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Economic Geography and Trade*

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Summary

Economic activity is unevenly distributed across space, both internationally and within countries. What determines this spatial distribution, and how is it shaped by trade? Classical trade theory gives the insights of comparative advantage and gains from trade, but is firmly aspatial, modelling countries as points and trade (in goods and factors of production) as either perfectly frictionless or impossible. Modern theory places this in a spatial context in which geographical considerations influence the volume of trade between places. Gravity models tell us that distance is important, with each doubling of distance between places halving the volume of trade. Modelling the location decisions of firms gives a theory of location of activity based on factor costs (as in classical theory), and also on proximity to markets, proximity to suppliers, and the extent of competition in each market. It follows from this that – if there is a high degree of mobility – firms and economic activity as a whole may tend to cluster, providing an explanation of observed spatial unevenness. In some circumstances falling trade barriers may trigger the deindustrialisation of some areas as activity clusters in fewer places. In other circumstances falling barriers may enable activity to spread out, reducing inequalities within and between countries. Research over the last several decades has established the mechanisms that cause these changes and placed them in full general equilibrium models of the economy. Empirical work has quantified many of the important relationships. However, geography and trade remains an area where progress is needed to develop robust tools that can be used to inform place-based policies (concerning trade, transport, infrastructure and local economic development), particularly in view of the huge expenditures that such policies incur.

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Introduction

Spatial unevenness is a striking characteristic of the world economy. Per capita income levels vary across countries by a factor of more than a hundred to one: within countries population and economic activity concentrate in cities that cover a small fraction of the national land area: global activity in some sectors – finance, high-tech, film-making – is concentrated in relatively few cities. Some of this is explained by physical geography but most of it is the outcome of economic processes. Textbook economic principles offer no explanation of this unevenness; under the standard assumptions of general equilibrium theory economic activity will tend to smear more or less uniformly across space. A recent literature combining insights from economic geography and from trade theory does offer an explanation, showing how trade may create spatial structures which are highly uneven. Relatively uniform distribution of activity may not be a (stable) equilibrium as clustering occurs.

This paper reviews the theory and the implications that flow from it. The central question to be addressed is: what determines the location of economic activity? The question can be posed at different spatial levels: location across nations, across regions, cities, or within a particular city. And it can be posed of different economic variables: the location of people or the location of jobs, in aggregate or in different sectors. The answer is important because the spatial distribution of income and prosperity follows from it. This paper focuses on the international angle and on why some places are more attractive locations for production – and hence offer higher wages and incomes – than others.

As usual in economics, the fundamental determinants are endowments, technology, and preferences. At a point in space these are natural resources, stocks of labour and capital, available technologies and institutions, and the preferences of inhabitants. Trade and economic geography bring the extra ingredient of spatial interaction, determined by the mobility of factors of production, technology, and the goods and services that they produce. The spatial scale of mobility varies, with labour moving freely within a country but generally not between countries; capital flows between countries but is often subject to regulation; the mobility of goods and services spans the spectrum from instantaneous global transmission of digital products to non-tradable supply of haircuts and restaurant meals. The impact of these spatial interactions depends on the economic environment in which they occur. Ideas can

move quite freely but the absorptive capacity of a firm or country to employ them varies widely. The effect of integrating separate national goods or service markets depends on characteristics of the regions that are integrating, and of the sectors that are being integrated.

The tasks facing researchers in economic geography and trade are therefore twofold. (i) To understand the form and extent of spatial interactions – what is mobile, what is immobile, and why? (ii) To understand the implications of these interactions for the spatial distribution of activity and prosperity, recognising the heterogeneity of types of interaction and of the economic environments in which they occur.

Partial answers to these questions come from the classic models of international trade dating back to Ricardo and the works of Heckscher and Ohlin. These models (at least in their current textbook form, e.g. Krugman et al. 2015) concentrate on trade in final goods, trade being driven by international differences in technology (Ricardo) or endowments (Heckscher-Ohlin). These models give us the key insights of comparative advantage and the gains from trade. However, they have no geography – countries are ‘points’ and mobility is either assumed to be perfect (frictionless trade in goods) or impossible (factor assumed immobile).¹ The economic environment of these models is one of constant returns to scale and perfect competition. These assumptions limit the set of questions that can be addressed, and also mean that the approach offers little insight into three predominant features of trade and economic geography. One is that most international trade flows are curtailed sharply by distance. The second is the presence of intra-industry trade – two-way trade flows in similar products between similar economies. And the third is spatial unevenness in economic activity.

Developments in economic geography and trade have gone a long way to fill these gaps. The ‘new’ trade theory of the 1980s adds imperfect competition and increasing returns, focusing attention on the behaviour of firms. This provides a theory of intra-industry trade, and also a framework in which to analyse the location decisions of firms. Building on this it became apparent that sufficiently high levels of spatial interaction – or to put it crudely, sufficiently many things being mobile – create the possibility that economic activity will tend to concentrate in relatively few places. In some circumstances trade is a driver of convergence between places, and in others causes divergence and creates spatial unevenness.

This paper provides a selective overview of this literature and the main results and insights that come from it. The overview is non-technical, giving references to previously published technical surveys. The next section of the paper deals with the geographical pattern of trade flows; it is largely empirical, but establishes the point that geography matters for trade. The following section turns to theory, outlining a basic model of location of ‘industry’.

Throughout the paper the term ‘industry’ is used to cover productive activities whose location is not fixed by dependence on natural resources (agriculture or mining) or by servicing geographically fixed assets (e.g. provision of utilities); it therefore covers manufacturing and large parts of the service sector. Following this the paper discusses applications of the theory and empirics, finally turning to directions for future research.

The Geography of Trade

The point of departure for studying economic geography and trade is to look at the economic geography *of* trade. The overwhelming feature is that trade flows are sharply curtailed by distance. Thus, the UK trades more with Ireland than it does with China, an economy fifty times larger. Geography and spatial frictions evidently matter for trade and the tool for researching them is the ‘gravity model’, first written down by Jan Tinbergen in 1962. Stripped down to essentials, it says that the value of trade between two countries is approximated by the relationship

$$X_{ij} = F(d_{ij}, Z_i, Z_j). \quad (1)$$

X_{ij} are the exports from i to j , d_{ij} are ‘between-country’ characteristics, in particular the distance between the two countries, Z_i are exporter country characteristics, and Z_j importer country features. A relationship of this type is consistent with a number of theoretical underpinnings providing that there are some trade frictions between countries and some reason for trade.²

There is good data on bilateral goods trade between most countries in the world so this relationship can be econometrically estimated. The simplest form is to assume the relationship is log-linear, use distance as the only between-country variable and GDP as the exporter and importer country characteristics. A thorough exposition of these models, the technical issues involved and the main results is contained in Head and Mayer (2014), on which following paragraphs draw.

The coefficients on income are generally close to unity, and the coefficient on distance is close to minus one.³ This implies that the effects of distance are large: trade volumes are proportional to the reciprocal of distance so each doubling of distance halves the volume of trade (conditional on GDP). The relationship is typically estimated on aggregate goods trade and across a wide range of countries so coefficients are average effects. These mask a lot of heterogeneity – trade in oil is quite different from trade in motor vehicle parts. Estimating the relationship for service trade is hard as bilateral service trade data is not widely available, although estimates suggest that the effect of distance is only slightly less for services than for goods trade. There are some estimates of internet trade, giving estimates of the gravity coefficient about 2/3rds that of corresponding trade flows (Lendle et al. 2016).

Many other variables have been added to the minimal version sketched above. Additional between-country measures include contiguity (+, indicating more trade), common language (+), colonial relationship (+), membership of a common regional integration agreement (+), common currency (+). Further measures of exporter and importer country characteristics include land area (-) and division of aggregate GDP into population and per capita GDP, both positive and the latter larger than the former.

Finally, there is evidence that the absolute value of the distance coefficient has increased over time, rising from around 0.95 in the 1970s to around 1.1 in recent studies (Disdier and Head, 2008). This seems surprising, particularly in view of popular writings on the death of distance (e.g. Cairncross, 1997), but it should be borne in mind that this is a slope coefficient and the intercept of the relationship was increasing through most of the period; trade was increasing relative to GDP, but long-distance trade increased less rapidly than short-distance.

These findings all indicate substantial geographical trade frictions. What underpins them? Numerous mechanisms can be posited although empirical study has not been successful in establishing the relative importance of each. Transport costs are the most obvious. Research suggests that the elasticity of transport costs with respect to distance is less than unity while the elasticity of trade with respect to transport costs is greater than unity (absolute value), these combining to give the trade/ distance coefficient of -1. Time in transit is important, and has probably become more so with the rise of international production networks. The importance of just-in-time delivery in these and other trades is put forward as one reason for the increase in the absolute value of the distance coefficient through time. Perhaps the most

important factor, if hard to quantity, is a package of costs of doing business at a distance. Firms and traders are likely to have better information about nearby markets than remote ones; it is easier transacting in similar time zones; face-to-face contact is important for building trust in relationships, and so on.

The Location of Activity: Theory

Geography matters for trade, and trade matters for shaping economic geography. To capture this a theory of location of economic activity is needed. Classical trade theory offers a theory, but as noted above, its assumptions proved too restrictive to provide insight into many important phenomena. In particular, the rise in the volume of intra-industry trade that occurred in the post-war period is not readily explained by models of trade under perfect competition. This fact, together with the increasing returns revolution in economic theory that took place in the 1980s, led to a change in the focus of trade theory with the ‘new trade theory’.

There are several ingredients, of which the most important is the focus on firms. Firms are modelled as having economies of scale (this giving them finite size and implying marginal cost below average cost); as having some market power, so able to price above marginal cost; and typically deriving this market power from product differentiation, modelled in the style pioneered by Dixit and Stiglitz (1977). Production sectors are typically modelled as monopolistically competitive, i.e. with the number of constituent firms determined by free entry/ exit until a zero profit condition is satisfied. The approach provides a fertile framework for addressing numerous issues. Intra-industry trade arises naturally as each firm can make profit by selling its product in each market. Such trade is consistent with the gravity relationship as, given likely price elasticities of demand for the products of particular firms, quite small trade frictions have a large impact on trade volumes. The framework enabled rich seams of work on foreign direct investment (Markusen, 2002) and on firm level heterogeneity, the latter using micro-level datasets (Melitz and Redding, 2014).

The approach also provides a framework for analysing firms’ location decisions and hence the economic geography of trade and production. The different forces at work can be illustrated for a single industry in a simple reduced form framework. A single firm in country i has sales volume in country j expressed as $x_{ij} = f(d_{ij}, c_i, m_j)$. Sales are a decreasing with

distance, d_{ij} , and with costs of production in country i , c_i , since both of these increase the price of goods supplied from i to j . However, they are an increasing function of the ‘market capacity’ of country j market, denoted m_j . Market capacity is the size of the country j market (expenditure in the sector under study) combined (inversely) with a measure of market crowdedness, i.e. the competitive pressure from other firms that supply this market.⁴

The total sales of a country i firm across all markets are $x_i = \sum_j f(d_{ij}, c_i, m_j)$ and, in models of this type, each firm breaks-even if sales reach a particular level, \bar{x} , making positive profits if sales exceed this and losses if they are less.⁵ The number of firms in country i is denoted n_i , and the monopolistic competition setting means that there is entry of country i firms, denoted $\Delta n_i > 0$, if profits are positive, and exit, $\Delta n_i < 0$, if firms are loss making, so

$$\Delta n_i = x_i - \bar{x} = \sum_j f(d_{ij}, c_i, m_j) - \bar{x}. \quad (2)$$

Equilibrium is when the number of firms has adjusted such that $\Delta n_i = 0$ for all i .

The mechanisms that bring about this equality are dependence of costs c_i and market capacity m_j , on the number of firms, n_i .⁶ The remainder of this section outlines four forces that drive this dependency and hence ensure that equation (2) is equal to zero.

Factor Costs

The first mechanism – and that akin to classical trade theory – is that factor prices and costs of production in the country are increasing in the scale of operation of the industry, so c_i is increasing in n_i . Thus, the scale of activity in country i , as represented by the number of firms, n_i , increases until wages and costs are bid up to the point where no further entry is profitable. This obviously depends on the size, productivity, and elasticity of supply of factors of production used in country i .

Market Size and Market Crowding

Entry of firms will not only bid up factor prices in the producing country, but also increase supply and therefore reduce prices in markets to which they export. Thus, market capacity m_j is a decreasing function of the number of firms in each of the countries that export to country j .⁷ If all countries are identical the solution is easy to see. The same number of firms

operates in each country, and the number is such that factor prices and output prices have jointly adjusted to make equation (2) equal to zero.

What if countries are not symmetric? If one country is $\alpha\%$ larger than another, one might guess that it has $\alpha\%$ more firms, and this would be correct if each country's firms took the same share of each market. But if there are trade frictions and gravity holds, then firms have a larger share of their home market than of their export markets. The larger country must then have more than $\alpha\%$ of the world's firms, as its firms have the largest share in the largest market. This is sometimes referred to as the home market effect, and it means that large centres (in different contexts large cities, regions or countries) are advantaged by the geography of gravity. The advantage takes some combination of larger countries having disproportionately more firms and, if factor prices are increasing in the number of firms, also having higher wages and higher real incomes. Empirical support for this effect is discussed later in this paper.⁸

Factor Mobility

A further mechanism comes into play if factors of production – labour in particular – is mobile between places. The home market effect discussed in the previous paragraph suggests that a large country might have higher wages and real incomes. With labour mobility, this attracts immigrants, further enlarging the size of the market (tending to increase market capacity, m_i) and perhaps also mitigating increasing factor costs (reducing c_i). If this effect is strong enough then the right-hand side of equation (2) becomes an *increasing* function of the number of firms n_i , so that having more firms creates a force for attracting still more. This mechanism is the driver of the 'core-periphery' model of Krugman (1991). The simplest version of this model has two regions that are identical in their underlying structure and parameters, and some workers and firms that are mobile between regions. Symmetry of structure and parameters means that there is always a symmetric equilibrium with the same number of firms in each region, but this may be unstable – if one region gets slightly larger it will attract firms and migrants and become still larger. In addition to the unstable symmetric equilibrium there are therefore two asymmetric equilibria, in which all firms have moved to either one region or the other. The model provides no prediction as to which might occur, but makes the fundamental point that spatial interactions can create divergence in economic outcomes between places that have identical economic fundamentals.

Linkages, Intermediate Goods, and Clusters

The combination of the home market effect and labour mobility create the possibility that the right-hand side of (2) is increasing in n_i . Other mechanisms, perhaps more relevant in the international context, can have the same effect. One such mechanism is the presence of intermediate goods, produced under conditions of product differentiation and monopolistic competition (Venables, 1996). More firms in a place mean a larger market for intermediate goods (a backwards linkage creating a larger market capacity, m_i for suppliers of intermediates). This attracts firms that supply intermediate goods, and proximity of suppliers to users brings a cost reduction (a forward linkage creating a lower c_i) for firms using the goods. This reinforces the attractiveness of the place for final goods production setting off the process of cumulative causation and clustering of industry in one place.

This is one example of a wider set of *agglomeration economies* that are generated by close and intense economic interaction and have the effect of raising productivity in affected areas and activities. They arise through several different mechanisms.⁹ Thick labour markets enable better matching of workers to firms' skill requirements. Better communication between firms and their customers and suppliers enables knowledge spillovers, better product design and timely production. A larger local market enables development of a larger network or more specialised suppliers. Fundamentally, larger and denser markets allow for both scale and specialisation. A good example is given by specialist workers or suppliers. The larger the market the more likely it is to be worthwhile for an individual to specialise and hone skills in producing a particular good or service. The presence of highly specialised skills will raise overall productivity. The specialist will be paid for the product or service supplied but, depending on market conditions, is unlikely to capture the full benefit created.¹⁰ Since the benefit is split between the supplier and her customers there is a positive externality. And this creates a positive feedback – more firms will be attracted to the place to receive the benefit, growing the market, further increasing the returns to specialisation, and so on. This is the classic process of cluster formation.

These mechanisms have both a spatial and a sectoral range. They may be sector specific, tied to particular labour skills, firm capabilities, or input-output linkage (in which case they are sometimes referred to as 'localisation' or 'Marshall-Romer' economies) or may operate across many sectors (in the regional economics literature referred to as 'urbanisation' or

‘Jacobs’ economies). They are developed rigorously in the literature, being given micro-economic foundations and set in a full general equilibrium framework in which not only the determinants but also the full implications of location choices are established.

To summarise, economic geography and trade gives a theory of industrial location determined by four mechanisms:

- i) Factor costs, in turn a function of endowments and technology.
- ii) Market access; trade costs, proximity, market size and market crowding
- iii) Supplier access and agglomeration; proximity to suppliers of intermediate goods and other complementary activities or sources of technological spillovers.
- iv) Factor mobility: the mobility of factors of production, feeding back to influence endowments and market size.

The first of these is the subject of classic trade theory, and the second adds trade frictions and gravity. Together they imply diminishing returns to expanding activity, and hence unique and stable equilibria. The third and fourth are at the centre of economic geography. They create positive feedbacks and hence the potential for multiple equilibria and the clustering of economic activity.¹¹

Issues and Applications

The approaches outlined in the preceding section have been applied to a number of issues, three of which are outlined in this section, starting with international inequalities, turning to emergent structure, and ending with trade and economic development.

Trade and International Inequalities

A central concern of much work in economic geography has been imbalance between successful and lagging regions. This may be within countries or, in the international context, shaping global inequalities and economic development. Central questions are: how does openness to trade affect international inequalities? In what circumstances do some countries benefit from trade while others lose, in relative or absolute terms?

The simplest economic geography framework for addressing this question is a world containing two countries and, to address the question in its purest form, the countries are

assumed to have identical fundamentals.¹² Each country has a single factor of production (labour, which is internationally immobile), and may potentially have activity in two sectors. One is perfectly competitive, operates under constant returns to scale and is freely traded. The other is an industrial sector, monopolistically competitive as sketched in the previous section. This sector also has the feature that its output is used both as final consumer goods and as intermediates in the same sector. Thus, inputs to ‘industry’ are both labour and industrial products; and the output of industry is partly for final consumption and partly intermediate inputs for industry.¹³ What happens as the cost of trading industrial goods between countries are reduced?

This is a model in which mechanisms (ii) and (iii) of the list above operate, but mechanisms (i) and (iv) are switched off. This captures the ‘fundamental trade-off in spatial economics’, between costs of mobility and various types of scale economies (Fujita and Thisse 2002). Mechanism (ii) is a force for dispersion of activity; given that there are consumers in both countries and trade costs, firms want to locate in both countries. Mechanism (iii) is a force for concentration and clustering; firms want to be close to supplier firms and customer firms. How does the balance change as trade barriers are reduced?

At prohibitively high trade costs industry must be located in both countries in order to meet the demands of consumers so, if the countries have identical fundamentals the equilibrium will be symmetric, with production equally divided and both economies identical. As trade costs are reduced so there is intra-industry trade and consumers and producers (users of intermediate goods) gain from importing foreign industrial varieties and from the potential for exports. The symmetric outcome remains an equilibrium but there are two critical levels of trade costs at which bifurcation of equilibrium takes place. These are illustrated on Figure 1a, which has the share of industrial employment in each country’s labour force on the vertical axis and trade frictions on the horizontal. At critical value $T(S)$ two further equilibria emerge, one with country 1 specialised in industry ($\lambda_1 = 1$) and country 2 retaining a lower level of industrial employment ($1 > \lambda_2 \geq 0$), the other symmetric (i.e. with country labels reversed). The reason is that, as outlined above, intermediate goods create an agglomeration force, with firms in an agglomeration benefitting from forward linkages (lots of suppliers in the same place) and backwards linkages (lots of local intermediate demand for their output).

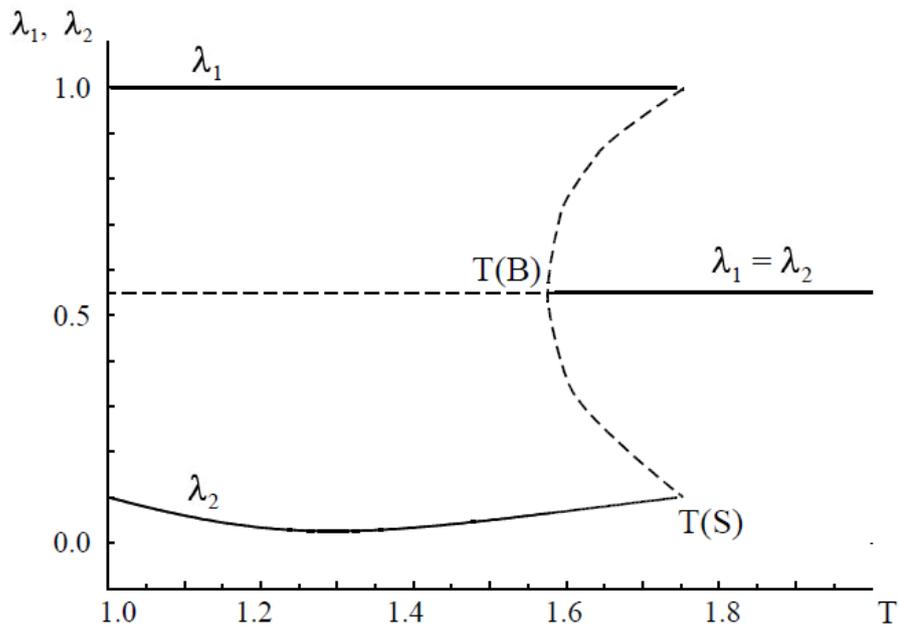
The second critical value is $T(B)$, the point of symmetry breaking. At trade costs lower than this the symmetric equilibrium is unstable (and therefore indicated by a dashed line). If one country has just slightly more industry than the other then it is profitable for further firms to move into this country, amplifying the difference between them. In the simplest model $T(S) > T(B)$ and in the interval between these values there are five equilibria, three of them stable and two (the curved dashed lines) unstable.

Figure 1b gives the corresponding real wages in each country, ω_i , relative to world average real wages (illustrated just for stable equilibria where country 1 has industry). Evidently, clustering of industry in one place creates international inequalities. The divergence of income levels reaches a maximum, beyond which further reductions in trade costs bring convergence of incomes, although not of economic structure. The reason is that, in this example, both the dispersion and concentration forces (mechanisms (ii) and (iii)) are assumed to operate only via trade costs, so as these costs go to zero so too does their effect. In the limit of perfectly free trade ($T = 1$) the location of industry becomes indeterminate, and all prices and incomes are the same in both countries (factor price equalisation).

How is this picture altered if other locations mechanisms are brought into play? Other agglomeration mechanisms (for example better labour market matching or skill development) increase the likelihood of agglomeration and makes it less dependent on trade costs, T . Thus, even with perfectly free trade, labour market forces might lead clusters to be persistent. Migration (mechanism (iv)) further increases the likelihood of clustering of activity as it tends to make large markets larger (the home market effect and core-periphery model). Migration may also operate by creating larger pools of labour – particularly skilled labour – in existing centres of activity. Pushing in the other direction are immobile factors, and the fact that centres of activity will have relatively high prices of such factors. In the urban context this is high land rents, and internationally it is high wages and labour costs.

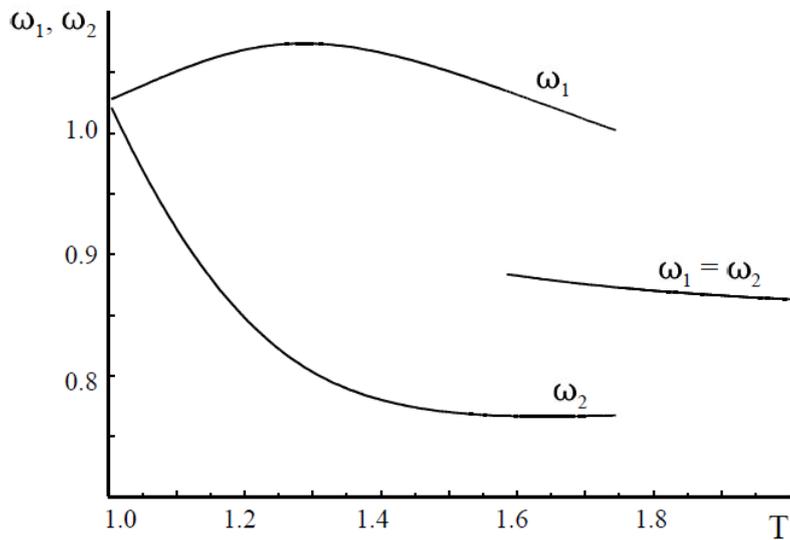
The structure of equilibria outlined above is radically different from that of classical trade theory, and provides alternative insights into the effects of trade. At its broadest, it gives insight into the rise and fall of international inequalities, from the great divergence (the rise of international inequalities following Northern Europe's industrialisation and the accompanying deindustrialisation of parts of Asia) through to the geographical spread of industry that has emerged during the era of globalisation.

Figure 1a: International inequalities; the location of industry



T: Trade cost factor; free trade where $T = 1$
 λ_i : Share of country i labour force in industry, $i = 1, 2$.

Figure 1b: International inequalities; relative real wages



T: Trade cost factor; free trade where $T = 1$
 ω_i : Real wage in country i relative to global average, $i = 1, 2$.

Based on Fujita et al. pp. 253-254.

Trade, Geography and Emergent Structure

The preceding sub-section took an example of a two country world, with just two sectors of activity. What does the structure of equilibria look like more generally? With many locations and clustering forces operating (in particular sectors and perhaps also in aggregate) we expect to see industrial activity concentrated in a subset of locations, with other places dependent on their natural resource (e.g. agricultural) base. The question then becomes, what is the size and shape of these clusters of activity? Are they high frequency (e.g. industrial activity in lots of small villages) or low frequency (concentrated in one or two locations from which they serve the world)? To address these questions Fujita et al. (1999) apply an approach from the classic work of Alan Turing (1952) on morphogenesis.

The starting point is 'flat earth' – a situation in which economic activity is smeared uniformly across space. If all points are identical (in fundamentals and outcomes) then this is an equilibrium, although it may be unstable. If so, slight perturbation will cause structure to emerge from the homogenous starting point as the system moves to an asymmetric equilibrium. The size and frequency of clusters that form at this frequency has a distinct eigenvalue, determined by parameters that drive the dynamic adjustment process. Thus, in simple cases it can be shown that if trade costs are high and agglomeration forces weak there will be high-frequency clustering, i.e. numerous small clusters of activity. Lower trade costs and/or stronger agglomeration leads to low-frequency outcomes, with fewer but larger centres. Increasing the share of immobile factors of production (whose prices are determined by demand at each point, rather than being set through international arbitrage) also leads to low-frequency outcomes and, if the share is large enough, will prevent clusters from forming at all.

These results are derived by starting, for each set of parameters, from 'flat-earth'. What happens if the starting point is an established pattern of clusters? The thought experiment is to suppose an initial situation of high-frequency clusters (established with high trade costs), and investigate what happens as trade costs are reduced. The answer is that the structure is robust over a wide range of trade costs, and only when a critical value of costs is reached does spatial structure reorganise to a lower frequency pattern. If the change was occurring through time the pattern would be one of punctuated equilibria; long periods of stability punctuated by periods of radical spatial reorganisation of as existing clusters unravel and new ones become established.

The robustness of a given spatial structure derives from several forces. One is the rents of agglomeration. An established centre has high productivity and a hence an advantage over other places. In equilibrium the advantage is captured by immobile factors – land in the case of cities, labour in the international context. Small changes may squeeze these rents, but not to the point where it ceases to be profitable to operate. This argument is amplified by the fact that capital – buildings, but also human capital in sector specific skills -- is sunk in existing centres, so is earning quasi-rents. The other side of this coin is the difficulty of establishing new activities in new places, this creating obstacles to economic development.

Economic Development and Coordination Failure

Agglomeration forces are generally driven by economies of scale which are external to individual economic agents (firms or workers) but internal to a place which, depending on context, may be a district within a city, a wider region, or a country as a whole. This externality creates a ‘first-mover problem’ and means that it is hard to start an activity in a new place. If a place has the activity then agglomeration benefits mean that productivity is high enough for the place to be competitive (even at relatively high wages). If the place does not have the activity then the productivity of a potential entrant is low, so entry is deterred. Coordinated action by many firms could achieve scale, but coordination failure may mean that the place remains trapped in a low-level equilibrium.

This problem is fundamental for the regeneration of areas of a city, for policy towards lagging regions, and for structural transformation in developing economies. For example, a developing economy may be accumulating factors of production and technology, and acquiring a potential comparative advantage in new sectors. However, in the absence of existing activity productivity is low, it is not profitable for any single firm to enter, and this potential comparative advantage is not realised. This coordination failure means that development of such sectors will commence later than is efficient and that there is scope for policy intervention. This argument formed the basis of ‘big-push’ models of economic development (Hirschman, 1958, Murphy and Shleifer 1989) and for policies that promote linkages between related sectors (Myrdal 1957, Hausman and Hidalgo 2009).

For practical purposes, the sectoral scope of agglomeration effects is important. Trade liberalisation and falling transport costs have enabled the development of global production networks in which a particular country (or city) specialises in a narrow part of the production

process, sometimes referred to as ‘task specialisation’.¹⁴ Such narrowly defined tasks may have an extreme factor intensity (e.g. be very unskilled labour intensive), so that factor cost differentials are particularly important in location decisions. Furthermore, it is easier for countries to achieve scale in production of narrow tasks than it is to get scale and productivity across a whole sector or range of sectors. Thus, a development path has been to create jobs through clusters of activity in sectors such as ready-made garments (employing 4 million people in Bangladesh, clustered around Dhaka), electronic components or assembly. However, global production networks have their own economic geography. They form between countries which have both significant factor cost differences and proximity (i.e. within East Asia and between the US and Mexico). And they are spatially uneven, as agglomeration economies have concentrated them in particular places. Coordination failure matters even at this fine task level, and has made it hard for new centres to become established, as witnessed by the numerous special economic zones that have been created around the world but which have failed to achieve this objective.

Empirical Studies

Agglomeration economies are a key mechanism in generating unevenness. There are many studies of the effect of economic scale and density on productivity, often undertaken on city level data, and the first raw finding is that the elasticity of productivity with respect to city size is of the order of 0.05-0.1. Thus, a city of 5 million inhabitants typically has productivity 12-26% higher than a city of ½ million. This raw number has been refined in many directions.¹⁵ For example, the skill and occupational mix of the labour force varies across cities, impacting on measured productivity. Controlling for observed measures of skill (e.g. education) typically brings the elasticity down by about a quarter. This might only be part of the story, as there may be sorting, meaning that people with higher innate ability (regardless of education) are disproportionately drawn to cities. The only way to observe this is to track individuals as they move in to cities or to cities of different sizes. Recent empirical work doing this suggests that the pure agglomeration effect has elasticity of 0.02 – 0.04 (Combes and Gobillon 2015). This is still a substantial number.¹⁶

Estimates can be produced by sector, and indicate that productivity effects are largest in high-tech sectors and business services. Corresponding to this, sectoral clustering is apparent in many sectors (ranging from financial services and films to the production of buttons).¹⁷ The

extent of clustering at the sectoral level has been demonstrated by authors including Ellison and Glaeser (1997), who show that many US industries are much more clustered than would be expected by randomness. This is linked to the home market effect by Davis and Weinstein (2003). In a neo-classical model spatial variation in expenditure on a sector should be linked with less than proportional variation in production, whereas in a geography model the home market effect would cause the increase in production to be more than proportional. They find the latter effect present in many manufacturing industries.

Finally: does geography matter for income differences? Effects are expected to show up in the prices of immobile factors and, within countries, this is apparent in variations in the price of land between rural and urban areas of different sizes. Internationally, several lines of research have looked at the impact of geography on income. The impact of natural geography is studied in a line of work following Sachs and Warner (2002), pointing to the sometimes negative impact of natural resource and fossil fuel abundance on per capita incomes. The impact of economic geography is studied by constructing various measures of access to markets and to suppliers (measures derived from estimating gravity trade models) and estimating their impact on income (Redding and Venables 2004, Head and Mayer 2011). These measures explain a substantial proportion of cross-country variation in per capita income, and estimated parameters are consistent with plausible values of model parameters. Establishing that the relationship is causal is problematic, particularly as other variables such as quality of institutions may be highly correlated with market access and income levels. In the search to find solutions to this problem researchers have looked for natural experiments, one notable one being the partition of Germany (Redding and Sturm 2008). West German cities close to the border with the East experienced substantial population decline, attributed by the authors to the loss of previous trading links and market access.¹⁸

Future Directions

Geography is now incorporated in economic models of international trade, although the focus has been predominantly on trade costs and gravity rather than the richer story of firm location, unevenness, and multiple equilibria. Firm location and spatial unevenness are developed more fully in the literature on urban and regional economics where there is both analytical and empirical work studying the location of activity and quantifying the agglomeration forces that shape it.

These developments have laid the foundations for thinking about policy, but the research literature is far from having a robust set of guidelines for formulation of spatial policy. Vast resources are spent trying to promote the development of lagging regions – internationally, within countries, and within cities. Much of this is done in the hope of achieving transformational change (i.e. encouraging positive feedback mechanisms to come into play so that an area will develop) but little is yet known about circumstances under which this is more or less likely to occur.¹⁹ To take one example, China's belt and road initiative is a trillion dollar experiment in economic geography and trade; do we have the tools to think through its likely effects? Developing such tools remains the challenge, and one route is through the emerging literature on quantitative spatial economics in which economic geography models are calibrated to urban or national data (Redding and Rossi-Hansburg 2017, Donaldson 2015). Effects of policy will always be context specific and, given increasing returns and multiple equilibria, have an inherent uncertainty. Prediction may not be possible, but quantitative tools firmly grounded in theory and data will provide a way of illustrating scenarios of possible outcomes.

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Further Reading

Accessible introductions to the area are Krugman (1991b), Moretti (2013). A textbook treatment is given by Brakman, et al. (2001). There are good surveys of a number of aspects of the literature, including Donaldson (2015) , Duranton & Puga (2004), Head & Mayer, (2004), (2015), Redding & Rossi-Hansburg (2017) . A comprehensive statement of early development of the field is Fujita et al. (1999).

Notes

¹ There are also distinct literatures on frictions due to trade policy and on the effects of factor mobility. See Norman and Venables (1995) for a synthesis of trade frictions and factor mobility in a Heckscher-Ohlin framework.

² Trade can be generated by national level product differentiation (Armington 1969), Ricardian productivity differences in a multi-commodity setting (Eaton and Kortum 2002), or factor endowments with firm level product differentiation (Helpman and Krugman 1985).

³ Nineteenth century ‘social physics’ hypothesised that human interactions were analogous to physical ones. Physical gravity operates in 3-dimensional space so distance has coefficient -2. The surface of the earth is 2-dimensional, so the analogous gravity coefficient would be expected to be -1.

⁴ The terminology follows Redding and Venables (2004). The familiar concept of country i market access is an inverse distance weighted sum of market capacities across countries j with which i trades, $market\ access_i = \sum_j m_j / d_{ij}$. See also Anderson (2011) for links with the gravity model.

⁵ The benchmark model sketched here assumes that all firms in a particular country/ industry are symmetric. If firms are heterogeneous, e.g. in their productivity levels, then the marginal firm breaks even and firms with higher productivities make positive profits. For development of such models see Melitz and Redding (2014).

⁶ In a particular sector of a closed economy there is just one equation and a single variable n_i . In a multi-country context i, j are values of an index over the total number of countries so that equation (2) is a simultaneous system determining the number of firms active in each country. Solution is subject to the impossibility of a negative number of firms, so $\Delta n_i \leq 0$, $n_i \geq 0$, complementary slack.

⁷ In the Dixit-Stiglitz framework the measure of market crowdedness is the price index of all varieties sold in the country j market.

⁸ For generalisation of the home market effect to many countries and industries see Behrens et al. (2009).

⁹ Discussion dates back to at least Alfred Marshall (Marshall 1920). For a modern survey see Duranton and Puga (2004).

¹⁰ The supplier will capture the full benefit only if able to perfectly price discriminate. Otherwise, the customer will also receive some consumer/ user surplus on the introduction of a new product. This observation is central to the wide-range of economic models in which the number and variety of goods and services offered is endogenous (following Dixit and Stiglitz 1977).

¹¹ For an elegant synthesis of the tension between dispersion and agglomeration forces and an application to intra-country unevenness see Allen and Arkolakis (2014).

¹² This section draws on Venables (1996), see also Fujita et al. (1999).

¹³ In general this would be through a full input-output matrix. In this example it is aggregated to a single sector using some of its own (differentiated) outputs as inputs.

¹⁴ See Grossman and Rossi-Hansburg (2008) and, for a wider view of global production networks, Baldwin (2016).

¹⁵ See Rosenthal and Strange (2004) for a survey.

¹⁶ In some contexts, it may not be appropriate to impose all these controls. Suppose that someone achieves high productivity by undertaking education to acquire a skill that is in demand only in large

cities. Then both the city and the education are necessary for attaining the productivity, and it would be wrong to attribute it all to education.

¹⁷ The city of Qiaotou produces 60% of the world's buttons and 200,000km of zippers per year.

¹⁸ There are substantial recent literatures re-evaluating the gains from trade and looking at the effects of transport improvements. These are outside the scope of this paper, and are both surveyed in Donaldson (2015).

¹⁹ An exception is the careful study of the Tennessee Valley Authority by Kline and Moretti (2013). See Duranton and Venables (2018) for further discussion of issues and a review of some of this literature.