Economic Geography: a Review of the Theoretical and Empirical Literature*

Stephen J. Redding†
LSE, Yale School of Management and CEPR

December 2008

Abstract

This paper reviews the new economic geography literature, which accounts for the uneven distribution of economic activity across space in terms of a combination of love of variety preferences, increasing returns to scale and transport costs. After outlining the canonical core and periphery model, the paper examines the empirical evidence on three of its central predictions: the role of market access in determining factor prices, the related home market effect in which demand has a more than proportionate effect on production, and the potential existence of multiple equilibria. In reviewing the evidence, we highlight issues of measurement and identification, alternative potential explanations, and remaining areas for further research.

Keywords: New economic geography, market access, home market effect, multiple equilibria

JEL classification: F12, F14, O10

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

†Department of Economics, London School of Economics, Houghton Street, London WC2A 2AE, United Kingdom. Tel: +44-20-7955 7483. Fax: +44-20-7831 1840. E-mail: s.j.redding@lse.ac.uk

1. Introduction

The uneven distribution of economic activity across space is one of the most striking features of economic life. Perhaps the clearest visual manifestation of this is the emergence and growth of cities. The share of the world's population living in cities grew from less than one tenth in 1300, to around one sixth in 1900, and to around one half today. Even more striking is the emergence of large metropolitan areas. By 1980 there were more than two million cities with more than one hundred thousand inhabitants and by 1995 fifteen cities had a population of greater than ten million.[1]

There is a long intellectual tradition in economics concerned with location choices. As is well known, Marshall (1920) highlights knowledge spillovers, locally-traded intermediate inputs and the pooling of specialized skills as three potential mechanisms for the agglomeration of economic activity. Subsequently, an extensive body of research in urban and regional economics examined the origins of mono-centric cities, the distribution of population concentrations across space and the organization of economic functions across these population concentrations.[2]

A key distinction in thinking about the determinants of location is that between first-nature and second-nature geography First-nature geography is concerned with locational fundamentals, including the physical geography of coasts, mountains and natural endowments. In contrast, second-nature geography is concerned with the location of agents relative to one another in geographic space, and the role that this plays in understanding spatial disparities. While first-nature geography is largely exogenous, second-nature geography is typically endogenous, and could be influenced, at least in principle, by policy.

The sources of the uneven distribution of economic activity across space have returned to prominence over the last three decades with the emergence of the "new economic geography" literature following Krugman (1991a).[3] This path-breaking paper was a key part of the citation for Paul Krugman's 2008 Nobel Prize and the research to which it gave rise is the subject of this literature review.[4] A key emphasis in the new economic geography literature is the development

[1]For a historical analysis of urbanization, see Bairoch (1988).

[2]See in particular Alonso (1964), Christaller (1933), Harris (1954), Lösch (1940), Muth (1961) and Mills (1967)

[3]For syntheses of the theoretical literature on new economic geography, see Fujita, Krugman and Venables (1991), Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2002), and Fujita and Thisse (2002).

[4]For other complementary reviews of the new economic geography literature, see Neary (2001), Ottaviano and Puga (1998), Overman, Redding and Venables (2001), and Head and Mayer (2004). For broader theoretical and empirical reviews of the sources of agglomeration, see Duranton and Puga (2004) and Rosenthal and Strange

of micro-founded models consistent with individual optimization and market clearing. The focus in this line of research is squarely on second-nature geography, in which spatially concentrated patterns of production and consumption can emerge endogenously from a featureless plain of *ex ante* identical locations.[5] Location choices are determined by a tension between agglomeration forces, which promote the spatial concentration of economic activity, and dispersion forces, which favor an equal distribution of economic activity. The agglomeration forces arise from pecuniary externalities due to a combination of love of variety preferences, increasing returns to scale and transport costs. The dispersion forces arise from product market competition and geographically immobile factors of production or amenities. The relative strength of these two sets of forces depends on transportation costs, so that changes in transportation costs result in endogenous changes in the distribution of economic activity across space.

A central theoretical prediction of the new economic geography literature is the so-called "home market effect." In neoclassical models, increases in expenditure lead to equal or less than proportionate increases in production of the good. In contrast, in economic geography models increases in expenditure typically lead to more than proportionate increases in the production of a good. The reason is that the change in expenditure affects the location decisions of firms and/or factors of production which result in turn in further changes in expenditure. A related implication of the home market effect is that nominal prices of factors of production vary endogenously across locations depending on their "market access." In locations with good market access, there is more value-added left after paying transportation costs to remunerate factors of production, which results in equilibrium in higher nominal factor prices. Both of these implications of the home market effect are amenable to empirical testing and we review a growing empirical literature that has examined the production and factor price implications of economic geography models.

Another central feature of new economic geography models is that pecuniary externalities in location choices can give rise to multiple equilibrium, so that the distribution of economic activity across space in not uniquely determined by locational fundamentals. While this possibility of multiple equilibria is a key feature of new economic geography models, there is much

(2004).

[5]In contrast, neoclassical trade theory emphasizes first-nature geography in the form of differences in factor endowments. For a lively debate on the contribution of first-nature geography towards spatial disparities in economic development, see for example Acemoglu, Johnson and Robinson (2002), Bloom and Sachs (1998), Gallup, Sachs and Mellinger (1998), Rodrik et al. (2004).

less evidence of the empirical relevance of such multiple equilibria, and this is an area where there remains considerable scope for further empirical research.

The remainder of the chapter is structured as follows. Section 2 reviews the canonical new economic geography model, the so-called "core and periphery" model of Krugman (1991a), and discusses other related theoretical models. Section 3 surveys the empirical evidence on the key theoretical predictions of new economic geography models. Section 4 discusses potential areas for further research and concludes.

2. Theoretical Literature

In the canonical "core and periphery" model of Krugman (1991a), the distribution of economic activity across space is determined by a tension between two agglomeration and dispersion forces. The two agglomeration forces are a "home market effect," where increasing returns to scale and transport costs imply that firms want to concentrate production near to large markets, and a "price index effect," where consumer love of variety and transport costs imply a lower cost of living near to large markets. The two dispersion forces are a "market crowding effect," where transport costs imply that firms close to large markets face a larger number of lower-priced competitors, and an immobile factor "agricultural labor," which together with transport costs provides an incentive for dispersed production across regions. We first outline the canonical model in its most stylized form, before discussing extensions and other related theoretical approaches.[6]

2.1. Preferences and Endowments

The economy consists of two regions, "North" and "South," where Southern variables are denoted by an asterisk. While we provide expressions below for the North, analogous relationships hold for the South. There are two goods: agriculture and manufacturing. Agriculture is a homogeneous good, which is produced with a constant returns to scale production technology under conditions of perfect competition, and is subject to zero transportation costs. In contrast, the manufacturing sector consists of many differentiated varieties, which are produced with an increasing returns to scale technology under conditions of monopolistic competition, and are

[6] Related research in regional and urban economics includes Fujita (1988), Henderson (1974, 1988) and Rivera-Batiz (1988).

subject to iceberg transportation costs such that $\tau > 1$ units have to be shipped between regions in order for one unit to arrive.[7]

Consumer preferences are defined over consumption of agriculture and manufacturing, C_A and C_M respectively, and are assumed to take the Cobb-Douglas functional form:

$$U = C_M^{\mu} C_A^{1-\mu}, \qquad 0 < \mu < 1.$$

The manufacturing consumption index, C_M, is defined over horizontally-differentiated varieties within the manufacturing sector, and is assumed to take the constant elasticity of substitution (CES) or Dixit and Stiglitz (1977) form:

$$C_M = \left[\sum_j c_j^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \qquad P_M = \left[\sum_j p_j^{1-\sigma} \right]^{\frac{1}{1-\sigma}},$$

where c_j denotes consumption of each variety, $\sigma > 1$ is the elasticity of substitution between varieties, P_M is the price index dual to C_M, and p_j denotes the price of each variety.

There are two factors of production: farmers and workers. While farmers can only be employed in the agricultural sector and are geographically immobile between regions, workers can only be employed in the manufacturing sector and are geographically mobile between regions. Each region is endowed with $(1-\mu)/2$ farmers and the economy as a whole is endowed with μ workers.[8]

2.2. Production Technology

In the agricultural sector, one unit of labor is required to produce one unit of output. In contrast, in the manufacturing sector there is a fixed cost of $\alpha > 0$ units of labor to produce each variety and a constant variable cost of $\beta > 0$ units of labor. Therefore the total labor required to produce x_j units of a manufacturing variety is:

$$l_{Mj} = \alpha + \beta x_j.$$

[7] While the assumptions of perfect competition, constant returns to scale and zero transportation costs in the agricultural sector are largely made for simplicity, they are not innocuous (see for example Davis 1999), although results generalize in a number of respects (see for example Fujita, Krugman and Venables 1999).

[8] Choosing units in which to measure farmers and workers such that their number is proportional to the shares of sectors in consumption expenditure turns out to be a convenient normalization that simplifies expressions.

2.3. Producer Equilibrium

The assumptions that farmers are geographically immobile and specific to the agricultural sector imply that both regions produce the agricultural good. Additionally, as the agricultural good is chosen as the numeraire, the assumptions of constant returns to scale, perfect competition and zero transport costs in the agricultural sector imply that the agricultural wage, w_A, in both regions is equal to one: $p_A = w_A = 1$.

Profit maximization in the manufacturing sector yields the standard result that the equilibrium price of each manufacturing variety is a constant mark-up over marginal cost, and as all varieties are symmetric, this equilibrium price is the same for all varieties:

$$p_{Mj} = p_M = \left(\frac{\sigma}{\sigma - 1}\right) \beta w.$$

Combining profit maximization and free entry yields the standard result that with a common constant elasticity of substitution between varieties, the equilibrium output of each variety is equal to a constant:

$$x_j = \bar{x} = \frac{\alpha (\sigma - 1)}{\beta}.$$

Finally, from the CES demand for manufacturing varieties, the "free on board" price of each variety must be sufficiently low given demand in both regions to sell exactly $\bar{x}$ units and make zero equilibrium profits:

$$(p_M)^\sigma = \frac{\mu}{\bar{x}} \left[Y P_M^{\sigma-1} + \tau^{1-\sigma} Y^* \left(P_M^*\right)^{\sigma-1} \right],$$

where Y denotes aggregate income, which equals aggregate expenditure.

Therefore combining CES demand, zero equilibrium profits and profit maximization, we obtain the following "wage equation," which will play a key role in the analysis below:

$$w_M = \left(\frac{\sigma - 1}{\sigma \beta}\right) \left[\frac{\mu}{\bar{x}} \left(Y P_M^{\sigma-1} + \tau^{1-\sigma} Y^* \left(P_M^*\right)^{\sigma-1} \right) \right]^{\frac{1}{\sigma}} \tag{1}$$

Intuitively, if the manufacturing sector is active in a region, the manufacturing wage must be sufficiently low given demand in both regions to sell exactly $\bar{x}$ units and make zero equilibrium profits. The right-hand side of (1) is a measure of a region's "market access" or "real market potential," which corresponds to a transport-cost weighted sum of market demand in each region. Therefore a key prediction of new economic geography models, which we examine further below, is that locations' nominal factor prices are systematically related to their market access.

2.4. Goods and Factor Markets

Another key relationship of the model relates the number of manufacturing varieties to the number of workers choosing to reside in a location. As only workers are employed in the manufacturing sector, the manufacturing production technology and factor market clearing together imply that the number of manufacturing varieties produced by a region is simply proportional to its number of manufacturing workers:

$$n = \frac{L_M}{\alpha + \beta \bar{x}} = \frac{L_M}{\alpha \sigma}. \tag{2}$$

Using the symmetry of equilibrium prices for manufacturing varieties, the manufacturing price index for each region depends on the number of varieties produced in each region, their equilibrium "free on board" prices, and transportation costs:

$$P_M = \left[n p_M^{1-\sigma} + \tau^{1-\sigma} n \left(p_M^* \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}. \tag{3}$$

Mobile manufacturing workers decide in which region to locate by comparing real wages. These depend on the manufacturing wage and the manufacturing price index, which can vary across regions, and the common price of the agricultural good:

$$\omega_M = \frac{w_M}{P_M^{\mu} p_A^{1-\mu}} \tag{4}$$

Finally, regional aggregate income equals the number of immobile farmers times the agricultural wage of one plus the number of mobile manufacturing workers times the manufacturing wage:

$$Y = w_M L_M + \frac{1-\mu}{2} \tag{5}$$

2.5. General Equilibrium

To characterize general equilibrium, it is convenient to make a number of normalizations. Choosing units in which to measure the output of manufacturing varieties so that $\beta = (\sigma - 1)/\sigma$, we obtain $p_M = w_M$. Similarly, choosing units in which to count manufacturing varieties such that $\alpha = \mu/\sigma$, we obtain $n_M = L_M/\mu$ and $\bar{x} = \mu$. Finally, the share of the economy's endowment of manufacturing workers that choose to locate in the North is denoted by λ, with the remaining share $\lambda^* = (1-\lambda)$ locating in the South.

Given these normalizations, general equilibrium can be represented by the following system of four simultaneous equations for the North, with four analogous equations holding in the South:

$$\begin{aligned} Y &= \mu\lambda w_M + \left(\frac{1-\mu}{2}\right), \qquad (6) \\ P_M &= \left[\lambda\left(w_M\right)^{1-\sigma} + (1-\lambda)\left(w_M^*\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \\ w_M &= \left[Y\left(P_M\right)^{\sigma-1} + \tau^{1-\sigma}Y^*\left(P_M^*\right)^{\sigma-1}\right]^{\frac{1}{\sigma}}, \\ \omega &= \frac{w_M}{\left(P_M\right)^{\mu}}. \end{aligned}$$

Together these eight equations for the two regions determine the eight endogenous variables that reference the general equilibrium: $\{Y,\ P_M,\ w_M,\ \omega\}$. All other endogenous variables can be written in terms of these elements of the equilibrium vector. As is frequently the case in the economic geography literature, the non-linearity of the model implies that closed form solutions for the equilibrium vector do not exist. Nonetheless, the properties of the general equilibrium system (6) can be characterized analytically, and we briefly summarize them here.[9]

The combination of love of variety preferences, increasing returns to scale and transport costs gives rise to general equilibrium forces that promote the agglomeration of all of the mobile manufacturing activity in one region. The first of these forces is the "price index effect," whereby the location with a larger manufacturing sector has a lower manufacturing price index, because a smaller proportion of the region's manufacturing consumption bears transport costs. This price index effect provides a "forward linkage," such that workers want to be close to abundant supplies of manufacturing goods. The second of these forces is the "home market effect," whereby increasing returns to scale imply that firms want to concentrate production in a single location, and transport costs imply that they want to concentrate production close to a large market. This home market effect provides a "backward linkage," such that firms want to locate proximate to large markets for manufacturing goods.

The home market effect has two important empirical implications, which will be examined in further detail below. The first of these empirical implications is evident from the right-hand

[9] For a complete analysis, see Fujita, Krugman and Venables (1999) and Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003).

side of the wage equation (1), which captures proximity to market demand in the two regions, as determined by aggregate income, Y, the price of competing varieties as summarized in the manufacturing price index, P, and transportation costs, $\tau^{1-\sigma}$. As a result of the home market effect, firms close to large markets pay higher nominal wages, because firms can charge higher "free on board" prices and still sell enough units of output to cover fixed production costs and make zero equilibrium profits. Therefore more value-added is left after paying transportation costs to remunerate factors of production. The second empirical implication of the home market effect is that an increase in manufacturing expenditure leads to a more than proportionate increase in manufacturing production. The reason is that the increase in expenditure induces firms to relocate in order to conserve transportation costs by concentrating production close to the expanded market.

While the home market effect alone implies higher nominal wages close to large markets, the home market and price index effects together imply higher real wages close to large markets. Therefore the two effects together provide an incentive for workers to locate close to large markets. While the home market and price index effects were both present in Krugman (1980), the key new element in the Krugman (1991a) model of economic geography is factor mobility. Suppose that one region initially has a larger share of manufacturing production. As a result of the home market and price index effect, the region with a larger share of manufacturing production has higher real wages, which induces more manufacturing workers to locate to close to the large market. As more manufacturing workers relocate to the larger region, the resulting increase in aggregate income and expenditure makes this region an even more attractive location for manufacturing firms, which further increases the region's real wage through the home market and price index effects. The presence of factor mobility in the Krugman (1991a) model therefore gives rise to a process of "cumulative causation," whereby the location choices of firms and worker mutually reinforce one another. Underlying this process of cumulative causation are pecuniary externalities (spillovers) between agents' location choices, whereby the decision of one agent to locate in a region increases the attractiveness of that region to other agents.

Although the home market and price index effects promote the agglomeration of manufacturing, there are two counteracting forces that promote its dispersion. The first of these is a "market crowding effect": in the presence of transport costs, the concentration of more manufacturing firms in a region reduces the manufacturing price index in that region. From the right-hand side of the wage equation (1), this reduction in the manufacturing price index decreases demand for each manufacturing variety, which reduces the maximum price that each firm can set consistent with zero equilibrium profits, and hence reduces the maximum wage that each firm can afford to pay. The second of these dispersion forces is immobile agricultural laborers: the more manufacturing firms that are located in a region, the greater the incentive for a manufacturing firm to relocate to the other region, in order to capture a larger share of the demand from immobile farmers in the other region by charging them a lower price net of transportation costs.

Depending on the value of the elasticity of substitution for manufacturing varieties, σ, and the share of mobile manufacturing activity in the economy, μ, there are two possible configurations of equilibria in the model. If the elasticity of substitution is sufficiently low and the share of manufacturing is sufficiently high, or more formally if $(\sigma - 1) < \mu\sigma$, agglomeration forces dominate dispersion forces for all values of transport costs. In contrast, if the elasticity of substitution is sufficiently high and the share of manufacturing activity is sufficiently low, $(\sigma - 1) > \mu\sigma$, and whether agglomeration forces dominate dispersion forces depends on the value of transportation costs (Krugman colorfully refers to the parameter condition in the above inequality as the "no black holes condition.")[10]

When agglomeration forces dominate dispersion forces, and regions are symmetric as considered here, the concentration of manufacturing activity in either region is a stable equilibrium. Which of these multiple equilibria is selected is not determined by model parameters, opening up a role for historical accident or forward-looking expectations in shaping the location of economic activity.[11] Furthermore, temporary policy interventions that shift the economy from one equilibrium to another can have permanent effects on the spatial distribution of economic activity.

For parameter values satisfying the "no black holes condition," $(\sigma - 1) > \mu\sigma$, whether

[10] While CES preferences within the manufacturing sector are in many ways a convenient simplification, they have the unattractive feature that the elasticity of substitution determines both the strength of love of variety and the equilibrium extent of increasing returns to scale. As CES preferences imply a constant mark-up of price over marginal cost, profit maximization and zero profits together imply that the equilibrium ratio of average cost to marginal cost is $\sigma/(\sigma - 1)$.

[11] Whether industrial location is determined by historical accident or forward-looking expectations cannot be determined without developing an explicitly dynamic model. Typically, the dynamics in new economic geography models are relatively *ad hoc*, although notable exceptions are Baldwin (2001), Krugman (1991b) and Matsuyama (1991).

agglomeration or dispersion forces dominate depends on the value of transportation costs. For high values of transportation costs, there is a unique stable equilibrium, as can be seen by considering the case of infinite transportation costs, in which case manufacturing firms locate in both regions to serve immobile farmers. As transportation costs fall, both dispersion and agglomeration forces are weakened, but the dispersion forces diminish more rapidly than the agglomeration forces. As a result, for transportation costs below a critical value (termed the “sustain point”), the concentration of manufacturing activity in either region can be sustained as an equilibrium. Below the sustain point, if all manufacturing activity is concentrated in one region, there is no incentive for a firm to deviate and relocate to the other region. For transportation costs below an even lower critical value (termed the “break point”), equilibria in which manufacturing activity is concentrated in a single region are the only stable equilibria. Below the break point, if any one firm deviates from a symmetric equilibrium and relocates to one of the two regions, all other manufacturing firms have an incentive to concentrate in that region. More formally, for parameter values satisfying the “no black holes condition,” the general equilibrium system (6) exhibits a Tomahawk Bifurcation, as shown graphically in Figure 1. In this region of the parameter space, small changes in transportation costs or other model parameters can have large and discontinuous effects on the spatial distribution of economic activity.

When manufacturing concentrates in one region, the other region produces only agriculture, and the resulting pattern of industrial location is described as having a “core-periphery” structure. The historical concentrations of manufacturing on the Eastern seaboard of the U.S.A. (Krugman 1991c) and in North-Western Europe (Combes and Overman 2004, Midelfart-Knarvik, Overman, Redding and Venables 2001) have both been interpreted in this way. Furthermore, the potential for changes in transportation costs to induce such polarization in the distribution of economic activity has attracted considerable public policy attention. For example, manufacturing activities have been historically less spatially concentrated in the European Union than in United States, raising the possibility that increasing European integration could prompt deindustrialization in some regions and the deepening of core-periphery patterns of the organization of economic activity (see for example Kim 1995 and Midelfart-Knarvik, Overman, Redding and Venables 2001).

2.6. Related Theoretical Approaches

While the canonical "core-periphery" model is highly stylized, many of the forces that it highlights carry over into more general settings. An important and influential line of research follows Krugman and Venables (1995) and Venables (1996) in considering intermediate inputs as a source of cumulative causation. If the manufacturing sector uses intermediate inputs, and its production technology exhibits love of variety, increasing returns to scale and transport costs, the concentration of manufacturing activity can occur even in the absence of factor mobility. As labor is considerably less mobile across countries than within countries, models of this form are particularly applicable in a cross-country context, and the absence of labor mobility can generate equilibrium real wage differences across countries. In Puga (1999), both factor mobility and intermediate input linkages are incorporated, and the implications of different production structures in the agricultural sector are considered.

A somewhat separate but equally important and influential line of research follows Helpman (1998) in assuming complete factor mobility and introducing immobile amenities, such as housing, as an alternative dispersion force to immobile agricultural labor. This line of research has been particularly influential in empirical work, because asymmetries between regions are more easily accommodated than in Krugman (1991a), and are compatible with positive manufacturing activity in each region. In models of this form, the equilibrium distribution of population across space is determined by a population mobility condition that requires real wages to be equalized. Supposing that utility is a Cobb-Douglas function of a consumption index of manufacturing varieties and consumption of a homogeneous immobile amenity, the population mobility condition takes the following form:

$$\omega_i \equiv \frac{w_i}{(P_{Mi})^{\mu} (P_{Hi})^{1-\mu}} = \omega, \tag{7}$$

for all locations i that are populated in equilibrium, where P_H denotes the price of the immobile amenity, and μ and $(1-\mu)$ are the expenditure shares of manufacturing and the immobile amenity respectively. Although population mobility equates real wages in the Helpman model, there are nominal wage differences across regions as a result of home market effect discussed above, and these nominal wage differences are offset in equilibrium by spatial variation in the nominal price of immobile amenities (such as housing). While both Krugman (1991a) and Helpman (1998) provide explanations for the spatial concentration of economic activity, their comparative statics with respect to transport costs differ. In Krugman (1991a), reductions in transport costs promote agglomeration, whereas in Helpman (1998) they have the converse effect.

While theoretical work in economic geography initially worked with CES preferences, subsequent work has considered quasi-linear preferences, as introduced by Ottaviano, Tabuchi and Thisse (2002). One of the key attractions of the quasi-linear functional form is that it permits closed-form solutions to be derived, although at the cost of imposing a constant marginal utility of income.[12] Other subsequent theoretical research has achieved greater analytical tractability by amending the core-periphery model in other ways, such as denominating the fixed and variable costs in terms of different factors of production (see for example Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud 2003). The resulting body of theoretical research is extensive in scope and rich in theoretical predictions, and general results have been derived linking the various formulations of the core and periphery model to one another (see Robert-Nicoud 2005).

Despite these advances, the non-linearity of models of new economic geography has typically constrained their theoretical analysis to stylized settings with a limited number of regions and industries. A number of the forces highlighted in economic geography models continue to operate in more general settings, including the role of market access in influencing nominal factor prices, as analyzed empirically by Redding and Venables (2004) and discussed below. Nonetheless, as with neoclassical trade theory, the analysis of these forces in more general settings can be more nuanced, as analyzed for the home market effect in Behrens, Lamorgese, Ottaviano and Tabuchi (2004). Finally, although the theoretical literature typically draws a contrast between manufacturing and agriculture, the growth of the service sector has sometimes led manufacturing to be interpreted as a composite sector including services. Nonetheless, location choices in the service sector may well involve distinct considerations and the exploration of these considerations remains under researched (for notable exceptions see Arzaghi and Henderson 2008 and Jensen and Kletzer 2005).

[12] In the quasi-linear specification, there is a downward-sloping linear demand curve for each differentiated variety. Total expenditure on differentiated varieties is determined from these demand curves given the profit-maximizing price for each differentiated variety. Once total expenditure on differentiated varieties is determined, all remaining income is spent on the homogeneous or outside good. As a result, increases in income are spent entirely on the homogeneous or outside good, and there are no income effects.

3. Empirical Evidence

This section reviews the empirical evidence on some of the key theoretical predictions of new economic geography models. We begin by discussing the measurement of agglomeration and generic identification problems in models with externalities. We next examine the relationship between market access and wages and the relationship between market access and industrial location. Finally, we examine the evidence on one of the central features of economic geography models, the existence of multiple equilibria.

3.1. Measurement and Identification

While the very existence of cities could be viewed as evidence of agglomeration, and while there is numerous anecdotal evidence of industrial clusters such as Silicon Valley in California and Route 128 in Massachusetts, the empirical measurement of agglomeration raises a number of challenges. Several different concepts are employed in the empirical literature. "Agglomeration" is typically used to refer to the degree to which economy activity as a whole is geographically concentrated. In contrast, "localization" is often used to refer to the degree to which economic activity in a particular industry is geographically concentrated after controlling for the geographic concentration of overall economic activity.[13] Both concepts are distinct from "industrial concentration," which refers to the degree to which economic activity in a particular industry is concentrated in a small number of plants irrespective of their geographical location.

As convincingly argued by Ellison and Glaeser (1997), when measuring the degree of localization of industries, it is important to control for industrial concentration. The reason is that the number of plants in an industry is often relatively small, in which case even random location patterns cannot be expected to produce perfectly regular location patterns, For example, suppose that 75 percent of employees in the U.S. vacuum cleaner industry work in one of four main plants. In this case, even if the plants locate separately, four locations must account for at least 75 percent of the employment in the industry even in the absence of any forces of cumulative causation. This concern is all the more important given the emphasis placed on increasing returns to scale in theories of new economic geography. To address this concern, Ellison and Glaeser (1997) develop a model-based measure of geographic concentration, which can

[13] This terminology differs somewhat from the historical usage in Hoover (1937). While "localization" is used in the same way, what is here termed "agglomeration" is historically referred to as "urbanization."

be compared against a null of random location (a “dartboard” approach), and which controls for the degree of industrial concentration.[14]

In an important paper, Duranton and Overman (2005) argue that empirical measures of localization should exhibit five features: (a) they should be comparable across industries, (b) they should control for the overall agglomeration of economic activity, (c) they should control for industrial concentration, (d) they should be unbiased with respect to scale and aggregation, (e) they should give an indication of the significance of the results. Duranton and Overman (2005) develop an approach based on spatial point patterns that satisfies these five criteria. Using data on four-digit manufacturing industries in the United Kingdom, they find that the majority of industries are localized at the 5 percent significance level, that localization takes place mostly between 0 and 50 kilometers, the degree of localization is highly skewed across industries, and that industries that belong to the same industrial branch tend to have similar location patterns.

One of the striking features of empirical studies measuring the extent of localization across industries is that the most localized industries are not necessarily those in which one might intuitively expect the strongest forces of cumulative causation (e.g. manufacture of cutlery in the United Kingdom). These findings highlight the fact that geographical concentration can arise as a result of geographic variation in natural advantages (e.g. mineral resources) as well as forces of cumulative causation. Indeed, Ellison and Glaeser (1997) develop an observational equivalence result that the relationship between mean measured levels of concentration and industry characteristics is the same regardless of whether concentration is the result of spillovers, natural advantage or a combination of the two. This in turn is related to the general identification problem in the social sciences of distinguishing spillovers from correlated individual effects (see in particular Manski 1999).

3.2. Market Access and Wages

As discussed above, one of the key theoretical predictions of new economic geography models is that nominal factor prices vary systematically across locations with their market access. This prediction relates to an older literature that relates spatial variation in economic activity to

[14] In addition to the U.S. evidence in Ellison and Glaeser (1997), Devereux, Griffith and Simpson (2004) report results for the UK, while Maurel and Sedillot (1999) report results for France.

measures of "market potential," defined as the distance-weighted sum of market demand:

$$MP_i = \sum_j (d_{ij})^{\gamma} Y_j, \tag{8}$$

where MP_i is the 'market potential' of location i, d_{ij} is the bilateral distance between locations i and j, and γ is a distance-weighting parameter, traditionally set at -1.[15]

New economic geography models can be viewed as providing micro-economic foundations for empirical measures of market potential. Consider for example the right-hand side of the wage equation (1). Suppose that the impact of transportation costs on market demand, $\tau^{1-\sigma}$, is proxied by the inverse of bilateral distance, as suggested by gravity equation estimates in which the coefficient on bilateral distance is close to minus one. Suppose also that we abstract from variation in the manufacturing price index, P, across locations. In this case, the right-hand side of the wage equation is proportional to traditional empirical measures of market potential (8). However, new economic models themselves imply that manufacturing price indices should vary systematically across locations, and therefore that in measuring market potential one should control for this variation in price indices. Following Redding and Venables (2004), we refer to theory-based measures of market potential that control for differences in price indices across locations as measures of "market access."[16]

Consider the following extension of the new economic geography model outlined in Section 2. Suppose that there are many regions indexed by i, factors of production are geographically immobile and manufacturing varieties are used as intermediate inputs to production with the same CES functional form as used for consumption (see Krugman and Venables 1995, Fujita, Krugman and Venables 1999, and Redding and Venables 2004). With the introduction of many regions and intermediate inputs, the wage equation (1) becomes:

$$\left(w^{\xi} P_M^{\eta}\right)^{\sigma} = \vartheta \sum_j \tau_{ij}^{1-\sigma} E_j P_{Mj}^{\sigma-1},$$

where the manufacturing cost function is assumed to have a Cobb-Douglas functional form with exponent η on intermediate inputs and ξ on labour; E_j denotes equilibrium expenditure on manufacturing varieties in location j, which now includes both final consumption and inter-

[15] See for example Clark et al. (1969), Dicken and Lloyd (1977), Keeble et al. (1982), Harris (1954), Hummels (1995) and Leamer (1997). For an early analysis of the role of transportation costs in influencing cross-country income, see Gallup, Mellinger and Sachs (1998).

[16] Head and Mayer (2004) instead use the term "real market potential."

mediate demand; ϑ absorbs earlier constants. This wage equation can be in turn re-written in the following intuitive form:

$$w_i = \theta MA_i^{\frac{1}{\xi\sigma}} SA_i^{\frac{\eta}{\xi(\sigma-1)}}, \tag{9}$$

$$MA_i \equiv \sum_j \tau_{ij}^{1-\sigma} E_j P_{Mj}^{\sigma-1}, \qquad SA_j \equiv \sum_i n_i \left(\tau_{ij} p_i\right)^{1-\sigma} = P_{Mj}^{1-\sigma} \tag{10}$$

where θ is again a constant. Market access, MA_i, measures a region's proximity to sources of market demand, while supplier access, SA_i, captures its proximity to sources of supply of intermediate inputs.

Redding and Venables (2004) use the structure of a new economic geography model to estimate theory-consistent measures of market access and supplier access from bilateral trade data. From the CES demand function, the aggregate value of bilateral exports of manufacturing varieties from location i to j can be written as follows:

$$n_i p_i x_{ij} = s_i \tau_{ij}^{1-\sigma} m_j, \tag{11}$$

where $s_i \equiv n_i p_i^{1-\sigma}$ is a measure of exporter i's "supply capacity," $m_j \equiv E_j P_{Mj}^{\sigma-1}$ is a measure of importer j's "market capacity." From this gravity equation for bilateral trade, supply capacity can be estimated using exporter fixed effects, market capacity can be estimated using importer fixed effects, and bilateral transportation costs can be proxied with for example measures of bilateral distance and contiguity.[17] Given estimates of market and supply capacity for each exporter and importer, market and supplier access can be constructed as:

$$MA_i = \sum_j \tau_{ij}^{1-\sigma} m_j, \qquad SA_j = \sum_i \tau_{ij}^{1-\sigma} s_i.$$

Having used the model's predictions for bilateral trade to estimate market and supplier access, these measures can be in turn used to examine the empirical relevance of the model's predictions for the relationship between spatial variation in nominal incomes and market and supplier access. Taking logarithms in equation (9), we obtain:

$$\ln w_i = \theta + \varphi_1 \ln SA_i + \varphi_2 \ln MA_i + u_i, \tag{12}$$

[17] For an alternative approach to estimating the gravity equation that exploits expenditure minimization and market clearing to solve explicitly for price indices, see Anderson and van Wincoop (2003).

where $\varphi_1 = \eta / (\xi (\sigma - 1))$, $\varphi_2 = 1/(\xi\sigma)$, and the stochastic error u_i includes cross-country variation in the price of other factors of production that enter manufacturing unit costs, technical differences, and other stochastic determinants of manufacturing wages.

Table 1 reports the results of estimating (12) using cross-country data with GDP per capita as a proxy for manufacturing wages. Because of the potential endogeneity of domestic market and supply capacity, only measures of foreign market and supplier access are considered (i.e. own country values are ignored, so the summations in (10) are over $j \neq i$). Column (1) presents the results using foreign market access alone. The estimated coefficient is positive and explains about 35% of the cross-country variation in income per capita. Column (2) includes information on supplier access as well. Separately identifying the coefficients on these two variables is difficult given their high degree of correlation. However, choosing values for η and σ implies a linear restriction on the estimated coefficients, $\varphi_1 = \varphi_2 \eta\sigma / (\sigma - 1)$, and column (2) reports the results of estimating for values of $\eta = 0.5$ and $\sigma = 10$, both of which are broadly consistent with independent empirical estimates. Including foreign supplier access reduces the magnitude of the estimated coefficient on foreign market access, but it remains highly statistically significant.

There are a number of potential concerns about these results. Are they in fact identifying an effect of economic geography, or instead picking up that rich countries tend to be located next to rich countries, particularly within the OECD? Or the results could in principle be driven by omitted variables (eg unobserved technology differences) that are correlated with both income per capita and foreign market and supplier access? To address these concerns, Redding and Venables (2004) report a number of robustness tests. For example, column (3) reports the results for non-OECD countries only, including control variables for factor endowments, physical geography, and social, political, and institutional considerations. Additionally, Column (4) repeats this specification for non-OECD countries using a measure of foreign market access based solely on distance and market capacities in OECD countries. This final specification examines the extent to which variation in income per capita across developing countries can be explained by access to OECD markets? Across each of these specification, the effect of foreign market access remains positive and significant.

While Redding and Venables (2004) focus on cross-country variation in incomes, Hanson (2005) examines cross-county variations in wages within the United States using the Helpman (1998) model. In the absence of intermediate inputs to production, the factor mobility condition

(7) together with equilibrium expenditure shares and market clearing imply that the wage equation can be written as follows:

$$w_i = \kappa + \sigma^{-1} \ln \left(\sum_j Y_j^{\frac{\sigma(\mu-1)+1}{\mu}} H_j^{\frac{(1-\mu)(\sigma-1)}{\mu}} w_j^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{ij}} \right) + \varepsilon_{i.} \tag{13}$$

where κ is a constant, Y_j denotes aggregate income, H_j is the stock of the non-traded amenity, and regional transport costs are modelled as an exponential function of distance: $e^{-\tau d_{ij}}$.

Columns (1) and (2) of Table 2 report the results of estimating equation (13) time-differenced using non-linear least squares for 1970-80 and 1980-90. The estimated coefficients are signed according to economic priors and statistically significant. The estimates of the elasticity of substitution, σ, are broadly in line with independent econometric estimates of this parameter and fall between the two time periods. The markup of price over marginal cost implied by these estimates ranges between 1.15 and 1.25. Consistent with the model, the estimated expenditure share on tradable goods, μ, lies between 0 and 1, although a value greater than 0.9 is somewhat high. The estimated value of transport costs, τ, rises between the two time periods, which is consistent with economic activity becoming more spatially concentrated in the Helpman (1998) model, and is also consistent with a shift in production away from low-transport-cost manufactures to high-transport-cost services. Finally, the theory-based measure of market access derived from the Helpman (1998) model outperforms the *ad hoc* measures of market potential discussed above, which do not control for variation across locations in the manufacturing price index.

Estimating the specification in time differences controls for unobserved heterogeneity across counties in the level of manufacturing wages. However, one potential concern is that wages have risen faster in counties with more attractive amenities (eg weather or natural geography) or more rapid human capital accumulation (both through the private rate of return to human capital acquisition and through any externalities), and these omitted variables could be correlated with changes in market access. [18] To address these concerns, Hanson (2005) shows that the results are robust to including controls for levels of human capital, demographic composition of the working age population, and exogenous amenities. The results including these controls are reported for 1980-90 in column (3) of Table 2.

[18] As human capital accumulation could be influenced in part by economic geography, it is not clear that one wants to control for this. For empirical evidence on the relationship between market access and skill acquisition, see Redding and Schott (2003).

Subsequent research has provided further evidence of a close relationship between market access and wages. For example, using data on a panel of countries over time, Mayer (2008) finds a strong correlation between changes in income and changes in market access. Using data on regions of the European Union, and exploiting both cross-section and time-series variation, Breinlich (2006) and Head and Mayer (2006) also find a strong empirical relationship between wages and market access. Using even more finely-spatially-disaggregated data within Indonesia, Amiti and Cameron (2006) again find evidence that second-nature geography matters and exploit information on intermediate input use to separate market and supplier access.[19] However, 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 indeed causal. An important concern is the omission of other determinants of wages that are correlated with market access, such as institutions and natural endowments. A further source of concern is that theoretical models of economic geography themselves suggest that market access is endogenous. Localized shocks to income in a region will also change the region's market access both directly – as the size of the region's own market is part of its market access – and indirectly by changing neighboring regions' market access and hence income, which in turn influences the region's own market access.

One strategy to address these concerns has been to use instruments for market access, which have included lagged population levels or growth rates, lagged transportation infrastructure, the distance of U.S. counties from the eastern seaboard, or the distance of countries from the United States, Europe and Japan. However, these instruments are only valid under demanding identification assumptions, which are unlikely to be satisfied in practice. For example, institutions, natural endowments and market access are all strongly persistent, and so it is unlikely that lagged population affects economic activity solely through market access. Similarly, distance from the Eastern seaboard of the U.S. could capture a wide range of factors including natural advantage and is unlikely to only affect economic activity through market access.

An alternative and influential strategy to address these concerns involves the use of trade liberalizations as a source of variation in market access. In a series of important papers, Hanson (1996), (1997), (1998) has used Mexico's trade liberalization of 1985 as a natural experiment

[19] Despite 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 land. A notable exception is Deckle and Eaton (1999).

that changes the relative market access of locations within the country. Mexico's unilateral liberalization of 1985 marked a major change in the direction of trade policy, which brought to an end four decades of import-substitution industrialization, and was followed by further regional integration in the guise of the North American Free Trade Agreement (NAFTA) of the early 1990s. Following the liberalization of the mid-1980s, there is evidence of a change in the distribution of economic activity within Mexico. For example, in the apparel industry Hanson (1996) finds that prior to trade liberalization, production was concentrated around Mexico City and largely orientated towards the Mexican market. In the aftermath of trade liberalization, there is a relocation of manufacturing activity towards the U.S. border and a shift from domestic production to offshore assembly for foreign (largely US) firms. Consistent with theories of new economic geography, this change in relative market access of locations is reflected in changes in relative wages. Prior to trade liberalization, the relative wages of locations exhibit a strong wage gradient in distance from Mexico city, while between 1985 and 1988 there is a statistically significant decline in the slope of this gradient. Therefore the strong regional wage gradient centred on Mexico City prior to trade liberalization at least partially breaks as production re-orientates towards the U.S. border.[20]

While evidence based on trade liberalizations has bolstered the case for a causal interpretation of the relationship between market access and wages, there remain a number of potential concerns. In particular, a large political economy literature models trade policy as an endogenous outcome that is determined by industry characteristics, such as supply and demand elasticities, and the ratio of imports to industry output.[21] Therefore, there remains the concern that changes in trade policy may not only alter market access and so result in changes in income or production, but changes in income or production may also lead to endogenous changes in trade policy and hence market access. To provide further evidence in support of a causal interpretation of the relationship between the distribution of economic activity and market access, Redding and Sturm (2008) examine the impact of the division of the Germany in the aftermath of the Second World War and the reunification of East and West Germany in 1990 as a source of exogenous variation in the relative market access of West German cities. In the absence of

[20] Other studies using trade liberalization as a source of variation in market access include Overman and Winters (2004) for the United Kingdom, Tirado, Paluzie and Pons (2002) for early-twentieth century Spain, and Nikolaus Wolf (2007) for early-twentieth century Poland.

[21] See for example the large literature following Grossman and Helpman (1994). The theoretical predictions of this literature receive empirical support in Goldberg and Maggi (1999) and subsequent contributions.

intermediate inputs, the factor mobility condition (7), together with equilibrium expenditure shares and market clearing, implies that the equilibrium population of each location i can be expressed as follows:

$$L_i = \chi (FMA_i)^{\frac{\mu}{\sigma(1-\mu)}} (CMA_i)^{\frac{\mu}{(1-\mu)(\sigma-1)}} H_i$$

where χ collects together constants, H_i again denotes a location's endowment of the non-traded amenity, and FMA_i and CMA_i are measures of firm and consumer market access, defined analogously to (10):

$$FMA_i \equiv \sum_j \mu Y_j \left(P_j^M\right)^{\sigma-1} (T_{ij})^{1-\sigma}, \qquad CMA_i \equiv \sum_j n_j (p_j T_{ji})^{1-\sigma}.$$

The key idea behind Redding and Sturm (2008)'s empirical approach is that German division caused West German cities close to the former border between East and West Germany ("treatment" cities) to experience a disproportionate loss of market access relative to other West German cities ("control" cities). The reason is that West German cities close to the East-West border lost nearby trading partners with whom they could interact at low transport costs prior to division. In contrast, the effect on West German cities further from the East-West border was more muted, because they were more remote from the trading partners lost, and therefore already faced higher transport costs prior to division.

The use of German division as a natural experiment to provide evidence of causal impact of market access has a number of attractive features. First, in contrast to cross-country studies, there is no obvious variation in institutions across cities within West Germany that could explain the differential performance of treatment and control cities. Second, as the analysis focuses on cities within West Germany, 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, as 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.

In line with the predictions of new economic geography models, Redding and Sturm (2008) find that the imposition of the East-West border led to a sharp decline in population growth of West German cities close to the border relative to other West German cities. Over the forty-year period of division, they estimate a decline in the annualized rate of population growth of

0.75 percentage points, implying a cumulative reduction in the relative size of East-West border cities of around one third. The market access based mechanism of new economic geography models is found to account for the relative decline of East-West border cities both qualitatively and quantitatively. They also provide evidence against alternative possible explanations, such as differences in industrial structure, differences in the degree of disruption during and in the aftermath of the Second World War, Western European integration, and fear of further armed conflict. Taken together, the results provide support for a causal interpretation of the relationship between market access and the spatial distribution of economic activity.

3.3. Market Access and Location Choices

The home market effect in economic geography models has implications not only for factor prices but also for the location of production. In neoclassical trade theories, increases in expenditure lead at most to equi-proportionate increases in production of a good, and typically lead to less than proportionate increases in production of a good because export supply curves are in general upward-sloping. In contrast, in new economic geography models increases in expenditure typically lead to more than proportionate increases in the production of a good (a "magnification effect"), because of the resulting change in firms' location decisions in a model with transport costs and increasing returns to scale.

In two ground-breaking papers, Davis and Weinstein (1999, 2003) used these contrasting predictions as the basis of a discriminating test between neoclassical and increasing returns to scale trade theories in a world of positive transport costs. Their empirical specification estimates the relationship between production of a good and measures of idiosyncratic demand, and examines whether the coefficient on idiosyncratic demand is greater than or less than one, while also controlling for other determinants of production. Davis and Weinstein (2003) consider a nested specification, where factor endowments are assumed to determine production at the more aggregate level (3 digit), while economic geography effects operate in disaggregated industries. Using data for 13 OECD countries, they first construct measures of 'idiosyncratic demand' for each 4-digit industry based on demand in the country and its trading partners, distance weighted. Estimating the effects of this demand variable on production in a pooled sample across countries and all 4 digit industries they find an elasticity of production with respect to demand of 1.6, indicating a strong home market effect. As industries could have different market structures, Davis and Weinstein (2003) also consider an augmented specification that allows for heterogeneity across industries. Disaggregating and running separate regressions for each three-digit industry (with the sample of countries and four-digit sub-industries), they find evidence of a home market effect (a coefficient on idiosyncratic demand of greater than unity) in a majority of industries, the estimated coefficient being significantly greater than unity in four industries, and significantly less than unity in two.

A similar pattern of results is found by Davis and Weinstein (1999) using a related specification and data for 29 sectors and 47 Japanese prefectures in 1985. Statistically significant home market effects are found in 8 out of 19 manufacturing sectors, including transportation equipment, iron and steel, electrical machinery, and chemicals. These effects are not only statistically significant but also quantitatively important: for the 8 sectors with statistically significant home market effects, a one standard deviation movement in idiosyncratic demand is found to move production, on average, by half a standard deviation. Additional evidence of home market effects is found using international trade data by Feenstra, Markusen and Rose (2001), Hanson and Xiang (2004), and Head and Ries (2001).

While there is therefore a strong body of empirical evidence of home market effects, there is less consensus on the relative importance of natural advantages (such as factor endowments) and the forces of cumulative causation emphasized by economic geography in determining the distribution of economic activity across space. In an influential paper, Ellison and Glaeser (1999) provide evidence that a relatively parsimonious set of measures of natural advantage explains at least 20 percent of the variation in employment shares across U.S. states and four-digit manufacturing industries. Their empirical specification regresses state-industry employment shares on interaction terms between state natural advantages and measures of the extent to which industries are dependent on these natural advantages. In another influential paper, Midelfart-Knarvik, Overman and Venables (2001) develop a general equilibrium model that explicitly incorporates both natural advantage and economic geography, and present evidence on their respective contributions for the European Union.

While considerable progress has been made examining the role of natural advantage and economic geography in influencing production location, this remains an interesting area for further research. Definitely determining when a variable reflects an exogenous natural advantage as opposed to an endogenous outcome of cumulative causation is sometimes difficult. Even when a sharp distinction between these two sets of considerations is possible, they are unlikely to be orthogonal to one another. And consistently estimating the impact of measures of cumulative causation is particularly challenging, because theories of new economic geography suggest that they are inherently endogenous, and potential sources for valid instruments are often unclear, as already discussed above.[22]

3.4. Multiple Equilibria

A central feature of new economic geography models is that there are ranges of parameter values for which there are multiple equilibrium distributions of economic activity across space. Which of these multiple equilibria is selected depends on historical accident or expectations.[23] This feature of new economic geography models contrasts with the predictions of neoclassical frameworks, in which locational fundamentals, such as institutions and natural endowments, are the primary determinants of location choices.

The potential existence of multiple equilibria has important policy implications. In this class of models, small and temporary policy interventions can have large and permanent effects by shifting the economy from one equilibrium to another. These ideas have reinvigorated debates about regional and industrial policy. They appear to offer the prospect that temporary subsidies or regulations can permanently alter the long-run spatial distribution of economic activity, with important consequences for the welfare of immobile factors.

While there is some anecdotal evidence of apparent examples of historical accident having long-lived effects on the distribution of economic activity across space, and an extensive theoretical literature on multiple equilibria in location, there is a surprising lack of systematic empirical evidence in favor of multiple steady-state distributions of economic activity.[24] On the contrary, in a seminal paper, Davis and Weinstein (2002) provide what appears to be strong empirical evidence against multiple evidence in industrial location. The key idea behind their empirical approach is that in a world with a unique long-run equilibrium distribution of economic activity determined by locational fundamentals, temporary shocks to the relative attractiveness of loca-

[22] One creative source of instruments in the literature on the relationship between productivity and population density is geology, which affects the height to which buildings can be constructed, and hence provides a plausibly exogenous source of variation in population density (see Rosenthal and Strange 2005).

[23] See Krugman (1991b) and Matsuyama (1991) for an analysis of the respective role of historical accident and expectations in models featuring multiple equilibria.

[24] For example, Krugman (1991c) discusses the case of carpet manufacturing in Dalton, Georgia.

tions have purely temporary effects, as economic activity gravitates back towards its long-run equilibrium. In contrast, in a world with multiple equilibrium distributions of economic activity across space, temporary shocks can have permanent effects, because they shift the distribution of economic activity between multiple equilibria.

To examine the empirical relevance of multiple equilibria in industrial location, Davis and Weinstein (2002) therefore consider the Allied bombing of Japanese cities during the Second World War as a large and temporary shock to the relative attractiveness of locations. Surprisingly, they find that city populations recovered very quickly from the war-time shock and cities return to their pre-war growth path within less than 20 years. If even the vast wartime devastation of cities observed in Japan cannot move the economy between multiple spatial configurations of economic activity, this appears to suggest an overwhelming role for fundamentals in determining the location of economic activity.

Following Davis and Weinstein (2002), a number of papers have examined the impact on bombing on the spatial distribution of economic activity. Davis and Weinstein (2008) show that not only the total population of Japanese cities but also the location of specific industries quickly return to their pre-war pattern. Brakman *et al.* (2004) find that the populations of West German cities recover rapidly from the devastation caused by the Second World War. Similarly, Miguel and Roland (2005) find that even the extensive bombing campaign in Vietnam does not seem to have had a permanent impact on the distribution of population and basic measures of economic development across the regions of Vietnam. Similarly, Bosker et al. (2008) find apparently little evidence of major shocks such as the plague on the relative growth of Italian cities over several centuries. Two exceptions from this general pattern of results are Bosker *et al.* (2006) and Bosker *et al.* (2007), who find some evidence of a permanent change in the distribution of population across West German cities after the Second World War.

While war-related destruction is an ingenious source for a large and temporary shock, a potential concern is that this shock may not be sufficient to change location decisions, which 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. Institutional constraints such as property rights and land-use regulations may also provide additional reasons why existing concentrations of population and industrial activity re-emerge. Finally, even if one observes changes in the location of population, as in Bosker *et al.* (2006) and Bosker *et al.* (2007), it remains unclear whether these are due to secular changes in fundamentals or a move between multiple steady-states.

To provide empirical support for the idea that location choices are not uniquely determined by locational fundamentals, Redding, Sturm and Wolf (2007) use the combination of the division of Germany after the Second World War and the reunification of East and West Germany in 1990 as a source of exogenous variation. As noted above, this natural experiment has a number of attractive features. German division, which was driven by military and strategic considerations during the Second World War and its immediate aftermath, provides a large exogenous shock to the relative attractiveness of locations. Division lasted for over 40 years, and was widely expected to be permanent, which makes it likely that it had a profound influence on location choices.

In their analysis, Redding, Sturm and Wolf (2007) focus on a particular industrial activity, namely Germany's airport hub, which has a number of advantages. In particular, there are substantial sunk costs involved in creating airport hubs and large network externalities associated with their operation, which suggests that airport hubs are likely to be particularly susceptible to multiple equilibria in their location. While Germany's airport hub was located in Berlin prior to the Second World War, it relocates to Frankfurt in the aftermath of Germany's division, and there is no evidence whatsoever of a return of the airport hub to Berlin following German reunification. Redding, Sturm and Wolf (2007) provide a variety of evidence that the difference in economic fundamentals between Berlin and Frankfurt, both prior to the Second World War and in the period since German reunification, is small relative to the substantial sunk costs of creating an airport hub. This pattern of results suggests that Berlin, Frankfurt and a number of other areas within Germany are potential steady-state locations of Germany's airport hub, in the sense that were the sunk costs of creating the hub to be incurred in those locations, there would be no incentive to relocate elsewhere.

While the attraction of focusing on a particular industrial activity susceptible to multiple steady-state locations is that it can be used to provide evidence in support of the relevance of multiple equilibria, it seems likely that other economic activities besides airport hubs have sufficiently large sunk costs and agglomeration forces for their locations not to be uniquely determined by fundamentals. Identifying the types of economic activities for which fundamentals dominate and the types of economic activities for which there are multiple steady-state locations remains an important area for future empirical research.

4. Conclusions and Areas for Further Research

There is by now an extensive and rich theoretical literature that examines the role of love of variety, increasing returns to scale and transport costs in determining the distribution of economic activity across space. Some of the central theoretical predictions of this literature appear to receive substantial empirical support, including the importance of market access in spatial variation in determining factor prices and the location of economic activity. The empirical relevance of other theoretical predictions, such as multiple equilibria in industrial location and the respective contributions of natural advantage and cumulative causation in shaping location choices remain the subject of ongoing research.

Despite the considerable theoretical and empirical advances that have been made, there remain a number of areas for potential further research. One is the respective contributions of love of variety, increasing returns to scale and transport costs and other potential sources of agglomeration, such as knowledge spillovers and the pooling of specialized skills as also emphasized by Marshall (1920). In particular, there is a large and rich theoretical literature in urban and macroeconomics emphasizing knowledge spillovers and external economies, and several of the empirical predictions of these models are closely related to those of theories of new economic geography.[25] Empirical evidence on the geographical localization of knowledge spillovers using patent citations is provided by Jaffe, Henderson and Trajtenberg (1993). In an influential recent paper, Ellison, Glaeser and Kerr (2007) use information on the characteristics of co-agglomerating industries to provide evidence on the respective contributions of all Marshall's three agglomeration forces.

While new economic geography models, and theories of agglomeration more generally, provide plausible explanations for higher wages in densely than in sparsely-populated areas, there are other possible explanations. One such possibility is the non-random selection of firms according to their productivity, as examined for example in Baldwin and Okubo (2006) and Combes,

[25] For further discussion and analysis of external economies, see for example Ciccone and Hall (2001), Combes, Duranton, Gobillon and Roux (2008), Duranton and Overman (2004), Fujita and Ogawa (1982), Greenstone, Hornbeck and Moretti (2008), Henderson (2003), Lucas and Rossi-Hansberg (2002), Rosenthal and Strange (2004, 2005), Rossi-Hansberg (2005), and Sveikauskas (1975).

Duranton, Gobillon, Puga and Roux (2008). Another related possibility is the non-random sorting of workers according to their observed or unobserved characteristics, as examined in Combes, Duranton and Gobillon (2008). Determining the respective contributions of agglomeration and the non-random sorting of firms and workers, both theoretically and empirically, is therefore an active area of research.

Another interesting avenue for further research concerns the relationship between theories of new economic geography and the city size distribution. While city growth appears largely uncorrelated with city size ("Gibrat's Law") and a linear relationship between log population rank and log population size with a unit coefficient ("Zipf's Law") appears to provide a rough approximation towards the observed city size distribution, neither of these features is typically generated by theories of new economic geography. Recent research in urban economics has begun to explore the economic forces underlying these statistical relationships and to provide explanations for the systematic departures from Zipf's Law that are observed in the upper and lower tails of the city size distribution.[26] Although this research has largely focuses on cities, historically in developed countries and in developing countries today much of the population resides in rural areas. Furthermore, there appear to be large and systematic departures from Gibrat's Law across both rural and urban areas, as examined by Michaels, Rauch and Redding (2008). In so far as urbanization − the concentration of population in towns and cities − is one of the most striking features of economic development, understanding the evolution of the population distribution across both rural and urban areas remains a pressing concern.[27]

In economic geography models, one of the central forces shaping the distribution of economic activity across space is transportation costs. While transportation costs are typically thought to have fallen over time, their future evolution climate change and a rise in the price of oil on the one hand and the development of new transportation technologies on the other is perhaps unclear. Furthermore, transportation costs are likely only a small component of overall trade costs, which also depend on the costs of acquiring and communicating information at a distance as well as the contracting costs of undertaking transactions at a distance. While transportation costs are relatively easy to measure and analyze (see in particular Anderson and van Wincoop

[26] See in particular Cordoba (2008), Duranton (2007), Eeckhout (2004), Gabaix (1999) Rossi-Hansberg and Wright (2007), and Holmes and Lee (2007).

[27] See Henderson and Wang (2007) and Henderson and Venables (2008) for analyses of the emergence of new cities as a source of growth in the urban population.

2004, Combes and Lafourcade 2005, Limao and Venables 2001, Hummels 2007, Hummels and Skiba 2004), far less is known about these other components of trade costs, and this is an active and exciting area of ongoing research.[28]

Finally, perhaps the most challenging issues facing empirical research in economic geography are the identification problems inherent in the study of endogenous choices of location, including in particular the generic problem of distinguishing spillovers from correlated individual effects. One approach to addressing these identification concerns exploits natural experiments and institutional variation, such as German division and reunification (e.g. Redding and Sturm 2008), the use of regression discontinuity design at borders to control for unobserved variation in natural advantage (e.g. Holmes 1998, Duranton, Gobillon and Overman 2007), and the use of historical patterns of land allocation to estimate externalities to crop planting (e.g. Holmes and Lee 2008). Perhaps one of the most fruitful approaches combines institutional variation with the discipline of a structural model to identify the parameters of interest (see in particular Holmes 2005, 2008).

In summary, while great theoretical and empirical advances have been made in the field economic geography, there remain a number of challenges and a host of interesting and important questions to be addressed.

[28] Influential studies on non-transportation components of trade costs, include Combes, Lafourcade and Mayer (2005), Duranton and Storper 2008), Gaspar and Glaeser (1997), Grossman and Rossi-Hansberg (2008), Harrigan and Evans (2005), Harrigan and Venables (2006), Leamer and Storper (2001) and Storper and Venables (2004).

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.

Alonso, W. (1964) *Location and Land Use*, Cambridge: Harvard University Press.

Amiti, Mary and Lisa Cameron (2007) "Economic Geography and Wages," *Review of Economics and Statistics*, 89(1), 15-29.

Anderson, James and Eric van Wincoop (2003) "Gravity with Gravitas: A Solution to the Border Puzzle," *American Economic Review*, 93(1), 170-192.

Anderson, James and Eric van Wincoop (2004) "Trade Costs", *Journal of Economic Literature*, vol. 42, no. 3, September, 691-751.

Arzaghi, Mohammad and Vernon Henderson (2008) "Networking Off Madison Avenue," Brown University, mimeograph.

Bairoch, P (1988) *Cities and Economic Development: From the Dawn of History to the Present*, University of Chicago Press.

Baldwin, Richard E. (2001) "Core-Periphery Model with Forward-Looking Expectations," *Regional Science and Urban Economics*, 31(1): 21–49.

Baldwin, Richard, Rikard Forslid, Philippe Martin, Gianmarco Ottaviano and Frederic Robert-Nicoud (2003) *Economic Geography and Public Policy*, Princeton (NJ): Princeton University Press.

Baldwin, Richard and Toshihiro Okubo (2006) "Heterogeneous Firms, Agglomeration and Economic Geography: Spatial Selection and Sorting," *Journal of Economic Geography*, 6, 323-346.

Behrens, Kristian, Andrea Lamorgese, Gianmarco I. P. Ottaviano and Takatoshi Tabuchi (2004) "Testing the Home Market Effect in a Multi-Country World: The Theory," *CEPR Discussion Paper*, 4468.

Bloom, David E., and Jeffrey D. Sachs (1998) "Geography, Demography and Economic Growth in Africa," *Brookings Papers on Economic Activity*, 1998(2), 207–73.

Bosker, Maarten, Steven Brakman, Harry Garretsen and Marc Schramm (2006) "A Century of Shocks: The evolution of the German City Size Distribution 1925-1999," Cesifo Working paper No. 1728.

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, Martin, Steven Brakman, Harry Garretsen, Herman De Jong and Marc Schramm (2008) "Ports, Plagues and Politics: Explaining Italian City Growth 1300–1861,"

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.

Christaller, W. (1933) *Central Places in Southern Germany*, Jena, Germany: Fischer (English translation by C. W. Baskin, London: Prentice Hall, 1966).

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

Clark, C, F. Wilson, and J. Bradley (1969) "Industrial Location and Economic Potential in Western Europe," *Regional Studies*, 3, 197-212.

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, and Sébastien Roux (2008) "Estimating Agglomeration Economies with History, Geology, and Worker Effects," University of Toronto, mimeograph.

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.

Combes, Pierre Philippe and Henry G. Overman (2004) "The Spatial Distribution of Economic Activities in the European Union," Chapter 64 in (eds) J. Vernon Henderson and Jacques Thisse, *Handbook of Urban and Regional Economics*, Volume 4, 2845-2909.

Combes, Pierre Philippe and Miren Lafourcade (2005) "Transport Costs: Measures, Determinants, and Regional Policy: Implications for France", *Journal of Economic Geography*, 5 (3), 319–349.

Combes, Pierre-Philippe, Miren Lafourcade, and Thierry Mayer (2005) "The Trade-Creating Effects of Business and Social Networks: Evidence from France." *Journal of International Economics*, 66(1), 1–29.

Cordoba, Juan-Carlos (2008) "On the Distribution of City Sizes," *Journal of Urban Economics*, 63(1), 177-197.

Davis, D. R. (1999) "The Home Market, Trade, and Industrial Structure," *American Economic Review*, 88(5), 1264-76.

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.

Devereux, Michael P., Rachel Griffith and Helen Simpson (2004) "The Geographic Distribution of Production Activity in the UK," *Regional Science and Urban Economics*, 35(5), 533-564.

Dicken, P and P. Lloyd (1977) *Location in Space*, New York: Harper and Row.

Dixit, Avinash and Joseph Stiglitz (1977) "Monopolistic Competition and Optimum Product Diversity," *American Economic Review*, LXVII, 97–308.

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

Duranton, Gilles, Laurent Gobillon and Henry G. Overman (2007) "Assessing the Effects of Local Taxation Using Microgeographic Data," London School of Economics, mimeograph.

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.

Duranton, Gilles and Michael Storper (2008) "Rising Trade Costs? Agglomeration and Trade with Endogenous Transaction Costs," *Canadian Journal of Economics*, 41(1), 292-319.

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 and Edward Glaeser (1999) "The Geographic Concentration of Industry: Does Natural Advantage Explain Agglomeration?", *American Economic Review*, 89(2), Papers and Proceedings, 311-6.

Ellison, Glenn, Edward Glaeser and William Kerr (2007) "What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns," Harvard University, mimeograph.

Feenstra, R.C., J.A. Markusen and A.K. Rose (2001) 'Using the Gravity Equation to Differentiate Among Alternative Theories of Trade', *Canadian Journal of Economics*, 34(2), 430-447.

Fujita, Masahisa (1988) "A Monopolistic Competition Model of Spatial Agglomeration: Differentiated Product Approach," *Regional Science and Urban Economics*, 18(1), 87-124.

Fujita, Masahisa, Paul Krugman and Anthony Venables (1999) *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.

Fujita, Masahisa and Jacques-Francois Thisse (2002) *Economics of Agglomeration: Cities, Industrial Location and Regional Growth*, Cambridge, England: Cambridge University Press.

Gabaix, Xavier (1999) "Zipf's 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.

Gaspar, J and Edward Glaeser (1997) "Information Technology and the Future of Cities," *Journal of Urban Economics*, 43, 136-156.

Goldberg, Pinelopi, and Giovanni Maggi (1999) "Protection for Sale: An Empirical Investigation," *American Economic Review*, 89(5), 1135–55.

Greenstone, Michael, Richard Hornbeck, and Enrico Moretti (2008) "Identifying Agglomeration Spillovers: Evidence from Million Dollar Plants," *NBER Working Paper*, 13833.

Grossman, Gene M. and Elhanan Helpman (1994) "Protection for Sale," *American Economic Review*, 84(4), 833–50.

Grossman, Gene M. and Esteban Rossi-Hansberg (2008) "Trading Tasks: A Simple Theory of Offshoring," *American Economic Review*, forthcoming.

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. (1998) ‘Regional Adjustment to Trade Liberalisation’, *Regional Science and Urban Economics*, 28(4), 419-44.

Hanson, Gordon H. (2005) “Market Potential, Increasing Returns, and Geographic Concentration,” *Journal of International Economics*, 67(1), 1-24.

Hanson, Gordon H., and Chong Xiang (2004) “The Home Market Effect and Bilateral Trade Patterns.” *American Economic Review*, 94(4): 1108–29.

Harrigan, James and Carolyn Evans (2005) “Distance, Time, and Specialization: Lean Retailing in General Equilibrium,” *American Economic Review*, 95(1), 292-313.

Harrigan, James and Anthony J. Venables (2006) “Timeliness and Agglomeration,” *Journal of Urban Economics*, 59, 300-316.

Harris, Chauncy D. (1954) “The Market as a Factor in the Localization of Industry in the United States,” *Annals of the Association of American Geographers*, 44(4), 315-348.

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.

Head, K. and J. Ries, (2001) “Increasing Returns Versus National Product Differentiation as an Explanation for the Pattern of US-Canada Trade,” *American Economic Review*, 91(4), 858–876.

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.

Henderson, J. V. (1988) *Urban Development: Theory, Fact and Illusion*, Oxford: Oxford University Press.

Henderson, J. V. (2003) "Marshall's Scale Economies," *Journal of Urban Economics*, 53, 1-28.

Henderson, J. Vernon and Anthony J. Venables (2008) "The Dynamics of City Formation," *NBER Working Paper*, 13769.

Henderson, J. Vernon and Hyoung Gun Wang (2007) "Urbanization and City Growth: the Role of Institutions," *Regional Science and Urban Economics*, 37(3), 283-313.

Hoover, E. M. (1937) *Location Theory and the Shoe and Leather Industries*, Cambridge, MA: Harvard University Press.

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. (2005) "The Location of Sales Offices and the Attraction of Cities," *Journal of Political Economy*, 113(3), 551-581.

Holmes, Thomas J. (2008) "The Diffusion of Wal-Mart and Economies of Density," *NBER Working Paper*, 13783.

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.

Hummels, David.(1995) "Global Income Patterns: Does Geography Play a Role?" Chapter 2 of Phd Thesis, University of Michigan.

Hummels, David (2007) "Transportation Costs and International Trade in the Second Era of Globalization," *Journal of Economic Perspectives*, 21(3), 131–54.

Hummels, David and Alexander Skiba (2004) “Shipping the Good Apples Out: An Empirical Confirmation of the Alchian-Allen Conjecture,” *Journal of Political Economy*, 112, 1384-1402.

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.

Jensen, J. Bradford and Lori G. Kletzer (2005) “Tradable Services: Understanding the Scope and Impact of Services Offshoring,” in (eds) Lael Brainard and Susan M. Collins, *Offshoring White-Collar Work – Issues and Implications*, Brookings Trade Forum, 75-134.

Keeble, D, P. Owens, and C. Thompson, (1982) “Regional Accessibility and Economic Potential in the European Community,” *Regional Studies*, 16, 419-32.

Kim, S (1995) ‘Expansion of Markets and the Geographic Distribution of Economic Activities: the Trends in US Regional Manufacturing Structure, 1860-1987’, *Quarterly Journal of Economics*, 110, 881-908.

Krugman, Paul (1980) “Scale Economies, Product Differentiation, and the Pattern of Trade,” *American Economic Review*, 70, 950-59.

Krugman, Paul (1991a) “Increasing Returns and Economic Geography,” *Journal of Political Economy*, 99(3), 483-499.

Krugman, Paul (1991b) “History Versus Expectations,” *Quarterly Journal of Economics*, 106(2), 651-667.

Krugman, Paul (1991c) *Geography and Trade*, Cambridge (MA): MIT Press.

Krugman, Paul and Anthony J. Venables,(1995) “Globalization and the Inequality of Nations,” *Quarterly Journal of Economics*, 857-880.

Leamer, Edward (1997) “Access to Western Markets and Eastern Effort,” in (ed) Zecchini, S, *Lessons from the Economic Transition, Central and Eastern Europe in the 1990s*, Dordrecht: Kluwer Academic Publishers, 503-26.

Leamer, Edward and Michael Storper (2001) "The Economic Geography of the Internet Age," *Journal of International Business Studies*, 32(4), 641-655.

Limao, Nuno, and Anthony J. Venables (2001) "Infrastructure, Geographical Disadvantage, Transport Costs and Trade," *World Bank Economic Review*, 15(3), 451-79.

Lösch, A. (1940) *The Economics of Location*, Jena, Germany: Fischer.

Lucas, Robert E. and Esteban Rossi-Hansberg (2002) "On the Internal Structure of Cities," *Econometrica*, 70(4), 1445-1476.

Manski, Charles F. (1999) *Identification Problems in the Social Sciences*, Cambridge MA: Harvard University Press.

Marshall, Alfred (1920) *Principles of Economics*, London: Macmillan.

Matsuyama, Kiminori (1991) "Increasing Returns, Industrialization, and Indeterminacy of Equilibrium," *Quarterly Journal of Economics*, 106(2), 617-650.

Maurel, F. and B. Sedillot (1999) "A Measure of the Geographic Concentration of French Manufacturing Industries," *Regional Science and Urban Economics*, 29(5), 575-604.

Mayer Thierry (2008) "Market Potential and Development," *CEPR Discussion Paper*, 6798.

Midelfart-Knarvik, Karen Helene, Henry G. Overman, Stephen Redding and Anthony J. Venables (2000) "The Location of European Industry," (joint with KarenHelene Midelfart-Knarvik, Henry Overman, and Anthony Venables) Economic Papers no. 142, European Commission, D-G for Economic and Financial Affairs, Brussels, 2000.

Midelfart-Knarvik, Karen Helene, Henry G. Overman and Anthony J. Venables (2000) "Comparative Advantage and Economic Geography: Estimating the Determinants of Industrial Location in the EU," *CEPR Discussion Paper*, 2618.

Miguel, Edward and Gérard Roland (2005) "The Long Run Impact of Bombing Vietnam," University of California Berkeley, mimeograph.

Mills, E. S. (1967) "An Aggregative Model of Resource Allocation in a Metropolitan Area," *American Economic Review*, 57, 197-210.

Muth, R. F. (1961) "The Spatial Structure of the Housing Market," *Papers and Proceedings of the Regional Science Association*, 7, 207-20.

Neary, J. Peter (2001) "Of Hype and Hyperbolas: Introducing the New Economic Geography," *Journal of Economic Literature*, 39(2), 536-561.

Ottaviano, Gianmarco I. P. and Diego Puga (1998) "Agglomeration in the Global Economy: A Survey of the "New Economic Geography," *World Economy*, 21(6), 707–731.

Ottaviano, Gianmarco, Takatoshi Tabuchi and Jacques Thisse (2002) "Agglomeration and Trade Revisited," *International Economic Review*, 43, 409-436.

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 (2004) "Trade Shocks and Industrial Location: The Impact of EEC accession on the UK," London School of Economics, mimeograph.

Puga, Diego (1999) "The Rise and Fall of Regional Inequalities," *European Economic Review*, 43(2), 303-334.

Redding, Stephen J., Ferdinand Rauch and Guy Michaels (2008) "Urbanization and Structural Transformation," *CEPR Discussion Paper*, 7016.

Redding, Stephen J. and Peter K. Schott (2003) "Distance, Skill Deepening and Development: Will Peripheral Countries Ever Get Rich?" *Journal of Development Economics*, 72(2), 515-41.

Redding, Stephen J. and Daniel M. Sturm (2005) "The Costs of Remoteness: Evidence from German Division and Reunification," *American Economic Review*, forthcoming.

Redding, Stephen J., Daniel M. Sturm and Nikolaus Wolf (2007) "History and Industrial Location: Evidence from German Airports," CEPR Discussion Paper, 6345, revise and resubmit, *Review of Economics and Statistics.*

Redding, Stephen J. and Anthony J. Venables (2004) "Economic Geography and International Inequality," *Journal of International Economics*, 62(1), 53-82.

Rivera-Batiz, Francisco L. (1988) "Increasing Returns, Monopolistic Competition, and Agglomeration Economies in Consumption and Production," *Regional Science and Urban Economics*, 18(1), 125-153.

Robert-Nicoud, Frederic (2005) "The Structure of Simple 'New Economic Geography' Models (Or, On Identical Twins)," *Journal of Economic Geography*, 5(2), 201-34.

Rodrik, Dani, Arvind Subramanian, and Francesco Trebbi (2004) "Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development," *Journal of Economic Growth*, 9(2): 131–65.

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.

Rosenthal, S. and W. Strange (2005) "The Attenuation of Agglomeration Economies: A Manhattan Skyline Approach," University of Toronto, mimeograph.

Rossi-Hansberg, Esteban (2005) "A Spatial Trade of Trade," *American Economic Review*, 95(5), 1464-1491.

Rossi-Hansberg, Esteban. and Mark L. J. Wright (2007) "Establishment Size Dynamics in the Aggregate Economy," *American Economic Review*, 97(5), 1639-1666.

Storper, Michael and Anthony J. Venables (2004) "Buzz: Face-to-face Contact and the Urban Economy," *Journal of Economic Geography*, 4, 351-370.

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.

Table 1: World Market Access, Supplier Access, and GDP per capita

ln*(GDP per capita)*	(1)	(2)	(3)	(4)
Obs	101	101	69	69
Year	1996	1996	1996	1996
η		0.5		
σ		10		
ln(FMA_i)	0.476	0.320	0.269	0.189
	[0.076]		*[0.112]*	*[0.096]*
ln(FSA_i)	-	0.178	-	-
		[0.039]		
Controls			Yes	Yes
R^2	0.346	0.360	0.669	0.654

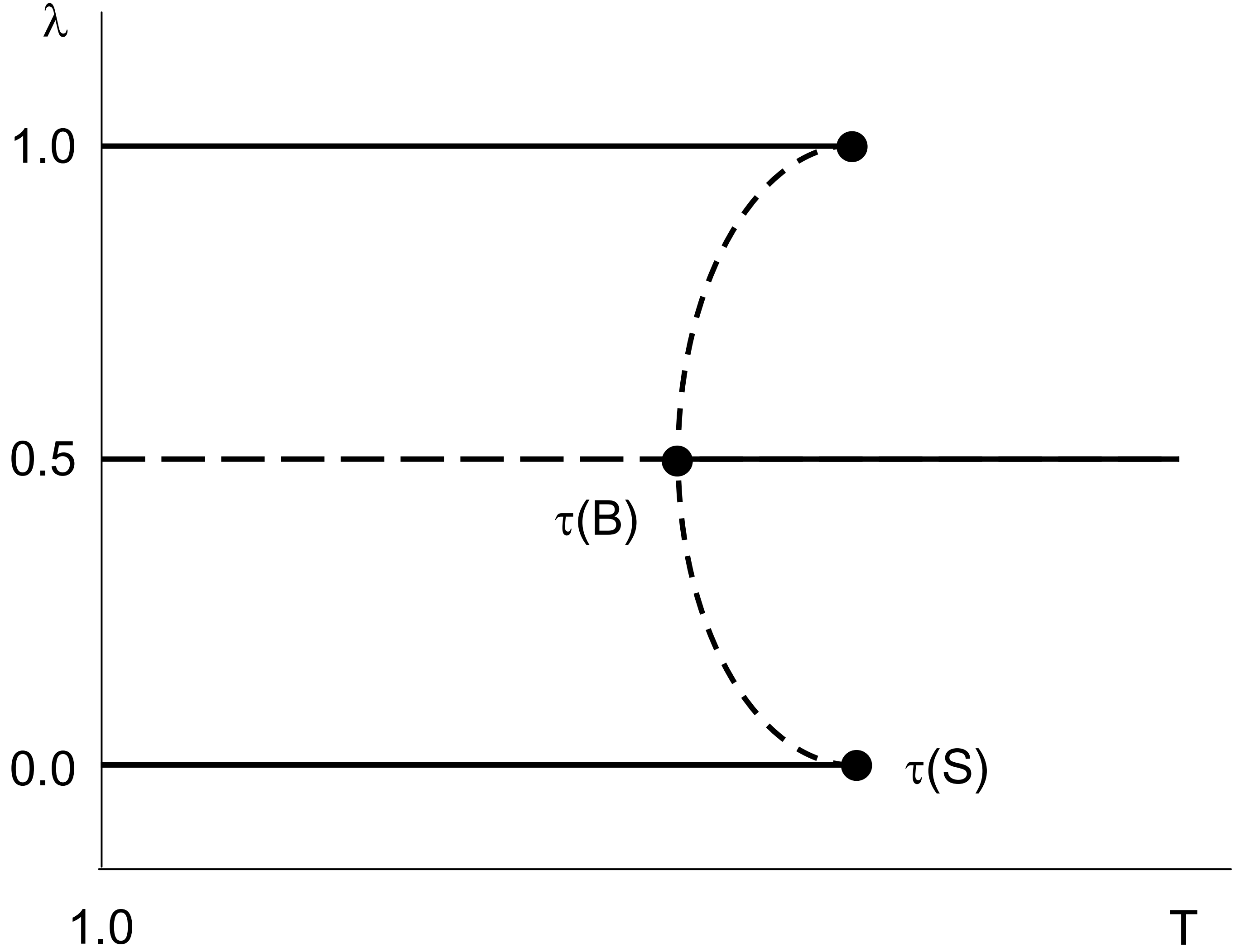
Notes: Dependent variable is ln(GDP per capita). Independent variables are ln(Foreign Market Access), ln(FMA_i), and ln(Foreign Supplier Access), ln(FSA_i). ln(FMA_i) and ln(FSA_i) are generated from estimates of a gravity equation for bilateral trade. As these variables are generated from a prior regression, bootstrapped standard errors are reported in square parentheses (200 replications). The results reported in Columns (1) and (2) are from Tables 2 and 5 of Redding and Venables (2004), while those in Columns (3) and (4) are from Table 3 of Redding and Venables (2004). The sample in Columns (1) and (2) includes 101 countries, whereas the sample in Columns (3) and (4) includes 69 non-OECD countries. Columns (3) and (4) include controls for log hydrocarbons per capita, log arable land per capita, number of mineral resources, fraction of land in the geographical tropics, prevalence of malaria, risk of expropriation, socialist rule during 1950-1995 and external war during 1960-1985. Column (4) estimates the model for 69 non-OECD countries with a measure of ln(FMA_i) constructed using only data on distance and OECD market capacities.

Table 2: Market Potential and Wages Across US Countries

	(1)	(2)	(3)
Obs	3705	3705	3705
Time Period	1970-80	1980-90	1980-90
σ	7.597	6.562	4.935
	(1.250)	*(0.838)*	*(1.372)*
μ	0.916	0.956	0.982
	(0.015)	*(0.013)*	*(0.035)*
τ	1.970	3.219	1.634
	(0.328)	*(0.416)*	*(0.523)*
Wage Controls	No	No	yes
Adj. R^2	0.256	0.347	0.376
Log Likelihood	-16698.1	-16576.9	-16479.9
Schwarz Criterion	-16714.0	-16592.9	-16575.5

Notes: Reported results are from Table 3 in Hanson (2005). Estimation is by non-linear least squares. Sample is all US counties in the continental United States, and the equation estimated is the time-difference of equation (13). All variables are scaled relative to weighted averages for the continental United States. The dependent variable is the log change in average annual earnings from Regional Economic Information System (REIS), US BEA. Regional income is total personal income from REIS. The housing stock is measured by total housing units from the US Census of Population and Housing. The specification in Column (3) includes controls for human capital, demographic characteristics, and exogenous amenities. Heteroscedasticity-consistent standard errors are in parentheses. The Schwartz Criterion is written as ln(L) - k*ln(N)/2, where k is the number of parameters.

Figure 1: Core-Periphery Bifurcation



Notes: The figure shows how the configuration of equilibria in Krugman (1991a) varies with transportation costs, τ. Solid lines denote stable equilibria. Dashed lines denote unstable equilibria. λ is the share of manufacturing workers in the North. $\tau(B)$ is the break point and $\tau(S)$ is the sustain point.