



CEP Discussion Paper No 925

April 2009

The Empirics of New Economic Geography

Stephen J. Redding

Abstract

Although a rich and extensive body of theoretical research on new economic geography has emerged, empirical research remains comparatively less well developed. This paper reviews the existing empirical literature on the predictions of new economic geography models for the distribution of income and production across space. The discussion highlights connections with other research in regional and urban economics, identification issues, potential alternative explanations and possible areas for further research.

Keywords: New economic geography, market access, industrial location, multiple equilibria
JEL Classifications: F12, F14, O10

This paper was produced as part of the Centre's Globalisation Programme. The Centre for Economic Performance is financed by the Economic and Social Research Council.

Acknowledgements

This paper was produced as part of the Globalization Programme of the ESRC-funded Centre for Economic Performance at the London School of Economics. Financial support under the European Union Research Training grant MRTN-CT-2006-035873 is also gratefully acknowledged. I am grateful to a number of co-authors and colleagues for insight, discussion and comments, including in particular Tony Venables and Gilles Duranton, and also Guy Michaels, Henry Overman, Esteban Rossi-Hansberg, Peter Schott, Daniel Sturm and Nikolaus Wolf. I bear sole responsibility for the opinions expressed and any errors.

Stephen Redding is Director of the Globalisation Programme at the Centre for Economic Performance and Professor of Economics in the Economics Department at the London School of Economics.

Published by
Centre for Economic Performance
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the prior permission in writing of the publisher nor be issued to the public or circulated in any form other than that in which it is published.

Requests for permission to reproduce any article or part of the Working Paper should be sent to the editor at the above address.

© S. J. Redding, submitted 2009

ISBN 978-0-85328-378-2

1 Introduction

Over the last two decades, the uneven distribution of economic activity across space has received renewed attention with the emergence of the “new economic geography” literature following Krugman (1991a). This path-breaking paper was a key part of the citation for Paul Krugman’s 2008 Nobel Prize. Whereas traditional neoclassical explanations for the distribution of economic activity across space emphasize “first-nature geography” (the physical geography of climate, topology and resource endowments), this new body of research stresses instead the role of “second nature geography” (the location of economic agents relative to one another in space).

The core building blocks of new economic geography models are product differentiation modeled through a love of variety assumption, increasing returns to scale and transport costs, which together create pecuniary externalities in agents’ location choices. When combined with either factor mobility or intermediate inputs, these three building blocks give rise to forces of cumulative causation and agglomeration.¹ As workers coalesce in a location, the resulting shift in expenditure increases the incentive for firms to concentrate production in that location (the “home market effect”). Similarly, as firms concentrate production in a location, the resulting reduction in the consumer price index increases the incentive for workers to coalesce in that location (the “price index effect”).

In new economic geography models, the tension between these agglomeration forces and dispersion forces in the form of immobile factors of production or non-traded amenities in inelastic supply determines the spatial distribution of economic activity.² For parameter values for which the agglomeration forces outweigh the dispersion forces, an uneven or core-periphery pattern of economic development can emerge. As new economic geography models typically abstract from first-nature geography by assuming that locations are symmetric, which region becomes a core or periphery is not determined within the model. As a result, a central implication of these models is that for a range of parameter values the distribution of economic activity is not uniquely determined by locational fundamentals but instead exhibits multiple equilibria.

Although a rich and extensive body of theoretical research on new economic geography has now emerged, empirical research remains comparatively less well developed. This paper briefly reviews the existing empirical literature on new economic geography, focusing on areas in which progress has been made and highlighting possible avenues for future inquiry. The discussion is necessarily selective and no attempt is made to be comprehensive.³ The remainder of the paper is structured as follows. In Section

¹In Krugman (1991a,b), geographically mobile manufacturing workers are the source of agglomeration, while in Krugman and Venables (1995) and Venables (1996) tradeable intermediate inputs play this role.

²In Krugman (1991a,b) geographically immobile agricultural workers provide the dispersion force, while Helpman (1998) emphasizes housing’s role as a non-traded amenity.

³For a synthesis of the theoretical literature, see Fujita, Krugman and Venables (2001). For more comprehensive reviews of the empirical literature, see Overman, Redding and Venables (2001) and Head and Mayer (2004).

2, we discuss the relationship between factor prices and market access. In Section 3, we examine the determinants of the location of production. Section 4 concludes.

2 Market Access and Wages

As discussed above, a key implication of love of variety, increasing returns to scale and transport costs is that firms have an incentive to concentrate production close to large markets. In equilibrium, this results in either greater production and/or higher equilibrium factor prices in locations close to large markets.

To derive the implications of new economic geography models for factor prices, consider the Krugman and Venables (1995) model, in which labor is immobile across locations and a monopolistically-competitive manufacturing sector uses tradeable intermediate inputs. A first condition for producer equilibrium is profit maximization, which with constant elasticity of substitution (CES) preferences implies that prices are a constant mark-up over marginal cost. A second condition for producer equilibrium is zero equilibrium profits, which together with profit maximization and a homothetic cost function implies that equilibrium output of each variety is equal to a constant (\bar{x}). Combining this result with equilibrium demand for manufacturing varieties, and summing demand across all locations, the equilibrium price of each manufacturing variety must be sufficiently low that output equals \bar{x} and firms make zero profits. Since prices are a constant mark-up over marginal cost, this in turn implies that equilibrium marginal costs must be sufficiently low given demand in all locations for output to equal \bar{x} and firms to make zero profits. We therefore obtain the following “wage equation” for the manufacturing sector: ⁴

$$\left(w_i^\alpha P_{Mi}^{1-\alpha}\right)^\sigma = \xi \sum_j \tau_{ij}^{1-\sigma} E_j P_{Mj}^{\sigma-1},$$

where i and j index locations; w is the nominal wage; P_M is the manufacturing price index; ξ absorbs constants; τ_{ij} denotes transportation costs such that $\tau_{ij} > 1$ units must be shipped from location i to location j in order for one unit to arrive; E denotes total expenditure on manufacturing varieties, which includes both final consumption and intermediate demand. Intuitively, the wage equation requires that supply equals demand at equilibrium prices, which are a constant mark-up over marginal cost. This wage equation can be in turn re-written in the following more convenient form:

$$w_i = \theta M A_i^{\frac{1}{\alpha\sigma}} S A_i^{\frac{1-\alpha}{\alpha(\sigma-1)}}, \quad (1)$$

where θ is again a constant and:

$$\begin{aligned} M A_i &\equiv \sum_j \tau_{ij}^{1-\sigma} m_j \equiv \sum_j \tau_{ij}^{1-\sigma} E_j P_{Mj}^{\sigma-1}, \\ S A_j &\equiv \sum_i \tau_{ij}^{1-\sigma} s_i \equiv \sum_i n_i (\tau_{ij} p_i)^{1-\sigma} = P_{Mj}^{1-\sigma}. \end{aligned} \quad (2)$$

⁴For a full derivation, see Fujita, Krugman and Venables (2001) or Redding and Venables (2004).

“Market access” (MA_i) measures proximity to sources of market demand, and is defined as the transport-cost weighted sum of “market capacities” (m_j) in each location, where m_j depends on total expenditure on manufacturing varieties (E_j) and the manufacturing price index (P_{Mj}).⁵ “Supplier access” (SA_i) measures proximity to sources of supply of intermediate inputs, and is defined as the transport-cost weighted sum of “supply capacities” (s_i) in each location, where s_i depends on the number of manufacturing varieties (n_i) and their “free on board” price (p_i).

As consumer preferences and intermediate input demands both take the CES form, the value of bilateral trade between each pair of locations can be written as a function of the importer’s market capacity, the exporter’s supply capacity and bilateral transportation costs. In Redding and Venables (2004), bilateral trade flows data are used to estimate market capacity, supply capacity and the determinants of transportation costs, and hence to construct theory-consistent measures of market and supplier access. Consistent with the wage equation (1), these measures of market and supplier access are found to explain a substantial proportion of the cross-country variation in per capita income and manufacturing wages. These findings are robust to including a large number of controls and the estimated coefficients on market and supplier access are consistent with plausible values for the parameters of the model. In more recent work, Mayer (2008) shows that this correlation between per capita income and market access holds not only in the cross-section but also in the time-series.

The assumption of labor immobility in Krugman and Venables (1995) is likely to be more relevant across countries than within countries, and implies that both nominal and real wages can vary across locations. In contrast, in Helpman (1998) love of variety, increasing returns and transport costs generate spatial variation in nominal wages, but labor mobility induces changes in the price of the non-traded amenity such that real wages are equalized across all locations that are populated in equilibrium:

$$\omega_i \equiv \frac{w_i}{P_{Mi}^\mu P_{Hi}^{1-\mu}} = \frac{MA_i^{1/\sigma}}{SA_i^{1-\mu/\sigma} P_{Hi}^{1-\mu}} = \omega, \quad (3)$$

where ω_i denotes the real wage; the nominal wage (w_i) again depends on market access; the manufacturing price index depends on supplier access; and P_{Hi} denotes the price of the non-traded amenity.⁶

Using data on US counties, Hanson (2005) finds a strong relationship between nominal wages and market access. Estimating the structural equation for nominal wages from the Helpman (1998) model yields plausible estimates for the structural parameters of the model, and the theory-based measure of market access from the model is found to have greater explanatory power than traditional *ad hoc*

⁵Head and Mayer (2004) refer to market access as “real market potential” to distinguish it from earlier *ad hoc* measures of market potential such as distance-weighted population. New economic geography models can be viewed as providing micro-foundations for measures of market potential, but emphasize nominal wages and manufacturing price indices as determinants of market potential in addition to transport costs and population.

⁶For a fuller derivation of this labor mobility condition, see for example the web-based technical appendix to Redding and Sturm (2008).

measures of market potential. Using data on regions of the European Union, and exploiting both cross-section and time-series variation, Breinlich (2006) and Head and Mayer (2006) provide further support for the empirical relationship between nominal wages and market access. Using even more finely-spatially-disaggregated data within Indonesia, Amiti and Cameron (2006) confirm the role of economic geography in influencing nominal wages, and exploit data on intermediate inputs to separate market and supplier access.⁷

While there is strong evidence of a clear association between wages and market access, a key challenge for the empirical literature has been to establish that this association is causal. In particular, it is difficult empirically to disentangle the effects of market access from other leading determinants of comparative economic development such as locational fundamentals or institutions.⁸ For example, the prosperity of a group of neighboring regions could reflect good access to one another's markets, but it could equally well reflect common good institutions or common favorable natural endowments.

To empirically disentangle market access from these other leading determinants of comparative economic development, one requires exogenous variation along at least one dimension. One approach is therefore to use instruments for market access, such as lagged population levels or growth rates. However, these instruments require demanding identification assumptions, which are unlikely to be satisfied in practice. For example, institutions and natural endowments are strongly persistent, and hence it is unlikely that lagged population affects economic activity solely through market access.

An alternative approach involves the use of trade liberalizations as a source of variation in market access. In influential work, Hanson (1996, 1997) has used Mexico's trade liberalization of 1985 as a natural experiment that changes the relative market access of regions. Following liberalization, there is evidence of a re-orientation of economic activity within Mexico towards the U.S. border and a shift from domestic production to offshore assembly for foreign (largely US) firms. Consistent with the predictions of new economic geography models, these changes in the location of production lead to a re-orientation of the strong regional wage gradient previously centred on Mexico City towards the U.S. border.⁹ While evidence based on trade liberalizations has bolstered the case for a causal interpretation of the relationship between market access and wages, there remain potential concerns. In particular, a large and influential political economy literature models trade policy as itself an endogenous outcome that could be influenced by market access.

⁷Despite a large empirical literature on the effect of market access on nominal wages, there has been relative little research examining the predictions of new economic geography models for the prices of immobile amenities such as housing. A notable exception is Deckle and Eaton (1999).

⁸Influential proponents of institutions include Acemoglu, Johnson and Robinson (2002), while Gallup, Mellinger and Sachs (1998) emphasize physical geography.

⁹Other studies using trade liberalization as a source of variation in market access include Overman and Winters (2006) for the United Kingdom, Tirado, Paluzie and Pons (2002) for early-twentieth century Spain, and Nikolaus Wolf (2007) for early-twentieth century Poland.

To isolate the role played by market access, Redding and Sturm (2008) use the division of Germany after the Second World War as a natural experiment that provides plausibly exogenous variation in market access. Following German division, those West German cities close to the former border between East and West Germany (“treatment” cities) experienced a disproportionate loss of market access relative to other West German cities (“control” cities). The reason is that these East-West border lost nearby trading partners with whom they could interact at low transport costs prior to division, whereas other West German cities were more remote from the trading partners lost, and therefore already faced higher transport costs prior to division.

The division of Germany has a number of attractive features for isolating the role played by market access. First, in contrast to cross-country studies, there is no obvious variation in institutions across cities within West Germany. Second, there are no obvious changes in natural advantage, such as access to navigable rivers or coasts, climatic conditions or the disease environment. Third, the change in market access following German division is much larger than typically observed in other contexts and the effects can be observed over a long period of time. Fourth, the drawing of the border dividing Germany into East and West Germany was based on military considerations that are unlikely to be correlated with pre-division characteristics of cities.

To examine the implications of German division for the distribution of population within West Germany, the real wage equalization condition (3) in the Helpman (1998) model can be re-written in the following form:

$$L_i = \chi(MA_i)^{\frac{\mu}{\sigma(1-\mu)}} (SA_i)^{\frac{\mu}{(1-\mu)(\sigma-1)}} H_i \quad (4)$$

where we have used the expression for the equilibrium price of the non-traded amenity; H_i is the stock of the non-traded amenity; SA_i is defined as in (3), but is now consumers’ access to sources of supply of manufacturing varieties; χ is a constant that depends on the common real wage across all locations.

The population mobility condition (4) implies that reductions in the relative market access of one set of locations lead to population outflows to other locations until the prices of the non-traded amenities in each location adjust to restore real wage equalization. In line with these predictions, Redding and Sturm (2008) find that the imposition of the East-West German border leads to a sharp decline in population growth of West German cities close to the East-West border relative to other West German cities. Over the forty-year period of division, the East-West border cities experience a decline in their annualized rate of population growth of 0.75 percentage points, implying a cumulative reduction in their relative size of around one third. The model can quantitatively account for the relative decline of East-West border cities and there is evidence against other potential explanations, such as differences in industrial structure, war-related disruption, fear of further armed conflict, and Western European integration. While this paper is one example of empirical research on new economic geography using a natural experiment as a source

of exogenous variation, there remain many issues in this area that could be fruitfully explored using such sources of exogenous variation.¹⁰

3 Location of Production

In addition to their implications for factor prices and the distribution of population, new economic geography models also have predictions for the location of economic activity within industries. Before examining these predictions, a first empirical challenge is measuring the extent to which economic activity in an industry is agglomerated or geographically concentrated. To address this issue, Ellison and Glaeser (1997) develop an index of geographical concentration, in which the observed distribution of economic activity within an industry is compared to a null hypothesis of random location (a “dartboard approach”). Importantly, this index controls for the extent to which economic activity in the industry is concentrated in a small number of plants, since with a small number of plants even random location cannot be expected to produce a regular location pattern.¹¹

As substantial departures from random location have been found for a number of industries and countries, a second empirical challenge is uncovering the determinants of these departures. As shown by Ellison and Glaeser (1997), externalities in location choices and unobserved heterogeneity in natural advantage provide two potential explanations for the geographic concentration of economic activity that are often observationally equivalent. This observational equivalence is in turn related to the more general identification problem in the social sciences of distinguishing spillovers from correlated individual effects (Manski 1995).

One empirical approach to distinguishing externalities from natural advantage has been pioneered by Davis and Weinstein (1999, 2003) and exploits the relationship between expenditure and production in new economic geography models. While neoclassical models imply that an increase in expenditure leads at most to a proportionate increase in production, the home market effect in new economic geography models predicts a more than proportionate response in production because of the relocation of firms and workers. Using data on European regions and OECD countries, Davis and Weinstein (1999, 2003) provide evidence of home market effects in a number of manufacturing industries. These empirical findings open up a number of avenues for further research, including exploiting additional sources of exogenous variation in expenditure, and examining both theoretically and empirically the home market effect in structural models of economic geography with many industries and locations.

In another landmark paper, Davis and Weinstein (2002) use data over a long historical time period

¹⁰Looking beyond new economic geography, Holmes (1998) uses discontinuities at U.S. state borders to examine the impact of state policies, while Holmes and Lee (2008) use institutional features of the distribution of land under the 1862 Homestead Act to estimate externalities in crop planting decisions.

¹¹See Duranton and Overman (2005) for a spatial point pattern approach to measuring geographical concentration that also addresses other measurement concerns, such as spatial scale and the statistical significance of departures from randomness.

for Japan and the natural experiment of Allied bombing of cities during the Second World War to discriminate between theories of increasing returns, random growth and locational fundamentals. Although theories of increasing returns appear to be most relevant after the industrial revolution, there is evidence of substantial dispersion in population density in Japan over a period of 8,000 years. Furthermore, the spatial distribution of population density exhibits substantial persistence over this long historical time period, despite large-scale changes in the nature of production and the economic environment. While theories of locational fundamentals appear to provide the most natural explanation for these findings, the degree of spatial dispersion in population density rises substantially after the industrial revolution, suggesting that theories of increasing returns could be important in accounting for this rise in dispersion.

Perhaps the most stark empirical findings in Davis and Weinstein (2002) are from the natural experiment of Allied bombing, which provides a large and temporary shock to the relative size of Japanese cities. While theories of random growth suggest that large temporary shocks should have a permanent effects on relative city size, those of locational fundamentals suggest that relative city size should gradually adjust back towards some long-run equilibrium level. In contrast, theories of increasing returns suggest that a large temporary shock could have a permanent effect, in so far as it shifts the economy between multiple equilibria. However, despite the magnitude of the shock to relative city size induced by Allied bombing, including the atom bombs dropped on Hiroshima and Nagasaki, Japanese cities return to their relative position in the distribution of city sizes within around 15-20 years.

These findings of a return to pre-existing patterns of economic activity appear inconsistent with theories of random growth and to provide support for those of locational fundamentals. Although the temporary shock of Allied bombing does not have a permanent effect on relative city size, this does not necessarily rule out theories of increasing returns, as there could be reasons why the temporary shock does not in fact shift the economy between multiple equilibria, as discussed further below. Nonetheless, in subsequent work, Davis and Weinstein (2008) show that the spatial distribution of employment in individual manufacturing industries in Japan is also strongly persistent in the face of the Allied bombing shock. Similarly, Brakman et al. (2004) find that the populations of West German cities recover relatively rapidly from the devastation caused by the Second World War, while Miguel and Roland (2006) find little evidence of permanent effects from the large-scale bombing of Vietnam.¹²

The empirical findings of Davis and Weinstein (2002, 2008) leave the empirical economic geography literature with something of a puzzle. On the one hand, there are several anecdotal examples of historical accident apparently having long-lived effects on the spatial distribution of economic activity, which are consistent with multiple equilibria.¹³ On the other hand, if even the large-scale shocks of war-time

¹²In contrast, Bosker, Brakman, Garretsen and Schramm (2007, 2008) find some evidence of a permanent effect of the Second World War on the spatial distribution of economic activity within West Germany.

¹³Perhaps the most famous anecdotal example is Dalton as a carpet manufacturing center in Georgia, as discussed in Krugman (1991b).

bombing cannot shift the economy between multiple equilibria, the empirical relevance of this central feature of new economic geography models appears unclear. Although a key appeal of new economic geography models to policy makers was the possibility for small and temporary policy interventions to have permanent effects on industry location, the absence of such effects from war-time bombing calls into question the feasibility of their achievement through policy interventions of economically plausible magnitudes.

While war-time bombing is an ingenious source of a large and temporary shock, there could be reasons why this shock does not shift the economy between multiple equilibria. The shock of war-time bombing is relatively short-lived, yet location decisions are forward-looking and involve substantial sunk costs. In addition, the continued existence of road networks and partially-surviving commercial and residential structures may serve as focal points around which reconstruction occurs. Furthermore, institutional constraints such as property rights and land-use regulations may also provide reasons why existing concentrations of population and industrial activity re-emerge. Therefore Redding, Sturm and Wolf (2008) consider the division of Germany and the reunification of East and West Germany as an alternative source of an exogenous shock that substantially affects the relative attractiveness of locations and persists for around forty years. Focusing on economic activity that is likely to be particularly susceptible to multiple equilibria in its location, and controlling changes in locational fundamentals over time, they provide evidence that the relocation of Germany's air hub from Berlin to Frankfurt is an example of such a shift between multiple equilibria.

Davis and Weinstein (2002)'s preferred interpretation of their empirical findings for Japan is that they provide support for a hybrid theory, in which locational fundamentals play a key role in establishing the basic pattern of relative population densities, and in which increasing returns play a strong role in determining the degree of dispersion. This interpretation suggests a number of interesting avenues for further research. What is the respective contribution of locational fundamentals and increasing returns? While New York's development was strongly influenced by the locational advantages of its superb natural harbor and the construction of the Erie Canal, how important are these factors in understanding its current size? Are the influences of natural advantages immutable or do these change over time with changes in production technology and the economic environment? If so, why is the pattern of population density so persistent in Japan, and how do the findings for Japan compare with those for other countries? Is the location of individual economic activities more susceptible to multiple equilibria than the distribution of population and economic activity as a whole? What kinds of economic activities are susceptible to multiple equilibria in their location, and what kinds of shocks can shift the location of these activities between multiple equilibria? Isolating the roles of natural advantages and increasing returns remains a fruitful area for further research.

In addition to distinguishing increasing returns from natural advantage, a further empirical challenge

is separating out different sources of agglomeration. The pecuniary externalities induced by love of variety, increasing returns to scale and transport costs are only one of the three sources of agglomeration outlined by Marshall (1920). The other two are knowledge spillovers (technological externalities) and the pooling of specialized skills, which have both been the subject of considerable attention, particularly in the urban economics literature.¹⁴ As shown by Ciccone and Hall (1996) and Duranton and Puga (2004), these three sources of externalities can have observationally equivalent effects on the spatial distribution of economic activity.

An innovative empirical approach to separating out Marshall's three agglomeration forces has recently been advanced by Ellison, Glaeser and Kerr (2007), which exploits information on industry co-agglomeration. Industries differ in the intensity with which they trade with one another, the extent to which they employ similar workers, and the degree to which they use similar technologies. Therefore the extent to which co-agglomerating industries trade intensively with one another, employ similar workers or use similar technologies provides evidence on the relative strength of Marshall's three agglomeration forces across industries. Although there is a large empirical literature on agglomeration, there is little evidence on the respective contributions of these alternative sources of agglomeration, or indeed on the spatial and industrial scales over which they operate. Therefore this area remains a priority for future research.¹⁵

One general area that is likely to prove particularly fruitful for further empirical research on new economic geography is in integrating findings from the urban economics literature. Two striking empirical regularities from the literature on cities relate to statistical properties of the distribution of city sizes and growth rates. First, there is evidence that Zipf's Law (a log linear relationship between city rank and size with a unit coefficient) provides a reasonable approximation to the observed distribution of city sizes. Second, there is evidence that Gibrat's (growth is uncorrelated with size) provides a reasonable approximation to the observed distribution of city growth rates. As famously observed by Krugman (1996), neither of these relationships emerge naturally from new economic geography models. While much of the literature on Zipf's and Gibrat's Laws has been purely statistical, recent years have seen the development of economic models that generate one or more of these relationships from microeconomic foundations, including in particular Gabaix (1999), Eeckhout (2004), Duranton (2007) and Rossi-Hansberg and Wright (2007). Finally, while Zipf's and Gibrat's Laws are reasonable approximations for cities, recent research incorporating rural as well as urban areas provides evidence of large and systematic departures from both, including Michaels, Rauch and Redding (2008) and Holmes and Lee

¹⁴For theoretical analyses of technological externalities in cities, see Henderson (1974), Fujita and Ogawa (1982) and Lucas and Rossi-Hansberg (2002). For empirical studies examining technological or human capital externalities, see for example Sveikauskas (1975), Jaffe, Henderson and Trajtenberg (1993), and Arzaghi and Henderson (2008).

¹⁵There is a large literature in urban economics that distinguishes between localization externalities within industries and urbanization externalities across industries. See for example the review in Rosenthal and Strange (2004).

(2007). Reconciling new economic geography models with these findings concerning the distributions of population size and growth remains an interesting area for further research.

Finally, while new economic geography models typically assume that firms and workers are homogeneous, a further empirical challenge is controlling for heterogeneity and selection. One line of recent research has controlled for the non-random sorting by workers by using movements of workers between locations to estimate separate location and worker fixed effects (see in particular Combes, Duranton and Gobillon 2008). Another line of recent research has distinguished agglomeration from selection by examining whether the distribution of firm sizes is left-truncated (selection) or right-shifted (agglomeration) in more densely-populated locations relative to less-densely populated locations (Combes, Duranton, Gobillon, Puga and Roux 2008). Again these are active and fruitful avenues for further research.

4 Conclusions

The award of Paul Krugman's 2008 Nobel Prize in part for his theoretical research on new economic geography provides an appropriate moment to evaluate empirical work in this area. While there is a substantial empirical literature showing that income and production are correlated with market access in the way suggested by new economic geography models, establishing causality and controlling for confounding factors are more challenging. Future empirical research is likely to focus on these identification concerns and discriminating between different agglomeration forces. One promising area for further inquiry lies in integrating insights from urban economics. Rather as in physics, one could look forward to an empirically-verified all-encompassing theory, which explains the geographic distribution of economic activity at multiple levels of spatial aggregation and determines the spatial scales at which different agglomeration forces operate.

References

- Acemoglu, Daron, Simon Johnson and James Robinson (2002) "Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution," *Quarterly Journal of Economics*, 117, 1231-1294.
- Amiti, Mary and Lisa Cameron (2007) "Economic Geography and Wages," *Review of Economics and Statistics*, 89(1), 15-29.
- Arzaghi, Mohammad and Vernon Henderson (2008) "Networking Off Madison Avenue," *Review of Economic Studies*, forthcoming.
- Bosker, Maarten, Steven Brakman, Harry Garretsen and Marc Schramm (2007) "Looking for Multiple Equilibria when Geography Matters: German City Growth and the WWII Shock," *Journal of Urban Economics*, 61(1), 152-69.

Bosker, Maarten, Steven Brakman, Harry Garretsen and Marc Schramm (2008) "A Century of Shocks: The evolution of the German City Size Distribution 1925-1999," *Regional Science and Urban Economics*, 38(4), 330-347.

Brakman, Steven, Harry Garretsen and Marc Schramm (2004) "The Strategic Bombing of German Cities during WWII and its Impact on City Growth," *Journal of Economic Geography*, 4(2), 201-218.

Breinlich, Holger (2006) "The Spatial Income Structure in the European Union - What Role for Economic Geography?", *Journal of Economic Geography*, November.

Ciccone, A and R. Hall (1996) "Productivity and the Density of Economic Activity," *American Economic Review*, 86(1), pages 54-70.

Combes, Pierre-Philippe, Gilles Duranton and Laurent Gobillon (2008) "Spatial Wage Disparities: Sorting Matters!" *Journal of Urban Economics*, 63(2), 723-742.

Combes, Pierre-Philippe, Gilles Duranton, Laurent Gobillon, Diego Puga and Sébastien Roux (2008) "The Productivity Advantages of Large Cities: Distinguishing Agglomeration from Firm Selection," University of Toronto, mimeograph.

Davis, D and D. Weinstein (1999) "Economic Geography and Regional Production Structure: An Empirical Investigation," *European Economic Review*, 43, 379-407.

Davis, Donald and David Weinstein (2002) "Bones, Bombs, and Break Points: The Geography of Economic Activity," *American Economic Review*, 92(5), 1269-1289.

Davis, Donald and David Weinstein (2003) "Market Access, Economic Geography and Comparative Advantage: An Empirical Assessment," *Journal of International Economics*, 59(1), 1-23.

Davis, Donald and David Weinstein (2008) "A Search for Multiple Equilibria in Urban Industrial Structure," *Journal of Regional Science*, 48(1), 29-65.

Dekle, R and J. Eaton (1999) 'Agglomeration and Land Rents: Evidence from the Prefectures', *Journal of Urban Economics*, 46, 200-14.

Duranton, Gilles (2007) "Urban Evolutions: The Fast, the Slow, and the Still," *American Economic Review*, 97(1), 197-221.

Duranton, Gilles and Henry G. Overman (2005) "Testing for Localization Using Micro-Geographic Data," *Review of Economic Studies*, 72, 1077-1106.

Duranton, Gilles and Diego Puga (2004) "Micro-Foundations of Urban Agglomeration Economies," in (eds) J. Vernon Henderson and Jacques-Francois Thisse, *Handbook of Regional and Urban Economics Volume 4: Cities and Geography*, 2063-2117. Amsterdam: Elsevier.

Eeckhout, Jan (2004) "Gibrat's Law for (All) Cities," *American Economic Review*, 94(5), 1429-1451.

Ellison, Glenn and Edward Glaeser (1997) "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach," *Journal of Political Economy*, 105(5), 889-927.

- Ellison, Glenn, Edward Glaeser and William Kerr (2007) "What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns," *NBER Working Paper*, 13068.
- Fujita, Masahisa, Paul Krugman and Anthony Venables (2001) *The Spatial Economy: Cities, Regions and International Trade*, Cambridge (MA): MIT Press.
- Fujita, M. and H. Ogawa (1982) "Multiple Equilibria and Structural Transition of Non-monocentric Urban Configurations," *Regional Science and Urban Economics*, 12, 161-96.
- Gabaix, Xavier (1999) "Zipfs Law for Cities: An Explanation," *Quarterly Journal of Economics*, 114(3), 739-767.
- Gallup, J.L., J. Sachs and A. D. Mellinger (1998) "Geography and Economic Development," in B. Pleskovic and J.E. Stiglitz (eds), *Annual World Bank Conference on Development Economics*, World Bank, Washington DC.
- Hanson, Gordon H. (1996) "Localization Economies, Vertical Organization, and Trade," *American Economic Review*, 86(5), 1266-78.
- Hanson, Gordon H. (1997) "Increasing Returns, Trade, and the Regional Structure of Wages," *Economic Journal*, 107, 113-133.
- Hanson, Gordon H. (2005) "Market Potential, Increasing Returns, and Geographic Concentration," *Journal of International Economics*, 67(1), 1-24.
- Head, Keith and Thierry Mayer (2004) "Empirics of Agglomeration and Trade," in Vernon Henderson and Jacques-François Thisse (eds.), *Handbook of Regional and Urban Economics*, Amsterdam: North-Holland.
- Head, Keith and Thierry Mayer (2006) "Regional Wage and Employment Responses to Market Potential in the EU," *Regional Science and Urban Economics*, 36(5), 573-95.
- Helpman, Elhanan (1998) "The Size of Regions," in (eds) David Pines, Efraim Sadka, and Itzhak Zilcha, *Topics in Public Economics: Theoretical and Applied Analysis*, Cambridge: Cambridge University Press, 33-54.
- Henderson, J. Vernon (1974) "The Sizes and Types of Cities," *American Economic Review*, 64(4), 640-56.
- Holmes, Thomas J. (1998) "The Effects of State Policies on the Location of Industry: Evidence from State Borders," *Journal of Political Economy*, 106(4), 667-705.
- Holmes, Thomas J. and Sanghoon Lee (2007) "Cities as Six-by-Six Mile Squares: Zipf's Law?," University of Minnesota, mimeograph.
- Holmes, Thomas J. and Sanghoon Lee (2008) "Economies of Density versus Natural Advantage: Crop Choice on the Back Forty," University of Minnesota, mimeograph.
- Jaffe, Adam, Rebecca Henderson and Manuel Trajtenberg (1993) "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations," *Quarterly Journal of Economics*, 434, 578-598.

- Krugman, Paul (1991a) "Increasing Returns and Economic Geography," *Journal of Political Economy*, 99(3), 483-499.
- Krugman, Paul (1991b) *Geography and Trade*, Cambridge (MA): MIT Press.
- Krugman, Paul (1996) "Confronting the Mystery of the Urban Hierarchy," *Journal of the Japanese and International Economies*, 10, 399-418.
- Krugman, Paul and Anthony J. Venables, (1995) "Globalization and the Inequality of Nations," *Quarterly Journal of Economics*, 857-880.
- Lucas, Robert E. and Esteban Rossi-Hansberg (2002) "On the Internal Structure of Cities," *Econometrica*, 70(4), 1445-1476.
- Manski, Charles F. (1995) *Identification Problems in the Social Sciences*, Cambridge MA: Harvard University Press.
- Marshall, Alfred (1920) *Principles of Economics*, London: Macmillan.
- Mayer Thierry (2008) "Market Potential and Development," *CEPR Discussion Paper*, 6798.
- Michaels, Guy, Ferdinand Rauch and Stephen J. Redding (2008) "Urbanization and Structural Transformation," *CEPR Discussion Paper*, 7016.
- Miguel, Edward and Gérard Roland (2006) "The Long Run Impact of Bombing Vietnam," *NBER Working Paper*, 11954.
- Overman, Henry G., Stephen Redding and Anthony Venables (2003) "The Economic Geography of Trade, Production and Income: A Survey of Empirics," in James Harrigan and E. Kwan Choi (eds.), *Handbook of International Trade*, Oxford: Blackwell.
- Overman, Henry G., and L. Alan Winters (2006) "Trade Shocks and Industrial Location: The Impact of EEC accession on the UK," CEP Discussion Paper No. 588, London School of Economics.
- Redding, Stephen J. and Daniel M. Sturm (2008) "The Costs of Remoteness: Evidence from German Division and Reunification," *American Economic Review*, 98(5), 1766-1797.
- Redding, Stephen J., Daniel M. Sturm and Nikolaus Wolf (2007) "History and Industrial Location: Evidence from German Airports," *CEPR Discussion Paper*, 6345.
- Redding, Stephen J. and Anthony J. Venables (2004) "Economic Geography and International Inequality," *Journal of International Economics*, 62(1), 53-82.
- Rosenthal, Stuart S. and William C. Strange (2004) "Evidence on the Nature and Sources of Agglomeration Economies," *Handbook of Regional and Urban Economics Volume 4: Cities and Geography*, (eds) J. Vernon Henderson and Jacques-Francois Thisse, Amsterdam: Elsevier.
- Rossi-Hansberg, Esteban. and Mark L. J. Wright (2007) "Establishment Size Dynamics in the Aggregate Economy," *American Economic Review*, 97(5), 1639-1666.
- Sveikauskas, L. A. (1975) "The Productivity of Cities," *Quarterly Journal of Economics*, 89, 393-413.

Tirado, Daniel A., Elisenda Paluzie, and Jordi Pons (2002) “Economic Integration and Industrial Location: The Case of Spain before WWI,” *Journal of Economic Geography*, 2(3), 343–63.

Venables, A.J. (1996) “Equilibrium Locations of Vertically Linked Industries,” *International Economic Review*, 37, 341-59.

Wolf, Nikolaus (2007) “Endowments vs. Market Potential: What Explains the Relocation of Industry after the Polish Reunification in 1918?” *Explorations in Economic History*, 44(1): 22–42.

CENTRE FOR ECONOMIC PERFORMANCE
Recent Discussion Papers

- | | | |
|-----|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| 924 | Rafael Gomez
Alex Bryson
Tobias Kretschmer
Paul Willman | Employee Voice and Private Sector Workplace Outcomes in Britain, 1980-2004 |
| 923 | Bianca De Paoli | Monetary Policy Under Alternative Asset Market Structures: the Case of a Small Open Economy |
| 922 | L. Rachel Ngai
Silvana Tenreyro | Hot and Cold Seasons in the Housing Market |
| 921 | Kosuke Aoki
Gianluca Benigno
Nobuhiro Kiyotaki | Capital Flows and Asset Prices |
| 920 | Alex Bryson
John Forth
Patrice Laroche | Unions and Workplace Performance in Britain and France |
| 919 | David Marsden
Simone Moriconi | 'The Value of Rude Health': Employees' Well Being, Absence and Workplace Performance |
| 918 | Richard Layard
Guy Mayraz
Stephen Nickell | Does Relative Income Matter? Are the Critics Right? |
| 917 | Ralf Martin
Laure B. de Preux
Ulrich J. Wagner | The Impacts of the Climate Change Levy on Business: Evidence from Microdata |
| 916 | Paul-Antoine Chevalier
Rémy Lecat
Nicholas Oulton | Convergence of Firm-Level Productivity, Globalisation, Information Technology and Competition: Evidence from France |
| 915 | Ghazala Azmat
Nagore Iriberrri | The Importance of Relative Performance Feedback Information: Evidence from a Natural Experiment using High School Students |
| 914 | L Rachel Ngai
Robert M. Samaniego | Accounting for Research and Productivity Growth Across Industries |
| 913 | Francesco Caselli
Tom Cunningham | Leader Behavior and the Natural Resource Curse |
| 912 | Marco Manacorda
Edward Miguel
Andrea Vigorito | Government Transfers and Political Support |
| 911 | Philippe Aghion
John Van Reenen
Luigi Zingales | Innovation and Institutional Ownership |

910	Fabian Waldinger	Peer Effects in Science – Evidence from the Dismissal of Scientists in Nazi Germany
909	Tomer Blumkin Yossi Hadar Eran Yashiv	The Macroeconomic Role of Unemployment Compensation
908	Natalie Chen Dennis Novy	International Trade Integration: A Disaggregated Approach
907	Dongshu Ou	To Leave or Not to Leave? A Regression Discontinuity Analysis of the Impact of Failing the High School Exit Exam
906	Andrew B. Bernard J. Bradford Jensen Stephen J. Redding Peter K. Schott	The Margins of US Trade
905	Gianluca Benigno Bianca De Paoli	On the International Dimension of Fiscal Policy
904	Stephen J. Redding	Economic Geography: A Review of the Theoretical and Empirical Literature
903	Andreas Georgiadis Alan Manning	Change and Continuity Among Minority Communities in Britain
902	Maria Bas	Trade, Technology Adoption and Wage Inequalities: Theory and Evidence
901	Holger Breinlich Chiara Criscuolo	Service Traders in the UK
900	Emanuel Ornelas John L. Turner	Protection and International Sourcing
899	Kosuke Aoki Takeshi Kimura	Central Bank's Two-Way Communication with the Public and Inflation Dynamics
898	Alan Manning Farzad Saidi	Understanding the Gender Pay Gap: What's Competition Got to Do with It?
897	David M. Clark Richard Layard Rachel Smithies	Improving Access to Psychological Therapy: Initial Evaluation of the Two Demonstration Sites
896	Giorgio Barba Navaretti Riccardo Faini Alessandra Tucci	Does Family Control Affect Trade Performance? Evidence for Italian Firms