing belt.
Roos	2001/ JR	THIRD	NEG's predictions for regional wages	30 states and 327 counties of West Germany	1992 & 1996	Nominal wages and their change	Disposable income, housing stock, geodesic distance between regions' centers, controls for labour heterogeneity	Econometric analysis (NLS on the wage equation)	Skilled workers' salaries and wages positively related to purchasing power in other regions. Salaries and wages of untrained workers determined by other factors ≠ market potential
Tomiura	2002/ Conf.	THIRD	Economic geography's prediction, period of increasing import shares	47 prefectures of Japan	1985, 90 & 2000, 21 manuf. indust.	Relative employmt growth	Initial conditions relative to national average	- Econometric analysis (Panel OLS & SUR for industry estimates). - Industries related with their import penetration ratio	Inter-industry linkages in same region undermined ⇒ less concentration. Local knowledge spillovers and immobile specialized labour affect regional growth. Proximity advantage irrelevant for tradable products

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Brakman, Garretsen & Schramm	2004/ JRS	THIRD	NEG's predictions for regional wages	151 districts (114 city-districts & 37 rural ones) of Germany	1995	Average hourly wage in manuf. & mining	Value-added, housing stock, land prices, average travel time from district to district, controls for employment structure & skill level, dummy variables	Econometric analysis: 1st: NLS and WLS on wage equation. With and without assuming real wage equalistion. 2nd: Comparison of estimation results with alternatives	Strong support for spatial wage structure and parameters once real wage equalization is not assumed. MP function slightly preferred over the wage curve and the wage equation.
Hanson	2005/ JIE	THIRD	NEG's predictions for regional wages	3075 counties of US	1970-1980 & 1980-1990	Change in earnings of wage & salary workers	Personal income, distance, housing stock, average annual earnings for wage and salary workers	Econometric analysis: 1- NLS and GMM on simple MP function. 2- NLS and GMM on model's augmented MP function	Nominal wages positively correlated with higher personal income, wages & housing stocks in surrounding locations. Augmented function improves fit
Egger, Huber & Pfaffermayr	2005/ ARS	THIRD	NEG's predictions for regional wages, period of trade & FDI liberalization, low internal migration	8 regions of Central and Eastern European countries	1991-99, 2-good categs. (intermediate & final)	Change in standard deviation of regional wages	Change in intermediate and final exports openness (X/GDP) and interaction terms	Econometric analysis (dynamic panel)	Rising openness → rising regional wage differentials ⇒ Trade liberalization foster sregional divergence. Intermediate goods exports seem to be a driving force.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Fingleton	2005/ PRS	THIRD	Whether Neoclassical Growth- or NEG-model explains better regional wage variations	408 unitary authority and local authority districts of Great Britain	2003	Wages	Market potential, labour force growth, schooling, technical knowledge, spatial spillovers	Econometric analysis (2SLS)	The two theories result in reduced forms that mirror the data reasonably accurately. The bootstrap J tests suggest that the NEG model rejects the neoclassical model
Knaap	2006/ RSUE	THIRD	NEG's predictions for regional wages	48 states of US.	1997	1st: Bilateral regional shipments 2nd: Wages	1st: Bilateral distance, dummy variables (border regions & if receiving and sending regions are the same) 2nd: Predicted MA or SA (constructed from 1st stage).	Econometric analysis: 1st: OLS panel with fixed effects & Tobit on gravity equation → regional MA/SA. 2nd: OLS on wage equation. Controls & instruments	Correlation between MA and wages is strong. When effect of own market taken out and geographical amenities added, only a weakened relationship remains ⇒ Explanatory power of access-variables is weak.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Breinlich	2006/ JEG	THIRD	NEG's predictions for regional wages, period of regional integration	193 regions of EU	1975-1997	1st: 111-exports/GDP (country level) 2nd: Gross value added per head of working population	1st: Bilateral distances (population-weighted), dummy variables for common language and for exporters & importers 2nd: Average predicted MA (constructed from 1st stage estimates) or per-year MA. 3rd: Idem 2nd including endowments	Three-stage analysis: 1st: OLS and Tobit on trade equation → estimates of bilateral trade costs & countries' MA. 2nd: OLS & IV on wage equation. 3rd: OLS on extended wage equation.	Market access = significant determinant of regional income levels. Improved access of peripheral regions → positive impact. Indirect benefits through better incentives for human and/or physical capital accumulation seem more important.
Head & Mayer	2006/ RSUE	THIRD	NEG model's predictions for regional wages and employment	57 NUTS-1-level regions of Europe	1985-2000, 13 manuf. indust.	1st: Bilateral exports (country level) 2nd: Wages	1st: Bilateral distance, dummy for national borders, language & importers and exporters fixed effects 2nd: Real MP, education attainment	Two-stage analysis: 1st: OLS on industry-, year- and country-specific trade equation → estimates of bilateral trade costs & real MP 2nd: OLS & IV on wage equation.	Real MP not equalized as predicted by the model with factor price equalization. Wages and employment respond to differentials in real MP. Wage adjustment is the main path towards spatial equilibrium.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Paillacar	2007/ *Mimeo*	THIRD	NEG's predictions for regional wages	27 states of Brazil	1999	1st: Internal, intranational & international trade flows 2nd: Regional and alternativelly individual wages	1st: Bilateral distances, dummy for contiguity, border regions & national borders, importers & exporters fixed effects. 2nd: Predicted MP at different spatial levels, schooling & controls.	Two-stage analysis: 1st: OLS and Gamma PML (GPML) on trade equation → estimates of real MP (local, national & international level). 2nd: OLS & IV on wage equation.	Important part of wages spatial inequality is due to worker heterogeneity, but MP also plays significant role. International component of MP also important.
Faber	2007/ G&Ch	THIRD	NEG's predictions, under regional integration	32 states of Mexico	1993-98 & 1998-2003, 43 manuf. indust.	Changes in shares of national manuf. employmt	Change in export potential, intermediate supply & import competition, road distance, interaction terms & controls.	Econometric analysis (pooled cross-sectional OLS and panel with region and sector fixed effects)	Industries with revealed CA and/or cross-border intermediate supplies grow more in regions with good foreign market access. Import competing industries gain in regions with poor market access.
Gonzales Rivas	2007/ ARS	THIRD	Endogenous growth theory's predictions	31 states and Federal District of Mexico	1940-2000 (10-year intervals)	Per capita income growth	Trade openness, interaction terms, infrastructure, human capital, physical capital, etc.	Econometric analysis (panel with region fixed effects, spatial lags and de-trended variables)	Openness benefits more regions with lower levels of education and higher levels of income & infrastructure. Latter effect greater ⇒ increased inequality

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Chiquiar	2008/ JIE	THIRD	TTT framework with transport costs' predictions, period of increasing integration	5 regions of Mexico	1990 & 2000	1- Wage (& its change) 2- Change in unskilled wages and in skill premium	Personal characteristics, site features & globalization variables	Econometric analysis (OLS & IV)	Evolution of wage differentials reflects heterogeneous impact of NAFTA. Market access to USA increasingly important. Consistent with Stolper-Samuelson theorem.
Granato (*Chapter 5*)	**2008/ CAF**	**THIRD**	**NEG & TTT's predictions**	**5 regions of Argentina**	**2003-2005**	**Manufact. exports**	**Manuf. gross geographic product, RTA dummies, transport costs, supply of labour, natural resources & infrastructure, GDP, other controls**	**Econometric analysis (OLS and PPML on a gravity equation)**	**Importance of infrastructure enhancement and transport-costs reduction for boosting regional export performance. Trade preferences important determining bilateral exports.**
Lafourcade & Paluzie	2011/ RS	THIRD	NEG's predictions, process of European integration	94 regions of France	1978-2000	Imports with neighboring countries	Contiguity dummies, inward stock of bilateral FDI, distance, interaction terms.	Econometric analysis (OLS & 2SLS on gravity equation with year origin & destination fixed effects).	Border regions trade more with nearby countries. They perform even better if they have good cross-border transport connections. Outperformance eroded for border regions located at periphery of Europe. Spatial distribution of inward FDI explains partly trade differentials.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Tirado, Pons and Paluzie	2009/ CSGR WP	THIRD	NEG's predictions for regional wages, period of changing external integration	47 provinces of Spain	1914, 20, 25 & 1930, 8 manuf. sectors	Differentials in nominal wages of skilled workers.	Distance to Barcelona, distance to Madrid, year dummies, time varying fixed effect for industry & fixed effect for year	Econometric analysis (Panel regression)	Existence of regional wage gradient centered on Barcelona explained by transport costs, which weakened after 1922. Protectionist policies favor loss of centrality of coastal location (Barcelona) and rise of other.
Calfat, Flores, Granato & Rivas (*Chapter 6*)	2009/ ELSNIT	THIRD	NEG & TTT's predictions	Regions of Paraguay and Uruguay	2003-2005, 30 products	Exports	GDP, distance variables, supply of infrastructure services, dummy variables	- Econometric analysis (OLS, pool & panel data on gravity equation with random errors) - Simulations for a 20% improvement in infrastructure	Improvements in infrastructure have positive effects on trade. The impact is greater on the export performance of Paraguay rather than on that of Uruguay.
FOURTH PHASE									

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Brülhart, Crozet & Koenig	2004/ WE	FOURTH	NEG's predictions for regional employment	202 regions of the European Union	1998	- GDP per capita. - Share of population employed in manuf. sector	Computed MP (for EU-15 regions assuming 3 scenarios), dummy variable for regions belonging to the EU's 'Objective 1' category,	Two-stage strategy: 1st: Econometric analysis (OLS with country fixed effects). 2nd: Simulation (MP calculated including accession countries & variables' predictions) + comparison fitted values.	Economic impacts of enlargement different depending on regions' geographic location relative to new member states. Distribution of market-access gains from 2004 enlargement will not reduce inequality among Objective 1 regions, but possible Balkans enlargement would have such an effect.
García Pires	2005/ PEJ	FOURTH	NEG's predictions	20 NUTS-2 regions of Portugal & Spain	1994	Market potential index & welfare	Impediments to international trade (all type of trade costs from tariffs to cultural differences)	1st: Calibration of the model. 2nd: Simulations	Scenario of complete integration between Portuguese & Spanish economy is favourable to most laggard regions. 'Lock-in' effects allow most central regions to continue in the forefront.
Haddad & Perobelli	2005/ ERSA Conf.	FOURTH	NEG and NTT's predictions	27 states of Brazil	1996, 8 sectors	Welfare & real GDP, import/expt corridors costs	Uniform 25% decrease in all tariff rates	CGE-model simulations (using inter-state & external trade flows) with & without transport costs of import/export corridors	High internal transportation costs impose spatial impediments for internal transmission of trade liberalization's potential benefits. A 'coastal effect' characterizes Brazil.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Brülhart & Koenig	2006/ ET	FOURTH	NEG's predictions and 'Comecon hypothesis' for regional wages and specialisation patterns, period of integration into EU	NUTS-3-level regions of Czech Republic, Hungary, Slovakia & Slovenia and NUTS-2-level regions of Poland	1996-2000	1st: Relative nominal wages 2nd: Relative sectoral employmt	1st: Distance, MA (two measures of proximity to the main EU markets), dummy for capital region 2nd: Distance, MA (two measures of proximity to the main EU markets), dummy for capital region	Econometric analysis: 1st: OLS pooled with country fixed effects and by country 2nd: OLS pooled by sector 3rd: Equations estimated in sample of 5 accession countries + 16 EU & EFTA countries, interacting MA with dummy for accession.	Significant support for the Comecon hypothesis. Manufacturing conforms to NEG predictions. The opposite for market service sectors. Accession countries marked by stronger discrete concentrations than Western European countries
Niebuhr	2006/ RRS	FOURTH	NEG's predictions for regional employment, period of reduction in non-tariff and other barriers	- 158 (205) regions of EU15. - 498 (612) regions of EU15	1975, 85, 95 & 2000	1st: Per capita gross value added, alternatively employmt density 2nd: Change in MP	1st: Income, distance & control variables. 2nd: Income in Western European regions, average of estimated coefficients for different years	Two-stage strategy: 1st: Econometric analysis (NLS, IV & SE) 2nd: Calculation of change in MP manipulating travel time matrix	Impact of market access on employment increases over time. Impact on per capita GVA, more or less unchanged. Internal EU border regions achieve above-average effects due to their location (centre). Low integration effects in external border regions due to peripheral location.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Huber, Pfaffermayr & Wolfmayr	2006/ ERSA	FOURTH	NEG's predictions for regional wages	241 NUTS-2 regions of EU15, new EU members, Switz. & Norway	Average 1999-2002	1st: Compensat per employee 2nd: GDP and wage-growth differentials	1st: Nominal gross VA, distance & controls, EFTA & CEEC-dummy 2nd: Estimated coefficients of within EU15 vs. EU - non EU market potential model	1st: Econometric analysis (OLS, IV & NLSQ on wage equation). 2nd: Simulation of EU enlargement (border effects converge to those among EU15).	Intra EU-borders' purchasing power has insignificant effect on regional wage structures, but EU15 external borders' one has significant effect. EU enlargement → pronounced wage effects in new members & to increasing regional disparities within new member states.
Brakman, Garretsen & Schramm	2006/ RSUE	FOURTH	NEG's predictions	NUTS-2 regions of the EU	1992-2000	1st: Wages 2nd: Gross value added (Theil-index inequality)	1st: Distance, mean annual sunshine, mean elevation above sea-level & dummy variables. 2nd: Initial (1992) distribution of GVA & alternative values for distance & substit. elasticity	1st: Econometric analysis (2SLS NLS & IV on wage equation). 2nd: Simulation of long-run equilibrium in Europe (real-wage equalisation).	Increased free-ness of trade (decreased distance parameter or substitution elasticity) ⇒ economic importance of core regions increases further and smaller regions in the vicinity of larger regions lose out
Teixeira	2006/ RSUE	FOURTH	NEG's predictions, period of dramatic fall in transport costs (45%)	18 districts of Portugal	1985 & 1998, 25 indust. branches	Employmt	- Transport costs, time period. - Estimates of exogenous variables from 1998, & 2010 planned transport costs	- Econometric analysis (TSLS, non-spatial and spatial, IV and FDTSLS) - Simulation of employment distribution for 2010	Expansion of road network has not resulted in greater spatial equity. Simulation of further expansion → industry will spread ⇒ bell-shaped relationship

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Niebuhr	2008/ IJPP	FOURTH	NEG's predictions for regional employment, period of reductions in tariffs/non-tariffs between EU15 & CEECs	- 158 (205) regions of EU15. - 943 regions of EU27.	1995 & 2000	1st: Per capita gross value added or alternatively employmt density 2nd: Change in MP	1st: Income, distance & control variables. 2nd: Income, average of estimated coefficients, alternative border impediments.	Two-stage strategy: 1st: Econometric analysis (NLS, IV & SE) 2nd: Calculation of change in MP for different scenarios.	New member states benefit more from enlargement than EU15 countries. Border regions realise higher integration benefits than non-border ones.
Redding & Sturm	2008/ AER	FOURTH	NEG's predictions, after division of Germany (1944-49) & reunification (1990)	119 West German cities	1919-2002	Population growth	1st: Assumed values for three parameters, distance & 1939 distribution of population (taken as equilibrium). 2nd: Time period (before & after division/reunif.), dummies & interaction terms	1st: Calibration of the model and simulation of post-war division (prohibitive transport costs) ⇒ predictions. 2nd: Econometric analysis (panel with city & time fixed effects).	Cities in West Germany close to the East-West border → substantial decline in population growth relative to other West German cities. Loss in market access → decline of border cities Evidence of recovery of border cities after the re-unification
Melchior	2008b /WP CASE	FOURTH	NTT's ("wage gap model") predictions	90 regions within 9 countries (resemble Europe)	-	Number of firms, nominal wage level, welfare	Spatial & non-spatial trade costs	Simulations of ten liberalisation scenarios (rather than calibration, plausible configuration of parameters)	Impact of Eastward extension of EU varies across regions. Reduction in distance-related trade costs is particularly good for peripheries. If some interior region is a "hub" → its real wages raise

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Brülhart, Carrère & Trionfetti	2009/ *Mimeo*	FOURTH	NEG's predictions for regional wages, opening of Central and Eastern European markets	2422 municipalities of Austria	1975-2002 (quarterly), 3 & 16 sectors	- Annual growth rate of wages - Annual growth rate of employmt	Time period (pre/post 1990), interaction between dummy for border regions and dummy for years from 1990 onwards, road distance to nearest border crossing to formerly communist neighbour country	1st: Econometric analysis (Panel with time & location fixed effects) 2nd: Comparison between estimates & predictions (simulations with model calibrated for pre-liberalisation distribution of pop.).	Border regions experience higher post-liberalisation growth of wages and employment. Wage responses preceded employment responses. NEG model with housing and locational taste heterogeneity implies similar labour mobility as the empirical estimates
Behrens, Ertur & Koch	2009/ *Mimeo*	FOURTH	NTT's predictions	30 states of U.S. & 10 provinces of Canada	1993	Merchand. shipments	GDP, internal absorption and distances	Econometric analysis (OLS, SARMA, GSM & SAR on gravity equation)	Controlling for spatial interdependence reduces border effects by capturing 'multilateral resistance'. Heterogeneous coefficient estimations → border effects & distance elasticities vary across provinces and states
Ferraz & Haddad	2009/ SRS	FOURTH	NEG and NTT's predictions	27 states of Brazil	2002, 8 sectors	Welfare & real GDP	Reduction in import tariff, maritime transport costs and port costs	CGE-model simulations (inter-state & external trade flows)	Prevalence of agglomeration forces could exacerbate regional inequality as import barriers are reduced up to certain level. Further removals can reverse this balance.
Melchior	2009/ WP CASE	FOURTH	NTT's ("wage gap model") predictions	90 regions within 9 countries (resemble Europe)	-	Number of firms, nominal wage level, welfare	Spatial & non-spatial trade costs	Simulations of liberalisation scenarios (no calibration) & comparison with actual empirical trends	Reduction in distance-related trade costs combined with east-west integration able to explain actual changes in Europe's economic geography.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Bosker, Brakman, Garretsen & Schramm	2010 JEG	FOURTH	NEG's predictions for regional wages	194-NUTSII regions of EU15	1919, 25, 33, 39, 50, 60, 70, 80, 88, 92 & 2002	1st: Wages 2nd: Workers in manuf (Herfindahl index)	1st: Distance & Country dummies. 2nd: Estimated parameters and others calculated. Alternatively, true initial distribution of labor & land.	1st: Econometric analysis (NLS panel data on wage equation). 2nd: Simulation of long-run (with/without labor mobility) for decrease interregional transport costs/border impediments.	Further integration for the former EU15 will be accompanied by higher levels of agglomeration → increased spatial inequality
Combes & Lafourcade	2011/ RSUE	FOURTH	NEG's predictions	341 "employment areas" of France	1993, 10 indust.	Labour demand	Calculated technology and preference parameters, nominal wages, cost for a truck to connect any pair of areas.	1st Econometric analysis (OLS with area & industry fixed effects and IV). 2nd: Simulation for transport costs reduction	Production mostly monocentric, profits higher in the core. Further falls in trade costs would make distribution of economic activities more unequal across areas.

Note: Since our objective is to survey contributions that focus on intra-country spatial effects of trade costs changes, other very interesting empirical contributions have been disregarded. Among them we would like mentioning: Amiti and Cameron (2007), Bosker and Garretsen (2009b), Brülhart and Sbergami (2009), Carrère *et al.* (2008, 2009), Castro *et al.* (2007), Coughlin and Segev (1999), Crozet and Koenig (2008), Demurger *et al.* (2002),Ezcurra Orayen *et al.* (2004), Hanson (2001), Lall and Chakravorty (2005), Lu and Tao (2009), Melchior (2008a), Mion (2004) and Ottaviano and Pinelli (2006).

APPENDIX C2

Figure 1: Maps of MERCOSUR member countries and their orthographic projection

MERCOSUR member countries	MERCOSUR orthographic projection
	

Source: The map on the left was get from: http://2.bp.blogspot.com/_kdcsVoFMTKM/SGKyAOZpdUI/AAAAAAAAGHc/j-E99ItQ0o0/s320/mercosur%5B1%5D.png
The one on the right was get from: http://commons.wikimedia.org/wiki/File:MERCOSUR_%28orthographic_projection%29.svg [labels added]

Figure 2: Map of Argentinean regions and provinces

Natural Regions	Provinces
Northwest	Jujuy (Ju), Salta (Sa), La Rioja (LR), Tucumán (Tu), Catamarca (Cat) and Santiago del Estero (SdE)
Northeast	Formosa (Fo), Chaco (Cha), Misiones (Mis), Corrientes (Corr) and Entre Ríos (ER)
Cuyo	San Juan (SJ), San Luis (SL) and Mendoza (Men)
Pampean	Córdoba (Cord), Santa Fé (SF), Buenos Aires (BA) and La Pampa (LP)
Patagonia	Neuquén (Ne), Río Negro (RN), Chubut (Chu), Santa Cruz (SC) and Tierra del Fuego (TF)

• From South to North, cities of: Pergamino (Buenos Aires), San Lorenzo and Coronda (Santa Fé).
• City of Puerto Iguazú.

Source: Author's elaboration based on http://www.comercioexterior.ub.es/fpais/argentina/regiones_de_argentina.htm

C2.1. Descriptive and inferential statistics

Table 1 shows statistical measures that characterise the distribution of gross manufacturing product in *A1* and *A2* between 1993 and 2005; while Table 2 displays characteristic values of those distributions. As it can be observed, the two series seem to show quite different behaviours.

Table 1: Descriptive Statistics, GMP. 1993-2005

Measure	A1	A2
Mean	37,47	6,67
Standard Deviation	3,27	0,62
Coefficient of Variation	0,087	0,093

Source: Author's calculation based on the database of the Ministry of Economy. Note: GMP in thousands of millions of pesos at constant prices.

Table 2: Percentiles of GMP's distributions. 1993-2005

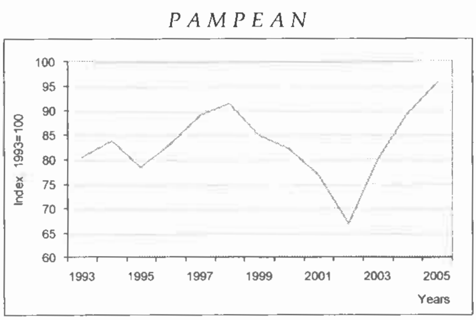
Location	0%	25%	50%	75%	100%
A1	30,31	35,98	37,40	40,05	43,12
A2	4,97	6,51	6,72	7,10	7,36

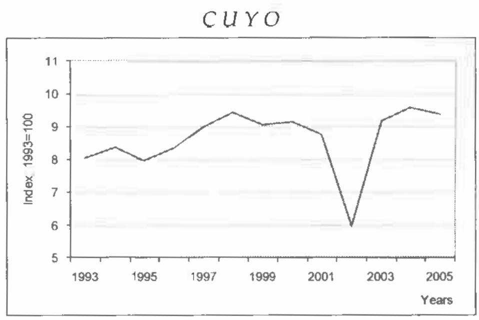
Source: Author's calculation based on the database of the Ministry of Economy. Note: GMP in thousands of millions of pesos at constant prices.

In order to complete the analysis, a univariate test is undertaken to compare the sample means of those distributions. After carrying out a F-test that makes us reject the null hypothesis of identical variances (p-value 1,48E-06), we apply a 2-tailed t-test for 2-sample unequal variances which allows to also reject the null hypothesis of equal means (p-value 7,16E-14). Therefore, we confirm *A1* and *A2*'s GMPs have shown dissimilar behaviours between 1993 and 2005.

C2.2. Location effects in each Argentinean region

Figures 3: Gross manufacturing product, Index 1993=100

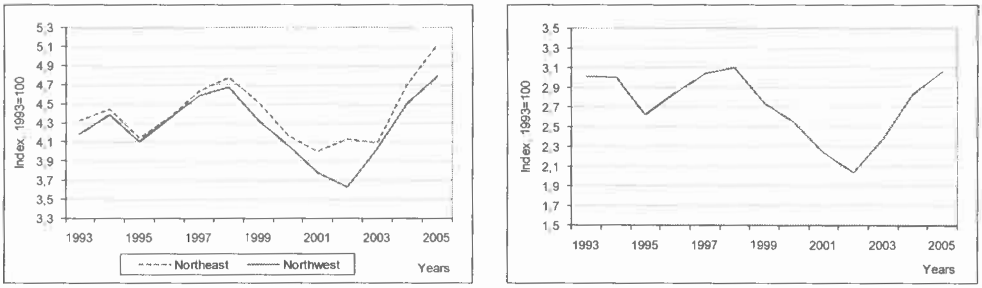




Source: Author's calculation based on the database of the Ministry of Economy.

Figures 3: Gross manufacturing product, Index 1993=100 (cont.)

NORTHWEST AND NORTHEAST — PATAGONIA



Source: Author's calculation based on the database of the Ministry of Economy.

C2.3. Dispersion measures: definitions and results

Dispersion measures were calculated applying the following definitions taken from Goerlich (1998), where: μ is the arithmetic mean of GMP_i; subscripts i and j refer to provinces; and N equals 24, the number of Argentinean political districts –from now on we generalise refering to them as 'provinces':[282]

- Squared variation coefficient: $VC(GMP)^2 = \frac{Var(GMP)}{\mu^2}$
- Gini coefficient: $G = \frac{1}{2\mu N^2}\sum_{i,j}\left|GMP_i - GMP_j\right|$
- Theil indices: $T(0) = \frac{-1}{N}\sum_i log\left(\frac{GMP_i}{\mu}\right)$

$$T(1) = \frac{1}{N}\sum_i\left(\frac{GMP_i}{\mu}\right)log\left(\frac{GMP_i}{\mu}\right)$$

Table 3 exhibits the set of statistical measures that characterise the distribution of provincial gross manufacturing product between 1993 and 2005. For continuous distributions, the Gini coefficient varies between 0, perfect equality, and 1, complete disparity. The minimum value Theil indexes *T(β)* assume is zero; *T(0)* is not upper-bounded, and the maximum value our *T(1)* can take is approximately 1,38.

[282] Note that, since we work with an absolute variable, GMP_i –instead of a relative one, for instance 'per capita' GMP_i– in Goerlich's expressions we replaced his p_i by 1/N, $\forall i$.

Table 3: Dispersion measures of provincial GMP

Measure	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
μ	1781	1853	1731	1835	1964	2021	1879	1816	1702	1470	1777	1975	2103
SD	4195	4352	4086	4326	4646	4784	4474	4351	4106	3485	4240	4717	5048
CV^2	5,547	5,514	5,568	5,558	5,593	5,602	5,673	5,743	5,819	5,620	5,695	5,704	5,760
GINI	0,763	0,763	0,766	0,766	0,766	0,767	0,769	0,773	0,775	0,767	0,774	0,771	0,772
Theil(0)	0,551	0,552	0,558	0,556	0,559	0,560	0,566	0,578	0,585	0,562	0,586	0,577	0,578
Theil(1)	0,562	0,561	0,566	0,565	0,567	0,568	0,572	0,579	0,584	0,564	0,576	0,573	0,575

Source: Author's calculation based on the database of the Ministry of Economy. Note: The arithmetic mean and the standard deviation are expressed in millions of pesos of 1993.

Within the family of Theil indexes $T(\beta)$, we choose to calculate $T(1)$ and $T(0)$ because of two main reasons, namely: a) for values of $\beta>2$, the index seems only sensible to equalisation of GMP_i among most industrialised provinces; and b) for $\beta \neq 0,1$, the decomposition by sub-sets of provinces does not seem suitable due to interpretative difficulties. Indeed, values of β within the interval [0, 1] seem to be reasonable (Goerlich, 1998).

C2.4. Spatial decomposition: definitions and results

In accomplishing the geographical decomposition of $T(0)$ and $T(1)$, we followed Goerlich (1998) and complementarily Ezcurra Orayen *et al.* (2004) and Cutrini (2005, 2006). Here, we summarise the main formulas applied:

- For $T(1)$ decomposition: $T(1)=\sum_{g=1}^{G}\frac{\mu_g}{\mu N_g}T_g(1)+T_0(1)$, where the index of internal disparity

for each group, g –i.e., $A1$ and $A2$– is $T_g(1)=\sum_{i\in g}\left(\frac{N_g}{N}\frac{GMP_i}{\mu_g}\right)log\left(\frac{GMP_i}{\mu_g}\right)$ and the index of external

disparity between the groups is $T_0(1)=\sum_{g=1}^{G}\left(\frac{\mu_g}{\mu N_g}\right)log\left(\frac{\mu_g}{\mu}\right)$.

- For $T(0)$ decomposition: $T(0)=\sum_{g=1}^{G}\frac{1}{N_g}T_g(0)+T_0(0)$, where the index of internal disparity

for each group is $T_g(0)=-\sum_{i\in g}\left(\frac{N_g}{N}\right)log\left(\frac{GMP_i}{\mu_g}\right)$ and the index of external disparity between the

groups is $T_0(0)=-\sum_{g=1}^{G}\frac{1}{N_g}log\left(\frac{\mu_g}{\mu}\right)$.

The following table presents the results of Theil decomposition computed for the border ($A1$) and remote ($A2$) Argentinean regions.

Table 4: 'A1-A2' Manufacturing Disparities - Internal and external components

Components	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Theil(0)	***0,551***	***0,552***	***0,558***	***0,556***	***0,559***	***0,560***	***0,566***	***0,578***	***0,585***	***0,562***	***0,586***	***0,577***	***0,578***
$T_{A1}(0)$	0,598	0,597	0,603	0,603	0,602	0,603	0,608	0,621	0,626	0,593	0,630	0,620	0,619
$T_{A2}(0)$	0,155	0,154	0,159	0,156	0,160	0,165	0,174	0,189	0,199	0,148	0,201	0,184	0,169
$\Sigma\omega T_g(0)$	0,339	0,339	0,344	0,342	0,344	0,348	0,355	0,369	0,377	0,333	0,379	0,366	0,356
$T_0(0)$	0,212	0,213	0,214	0,214	0,214	0,213	0,211	0,209	0,209	0,229	0,206	0,211	0,221
Theil(1)	***0,562***	***0,561***	***0,566***	***0,565***	***0,567***	***0,568***	***0,572***	***0,579***	***0,584***	***0,564***	***0,576***	***0,573***	***0,575***
$T_{A1}(1)$	0,430	0,428	0,431	0,431	0,432	0,432	0,437	0,443	0,447	0,419	0,440	0,436	0,434
$T_{A2}(1)$	0,166	0,166	0,171	0,168	0,174	0,181	0,195	0,215	0,229	0,149	0,225	0,202	0,179
$\Sigma\omega T_g(1)$	0,389	0,388	0,392	0,391	0,393	0,394	0,400	0,408	0,413	0,381	0,407	0,401	0,396
$T_0(1)$	0,173	0,173	0,174	0,174	0,174	0,173	0,172	0,171	0,171	0,183	0,169	0,172	0,179

Source: Author's calculation based on the database of the Ministry of Economy.
Note: ω symbolises the corresponding weight, $1/N_g$ for *T(0)* and $\mu_g/\mu N_g$ for *T(1)*.

The inspection of alternative groupings was conducted trying to put together the most homogeneous provinces in terms of distance to MERCOSUR –better to say, its greater market– and initial industrial development. Therefore, we first divide the country into four regions that gather provinces in terms of road distance between their capital cities and the city of Puerto Iguazú, which is the nearest Argentinean city to Brazil, located at the tripartite frontier of Argentina with Brazil and Paraguay (see Map 2).[283]

As a result, the following groups of provinces were created:

- 'G1': Misiones, Corrientes, Chaco and Formosa (less than 1000 kilometres away from Puerto Iguazú).
- 'G2': Entre Ríos, Santa Fe, city of Buenos Aires, Buenos Aires, Córdoba, Tucumán, Santiago del Estero, Catamarca, Salta and Jujuy (more than 1000 and less than 1600 kilometres).
- 'G3': La Pampa, San Luis, Mendoza, San Juan and La Rioja (more than 1600 and less than 2100 kilometres).
- 'G4': Neuquén, Río Negro, Chubut, Santa Cruz and Tierra del Fuego (more than 2100 kilometres away from Puerto Iguazú).[284]

As one can observe in Table 5 –look at the two pairs of rows labelled '4-Group'– disparities inside the four groups are more important than those across them. Furthermore, the most unequal group ('G2') –namely, the one for which the intra-group component is the highest– comprises the largest number of provinces.

Trying to improve the outcome we get, 'G2' was divided into two sub-groups: 'G2a', congregating provinces with a gross manufacturing product bigger than the domestic average in every year of the period –*i.e.* Santa Fe, city of Buenos Aires, Buenos Aires and Córdoba– and 'G2b' comprising the less industrialised districts –namely, Entre Ríos, Tucumán, Santiago del Estero, Catamarca, Salta and Jujuy. For this new partition, disparities changed their character; the two pairs of rows for '5-Group' show that most of manufacturing dispersion across

[283] We consider the length of the quickest Argentinean route between the two cities, which is calculated by the electronic atlas "Ruta 0" –at www.ruta0.com. To use road distances is the approach already applied by several authors, such as Combes and Lafourcade (2005) and Crozet (2004) for European countries and Figueras and Arrufat (2006) for Argentina.

[284] So, considering the five natural Argentinean regions already presented, it can be said that: 'G1' comprises the Northeast without the province of Entre Ríos; 'G2' gathers Entre Ríos and part of both, the Pampean region and the Northwest; 'G3' joins Cuyo and the other part of those two natural regions; and 'G4' is Patagonia.

provinces is due to inter-group instead of intra-group divergence. In other words, partition '5-Group' gathers more similar or homogeneous provinces as regards their industrial level, besides acknowledging for distance-related matters.

Table 5: Theil Decomposition for '4-Group' and '5-Group'

Components	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Theil(0)	***0,551***	***0,552***	***0,558***	***0,556***	***0,559***	***0,560***	***0,566***	***0,578***	***0,585***	***0,562***	***0,586***	***0,577***	***0,578***
4-Group													
Intra-group	50,8%	49,9%	49,7%	49,7%	49,7%	49,9%	50,2%	50,4%	50,8%	49,3%	50,4%	50,6%	50,5%
Inter-group	49,2%	50,1%	50,3%	50,3%	50,3%	50,1%	49,8%	49,6%	49,2%	50,7%	49,6%	49,4%	49,5%
5-Group													
Intra-group	20,4%	19,7%	19,6%	19,6%	19,6%	20,0%	20,6%	20,9%	21,7%	20,9%	22,0%	21,8%	21,4%
Inter-group	79,6%	80,3%	80,4%	80,4%	80,4%	80,0%	79,4%	79,1%	78,3%	79,1%	78,0%	78,2%	78,6%
Theil(1)	***0,562***	***0,561***	***0,566***	***0,565***	***0,567***	***0,568***	***0,572***	***0,579***	***0,584***	***0,564***	***0,576***	***0,573***	***0,575***
4-Group													
Intra-group	67,3%	66,8%	66,8%	66,8%	66,9%	67,0%	67,4%	67,7%	68,0%	66,0%	67,3%	67,2%	66,8%
Inter-group	32,7%	33,2%	33,2%	33,2%	33,1%	33,0%	32,6%	32,3%	32,0%	34,0%	32,7%	32,8%	33,2%
5-Group													
Intra-group	23,2%	22,8%	23,0%	22,9%	23,0%	23,3%	24,1%	24,6%	25,3%	22,7%	24,5%	24,0%	23,3%
Inter-group	76,8%	77,2%	77,0%	77,1%	77,0%	76,7%	75,9%	75,4%	74,7%	77,3%	75,5%	76,0%	76,7%

Source: Author's calculation based on the database of the Ministry of Economy.

In addition we checked whether other type of partitions behaves better than the previous ones; that is, we evaluate whether they exhibit lower divergence within its groups. Specifically, we evaluated two alternatives: to divide the country into the five well-known natural regions, and to partition it emphasizing the level of industrial development each territory had at the time MERCOSUR was launched. For the latter, the country was split into two broad locations, namely: the 'Manufacturing' provinces, those with a gross manufacturing product bigger than the manufacturing domestic average in every year of the period –*i.e.* Santa Fe, city of Buenos Aires, Buenos Aires, Córdoba and Mendoza– and the 'Non-Manufacturing' or remaining nineteen provinces.

Table 6 presents the results of Theil decomposition computed for these two alternative partitions. As it can be observed, they are well-behaved; external disparities are more important than internal ones in explaining manufacturing divergences across provinces. Moreover, these partitions gather more homogeneous territories, in terms of manufacturing, than our primitive division '*A1-A2*'; but none of them behaves better than partition '*5-Group*'. Though *T(0)* seems to favour '*M vs NM*' over the latter; *T(1)* conclusively favours '*5-Group*'.

After the complete scrutiny accomplished, and as a result of it, we selected partition '*5-Group*' to complete our analysis. Table 7 presents the indexes of internal disparity for each group $T_g(\beta)$ and the index of external disparity $T_0(\beta)$.

Table 6: Theil Decomposition for 'Natural Regions' and 'Manufacturing vs.Non-manufacturing'

Components	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Theil(0)	***0,551***	***0,552***	***0,558***	***0,556***	***0,559***	***0,560***	***0,566***	***0,578***	***0,585***	***0,562***	***0,586***	***0,577***	***0,578***
Natural Regs													
Intra-group	25,0%	24,4%	24,2%	24,2%	24,2%	24,3%	24,7%	24,7%	25,2%	25,7%	25,6%	25,7%	25,6%
Inter-group	75,0%	75,6%	75,8%	75,8%	75,8%	75,7%	75,3%	75,3%	74,8%	74,3%	74,4%	74,3%	74,4%
M vs NM													
Intra-group	19,8%	19,6%	20,1%	20,1%	19,6%	19,4%	19,6%	19,3%	19,8%	23,6%	20,6%	20,8%	21,6%
Inter-group	80,2%	80,4%	79,9%	79,9%	80,4%	80,6%	80,4%	80,7%	80,2%	76,4%	79,4%	79,2%	78,4%
Theil(1)	***0,562***	***0,561***	***0,566***	***0,565***	***0,567***	***0,568***	***0,572***	***0,579***	***0,584***	***0,564***	***0,576***	***0,573***	***0,575***
Natural Regs													
Intra-group	34,3%	33,9%	34,0%	34,0%	34,0%	34,2%	34,8%	35,1%	35,6%	34,0%	34,9%	34,7%	34,3%
Inter-group	65,7%	66,1%	66,0%	66,0%	66,0%	65,8%	65,2%	64,9%	64,4%	66,0%	65,1%	65,3%	65,7%
M vs NM													
Intra-group	27,2%	27,0%	27,3%	27,4%	27,1%	26,9%	27,1%	26,8%	27,1%	28,9%	26,6%	27,0%	27,7%
Inter-group	72,8%	73,0%	72,7%	72,6%	72,9%	73,1%	72,9%	73,2%	72,9%	71,1%	73,4%	73,0%	72,3%

Source: Author's calculation based on the database of the Ministry of Economy.

Note: 'M vs. NM' stands for the partition called 'Manufacturing vs.Non-manufacturing'.

Table 7: '5-Group' Manufacturing Disparities - Internal and external components

Components	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
$T_{G1}(0)$	0,090	0,085	0,089	0,086	0,080	0,083	0,095	0,095	0,111	0,151	0,116	0,119	0,131
$T_{G2a}(0)$	0,145	0,142	0,147	0,146	0,146	0,146	0,154	0,158	0,166	0,140	0,151	0,147	0,144
$T_{G2b}(0)$	0,057	0,058	0,058	0,058	0,060	0,061	0,062	0,064	0,066	0,073	0,071	0,069	0,068
$T_{G3}(0)$	0,209	0,205	0,205	0,202	0,210	0,219	0,232	0,249	0,262	0,181	0,263	0,246	0,224
$T_{G4}(0)$	0,074	0,066	0,062	0,064	0,064	0,061	0,053	0,052	0,046	0,061	0,057	0,061	0,067
$\Sigma\omega T_g(0)$	0,113	0,109	0,109	0,109	0,110	0,112	0,116	0,121	0,127	0,117	0,129	0,126	0,124
$T_0(0)$	0,438	0,443	0,448	0,448	0,449	0,448	0,449	0,457	0,458	0,445	0,457	0,451	0,454
$T_{G1}(1)$	0,072	0,067	0,069	0,068	0,064	0,066	0,076	0,075	0,087	0,117	0,087	0,090	0,100
$T_{G2a}(1)$	0,135	0,133	0,135	0,135	0,135	0,136	0,142	0,145	0,150	0,133	0,141	0,140	0,138
$T_{G2b}(1)$	0,053	0,054	0,053	0,054	0,055	0,056	0,056	0,057	0,058	0,063	0,062	0,060	0,059
$T_{G3}(1)$	0,174	0,170	0,168	0,166	0,174	0,182	0,193	0,209	0,219	0,144	0,216	0,201	0,180
$T_{G4}(1)$	0,060	0,053	0,053	0,054	0,052	0,050	0,043	0,043	0,039	0,059	0,055	0,057	0,063
$\Sigma\omega T_g(1)$	0,130	0,128	0,130	0,129	0,130	0,132	0,138	0,142	0,148	0,128	0,141	0,138	0,134
$T_0(1)$	0,432	0,434	0,436	0,436	0,437	0,435	0,434	0,437	0,436	0,436	0,435	0,435	0,441

Source: Author's calculation based on the database of the Ministry of Economy.

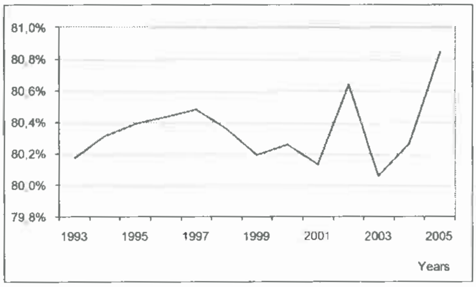
Note: ω symbolises the corresponding weight, $1/N_g$ for *T(0)* and $\mu_g/\mu N_g$ for *T(1)*.

C2.5. More about the spatial effects in Argentina

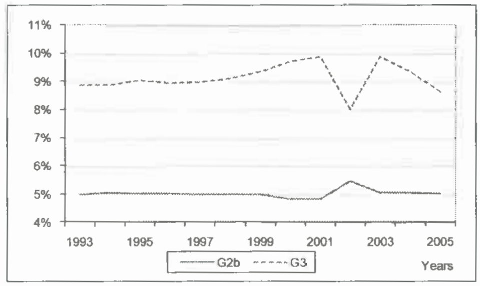
The following figures present the evolution of different spatial indicators for partition '5-*Group*', between 1993 and 2005. Figures 4 show the evolution of absolute concentration, and Figure 5 displays the evolution of absolute specialisation.

Figures 4: Absolute concentration in the '5-Group'

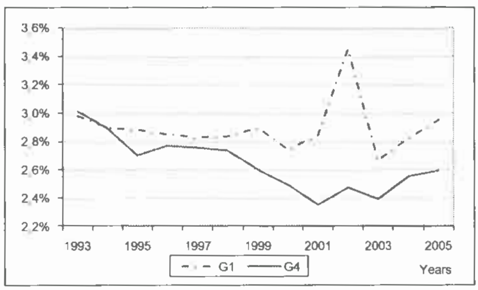
GROUP 'G2a'



GROUPS 'G2b' and 'G3'

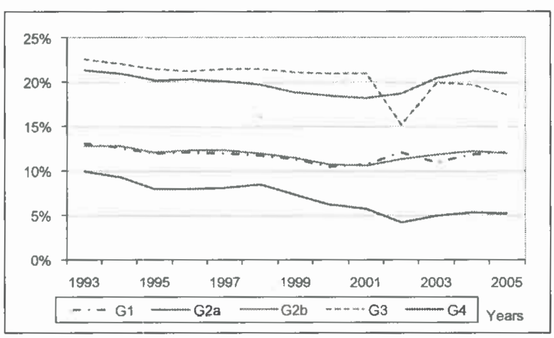


GROUPS 'G1' and 'G4'



Source: Author's calculation based on the database of the Ministry of Economy.

Figure 5: Absolute specialisation in the '5-Group'

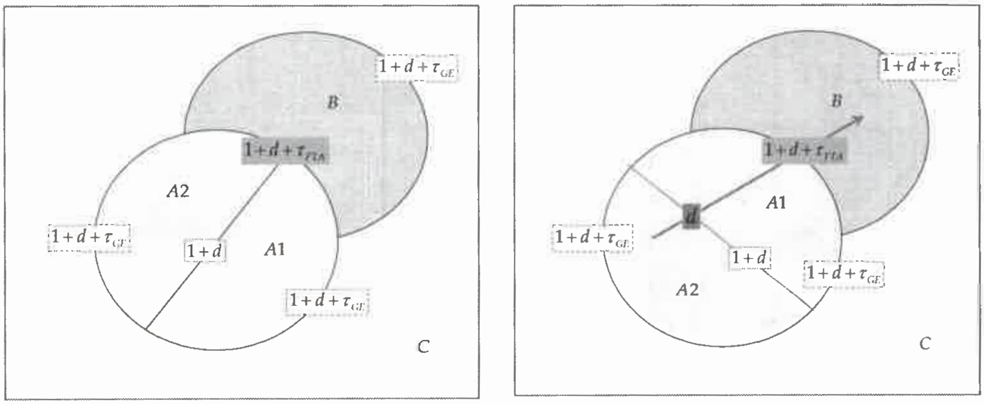


Source: Author's calculation based on the database of the Ministry of Economy.

APPENDIX C3

Figures 1: Squematic representation of each scenario

'Gateless' scenario **'Gated' scenario**



As it is clear from these figures, the only difference between the two scenarios is that varieties produced in *A2* and sold in country *B* 'pay' different trade costs. While in the 'Gateless' scenario they 'pay' the same as firms located in *A1*, $t_{A2B} = 1 + d + \tau_{FTA}$; in the 'Gated' scenario they 'pay' more, $t_{A2B} = 1 + 2d + \tau_{FTA}$.

C3.1. Spatial long-run equilibrium in a R-region setting with symmetric trade costs

In a *R*-region setting where every trade cost is identical and since $\lambda_r H = n_r$, expression (9') can be rewritten as:

$$\pi_r^* = \frac{\mu Y}{\sigma H}\left[\frac{\Xi_r}{\lambda_r + t^{1-\sigma}(1-\lambda_r)} + \sum_{s\neq r}\frac{t^{1-\sigma}\Xi_s}{\lambda_s + t^{1-\sigma}(1-\lambda_s)}\right]$$

Hence, every bilateral profit differential can be expressed as:

$$\pi_r^* - \pi_s^* = \frac{\mu Y}{\sigma H}\left(1-t^{1-\sigma}\right)\left[\frac{\Xi_r}{\lambda_r + t^{1-\sigma}(1-\lambda_r)} - \frac{\Xi_s}{\lambda_s + t^{1-\sigma}(1-\lambda_s)}\right]$$

which is zero in the interior long-run equilibrium.

Totally differentiating the latter with respect to λ_r and operating we get:

$$\left.\frac{d(\pi_r^* - \pi_s^*)}{d\lambda_r}\right|_{\lambda_r = \lambda_r^*} = -\frac{\mu Y}{\sigma H}\left\{\frac{\left(1-t^{1-\sigma}\right)^2\Xi_r}{\left[\lambda_r + t^{1-\sigma}(1-\lambda_r)\right]^2} + \frac{\left(1-t^{1-\sigma}\right)^2\Xi_s}{\left[\lambda_s + t^{1-\sigma}(1-\lambda_s)\right]^2}\right\}$$

which is negative since the expression between curly brackets is positive; so, every interior equilibrium is stable.[285]

Moreover, solving the location condition, one get the equilibrium location pattern for parameter values that yield $\lambda_r^\circ \in \left]0,1\right[\ \forall r$:

[285] This assessment of stability, which resorts on informal methods, is typical in the NEG literature. It is worth mentioning that Robert-Nicoud (2002), building on Baldwin (2001), shows this informal test corresponds to the formal, local stability of the model.

$$\lambda_r^{\circ} = \Xi_r + (R\Xi_r - 1)\frac{t^{1-\sigma}}{(1-t^{1-\sigma})}$$

If regions are equally sized, $\Xi_r = 1/R$, the only stable long-run interior equilibrium is the symmetric one: $\lambda_r^{\circ} = \Xi_r = 1/R$. On the other hand, when regions are of different size, those above the average –*i.e.* the second term is positive– receive capital flows ($\lambda_r^{\circ} > \Xi_r$); while those below it expulse modern-sector firms ($\lambda_r^{\circ} < \Xi_r$).

C3.2. Comparative statics in a 3-region setting with domestic locations

Let first rewrite expression (11) as:

$$\lambda_{A1}^{\circ} = \mathrm{I}_1\Xi_{A1} + \mathrm{I}_1\mathrm{I}_2(\Xi_{A1} - \Xi_{A2}) - \mathrm{I}_3 t_B^{1-\sigma}$$

where $\mathrm{I}_1 \equiv \frac{1-2t_B^{2(1-\sigma)} + t_A^{1-\sigma}}{(1-2t_B^{1-\sigma} + t_A^{1-\sigma})(1-t_B^{1-\sigma})}$; $\mathrm{I}_2 \equiv \frac{t_A^{1-\sigma} - t_B^{1-\sigma}}{1-t_A^{1-\sigma}}$ and $\mathrm{I}_3 \equiv \frac{1}{1-2t_B^{1-\sigma} + t_A^{1-\sigma}}$ are positive as long as $t_A < t_B$.

The derivative of the spatial allocation of capital in *A1* around the equilibrium is:

$$\frac{\partial \lambda_{A1}^{\circ}}{\partial t_B} = \frac{\partial \mathrm{I}_1}{\partial t_B}\Xi_{A1} + \left[\frac{\partial \mathrm{I}_1}{\partial t_B}\mathrm{I}_2 + \frac{\partial \mathrm{I}_2}{\partial t_B}\mathrm{I}_1\right](\Xi_{A1} - \Xi_{A2}) - \left[\frac{\partial \mathrm{I}_3}{\partial t_B} t_B^{1-\sigma} + \mathrm{I}_3(1-\sigma)t_B^{-\sigma}\right] \quad \text{(C3.1)}$$

where $\frac{\partial \mathrm{I}_2}{\partial t_B}, \frac{\partial \mathrm{I}_3}{\partial t_B} > 0$ and the sign of $\frac{\partial \mathrm{I}_1}{\partial t_B}$ is not unambiguously determined.[286] Nonetheless, conditions $t_A < t_B$ and $t_A^{1-\sigma} > 2t_B^{1-\sigma} + 2t_B^{2(1-\sigma)} - 1$ guarantee $\frac{\partial \mathrm{I}_1}{\partial t_B} < 0$.[287]

Analysing (C3.1) term by term, we have:

- If the above conditions hold, the first term shows external trade liberalisation increases agglomeration in proportion to the local market size. Nonetheless, as trade openness increases exceeding a threshold level, there might be incentives for de-agglomeration.[288] In other words, local market size might be less attractive when external openness makes location in region *B* more profitable.
- The second term is negative whenever $\left|\frac{\partial \mathrm{I}_1}{\partial t_B}\mathrm{I}_2\right| > \left|\frac{\partial \mathrm{I}_2}{\partial t_B}\mathrm{I}_1\right|$. So firms are likely to be attracted to *A1*'s market as long as the difference between t_A and t_B (I_2) is large enough and albeit domestic markets are segmented.
- Finally, the third term has a negative sign if $t_A^{1-\sigma} < 4t_B^{1-\sigma} - 1$, which holds when $t_A \le t_B < 3^{\frac{1}{\sigma-1}}$. Therefore, for medium and low external trade costs, trade liberalisation gives incentives to firms for moving into country *A*; while for some trade-costs pairs $t_A < t_B$ with t_B high enough domestic de-agglomeration might be stimulated.

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[286] The derivates are: $\frac{\partial \mathrm{I}_1}{\partial t_B} = \frac{-(\sigma-1)t_B^{-\sigma}\left[-4t_B^{1-\sigma}(1-t_B^{1-\sigma})(1-2t_B^{1-\sigma} + t_A^{1-\sigma}) + (1-2t_B^{2(1-\sigma)} + t_A^{1-\sigma})(3-4t_B^{1-\sigma} + t_A^{1-\sigma})\right]}{(1-t_B^{1-\sigma})^2(1-2t_B^{1-\sigma} + t_A^{1-\sigma})^2}$, $\frac{\partial \mathrm{I}_2}{\partial t_B} = \frac{(\sigma-1)t_B^{-\sigma}}{1-t_A^{1-\sigma}}$ and $\frac{\partial \mathrm{I}_3}{\partial t_B} = \frac{2(\sigma-1)t_B^{-\sigma}}{(1-2t_B^{1-\sigma} + t_A^{1-\sigma})^2}$.

[287] Specifically, they guarantee the expression between brackets in $\frac{\partial \mathrm{I}_1}{\partial t_B}$ is positive. The second condition holds for every trade-costs pair $t_A \le 2^{\frac{1}{\sigma-1}} < t_B$ and for some pairs with $t_A \le 1{,}618^{\frac{1}{\sigma-1}} < t_B$.

[288] Since condition $t_A^{1-\sigma} > 2t_B^{1-\sigma} + 2t_B^{2(1-\sigma)} - 1$ could reverse its sign, it might not be possible to guarantee $\frac{\partial \mathrm{I}_1}{\partial t_B} < 0$.

The same procedure can be applied to expression (12), hence:

$$\lambda_B^{\circ} = 1 + \mathrm{I}_1(\Xi_B - 1) + \mathrm{I}_3 2t_B^{1-\sigma} \quad \text{and} \quad \frac{\partial\lambda_B^{\circ}}{\partial t_B} = \frac{\partial \mathrm{I}_1}{\partial t_B}(\Xi_B - 1) + \frac{\partial \mathrm{I}_3}{\partial t_B} 2t_B^{1-\sigma} - \mathrm{I}_3 2(\sigma - 1)t_B^{-\sigma}$$

If $\frac{\partial \mathrm{I}_1}{\partial t_B} < 0$, the last derivative is positive as long as the two first terms are greater than the last one. So, under the conditions already mentioned, trade openness may reduce location in *B*. In other words, as location in other markets becomes more profitable, firms may move from *B* to domestic markets. Nevertheless, at some point, further trade liberalisation might induce agglomeration in *B* –*i.e.* $\frac{\partial \mathrm{I}_1}{\partial t_B}$ could be positive– and this stimulus would be stronger the larger is market *B*, the more segmented market *A* remains and the higher is the elasticity of substitution between varieties.

The derivative of the spatial allocation of capital in *A1* with respect to internal trade costs is:

$$\frac{\partial\lambda_{A1}^{\circ}}{\partial t_A} = \frac{\partial \mathrm{I}_1}{\partial t_A}\Xi_{A1} + \left[\frac{\partial \mathrm{I}_1}{\partial t_A}\mathrm{I}_2 + \frac{\partial \mathrm{I}_2}{\partial t_A}\mathrm{I}_1\right](\Xi_{A1} - \Xi_{A2}) - \frac{\partial \mathrm{I}_3}{\partial t_A} t_B^{1-\sigma} \qquad \text{(C3.2)}$$

where $\frac{\partial \mathrm{I}_1}{\partial t_A}, \frac{\partial \mathrm{I}_3}{\partial t_A} > 0$ and $\frac{\partial \mathrm{I}_2}{\partial t_A} < 0$.[289]

While the first term is positive, the second and third ones are negative as long as $\Xi_{A1} > \Xi_{A2}$ and t_A is low enough. Hence, intuitively, as domestic trade gets freer and choosing location between *A1* and *A2* becomes unimportant local-market size becomes a less relevant determinant of location. On the contrary and simultaneously, domestic agglomeration tends to be fostered in proportion to the level of external and internal openness and, hence, strengthened as internal trade is liberalised.

As regards domestic inequalities, expression (13) can be rewritten as:

$$\lambda_{A1}^{\circ} - \lambda_{A2}^{\circ} = \mathrm{I}_4 \frac{(\Xi_{A1} - \Xi_{A2})}{1 - t_A^{1-\sigma}}$$

where $\mathrm{I}_4 \equiv \frac{1 - 2t_B^{2(1-\sigma)} + t_A^{1-\sigma}}{1 - t_B^{1-\sigma}} > 0$ for $t_A < t_B$.

The derivative of this expression with respect to external trade costs is:

$$\frac{\partial(\lambda_{A1}^{\circ} - \lambda_{A2}^{\circ})}{\partial t_B} = \frac{-(\sigma-1)t_B^{-\sigma}\left[1 - 2t_B^{1-\sigma}(2 - t_B^{1-\sigma}) + t_A^{1-\sigma}\right]}{(1 - t_B^{1-\sigma})^2}\frac{(\Xi_{A1} - \Xi_{A2})}{1 - t_A^{1-\sigma}} \qquad \text{(C3.3)}$$

which is negative, *i.e.* the expression between brackets is positive when $\Xi_{A1} > \Xi_{A2}$, for most pairs $t_A < t_B$.[290] Therefore, if domestic size asymmetries already exist, external trade liberalisation gives incentives to augment them. Nonetheless, at some level of external openness –when $t_B < 2^{\frac{1}{\sigma-1}}$– for which the margin $t_A < t_B$ is not so big, further liberalisation could reduce domestic disparities as agglomeration within the biggest location decreases and *A1*'s market size turns to be a less relevant determinant of location.

[289] The derivates are: $\frac{\partial \mathrm{I}_1}{\partial t_A} = \frac{(\sigma-1)t_A^{-\sigma} 2t_B^{1-\sigma}}{(1 - 2t_B^{1-\sigma} + t_A^{1-\sigma})^2}$, $\frac{\partial \mathrm{I}_2}{\partial t_A} = \frac{-(\sigma-1)t_A^{-\sigma}(1 - t_B^{1-\sigma})}{1 - t_A^{1-\sigma}}$ and $\frac{\partial \mathrm{I}_3}{\partial t_A} = \frac{(\sigma-1)t_A^{-\sigma}}{(1 - 2t_B^{1-\sigma} + t_A^{1-\sigma})^2}$.

[290] Specifically, for those pairs that confirm $t_A^{1-\sigma} > 4t_B^{1-\sigma} - 2t_B^{2(1-\sigma)} - 1$, which are almost all pairs $t_A < t_B$ except some with $t_B < 2^{\frac{1}{\sigma-1}}$.

Indeed, as expression (C3.1) also reveals, when external openness overpasses a threshold and the difference between t_A and t_B (I_2) is not so big, the first and second terms may reverse their signs. Intuitively, domestic market segmentation *vis-à-vis* greater international market integration might discourage agglomeration in country *A*.

Finally, the derivative of domestic asymmetries with respect to internal trade costs is:

$$\frac{\partial\left(\lambda^{\circ}_{A1}-\lambda^{\circ}_{A2}\right)}{\partial t_A}=\frac{-(\sigma-1)t_A{}^{-\sigma}}{\left(1-t_B{}^{1-\sigma}\right)\left(1-t_A{}^{1-\sigma}\right)}\left[1+\frac{\left(1-2t_B{}^{2(1-\sigma)}+t_A{}^{1-\sigma}\right)}{\left(1-t_A{}^{1-\sigma}\right)}\right]\left(\Xi_{A1}-\Xi_{A2}\right)$$

which is negative as long as $\Xi_{A1}>\Xi_{A2}$ and $t_A<t_B$. As domestic trade gets freer and external barriers are not so low, agglomeration tends to increase in the large domestic region.

C3.3. Comparative statics in a 3-region setting with a gate effect

Similarly as before, expressions (14) and (15) can be rewritten as:

$$\lambda^{\circ}_{A1}=1+\mathrm{I}'_1\left(\Xi_{A1}-1\right)+\mathrm{I}'_3 2t_N{}^{1-\sigma}$$

$$\lambda^{\circ}_{A2}=\mathrm{I}'_1\Xi_{A2}+\mathrm{I}'_1\mathrm{I}'_2\left(\Xi_B-\Xi_{A2}\right)-\mathrm{I}'_3 t_N{}^{1-\sigma}$$

where $\mathrm{I}'_2\equiv\frac{t_N{}^{1-\sigma}-t_D{}^{1-\sigma}}{1-t_D{}^{1-\sigma}}>0$ for $t_N<t_D$ and $\mathrm{I}'_1\equiv\frac{1-2t_N{}^{2(1-\sigma)}+t_D{}^{1-\sigma}}{\left(1-2t_N{}^{1-\sigma}+t_D{}^{1-\sigma}\right)\left(1-t_N{}^{1-\sigma}\right)}$ and $\mathrm{I}'_3\equiv\frac{1}{1-2t_N{}^{1-\sigma}+t_D{}^{1-\sigma}}$ are positive if $\left(\frac{1+t_D{}^{1-\sigma}}{2}\right)^{\frac{1}{1-\sigma}}<t_N<t_D$.[291]

The derivatives of λ°_{A1} and λ°_{A2} around are equilibrium are:

$$\frac{\partial\lambda^{\circ}_{A1}}{\partial t_N}=\frac{\partial\mathrm{I}'_1}{\partial t_N}\left(\Xi_{A1}-1\right)+\frac{\partial\mathrm{I}'_3}{\partial t_N}2t_N{}^{1-\sigma}-\mathrm{I}'_3 2(\sigma-1)t_N{}^{-\sigma} \qquad \text{(C3.4)}$$

$$\frac{\partial\lambda^{\circ}_{A2}}{\partial t_N}=\frac{\partial\mathrm{I}'_1}{\partial t_N}\Xi_{A2}+\left[\frac{\partial\mathrm{I}'_1}{\partial t_N}\mathrm{I}'_2+\frac{\partial\mathrm{I}'_2}{\partial t_N}\mathrm{I}'_1\right]\left(\Xi_B-\Xi_{A2}\right)-\left[\frac{\partial\mathrm{I}'_3}{\partial t_N}t_N{}^{1-\sigma}-\mathrm{I}'_3(\sigma-1)t_N{}^{-\sigma}\right] \qquad \text{(C3.5)}$$

where $\frac{\partial\mathrm{I}'_1}{\partial t_N}$, similarly as in (C3.1), can be positive or negative and $\frac{\partial\mathrm{I}'_2}{\partial t_N},\frac{\partial\mathrm{I}'_3}{\partial t_N}<0$.[292]

In expression (C3.4), the first term can be negative or positive while the second and third terms are unambiguously negative. Let assume the former is negative, *i.e.* $\frac{\partial\mathrm{I}'_1}{\partial t_N}>0$: a reduction in t_N, which means freer access from/to *A1* to/from the other two markets, increases agglomeration within *A1*.[293] This force is stronger the smaller is local market with respect to world's market and the higher is t_D –thus, the stronger the gate effect. Anyhow, for high t_N (and higher t_D) it is possible that *A1*'s increasing access-advantage is not yet enough to counterbalance its initial restriction to trade.

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[291] Indeed, they are always positive for $t_N>2^{\frac{1}{\sigma-1}}$; and they can be (or not) for lower values of t_N.

[292] Specifically, derivatives are: $\frac{\partial\mathrm{I}'_1}{\partial t_N}=\frac{-(\sigma-1)t_N{}^{-\sigma}\left[-4t_N{}^{1-\sigma}\left(1-t_N{}^{1-\sigma}\right)\left(1-2t_N{}^{1-\sigma}+t_D{}^{1-\sigma}\right)+\left(1-2t_N{}^{2(1-\sigma)}+t_D{}^{1-\sigma}\right)\left(3-4t_N{}^{1-\sigma}+t_D{}^{1-\sigma}\right)\right]}{\left(1-t_N{}^{1-\sigma}\right)^2\left(1-2t_N{}^{1-\sigma}+t_D{}^{1-\sigma}\right)^2}$, $\frac{\partial\mathrm{I}'_2}{\partial t_N}=\frac{-(\sigma-1)t_N{}^{-\sigma}}{1-t_D{}^{1-\sigma}}$ and $\frac{\partial\mathrm{I}'_3}{\partial t_N}=\frac{-2(\sigma-1)t_N{}^{-\sigma}}{\left(1-2t_N{}^{1-\sigma}+t_D{}^{1-\sigma}\right)^2}$.

[293] Condition $t_D{}^{1-\sigma}<4t_N{}^{1-\sigma}+4t_N{}^{2(1-\sigma)}-2$, which guarantees $\frac{\partial\mathrm{I}'_1}{\partial t_N}$ is positive, is satisfied for every pair $t_N<2{,}35^{\frac{1}{\sigma-1}}\leq t_D$ and for some pairs $2{,}35^{\frac{1}{\sigma-1}}<t_N<2{,}73^{\frac{1}{\sigma-1}}\leq t_D$.

As regards location in *A2*, we have that the third term of (C3.5) is positive, the first one is also under the above conditions –that ensure I'_1, I'_3 and $\frac{\partial I'_1}{\partial t_N} > 0$– and the second term can be positive as long as $\Xi_B > \Xi_{A2}$ and $\left|\frac{\partial I'_1}{\partial t_N} I'_2\right| > \left|\frac{\partial I'_2}{\partial t_N} I'_1\right|$. Hence, a reduction in t_N is likely to foster dispersion out of *A2*. Nonetheless, three different situations are also possible, namely: a) I'_1, $I'_3 > 0$ and $\frac{\partial I'_1}{\partial t_N} < 0$; b) I'_1, $I'_3 < 0$ and $\frac{\partial I'_1}{\partial t_N} > 0$; or c) I'_1, $\frac{\partial I'_1}{\partial t_N} > 0$ and $I'_3 < 0$; and each of them may give rise to different combinations of spatial forces. For instance, in the first scenario, 'nearby' trade liberalisation may put into motion some counterbalancing forces acknowledging for *A2*'s relative protection against competition from foreign firms.

Rewriting expression (16) as:

$$\lambda^{\circ}_{A1} - \lambda^{\circ}_{A2} = I'_1(\Xi_{A1} - \Xi_{A2}) + I'_1 I'_2(\Xi_{A2} - \Xi_B) + I'_4 t_N^{1-\sigma}$$

where $I'_4 \equiv \frac{t_N^{1-\sigma} - 4t_D^{1-\sigma}}{1 - t_N^{1-\sigma}}$ and is positive for some pairs $t_N < t_D$.[294]

The derivative with respect to t_N is:

$$\frac{\partial(\lambda^{\circ}_{A1} - \lambda^{\circ}_{A2})}{\partial t_N} = \frac{\partial I'_1}{\partial t_N}(\Xi_{A1} - \Xi_{A2}) + \left[\frac{\partial I'_1}{\partial t_N} I'_2 + \frac{\partial I'_2}{\partial t_N} I'_1\right](\Xi_{A2} - \Xi_B) + \frac{\partial I'_4}{\partial t_N} t_N^{1-\sigma} - I'_4(\sigma - 1)t_N^{-\sigma} \quad \text{(C3.6)}$$

where $\frac{\partial I'_4}{\partial t_N} = \frac{-(\sigma - 1)t_N^{-\sigma}(1 - 4t_D^{1-\sigma})}{(1 - t_N^{1-\sigma})^2}$ can be positive or negative for $t_N < t_D$.[295]

No general conclusion can be derived about domestic disparities when t_N diminishes. Though it is possible that under the former conditions –*i.e.* I'_1, $\frac{\partial I'_1}{\partial t_N} > 0$, $\left|\frac{\partial I'_1}{\partial t_N} I'_2\right| > \left|\frac{\partial I'_2}{\partial t_N} I'_1\right|$ and $\Xi_B > \Xi_{A1} > \Xi_{A2}$– internal asymmetries tend to increase; it can also be the other way arround. In any case, a raise of domestic disparities as trade is liberalised is more likely when the foreign market is larger than domestic ones, domestic disparities are not so relevant and elasticity of substitution between varieties is higher, among others.

Finally, with respect to the reaction of domestic firms to changes in t_D:

$$\frac{\partial \lambda^{\circ}_{A1}}{\partial t_D} = \frac{\partial I'_1}{\partial t_D}(\Xi_{A1} - 1) + \frac{\partial I'_3}{\partial t_D} 2t_N^{1-\sigma}$$

$$\frac{\partial \lambda^{\circ}_{A2}}{\partial t_D} = \frac{\partial I'_1}{\partial t_D}\Xi_{A2} + \left[\frac{\partial I'_1}{\partial t_D} I'_2 + \frac{\partial I'_2}{\partial t_D} I'_1\right](\Xi_B - \Xi_{A2}) - \frac{\partial I'_3}{\partial t_D} t_N^{1-\sigma}$$

where $\frac{\partial I'_1}{\partial t_D}$, $\frac{\partial I'_2}{\partial t_D}$ and $\frac{\partial I'_3}{\partial t_D} > 0$.[296]

While the first term in the former expression is negative, the second is positive. So, a reduction in t_D seems more likely to increase location within *A1* if t_N is not so low and *A1*'s market is big enough to compensate *A2*'s increased market accesibility. As regards location in *A2*, it may decrease with that reduction. Therefore, domestic disparities might increase.

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[294] In particular, for $t_D > 4^{\frac{1}{\sigma-1}} t_N$.

[295] It is positive for $t_D > 4^{\frac{1}{\sigma-1}} \geq t_N$ and negative when $4^{\frac{1}{\sigma-1}} > t_D > t_N$.

[296] Specifically, $\frac{\partial I'_1}{\partial t_D} = \frac{(\sigma - 1)t_D^{-\sigma} 2t_N^{1-\sigma}}{(1 - 2t_N^{1-\sigma} + t_D^{1-\sigma})^2}$, $\frac{\partial I'_2}{\partial t_D} = \frac{(\sigma - 1)t_D^{-\sigma}(1 - t_N^{1-\sigma})}{(1 - t_D^{1-\sigma})^2}$ and $\frac{\partial I'_3}{\partial t_D} = \frac{(\sigma - 1)t_D^{-\sigma}}{(1 - 2t_N^{1-\sigma} + t_D^{1-\sigma})^2}$.

C3.4. Location in the full 4-region setting: 'Gateless' scenario

The system of equations can now be written as follows:

$$\Omega^*_{A1} = (1-2\theta)\left[\frac{\rho}{DA1''} + \frac{t_A^{\,1-\sigma}(1-\rho)}{DA2''}\right] + \theta\left[\frac{t_{FTA}^{\,1-\sigma}}{DB''} + \frac{t_{GE}^{\,1-\sigma}}{DC''}\right]$$

$$\Omega^*_{A2} = (1-2\theta)\left[\frac{t_A^{\,1-\sigma}\rho}{DA1''} + \frac{(1-\rho)}{DA2''}\right] + \theta\left[\frac{t_{FTA}^{\,1-\sigma}}{DB''} + \frac{t_{GE}^{\,1-\sigma}}{DC''}\right]$$

$$\Omega^*_{B} = (1-2\theta)t_{FTA}^{\,1-\sigma}\left[\frac{\rho}{DA1''} + \frac{(1-\rho)}{DA2''}\right] + \theta\left[\frac{1}{DB''} + \frac{t_{GE}^{\,1-\sigma}}{DC''}\right]$$

$$\Omega^*_{C} = (1-2\theta)t_{GE}^{\,1-\sigma}\left[\frac{\rho}{DA1''} + \frac{(1-\rho)}{DA2''}\right] + \theta\left[\frac{t_{GE}^{\,1-\sigma}}{DB''} + \frac{1}{DC''}\right]$$

and denominators are re-defined: $DA1'' \equiv \lambda_{A1} + t_A^{\,1-\sigma}\lambda_{A2} + t_{FTA}^{\,1-\sigma}\lambda_B + t_{GE}^{\,1-\sigma}\lambda_C$, $DA2'' \equiv t_A^{\,1-\sigma}\lambda_{A1} + \lambda_{A2} + t_{FTA}^{\,1-\sigma}\lambda_B + t_{GE}^{\,1-\sigma}\lambda_C$, $DB'' \equiv t_{FTA}^{\,1-\sigma}(\lambda_{A1} + \lambda_{A2}) + \lambda_B + t_{GE}^{\,1-\sigma}\lambda_C$ and $DC'' \equiv t_{GE}^{\,1-\sigma}(\lambda_{A1} + \lambda_{A2} + \lambda_B) + \lambda_C$.

The following expression shows the direction that capital flows may take between location *A1* and RoW.[297]

$$\operatorname{sgn}\left(\pi^*_{A1} - \pi^*_C\right) = \operatorname{sgn}\left\{\begin{array}{l}\frac{(1-2\theta)}{\Lambda}\left[\rho\left(1 - t_{GE}^{\,1-\sigma}\right)DA2'' + (1-\rho)\left(t_A^{\,1-\sigma} - t_{GE}^{\,1-\sigma}\right)DA1''\right] + \\ + \frac{\theta}{DB''DC''}\left[\left(t_{FTA}^{\,1-\sigma} - t_{GE}^{\,1-\sigma}\right)DC'' - \left(1 - t_{GE}^{\,1-\sigma}\right)DB''\right]\end{array}\right\} \qquad \text{(C3.7)}$$

C3.5. Formal analysis of market-access and market-crowding effects in the 'Gateless' scenario

Let propose a thought experiment to isolate in expression (19) each force: market-access and market-crowding effects. The latter is disregarded by assuming each domestic region albergates the same number of firms, $\lambda_{A1} = \lambda_{A2} = \lambda_{\overline{A}}$. On the other hand, the market-crowding effect is isolated when domestic locations are equally sized, $\Xi_{A1} = \Xi_{A2}$ or ρ=0,5.

Under the first assumption, expression (19) can be written as:

$$\operatorname{sgn}\left(\pi^*_{A1} - \pi^*_{A2}\right) = \frac{(1-2\theta)\left(1 - t_A^{\,1-\sigma}\right)}{{}^{MA}\Lambda}\operatorname{sgn}\left[(2\rho - 1)DA''\right] \qquad \text{(C3.8)}$$

where $DA'' = \left(1 + t_A^{\,1-\sigma}\right)\lambda_{\overline{A}} + t_{FTA}^{\,1-\sigma}\lambda_B + t_{GE}^{\,1-\sigma}\lambda_C$ and

$${}^{MA}\Lambda \equiv \left(1 + 2t_A^{\,1-\sigma} + t_A^{\,2(1-\sigma)}\right)\lambda_{\overline{A}}^2 + \left(1 + t_A^{\,1-\sigma}\right)\lambda_{\overline{A}}\left(t_{FTA}^{\,1-\sigma}\lambda_B + t_{GE}^{\,1-\sigma}\lambda_C\right) + t_{FTA}^{\,2(1-\sigma)}\lambda_B^2 + t_{GE}^{\,2(1-\sigma)}\lambda_C^2 + 2\left(t_{FTA}t_{GE}\right)^{1-\sigma}\lambda_C\lambda_B$$

.

[297] Remember that $\Lambda \equiv t_A^{\,1-\sigma}\left(\lambda_{A1}^2 + \lambda_{A2}^2\right) + \left(1 + t_A^{\,2(1-\sigma)}\right)\lambda_{A1}\lambda_{A2} + \left(1 + t_A^{\,1-\sigma}\right)\left(\lambda_{A1} + \lambda_{A2}\right)t_{GE}^{\,1-\sigma}\lambda_C + \left(1 + t_A^{\,1-\sigma}\right)\left(\lambda_{A1} + \lambda_{A2}\right)t_{FTA}^{\,1-\sigma}\lambda_B + \\ + t_{FTA}^{\,2(1-\sigma)}\lambda_B^2 + t_{GE}^{\,2(1-\sigma)}\lambda_C^2 + 2\left(t_{FTA}t_{GE}\right)^{1-\sigma}\lambda_C\lambda_B$

Thus, the larger location *A1* (ρ>0,5), the higher positive profit differential and, hence, stronger agglomeration within *A1*. Inversely, due to the market-access effect, the profit differential will be negative if *A2* is the larger location.

Under the second assumption, (19) can be expressed as:

$$\mathrm{sgn}\left(\pi^*_{A1} - \pi^*_{A2}\right) = \frac{(1-2\theta)\left(1-t_A^{\ 1-\sigma}\right)^2}{\Lambda}\mathrm{sgn}\left[0{,}5(\lambda_{A2} - \lambda_{A1})\right] \qquad \text{(C3.9)}$$

Therefore, market-crowding effect acts promoting location in the less crowded region. Namely, if *A2* is more crowded ($\lambda_{A2} > \lambda_{A1}$) the profit differential is positive; so, capital flows from *A2* to *A1*.

C3.6. Location in the full 4-region setting: 'Gated' scenario

The system of equations is now:

$$\Omega^*_{A1} = (1-2\theta)\left[\frac{\rho}{DA1'''} + \frac{t_A^{\ 1-\sigma}(1-\rho)}{DA2'''}\right] + \theta\left[\frac{t_{FTA1}^{\ 1-\sigma}}{DB'''} + \frac{t_{GE}^{\ 1-\sigma}}{DC'''}\right]$$

$$\Omega^*_{A2} = (1-2\theta)\left[\frac{t_A^{\ 1-\sigma}\rho}{DA1'''} + \frac{(1-\rho)}{DA2'''}\right] + \theta\left[\frac{t_{FTA2}^{\ 1-\sigma}}{DB'''} + \frac{t_{GE}^{\ 1-\sigma}}{DC'''}\right]$$

$$\Omega^*_{B} = (1-2\theta)\left[\frac{t_{FTA1}^{\ 1-\sigma}\rho}{DA1'''} + \frac{t_{FTA2}^{\ 1-\sigma}(1-\rho)}{DA2'''}\right] + \theta\left[\frac{1}{DB'''} + \frac{t_{GE}^{\ 1-\sigma}}{DC'''}\right]$$

$$\Omega^*_{C} = (1-2\theta)t_{GE}^{\ 1-\sigma}\left[\frac{\rho}{DA1'''} + \frac{(1-\rho)}{DA2'''}\right] + \theta\left[\frac{t_{GE}^{\ 1-\sigma}}{DB'''} + \frac{1}{DC'''}\right]$$

and denominators are: $DA1''' \equiv \lambda_{A1} + t_A^{\ 1-\sigma}\lambda_{A2} + t_{FTA1}^{\ 1-\sigma}\lambda_B + t_{GE}^{\ 1-\sigma}\lambda_C$, $DA2''' \equiv t_A^{\ 1-\sigma}\lambda_{A1} + \lambda_{A2} + t_{FTA2}^{\ 1-\sigma}\lambda_B + t_{GE}^{\ 1-\sigma}\lambda_C$, $DB''' \equiv t_{FTA1}^{\ 1-\sigma}\lambda_{A1} + t_{FTA2}^{\ 1-\sigma}\lambda_{A2} + \lambda_B + t_{GE}^{\ 1-\sigma}\lambda_C$ and $DC''' \equiv t_{GE}^{\ 1-\sigma}(\lambda_{A1} + \lambda_{A2} + \lambda_B) + \lambda_C$.

The following expression represents motives behind capital movements between *A2* and *B*:

$$\mathrm{sgn}\left(\pi^*_{A2} - \pi^*_{B}\right) = \mathrm{sgn}\left\{\frac{(1-2\theta)}{\Phi}\left[\rho\left(t_A^{\ 1-\sigma} - t_{TFA1}^{\ 1-\sigma}\right)DA2''' + (1-\rho)\left(1 - t_{TFA2}^{\ 1-\sigma}\right)DA1'''\right] + \theta\frac{\left(1 - t_{TFA2}^{\ 1-\sigma}\right)}{DB'''}\right\}$$

(C3.10)

Expressions below show how and why capital movements take place between each domestic region and *C*.

$$\mathrm{sgn}\left(\pi^*_{A1} - \pi^*_{C}\right) = \mathrm{sgn}\left\{\begin{array}{l}\dfrac{(1-2\theta)}{\Phi}\left[\rho\left(1 - t_{GE}^{\ 1-\sigma}\right)DA2''' + (1-\rho)\left(t_A^{\ 1-\sigma} - t_{GE}^{\ 1-\sigma}\right)DA1'''\right] + \\ + \dfrac{\theta}{DB'''DC'''}\left[\left(t_{FTA1}^{\ 1-\sigma} - t_{GE}^{\ 1-\sigma}\right)DC''' - \left(1 - t_{GE}^{\ 1-\sigma}\right)DB'''\right]\end{array}\right\} \qquad \text{(C3.11)}$$

$$\mathrm{sgn}\left(\pi^*_{A2} - \pi^*_{C}\right) = \mathrm{sgn}\left\{\begin{array}{l}\dfrac{(1-2\theta)}{\Phi}\left[\rho\left(t_A^{\ 1-\sigma} - t_{GE}^{\ 1-\sigma}\right)DA2''' + (1-\rho)\left(1 - t_{GE}^{\ 1-\sigma}\right)DA1'''\right] + \\ + \dfrac{\theta}{DB'''DC'''}\left[\left(t_{FTA2}^{\ 1-\sigma} - t_{GE}^{\ 1-\sigma}\right)DC''' - \left(1 - t_{GE}^{\ 1-\sigma}\right)DB'''\right]\end{array}\right\} \qquad \text{(C3.12)}$$

C3.7. Formal analysis of market-access and market-crowding effects in the 'Gated' scenario

As before, let isolate both effects: market-access and market-crowding. Assuming $\lambda_{A1} = \lambda_{A2} = \lambda_{\bar{A}}$, expression (21) can be written as:

$$\operatorname{sgn}\left(\pi^*_{A1} - \pi^*_{A2}\right) = \operatorname{sgn}\left[\begin{array}{l} \dfrac{(1-2\theta)\left(1-t_A{}^{1-\sigma}\right)}{{}^{MA}\Phi}\left\{(2\rho-1)\left[\left(1+t_A{}^{1-\sigma}\right)\lambda_{\bar{A}} + t_{GE}{}^{1-\sigma}\lambda_C\right] + \lambda_B\left[\rho t_{FTA2}{}^{1-\sigma} - (1-\rho)t_{FTA1}{}^{1-\sigma}\right]\right\} + \\ + \dfrac{\theta}{{}^{MA}DB'''}\left(t_{FTA1}{}^{1-\sigma} - t_{FTA2}{}^{1-\sigma}\right) \end{array}\right].$$

(C3.13)

where $^{MA}DB''' \equiv \left(t_{FTA1}{}^{1-\sigma} + t_{FTA2}{}^{1-\sigma}\right)\lambda_{\bar{A}} + \lambda_B + t_{GE}{}^{1-\sigma}\lambda_C$ and $^{MA}\Phi \equiv \left(1+2t_A{}^{1-\sigma} + t_A{}^{2(1-\sigma)}\right)\lambda_{\bar{A}}^2 + \left(1+t_A{}^{1-\sigma}\right)\left(t_{FTA1}{}^{1-\sigma}\lambda_B + t_{GE}{}^{1-\sigma}\lambda_C\right)\lambda_{\bar{A}} + \left(1+t_A{}^{1-\sigma}\right)\left(t_{FTA2}{}^{1-\sigma}\lambda_B + t_{GE}{}^{1-\sigma}\lambda_C\right)\lambda_{\bar{A}} + t_{FTA2}{}^{2(1-\sigma)}\lambda_B^2 + t_{GE}{}^{2(1-\sigma)}\lambda_C^2 + 2\left(t_{FTA2}t_{GE}\right)^{1-\sigma}\lambda_B\lambda_C$

Let concentrate on the expression between curly brackets: the first term is positive if the gate location is larger (ρ>0,5) and the second term can be positive or negative, depending on the gate effect ($t_{FTA1} < t_{FTA2}$), and its magnitude depends on λ_B. Hence, though agglomeration in *A1* seems more likely, no definite conclusiones can be derived with respect to the market-access effect.

Finally, under the assumption that both domestic regions are symmetric in terms of size, (21) can be written as:

$$\operatorname{sgn}\left(\pi^*_{A1} - \pi^*_{A2}\right) = \operatorname{sgn}\left\{\begin{array}{l} \dfrac{(1-2\theta)\left(1-t_A{}^{1-\sigma}\right)}{\Phi}0{,}5\left[\left(1-t_A{}^{1-\sigma}\right)\left(\lambda_{A2} - \lambda_{A1}\right) - \left(t_{FTA1}{}^{1-\sigma} - t_{FTA2}{}^{1-\sigma}\right)\lambda_B\right] + \\ + \dfrac{\theta}{DB'''}\left(t_{FTA1}{}^{1-\sigma} - t_{FTA2}{}^{1-\sigma}\right) \end{array}\right\} \quad \text{(C3.14)}$$

Therefore, if *A2* is more crowded than *A1* ($\lambda_{A2} > \lambda_{A1}$), agglomeration within *A1* is likely to be fostered as long as either the difference between $t_{FTA1}{}^{1-\sigma}$ and $t_{FTA2}{}^{1-\sigma}$ or λ_B is not so big.

C3.8. Welfare effects of regional integration

Expressions below show how welfare of consumers in *B* and *C*, respectively, changes with preferential trade liberalisation.

$$\frac{\partial V_B}{\partial \tau_{FTA}} = \Theta_B\left\{\begin{array}{l} \left[\left(1-t_{GE}{}^{1-\sigma}\right)\dfrac{\partial \lambda_B}{\partial \tau_{FTA}} + \left(t_{FTA1}{}^{1-\sigma} - t_{GE}{}^{1-\sigma}\right)\dfrac{\partial \lambda_{A1}}{\partial \tau_{FTA}} + \left(t_{FTA2}{}^{1-\sigma} - t_{GE}{}^{1-\sigma}\right)\dfrac{\partial \lambda_{A2}}{\partial \tau_{FTA}}\right] + \\ + \left[\dfrac{\partial t_{FTA1}{}^{1-\sigma}}{\partial \tau_{FTA}}\lambda_{A1} + \dfrac{\partial t_{FTA2}{}^{1-\sigma}}{\partial \tau_{FTA}}\lambda_{A2}\right] \end{array}\right\}$$

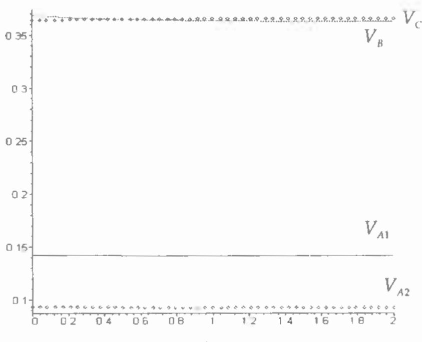
$$\frac{\partial V_C}{\partial \tau_{FTA}} = \Theta_C\left(1-t_{GE}{}^{1-\sigma}\right)\frac{\partial \lambda_C}{\partial \tau_{FTA}}$$

As it is well-known, welfare in each region increases with trade liberalisation if and only if consumer prices diminish. For instance, look at $\frac{\partial V_B}{\partial \tau_{FTA}}$. The expression inside the first pair of brackets reveals that production shifting has three indirect effects that depend on exchange-costs differentials across regions. Namely, if firms located inside the bloc *–i.e.* within *B*, *A1* or *A2*– have higher accessibility to *B*'s market than firms located in RoW, relocation towards (beyond) the bloc may benefit (harm) consumers in *B*. Finally, the expression inside the second pair of brackets shows the welfare-improving effect that a fall in prices of goods imported from *A1* and *A2* provokes.

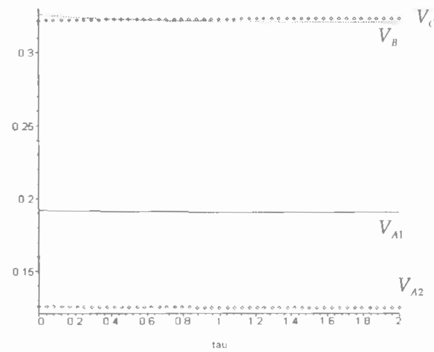
Figures 2 summarise how welfare levels in each region are modified as RI takes place when there is no gate effect; and Figures 3 show the welfare impacts of RI when there is a border effect.

Figures 2: 'Gateless' case. Welfare implications

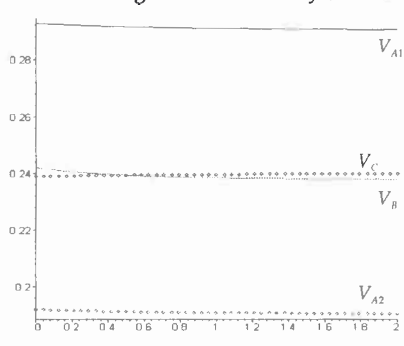
Case of large foreign countries (θ=3/8)



Case of symmetrically sized countries (θ=1/3)



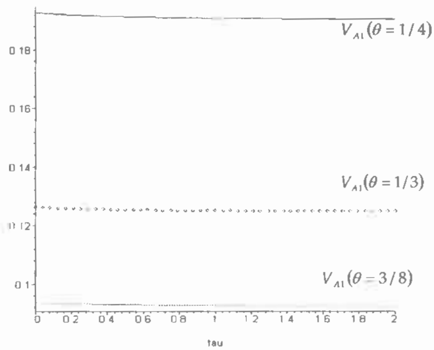
Case of a big domestic country (θ=1/4)



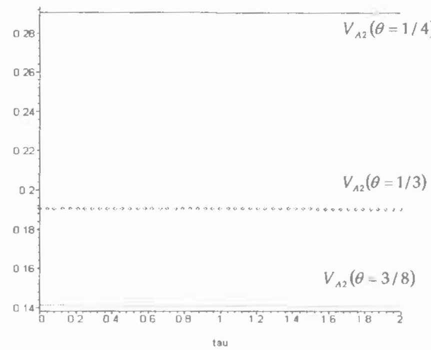
Figures 3: 'Gated' case. Welfare implications

Case of a big remote location (ρ=0,4)

V_{A1}

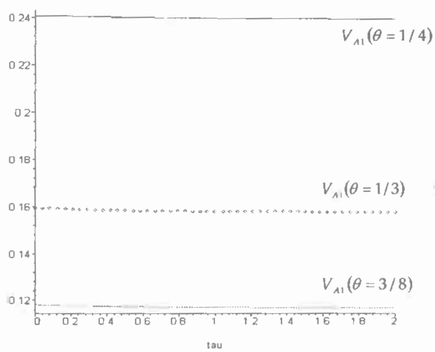


V_{A2}

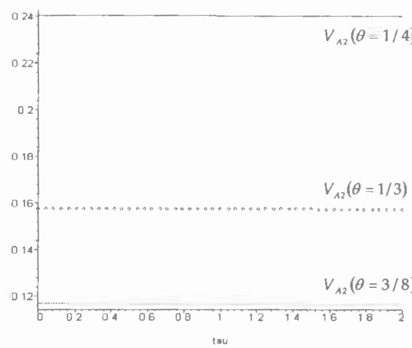


Case of symmetrically sized locations (ρ=0,5)

V_{A1}

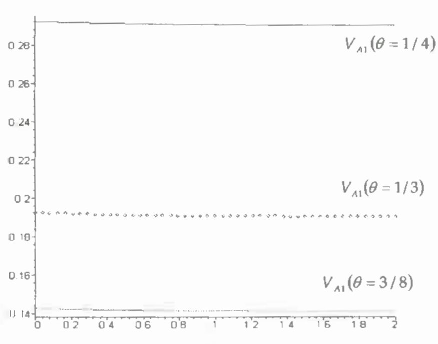


V_{A2}

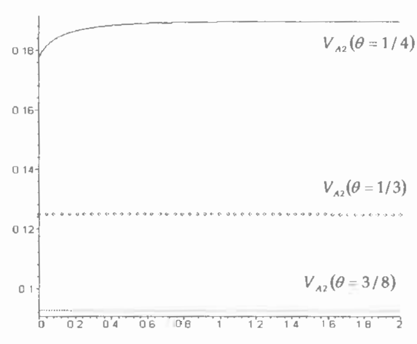


Case of a large border location (ρ=0,6)

V_{A1}



V_{A2}



APPENDIX C4

C4.1. Completing the model

The non-tradable sector is kept as simple as possible. It produces a homogeneous good under CRS and perfect competition; and its output cannot be traded inter-regionally –or, what is the same, its costs of trade are infinite.

It is assumed that the production of Z_r units requires a variable amount ζZ_r of a Cobb-Douglas composite input, which combines labour with share $\eta \in]0,1[$, and infrastructure services with input share $(1-\eta)$. Therefore, the production and cost functions of a firm in sector Z are, respectively:

$$Z_r = \zeta l_r^{\eta} M_r^{1-\eta} \qquad \text{and} \qquad TC_r^Z = \zeta Z_r w_r^{\eta} m_r^{1-\eta}$$

In each region, the Z sector maximises its profits. Under CRS and perfect competition, the first order conditions imply that $p_r^Z = \zeta w_r^{\eta} m_r^{1-\eta}$, and inputs demands take the following form:

$$l_r^Z = \eta \frac{Z_r}{w_r} \zeta w_r^{\eta} m_r^{1-\eta} \qquad \text{and} \qquad M_r^Z = (1-\eta)\frac{Z_r}{m_r} \zeta w_r^{\eta} m_r^{1-\eta}$$

The sector's production equalises final demand of the homogeneous good, $Z_r p_r^Z = Z_r \zeta w_r^{\eta} m_r^{1-\eta} = (1-\mu)Y_r$. Therefore, we can express inputs demands in terms of regional income:

$$l_r^Z = \eta \frac{(1-\mu)Y_r}{w_r} \quad \text{(C4.1)} \qquad \text{and} \qquad M_r^Z = (1-\eta)\frac{(1-\mu)Y_r}{m_r} \quad \text{(C4.2)}$$

C4.2. Agglomeration and dispersion forces

As in Chapter 3, let examine the behaviour of rental rates differentials across regions in order to get intuition on how the model works. Firms decide whether to move between any two regions, let say 1 and 2, by evaluating that differential. From expression (16) it is known that:

$$\pi_1^* - \pi_2^* = \frac{\Psi_1^{1-\sigma}}{\sigma} RMP_1 - \frac{\Psi_2^{1-\sigma}}{\sigma} RMP_2$$

Replacing Real Market Potentials (17):

$$\pi_1^* - \pi_2^* = \frac{1}{\sigma}\left\{ \Psi_1^{1-\sigma} \sum_{s\in R} \left[\frac{t_{1s}^{1-\sigma}\left(E_s^{Qfin} + E_s^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{qs}^{1-\sigma} \Psi_q^{1-\sigma}} \right] - \Psi_2^{1-\sigma} \sum_{s\in R} \left[\frac{t_{2s}^{1-\sigma}\left(E_s^{Qfin} + E_s^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{qs}^{1-\sigma} \Psi_q^{1-\sigma}} \right] \right\}$$

that can be re-expressed as:

$$\pi_1^* - \pi_2^* = \frac{1}{\sigma}\sum_{s\in R}\left[\frac{\left(\Psi_1^{1-\sigma}t_{1s}^{1-\sigma} - \Psi_2^{1-\sigma}t_{2s}^{1-\sigma}\right)\left(E_s^{Qfin} + E_s^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{qs}^{1-\sigma}\Psi_q^{1-\sigma}}\right] \qquad \text{(C4.3)}$$

where, remember: $E_r^{Q\text{int}} = n_r \rho\beta\Psi_r x_r(i)$, $\Psi_r \equiv w_r^{\alpha} m_r^{\gamma} P_r^{\rho}$ and $P_r = \frac{\sigma}{\sigma-1}\beta\left[\sum_{s\in R} n_s t_{sr}^{1-\sigma}\Psi_s^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$.

Let propose sucessive thought experiments trying to isolate and illustrate the two sorts of both agglomeration and dispersion forces present in the model.

<u>Backward linkage</u>

Starting from a long-run equilibrium in which manufacturing firms are active in every region, let imagine a firm located in region 1 relocates in region 2 ($dn_1 = -1, dn_2 = 1$) and no other movement happens. Keeping price indices and denominators constant, the only variable that changes is expenditure; since firms buy intermediates, $E_2^{Q\text{int}}$ increases and $E_1^{Q\text{int}}$ diminishes. So, the initial 'production shifting' *–i.e.* the relocation of that firm– gives rise to 'expenditure shifting'; which, in due course, provokes a 'profit shifting'.

How the latter happens? Mathematically, we can re-write (C4.3) as:

$$\pi_1^* - \pi_2^* = \frac{1}{\sigma}\left[\begin{array}{l}\frac{\left(\Psi_1^{1-\sigma}t_{11}^{1-\sigma} - \Psi_2^{1-\sigma}t_{21}^{1-\sigma}\right)\left(E_1^{Qfin} + E_1^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{q1}^{1-\sigma}\Psi_q^{1-\sigma}} + \frac{\left(\Psi_1^{1-\sigma}t_{12}^{1-\sigma} - \Psi_2^{1-\sigma}t_{22}^{1-\sigma}\right)\left(E_2^{Qfin} + E_2^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{q2}^{1-\sigma}\Psi_q^{1-\sigma}} + \ldots + \\ + \frac{\left(\Psi_1^{1-\sigma}t_{1R}^{1-\sigma} - \Psi_2^{1-\sigma}t_{2R}^{1-\sigma}\right)\left(E_R^{Qfin} + E_R^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{qR}^{1-\sigma}\Psi_q^{1-\sigma}}\end{array}\right]$$

(C4.4)

Since intermediate expenditures $E_2^{Q\text{int}}$ and $E_1^{Q\text{int}}$ are the only variables changing; the two first terms within brackets are the ones affected. Re-arranging just those terms:

$$\pi_1^* - \pi_2^* = \frac{1}{\sigma}\left\{\begin{array}{l}\Psi_1^{1-\sigma}\left[\frac{t_{11}^{1-\sigma}\left(E_1^{Qfin} + E_1^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{q1}^{1-\sigma}\Psi_q^{1-\sigma}} + \frac{t_{12}^{1-\sigma}\left(E_2^{Qfin} + E_2^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{q2}^{1-\sigma}\Psi_q^{1-\sigma}}\right] + \\ -\Psi_2^{1-\sigma}\left[\frac{t_{21}^{1-\sigma}\left(E_1^{Qfin} + E_1^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{q1}^{1-\sigma}\Psi_q^{1-\sigma}} + \frac{t_{22}^{1-\sigma}\left(E_2^{Qfin} + E_2^{Q\text{int}}\right)}{\sum_{q\in R} n_q t_{q2}^{1-\sigma}\Psi_q^{1-\sigma}}\right] + \ldots\end{array}\right\} \qquad \text{(C4.5)}$$

Taking a simplifying assumption, namely: $t_{11}^{1-\sigma} = t_{22}^{1-\sigma} = 1$ and $t_{12}^{1-\sigma}, t_{21}^{1-\sigma} < 1$; it is evident that the expression inside the first brackets diminishes with 'expenditure shifting', while that inside the second ones increases.[298] Hence, 'profit shifting' $\left(\pi_1^* - \pi_2^*\right) < 0$ takes place; which in turn will give rise, again, to 'production shifting' from region 1 to region 2.

[298] As regards the fuctional form assumed for trade costs ($t_{rs} = e^{\tau_{rs}}\delta_{rs}^{\phi}e^{\sum_k \varphi_k \lambda_{rs}^k}$), the latter simplification implies $\delta_{rr} = 1$ and $e^{\tau_{rs}}\delta_{rs}^{\phi}e^{\sum_k \varphi_k \lambda_{rs}^k} > 1$.

Forward linkage

Let make a similar though experiment, but now expenditures and denominators remain constant. Start from a long-run configuration and imagine a firm in region 1 relocates in 2 ($dn_1 = -1, dn_2 = 1$). Using the definition of Ψ_1 and Ψ_2, equilibrium price indices (P_1 and P_2) and, as before, the assumption that $t_{11}^{1-\sigma} = t_{22}^{1-\sigma} = 1$ and $t_{12}^{1-\sigma}, t_{21}^{1-\sigma} < 1$, we know that 'production shifting' gives rise to 'cost shifting' as P_1 increases –so, production costs in region 1, Ψ_1, also rise– and P_2 and Ψ_2 diminish. In turn, as it is patent from expression (C4.3) or (C4.4), the negative terms augment and the positive ones diminish; so $(\pi_1^* - \pi_2^*) < 0$. In other words, the 'cost shifting' gives rise to 'profit shifting'; which, in turn, makes the cycle repeat (production shifting-cost shifting-profit shifting) favouring location within region 2.

Market-crowding effect

Let illustrate now how intensified competition in the modern sector Q operates.[299] We simplify the analysis turning off agglomeration forces; that is, making ρ (input share of intermediate varieties within Q's production) equal to zero such that both backward and forward linkages vanish –*i.e.* $E_r^{Q\text{int}} = 0$ and $\Psi_r \equiv w_r^{\alpha} m_r^{\gamma}$.[300] Under this assumption, expression (C4.3) can be written as:

$$\pi_1^* - \pi_2^* = \frac{1}{\sigma} \sum_{s \in R} \left\{ \frac{\left[(w_1^{\alpha} m_1^{\gamma})^{1-\sigma} t_{1s}^{1-\sigma} - (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} t_{2s}^{1-\sigma} \right] E_s^{Qfin}}{\sum_{q \in R} n_q t_{qs}^{1-\sigma} (w_q^{\alpha} m_q^{\gamma})^{1-\sigma}} \right\} \qquad \text{(C4.6)}$$

Or, better, re-writing (C4.5) as:

$$\pi_1^* - \pi_2^* = \frac{1}{\sigma} \left\{ \begin{array}{l} (w_1^{\alpha} m_1^{\gamma})^{1-\sigma} \left[\begin{array}{l} \dfrac{t_{11}^{1-\sigma} E_1^{Qfin}}{n_1 t_{11}^{1-\sigma} (w_1^{\alpha} m_1^{\gamma})^{1-\sigma} + n_2 t_{21}^{1-\sigma} (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} + \dots + n_R t_{R1}^{1-\sigma} (w_R^{\alpha} m_R^{\gamma})^{1-\sigma}} + \\ + \dfrac{t_{12}^{1-\sigma} E_2^{Qfin}}{n_1 t_{12}^{1-\sigma} (w_1^{\alpha} m_1^{\gamma})^{1-\sigma} + n_2 t_{22}^{1-\sigma} (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} + \dots + n_R t_{R2}^{1-\sigma} (w_R^{\alpha} m_R^{\gamma})^{1-\sigma}} \end{array} \right] + \\ - (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} \left[\begin{array}{l} \dfrac{t_{21}^{1-\sigma} E_1^{Qfin}}{n_1 t_{11}^{1-\sigma} (w_1^{\alpha} m_1^{\gamma})^{1-\sigma} + n_2 t_{21}^{1-\sigma} (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} + \dots + n_R t_{R1}^{1-\sigma} (w_R^{\alpha} m_R^{\gamma})^{1-\sigma}} + \\ + \dfrac{t_{22}^{1-\sigma} E_2^{Qfin}}{n_1 t_{12}^{1-\sigma} (w_1^{\alpha} m_1^{\gamma})^{1-\sigma} + n_2 t_{22}^{1-\sigma} (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} + \dots + n_R t_{R2}^{1-\sigma} (w_R^{\alpha} m_R^{\gamma})^{1-\sigma}} \end{array} \right] + \\ + \dfrac{\left[(w_1^{\alpha} m_1^{\gamma})^{1-\sigma} t_{13}^{1-\sigma} - (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} t_{23}^{1-\sigma} \right] E_3^{Qfin}}{n_1 t_{13}^{1-\sigma} (w_1^{\alpha} m_1^{\gamma})^{1-\sigma} + n_2 t_{23}^{1-\sigma} (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} + \dots + n_3 t_{R3}^{1-\sigma} (w_R^{\alpha} m_R^{\gamma})^{1-\sigma}} + \dots + \\ + \dfrac{\left[(w_1^{\alpha} m_1^{\gamma})^{1-\sigma} t_{1R}^{1-\sigma} - (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} t_{2R}^{1-\sigma} \right] E_R^{Qfin}}{n_1 t_{1R}^{1-\sigma} (w_1^{\alpha} m_1^{\gamma})^{1-\sigma} + n_2 t_{2R}^{1-\sigma} (w_2^{\alpha} m_2^{\gamma})^{1-\sigma} + \dots + n_R t_{RR}^{1-\sigma} (w_R^{\alpha} m_R^{\gamma})^{1-\sigma}} \end{array} \right\}$$

(C4.7)

In this though experiment, a firm originally located in region 1 relocates in 2 ($dn_1 = -1, dn_2 = 1$) and no other movement happens. We concentrate on the denominators and, to simplify, we further assume bilateral trade costs are equal ($t_{rs}^{1-\sigma} = t_{rq}^{1-\sigma} < 1 \quad \forall r \neq s, q$),

[299] As Fujita and Mori (2005b) explain, the existence of spatially-attached local demand is essential for the deviating firm to reap the benefit of low competition intensity in the receiving region.

[300] Note that this assumption implies the model boils down to a FC setting like in Chapter 3.

regions are equally sized and production costs are the same across locations. As it is clear from expression (C4.7), the first and second terms within the curly brackets are the only ones that change.[301] Concentrating on them, it can be grasped that the first ratios within the two pairs of square brackets increase while the second ratios diminish –because the former's denominators decrease and the second's ones augment. Since $t_{11}^{1-\sigma} = t_{22}^{1-\sigma} = 1$ and $t_{12}^{1-\sigma}, t_{21}^{1-\sigma} < 1$, we conclude that the expression within the first pair of square brackets is greater after relocation and the one inside the second pair –which is negative– is smaller. Therefore, $(\pi_1^* - \pi_2^*) > 0$; in other words, the 'market-crowding effect' promotes 'profit shifting' and 'production shifting' towards region 1; hence, reverting the initial movement.

Factor-price effect

To conclude, let illustrate how the 'factor-price effect' opperates. Again, we simplify the analysis turning off agglomeration forces and assuming $t_{11}^{1-\sigma} = t_{22}^{1-\sigma} = 1$, $t_{12}^{1-\sigma}, t_{21}^{1-\sigma} < 1$ and expenditures and denominators remain constant. Start from a long-run configuration and imagine a firm in region 1 relocates in 2 ($dn_1 = -1, dn_2 = 1$). As a result, modern-sector firms' demand for labour and infrastructure services increase in region 2 and diminish in region 1. Since the local amount of these resources is fixed and inelastically supplied, and the traditional sector also demands for their services, factor prices change. Hence, 'production shifting' gives rise to 'factor-price effect' as w_2 and m_2 increase and w_1 and m_1 diminish. As it is patent from the numerator in expression (C4.6), the negative terms diminish and the positive ones augment; so $(\pi_1^* - \pi_2^*) > 0$. In other words, the 'factor-price effect' fosters 'profit shifting'; therefore, reverting the initial movement.

C4.3. Comparing estimable specifications

Some of the features our specification displays have been already introduced into gravity equations by authors such as Anderson and van Wincoop (2003), Baldwin and Taglioni (2006) and Shepherd and Wilson (2006). Let compare expression (21) –alternatively (22)– with some of them. Remember, our specification is:

$$X_{rs} = aG_r e^{(1-\sigma)\tau_{rs}} \delta_{rs}^{(1-\sigma)\phi} e^{(1-\sigma)\sum_k \varphi_k \lambda_{rs}^k} \left(w_r^{\alpha} m_r^{\gamma}\right)^{-\sigma} \left(E_s^{Qfin} + E_s^{Q\mathrm{int}}\right) P_r^{-\rho\sigma} P_s^{\sigma-1}$$

Taking logarithms, it can also be written as:

$$\ln X_{rs} = a' + \ln G_r - (\sigma - 1)\tau_{rs} - (\sigma - 1)\phi \ln \delta_{rs} - (\sigma - 1)\sum_k \varphi_k \lambda_{rs}^k + \ln\left(E_s^{Qfin} + E_s^{Q\mathrm{int}}\right) + (\sigma - 1)\ln P_s - \ln RMP$$

The most standard gravity equation is:

$$\ln X_{rs} = \ln Y_r - (\sigma - 1)\ln dist_{rs} + \ln E_s + \varepsilon_{rs}$$

where market sizes and distance are the only determinants of trade flows considered.

[301] Note that $t_{13}^{1-\sigma} = t_{23}^{1-\sigma} = \ldots = t_{1R}^{1-\sigma} = t_{2R}^{1-\sigma}$ and production costs are assumed to be equal; thus, opposite changes in n_1 and n_2 exactly compensate each other in every denominator but in the two first ones.

Shepherd and Wilson (2006) propose the following specification based on Anderson and van Wincoop (2003):[302]

$$\ln X_{rs} = b_0' + \ln Y_r - \ln Y - (\sigma-1)\vartheta \ln d_{rs} - (\sigma-1)\sum_k \lambda_{rs}^k \ln \varphi_k + \ln E_s + (\sigma-1)\ln P_s + (\sigma-1)\ln RMP_r + \varepsilon_{rs}$$

In comparison with the standard equation, this specification takes into consideration other determinants of trade costs –namely, tariffs and other observable bilateral components– the real market potential of the sending (or exporter) region and a multilateral resistance term *à la* Anderson and van Wincoop.

Though more similar to our specification, Shepherd and Wilson's equation proposes a positive relationship between the real market potential of the exporter (RMP_r) and trade flows, while our model predicts a negative one. Namely, while in the former a higher RMP_r encourages trade due to an increase in the relative prices of domestic varieties; in our model assuming vertical linkages a higher RMP_r inhibits trade since domestic production costs also increase.

C4.4. Some distinguishing characteristics of our export equation

Let first compare our new setting with that of Chapter 3, where neither VL nor infrastructure were considered. While in that chapter the effect of distance and tariff and non-tariff barriers on trade costs is exactly the same and equals unity ($\frac{\partial t_{rs}}{\partial d_{rs}} = \frac{\partial t_{rs}}{\partial \tau_{rs}} = 1$); in the new setting the effect of transport costs –closely related to distance– is different from that of policy barriers to trade $-\frac{\partial t_{rs}}{\partial \delta_{rs}} = \frac{\phi}{\delta_{rs}} t_{rs}$ and $\frac{\partial t_{rs}}{\partial \tau_{rs}} = t_{rs}$, respectively.

In addition, the effect of trade costs on prices also changes due to the presence of VL; indeed, it is $\frac{\partial p_{rs}}{\partial t_{rs}} = \frac{\sigma}{\sigma-1}\beta$ in Chapter 3 and $\frac{\partial p_{rs}}{\partial t_{rs}} = \frac{\sigma}{\sigma-1}\beta\Psi_r$ in Chapter 4.

Second, focusing in the new model let put side by side the comparative statics of production and transport infrastructure over prices and trade flows: $\frac{\partial p_{rs}}{\partial m_r} = \frac{\gamma}{m_r} p_{rs}$ and $\frac{\partial p_{rs}}{\partial \delta_{rs}} = \frac{\phi}{\delta_{rs}} p_{rs}$; $\frac{\partial X_{rs}}{\partial m_r} = \frac{-\sigma\gamma}{m_r} X_{rs}$ and $\frac{\partial X_{rs}}{\partial \delta_{rs}} = \frac{-(\sigma-1)\phi}{\delta_{rs}} X_{rs}$.

As it is obvious, though the direction of those effects is identical, their magnitude may very likely differ.

[302] A similar expression is presented in Baldwin and Taglioni (2006), who extend Anderson and van Wincoop (2003) to allow for panel data.

APPENDIX C5

Table 1: Studies on the role of transport costs and infrastructure in determining location and export performance

Author/s	Year/Publ	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Bougheas, Demetriades & Morgenroth	1999/ JIE	Trade theory's predictions	9 European countries	1970-90	Exports	GDP, distance, stocks of public capital, length of motorway network & adjacency dummy. Alternatively, infrastructure scaled by distance between the pair of countries	Econometric analysis (SUR, IV-SUR on gravity equation)	Coefficients of infrastructure variables are positive and significant. The inclusion of infrastructure indicators improves the fit of the model.
Limão & Venables	2001/ WBER	Trade theory's predictions	93 countries	Various years	Imports	GDP, per capita GDP, distance, infrastructure (average of density roads, rail & telephone lines) of origin/destination or of the transit country, dummy variables (border, island).	Econometric analysis (Tobit on gravity equation)	Including infrastructure measures increases the predictive power of estimates. Elasticity of trade with respect to transport costs is high, at around -3
Martinez-Zarzoso & Nowak-Lehmann	2003/ JAE	Trade theory's predictions	20 countries (four MERCOSUR members, Chile & EU15)	1988-1996	Exports	GDP, distance, population, importer & exporter infrastructure (average of density roads, rail & telephone lines), squared differences in per capita incomes, real exchange rates & dummy variables (contiguity, common language, PTAs)	Econometric analysis (OLS pool on gravity equation, panel with time invariant country-specific effects & GLS)	Infrastructure, income differences and exchange rates are found to be important determinants of bilateral trade flows.

Author/s	Year/Publ	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Nordås & Piermartini	2004/ WTO WP	Trade theory's predictions	138 countries	2003	Imports	GDP, distance, dummy variables (border, language, island & landlocked), applied bilateral tariff rate, infrastructure (average of density roads, rail, telephone lines, airports, ports & time for customs clearance), dummies for quality of infrastructure and other regressors.	Econometric analysis (OLS on gravity equation; one estimate with country fixed effects)	Bilateral tariffs have a significant negative impact on trade; quality of infrastructure is an important determinant; port efficiency has a large impact; timeliness and access to telecommunication more important for competitiveness in particular sectors.
Acosta Rojas, Calfat & Flôres	2005/ EE	Trade theory's predictions after the signature of the FTA by the Andean Community	Five Andean Community member countries	1993-1999	Imports	GDP, distance modified by infrastructure (average of density roads, rail, telephone lines & electricity generation), dummy variables (contiguity, PTA)	Econometric analysis (yearly OLS on gravity equation)	Reducing the cost and improving the quality of transport systems through infrastructure development improves international market access and prompts an increase in trade
Shepherd & Wilson	2006/WB PR WP	NTT's predictions	27 countries across Europe & Central Asia	2003, 6 sectors	Imports	Minimum distance road aggregated to the country level, road quality, applied tariffs, trade facilitation & dummy variables (contiguity, colonization & language)	- Econometric analysis (OLS, PPML & NB2 on gravity equation, with fixed effects) - Simulations (four counterfactuals)	Improved road quality, lower tariffs and better trade facilitation are associated with stronger bilateral trade flows. Road upgrade could increase trade by 50% over baseline. Cross-country spillovers due to overland transit are important

Author/s	Year/Publ	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Carrère & Grigoriou	2008/ E&D WP	Trade theory's predictions	167 countries	1992-2004	Imports	GDP, distance, transporting, infrastructure (average of density roads, rail & telephone lines), dummy variables (common borders & landlockedness) remoteness indices	Econometric analysis (GLS & HT panel on gravity equation)	Improvement in own infrastructure modestly raises exports. Improvement in transit-country infrastructure would raise exports more hugely. Other dimensions of landlockedness are great impediments to trade.
Overman & Winters	2005/ EP	NEG & TT's predictions after the accession of the UK to EEC (1973)	92 ports or local groups of ports of UK	1970-92, 54 two-digit SITC(R)	Five-port concentration ratio, Herfindhal index & port shares for imports and exports	Distance between each port and Dover in kilometres, weighted by shares of the particular flow passing through each port.	Descriptive: pre- and post-accession	Trade reorientated in favour of ports located nearer to continent.
Overman & Winters	2006/ CEPR	NEG's predictions after the accession of the UK to EEC (1973)	11 port regions of UK	1970-92, 80 sectors & 54 commodities	- Employmt by/per sector - Share of port group in total trade of each good	- Import competition, access to intermediate goods, export markets & idiosyncratic shock - Share of each destination in that trade, time trend, dummy variables for some countries.	Econometric analysis - Panel with establishment specific fixed effect, & year dummies - OLS and IV	Better access to export markets and intermediate goods increase employment; increased import competition decreases employment. Accession changed the country-composition of UK trade.

Author/s	Year/Publ	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Benedictis, Calfat & Flôres	2006/ IOB *mimeo*	Trade theory's predictions	22 provinces of Ecuador	1994-2004	Exports	GDP, physical distance, combined infrastructure index (PCA of density roads, electricity consumption & telephone lines), dummy variables (Andean Community, adjacency)	Econometric analysis (OLS on gravity equation)	Infrastructure is an important determinant of the exporting capability of the regions.
Buys, Diechmann & Wheeler	2006/ *Mimeo*	NTT's predictions	36 countries & 83 (77) cities	2000-03	Average trade flows	Road transport quality indicators, actual road distances, estimates of economic scale for trading partners, GDPs & controls for six RTAs	- Econometric analysis (OLS on gravity equation) - Estimation of inter-city trade flows, using estimated parameters - Simulation of upgrading network transport quality.	Continental network upgrading would expand overland trade, with major direct and indirect benefits for the rural poor
Teixeira	2006/ RSUE	NEG's predictions during period of dramatic fall in transport costs	18 districts of Portugal	1985 and 1998, 25 industrial branches	Employmt	- Transport costs (lowest cost itineraries between Portuguese districts), time period, and instrumental variables - Estimates of exogenous variables from 1998 & the 2010 planned transport cost values.	- Econometric analysis (TSLS, non-spatial and spatial, IV and FDTSLS) - Simulation of employment distribution for 2010	Expansion of road network has not resulted in greater spatial equity. However, simulation of a further expansion suggests that industry will spread ⇒ bell-shaped relationship between transport costs and agglomeration

Author/s	Year/Publ	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Ferraz & Haddad	2009/ SRS	NEG and NTT's predictions	27 states of Brazil	2002, 8 sectors	Welfare & real GDP	Reduction in each: import tariff, maritime transport costs and port costs	Simulations with a CGE-model (using inter-state & external trade flows)	Prevalence of agglomeration forces over diversion forces could exacerbate regional inequality as import barriers are reduced up to certain level. Further removals can reverse this balance.
Castro & Saslavsky	2009/ Fund. CIPPEC	NEG & TT's predictions	24 provinces of Argentina	1994-2004	Exports	Gross geographic product, GDP, population, distance, dummy variables (border country, common language, landlocked-ness), unemployment and supply of paved roads, skilled labour, electricity & phones.	Econometric analysis (Panel on gravity equation with origin, destination & year fixed effects)	Importance of distance as an impediment for provincial trade. This is especially important for provinces located in the North East and North West of the country. While the supply of skilled labour is not a major determinant of export performance, infrastructure (roads, electricity, fixed phones) is.
Combes & Lafourcade	2011/ RSUE	NEG's predictions	341 'employmt areas' of France	1993, 10 industries	Labour demand	Calculated technology and preference parameters, nominal wages, cost for a truck to connect any pair of areas through cheapest route on the real road transport network.	- Econometric analysis (OLS with area & industry fixed effects and IV). - Simulation of equilibrium for transport costs reduction	Further falls in trade costs would, at least in the short-run, make distribution of economic activities simultaneously more unequal across areas.
Lafourcade & Paluzie	2011/ RS	NEG predictions during process of European	94 regions of France	1978-2000	Imports with neighboring	Contiguity dummies, inward stock of bilateral FDI, distance, interaction terms.	Econometric analysis (OLS & 2SLS on gravity equation with year origin &	Border regions trade more with nearby countries than predicted by the gravity norm. They perform even better if they have good cross-

Author/s	Year/Publ	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
		integration			countries		destination fixed effects).	border transport connections. This outperformance eroded drastically for the border regions located at the periphery of Europe.

Table 2: Data and Sources

Variable	Description	Units	Years	Source
X_{rst}	Current manufacturing exports of each region, calculated applying ISIC 4 digit-level classification. (*)	Dollars; converted into thousands.	2003-2005	National Institute of Statistics and Census (INDEC).
GMP_{rt}	Current manufacturing GGP of each region, calculated applying ISIC at 2 digit-level.	Pesos; converted into thousands of dollars.	2003-2005	Ministry of the Economy and exchange rate from Centre of International Economy http://cei.mrecic.gov.ar/home.htm
GDP_{st}	Current GDP of each country partner.	Dollars; converted into thousands.	2003-2005	World Bank's "World Development Indicators" (WDI).
$dist^{I}_{rq}$, $dist^{II}_{rq}$	Constructed using the length of the shortest Argentinean route between each pair of cities.	Kilometres	2007	Electronic atlases "Ruta 0" (www.ruta0.com) and "Welcome Argentina" (http://www.welcomeargentina.com)
$dist_{qs}$ and $GCdist_{rs}$	Great circle distance	Kilometres	2007	Electronic calculator "Great Circle Calculator (GUI)" (http://216.147.18.102/dist/)
$roads_{rt}$	Length of paved road in each province.	Kms. per 100 square kms.	2003-2005	Author's calculations based on INDEC, Secretariat of Transport and Ministry of Internal Affairs.
$elect_{rt}$	Total consumption of electricity in each province per capita.	MW per hour	2003-2005	Author's calculations based on Secretariat of Energy.
$MERCO_{s}$	Dummy variable; 1 for members of MERCOSUR.	0-1	-	Author's calculations.
$ASOMER_{s}$	Dummy variable; 1 for associated members of MERCOSUR.	0-1	-	Author's calculations.
$NAFTA_{s}$	Dummy variable; 1 for members of NAFTA.	0-1	-	Author's calculations.
EU_{s}	Dummy variable; 1 for members of EU15.	0-1	-	Author's calculations.
Population	Provincial population	Number	2003-2005	INDEC (2005)
Land area	Provincial area.	Square kms.		INDEC (2011)

Note: (*) Between 2003 and 2005, around 42 and 44 percent of total Argentinean exports are manufacturing ones.

C5.1. Internal and external transport costs

The following Table presents the list of exit nodes used to calculate both internal and external distance measures.

Table 3: Exit nodes within Argentinean regions

Natural Region	Partner country	Closest exit node	Av. min kms.	Kms. most distant capital	S. lat. exit node	W. long. exit node
Pampeana	Brazil	Paso de los Libres	797	1193	29°43′	57°07′
Pampeana	Uruguay	Paso Gualeguaychú	444	740	33°10′	58°30′
Pampeana	Paraguay	Paso Clorinda	1211	1560	25°16′	57°42′
Pampeana	Bolivia	Paso La Quiaca	1596	1871	22°12′	64°50′
Pampeana	Chile	Paso Cristo Redentor	1089	1311	32°49′	70°05′
Pampeana	Mexico	Puerto de Buenos Aires	369	716	34°36′	58°22′
Pampeana	EU (15)	Puerto de Buenos Aires	369	716	34°36′	58°22′
Pampeana	USA	Puerto de Buenos Aires	369	716	34°36′	58°22′
Pampeana	Canada	Puerto de Buenos Aires	369	716	34°36′	58°22′
Pampeana	China	Puerto de Buenos Aires	369	716	34°36′	58°22′

Natural Region	Partner country	Closest exit node	Av. min kms.	Kms. most distant capital	S. lat. exit node	W. long. exit node
Northeast	Brazil	Paso Santo Tomé	489	669	28°36′	56°01′
Northeast	Uruguay	Paso Concordia	598	799	31°18′	51°01′
Northeast	Paraguay	Paso Clorinda	418	817	25°16′	57°42′
Northeast	Bolivia	Paso S. Mazza	1222	1406	22°10′	65°37′
Northeast	Chile	Paso Jama	1443	1645	23°14′	67°01′
Northeast	Mexico	Puerto Rosario	521	926	33°10′	60°28′
Northeast	EU (15)	Puerto Rosario	521	926	33°10′	60°28′
Northeast	USA	Puerto Rosario	521	926	33°10′	60°28′
Northeast	Canada	Puerto Rosario	521	926	33°10′	60°28′
Northeast	China	Puerto de Buenos Aires	934	1154	34°36′	58°22′
Patagonia	Brazil	Paso de los Libres	2461	3708	29°43′	57°07′
Patagonia	Uruguay	Paso Gualeguaychú	2007	3275	33°10′	58°30′
Patagonia	Paraguay	Paso Clorinda	2830	4090	25°16′	57°42′
Patagonia	Bolivia	Paso La Quiaca	3132	4268	33°10′	50°58′
Patagonia	Chile	Paso Integrac. Austral	1120	1986	52°08′	69°31′
Patagonia	Mexico	Puerto S. Antonio Este	909	2065	40°48′	64°52′
Patagonia	EU (15)	Puerto S. Antonio Este	909	2065	40°48′	64°52′
Patagonia	USA	Puerto S. Antonio Este	909	2065	40°48′	64°52′
Patagonia	Canada	Puerto S. Antonio Este	909	2065	40°48′	64°52′
Patagonia	China	Puerto de Buenos Aires	1901	3088	34°36′	58°22′
Northwest	Brazil	Paso de los Libres	1265	1458	29°43′	57°07′
Northwest	Uruguay	Paso Concordia	1121	1375	31°18′	51°01′
Northwest	Paraguay	Paso Clorinda	1113	1238	25°16′	57°42′
Northwest	Bolivia	Paso La Quiaca	673	1031	33°10′	50°58′
Northwest	Chile	Paso Jama	738	1096	23°14′	67°01′
Northwest	Mexico	Puerto Rosario	932	1208	33°10′	60°28′
Northwest	EU (15)	Puerto Rosario	932	1208	33°10′	60°28′
Northwest	USA	Puerto Rosario	932	1208	33°10′	60°28′
Northwest	Canada	Puerto Rosario	932	1208	33°10′	60°28′
Northwest	China	Puerto de Buenos Aires	1250	1526	34°36′	58°22′
Cuyo	Brazil	Paso de los Libres	1290	1398	29°43′	57°07′
Cuyo	Uruguay	Paso Gualeguaychú	1048	1177	33°10′	58°30′
Cuyo	Paraguay	Paso Clorinda	1600	1692	25°16′	57°42′
Cuyo	Bolivia	Paso La Quiaca	1540	1627	33°10′	50°58′
Cuyo	Chile	Paso Cristo Redentor	346	466	32°49′	70°05′
Cuyo	Mexico	Puerto Rosario	757	913	33°10′	60°28′
Cuyo	EU (15)	Puerto Rosario	757	913	33°10′	60°28′
Cuyo	USA	Puerto Rosario	757	913	33°10′	60°28′
Cuyo	Canada	Puerto Rosario	757	913	33°10′	60°28′
Cuyo	China	Puerto de Buenos Aires	984	1113	34°36′	58°22′

Source: Author's calculations. Note: Each exit node selected has a main custom office in operation.

C5.2. Sensitivity analysis

Let first present the results of the regressions of specification I by year and on the average.

Table 4: Argentinean Regional Export Performance
Estimations by year and on average

Expl. Vars \ Estimator	I - 2003	I – 2004	I - 2005	I - average 2003-2005
$\ln GMP_{rt}$	0,880***	0,864***	0,899***	0,881***
	(6,99)	(7,74)	(7,67)	(7,70)
$\ln GDP_{st}$	0,533***	0,514***	0,539***	0,529***
	(5,16)	(4,64)	(5,25)	(5,02)
$\ln dist^{l}_{rq}$	-0,902**	-0,873**	-0,847**	-0,868**
	(-3,30)	(-3,05)	(-3,13)	(-3,17)
$\ln dist_{qs}$	-0,089	-0,040	-0,047	-0,064
	(-0,67)	(-0,30)	(-0,52)	(-0,48)
$\ln roads_{rt}$	0,783**	0,745**	0,701**	0,737**
	(2,95)	(2,78)	(2,62)	(2,85)
$\ln elect_{rt}$	0,520	0,697*	0,711**	0,654*
	(1,73)	(2,25)	(2,81)	(2,46)
$MERCO_s$	1,440***	1,775***	2,056***	1,778***
	(5,51)	(6,69)	(7,85)	(6,86)
$ASOMER_s$	1,549**	1,857***	2,108***	1,854***
	(3,33)	(4,02)	(4,73)	(4,12)
$NAFTA_s$	-1,165*	-0,861	-0,635	-0,875
	(-2,25)	(-1,52)	(-1,19)	(-1,62)
EU_s	-1,149***	-1,113**	-0,820*	-1,024**
	(-3,78)	(-3,38)	(-2,46)	(-3,18)
Const	-6,246**	-7,984**	-9,403***	-8,034***
	(-2,76)	(-3,16)	(-4,35)	(-3,72)
RESET test p-value	0,160	0,168	0,119	0,129
GNR test p-value	0,10	0,095	0,096	0,091
Pseudo R^2	0,865	0,860	0,875	0,868
N° obs.	120	120	120	120
Wald chi^2 (10)	1489,58	1395,42	1750,54	1664,59

Note: Dependent variable is exports. Standard errors adjusted for clustering by region-partner-pair. z-statistics under the point estimates. * for p-values < 0,05, ** for p-values < 0,01 and *** for p-values < 0,001. Estimation method is PPML.

The following Tables show the results of the IV estimation, second and first stages respectively:

Table 5: Argentinean Regional Export Performance (instrumental variables)
Period 2003-2005

Expl. Vars \ Estimator	I	II	III
$\ln GMP_{rt}$	0,925*** (8,60)	0,960*** (8,18)	1,067*** (8,15)
$\ln GDP_{st}$	0,522*** (5,02)	0,529*** (5,05)	0,553*** (4,81)
$\ln dist^{I}_{rq}$	-0,840*** (-3,08)	-	-
$\ln dist^{II}_{rq}$	-	-0,528** (-2,73)	-
$\ln dist_{qs}$	-0,058 (-0,44)	-0,089 (-0,68)	-
$\ln GCdist_{rs}$	-	-	-0,257 (-1,26)
$\ln roads_{rt}$	0,710** (2,89)	0,671* (2,55)	0,689* (2,10)
$\ln elect_{rt}$	0,497 (1,84)	0,242 (1,05)	-0,059 (-0,23)
$MERCO_s$	1,766*** (6,72)	1,748*** (6,90)	0,995** (2,84)
$ASOMER_s$	1,829*** (4,01)	1,847*** (4,15)	1,040** (2,96)
$NAFTA_s$	-0,867 (-1,61)	-0,861 (-1,61)	-1,048 (-1,78)
EU_s	-1,029** (-3,20)	-1,002** (-3,11)	-1,094** (-3,47)
First-stage Residuals	-1,207*** (-3,55)	-1,273*** (-3,64)	-1,309** (-3,47)
Const	-7,328** (-3,32)	-7,700*** (-3,55)	-8,770*** (-3,93)
RESET test p-value	0,189	0,142	0,09
GNR test p-value	0,097	0,095	0,096
Pseudo R^2	0,866	0,866	0,863
N° obs.	360	360	360
Wald chi^2 (#)	1698,62	1609,83	1449,33

Note: Dependent variable is exports. Standard errors adjusted for clustering by region-partner-pair. z-statistics under the point estimates. * for p-values < 0,05, ** for p-values < 0,01 and *** for p-values < 0,001. Estimation method is PPML. GMP_{rt} is instrumented by population and land area.

We look at the coefficients on the first stage residuals in Table 5 in order to test for endogeneity. Since those coefficients are significantly different from zero, it may indicate an endogeneity problem is present. Therefore, the baseline PPML estimations may not be consistent.

Table 6: First stage instrumental variable regressions
Period 2003-2005

Expl. Vars \ Estimator	I	II	III
$\ln population_{rt}$	2,654*** (93,64)	2,607*** (74,15)	2,655*** (97,58)
$\ln area_{r}$	-3,228*** (-36,49)	-3,308*** (-33,48)	-3,231*** (-37,82)
$\ln GDP_{st}$	0,004 (1,27)	0,002 (0,62)	0,003 (1,07)
$\ln dist^{I}_{rq}$	0,000 (0,03)	-	-
$\ln dist^{II}_{rq}$	-	-0,085** (-2,88)	-
$\ln dist_{qs}$	-0,006 (-0,78)	-0,003 (-0,20)	-
$\ln GCdist_{rs}$	-	-	0,002 (1,07)
$\ln roads_{rt}$	-1,379*** (-21,51)	-1,324** (-18,75)	-1,380*** (-21,53)
$\ln elect_{rt}$	2,276*** (26,45)	2,373*** (23,64)	2,278*** (26,54)
$MERCO_{s}$	-0,007 (-0,17)	0,007 (0,13)	0,018 (0,50)
$ASOMER_{s}$	-0,004 (-0,10)	0,012 (0,20)	0,019 (0,51)
$NAFTA_{s}$	-0,006 (-0,23)	-0,035 (-1,13)	0,001 (0,05)
EU_{s}	0,003 (0,15)	-0,030 (-1,12)	0,006 (0,27)
Const	-0,792 (-1,37)	0,555 (0,63)	-0,838 (-1,46)
Pseudo R^2	0,986	0,987	0,986
N° obs.	360	360	360
F(11,119)	44546,05	18558,26	58952,58

Note: Dependent variable is GMP_{rt} in logarithm. Standard errors adjusted for clustering by region-partner-pair. t-statistics under the point estimates. * for p-values < 0,05, ** for p-values < 0,01 and *** for p-values < 0,001. Estimation method is OLS.

Let now run panel-model regressions.

Table 7: Argentinean Regional Export Performance (panel models)
Period 2003-2005

Expl. Vars \ Estimator	Fixed Effects	Random Effects
$\ln GMP_{rt}$	0,308*** (1724)	0,308*** (1724)
$\ln GDP_{st}$	0,835*** (8854)	0,835*** (8854)
$\ln dist^{I}_{rq}$	-	-1,845*** (-4,84)
$\ln dist_{qs}$	-	-0,753 (-1,86)
$\ln roads_{rt}$	0,674*** (1052)	0,674*** (1052)
$\ln elect_{rt}$	-0,810*** (-1223)	-0,810*** (-1223)
$MERCO_{s}$	-	1,128 (0,63)
$ASOMER_{s}$	-	1,326 (0,80)
$NAFTA_{s}$	-	-1,343 (-1,26)
EU_{s}	-	-1,488 (-1,60)
Const	-	21,372*** (4,27)
RESET test p-value	0,000	-
GNR test p-value	0,012	-
N° obs.	342	360
Wald chi² (#)	5,24e+08	5,24e+08

Note: Dependent variable is exports. In FE, 6 groups (18 obs) dropped by STATA because of all zero outcomes. z-statistics under the point estimates. * for p-values < 0,05, ** for p-values < 0,01 and *** for p-values < 0,001. Estimation method is PPML.

The Hausman test for the null hypothesis (H_0) that the difference in coefficients of FE model and RE model is not systematic –with statistic $\chi^2(4) = 223{,}08$ – is rejected.[303] In other words, the RE estimator is inconsistent.

[303] Note the most notorious difference between these results and previous ones is the negative effect of electricity consumption over regional exports. In addition, the relative magnitude of market-size coefficients, regional and foreign, is the inverse as before.

C5.3. *Trying to recover some parameter values*

If regardless of the limitations of this study –repeatedly mentioned in the chapter– and being conscious that we have just tried to confront a specification derived from the NEG model developed in Chapter 4 with data under the working assumption that the model obtains a specific equilibrium, we make the pretty 'irresponsible' attempt to recover the parameters values, we find that:

$$Exp_{rst} = \exp\begin{bmatrix} b_0 + b_1 \ln GMP_{rt} + b_2 \ln GDP_{st} + b_{31} \ln dist_{rq} + b_{32} \ln dist_{qs} + b_{41} \ln roads_{rt} + b_{42} \ln elect_{rt} + b_{51} MERCO_s + \\ + b_{52} ASOMER_s + b_{53} NAFTA_s + b_{54} EU_s \end{bmatrix} + v_{rst}$$

- b_0, which should be equal to $\ln\left(\frac{\sigma-1}{\sigma\beta}\right)^{\sigma}$, is negative and greater than one in absolute value, a magnitude in accordance with the model.
- b_1, b_2 are lower than one and not identical as they should be in the model, though GDP_{st} is not measuring what it theoretically should. IV estimation makes b_1 be close to one.
- b_{31}, b_{32} are, as expected, negative. From a strict theoretical point of view, it seems both should be equal to $-(\sigma-1)\phi$; nonetheless they differ and b_{32} is not statistically different from zero.
- b_{41}, b_{42}, as expected, are positive –*i.e.* the inverse of $-\sigma\gamma$.
- $b_{51}, b_{52} > 0$ and $b_{53}, b_{54} < 0$ as we expected from the gravity literature. In terms of the model in Chapter 4, their absolute value should be close to $(\sigma-1)$.

Some very rough calculations may tell us that: σ should be around 2,03 and 2,8; γ between 0,24 and 0,35 when considering road infrastructure; ϕ for domestic shipments should be between 0,3 and 0,84, for international shipments it should be around 0,03 and 0,09 and β should be around 12,6 and 14,2.[304]

In comparison, other authors have found the following: a) Bosker *et al.* (2010), who obtain the following estimates applying NLS panel data techniques on the wage equation for the 194 NUTSII EU regions over the period 1992–2000: σ = 7,12 and ϕ = 0,102; b) Behrens *et al.* (2010), applying an iterative solver and using the well-known Canada-US interregional trade data by Anderson and van Wincoop (2003), estimate ϕ is equal to 0,149; and c) Balistreri *et al.* (2011), calibrating the model for the Global Trade Analysis Project (GTAP) dataset for 2001 and allowing parameters to be free, find a value of 0,155 for ϕ. In addition, Hummels' (2001) estimates taken directly off observed transportation cost margins are: 0,27 for transport margins informed in international trade statistics and 0,46 for US air freight charges.

[304] They are calculated taking results from IV estimation.

Hence, though these magnitudes are not comparable with ours, we may notice that there seems to be a very strong distance decay within Argentina (ϕ = 0,35 - 0,85), which is more in line with Hummels' estimates.

APPENDIX C6

Tables 1: Index of infrastructure: ranking of regions within each MERCOSUR country

Argentina

Cod	Region	Infrastruct. Index	Ranking
ACF	Ciudad Autonoma de Bs Aires	7.25	1
ACT	Chubut	3.92	2
ANE	Neuquen	1.24	3
ATF	Tierra del Fuego	0.79	4
ACA	Catamarca	0.65	5
AAZ	Santa Cruz	0.64	6
ASF	Santa Fe	0.61	7
AZA	Mendoza	0.44	8
ASL	San Luis	0.44	9
AOB	Cordoba	0.24	10
ALR	La Rioja	0.16	11
ARN	Rio Negro	0.06	12
ATN	Tucuman	0.04	13
ABA	Buenos Aires	-0.02	14
ALP	La Pampa	-0.03	15
ANN	San Juan	-0.05	16
AER	Entre Rios	-0.09	17
AMI	Misiones	-0.34	18
ARR	Corrientes	-0.59	19
AJU	Jujuy	-0.69	20
AHA	Chaco	-0.83	21
ASA	Salta	-0.85	22
AFO	Formosa	-0.91	23
ASE	Santiago del Estero	-0.96	24
PMP	Pampeana	8.05	1
PTG	Patagonia	6.64	2
CYO	Cuyo	0.82	3
NOA	NOA	-1.65	4
NEA	NEA	-2.75	5

Brasil

Cod	Region	Infrastruct. Index	Ranking
BDF	Distrito Federal	2.68	1
BRJ	Rio de Janeiro	1.87	2
BSP	Sao Paulo	1.63	3
BSC	Santa Catarina	1.16	4
BPR	Parana	1.04	5
BRS	Rio Grande do Sul	0.74	6
BES	Espirito Santo	0.53	7
BMG	Minas Gerais	0.21	8
BPE	Pernambuco	0.21	9
BMA	Maranhao	0.10	10
BGO	Goias	0.07	11
BRN	Rio Grande do Norte	0.05	12
BSE	Sergipe	0.05	13
BMS	Mato Grosso do Sul	0.03	14
BMT	Mato Grosso	-0.22	15
BAL	Alagoas	-0.30	16
BPB	Paraiba	-0.41	17
BCE	Ceara	-0.56	18
BRO	Rondonia	-0.62	19
BAM	Amazonas	-0.65	20
BPA	Para	-0.68	21
BRR	Roraima	-0.69	22
BAP	Amapa	-0.71	23
BAC	Acre	-0.84	24
BBA	Bahia	-0.90	25
BTO	Tocantins	-1.00	26
BPI	Piaui	-1.24	27
BSE	SUDESTE	4.24	1
BSU	SUL	2.94	2
BCE	CENTRO-OESTE	2.56	3
BNE	NORDESTE	-3.00	4
BNT	NORTE	-5.18	5

Paraguay

Cod	Region	Infrastruct. Index	Ranking
PAC	Asuncion_central	1.12	1
PMI	Misiones	-0.74	2
PGI	Guaira	-0.79	3
PPR	Alto Paranß	-0.80	4
PPH	Pdte. Hayes	-0.82	5
PCD	Cordillera	-0.86	6
PIT	Itapua	-0.95	7
PPG	Paraguari	-0.95	8
PCG	Caaguazu	-0.95	9
PNM	Neembucu	-1.03	10
PCP	Concepcion	-1.03	11
PAM	Amambay	-1.10	12
PSP	San Pedro	-1.22	13
PCI	Canindeyu	-1.22	14
PCZ	Caazapa	-1.35	15
PAP	Alto Paraguay	-1.36	16
PBQ	Boqueron	-1.41	17
PYF	Py_frontier	-5.67	1
PYI	Py_inter	-9.79	2

Uruguay

Cod	Region	Infrastruct. Index	Ranking
UCA	Canelones	2.51	1
UMO	Montevideo	2.38	2
UMA	Maldonado	1.98	3
USJ	San Jose	1.64	4
UCO	Colonia	0.60	5
ULA	Lavalleja	0.32	6
URO	Rocha	0.08	7
UFS	Flores	-0.03	8
UTT	Treinta y Tres	-0.19	9
USO	Soriano	-0.28	10
UPA	Paysandu	-0.35	11
UFD	Florida	-0.35	12
URN	Rφo Negro	-0.56	13
UDU	Durazno	-0.68	14
USA	Salto	-0.75	15
UAR	Artigas	-0.80	16
UTA	Tacuarembo	-0.86	17
URV	Rivera	-0.93	18
UCL	Cerro Largo	-0.97	19
UR1	U region 1	9.11	1
UR2	U region 2	-2.23	2
UR3	U region 3	-4.10	3

Note: Negative values of the Index appear after standarisation. Argentinean regions are those referred in Chapters 2 and 5. Brazilean ones are: 'Norte' (Acre, Amapá, Amazonas, Pará, Rondônia, Roraima and Tocantis), 'Noreste' (Alagoas, Bahía, Ceará, Maranhão, Praíba, Pernambuco, Piauí, Rio Grande do Norte and Sergipe), 'Centro-Oeste' (Goiás, Mato Grosso, Mato Grosso do Sul and Distrito Federal), 'Sudeste' (Espíritu Santo, Minas Gerais, Rio de Janeiro and São Paulo) and 'Sur' (Paraná, Río Grande do Sul and Santa Catarina). Paraguayan regions are: 'Frontier' (Alto Paraná, Amambay, Caaguazú, Canindeyú, Central, Itapúa, Misiones and Ñeembucú) and 'Interior' (Alto Paraguay, Boquerón, Caazapá, Concepción, Cordillera, Guairá, Paraguarí, Presidente Hayes and San Pedro). Uruguayan ones are: 'Region 1' (Montevideo, Canelones, Colonia, Maldonado y San José), 'Region 2' (Flores, Florida, Paysandú, Río Negro, Rocha, Salto and Soriano) and 'Region 3' (Artigas, Cerro Largo, Durazno, Lavalleja, Rivera, Tacuarembó and Treinta y Tres).

Table 2: Regression results for ten selected products with export potential. Estimations by product

Period 2003-2005

	01112 Bovine meat not frozen, boneless		01122 Meat and frozen boneless bovine		61142 Other bovine and equine leather p.		04231 Semi-processed or prepared rice		02499 Other types of cheese	
	OLS	GLS Random	OLS	GLS Random	OLS	GLS Random	OLS	GLS Random	OLS	GLS Random
lgdp _ i	0,65*** (8,56)	0,93*** (8,01)	0,19* (1,91)	0,19 (1,48)	0,13 (1,43)	0,14 (1,18)	-1,35*** (-4,52)	-1,31*** (-2,65)	-0,52** (-2,41)	-0,40 (-1,29)
lgdp _ j	0,72** (9,31)	0,97*** (9,79)	0,40*** (3,47)	0,35*** (3,18)	0,28*** (4,31)	0,20** (2,24)	0,36*** (2,8)	0,16 (0,88)	0,57*** (9,97)	0,42*** (3,55)
ldist _ ii	0,06 (0,79)	0,22*** (3,64)	0,05 (0,77)	0,05 (1,48)	-0,07 (-1,29)	-0,01 (-0,34)	0,05 (0,2)	0,39* (1,65)	-0,26 (-1,42)	-0,16 (-0,92)
ldist _ ij	-0,69*** (-6,9)	-0,60*** (-5,11)	-0,30** (-2,15)	-0,17 (-0,98)	-0,21* (-1,92)	-0,09 (-0,67)	-0,23* (-1,78)	0,16 (0,6)	-0,38*** (-3,75)	-0,18 (-1,51)
lINFRA	-0,12* (-1,77)	0,19*** (2,73)	0,29** (2,33)	0,40*** (2,92)	0,06 (1,05)	0,05 (0,58)	1,35*** (2,66)	1,67*** (4,05)	0,09 (0,27)	0,54** (2,15)
Bord	0,20 (0,28)	1,12 (1,35)	-0,36 (-1,19)	0,16 (0,22)	-0,46 (-1,49)	-0,19 (-0,29)	2,02*** (3,99)	2,07*** (2,65)	0,55 (1,66)	1,15 (1,37)
Locked _ i	0,18 (0,71)	0,56 (1,56)	-0,19 (-0,94)	-0,04 (-0,14)	0,09 (0,38)	-0,04 (-0,14)	-0,87 (-1,51)	-0,87 (-0,86)	-0,12 (-0,28)	0,25 (0,44)
Const	-7,25*** (-4,3)	-11,28*** (-7,78)	3,33 (0,98)	2,38 (1,2)	5,51*** (4,72)	4,88*** (3,11)	14,88*** (4,49)	11,76*** (2,15)	8,71*** (3,55)	6,69** (1,98)
R^2	0,23	0,20	0,21	0,21	0,10	0,09	0,40	0,32	0,34	0,29
N° obs.	557	557	206	206	274	274	73	73	97	97
N° groups		227		88		113		32		43
Rho		0,86		0,84		0,89		0,85		0,87

Note: t-statistics under the point estimates. * for p-values < 0,05, ** for p-values < 0,01 and *** for p-values < 0,001.

Table 2: Regression results for ten selected products with export potential. Estimations by product (cont.)

Period 2003-2005

	02222 Milk and cream in solid form		06111 Unrefined sugar cane		29193 Guts, bladders and stomachs of animals		82119 Parts of the seats		55132 Other [illegible] oils	
	OLS	**GLS Random**	**OLS**	**GLS Random**	**OLS**	**GLS Random**	**OLS**	**GLS Random**	**OLS**	[illegible]
lgdp _ i	-1,41*** (-5,48)	-1,10*** (-3,07)	-0,41** (-2,14)	-0,14 (-0,72)	0,28** (2,2)	0,26 (1,61)	0,29** (2,44)	0,37** (2,15)	-0,34 (-0,98)	-0,2[illegible] (-1,[illegible]
lgdp _ j	0,01 (0,1)	-0,10 (-0,7)	0,35*** (4,78)	0,32*** (3,15)	0,21*** (2,66)	0,24** (2,19)	0,70*** (8,51)	0,62*** (5,04)	0,18* (1,91)	0,17 (1,31)
ldist _ ii	0,17 (0,73)	-0,15 (-0,69)	-0,57*** (-5,5)	-0,51*** (-4,35)	0,02 (0,28)	-0,08 (-1,49)	-0,11 (-1,43)	-0,10 (-1,04)	-0,07 (-0,86)	-0,10 (-1,28)
ldist _ ij	-0,45*** (-4,48)	-0,46** (-2,44)	-1,29*** (-3,92)	-0,95*** (-3,11)	-0,14 (-1,37)	-0,17 (-0,98)	-0,49*** (-4,85)	-0,39** (-2,26)	0,23 (0,82)	0,21 (0,75)
lINFRA	1,21*** (2,85)	0,87** (2,11)	1,16** (2,61)	0,69* (1,93)	0,13 (0,82)	0,11 (0,7)	-0,38*** (-4,04)	-0,29** (-2,26)	0,90 (1,54)	0,80* (1,9)
Bord	-2,44*** (-3,51)	-2,63** (-2,49)			0,12 (0,28)	0,10 (0,15)	0,65 (1,17)	0,67 (0,98)	3,08*** (3,96)	2,85*** (2,98)
Locked _ i	-0,70 (-1,23)	-0,51 (-0,66)	1,56** (2,33)	1,22* (1,93)	0,05 (0,2)	0,11 (0,31)	-0,98*** (-3,01)	-0,48 (-1,07)	1,52*** (2,89)	1,53*** (2,6)
Const	19,71*** (8,52)	19,87*** (5,11)	19,46*** (5,51)	14,18*** (5,65)	1,53 (0,94)	0,12 (0,04)	-3,80 (-1,57)	-5,41 (-1,57)	3,46* (1,69)	3,27 (1,52)
R^2	0,36	0,34	0,50	0,47	0,13	0,12	0,30	0,30	0,49	0,48
N° obs.	129	129	96	96	220	220	245	245	52	52
N° groups		69		48		95		118		25
Rho		0,75		0,79		0,87		0,78		0,51

Note: t-statistics under the point estimates. * for p-values < 0,05, ** for p-values < 0,01 and *** for p-values < 0,001.