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THE EMPIRICS OF NEW ECONOMIC GEOGRAPHY

Stephen J. Redding

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Stephen J. Redding, London School of Economics (LSE), Yale School of Management and CEPR

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Centre for Economic Policy Research
53–56 Gt Sutton St, London EC1V 0DG, UK
Tel: (44 20) 7183 8801, Fax: (44 20) 7183 8820
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

The Empirics of New Economic Geography

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.

JEL Classification: F12, F14 and O10
Keywords: industrial location, market access, multiple equilibria and new economic geography

Stephen J Redding
Centre for Economic Performance
and Department of Economics
London School of Economics (LSE)
Houghton Street
London WC2A 2AE

Email: s.j.redding@lse.ac.uk

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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), which 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

[1] In 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. While initial research modeled the love of variety using a Constant Elasticity of Substitution (CES) functional form, recent research has also considered the quasi-linear functional form following Ottaviano, Tabuchi and Thisse (2002).

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

attempt is made to be comprehensive.[3] The remainder of the paper is structured as follows. In Section 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:

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

[3] For syntheses of the theoretical literature, see Thisse (2009) in this special issue, Fujita, Krugman and Venables (2001), Fujita and Thisse (2002), and Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003). For more comprehensive reviews of the empirical literature, see Overman, Redding and Venables (2001) and Head and Mayer (2004).

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

where θ is again a constant and:

$$MA_i \equiv \sum_j \tau_{ij}^{1-\sigma} m_j \equiv \sum_j \tau_{ij}^{1-\sigma} E_j P_{Mj}^{\sigma-1}, \tag{2}$$
$$SA_j \equiv \sum_i \tau_{ij}^{1-\sigma} s_i \equiv \sum_i n_i \left(\tau_{ij} p_i\right)^{1-\sigma} = P_{Mj}^{1-\sigma}.$$

"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 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 a non-traded amenity such that real wages are equalized across all locations that are populated in equilibrium:

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

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]

[5] Head 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 incomes and manufacturing price indices as determinants of market potential in addition to transport costs and population.

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

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* 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

[7]Despite a large empirical literature on the effect of market access on nominal wages, there has been relatively 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).

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

[9]Other 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-

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.

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 cities 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:

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

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

twentieth century Poland.

around one third. A variety of additional pieces of evidence are provided in support of a market-access-based explanation and against other potential explanations, such as differences in industrial structure, war-related disruption, fear of further armed conflict, and Western European integration.

The analysis in Redding and Sturm (2008) combines exogenous variation from a natural experiment with a quantitative analysis of a theoretical model of economic geography. More generally, the use of natural experiments as sources of exogenous variation and the structural estimation of quantitative models provide two complementary approaches to strengthening the evidence base in support of new economic geography models.[10] Each of these approaches allows the predictions of new economic geography models to be compared with those of alternative potential explanations, while the quantitative analysis of theoretical models also facilitates an analysis of counterfactuals.[11]

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 plants, since with a small number of plants even random location cannot be expected to produce a regular location pattern.[12]

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

[10] Other empirical research exploiting natural experiments includes Holmes (1998), which uses discontinuities at U.S. state borders to examine the impact of state policies, and Holmes and Lee (2008), which uses institutional features of the distribution of land under the 1862 Homestead Act to estimate externalities in crop planting decisions. Other research examining the quantitative predictions of theoretical location models includes Holmes (2005), Duranton (2007), and Rossi-Hansberg and Wright (2007).

[11] Another potentially fruitful line of inquiry is strengthening the links between the spatial econometrics literature (as reviewed by Pinkse and Slade 2009 in this special issue) and theoretical location models.

[12] See 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.

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 Japanese regions and OECD countries, Davis and Weinstein (1999, 2003) provide evidence of home market effects in a number of manufacturing industries. Other empirical studies finding evidence of home market effects using international trade data include Feenstra, Markusen and Rose (2001), Head and Ries (2001), and Hanson and Xiang (2004). 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 important paper, Davis and Weinstein (2002) use data over a long historical time period 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 effect 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.[13]

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 accidents apparently having long-lived effects on the spatial distribution of economic activity, which are consistent with multiple equilibria.[14] On the other hand, if even the large-scale shocks of war-time 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 an 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

[13] In 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.

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

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.[15] 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. Furthermore, while most existing research focuses on agglomeration forces in production, agglomeration forces in consumption are also arguably important, as evident from the wider range and higher quality of consumption amenities available in large cities (see for example Glaeser, Kolko and Saiz 2001). Therefore further research separating out the various possible agglomeration forces remains a priority.[16]

[15]For 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).

[16]There is a large literature in urban economics that distinguishes between localization externalities within industries and

Despite the centrality of trade costs to new economic geography models, there is relatively little empirical research on the nature of these costs. While some detailed evidence is available for transportation costs (see in particular Limao and Venables 2001 and Hummels 2007), there is a scarcity of evidence on other trade frictions such as information and communication costs. Although iceberg trade costs are a convenient simplification in new economic geography models, recent research in international trade emphasizes fixed costs of trade (see in particular Melitz 2003), and variable trade costs can be based on quantity rather than value (with implications for the composition of trade as examined in Hummels and Skiba 2004). More generally, transportation and trade are separate sectors of the economy and their organization can have important implications for the volume and pattern of trade. For example, trade costs can be asymmetric (as when the volume of trade varies depending on its direction) and the organization of trade networks can be itself endogenous to the spatial distribution of economic activity.

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 Law (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 (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 non-random sorting of 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, Duran-

urbanization externalities across industries. See for example the review in Rosenthal and Strange (2004).

ton, 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.

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