



Krugman's *Papers in Regional Science*: The 100 dollar bill on the sidewalk is gone and the 2008 Nobel Prize well-deserved*

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Abstract. This paper reviews Paul Krugman's fundamental contributions to new trade theory (NTT) and new economic geography (NEG) on the occasion of his 2008 Nobel Prize. We appraise the impact his work had on the field of regional science broadly defined, and we quantify its influence on papers published in *Papers in Regional Science (PIRS)* between 1991 and 2009 (vols. 70–87 and papers in press). We then discuss in more detail a few contributions published in *PIRS* that extend his original analysis in various directions. Finally, we briefly speculate on where NEG is headed to and which are the research directions that should be explored more thoroughly in the future.

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1 Introduction

If the Chinese calendar had a 'Year of Space', it would most certainly be 2008. This year is, in retrospect, an exceptional year to be remembered by the spatial economic community for various reasons. Several major events occurred during that year, and all of them remind us forcefully that spatial issues are key to understanding how the economy, broadly defined, works.

First of all, housing represents the single most important expenditure item and asset for households throughout the world. The Subprime Mortgage Crisis, and the ensuing decline of U.S. house prices in 2006–07, triggered the worst economic crisis since the Great Depression of 1929. Although a key reason for the depth and severity of that crisis must be sought in the

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financial sector, and in more broadly defined macroeconomic imbalances that have been building up over time, it was nevertheless the decline in house prices that sparked it. The crisis also showed us that housing markets are local in nature and that local risks are difficult to hedge against. Indeed, though the crisis is global, it does not affect all countries or regions equally deeply. According to *The Economist's* house-price indicator, the free-fall of the twelve months leading up to the third quarter of 2008 was most pronounced in the U.S. (−16.6% according to the S&P/Case-Shiller index) and Britain (−13.9%) but did not seem to have hit Hong Kong or Singapore as yet (+14.6% and +8.3%, respectively).¹ Whereas some countries suffer more than others, the impacts of the crisis also display a pattern of strong regional differences within countries. This can be seen from the U.S. east/west divide: with respect to their peak values, house prices which dropped by 31.3% in Las Vegas and by about 18% in California, but by only about 3% in New Jersey. All of this reminds us that location does matter.

Second, on 13 October, 2008, Paul Robin Krugman was awarded the 2008 Nobel Prize in Economic Sciences for ‘his analysis of trade patterns and location of economic activity’. The award of the prize to Krugman has definitely established the New Economic Geography (NEG), which blends aspects of regional science and international economics, as a full member of the selective club of ‘mainstream economics’. While this prize is, in retrospect, certainly the result of the joint efforts of the spatial economics community as a whole over the last two decades, Krugman was beyond doubt the key player in “placing geographical analysis squarely in the economic mainstream” (Krugman 1998, p. 7) and in conferring it the central role it now assumes. In addition, while the Nobel prize was solely awarded for his academic contributions, the now uncontroversial importance of spatial issues in economics was even more due to Krugman’s ability to popularize this complicated theory with the help of easy-to-read books (Krugman 1991c, 1995) and state-of-the-art syntheses (Helpman and Krugman 1985; Fujita et al. 1999b). We note that the Nobel committee has, of course, largely awarded the prize to Krugman also for developing the so-called New Trade Theory (NTT).

Last, pervasive spatial imbalances have also put economic geography at the centre of the policy debate. The European Union’s Structural Funds are an old example. More recently, the World Bank has named its 2009 *World Development Report* ‘Reshaping Economic Geography’. As its title indicates, this report focuses especially on the geographical aspects of uneven international development and the structural changes affecting the space-economy, in particular the challenges of urbanization in developing countries.

Taken together, these three events attest to the fact that spatial issues now uncontroversially belong to the forefront of both economic theory and public policy. Given the foregoing, 2009 seems to be an appropriate year to ponder over where spatial economics is coming from, where we stand, and where we are headed to. Since a myriad of excellent surveys and syntheses on NEG have been published during the last decade, we do not want to add another survey on the origins and ramifications of the discipline to the already long list of existing ones.² Instead, we will briefly discuss what we believe are Krugman’s fundamental contributions to the field of international trade and spatial economics, and how these contributions have affected the research agenda of the community in general and via the papers published in *PIRS* in particular. To this end, the remainder of this essay first summarizes his main contributions and presents some quantitative evidence on their impact on *PIRS*. Then, it briefly discusses how the papers published in *PIRS* between 1991 and 2009 (vols. 70–87) have extended and enriched Krugman’s analyses in various directions. We will also expand a bit more on contributions, published in

¹ However, the housing market in Singapore did slow down *vis-à-vis* the previous year (from +27.6% to +8.3%). In addition, the regions that seem to be the most hardly hit tend also to be those in which house prices grew the most in the past decade (see *The Economist*, ‘Popping Sounds’, 4 December 2008).

² See, e.g., Krugman (1998), Fujita and Krugman (2004), Ottaviano and Thisse (2005), Fujita and Mori (2005), Brakman and Garretsen (2009), Fujita and Thisse (2009), and Redding (2009).

PIRS, that are important to the fields of trade and NEG. Finally, this essay discusses where new economic geography is headed to and which are the avenues that should attract, in our opinion, more research in the future. Needless to say, the selection of *PIRS* papers and the suggested directions for future research necessarily reflect our own subjective views on the topic. We claim, in particular, that the trade theory has already witnessed a post-Krugman revolution but that NEG still awaits the next big push.

2 Trade and geography

Krugman's key contributions are associated with the fields of new trade theory and new economic geography.³ Let us briefly summarize his main works in those two fields by starting with NTT and by showing how NEG naturally grew out of this first research direction.

2.1 Trade

In two by now classic papers, Krugman (1979a, 1980) developed a new theory of international trade that was completely orthogonal to the then dominant paradigm grounded in competitive theory. Starting from the empirical observation that the share of interindustry trade in total world trade steadily declined since the end of the second World War, Krugman developed two 'simple' models of intraindustry trade between similar countries, where trade is neither based on differences in technologies (Ricardian) nor on differences in relative factor endowments (Heckscher-Ohlin). His key contribution is to embed a tractable general equilibrium model of imperfect competition, based on previous work by Dixit and Stiglitz (1977), into a trading world.⁴ In this framework, firms produce differentiated product varieties under internal increasing returns to scale. When countries are allowed to trade, each country specializes in a limited range of varieties in order to take advantage of the increasing returns, and exchanges them for the products produced by the other countries. Trade thus naturally leads to specialization, expands consumers' choice sets and increases efficiency by allowing firms to move down their average cost curve through longer production runs. Although the 'constant elasticity framework' proposed by Krugman (1980) and extended in numerous applications is arguably a rather special one, it has allowed the profession to derive deep insights into the workings of trade and the space-economy.⁵

In order to talk halfway sensibly about spatial issues, the frictions that distance imposes on the movements of goods and factors have to be taken into consideration. One of the least well appreciated, yet fundamental, contributions of Krugman's 1980 paper is to add transportation costs to the picture. Most of the neoclassical trade theory until then just compared the autarchic equilibrium (in which trade costs are prohibitive) with the free trade equilibrium (in which trade costs are zero). As argued by Deardorff (1984, p. 470), "like frictions in physics, transport costs are almost universally ignored in trade models in the sanguine hope that if included they would

³ Krugman also significantly contributed to the literature on currency crises and exchange rate fluctuations (see, e.g., Krugman 1979b; Baldwin and Krugman 1989). However, the latter strand of research had only a very limited impact on research published in *PIRS*, totalling just three citations over the period 1991–2009. We hence restrict ourselves exclusively to Krugman's contributions to trade and geography.

⁴ Ethier (1982) contemporaneously developed a similar idea. In Krugman's paper, final consumers have Constant Elasticity of Substitution (CES) preference for varieties whereas in Ethier's, intermediate goods are aggregated with a CES production function into a homogeneous final good. Norman and Lancaster developed similar ideas independently from Krugman at around the same time.

⁵ In his own delightful words, Krugman reminds us that "the generality [of the competitive model] was really spurious. The generality was generality given the big unreasonable assumptions upfront" (Krugman, 2008a).

not materially affect the results". Yet, they do materially affect some important results. For instance, transportation and trade costs are central to the most fundamental result in Krugman's 1980 paper: the *home market effect* (HME).⁶ This result states that, *ceteris paribus*, the country with the larger demand for a good will, at equilibrium, produce a more than proportionate share of that good and be a net exporter of it. Put differently, this finding allows us to validate the Linder hypothesis according to which local demand is a driver for export specialization. Note that this result is not trivial. Actually, Krugman himself thought for a while that it ought to be wrong (in his own words, he sat down to "prove that we do not actually get a Home Market Effect in these models"; Krugman 2008a), and it was only after working carefully through the model's maths that he realized that the HME was a sound and robust theoretical result. Trade costs are crucial to this outcome. Without trade costs markets are not segmented, and without market segmentation firm location is irrelevant. Once trade costs are added to the picture, they interact with scale economies and firms will, other things being equal, settle in the location with the largest access to markets. Thus, at equilibrium, larger markets host either more increasing returns firms, or have higher factor prices, or both. The HME that Krugman uncovered in his 1980 paper and that was refined in Helpman and Krugman (1985) is the distinctive feature common to NTT and NEG. Several researchers have since then exploited this result to discriminate between the neoclassical and the NTT/NEG explanations of trade (Davis and Weinstein 1999, 2003; Head and Ries 2001; Brülhart and Trionfetti 2005). Note that the HME result can be generalized in cases of many varieties (Brülhart and Trionfetti 2005) and many countries (Behrens et al. 2005) and is, therefore, quite robust. When taken to the data, it suggests that patterns of production and trade of about half of world manufacturing output seem to be characterized by increasing returns to scale (Brülhart and Trionfetti 2005).

In our view, Krugman's (1979a, 1980) contributions also provided the shoulders on which the next 'revolution' could stand in the early twenty-first century. In the neoclassical model, 'firms' are immaterial since their equilibrium size is undetermined. By contrast, increasing returns to scale at the firm level play a central role in the NTT. The size of the representative firm then becomes an adjustment variable that pins down profits to zero and that resolves the tension between scale economies and consumers' love for variety. Whereas in Krugman's papers all firms are symmetric, the compilation of firm-level data in the late 1990s in various countries, developed and developing alike, revealed systematic patterns about the export behaviour of firms and systematic differences between exporters and purely domestic firms (e.g., Bernard and Jensen 1999; Tybout 2003; Eaton et al. 2004). For instance, exporters are larger, more productive and more capital-intensive than purely domestic firms. Jean (2002) and Melitz (2003) designed a framework that accounts for the first two facts and show how trade liberalization increases aggregate productivity by having the worst firms shutting down (in Melitz's model only), the best of them self-selecting into export markets, and by reallocating market shares towards the most productive firms (in both models).⁷ The conceptual breakthrough in these models is to move away from the representative firm framework and to model productivity heterogeneity explicitly *à la* Hopenhayn (1992). The link between Krugman's original 1980 model and Melitz's 2003 paper is crystal clear: the Melitz model (almost) boils down to a Krugman model when each firm is replaced by a 'fictional firm' that has the economy's average productivity.

This twenty-first century revolution, which puts the firm at the centre of trade theory, had a second avatar. It starts from the fact that trade data also reveals that about two thirds of world trade has one multinational firm at either end of the transaction, and that one third of world trade

⁶ Trade costs have also begun to play a more central role in classical trade theory (see, e.g., Dornbusch et al. 1977; Eaton and Kortum 2002; Rossi-Hansberg 2005), yet remain often of secondary importance.

⁷ The two models were developed independently and are quite similar. However, Jean's (2002) model lacks the 'exit' margin of adjustment that is present in Melitz (2003).

is intra-firm (for a lucid synthesis of the literature, see Markusen 2002). Accordingly, another strand of the literature extends trade theory in the direction of the property-rights theory of the firm (Grossman and Hart 1986; Hart and Moore 1990) to study how foreign direct investment and import decisions interact with one another (Antràs 2003; see Antràs and Rossi-Hansberg 2008, for a review). Finally, the renewed academic interest for offshoring helps understand some important positive and distributive effects of intra-firm and arm's length trade patterns alike (Grossman and Rossi-Hansberg 2008).⁸

These two recent breakthroughs in international trade, sometimes referred to as the 'new NTT' and possibly as important as the NTT itself, stand on the shoulders of Krugman and other giants in the field. They would not have been possible without Krugman's seminal contributions, which allowed us to deepen our understanding of trade by showing that:

- increasing returns and product differentiation are a source of intra-industry trade. This type of trade gives rise to additional gains, which can offset the Stolper-Samuelson effects (Krugman 1981; see Helpman and Krugman 1985, for a synthesis).
- large countries offer a locational advantage via the interactions of increasing returns, market size and trade costs. The HME has become the analytical basis on which most empirical applications of NTT and most of the subsequent NEG literature are built.
- solid micro-foundations for gravity equations can be derived (among others) from the CES model, which allowed a breath of new life into the empirical trade literature trying to quantify trade frictions and to explain the pattern of trade flows.
- NTT served to pave the way for the 'new NTT' which adds firm-level heterogeneity and issues pertaining to firms' boundaries and organizational choices to the picture.

2.2 Geography

New economic geography quite naturally grew out of the new trade theory. The HME result established by Krugman launched NEG as the basic building block for the whole subsequent literature that explains agglomeration as the outcome of the interaction of increasing returns, trade costs and factor price differences. Although the step from NTT to NEG was, in retrospect, a small one, it took Krugman 11 years to actually take it. By doing so, Krugman managed to unify trade and location theory, an endeavour that many people had nurtured before him without ever succeeding in doing so. He also provided a first answer to the thorny question of why some countries or regions are much more abundant in capital than others. As is well known, traditional Heckscher-Ohlin theory squarely fails to explain the uneven distribution of capital across space; rather, it assumes it. NEG, on the contrary, provides a powerful explanation of the uneven spatial distribution of factor endowments. This contribution is as crucial as modelling the economic determinants of technical progress in growth models (as in Romer 1986, 1990; Grossman and Helpman 1991; Aghion and Howitt 1992) rather than simply assuming it.

In Krugman's own words, this passage from NTT to NEG was "obvious in retrospect; but it certainly took me a while to see it. Why exactly I spent a decade between showing how the interaction of transport costs and increasing returns at the level of the plant could lead to the 'home market effect' and realizing that the techniques developed there led naturally to simple models of regional divergence (Krugman 1980, 1991a and c) remains a mystery to me. The only good news was that nobody else picked up that \$100 bill lying on the sidewalk in the interim."⁹ Unfortunately for us, that 100 dollar bill is definitively gone. Luckily, it has transmogrified into a well-deserved Nobel Prize.

⁸ See also Robert-Nicoud (2008) for a study of the effects of offshoring in a NEG framework.

⁹ Krugman (1999) "Was it all in Ohlin?" Available at URL: <http://web.mit.edu/krugman/www/ohlin.html>

Table 1. Citations of Krugman's works (all journals)

Title	Year	Journal	Citations
<i>Ten most cited papers</i>			
Increasing returns and economic geography	1991	<i>Journal of Political Economy</i>	857
Model of balance-of-payment crises	1979	<i>Journal of Money, Credit and Banking</i>	457
Scale economies, product differentiation, and the pattern of trade	1980	<i>American Economic Review</i>	417
Increasing returns, monopolistic competition and international trade	1979	<i>Journal of International Economics</i>	371
The myth of Asia's miracle	1994	<i>Foreign Affairs</i>	332
Globalization and the inequality of nations*	1995	<i>Quarterly Journal of Economics</i>	279
A reciprocal dumping model of international trade*	1983	<i>Journal of International Economics</i>	240
History versus expectations	1991	<i>Quarterly Journal of Economics</i>	169
Model of innovation, technology-transfer, and the world distribution of income	1979	<i>Journal of Political Economy</i>	165
Intra-industry specialization and the gains from trade	1981	<i>Journal of Political Economy</i>	153
<i>Other economic geography papers</i>			
Trade policy and the Third World metropolis*	1996	<i>Journal of Development Economics</i>	85
What's new about the New Economic Geography?	1998	<i>Oxford Review of Economic Policy</i>	85
First nature, second nature and metropolitan location	1993	<i>Journal of Regional Science</i>	68
History and industry location – the case of the manufacturing belt	1991	<i>AER P&P</i>	67
When is the economy monocentric? Von Thünen and Chamberlin unified*	1995	<i>Regional Science and Urban Economics</i>	65
On the number and location of cities	1993	<i>European Economic Review P&P</i>	63
Integration, specialization and adjustment*	1996	<i>European Economic Review P&P</i>	60
Space: The final frontier	1998	<i>Journal of Economic Perspectives</i>	59

Sources and notes: Data from ISI Social Science Citation index (Thomson Reuter), accessed on 27 and 28 January 2009. The list includes single authored and co-authored academic journal articles (*), yet excludes the monographs. We only report the 10 most cited papers, as well as the papers dealing with spatial topics and having received to date at least 50 citations.

It should be clear by now that NTT and NEG are closely related and share the same methodological and conceptual framework. Whereas the former focuses on the patterns of trade taking the initial distribution or factor endowments as given, the second focuses on the case where factor endowments change as they re-allocate across countries and regions in response to trade-driven incentives. Krugman's contribution which launched the field of NEG is his seminal paper "Increasing returns and economic geography" (Krugman 1991a).¹⁰ As can be seen from Table 1, by early 2009, this paper totalled 857 citations, almost twice as many as his second-most cited paper. On top of that, Krugman states that this paper is "the love of my life in academic work" (Krugman 2008b).

The key features of Krugman's 1991a and c 'core-periphery' (CP) model are the following (see Baldwin et al. 2003): HME and HME magnification; circular causality; endogenous asymmetry; catastrophic agglomeration; locational hysteresis; overlap and self-fulfilling expectations; and hump-shaped agglomeration rents.

We have already extensively commented on the HME. Yet, one additional finding is of importance. Indeed, it turns out that the HME is magnified by low trade and transportation costs

¹⁰ Edward Glaeser praised Krugman's paper as being "the first article that provides a clear, internally consistent mathematically rigorous framework for thinking simultaneously about trade and the location of people and firms across space. It is one of only two models that I insist that Harvard's Ph.D. students in urban economics be able to regurgitate, equation by equation." (Edward L. Glaeser, 'Honoring Paul Krugman', available online at URL: <http://economix.blogs.nytimes.com/2008/10/13/honoring-paul-krugman/>).

(see Head and Ries 2001, for an empirical application of this idea). The underlying intuition is that when trade or transportation costs are prohibitive then firms will locate in all markets more or less in proportion to each market's size. When trade or transportation costs fall, however, some firms will re-locate to the largest markets and/or those that are centrally located so as to exploit scale economies and access to consumers. In other words, location becomes relatively more important, not less, in an increasingly interconnected world. The world is not flat. Distance is alive, and kicking.

The key distinction that sets apart NEG models from NTT is that the spatial distribution of demand is exogenous in the latter and endogenously determined at equilibrium in the former. This is because income is embodied in mobile factors of production in NEG models but is disembodied in NTT models (e.g., Flam and Helpman 1987; Martin and Rogers 1995). Therefore, large markets attract a large number of firms, and markets that have a large number of firms are larger: the causality is circular. In less colloquial terms, the sectoral mobility of workers (Faini 1984; Venables 1994, 1996; Krugman and Venables 1995), the migration of entrepreneurs (Forslid and Ottaviano 2003) or of skilled workers (Krugman 1991a), the local accumulation of capital (Walz 1996; Baldwin 1999) or the de-location of firms (Robert-Nicoud 2006) magnify initial size differences under some conditions. To see this, take a two-region economy, with one region being endowed with 60% of the population. By the HME and the segmentation of markets, the larger region will initially host, say, 70% of manufactures. Each manufacturing firm is run by entrepreneurs, uses intermediate inputs and employs workers and capital: if primary factors can migrate or accumulate and take their income with them, as the NEG assumes but the NTT does not, then the resulting market size difference is even larger and the cycle repeats.¹¹ A corollary of this circular causality is that arbitrarily small initial regional differences, or locational 'historic mistakes', might build up into sizeable differences in the long run. As a result, two initially identical regions might end up having very different outcomes (endogenous asymmetry). South Korea and the Philippines had a very similar level of development fifty years ago but are now worlds apart (Puga and Venables 1996). It may be that one region ends up being industrialised while the other loses all its industry. This form of catastrophic agglomeration is called a 'sub-critical bifurcation' in the mathematical jargon. It also means that a temporary shock might have permanent effects (locational hysteresis) and that equilibrium multiplicity is present, giving rise to self-fulfilling expectations (Krugman 1995; Matsuyama 1995; Baldwin 2001).

Krugman's (1991a) original CP model has triggered a myriad of follow-up contributions and extensions. Summarizing all of them is a daunting task beyond the scope of this short review, which prompts us to be selective.¹² Many papers have shown that, when one augments the model for heterogeneity among agents (Murata 2003), or adds dispersion forces like congestion costs (Helpman 1998; Tabuchi 1998), or endogenous transport costs (Behrens et al. 2009), or imperfectly elastic local factor supplies (Krugman and Venables 1995), then the bifurcation becomes super-critical.¹³ Super-critical bifurcations do not rule out equilibrium multiplicity and the

¹¹ Against these agglomeration or centripetal forces, the simplest NEG models display some market crowding, a dispersion or centrifugal force. Loosely speaking, each spatially concentrated firm has a smaller market share. The tension between the agglomeration and dispersion forces boils down to weighing the advantages of being a small fish in a large bowl against being a large fish in a small bowl.

¹² Let us mention that Krugman used mostly numerical simulations in his 1991 paper. Puga (1999) provided an analytical expression for the 'break point', a key qualitative property of the model. Mossay (2006) shows that the short-run equilibrium exists and is unique, Robert-Nicoud (2005) establishes the properties of the long-run equilibrium (showing formally the scope for location hysteresis and catastrophic agglomeration) and ranks the 'break' and 'sustain points'. Finally, Robert-Nicoud (2005) and Ottaviano and Robert-Nicoud (2006) together show that all the simple NEG models are isomorphic, namely, the qualitative properties of the location equilibrium do not depend on the transmission mechanism for agglomeration economies (migration, factor accumulation, input-output linkages). The normative properties of the CP model have been analysed in Charlot et al. (2006).

¹³ In a very recent paper, Berliant and Kung (2009) show that the sub-critical bifurcation result is a theoretical peculiarity that is not robust to multidimensional comparative statics exercises.

resulting possibility of location hysteresis and self-fulfilling expectations. Yet, they imply that agglomeration proceeds smoothly, which is important if one is to take NEG-type models to the data. Davis and Weinstein (2002, 2008), for example, exploit the not-so-natural experiment of the bombing of Japanese cities during the Second World War to test for location hysteresis. They find that this temporary shock had a permanent effect on neither the growth path nor the industry composition of Japanese cities. By contrast, Redding and Sturm (2008) find that the division and reunification of Germany in the second half of the twentieth century, both temporary shocks, did have a permanent effect on German cities, especially those close to the border that cut across the country for four decades.¹⁴ Locational hysteresis has crucial consequences for (regional) policy. First, it implies that a temporary policy – including temporary mistakes – may have long-run effects. Second, it implies that once the economy is locked in a spatial equilibrium configuration, small policies that used to work become ineffective. The fact that there is high persistence in the ranking of European regions by incomes per capita or unemployment suggest that this might be more than a theoretical curiosity (Puga 2002).

Finally, let us point out that Krugman's contribution has also influenced fields that, a priori, seem not to be directly related to economic geography. The tax competition literature constitutes a nice illustrative example. Building on the observation that core-periphery equilibria, whereby manufactures are spatially concentrated in a single location, are corner solutions, the circular causation mechanism that causes such outcomes to arise creates agglomeration rents. As a result, these rents can be taxed away at the corner equilibrium without inducing the mobile tax base to move out. The striking result there is that tax competition might induce a race-to-the-top. This contrasts sharply with the race-to-the-bottom result of neoclassical models.¹⁵

To summarize, Krugman's seminal contribution to NEG allows us to:

- understand how market size influences location choices, yet how location choices may influence market size (forward and backward linkages). Because of self-sustaining circular processes, multiple equilibria may arise.
- understand why historical accidents matter and why location patterns may be extremely persistent. This is a valuable lesson for regional policy, yet it tends to be too often forgotten in the policy debate.
- revisit location theory in general equilibrium and connect it to international trade theory. For the first time, we can think about the location of firms and demands in a unified framework, where it is clear 'where the money comes from and where the money goes to'.
- extend the NEG analysis in many directions, including fields which seem remote from spatial considerations. Yet, one should keep in mind that almost all economic issues have at least some spatial dimension, which bodes well for the bright future that NEG should still have in the years to come.

2.3 *It wasn't all in either Ohlin or von Thünen*

To sum it up, although Krugman's contributions may seem 'simple' with hindsight, they are profound and not readily understandable by people without formal economic training. As Edward Glaeser put it squarely, "Krugman's fame as a public intellectual should not lead anyone to think

¹⁴ See also Bosker et al. (2007).

¹⁵ Kind et al. (2000), Ludema and Wooton (2000) and Baldwin and Krugman (2004) all exploit this property to revisit the tax competition literature. See Krogstrup (2008) for a synthesis. It is worth mentioning that any type of rent may serve to alleviate the race-to-the-bottom. For example, in Behrens and Picard (2008), firms may endogenously choose to go multinational, which creates 'organizational rents' that may be taxed away without triggering full de-location of firms.

that they understand his contributions to economic research just because they regularly read his columns".¹⁶ While this is certainly true, one of Krugman's most obvious talents and special strengths is to popularize and to vulgarize the field by making profound ideas 'easily' understandable. The famous physicist Stephen Hawking was once told by his editor that for every equation he included in his books, he would cut his readership by half. Eventually, Hawking (1988) decided to only include a single equation, namely $E = mc^2$ in his bestseller *A brief history of time*. Just like him, Krugman writes in a field where equations abound. And just like him, Krugman did a wonderful job in making deep ideas understandable to a broader public. He is a 'natural born writer' and, let's admit it, many of us are secretly jealous of his writing skills. The brio with which he achieved this goal can be most clearly seen from his two books *Geography and trade* (Krugman 1991c) and *Development, geography, and economic theory* (Krugman 1995), both of which are, as we will see below, among his most cited works in *PIRS* (and in general).

Let us close this short review by mentioning that success breeds critique, and that part of the complaints are justified. There has, in particular, been strong critique voiced by more traditional economic geographers. Indeed, countless questions have been asked on what is really new in the new economic geography, which is often just dismissed as a "case of mistaken identity: it is not that new, and it most certainly is not geography" (Martin 1999, p. 67). Part of that critique is motivated by methodological considerations as the "strait-jacket of the mathematical mainstream" has rebuffed a lot of potential readers who are a afraid of "the ghosts of maximisation and equilibrium [that] still lurk in the background". While geographers feel uncomfortable about the mainstream economic approach to NEG, the economic mainstream itself has also criticized the new paradigm. In particular, it has asked how general results can be that look most of the time like a "near-impenetrable soup of CES algebra" and must often be derived numerically (Neary 2001). The addition of other NEG models proposing alternative channels through which agglomeration forces operate or alternative microeconomic foundations are useful in attenuating such type of worries.¹⁷ On top of that, as argued by Neary (2001), NEG models have rather rudimentary views of firms, which may limit their usefulness for understanding problems of industry location and change. In our view, this is still an under-developed area of research.¹⁸ Last, the 'heady prose style' that makes Krugman so attractive to laymen is also not to everyone's taste.

While Krugman himself directly asked the question "Was it all in Ohlin?" (Krugman 1999) when thinking about NTT, Masahisa Fujita indirectly raised a similar question "Was it all in von Thünen?" when thinking about NEG (Fujita and Krugman 2002). Whatever the answers to these questions may be, in our view Krugman's NEG theory is more than a brilliant synthesis of Ohlin and von Thünen. Instead, it is fair to summarize our brief survey so far by saying that there are plenty of new findings and methods in both NTT and NEG. This belief was apparently shared by the Nobel committee.

3 A Nobel legacy

3.1 Quantitative overview

To get a feeling for how important Krugman's work has been for research published in *PIRS*, we first present some quantitative evidence on the impact his writings had in terms of citations. To

¹⁶ Op. cit.

¹⁷ See Robert-Nicoud (2005) and Ottaviano and Robert-Nicoud (2006) on the former theme and Ottaviano et al. (2002) and Behrens et al. (2009) on the latter.

¹⁸ Duranton and Puga (2005) study the shift in the pattern of specialization of cities. They provide evidence that cities increasingly specialise by function, not sectors, and suggest that a NEG-like mechanism is at work. Defever (2006) studies the functional specialization of vertical FDI in Europe whereas Gaschet (2002) and Rossi-Hansberg et al. (2009) study the functional specialization within cities, namely, of suburbs and central business districts.

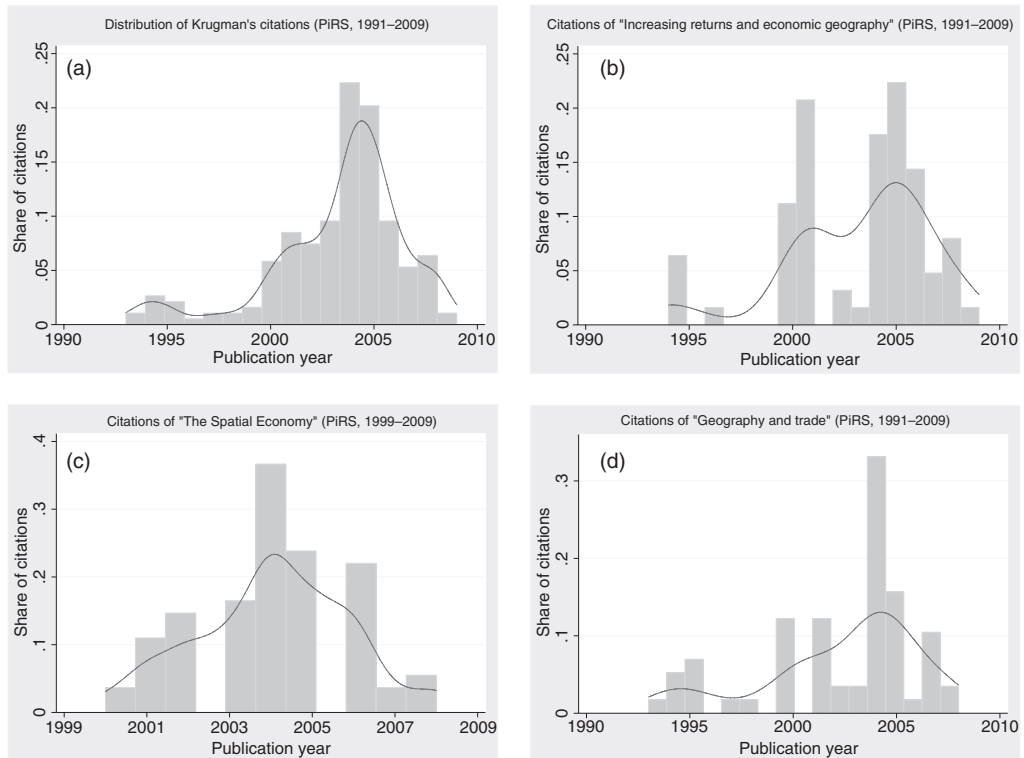


Fig. 1. Distribution of citations to Krugman's papers in *PIRS*. (a) All citations; (b) Citations of 1991a; (c) Citations of 1999; (d) Citations of 1991c

do so, and to focus mainly on the NEG aspects of his work, we have identified all citations to Krugman in papers published in *PIRS* after his 1991 *Journal of Political Economy* paper came out. This yields a set of 93 papers that totalled 200 citations to Krugman's works. Figure 1(a) depicts the yearly distribution of citations to Krugman between 1991 and 2009.

As can be seen from Figure 1(a), the bulk of citations is concentrated over the five year period 2001–2006, with a marked spike in 2004–2005.¹⁹ This general pattern persists even when breaking down the citations according to the most cited works of Krugman. As can be seen from Table 2, three monographs (Krugman 1991c, 1995; Fujita et al. 1999b) top the list, as well as the seminal *Journal of Political Economy* paper. When taken together these four works account for more than half of Krugman's citations in *PIRS*.

Figures 1(b)–1(d) depict the year-by-year citation patterns for his top three cited works in *PIRS*. By comparing with Figure 1(a), we can see that the general pattern looks the same: after an initially calm period, citations pick up at a faster pace after 2000, with a spike around 2004–2005 and a decreasing phase since then.

A rough breakdown of the papers in *PIRS* according to how many distinct works of Krugman they cite is also in structive. There are 47 papers citing Krugman once, 18 papers citing him twice, 17 papers citing him thrice and, finally, 11 papers citing him more than 3 times. The number of distinct citations to Krugman, per paper citing him in *PIRS*, has also slightly

¹⁹ Part of the spike is driven by two survey papers (Fujita and Krugman 2004; Fujita and Mori 2005), who account for 12 and 18 citations, respectively. However, even by excluding these two papers, the spike remains.

Table 2. Citations of Krugman's works (*PIRS* only since 1991)

Title	Year	Journal/Publisher	Citations
<i>Five most cited works</i>			
<i>The Spatial Economy: Cities, Regions and International Trade</i>	1999	MIT Press, Cambridge, MA	33
<i>Geography and Trade</i>	1991	MIT Press, Cambridge, MA	31
<i>Increasing returns and economic geography</i>	1991	Journal of Political Economy	28
<i>Development, Geography, and Economic Theory</i>	1995	MIT Press, Cambridge, MA	12
Trade policy and the Third World metropolis*	1996	<i>Journal of Development Economics</i>	6
Total citations in <i>PIRS</i>			200

Sources and notes: Authors' own source. The list includes both academic journal papers and monographs. This citation information covers the years 1991–2009 (*PIRS* vols. 70–87 and papers in press as of 28 January 2009).

increased over time. Whereas the average publication date of papers citing him once was around May 2002, that of papers citing him more than three times was around August 2003.

Turning to their content, the papers published in *PIRS* and based on initial contributions by Krugman, can be roughly classified into several broad categories as follows:

First, two syntheses and surveys of NEG in general are provided by Fujita and Krugman (2004) and Fujita and Mori (2005). Furthermore, Polenske and Hewings (2004), Cheshire and Malecki (2004), Waldorf (2004), Arbia and Fingleton (2008) provide additional surveys on various related topics, whereas Combes et al. (2005) propose a unified treatment of urban economics and NEG. The more topical contributions, partly based on Krugman's works, may be classified as follows:

3.1.1 Integration, divergence and convergence

From the very beginning, Krugman's contributions were perceived as offering a useful framework to think about issues of economic integration, regional divergence, convergence, equity and policy (Suarez-Villa and Cuadrado Roura 1993; Abraham and Van Rompuy 1995; Hansen 1995; Bhatta and Lobo 2000; Lanaspá-Santolaria et al., 2002; Le Gallo and Ertur 2003; Dall'èrba and Le Gallo 2008; Bande and Karanassou 2009; Bosker 2009), as well as the potential impacts of the European Monetary Union (Abraham and van Rompuy 1995). His international trade contributions also partly revitalized the analysis of the regional effects of the North American integration process, for example, the Canada-US border effect (Brown and Anderson 2002; Coughlin and Wall 2003). His analysis has further been extended to investigate the important issue of unemployment disparities across regions (Südekum 2005; Wheeler 2007). In general, a lot of analyses dealing with the spatial aspects of economic restructuring and changes in the spatial allocation of production and population have drawn, quite naturally, upon his work (Mur and Trivez 1998; Park 2000; Blien and Wolf 2002). The interactions between trade policy and regional inequalities is also a topic that has benefitted from Krugman's original work, especially for assessing how deeper economic integration at the national level may impact on the economic geography within countries involved in this process (Paluzie 2001).²⁰ The usefulness of Krugman's framework for dealing with these interrelated regional issues can be clearly gauged from how many papers in *PIRS* have dealt with these questions since 1991.

²⁰ See also Krugman and Livas Elizondo (1996), Monfort and Nicolini (2000) and Behrens et al. (2007).

3.1.2 Extensions of his models

The basic CP model is based on strong assumptions, some of which have been relaxed in subsequent work. First, one of the least desirable aspects of Krugman's model when it comes to more applied work is that there exist no stable asymmetric equilibria. However, such equilibria can be obtained when transport costs are allowed to vary with the regional population distribution (Lanaspa and Sanz 2001). Bridging the substantial gap between transport economics and NEG, which have to date evolved in a quite unconnected way, appears to be an important item on the research agenda (Glaeser and Kohlhase 2004; Rietveld and Vickerman 2004). The main reason for this is that transport costs (together with factor mobility) are the single most distinctive feature of NEG models, and as such their changes over time and space should be explained rather than just assumed. Several contributions in *PIRS* have also highlighted the potential payoffs to a better modelling of spatial frictions and transportation infrastructure in general (Glaeser and Kohlhase 2004; McCann and Shefer 2004; Behrens 2006; see Shefer and Aviram 2005, for an empirical analysis). Note also that, in the same line of thought, several contributions have investigated whether redispersion obtains for low trade costs when either congestion costs (Alonso-Villar 2008) or pollution (Hosoe and Naito 2006) are added to the model.²¹ Second, Krugman's models have been extended to continuous space (Arbia 2001) or to more than two regions (Simonen 2006), both of which are very important from an applied point of view.²² Last, there have been some extensions of Krugman's model to a more careful modelling of the background *A*-sector by, for example, allowing for negative external effects of manufacturing on the *A*-sector (Hosoe and Naito 2006).

3.1.3 Cross fertilization

Krugman's contributions also had a profound impact on fields not directly associated with regional science in general. In particular, as can be seen from the publications in *PIRS*, he influenced the fields of urban economics and growth. The importance of space in growth phenomena has been increasingly recognized as of late (Fingleton and Lopez-Bazo 2006; Naudé and Krugell 2006). In particular, there may generally be a conflict between equity and efficiency, channelled by growth (Dupont 2007). It is worth pointing out that spatial econometric techniques are now more often used to estimate growth and NEG models with spatial spillovers across regions, a point we will come back to in what follows.²³ Krugman's analysis also had a significant impact on certain aspects of urban economics, where the formation of centre and sub-centres could be modelled using the same techniques.²⁴ NEG has then been applied to more urban issues, for example, to explain the size of primate cities or urban giants in developing countries (Dascher 2002; Candeau 2008). Finally, see Gaschet (2002) on suburbanization and the functional specialization of cities.

3.1.4 Empirical work

Though Krugman himself has not, to our knowledge, published empirical work, his framework has quite naturally been used to revisit several empirical questions. One of the most useful

²¹ See also Krugman and Venables (1995), Helpman (1998) and Tabuchi (1998).

²² Krugman (1993), Fujita and Krugman (1995), Behrens et al. (2005) and Stelder (2005).

²³ Ertur and Koch (2007).

²⁴ Strictly speaking, the original works in this field are Ogawa and Fujita (1980), and Fujita and Ogawa (1982). These two analyses rely on external effects. Abdel-Rahman and Fujita (1990) use the monopolistic competition framework to explain the existence of urban centres through market mechanisms.

contributions derived from Krugman's trade theory is to provide more solid micro-foundations for the gravity equation. Gravity has always been of interest to regional scientists (Isard 1999), and that gravity equations can be derived from his NTT models was soon recognized. A natural application is then to use gravity to estimate border effects and the impacts of trade integration (Brown and Anderson 2002), and how regions are linked by the channels of trade (Polenske and Hewings 2004). A key finding is that market access matters for industry location and wages (He 2003).²⁵

Another aspect that is worth mentioning and that can be seen from the papers published in *PIRS* is that the links between NEG and spatial interaction/networks/spatial data analysis/spatial econometrics have since long been 'in the air' (Ying 2000; Johansson and Quigley 2004; Arbia and Fingleton 2008; Ciriaci and Palma 2008; Dall'Erba and Le Gallo 2008; Yu and Wei 2008). Quite surprisingly, Krugman's work has been extensively cited in papers related to the more general concepts of 'externalities', 'spatial spillovers', 'knowledge spillovers' and 'spatial dependence' (Anselin et al. 2000; Bade and Nerlinger 2000; Breschi and Lissoni 2001; de Groot et al. 2001; McCann and Simonen 2005; Englestoft et al. 2006; Acs et al. 2007; Maggioni et al. 2007), though Krugman's theory is essentially silent on pure external effects and not well-suited to the analysis of spatial dependence as it deals, in its basic form, with just two spatial entities. Opening the black-box of externalities is desirable (Autant-Bernard et al. 2007), and one advantage of NEG is that the external effects are channelled by the market.

Krugman's contribution also influenced papers dealing essentially with issues of spatial interdependence and the question of how cores and peripheries interact, and how far those interactions extend (e.g., how are population changes transmitted and how do they influence core-hinterland relationships; see Barkley et al. 1995). Furthermore, the debate on the existence or not of 'agglomeration shadows' and 'cannibalization effects' has been partly sparked by Krugman's work (see Behrens and Robert-Nicoud 2008 and Partridge et al. this issue).

Let us finally mention that although many empirical contributions refer to Krugman's works, there are to date only very few direct tests of NEG (see, e.g., Lanaspá-Santolaria et al. 2002, and to a lesser extent He 2003, on econometric evidence for the re-dispersion effect in Krugman and Venables 1995). There are, in particular, only few 'tests' of NEG against alternative models (see Fingleton 2005). More work is called for here and this is maybe the single most important future research direction.

3.2 Some selected contributions

Let us briefly expand on a few selected contributions to *PIRS* that have extended Krugman's original work into various directions.²⁶

In *The new economic geography: Past, present and the future*, Paul Krugman and Masahisa Fujita (2004) provide a lucid retrospective about how NEG was born, where it comes from, what the state-of-the-art is today, and which avenues should be explored further in the future. Though the paper is now five years old (it was originally published in the 'Golden Anniversary Issue' of *PIRS*, and on the occasion of Krugman and Fujita sharing the first Alonso Award), it is still required reading for anyone interested in NEG. Who could possibly better analyse the field and provide a retrospective than two *grand maîtres* of NEG themselves? We tried very hard to do so, but we humbly admit our defeat and tip our hats to the masters. When speculating on the future of NEG and exploring its current state-of-the-art, Masahisa Fujita and Tomoya Mori provide the

²⁵ See also Redding and Venables (2004) and Hanson (2005).

²⁶ A compilation of these articles is available online at URL: <http://www.wiley.com/bw/journal.asp?ref=1056-8190> in the Virtual Issue in honor of Paul Krugman's 2008 Nobel Prize in Economic Sciences. Needless to say that the following choice of menu reflects our own preferences.

currently best overview in *Frontiers of the new economic geography*. Fujita and Mori summarize the latest developments and suggest the areas that need to be explored in greater detail. Many of their suggestions coincide, unsurprisingly, with the future research directions we highlight at the end of the present paper.

In *Trade policy and regional inequalities*, Elisenda Paluzie (2001) investigates how the internal geography of a country is influenced by a process of international economic integration. Starting from the observation that inequalities across Spanish regions have been increasing since Spain's accession to the EU in 1986, she develops a three region model in which labour is mobile across the two regions of a country but not mobile between the country and at third region (the rest-of-the-world, ROW). The model follows closely the original set-up by Krugman (1991a and c), but includes three regions as in Krugman and Livas Elizondo (1996). Contrary to that latter paper, where the dispersion force is given by urban congestion costs (a 'push' factor), dispersion is due to immobile dispersed demand (a 'pull' factor). Using numerical examples, Paluzie shows that increasing trade liberalization with the ROW makes full agglomeration within the liberalizing country more likely to occur. Put differently, external integration may trigger internal regional divergence. The other equilibrium properties are as in Krugman (1991a). It is worth pointing out that her result is opposite to the one in Krugman and Livas Elizondo (1996). Hence, trade liberalization with the ROW may have very different impacts on the liberalizing country, depending on whether dispersion forces operate through 'push' or 'pull' factors.²⁷ In the end, this seems to be an empirical question.

In *Multiple equilibria, stability, and asymmetries in Krugman's core-periphery model*, Luis Fernando Lanaspá and Fernando Sanz (2001) show that stable asymmetric equilibria may arise in Krugman's core-periphery model when the iceberg transport costs are allowed to vary with the spatial distribution of population. Their idea that transport costs are not constant is assumed to capture the fact that "small regions with limited industry do not suffer high congestion costs, but neither do they benefit from sufficient infrastructure". The authors assume that unit transport costs are highest when manufacturing activity agglomerates in either one region, whereas they are lowest in the case of dispersion. Once transport costs are allowed to vary with the regional population size in such a way, Lanaspá and Sanz show that stable asymmetric equilibria exist. The intuition is that agglomeration becomes self-defeating as it raises trade costs, which partly offsets the centrifugal force. The key contribution of Lanaspá and Sanz is to show that the functional form of transport costs is crucial for the agglomeration results one obtains. Although this is a crucial first step, they do not unfortunately provide convincing micro-foundations for how and why transport costs should vary in such a way. Much too little attention has been paid to these aspects thus far.²⁸

In *A model of economic geography with demand-pull and congestion cost*, Olga Alonso-Villar (2008) embeds urban congestion costs (affecting consumption) into the analytically solvable model due to Forslid and Ottaviano (2003). By including an additional dispersion force that is independent of transport costs, she shows that the 'bell-shaped pattern' of agglomeration obtains. In other words, agglomeration occurs for intermediate values of transport costs, whereas at either high or low values dispersion prevails.²⁹ Furthermore, stable asymmetric equilibria may exist, and agglomeration proceeds smoothly instead of being catastrophic. These

²⁷ Behrens et al. (2007) obtain results similar to Krugman and Livas Elizondo (1996). In their model, price competition increases with trade liberalization, which pushes domestic firms apart as they seek to relax competition by dispersing internally. Monfort and Nicolini (2000) obtain results similar to Paluzie within a four region Krugman-type framework.

²⁸ The analysis in Lanaspá and Sanz (2001) appears to be the first to recognize, within an NEG framework, that transport costs are not invariant to the spatial distribution of demand. More recent treatments, which model how transport costs are set in the transport sector and vary with the volume of trade across regions include Mori and Nishikimi (2002), Behrens et al. (2007), Behrens and Picard (2008) and Behrens et al. (2009).

²⁹ See also Tabuchi (1998), Puga (1999), Pflüger and Südekum (2008) and Robert-Nicoud (2008).

findings are, in our view, important as the empirical evidence suggests that a process of re-dispersion is currently underway in a certain number of countries, which conflicts with the basic CP model's predictions. Furthermore, we do not usually observe full agglomeration in the real world, which makes this type of model more fruitful as a possible (and much needed) empirical building block (see also Lanaspá and Sanz 2001).

In *Increasing returns and spatial unemployment disparities*, Jens Südekum (2005) introduces efficiency wages in a NEG model. Workers may shirk or prefer to exert costly effort; if they shirk, they may be detected and fired, in which case they enter the pool of unemployed workers looking for a job. Firms may then prevent shirking by paying wages that are high enough to make shirking less attractive than exerting effort. As a result, employed workers do not shirk at equilibrium and the pool of unemployed is fed by the exogenous, random destruction of jobs. Unemployed workers find jobs randomly and the probability of finding a job is decreasing in the unemployment rate. Taken together, both pieces simply state that the equilibrium relationship between the local (regional) wage and the local (regional) unemployment rate is negative (for a given local labour force). As a result, regions that have a higher wage also have a lower unemployment rate. Put differently, spatial inequalities take two dimensions in the model, and one is the flip side of the other. In a striking departure from the neoclassical model due to Blanchflower and Oswald (1994), Südekum then shows that inter-regional labour migration may be an disequilibrating force, as in Krugman (1991a), in which case migration triggers regional divergence of both unemployment rates and incomes. The drawback of Südekum's analysis, however, is that he does not provide a full analytical characterization of the equilibrium. It may then be the case that the industrialised region has lower wages and more unemployment for some parameter values than the rural one at equilibrium.³⁰ However, for other parameter configurations, the industrialised region has a lower unemployment rate and higher wages than the rural one, which accords well with the European Union's spatial inequality patterns that Südekum's model aims to illustrate.

In *Do geographical agglomeration, growth and equity conflict?*, Vincent Dupont (2007) embeds an endogenous growth model into a NEG model as in Baldwin et al. (2003: ch. 7). The source of non-decreasing returns to capital in the aggregate production function is a learning curve in the innovation sector as in, for example, Romer (1990). These spillovers, however, decay over distance, which implies that regional growth rates might diverge. It also implies that the balanced (asymptotic) growth rate is maximized when industry is agglomerated. This mechanism is the source of a potential regional equity-efficiency conflict. When transportation costs are sufficiently low, both regions benefit from agglomeration – but one (the core) benefits more than the other (the periphery). The periphery might benefit from agglomeration because the cost of importing all varieties of the manufacturing good is more than compensated by a higher rate of (nominal) income growth. In addition, individuals have heterogeneous ownership of production factors. Insofar as a higher rate of innovation reduces the private returns to it (i.e., the returns to capital), then agglomeration of manufacturing activities and innovation reduces individual inequality (under the assumption that individuals owning relatively more capital earn an income that is higher than that of individuals owning relatively more labour). The policy implications are stark enough to be worth stressing: policies that seek to redistribute economic activity across space may reduce the rate of innovation in the economy and worsen income inequalities among individuals. It is not unrealistic, but beyond the scope of Dupont's paper, to imagine congestion mechanisms that inverse the relationship between the spatial concentration of manufacturing and the aggregate growth rate. More theoretical and empirical work is needed

³⁰ It is a little-known feature of Krugman (1991a) that the nominal wage is lower in the industrialized region than in the rural one for some parameter values.

here, but Dupont's work clearly cautions policy-makers against unpleasant side effects of active regional policies (see also Dupont and Martin 2006, on this theme).

In *Beyond neoclassical orthodoxy: A view based on the new economic geography and UK regional wage data*, Bernard Fingleton (2005) runs an empirical horse race between a neoclassical growth model and a NEG model to 'explain' regional wage variations in the United Kingdom. He finds that the NEG-blended model has superior explanatory power than the neoclassical model. This vindicates the role of increasing returns to scale and transportation costs in explaining spatial disparities, as emphasized by Krugman's (1991a) model. In related work, Fingleton (2006) shows that urban economic models, in which transportation costs play no role but congestion costs are all too important, perform even better than the NEG model in explaining the British regional wage patterns. These findings suggest what mix of components successful NEG-based empirical models might require.

4 In search of the next revolution

Although NTT and NEG are all about increasing returns, we believe that the pure NEG theory has recently moved into a phase of decreasing returns from a purely scientific perspective. As can be seen from all panels of Figure 1, the number of citations to Krugman's work in *PIRS* declined from 2004–2005 on. While we do not want to speculate on the reasons for this, we believe that it is partly due to the fact that NEG is in search of the next revolution. Such a revolution has, as we pointed out before, already occurred in the NTT, which has developed models of heterogeneous firms that allow for detailed and structural empirical investigation using the increasingly available micro-level databases, and which has started to address the issues of intra-firm trade and of the boundaries of the multinational firm. A similar revolution is yet awaited in NEG, and we conclude this paper by speculating on the research directions that should, in our opinion, be explored more thoroughly in the future.

So far, we have managed to write a survey on the NEG without quoting Marshall (1920). Actually, most papers in the field cite him, often in the first few paragraphs. There are good reasons for this: Marshall proposes a very useful typology that emphasizes knowledge spillovers, labour market pooling and, albeit implicitly, the interaction between increasing returns to scale and local input sharing as sources of agglomeration economies (see Duranton and Puga 2004, for a comprehensive survey). With its emphasis on scale economies and market segmentation (and, therefore, on what constitutes a 'local' market), the NEG clearly falls into the last category. The question as to which of these sources is the most important in explaining location patterns is clearly empirical, yet of fundamental importance. Indeed, a satisfying answer to it is likely to indicate whether or not the mechanisms put forward by the NEG are really important in shaping the space-economy. Ellison et al. (1997), as well as the literature synthesized in Rosenthal and Strange (2004), constitute important steps in this direction. Another field of research concerns the extent of agglomeration economies: do firms and workers benefit from the proximity of other firms' workers that belong to the same industry (localization economies) or the density or size of the city at large (urbanization economies)? Duranton and Puga (2001) propose a model of nursery cities in which urbanization economies are important for innovation but localization economies are a positive determinant of industry productivity in the final stage of the product cycle (mass production). Early empirical evidence provides support for both types of agglomeration economies (Glaeser 1992; Henderson et al. 1995; see Henderson 2005, for a survey) but more recently the case for urbanization economies seems to be less strong (Henderson 2003; Rosenthal and Strange 2003). This raises a puzzle: large cities being typically associated with larger congestion and housing costs, one may then wonder how Tokyo, Mumbai, New York, Mexico City and other very large cities in the world sustain such a diversified

industry mix if the external benefits from co-locating unrelated industries are indeed negligible. Perhaps the reason is related to forces emphasized by the NEG, and a satisfying answer to this question seems warranted.

Another promising field for further research is to disentangle the various causes that can explain the positive relationship between city size or density and earnings (Sveikauskas 1975; Ciccone and Hall 1996). Recent empirical studies that use individual data reveal that the most skilled workers sort themselves into large population centres (see Combes et al. 2008, for French areas; and Bacalod et al. 2008, for U.S. cities). Controlling for individual characteristics weakens the measured elasticity between city size and labour productivity (when labour productivity is measured by average wages, the measured elasticity typically falls into the 3 to 8% range; see Rosenthal and Strange 2004). More interestingly, these data reveal that this elasticity rises with individuals' skill level (Wheeler 2001) and skill type (Bacalod et al. 2008, show that the urban skill premium is largest for individuals with cognitive and people skills). This raises several issues. First, why are agglomeration economies stronger for workers closer to the top of the skill distribution? Second, does sorting and selection reinforce or weaken agglomeration forces?³¹

More work is also needed on the purely empirical front. Up to now, there have been no really conclusive tests on NEG (Head and Mayer 2004). One daunting challenge is to generalize existing models, which are typically two country or two region models, into N -region models in order to test the theoretical predictions of the paradigm appropriately. This point may look minor; it is not. To see why, take the HME again. It predicts that large countries should have a more than proportional share of manufacturing (Davis and Weinstein 1999), irrespective of their location. Switzerland, a small country at the heart of the 'blue banana' in Western Europe, turns out to be more industrialized than equally small African or Eastern European countries. This is because, in an N -country world, the appropriate formulation of the HME predicts that countries with good access to markets should attract a large amount of manufacturing firms and jobs (Davis and Weinstein 2003). However, when bilateral transportation and trade costs are not symmetric, even more subtle effects take place and large neighbours may cast a shadow on smaller ones (Behrens et al. 2005, 2007; Partridge et al. this issue). In short, theoretical predictions that emerge from a simple two country model may not lend themselves easily to empirical testing without complex qualifications. In addition, the gap between NEG and spatial methods for data analysis/spatial econometrics deserves to be narrowed (Fingleton 2008).

Though many researchers, including ourselves, believe that most of the low-hanging fruits of the NEG theory tree have already been harvested, more theoretical work would nevertheless be welcome. This includes, among other things, relaxing "silly but convenient assumptions" and stepping slightly away from "Dixit-Stiglitz, icebergs, evolution and the computer" (Fujita and Krugman 2004: 142). We acknowledge that the current paradigm is largely built on "intellectual cheap tricks, or strategic simplifications, which only an economist could love" (Fujita and Krugman 2004: 150). Several authors have started to respond to Fujita and Krugman's call (2004: 159): "eventually, further advances in the new economic geography depend largely on the ability of the economics profession to develop a more general class of general equilibrium models involving imperfectly competitive markets in space".

Ottaviano et al. 2002 and, building on Behrens and Murata (2007), Behrens et al. (2008) propose alternative models building on monopolistic competition frameworks that differ from Dixit and Stiglitz's. Both individual preferences and the equilibrium market conduct of firms differ in these three models. These are welcome developments, insofar as they reassure us that some of the most novel theoretical results in Krugman (1991a) have some degree of generality,

³¹ Recent theoretical work on selection and agglomeration suggests that the answer is ambiguous (Behrens and Robert-Nicoud 2008). See also Baldwin and Okubo (2006) and Combes et al. (2008).

rather than being the outcome of a collection of insightful examples.³² More work is also needed to understand how the transportation industry works and how it affects the spatial economy. This is an avenue that has started to be explored, but much more needs to be done in this direction.

Finally, NEG models are complicated to work with. For this reason, numerical simulations are often needed. Therefore, we need to better understand and design the calibration exercises (quantified models) in the field. Such exercises allow us to run counterfactual simulations; they are already largely used in macroeconomic models and in international trade (e.g. Eaton and Kortum 2002; Bernard et al. 2003). New economic geography is lagging behind. Since 1991, little progress has unfortunately been made in this direction.

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³² See also Baldwin et al. (2003) and Robert-Nicoud (2005) on this theme.

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Artículos sobre Ciencia Regional basados en Krugman: El billete de 100 dólares en la acera ha desaparecido y el Premio Nobel de 2008 bien merecido

Kristian Behrens and Frederic Robert-Nicoud

Resumen. Con ocasión de su Premio Nobel de 2008, este artículo revisa las contribuciones fundamentales de Paul Krugman a la nueva teoría del comercio (NTT, por sus siglas en inglés) y a la Nueva Geografía Económica (NEG, por sus siglas en inglés). Valoramos el impacto que ha tenido su trabajo en el campo de la Ciencia Regional en su más amplia definición, y cuantificamos su influencia sobre artículos publicados en *Papers in Regional Science* (PiRS) entre 1991 y 2009 (vols. 70-87 y artículos en prensa). A continuación discutimos en más detalle unas pocas contribuciones publicadas en PiRS que amplían su análisis original en varias direcciones. Finalmente, especulamos brevemente sobre adónde se dirige la NEG y cuales son las avenidas de investigación que deberían ser exploradas en mayor profundidad en el futuro.

JEL classification: F12, R12

Palabras clave: Paul R. Krugman, Premio Nobel 2008 en Ciencias Económicas, Nueva Teoría del Comercio, Nueva Geografía Económica

要旨: 本論では、ポール・クルーグマンの2008年ノーベル賞受賞に当たり、同氏の新貿易理論 (new trade theory : NTT) 及び新経済地理学 (New Economic Geography : NEG) に対する基礎的貢献について再検証する。我々は、クルーグマンの研究が広義に定義される地域科学に及ぼした影響を評価するとともに、1991年から2009年にかけて *Papers in Regional Science* (PiRS) 誌で発表された論文 (vol.70-87に発表された論文及び近刊論文) に対する同氏の影響を定量化する。その後、クルーグマンの当初の分析を様々な方向へ拡張させた PiRS 誌掲載論文におけるいくつかの貢献について、より詳細に論じる。最後に、新経済地理学がどの方向に向かっているのか、また、今後より徹底的に探究すべき研究の方向は何なのかについて手短かに考察する。