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# REGIONAL NEW ECONOMIC GEOGRAPHY: AN APPRAISAL

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## Abstract

During the last century there has been a huge reduction in trade costs at almost every spatial scale impelled 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 estrigent fall has provoked an explosion of physical, trade and investment integration and, hence, important and lasting effects on the economy at different dimensions. Among them, one that has received special attention from economic literature is the spatial dimension, which indeed is the focus of this article.

Since our emphasis is put on countries or 'large spatial scales', where the type of externalities that more likely operates is neither localization nor urban economies but pecuniary external effects, the paper concentrates on NEG models. More specifically, it presents a *very up-dated and complete survey* of the NEG literature, both theoretical and empirical, on the spatial effects of trade costs on the distribution of economic activity *within countries*.

The NEG framework has successfully evolved thanks to many fruitful contributions and extensions proposed enhancing first-generation models. 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.

Nonetheless, despite the considerable advances, to date theoretical research still has some limitations regarding relevant issues, such as the application of a general model of monopolistic competition, the discussion on the appropriate treatment of alternative cumulative causation processes at different spatial scales, and the proper inclusion of the transport sector, which is central for thereafter carrying out insightful applied work.

With reference to empirical literature, this article finds that the number of papers studying intra-country spatial effects of trade costs has multiplied within the last ten years. The challenge now is, taking theory more seriously, to apply structural specifications, to exploit natural experiments for analysing spatial phenomena and to use innovative research tools –such as spatial econometric techniques and CGE simulations. Moreover, the invitation is to further advance in useful policy-oriented analyses.

JEL classification: R00, F13, F15, R40

Keywords: Regional Economics, Trade Liberalisation, Economic Integration, Transportation Systems

## 1.1. Introduction

During the last century there has been a huge reduction in trade costs at almost every spatial scale impelled 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 estrigent 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 fifteen years is the spatial dimension, which indeed is the focus of this paper.

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. Nonetheless, the manner in which this happens in a given territory is not unique nor innocuous.

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, 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 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 New Trade theory 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-called New New Trade theory, which assumes heterogeneity across firms, predicts that regions with the most productive firms would increase their aggregate productivity; in other words, would tend to concentrate production and the best firms.<sup>1</sup>

Spatial economics is another area of study that provides an alternative fruitful framework for analysing how territories respond to changes in trade costs.<sup>2</sup> Focusing on different geographical scales, the two canonical models that nowadays dominate the field may help to understand how this occurs.<sup>3</sup> The Urban Systems theory, because of its focus on reduced spatial scales –namely, neighbours, cities and districts– helps to explain 'spikes' of economic activity. On the other hand, the second model or the so-called New Economic Geography (henceforth, NEG) relying on market-mediated dispersion/agglomeration forces is useful for explaining trends at large spatial scales. 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.<sup>4</sup>

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<sup>1</sup> These are insights that one can be derived, for instance, from Jean's (2002) and Melitz's (2003) models.

<sup>2</sup> 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).

<sup>3</sup> These two frameworks rely on the trade-off between externalities and mobility costs, differing in the key assumptions they consider to set up the typical agglomeration/dispersion balance. While the former, which builds on Henderson's (1974) work, relies on local agglomeration effects, commuting costs and local congestion effects; NEG core models assume instead firm level increasing returns and trade costs.

<sup>4</sup> For a deep and didactic comparison of the approaches proposed by both canonical models, see Combes *et al.* (2005).

Since the emphasis of this paper is put on countries or large spatial scales, where the type of externalities that more likely operates is neither localization nor urban economies, but pecuniary external effects, this article concentrates on NEG models.<sup>5</sup> More specifically, it surveys the NEG literature on the spatial effects of trade costs changes on the distribution of economic activity within countries.

The remainder of the paper is laid out as follows. Next section examines the main characteristics of the NEG framework highlighting the progresses it has had. Sections three and four reviews what theory and applied research, respectively, have proposed to address the impacts of trade costs changes on domestic economic landscapes. Finally, section five concludes.

## ***1.2. NEG models: Main features***

NEG is a pretty new strand of the literature, pioneered by Krugman (1991a,b) that can be defined as the study of where economic agglomeration takes place and why. 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.<sup>6</sup>

Although the nature of both agglomeration and dispersion forces vary across different NEG settings, the very essential ingredients behind these models are common.<sup>7</sup> First, as it was already mentioned, 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 that firms face internal increasing returns, 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

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<sup>5</sup> As Fujita and Thisse (2002, ch.8) put forward, several reasons can explain the choice of studying pecuniary externalities instead of technological ones. Moreover, one can reasonably argue that pecuniary externalities arising from imperfect competition provide a stronger explanation of agglomeration than face-to-face interactions when considering large geographical areas like a country. At the spatial scale of a country, the sources of agglomeration seem to do more with vertical linkages or market-interactions between firms and population than with direct physical contacts.

<sup>6</sup> 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 (2009a).

<sup>7</sup> It is worth mentioning that 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, alternatively, 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, alternatively, like 'market-crowding' and 'immobile demand' effects.

expenditure locates along with production due to the existence of a feedback mechanism that operates from the latter to the former, known as ‘forward’ or ‘cost’ linkage.

Models assume this connection 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 depreciation of capital (Baldwin, 1999; Martin & Ottaviano, 1999; Baldwin *et al.*, 2001).<sup>8</sup> 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 causality’ or ‘cumulative causality’.

The micro-founded interactions among all those ingredients yield agglomeration and dispersion forces to emerge; the tension between them turns out to be decisive in determining the spatial structure of the economy. If agglomerative 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 pulling and pushing forces<sup>9</sup>; on the other hand, the spatial effects of changes in these costs crucially depend on the nature and extent of the forces involved.<sup>10</sup> 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 presence of multiple long-run equilibria and for the existence of both types, stable and unstable.<sup>11</sup>

To begin with our description of the evolution NEG theoretical models have shown, let us briefly refer to Krugman’s (1991a,b)<sup>12</sup> pioneer 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

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<sup>8</sup> 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.

<sup>9</sup> 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.

<sup>10</sup> Fujita and Mori (2005b) carry out a comprehensive analysis of this important feature of NEG models.

<sup>11</sup> Robert-Nicoud (2005) and Ottaviano and Robert-Nicoud (2006) carefully analyse the qualitative properties of the NEG long-run equilibrium.

<sup>12</sup> In fact, as some authors point out, Fujita (1988) is previous and presents a more general model than Krugman. Whatever his merit, it is fair to say that he has not reached the level of visibility and ‘popularity’ achieved by Krugman.

sector<sup>13</sup> and perfectly competitive traditional one; iceberg trade costs<sup>14</sup> in the modern sector 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.<sup>15</sup>

Krugman's path-breaking contribution dramatically changes the state of the art in the field of Spatial Economics, giving rise to a very prolific research programme extending the spatial analysis in many directions and addressing many novel concerns.<sup>16</sup> 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<sup>17</sup>, relying instead on either a linear model of monopolistic competition or an oligopoly *à la* Cournot.

Put forth by Ottaviano *et al.* (2002), quadratic utility functions and non-frictional trade costs give rise to linear and, hence, more tractable settings. This type of models, which display similar results as the CP but allowing for clearer comparative static results<sup>18</sup>, 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.<sup>19</sup> On the other hand, linear settings have a partial 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.<sup>20</sup>

In the case of oligopoly, Combes (1997) proposes a two-region model that yields similar results as DS settings. Namely, firms agglomerate in the territory with larger number of

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<sup>13</sup> 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.

<sup>14</sup> Transportation is modeled as a costly activity that uses the transported good itself; hence, certain fraction of the good melts on the way.

<sup>15</sup> For a short but vey didactic presentation of the CP model, see Redding (2009a); and for a summarised formal version see Brakman and Garretsen (2009).

<sup>16</sup> 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).

<sup>17</sup> For a comprehensive analysis of the implications of the DS model, see for instance Matsuyama (1995) and Baldwin *et al.* (2003, ch.2).

<sup>18</sup> 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.

<sup>19</sup> While non-linear models display constant own-price elasticities of demand –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.

<sup>20</sup> At this point, it is due to point out that 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.

firms if transport costs are low or economies of scale are high<sup>21</sup>, and production shifting prompts expenditure shifting, giving rise to cumulative causation. Compared with monopolistically competitive settings, an 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. One of the issues initially put forward was whether Samuelson's iceberg costs are more or less realistic (or crucial) than additive trade costs in terms of spatial results and welfare outcomes.<sup>22</sup> Beyond well-founded arguments, the conclusion of the literature is that NEG main spatial and welfare results seem to be robust to alternative formulations of trade costs.<sup>23</sup>

Apart from this initial debate on the form of trade costs, many 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 weakened 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.

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<sup>21</sup> 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.

<sup>22</sup> For some interesting discussions on these issues, see Behrens (2004, 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."

<sup>23</sup> Notwithstanding, it is due to mention that 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.

Very recently and taking a step forward by following Takahashi's (2006) idea<sup>24</sup>, Behrens *et al.* (2009a) provides for a setting that makes trade costs completely endogenous. 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. Hence, the observation put forward by Lafourcade and Thisse (2009, page 31) among others –*i.e.* researchers involved with the empirical agenda– about the failure of NEG “... to provide an explicit description of the interactions between the transport and manufactured sectors as well as between carriers themselves” is likely to be part of the past before long.<sup>25</sup>

### 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 has been to augment the number of regions considered.

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.<sup>26</sup>

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) and Behrens *et al.* (2007b)<sup>27</sup> who develop a DS trade model with potential asymmetric trade costs; Bosker *et al.* (2007a), presenting a multi-region Puga (1999) setting with pair specific trade costs and asymmetrically sized regions; Combes and Lafourcade (2008) who propose a model under Cournot competition; and Granato (2008), who re-dimensions Robert-Nicoud's (2002) original model into a multi-region setting.

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<sup>24</sup> 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.

<sup>25</sup> The authors arrive to this conclusion after completing an updated survey of NEG main contributions as regards transport analysis.

<sup>26</sup> 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”.

<sup>27</sup> This paper is a revised and published version of Behrens *et al.*'s (2003) highly quoted CEPR discussion paper 4065, titled “Interregional and international trade: Seventy years after Ohlin”.



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

#### *1.2.d- Initial regional asymmetries*

Another interesting extension of the standard NEG set-up is the incorporation of asymmetries across regions to allow for a more diversified and richer explanation of spatial economic 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.

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<sup>28</sup>, there are more recent contributions that assume it within a more than two-region model. The initial contributions in this line are those of Crozet and Koenig (2004a), Brülhart *et al.* (2004), Granato (2005) 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. Within these settings and depending on the relative size and accessibility level of border regions, the latter may be benefited or, in contrast, damaged as a result of trade liberalisation.

More vanguard contributions, such as those of Bosker *et al.* (2007a), Combes and Lafourcade (2008) 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. Relying on simulations, these papers find that the reaction of spatial agglomeration to increasing integration importantly change in comparison with what happen in a setting with less geographical structure.<sup>29</sup>

With respect to comparative advantage, some NEG settings introduce this type of asymmetry under the Ricardian form, while others adopt the Heckscher-Ohlin's 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.<sup>30</sup> 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.

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<sup>28</sup> See, for instance, Baldwin *et al.* (2003).

<sup>29</sup> In this vein, Bosker *et al.* (2007a, page 20) conclude "... the simulated effects of increased integration depend crucially (and predictably) on the type(s) of asymmetric geography structure imposed".

<sup>30</sup> 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, ch.12) apply both comparative advantage assumptions to extend their Footloose Capital model.

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 the 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.

### **1.2.e- More recent extensions**

More recent NEG contributions deal with many other interesting issues such as the spatial fragmentation of production, heterogeneous firms, knowledge and information externalities, workers' heterogeneity and the relationship between agglomeration and growth.<sup>31</sup>

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 units across space.

The second extension has been introduced as a natural by product of Melitz's (2003) and subsequent contributions to the New New Trade theory.<sup>32</sup> For instance, the research accomplished by Ottaviano (2005) and Baldwin and Okubo (2005, 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 a 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.

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, it facilitates the development of "... *a comprehensive theory of spatial economics ...*" (Fujita, 2007, page 482) applicable to any geographic scale. In other words, it is a step toward the synthesis between the two canonical models that dominate the field. 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).<sup>33</sup>

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 (Amity and Pissarides, 2005), its incorporation to NEG settings adds other

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<sup>31</sup> For a survey on these contributions, see Fujita and Mori (2005a).

<sup>32</sup> Such as Baldwin and Robert-Nicoud (2008), Bernard *et al.* (2003), Ederington and McCalman (2008), Helpman *et al.* (2004), Helpman *et al.* (2008), Melitz and Ottaviano (2008) and Yeaple (2005).

<sup>33</sup> 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).

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 more likely.

### **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 willingness 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. Just as examples one can mention the concern some authors have put on 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<sup>34</sup>; Candau, 2008a) and the philosophical and methodological enquiry Nijkamp (2007) puts forward as regards the 'legitimacy' of the *ceteris paribus* postulate for the analysis of spatial-economic interactions.<sup>35</sup>

## **1.3. Theoretical research in regional NEG**

Having summarised some of 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 trade costs changes. 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.<sup>36</sup> 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.<sup>37</sup>

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<sup>34</sup> This paper is the revised and published version of Bosker and Garretsen's (2006) *CESifo Working paper* N° 1769.

<sup>35</sup> Even more, some authors such as Rafiqui (2009) highlight the importance New Institutional Economics has for economic geography.

<sup>36</sup> For an updated survey of this literature, see Brülhart's (2009) work-in-progress.

<sup>37</sup> 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.

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 papers 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 presents a summary of the articles surveyed.

Before starting with the survey itself, let us 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 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 regional models in the following paragraphs.

### ***1.3.a- First generation***

Krugman and Livas Elizondo (1996) and Krugman (1996) are the first researchers that, as the NEG tradition recognises, 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.<sup>38</sup>

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

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<sup>38</sup> Their setting acknowledges for both intra and inter-national trade costs but disregards circular causality.

two countries tends to foster dispersion of economic activity across domestic regions; a result at odds with Martin and Rogers' finding.<sup>39</sup>

Moreover, Krugman –who extends the analysis to consider the locational impacts of transport infrastructure– highlights both the interrelation there exists between transport and tariff and non-tariff costs and the effects that changes in each of these costs have on 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', a foreign immobile demand and takes one out of two alternative approaches to handle dispersion forces within countries, namely: one that involves 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)<sup>40</sup> and Moncarz and Bleaney (2007) obtain the same result as their predecessors: international trade liberalisation tends to increase dispersion within countries.<sup>41</sup> 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 propitiates the emergence of agglomerated national landscapes.

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.<sup>42</sup> 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 is either congestion costs or regional immobile demand. As a result, dispersion remains being fostered by the former, while agglomeration tends to emerge thanks to the latter.

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<sup>39</sup> Being precise, the authors study the effects of unilateral trade liberalisation when export goods are freely traded.

<sup>40</sup> The model we addressed is that presented in pages 331-335, which is directly comparable with the rest of studies since it assumes only one industrial good.

<sup>41</sup> Nevertheless, when additional agglomeration forces are introduced –such as those generated by vertical linkages 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. Quoting Alonso Villar (2001, page 1368): “... *contrary to Krugman (1991, 1992), we find that, when a country has a low level of industrialisation, an immobile demand represented by foreign markets leads to concentration instead of dispersion*”.

<sup>42</sup> For a detailed argumentation on the latter, see Crozet and Koenig (2004a) and Behrens *et al.* (2007b).

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 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.<sup>43</sup> 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) and Crozet and Koenig (2004a), 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.<sup>44</sup> 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 (2009, 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)”.<sup>45</sup>

As it may be apparent from the above exposition, much of the focus within the first-generation is related with whether alternative assumptions about dispersion forces could imply either disagreeing 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.

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) and Crozet and Koenig (2004a) –the ‘geographic approach’ from now on– are the first

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<sup>43</sup> 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.

<sup>44</sup> 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.

<sup>45</sup> The result obtained by Brülhart *et al.* and Crozet and Koenig is further reinforced by the one get in Granato (2005). 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.

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***” (page 1297 [emphasis added]). In other words, the authors stress the interrelation there 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.<sup>46</sup>

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.<sup>47</sup> In particular, the model predicts international trade liberalisation may promote agglomeration in one country as a corollary of its partner’s agglomerated

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<sup>46</sup> 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.

<sup>47</sup> 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 certain degree of accessibility. Mansori (2003) presents another way to model access heterogeneity.

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 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 get 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 to allow for a richer geographical structure by assuming either asymmetric spatial relations or unequal initial endowments across regions.<sup>48</sup>

The first contribution within this strand is García Pires' (2005) multi-regional setting that, emulating Fujita *et al.*'s (1999, ch.18) setting in pages 335-338, adds cumulative causation operating across both regions and countries, *i.e.* vertical linkages 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.<sup>49</sup>

Another exponent of this strand is Bosker *et al.* (2007a) 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.<sup>50</sup>

Other related article is due to Combes and Lafourcade (2008) who aim to study France's economic geography.<sup>51</sup> The authors propose a Cournot competition multi-industry model

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<sup>48</sup> Behrens *et al.*'s (2006c) 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.

<sup>49</sup> 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).

<sup>50</sup> In the first case, agglomeration could be too extreme; while in the second case, the likelihood of a reversed result –*i.e.* a dispersed outcome– increases.

<sup>51</sup> This is a revised version of Combes and Lafourcade's (2001) well-known CEPR discussion paper 2894.



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.<sup>52</sup>

By supposing intra and international VL, these third-generation settings acknowledge for internationally mobile (intermediate) demand. Hence, they spread within the literature a curious feature due to Fujita *et al.* (1999) that gives rise to strengthened outward oriented agglomeration forces *vis-à-vis* previous models –which standard practice is to assume an internationally immobile (final) demand. Granato (2008) makes a contribution to this strand of the literature. It presents a multi-region model that assumes VL, regional comparative advantage and trade costs *à la* Behrens *et al.* (2007a). The results found for Argentina suggest that specific intra-national transport policies would be appropriate for boosting industrial location towards nowadays lagged regions.

The introduction of international rent-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 rent-shifting across 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.<sup>53</sup>

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.

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<sup>52</sup> Intra-regional inequality has not been referred to before in this survey because this paper regards regions as dimensionless points.

<sup>53</sup> Indeed, the final outcome will depend on how sensitive the results are to a robustness issue: the importance of immobile demand for determining market-potentials and, thus, dispersion forces.

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 how trade costs impact on the internal economic geography of a given country.<sup>54</sup> 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 us briefly discuss two interesting remarks reckon authors have made about this literature. First, some authors as Behrens *et al.* (2007b) and Lafourcade and Thisse (2009) 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 nor even on the geographical scope at which the latter should operate.<sup>55</sup> 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.

Second, from a methodological point of view, an important issue that has been raised is about the adequacy of relying on numerical solutions instead of obtaining definite algebraic solutions. Some authors argue that relying on numerical simulations may be misleading in providing definite results that could be taken as solid base for policy analysis. However, the tendency to apply numerical simulations and other quantitative methods seems to be quite inexorable. Multiple regions and countries, different kinds of asymmetries, various rent-shifting channels 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 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) counterfactuals, as it will be clear from the following section.<sup>56</sup>

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<sup>54</sup> Quoting Brühlhart (2009, 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”.

<sup>55</sup> Indeed, there is a need for debating whether each rent-shifting mechanism may have a global, national, regional or none extent at all.

<sup>56</sup> For instance, authors such as Bröcker (1998), Forslid *et al.* (2002a) and Forslid *et al.* (2002b) propose to study the multi-regional (and multi-sector) effects of trade costs reductions by means of general equilibrium simulations instead of deriving analytical solutions from a full-fledge theoretical model.

#### 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 empirical 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 great interest primely from researchers studying regional integration processes such as the EU and 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.<sup>57</sup> This has been accomplished mainly at cross-country level; nevertheless, in the last ten years within-country studies are increasingly being conducted.

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.<sup>58</sup> 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 in EU studies, some of the most outstanding cross-country contributions are also reviewed.<sup>59</sup>

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 of empirical studies to the NEG approach 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 alternative, better to say, complementary approaches. Thus, this survey does not only revise empirical research that formally and explicitly relies on NEG models, but also papers that,

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<sup>57</sup> For comprehensive reviews of this empirical literature, see e.g. Combes (2009), Combes and Overman (2004), Head and Mayer (2004), Overman *et al.* (2003) and Redding (2009b).

<sup>58</sup> It is due to mention that many empirical papers, related with location issues but focusing on aspects different from our main interests, are disregarded in this survey. For example, studies applying discrete choice models (DCM) 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 (CDM) 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.* (2009).

<sup>59</sup> Mainly those accomplished during the first years of empirical research on economic geography.

though adopting a different theoretical perspective or taking a more ad-hoc strategy, make interesting contributions as regards our main interests.

This section is organized as follows: first, it refers to descriptive works, to afterwards surveying papers that propose either more analytical or theoretically grounded methodologies. More 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 the Appendix present a summary of the articles reviewed.

#### **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;<sup>60</sup> 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 the 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.<sup>61</sup>

The validity of these contributions has been, nonetheless, questioned. The weak relationship between theory and the specifications used tend to undermine the reliability of their results. At the centre of this appraisal are matters as: the type of index used, the right-hand-side variables considered, and the 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 terms of data and computing-power

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<sup>60</sup> That is the case *e.g.* of Brülhart and Torstensson (1996), Ellison and Glaeser (1997) and Hallet (2002).

<sup>61</sup> Articles in this line are: Ades and Glaeser (1995), Amiti (1999), Brun and Renard (2000), Ellison and Glaeser (1999), Kim (1995, 1999), Midelfart-Knarvik *et al.* (2000b), Pernia and Quising (2003) and Ramcharan (2009).

requirements– satisfy many of the properties one would expect from a meaningful concentration index.<sup>62</sup>

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.<sup>63</sup> 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 proposes explanatory spatial data analysis; they analyse location patterns across domestic regions as international trade is liberalised.<sup>64</sup> Interesting examples within this set are the contributions made by Brülhart and Traeger (2005), Combes *et al.* (2008b) and Das and Barua (1996), among others, which spread the use of novel indices to measure agglomeration.<sup>65</sup> 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 individual regions (sectors) to the overall geographic concentration of economic activity.<sup>66</sup>

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 to look at regional wage differentials as an explanation for location within countries, a prediction coming from NEG models. Applying a descriptive methodology to study the spatial structure of US,

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<sup>62</sup> 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) –published version of the highly quoted Duranton and Overman's (2002) *CEPR Discussion Paper* 3379.

<sup>63</sup> For additional discussions on this issue, see for instance Head and Mayer (2004), Brakman and Garretsen (2006) and Behrens and Thisse (2007).

<sup>64</sup> Other articles in this line are Overman and Winters (2005, 2006), Pons *et al.* (2002) and Sjöberg and Sjöholm (2004).

<sup>65</sup> Other papers in this line are Cutrini (2005), Kanbur and Zhang (2005) and Granato (2008).

<sup>66</sup> 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.

Canada and Mexico before and after NAFTA, the author finds that 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 Tirado *et al.* (2002), Chiquiar (2005), Daumal (2007) and Crozet and Koenig (2004b)<sup>67</sup> regress specifications aiming to disentangle how trade liberalisation, intra- and inter-country, changes location patterns. For instance, Tirado and co-authors study Spain's geography between 1856 and 1893, when the basic network of railways was established. Regressing an index of industrial intensity for industrial production on year dummies, human capital, tax payment and a centrality measure, they find evidence supporting the trade-induced agglomeration hypothesis.

Other authors within this second phase build on an approach due to Midelfart-Knarvik and co-authors. In few words, Midelfart-Knarvik *et al.* (2000a, 2002) propose to econometrically estimate a specification that attempts to represent testable hypotheses about concentration and specialisation patterns derived from NEG and Trade theories.<sup>68</sup> Thus, their articles, which regresses a concentration index on variables capturing country and industry characteristics 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.<sup>69</sup>

Among the authors who apply this methodology one can mention Wen's (2004) study of the Chinese economy, Volpe Martincus' (2009) study of Brazil<sup>70</sup> and Sanguinetti and Volpe Martincus' (2009) analysis of Argentina<sup>71</sup>; 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 took place 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 that lower trade protection may have fostered dispersion from the main domestic market, Buenos Aires, towards interior provinces.

Finally, another group of articles within this second phase proposes the estimation of gravity equations to disentangle whether trade performance across domestic regions can be

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<sup>67</sup> Besides the already mentioned papers by Brühlhart and Traeger (2005), Combes *et al.* (2008b), Das and Barua (1996) and Kanbur and Zhang (2005).

<sup>68</sup> It is worth mentioning that Midelfart-Knarvik *et al.* (2000b) is a close antecedent of that pair of papers. Other related contributions are those due to Brühlhart (2001) and Haaland *et al.* (1999).

<sup>69</sup> At aggregate level, this approach is also applied by Sanguinetti *et al.* (2004) to study location within MERCOSUR.

<sup>70</sup> This paper is the published version of Volpe Martincus' (2005) "Do economic integration and fiscal competition help to explain location patterns?", *ZEI Working Paper* B04-15, that is available at: [http://www.univ-pau.fr/RECHERCHE/CATT/colloques/REFI/PDF/VOLPE\\_MARTINCUS\\_DEF.pdf](http://www.univ-pau.fr/RECHERCHE/CATT/colloques/REFI/PDF/VOLPE_MARTINCUS_DEF.pdf)

<sup>71</sup> This paper is the published version of Sanguinetti and Volpe Martincus' (2005) "Does Trade Liberalization Favour Spatial De-concentration of Industry?", mimeo of the Universidad Torcuato Di Tella.

reasonably explained by NEG and Trade theories.<sup>72</sup> 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 play 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 not so different questions 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.<sup>73</sup>

Within the reduced-form group, the typical strategies are either to estimate a standar 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.<sup>74</sup> 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 –*i.e.* taking theory even more seriously– 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)<sup>75</sup> and the other due to Redding and Venables (2004), to evaluate the role play by real market access in determining regional wages. While the former author 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 in determining salaries and wages of skilled workers.<sup>76</sup> Similarly, Tirado *et al.* (2009)<sup>77</sup>, who test the existence of regional nominal wage

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<sup>72</sup> 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) –note that Hanson and Xiang's paper is the published version of their 2002 *NBER Working Paper* 9076.

<sup>73</sup> For a complete methodological survey on these two empirical strategies, see Combes' (2009) work-in-progress.

<sup>74</sup> Among those studies we can mention: Chiquiar (2008), Egger *et al.* (2005), Faber (2007), Gonzáles Rivas (2007), Hanson (1998b) and Tomiura (2002).

<sup>75</sup> This is the published version of Hanson's 2001 mimeo, posted at the Graduate School of International Relations and Political Studies' (University of California, San Diego) Web site.

<sup>76</sup> Brakman *et al.* (2004) coincide with Roos' conclusion. They find strong support for the spatial wage structure across German districts in 1995.

<sup>77</sup> Which is a revised version of Tirado, Pons and Paluzie's mimeo 2004 titled "Industrial agglomerations and wage gradients: the Spanish economy in the interwar period", available at <http://www.ub.edu/dpteco/RSUERRevision.pdf>. Note that the authors combine two reduced form estimations of

gradients, find support for a gradient centered on Barcelona before 1922, which is weakened afterwards when protectionist policies are put into place. The authors find 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 designed by Redding and Venables, various investigations have been 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.<sup>78</sup> 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 (2008) investigate whether the European integration process has changed the geography of trade within France. The authors assume that trade costs are composed of two elements: transport costs and specific cross-border costs; and that transport costs depend on the existence (or not) of cross-border infrastructures. Applying this approach, they find that French border regions trade on average 72% more with neighbour countries than do interior regions, perform better if they have good 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. Fairly in line with Lafourcade and Paluzie’s research, Granato (2008) and Calfat *et al.* (2009) propose to study how regional trade performance in Argentina and other MERCOSUR member countries is affected by transport costs and infrastructure.

#### **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 adding interesting simulation exercises. 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 the degree of agglomeration by means of numerical simulations based on multi-region NEG models. So, they first calibrate NEG models

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the market access effect, one proposed indeed by Hanson (2005) and the other put forward by Hanson (1996, 1997).

<sup>78</sup> Worth is to mention that most of these studies use trade flows at country level instead of intra-country ones because of availability.



numerically to secondly compute simulations for scenarios that differ in terms of market access levels. Within this strand we can mention several papers, such as Bosker *et al.* (2007a), Brakman *et al.* (2006), Brühlhart *et al.* (2004), Brühlhart *et al.* (2009), García Pires (2005), Huber *et al.* (2006)<sup>79</sup> and Niebuhr (2006, 2008)<sup>80</sup>, which 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)<sup>81</sup> 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. Also with an original strategy, Combes and Lafourcade (2008) 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 New Trade theory, Bröcker (1998) finds 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 (2008, 2009) do the proper as regards Europe.

Finally, the underdeveloped but very promising third approach suggests the application of structural spatial econometrics in NEG empirical studies.<sup>82</sup> In the spirit of intra-country studies addressing either the location of foreign direct investment (FDI) –e.g. Coughlin and Segev (1999) and Castro *et al.* (2007)– or the patterns of trade as in Behrens *et al.* (2009b, see Box 1), some authors try to corroborate NEG predictions by means of spatial econometrics. That is the case of Huber *et al.* (2006) and Mion (2004) who assess the role of market potential in shaping regional wage structures.

This potentially rich line of research, which is just sprouting, shows up as a promise that will very likely provide for a better understanding of how agglomeration forces operate across domestic regions. One can easily imagine there is plenty of space for contributions

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<sup>79</sup> Worth is to note that Huber and co-authors are one of the first, at least to our knowledge, to introduce the use of spatial econometric techniques in this literature. There are other antecedents on the application of these techniques for studying different location issues; e.g. Coughlin and Segev (1999) who try to explain the pattern of FDI location across China.

<sup>80</sup> These papers by Niebuhr are the published versions of *HWWA Discussion Paper 307* and *HWWA Discussion Paper 330*, respectively.

<sup>81</sup> This is the published version of Redding and Sturm's (2005) *Political Economy and Public Policy Series* paper.

<sup>82</sup> For an updated overview of the spatial econometrics literature, its problems and suggestions for future research see Pinkse and Slade (2009).

applying this approach to empirical NEG, whether such an approach will flourish crucially depends on the availability of data.<sup>83</sup>

**Box 1: A digression on the gravity equation and its application within 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.<sup>84</sup>

As we have pointed out, 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 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.

Nonetheless, as some authors point out, both approaches 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.

**1.4.f- 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

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<sup>83</sup> Nonetheless, the application of theoretically grounded spatial econometrics in NEG studies is yet a debt ... or a dream.

<sup>84</sup> See, for instance Anderson and van Wincoop (2003), Behrens and Thisse (2007) and Behrens *et al.* (2009b).

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 corroborate NEG predictions and, more recently, to exploit natural experiments for analysing spatial phenomena.<sup>85</sup>

In addition, renewed methodologies and strategies have been proposed, showing notable improvements. Nowadays, 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 a 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).

Nonetheless, 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.

### ***1.5. Concluding remarks***

Since Krugman's pioneering works, there has been a revival of research on the geographical distribution of economic activity, in general, and regarding domestic landscapes. Our revision 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 regards empirics and, moreover, policy-oriented regional issues. In what it follows we synthesize our findings.

The NEG framework has successfully evolved thanks to many fruitful contributions and extensions proposed. 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.

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<sup>85</sup> '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 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. Examples of natural experiments are those studied by Bosker *et al.* (2007b, 2008), Combes *et al.* (2008b), Davis and Weinstein (2008), Redding and Sturm (2008), Redding *et al.* (2007), Tirado *et al.* (2009) and Wolf (2007) among others.

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 discussion on the appropriate treatment of alternative cumulative causation processes at different spatial scales, 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 deeper and more insightful treatment of issues which, from a regional perspective, are central.

With reference to empirical literature, this paper 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 are addressed but also and more recently inter- and intra-national transport costs. The challenge now 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.

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# APPENDIX

*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 demand	immobile	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
Haaparant a	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.
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.

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.		
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.
Brühlhart, 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/ <i>Mimeo</i>	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 2)	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)
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)



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.		
Bosker, Brakman, Garretsen & Schramm	2007/ CESifo WP	Many	DS	Iceberg	Alternatively accessibility & size asymmetries	Trade costs Case labour mobility	Partially demand	immobile	IRS/TC + VL	IRS/TC + LM + VL	Reciprocal trade liberalis.	Ambiguous (simulation = domestic agglom.)
Combes & Lafourcade	2008/ mimeo	Many	Cournot	Iceberg	Accessibility, size & CA asymmetries	Trade costs	Partially demand	immobile	IRS/TC + VL + LM		Intra-nat. liberalis.	Ambiguous (simulation = domestic agglom.)
Granato (Chapter 3)	2008/ CAF	Many	DS	Iceberg	Accessibility & CA asymmetries	Trade costs	Partially demand	immobile	IRS/TC + VL		Intra-nat. liberalis.	Ambiguous

Note: The acronyms used are: DS = Dixit-Stiglitz, CA = comparative advantage, IRS = increasing 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
<b>F I R S T P H A S E</b>									
Ades & Glaeser	1995/ QJE	FIRST	Alternative explanations for urban primacy	85 countries	Average 1970-85	Average <b>population</b> 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.
Brühlhart & 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 <b>employmt and trade</b>	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 <b>industry prod. and employmt</b>	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
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 <b>output</b> 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.
<b>S E C O N D P H A S E</b>									
Haaland, Kind, Midelfart-Knarvik & Torstensson	1999/ CEPR	FIRST	TTT, NTT & NEG's predictions	13 European countries	1985 & 1992, 35 indust.	Relative & absolute concent. for <b>production (also employ. &amp; VA)</b>	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

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
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 <b>output</b>	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.
Brühlhart	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 <b>employmt and exports</b>	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.
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 <b>industry production</b>	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 <b>manuf. production value</b>	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.
<b>THIRD PHASE</b>									
Redding & Venables	2004/ JIE	THIRD	NEG's predictions for regional wages	101 countries	1994	1 <sup>st</sup> : Bilateral exports 2 <sup>nd</sup> : Per capita GDP as a proxy for wages	1 <sup>st</sup> : Bilateral distance, border, country/partner dummies (alternatively, GDP & openness). 2 <sup>nd</sup> : Predicted MA & SA and controls for different characteristics.	Econometric analysis: 1 <sup>st</sup> : OLS & Tobit on trade equation → estimates of bilateral transport costs & market/supply capacities. 2 <sup>nd</sup> : 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
<b>FOURTH PHASE</b>									

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Forslid, Haaland, Midelfart- Knarvik & Maestad	2002/ ET	FOURTH	TTT, NTT & NEG (VL)'s predictions	10 world regions (5 European)	1992, 14 indust.	Real <b>income</b> , manuf. <b>exports</b> & <b>imports</b> , sectoral <b>production</b> , <b>wages</b> , 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, geographica l concent. for <b>production</b> , <b>factor prices</b> and <b>welfare</b> .	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
<b>F I R S T P H A S E</b>									
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 <b>employmt</b>	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 <b>employmt</b>	-	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	<b>Welfare</b>	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 <b>value added</b>	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.
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 <b>employmt</b>	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 explained by: natural advantages and intra-industry spillovers. Importance of locating closer to customers.
Brun & Renard	2000/ CERD IWP	FIRST	NTT's predictions	30 regions of China	1988-94, 30 sectors	Isard coefficient of regional special. for <b>value added</b>	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 <b>gross value added</b>	-	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

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 <b>gross regional domestic product, openness &amp; welfare</b>	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: 1° by 1° (longitude/latitude) cells within 128 countries	World: 1990 US: 1900-1930	Spatial Gini coefficient for <b>Gross Cell Product</b>	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
<b>S E C O N D P H A S E</b>									
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 <b>different output variables</b>	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.
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. <b>employmt</b>	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 <b>industrial product</b>	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.
Tirado, Paluzie & Pons	2002/ JEG	SECOND	Trade theories' predictions	45 provinces of Spain	1856 & 1893, 9 sectors	Index of industrial intensity for <b>indust. production</b>	Time period (1856: prior 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
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 <b>employmt and VA</b>	-	Descriptive	High concentration has not decreased. Not obvious relation between concentration and protection.
Wen	2004/ JDE	SECOND	4 hypotheses derived from NEG, after market-oriented economic reforms	30 provinces of China	1993	Regional share in <b>industrial GDP</b>	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 <b>urban population</b> 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 <b>imports &amp; exports</b>	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.
Brühlhart & 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 <b>employmt (value added)</b>	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
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 <b>employmt</b>	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.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
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 <b>consumpt</b>	Trade/GDP, time periods (pre/post rural reform 79), decentralisation & 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 <b>output</b>	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.
Overman & Winters	2006/ CEPR	SECOND	NEG's predictions, after accession of UK to EEC	11 port regions of UK	1970-92, 80 sectors & 54 comms	1 <sup>st</sup> : <b>Employment</b> 2 <sup>nd</sup> : <b>Share of port group in total trade</b> of each good	1 <sup>st</sup> : Import competition, access to intermediates, export markets & idiosyncratic shock 2 <sup>nd</sup> : Share each destination in trade, time trend, dummies for destination.	Econometric analysis 1 <sup>st</sup> : Panel with establishment specific fixed effect, & year dummies 2 <sup>nd</sup> : 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 (Chapter 4)	2007/ AAEP	SECOND	NEG's predictions, period of regional integration	24 provinces of Argentina	1993-2005	Dissimilarity entropy indices for <b>gross manuf. product</b>	Time period (pre- and post-Single Market trend)	Descriptive: measurement and decomposition	Manufacturing disparities increased. MERCOSUR fosters agglomeration in most developed border locations.
Combes, Lafourcade, Thisse & Toutain	2008/ PSE WP	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 <b>population, employment and value-added</b>	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.
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 <b>income per capita</b>	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.



Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Volpe Martincus	2009/ JRS	SECOND	TTT, NTT and NEG predictions	27 states of Brazil	1990 & 1998, 21 manuf. sectors	Share in sector <b>employmt</b>	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.
Sanguinetti & Volpe Martincus	2009/ RSUE	SECOND	NEG's predictions	24 provinces of Argentina	1985 & 1994, 125 manuf. indust.	Share in sector <b>employmt</b>	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	<b>Exports</b>	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.
<b>THIRD PHASE</b>									
Hanson	1996/ AER	THIRD	Model production networks (external economies)'s predictions	32 states of Mexico	1970, 75, 80, 85 & 1988, apparel industry	Regional <b>wage differentials</b> 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.
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. <b>wage differentials</b> 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 <b>employmt</b>	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	<b>Nominal wages</b> 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

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Tomura	2002/ Conf.	THIRD	Economic geography's prediction, period of increasing import shares	47 prefectures of Japan	1985, 90 & 2000, 21 manuf. indust.	Relative <b>employt</b> 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 $\Rightarrow$ less concentration. Local knowledge spillovers and immobile specialized labour affect regional growth. Proximity advantage irrelevant for tradable products
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 <b>wage</b> 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: 1 <sup>st</sup> : NLS and WLS on wage equation. With and without assuming real wage equalisation. 2 <sup>nd</sup> : 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 <b>wage</b> & <b>salary workers</b>	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 <b>wages</b>	Change in intermediate and final exports openness (X/GDP) and interaction terms	Econometric analysis (dynamic panel)	Rising openness $\rightarrow$ rising regional wage differentials $\Rightarrow$ Trade liberalization foster regional divergence. Intermediate goods exports seem to be a driving force.
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	<b>Wages</b>	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	1 <sup>st</sup> : Bilateral regional <b>shipments</b> 2 <sup>nd</sup> : <b>Wages</b>	1 <sup>st</sup> : Bilateral distance, dummy variables (border regions & if receiving and sending regions are the same) 2 <sup>nd</sup> : Predicted MA or SA (constructed from 1 <sup>st</sup> stage).	Econometric analysis: 1 <sup>st</sup> : OLS panel with fixed effects & Tobit on gravity equation $\rightarrow$ regional MA/SA. 2 <sup>nd</sup> : 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 $\Rightarrow$ 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	1 <sup>st</sup> : 111- <b>exports/GDP</b> (country level) 2 <sup>nd</sup> : <b>Gross value added</b> per head of working population	1 <sup>st</sup> : Bilateral distances (population-weighted), dummy variables for common language and for exporters & importers 2 <sup>nd</sup> : Average predicted MA (constructed from 1 <sup>st</sup> stage estimates) or per-year MA. 3 <sup>rd</sup> : Idem 2 <sup>nd</sup> including endowments	Three-stage analysis: 1 <sup>st</sup> : OLS and Tobit on trade equation → estimates of bilateral trade costs & countries' MA. 2 <sup>nd</sup> : OLS & IV on wage equation. 3 <sup>rd</sup> : 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.	1 <sup>st</sup> : Bilateral <b>exports</b> (country level) 2 <sup>nd</sup> : <b>Wages</b>	1 <sup>st</sup> : Bilateral distance, dummy for national borders, language & importers and exporters fixed effects 2 <sup>nd</sup> : Real MP, education attainment	Two-stage analysis: 1 <sup>st</sup> : OLS on industry-, year- and country-specific trade equation → estimates of bilateral trade costs & real MP 2 <sup>nd</sup> : 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.
Paillacar	2007/ <i>Mimeo</i>	THIRD	NEG's predictions for regional wages	27 states of Brazil	1999	1 <sup>st</sup> : Internal, intranational & international <b>trade flows</b> 2 <sup>nd</sup> : Regional and alternatively individual <b>wages</b>	1 <sup>st</sup> : Bilateral distances, dummy for contiguity, border regions & national borders, importers & exporters fixed effects. 2 <sup>nd</sup> : Predicted MP at different spatial levels, schooling & controls.	Two-stage analysis: 1 <sup>st</sup> : OLS and Gamma PML (GPML) on trade equation → estimates of real MP (local, national & international level). 2 <sup>nd</sup> : 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. <b>employt</b>	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 <b>income</b> 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- <b>Wage</b> (& its change) 2- Change in <b>unskilled wages</b> and in <b>skill premium</b>	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. <b>exports</b>	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	2008/ RS	THIRD	NEG's predictions, process of European integration	94 regions of France	1978-2000	<b>Imports</b> 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.
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 <b>wages</b> 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/ ELSNI T	THIRD	NEG & TTT's predictions	Regions of Paraguay and Uruguay	2003-2005, 30 products	<b>Exports</b>	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
Brühlhart, 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: 1 <sup>st</sup> : Econometric analysis (OLS with country fixed effects). 2 <sup>nd</sup> : 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)	1 <sup>st</sup> : Calibration of the model. 2 <sup>nd</sup> : 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/exprt 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.
Brühlhart & 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	1 <sup>st</sup> : Relative nominal wages 2 <sup>nd</sup> : Relative sectoral employmt	1 <sup>st</sup> : Distance, MA (two measures of proximity to the main EU markets), dummy for capital region 2 <sup>nd</sup> : Distance, MA (two measures of proximity to the main EU markets), dummy for capital region	Econometric analysis: 1 <sup>st</sup> : OLS pooled with country fixed effects and by country 2 <sup>nd</sup> : OLS pooled by sector 3 <sup>rd</sup> : 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	1 <sup>st</sup> : Per capita gross value added, alternatively employmt density 2 <sup>nd</sup> : Change in MP	1 <sup>st</sup> : Income, distance & control variables. 2 <sup>nd</sup> : Income in Western European regions, average of estimated coefficients for different years	Two-stage strategy: 1 <sup>st</sup> : Econometric analysis (NLS, IV & SE) 2 <sup>nd</sup> : 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	1 <sup>st</sup> : <b>Compensat per employee</b> 2 <sup>nd</sup> : <b>GDP and wage- growth differentials</b>	1 <sup>st</sup> : Nominal gross VA, distance & controls, EFTA & CEEC-dummy 2 <sup>nd</sup> : Estimated coefficients of within EU15 vs. EU - non EU market potential model	1 <sup>st</sup> : Econometric analysis (OLS, IV & NLSQ on wage equation). 2 <sup>nd</sup> : 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	1 <sup>st</sup> : <b>Wages</b> 2 <sup>nd</sup> : <b>Gross value added</b> (Theil-index inequality)	1 <sup>st</sup> : Distance, mean annual sunshine, mean elevation above sea-level & dummy variables. 2 <sup>nd</sup> : Initial (1992) distribution of GVA & alternative values for distance & substit. elasticity	1 <sup>st</sup> : Econometric analysis (2SLS NLS & IV on wage equation). 2 <sup>nd</sup> : 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	<b>Employmt</b>	- Transport costs, time period. - Estimates of exogenous variables from 1998, & 2010 planned transport costs	- Econometric analysis (TSLS, non-spatial and spatial, IV and FDTLS) - 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
Bosker, Brakman, Garretsen & Schramm	2007/ CESifo WP	FOURTH	NEG's predictions for regional wages	194-NUTSII regions of EU15	1919, 25, 33, 39, 50, 60, 70, 80, 88, 92 & 2002	1 <sup>st</sup> : <b>Wages</b> 2 <sup>nd</sup> : <b>Workers in manuf</b> (Herfindahl index)	1 <sup>st</sup> : Distance & Country dummies. 2 <sup>nd</sup> : Estimated parameters and others calculated. Alternatively, true initial distribution of labor & land.	1 <sup>st</sup> : Econometric analysis (NLS panel data on wage equation). 2 <sup>nd</sup> : 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
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	1 <sup>st</sup> : <b>Per capita gross value added</b> or alternatively <b>employmt density</b> 2 <sup>nd</sup> : Change in <b>MP</b>	1 <sup>st</sup> : Income, distance & control variables. 2 <sup>nd</sup> : Income, average of estimated coefficients, alternative border impediments.	Two-stage strategy: 1 <sup>st</sup> : Econometric analysis (NLS, IV & SE) 2 <sup>nd</sup> : 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.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
Combes & Lafourcade	2008/ <i>Mimeo</i>	FOURTH	NEG's predictions	341 "employment areas" of France	1993, 10 indust.	<b>Labour demand</b>	Calculated technology and preference parameters, nominal wages, cost for a truck to connect any pair of areas..	1 <sup>st</sup> : Econometric analysis (OLS with area & industry fixed effects and IV). 2 <sup>nd</sup> : 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.
Redding & Sturm	2008/ AER	FOURTH	NEG's predictions, after division of Germany (1944-49) & reunification (1990)	119 West German cities	1919-2002	Population growth	1 <sup>st</sup> : Assumed values for three parameters, distance & 1939 distribution of population (taken as equilibrium). 2 <sup>nd</sup> : Time period (before & after division/reunif.), dummies & interaction terms	1 <sup>st</sup> : Calibration of the model and simulation of post-war division (prohibitive transport costs) ⇒ predictions. 2 <sup>nd</sup> : 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
Brühlhart, Carrère & Trionfetti	2009/ <i>Mimeo</i>	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 <b>wages</b> - Annual growth rate of <b>employmt</b>	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	1 <sup>st</sup> : Econometric analysis (Panel with time & location fixed effects) 2 <sup>nd</sup> : 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/ <i>Mimeo</i>	FOURTH	NTT's predictions	30 states of U.S. & 10 provinces of Canada	1993	<b>Merchand. shipments</b>	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.

Author/s	Year/ Publ	Phase	Hypothesis analysed	Countries/ regions	Period & sectors	Variable/s analysed	Indep. variables	Method applied	Results
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.

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).