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What Should Policy Makers Learn From Recent Advances
in Growth Theory and New Economic Geography?

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Abstract: During the last decade issues such as growth and convergence, core-periphery structures, and regional development have come to the forefront in policy circles. At the same time as political concerns about regional development increased, new theories of economic growth and economic geography were developed. This paper provides a brief review of this literature and attempts to draw out some policy conclusions. The most fundamental policy implication of the models discussed above is that one needs to understand the mechanisms that determine growth and the location of economic activity. The endogenous growth literature highlights the role of externalities and spillovers which require that governments fulfil the important role to ensure that the engines of growth are supplied at the optimal level. The major contribution of the new economic geography is that it shows that concentration and the emergence of cities is a natural outcome of market interaction.

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What Should Policy Makers Learn From Recent Advances in Growth Theory and Economic Geography?

1. Introduction

During the last decade issues such as growth and convergence, core-periphery structures, and regional development have come to the forefront in policy circles. Within the EU, the Single Market project led to a recognition that not all countries would benefit equally from the deepening of the EU (Braunerhjelm et.al., 2000). Thus, the process of EU integration itself may lead to income divergences, which led the EU Commission to reform the Structural Funds and introduce the Cohesion Funds (see Cecchini, 1998). At the national level within Ireland there has also been renewed interest in the issue of Irish regional development from a policy perspective. Evidence for this can be found in the National Development Plan, where for the first time, the government committed itself to the drawing up of a National Spatial Strategy, which has since been published and which is to address the future spatial structure of Ireland. This concern about regional development emerged since, despite the exceptional performance of the national economy, at the regional level development during the 1990's was characterised by divergence between the Irish regions despite the fact that all regions grew more rapidly than the EU average.

At the same time as political concerns about regional development increased, new theories of economic growth and economic geography were developed. These have been among the most dynamic fields of economic research over the last decade and a half, which follows a period during which economists at least displayed little interest in these topics. An important feature of the development of these fields of research is the fact that they utilise some of the same modelling advances and both make predictions about development of

regions and countries, and indeed the two types of models have been successfully merged by a number of authors. Furthermore, the increased attention to growth and economic geography has also led to advances in the more traditional models of economic growth and trade. For example the impact of human capital development on growth has been studied in a traditional Solow-Swan model (see Makiw, Romer and Weil, 1992). Similarly distance has been incorporated into trade models yielding some predictions on the geography of trade patterns (see Bougheas, Demetriades and Morgenroth, 1999, and Limao and Venables, 1999). In both cases these studies are complementary to the new theories of growth and economic geography, and indeed some researchers work on both traditional and new approaches.

The important innovation of both literatures is that all results are derived from the actions of individuals and firms in the market place in a general equilibrium setting. So, for example, growth arises out of the actions of individuals who find it beneficial for them to acquire a higher level of human capital, which through externalities raises the productivity of the whole economy. Similarly the geographic distribution of economic activity is the outcome of market forces rather than some ad hoc mechanism that is simply assumed or imposed. This means that these new models have the attractive property that they are rigorously derived and do not ignore the implications of changes in one variable on the rest of the economy. However, on the negative side, in order to make the models mathematically tractable they require many simplifications and in particular some restrictive assumptions regarding individual preferences and the cost functions facing firms (see Neary, 2001).

In order to gauge the impact of the theories a simple search for some key words in the widely used bibliographic database *Econlit* can be used since this contains entries for the vast majority of economics publications. For example a search for the two words *endogenous* and *growth* yielded 1280 entries for the period including 1986, the year the first article on endogenous growth was published by Paul Romer (Romer, 1986) until early in 2002. For the period

from 1960 to 1985 there were only two entries that contained these two words either in the title, abstract or key words. A similar search for *agglomeration* and *economies* which are key for the new economic geography 120 entries were found for the period 1991, when Paul Krugman published his first article on economic geography (Krugman, 1991) to 2002, with just 28 entries for the period before 1991.

Given that these new theoretical developments which have also generated associated empirical research, have received widespread attention within the economics profession, have been associated with some of the best known figures in economics, and their emergence also coincides with a significant interest among policy makers in regional development issues, a natural question is to ask what policy lessons if any can be drawn from this new body of research and such a review is the subject of this paper. Indeed, particularly the Irish National Spatial Strategy (NSS) could have been considerably improved if it had drawn on this large research literature¹. However, given the many contributions to both literatures this paper can only aim to draw out the main findings on policy rather than provide a thorough review of the complete literature. For more complete discussions of the new growth literature the reader is referred to books such as Hammond and Roriguez-Clare (1993), Aghion and Howitt (1998), or Barro, R. and X. Sala-i-Martin (1995) and for a review of the new economic geography literature to . Fujita, Krugman and A. J. Venables (1999), Fujita and Thisse (2002) or Neary (2001).

At this point it must highlighted that the new economic geography literature has not found favour in all quarters. In particular, this literature has been attacked by some geographers, notably Ron Martin (see Martin, 1996, 1999). Martin firstly is critical of the fact that economists have largely ignored geography in models of trade and growth. However, now that economists are increasingly incorporating geography into their models and indeed aim to explain the economic geography, Martin is scathing about their use mathematics. Overall Martin argues that what he calls new geographical

¹ See Morgenroth (2003b) for a critique of the National Spatial Strategy.

economics is neither new nor geography. Be that as it may this paper will not pursue this rather tetchy methodological debate and will stick with the term new economic geography. This is preferred over the term geographical economics since this literature seeks to explain the general forces that give rise to the emergence of geographic concentration of economic activity and therefore the economic geography of regions countries and the world.

It is however worth noting that it seems particularly appropriate for economists to study geographical location of economic activity, and the resulting geographic patterns of agglomeration and dispersion, since it is the allocation of scarce resources through human interaction that determines the economy and therefore economic geography. Economics is the study how scarce resources are allocated; not just across individuals and time but also space.

2. New growth theory

As was shown above the literature on endogenous growth started 5 years before that on new economic geography and has lead to a much more extensive body of research. In this section the origins of this literature are briefly reviewed and its major advance are highlighted.

The major shortcoming of the older literature on economic growth was the fact that technical progress which is the ultimate source of growth could not be modelled and was therefore taken to be exogenous. Thus, the long run growth rate in these models depends just on the rate of exogenous technical progress and/or population growth which is also exogenous. Thus, given the exogeneity of the engines of growth, policy could not alter the long-run steady state growth rates, rather it could only alter the transition path towards that long-run equilibrium. The role for policy makers was therefore confined to ensuring that markets work efficiently (an assumption of these models). An important implication of these models is that poor countries should grow faster than rich countries, i.e.. they should converge as long as they have the same steady state. This would arise out of diminishing returns to capital, in other

words as economies accumulate capital its average product declines, thus countries starting at a lower level of capital should have higher growth rates.

The recent endogenous growth theory has addressed the shortcomings of the earlier pioneering literature. In particular it has focused on how the limitations of diminishing returns could be overcome. In particular these models have investigated how the accumulation of reproducible factors such as infrastructure, human capital or knowledge/ innovation or through specialisation, trade, financial intermediation and social capital. Clearly, it is these factors together that account for differences in growth rates between countries and there are important complementarities between them. Thus, successful R&D activities will require individuals with a high level of human capital. Similarly, people with a higher level of human capital more readily adopt innovations. However, it is difficult to incorporate all these factors into one model.

2.1. R&D/ Knowledge

Technical progress is to a large extent driven by research and development (R&D) activities. This has been incorporated into growth models as the accumulation of knowledge (e.g. Romer, 1986) or improvements in the quality of intermediate inputs (e.g. Aghion and Howitt, 1992, 1998). In the Romer model learning by doing results from the investment process which implies that the knowledge of the workforce is a function of the capital stock. Since the state of knowledge is embodied in capital it is in effect a public good available to all individual producers. Thus, investment by individual producers generate an externality through an increase in this public good, which gives rise to increasing returns at the aggregate economy wide level.

Romer (1990) goes further by dropping the assumption of perfect competition which cannot hold if knowledge/technology is a non-rival partially excludable good. Thus he derives a model where R&D is subject to fixed costs and where the market structure is characterised by monopolistic competition which utilises the specification of Dixit and Stiglitz (1977). The interesting results of

this model include the prediction that the rate of technical change is sensitive to the interest rate since research needs to be carried out now in order to yield technical progress in the future so the benefits of research do not accrue immediately. In this model research is carried out by individuals with high human capital and the stock of human capital generates growth. In equilibrium there is not enough human capital.

In another model (Ben-David and Loewy, 2000), the level of human capital in a country is determined by knowledge accumulation in that country and by knowledge accumulation in other countries. The impact of 'foreign' knowledge accumulation on the domestic economy depends on the ability of the domestic economy to access this knowledge which is determined by trade. Higher levels of trade result in higher growth rates since this increases the spillover (externality) from foreign knowledge. The model predicts conditional convergence among countries that trade extensively with one another.

2.2. Infrastructure

Another avenue that has been explored is the effect of public infrastructure, which is typically modelled as an additional input in the production function (Barro, 1990, Futagami et. al., 1993). Public infrastructure raises the marginal product of private capital thus sustaining growth. However, it is important to note that infrastructure has to be financed through taxes and it is therefore important that the tax revenue is spent in infrastructure that is more productive than any other expenditure that could have been financed by the tax take. Another important way in which infrastructure impacts on economies is by connecting them. Thus, Kelly (1997) argued along Smithian lines that infrastructure allows for an expansion of markets which in turn increases specialisation which improves efficiency and therefore growth. In this model growth is subject to threshold effects, requiring sufficient infrastructure to properly integrate markets which then increases specialisation. Another way in which infrastructure has been incorporated into growth models is to assume that infrastructure reduces the cost of intermediate inputs by fostering specialisation (Bougheas, Demetriades and Mamuneas, 2000). This model

yields a non-monotonic relationship between infrastructure and long-run growth. An important finding of this model is that infrastructure accumulation is very productive if the tax rate is low and counter-productive if the tax rate is too high.

Much of the recent literature on the effects of infrastructure on growth has focused on the estimation of the rate of return to infrastructure. This is inferred from the output elasticity of infrastructure, and the latter is estimated under the assumption that infrastructure enters the production function as a public intermediate factor input. An alternative approach involves the estimation of a cost function and associated factor demand functions which yields shadow values for infrastructure.

A consensus is emerging that infrastructure almost always has a positive impact on growth. However, the size of that impact has been the subject of much debate ever since Aschauer (1989a, 1989b) found that the US output elasticity with respect to infrastructure lay between the values 0.39 and 0.80. Taking the lower value of the elasticity, this estimate implied that a 1% increase in the stock of infrastructure (\$19.38 billion) would result in an immediate increase in output of 0.39% (\$16.8 billion).² Similar results were found by Wylie (1996) for Canada.

These results have been subjected to a substantial body of criticism which focused largely on issues related to the econometric estimation of the underlying production function. Thus, Holtz-Eakin (1994) found that infrastructure had at best a negligible effect on output. Subsequently numerous studies have addressed this issue with many finding a positive impact of infrastructure on output, but often a more modest one than found in the early studies of Aschauer. Generally, the production function studies suggest that the elasticity of output with respect to infrastructure is likely to lie in the range 0.1 to 0.4, while cost function studies find somewhat smaller cost elasticities of between -0.05 and -0.2. Thus, an increase in the stock of

² Using this elasticity the marginal product of infrastructure would have been 0.96 in 1991!

physical infrastructure (roads, railways, ports, telecommunications, etc.) almost always leads to increased output. In part, this arises from the role of infrastructure as a direct factor input into production. In part, it arises from the role of infrastructure in increasing the productivity of other factors. In large countries or regions, where spillover effects are internalised, the impacts are bigger than in smaller countries or regions, where some of the spillover effects leak out into adjoining countries or regions.

2.3. Human Capital

The role of human capital is a vital field of research since human capital can be viewed as an essential prerequisite to the adoption of the types of change induced by globalisation and new technologies. Human capital has been integrated into growth models in different ways and thus this literature is particularly rich in that it also provides interesting empirical tests of the different models.

Human capital can be acquired through education, learning-by-doing or be passed on between generations. However, a crucial distinction has been made between models where human capital is needed for R&D purposes (see Aghion and Howitt, 1992) and models where human capital enters directly in the production function (Lucas, 1988). The former approach implies that growth is driven by the stock of human capital whereas the latter implies that growth is driven by the process of accumulation of human capital (see Aghion and Howitt, 1998). The Lucas approach assumes that the marginal product of human capital remains positive regardless of the state of technology, which is unrealistic. On the other hand the Aghion and Howitt approach incorporates scale effects that suggest that large countries should grow faster since, other things being equal large countries possess a larger stock of human capital. However, this prediction is not supported by the data (see Jones, 1995, Cannon, 2000).

The empirical evidence at the macro level is not conclusive regarding the growth effects of human capital. Thus, while studies by Benhabib and Spiegel

(1994) and Pritchett (2001) find little evidence that human capital growth positively affects output growth, other studies (e.g. Temple, 1999 and Bassanini and Scarpetta, 2001) do find a correlation between the two. At least to some extent these conflicting results can be attributed to the difficulty in measuring human capital (Hanushek and Kimko, 2000). Thus, in the empirical literature human capital has been proxied by the percentage of the population of school going age which takes part in second level education, the average years of schooling of the population, the pupil teacher ratio, expenditure in education and average test results.

An important issue that is receiving a lot of attention at the moment relates to the fact that in contrast to the empirical macro literature, there is a broad consensus in the empirical micro economic literature that education has a positive and significant effect on individual earnings (see Ashenfelter, Harmon & Oosterbeek, 1999).

2.4. Finance

An important factor in the development of firms is the role of financial intermediation (see the review by Pagano, 1993). As was noted above interest rates can have a negative impact on investment in R&D and thus reduce growth. However, there are other ways in which financial intermediation can impact on growth. For example the way in which savings are transformed into investment depend on the financial intermediaries. If these are inefficient or work in a non-competitive environment this can lead to less funding being made available for investment since in this case the financial intermediaries may increase their margins. Government policy through the imposition of high reserve requirements, taxes or other regulation can also significantly reduce the fraction of savings that is funnelled into investment.

Another way in which financial intermediaries have an important bearing on growth is through the allocation of capital. If they allocate resources to inefficient companies then growth is likely to be lower than if they allocated the

capital to highly efficient firms. Clearly the allocation decisions are also subject to risk, thus the investments with the higher potential return also are often those with the higher risk. In general financial intermediaries through their portfolio can hedge the risk better than individuals, which implies that the more risky but potentially more productive investment is more likely to be undertaken by financial intermediaries (Greenwood and Jovanovich, 1990, King and Levine, 1993a).

Financial intermediaries also allow for risk sharing. For example firms may be reluctant to specialise into narrow niches which would improve efficiency if this leaves them vulnerable to shocks. In such a situation access to stock markets lets these firms hedge this risk which thus frees them up to specialise, thus leading to higher aggregate growth in the economy (see Saint-Paul, 1992). Improved capital markets also allow individuals to hedge against risk although the impact of this tends to be ambiguous since it may give rise to more saving or less saving or even borrowing. Of course borrowing in order to develop human capital does tend to increase growth.

Empirically there is some support for the theoretical models. For example King and Levine (1993b) find support for the link between financial development and growth in cross-country regressions using a range of indicators. However, one needs to be careful interpreting such results since they ignore the peculiarities of the financial sectors of the individual countries. This is pointed out by Arestis and Demetriades (1997), who find that, using time series data the evidence is somewhat more mixed. Furthermore, the causation is not always from finance to growth as pointed out in the work of Demetriades and Hussein (1996).

2.5. Trade/ Openness/ Integration

In a number of models highlighted above the degree of specialisation and the size of the market were the drivers of growth. Clearly, trade allows firms access to larger markets than their own domestic market and this may also therefore drive growth. Rivera-Batiz and Romer (1991) show in a simple

model that if the mechanism that generates growth, e.g. R&D, is subject of increasing returns to scale then integration by increasing the extent of the market will lead to growth. Along similar lines, trade allows for a transfer of technology, which should lead to higher growth in countries that lag behind in terms of technological development. However, in models where such spillovers are limited geographically the general result is that the trade pattern after integration will be determined by initial conditions. Thus countries that are ahead in their technological development end up dominating the market in these high tech sectors and will grow faster, despite the fact that trade is welfare-improving in all countries. A further implication of being locked into the low-tech sectors is that the returns to education drop and therefore the incentives for individuals to gain higher levels of education decline thus reinforcing the lagging nature of that economy (Saarenheimo, 1993). However, government policy in the form of R&D subsidies can help change this outcome and allow a lagging country to become dominant in the high tech sector (Grossman and Helpman, 1991).

Of course trade will also lead to increasing competition, which should reduce prices and improve efficiency. This is not only the case in the market for final products but also that for innovations (Baldwin and Forslid, 2000). Thus, increased competition reduces mark-ups which if this applies to the innovation sector, reduces the cost of investments. Of course if financial services are traded then there will also be gains from reduced mark-ups in the financial sector (see above).

An analysis of a further expansion of a common market has also been carried out by Walz (1998). He showed that the integration of a technologically lagging country through trade liberalisation increases overall growth in the common market due to a reallocation of resources due to increased competition. However, the worker in the high tech sectors of the existing members are likely to see a decline in their relative wage and thus these workers loose out.

There is empirical evidence to support some of these models. For example a study by Coe and Moghadam (1993) finds that a large proportion of the growth of the French economy was derived from the benefits of increasing integration and trade in the EU. However one needs to interpret some of the empirical evidence carefully since the causation may also run from growth to trade and particularly exports.

2.6. Social Capital

Finally, it is clear that the context in which individuals make decisions is an important determinant of the type of investment decision that will be made. Thus, the institutional framework, the rule of law, absence of corruption, the existence of trust among individuals etc., which might be summarised by the term social capital, are also important. While social capital is more difficult to incorporate into conventional mathematical growth models, there this has not precluded economic research in this area. For example in a recent paper Zak and Knack (2001) develop a general equilibrium growth model where individuals face moral hazard problems. They show that in an environment where there is little trust investment will be lower, which will reduce growth. In this literature social capital affects the development of all other types of capital mentioned above. Overall there appears to be empirical support for the notion that social capital matters (see, Knack and Keefer, 1997 Zak and Knack, 2001, Hall and Jones, 1999).

3. New Economic Geography

Within the economics profession space has been one of the most neglected aspects in human interaction and economic development. This is perhaps surprising, especially since early economists like Marshall, Cournot, Christaller, Lösch etc. did recognise the importance of geography. The new economic geography is not limited to the writings of Paul Krugman, rather it is fast becoming a wider field which also incorporates geography into traditional models of trade.

The central aim of this literature is to explain how the economic geography, that is the degree of agglomeration and dispersion of economic activity and people come about. Thus it aims not simply at description of the economic geography, nor does it aim to explain the development of one small-scale location by focusing on the characteristics which distinguish such a region from other regions. Rather it attempts to distil out the major processes that are important in the development the economic geography in all regions. Once one can explain how the spatial economies come into existence and operate one can progress to prediction and policy analysis. A description of the spatial patterns that are apparent is not enough to do policy analysis since it will not yield sufficient information on how the spatial pattern came into existence and therefore how policy can change the behaviour that will then change the spatial pattern. Similarly a description will not be much use for prediction since it captures a point in time only, or, if it does cover a period of time, the lack of a rigorously developed behavioural foundation, could be ill founded (simple extrapolation).

As will be seen this new literature incorporates some old ideas into models that utilise some advances in modelling techniques. It thus allows for a rigorous analysis using the language of logic. This approach yields testable models that generalise the development of economies in space that allow a focus on the important aspects by disregarding the less important ones.

3.1. Core Periphery

The basic new economic geography models have evolved from the new trade literature which was also importantly influenced by Krugman (e.g. Krugman 1980 and Brander and Krugman, 1983). In his 1980 paper Krugman developed a model, which incorporates economies of scale, product differentiation and imperfect competition. Goods are produced with just one factor of production and the production is subject to a fixed cost and a constant marginal cost, which implies that average cost declines at a diminishing rate at all output levels. In this model trade takes place due to increasing returns and each good will only be produced in one country by one

firm and the gains from trade arise in the form of greater product diversity than would be produced in the autarkic situation. Thus, the increasing returns are pecuniary external returns to scale that arise out of the increase in the variety of goods, rather than returns to scale that arise out of spillovers (e.g. technology).

The introduction of transport costs of the 'ice-berg' variety results in different prices being charged for the goods in different countries since transport cost only apply to international trade. The important result from the introduction of transport costs into this model is that countries will export the goods for which there is a large domestic demand. This is due to the assumption of increasing returns. A larger domestic market allows firms to produce at a lower cost which means that their exports are also cheaper after transport costs have been added than when domestic demand is low. This also implies that the workers in the large country are better off since they face a lower price for consumption goods. Thus, the assumption of increasing returns in conjunction with transport costs gives rise to a home market effect.

Krugman (1991) extends this framework of increasing returns and transport costs in a model of two regions where there are two sectors, one being agriculture that is characterised by constant returns and production of which is tied to land and the other being manufacturing that can locate anywhere and that is characterised by increasing returns. Agricultural workers who are immobile produce the agricultural output while the manufacturing workers are fully mobile. In this model the transportation of agricultural goods is not subject to transport cost but that of manufacturing products does incur transport costs. The number of products that are produced in each region are proportional to the number of workers resident in them. Again the model gives rise to a home market effect but a second 'competition effect' implies that manufacturing workers who live in a less populated region face less competition in the local market which to some extent outweighs the benefit of locating in the larger market.

Once workers are allowed to migrate between regions an interesting result is obtained. Workers choose to locate where their real wage is highest and this has an implication for the mobility of workers and the concentration of manufacturing firms. Thus, if transport costs are high, the share of manufacturing is small or if returns to scale are small then the manufacturing firms will be distributed according to the distribution of agricultural workers. However, if the converse is the case then manufacturing firms will concentrate in that region which has a higher starting population. This is due to the fact that a slightly higher population in the home market reduces the cost of manufactured products in that region which will be reinforced through immigration. For example, if transport costs are low, a region with a slightly higher starting population will attract manufacturing firms due to increasing returns provided there are sufficient to outweigh the transport costs incurred in serving the smaller market. This will also result in lower prices for consumption goods in that region which will attract more workers which further reinforces the agglomeration process.

Infrastructure has been added into this model by Martin and Rogers (1995) in order to analyze the effect of infrastructure on the international location of firms. In this model domestic transport costs and international transport costs are differentiated in that the former are strictly smaller than transport costs for imported goods. These transport costs directly depend on the quality of infrastructure and the authors distinguish between infrastructure that affects domestic transport costs and that which affects international transport costs. The agricultural good that is introduced to tie down wage rates is traded without incurring transport costs.

Production in this model is specified in a slightly different way to the Krugman (1991a) model in that each good is produced using capital and labour subject to a fixed capital requirement which, with given capital endowments, determines the total number of goods that can be produced in each economy. However, capital is mobile while labour is immobile. The agricultural good is produced under constant returns to scale using only labour. In the autarkic

situation the location of firms is fixed by the location of capital. However, when trade and capital are allowed to flow, firms locate in the countries with a better infrastructure, higher incomes and larger markets. This arises out of the fact that a better domestic infrastructure reduces the price of the domestically produced good to the consumer, therefore increasing demand in this product which allows firms to better exploit the increasing returns to scale. This effect is magnified if international infrastructure is also good which reduces international transport costs, thereby increasing international demand. If returns to scale are large then differences in the capital endowment will lead to a flow of capital into the capital rich country since this will have a higher income which through increased demand will outweigh the benefit of less competition in the capital poor country. As in Krugman (1991) a larger market will attract capital flows due to the home market effect. In general this suggests one should observe increased specialisation.

With infrastructure improvements funded through lump sum taxes, Martin and Rogers (1995) evaluate the effect of improving infrastructure. If the reduction in demand due to the taxes is less than the increase in demand for local goods due to the reduction in transport costs as a result of the improvement of infrastructure, then firms will relocate to the home country if the domestic infrastructure is improved. An important result of the model is that, if international infrastructure is improved and domestic infrastructure is poor then firms will relocate to the other country, since they can supply the foreign market subject to low transport costs while being able to concentrate on the larger market that is subject to lower domestic transport costs. This result therefore predicts that improvements in international infrastructure would result in increased polarisation between countries since the country with the poorer domestic infrastructure loses industry. This prediction casts a doubt over the EU Structural Funds and Trans-European Network programmes that are supposed to foster convergence through improvements in the productive environment that would sustain industry in the weaker countries.

The evidence on this prediction appears to point in the opposite direction. Countries like Ireland and Portugal which have received large amounts of funding from the EU, a considerable amount of which has been spent on the improvement of international infrastructure links, have converged rapidly. In the case of Ireland at least the convergence has to a great extent been due to foreign direct investment (FDI) which has located in Ireland despite a serious shortfall in domestic infrastructure (see Fitz Gerald, Kearney, Morgenroth and Smyth, 1999). This conflict between the theoretical model and the experience of Ireland and Portugal may be explained by the way in which infrastructure and transport costs are specified in this model. Thus, the distinction between international and domestic infrastructure is somewhat unrealistic since it is difficult to identify any infrastructure that acts only as international infrastructure. For example a port is likely to be used for both domestic and international trade and airports are typically used for both international and domestic flights. Thus, an improvement in an international infrastructure link is likely to also reduce domestic transport costs.

Hanson (1996) presents some empirical evidence showing that, following the signing of the North American Free Trade Agreement, manufacturing firms relocated from Mexico City to the Mexico-US frontier. Furthermore there is some evidence for the EU that specialisation is increasing (Amiti, 1998). This story signals that there may be a danger for some countries from the EU policy of infrastructural investment to reduce transport costs, since, over a certain range of values for these costs, improved access to the core may actually hurt rather than help industry located in the periphery. However, this result is dependent on the importance of transport costs at a sectoral level. Industries which face low or negligible transport costs, may prefer to locate in peripheral countries provided that there are other cost advantages. This may explain why Ireland has been so successful in attracting firms in the high tech computer sector.

Firm location can also be affected by the presence of intellectual or human capital, which is closely related to R&D, and this is particularly true for high

technology industries. A study of the growth and location of the American biotechnology industry found that intellectual human capital flourishes in proximity to universities (see Zucker et. al., 1998). Innovative activity, and thus intellectual human capital, develops better in an environment of knowledge-based diversity (with complementary activities) than in one characterised by specialisation in a narrow range of economic activity (Audretsch and Feldman, 1998). Furthermore, the knowledge spillovers from intellectual human capital are spatially restricted and thus create agglomeration economies (Audretsch, 1998). Both of these factors impact on regional development within a country by restricting the number of locations at which innovative activity flourishes and by limiting the spillovers to a smaller geographical area. Notably these type of spillovers are not part of the new economic geography literature.

Spillovers in general seem to be spatially limited and it has been shown, using data for European regions, that a region's economic performance is related to the performance of its neighbouring regions (see Quah, 1996). Thus, spatial spillovers matter more than national characteristics in explaining income inequalities. This implies that the regional development potential is determined by the characteristics of the region and its neighbouring regions. The crucial characteristics that determine a region's development potential are infrastructure, location, agglomeration and sectoral structure (Biehl, 1991). Clearly, location cannot be changed and agglomeration and sectoral structure can only be changed over the longer term. Thus, infrastructure represents the only direct instrument of government policy for regional development. Infrastructure, by improving access and the general production environment, can help in attracting outside investment and foster domestic firms. However, the provision of infrastructure needs to be considered together with the other regional development determinants. It is unlikely that infrastructure on its own will help a region develop. Thus, it is important to target infrastructure investment to specific nodes - towns and cities - where agglomeration economies are more likely to exist and where the industrial structure is more developed.

In one of the most thorough studies to date Dluhosh (2000) studies how the integration process in the EU impacts on the spatial division of labour. In her study she not only analyses the new economic geography models as outlined above but also proposes another mechanism, namely the reduction of communications costs rather than transport costs, cost competition and technology, that determine the economic geography. The main conclusion of this study is that while transport costs and the monopolistic competition of the Krugman type models have some role to play, cost competition due to the integration yields a more fragmented economic geography.

3.2. City Formation, City Growth and Urban Hierarchies

Given that these new models are capable of generating concentrations of economic activity, an obvious extension to the models might be to investigate whether they can also generate the emergence of cities, and if so whether special patterns in the distribution of cities emerge.

The interest of Krugman in the formation of cities stem from a widely recognised phenomenon that is generally known as Zipf's law. This states that there should be linear relationship between the logarithm of the rank of cities defined by their population and size of the population. Indeed, when graphed the slope of this relationship is often found to be -1 . This is clearly an intriguing phenomenon that deserves some explanation, and indeed many researchers in a number of disciplines have investigated this. In order to investigate the emergence of an urban hierarchy, researchers of the new economic geography persuasion first had to construct a behavioural model that can explain the emergence of cities.

One attempt is the so-called racetrack economy, in which the standard new economy geography model is extended by assuming that locations are evenly spread around a circumference (Fujita, Krugman and Venables, 1999). Starting with an even distribution of manufacturing, if this is not an equilibrium

i.e. there are forces that generate a relocation of workers or firms, then the economy will move towards a pattern of agglomeration. Of course since transport costs are crucial in this model the agglomerated locations will be spread evenly around the circumference, with the number decreasing with decreasing transport costs which thus also induce a longer distance between locations.

This model has been further extended by assuming that rather than being located on a circumference, the locations are located on an infinite line. In this case the initial position is one with just one agglomeration of population, i.e. one city. In contrast to the other models here, labour can switch between uses from low tech to high tech which implies that both sectors will have to pay the same wage. With one agglomeration only this will also be the location where industry will locate. What is interesting is that when the population is allowed to grow new cities will emerge. Of course since there are increasing returns and transport costs, there is no economic activity in close proximity to cities. This model shows that population growth results in a move from a monocentric to a polycentric urban structure. With the further extension of many industries an urban hierarchy results in which one contains firms from all sectors while the others only contain a selection of sectors.

3.3. Agglomeration and Growth

Of course if agglomeration economies exist, these can also impact on the growth performance of regions. Martin and Ottaviano (2001) incorporate this type of mechanism into a model a growth model. They show that growth and agglomeration are mutually self-reinforcing. Thus, growth increases agglomeration and agglomeration increases growth. The model also shows that due to the continuous creation of new firms some firms re-locate to peripheral regions. Another contribution along these lines is that of Baldwin and Forslid (2000). They show that growth leads to agglomeration but that knowledge spillovers lead to dispersal of industry. In their model integration through a reduction in transactions costs for goods trade leads to increased concentration while integration that leads to a freer flow of ideas leads to

dispersal. Another important finding of this model is that agglomeration not only maximises total growth globally but also raises growth for all regions, which reduces the negative impact of increased agglomeration.

4. What are the Policy Implications?

In the two sections on endogenous growth theory and new economic geography policy implications were not explicitly highlighted. However, the usefulness of these models will ultimately be measured by their success in explaining the observed patterns of growth, convergence and the spatial distribution of economic activity and by their success in guiding policy. By summarising the policy implications of these models one also isolates issues that have yet to be addressed.

The most fundamental policy implication of the models discussed above is that one needs to understand the mechanisms that determine growth and the location of economic activity. This is quite distinct from simple and sometimes even simplistic descriptive approaches. That is not say that description is not a valuable exercise, but it cannot yield robust results for policy makers. This is especially true if the descriptive studies lack theory as is highlighted in the following quote:

“It is quite wrong to try founding a theory on
observable magnitudes alone. It is the theory
which decides what we can observe.”

- Albert Einstein

With regard to the endogenous growth theory a number of important implications emerge. Firstly, almost all models incorporate some kind of externality or spillover, which generates additional growth through their public good nature. As is well known from the theory of public goods, these are rarely provided at their most efficient level through the market. The presence of externalities and spillovers therefore also implies that the engines of growth

tend not to be provided at the optimal level. This market failure means that there is an important role for government to ensure that the engines of growth are supplied at the optimal level. This can be achieved through regulation or may require direct action by government, such as subsidies or the public provision of educations and infrastructure. This stands in contrast to the older growth literature in which the role of government was to merely ensure that markets were working competitively. However, an important implication of these new models is that convergence is no longer guaranteed, and that policy has long lasting effects. This of course also applies to bad policies.

At a time when there is a debate about EU expansion and further integration, it is worth noting that integration is predicted to enhance growth. This is of course consistent with the experience of previous enlargements. Integration and trade are always welfare improving in aggregate, but may require additional policy responses. Thus, countries that join a customs union with a poor industrial structure may not be able to fully benefit from membership even though they are better off with trade and integration.

The major contribution of the new economic geography is that it shows that concentration and the emergence of cities is a natural outcome of market interaction, if centripetal forces exceed the centrifugal forces. Empirically we see an increase in urbanisation, particularly at a time when the economy has changed to a high-tech economy. It is likely that such centripetal forces are therefore more important to high tech industries, and indeed if these were diminished through policy such industries may well relocate to places where there are no such constraints. Of course government policy is unlikely to undermine these powerful market forces. Therefore, regional development policies should be centre-based, encouraging selected centres in conjunction with their respective hinterlands. In this respect the results of the endogenous growth theory are particularly pertinent.

A word of warning regarding concentration is nevertheless warranted. Even if centripetal forces are vital, over-concentration into one urban centre due to

the inability, for whatever reason, of others to develop is likely to be damaging to growth. Henderson (2000) shows that over-concentration of the population in one urban centre reduces growth. Indeed, he points to Dublin as one example of a city that is too large relative to the overall size of the population of the country within which it is located. This raises an important question for policy makers about the optimal level of concentration/ dispersal.

A further drawback of the new economic geography approach is that it relies on transport costs. Some researchers argue that these have been decreasing rapidly and should therefore not play such an important role. However, the rate of decrease in transport costs is not dramatic. Another issue that is likely to be important is the fact that non-pecuniary economies to scale are ignored in the new literature. Thus, this literature does need to develop further in order to provide a general explanation of the economic geography of the world.

5. Conclusion

This paper provided a brief non-technical review of the recent literature on economic growth and new economic geography. A thorough review of these literatures is clearly beyond the scope of this paper and the reader is referred to some of the excellent reviews that have been published. However, these are often aimed at an academic audience and hence fail to draw out the important policy conclusions, something this paper has attempted to do. Clearly with the brevity of this review a lot of interesting findings have been ignored. Also in such a non-technical review it is difficult to draw out some of the advances that have been made in the new literature. However, it is hoped some of the flavour of these extensive literatures could be conveyed.

Among the major contributions of these fields of research is the fact that they give firm theoretic foundations to phenomena that had often been described but the mechanisms of their emergence had not been properly modelled. Importantly this moves away from simply asserting that these mechanisms are responsible to proving that they actually operate. This then also allows the full

implications of policy to be analysed. For example, in the endogenous growth models infrastructure has been included as a driver of growth. This may seem obvious. But it is not that obvious that infrastructure which has to be financed through taxes has the biggest positive impact if tax rates are low. Such an analysis is not possible without rigorous models. Of course this also implies that without knowledge of the mechanisms tax policy could be erroneous.

The important lesson of this is that policy makers should focus their attention on studies that aim to uncover the reasons for certain phenomena rather than those that simply describe them. Given the complexity of the factors that impinge on regional development this would seem to be particularly important with regard to policies such as the National Development Plan and the National Spatial Strategy.

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