METHODS AND MODELS FOR PLANNING THE DEVELOPMENT OF REGIONAL AIRPORT SYSTEMS

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by Kenneth Button

1. Introduction

I am going to begin by making a statement that is heretical to most transportation lobbyists and enthusiast. The importance of transportation as a driving force for local, regional economic development can often be exaggerated. It is quite clear, for example, from experience that unless a region has the capability of producing something that other regions want it is unlikely to gain very much from enhanced external transportation facilities. The simple idea that “Build it and they will come”, to quote from the Kevin Costner movie, the appositely entitled *Field of Dreams*, is largely a fallacy that makes for good entertainment but not good public policy formulation.

Indeed, in some cases, even if a region does have something that other regions want, opening it up by enhancing transportation may indeed prove counter productive. I am thinking especially in this case of factors of production, and in particular of skilled labor, that can be sucked out of a region if it becomes more accessible. But the same may be true of a variety of minerals where the producing country gains little for any transportation investment if it does not generate value added.

Nevertheless, in the right context, and in the appropriate form, transportation improvements, of the appropriate kind, can allow a region to exploit its potential for exporting and, especially if one believes in the Keynesian export base model of local growth[1], can lead to its economic develoment. As the transportation economist, Denys Munby (1968), put it 40 years ago, "Only the psychologically disturbed or inadequate want transport for its own sake". In other words the demand for transportation services is a derived one, but their

[1] Guccione and Gillen (1980) provide a outline of the theory, together with an effort to combine it with more conventional neo-classical regional growth theory.

appropriate provision can enable the benefits of a myriad of other, final benefits to be enjoyed.

In the past there are clearly demonstrable cases of transportation being a prime mover in the opening up of regions to allow their economic potential to be developed. The sailing vessels of the "Age of Discovery" from the fifteenth to the early seventeenth centuries offer a classic example, there was a "Transport Revolution" in Britain that paralleled the nation's "Industrial Revolution", and the opening up of the American west by railroads is another. More recently, and this is admittedly on a somewhat smaller scale but germane to our discussion, the economic and social importance of cheap and wide spread air transportation cannot be underestimated as a major facilitator for tourism growth in many parts of the world, and for the specific locations where concentrations of high-technology have emerged are almost inevitably linked to good air transportation access.

The empirical evidence on the role of air transportation, our focus in this chapter, as a facilitator for regional economic development is slowly growing. Considerable work at the micro-level, for example, has been done, often for legal reasons as part of an economic or environmental impact analysis, of the local employment and income effects of providing or improving air transportation in a region. There is also an expanding body of largely academic literature that has concerned itself with the more specific effects of air transportation availability including those on particular industrial sectors such a tourism or high-technology industries, and on the wider economic implications of air traffic transfers away from other regions – while adding air capacity is seldom a zero sum gain there are inevitably opportunity costs for other regions in doing so.

However, while some of this analysis is highly sophisticated, and some certainly less so, it is seldom put within the broader framework of modern economic growth theory. One reason for this is that the study of transportation often tend to be stove-piped and treated without due consideration of its larger impacts. Most of it is, in effect, comparative static set within the confines of *ad hoc* partial equilibrium analysis. While this may have a use in local decision-making, it provides little insight into what the new air transportation capacity will do in terms of its long-run effects and its larger, structural impacts on the national economy into which any region fits. For this we need to have better general equilibrium models that track the effects of air transportation activities through all the other sectors of the economy. Unfortunately while the theoretical underpinning of computable general equilibrium models is advancing their application in practice lags.

This paper initially sets out the broad role that improved transportation, including air transportation, plays in spatial economic development, and with

this discusses some of the reasons why policy makers may be interested in interfering in the market process for air transportation rather than simply leaving it to commercial decision-makers.[2] We then move to consider some of the methods that have been used to assess the implications of enhanced air services for a particular area and discuss some of the findings that have emerged.

2. Regional economic growth

Neo-classical economics

Economists have struggled over many years to explain why some regions' economies, or indeed national economies, perform better than others. Traditional neo-classical, long-run macro-economic growth theory of the type espoused by Robert Solow (1957) and others argues that per capita income in a region or country depends on local factor endowment, the savings rate, and the impact of exogenously determined "technical progress"[3].

Where regional neo-classical, as opposed to macro, growth models differed from this to some extent is that they treat labor and other factor supplies as both dependent on the internal demographics and inherent resource base of a region and also upon factor movements between regions. While most national economies experience relatively small flows of factors of production between them, the much laxer border restrictions within a region tend to foster such flows. This makes factor growth in a region more elastic[4].

Basically, this spatial mobility of factors of production can help to compensate for an initial shortage of a factor in a region. Hence, a specific region may grow when there is capital abundance by "importing" labor from

[2] It is taken as axiomatic that interventions may be made for environmental and security reasons and to ensure a minimum level of mobility for social and political reasons, rather our interest initially is in interventions with the intent to increase economic growth and to foster economic development in particular geographical areas.

[3] More formally, an exogenous growth model of the Solow type can be formulated by taking a simple Cobb-Douglas production function of the form, $Y = A(t)K^{1-b} L^{b}$ (where Y is net national product, K is the capital stock, L is the labor stock and A is the level of technology) the fact that A is a function of time (t) indicates the standard neo-classical assumption that technology only improves over time for reasons external to the model.

[4] The recent experience of the EU in allowing labor and mobility within its borders indicates just how mobile factors can be.

other regions. This, combined with the natural growth in labor supply within the region, can lead to growth through more efficient use of the complementary capital stock although in the long-run there will be convergence in per capita income between the regions, albeit at a higher average wager rate. One can consider parallel movements of capital but this is less relevant to air transportation.

Figure 1 offers a simple illustration of the larger point[5]. There are two regions, **A** and **B**. Region **A** enjoys high income and low unemployment (U+: Y–) whilst **B** is the mirror image of this. There are decreasing returns to factors of production, including capital. The neo-classical economic model assumes that with zero costs of migration (including zero transportation costs) and a homogeneous labor force, labor will move from **B** to **A** seeking work and higher pay whereas, on the assumption of uniform commercial risk across regions, capital will move from **A** to **B** where it can be combined with abundant, cheap labor to maximize returns.

Wages will fall in **A**, unemployment increase, and the return on capital will rise as the labor supply grows and capital becomes scarcer. The additional capital and the decreasing size of the labor force in **B** will push down the marginal return on investment and concurrently push up wages. The process continues until labor costs and unemployment levels are equalized. This equalization is achieved in a world of zero transportation costs and full information about opportunities.

The problems with this way of looking at regional development, is that it relies on a number of relatively strong assumptions. Factor movement is not frictionless, there exist distance, information, and money costs. Also factors of production are not homogeneous, and some are more mobile than others. Young, skilled, highly educated workers, for example, tend to be more mobile than those lacking these characteristics. Investors consider returns on their capital relative to risk incurred – they are not risk neutral. There is also the issue of technical progress that is simply treated as a sort of residual, and uncontrollable factor in the neo-classical framework. This seems excessively fatalistic.

In addition, the recent empirical analysis that has been completed hardly gives solid support for the neo-classical idea. Testing the validity the alternative theories, in the absence of easily quantifiable counterfactuals, has frequently involved looking at secondary evidence, and in particular at evidence shedding light on whether there is convergence in the economic growth paths of regions or, at the macro-level, nations. The empirical question that is explo-

[5] The figure is developed from Robert Hart (1975a; b).

red becomes one of whether there is convergence in regional economic growth rates in, generally, per capita income or productivity as is an outcome of the neoclassical model.

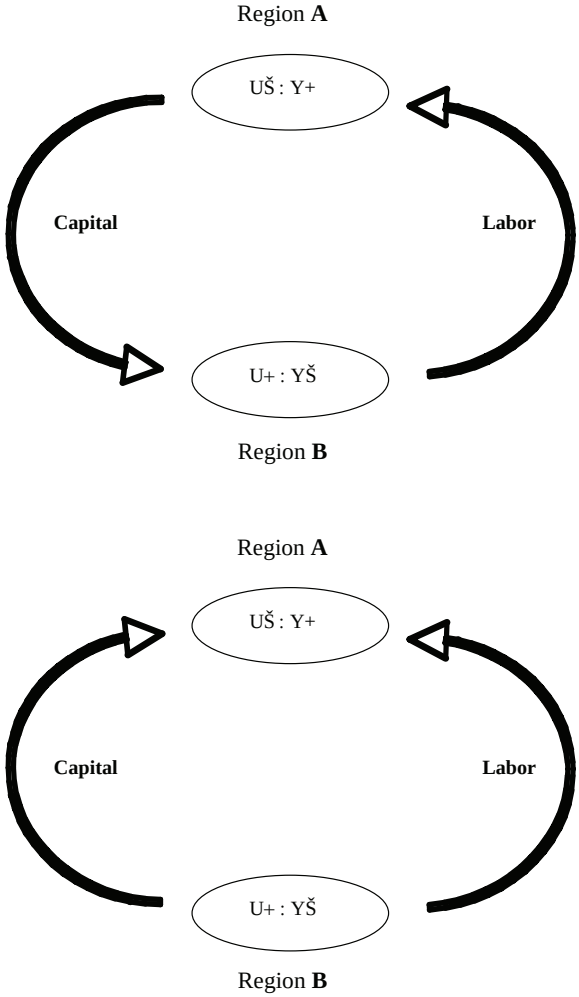

Fig. 1 - Simplified theories of migration (upper – the neo-classical models; lower – the endogenous growth model)

Empirical findings

The extensive empirical analysis that has emerged has been assisted by the improved data made available in recent years, as well as new models, enhanced econometric techniques, and better understandings of how to measure convergence. In particular, there has been the development of the concept of β – convergence measures (Barro and Sala-i-Martin, 1992) that has allows a more rigorous analysis of economic convergence than the more traditional σ–convergence measure[6].

The estimation of possible β–convergence involves a mean-reversion calculation and it occurs if there is a negative relationship between the growth rate of income per capita and the level of initial income[7]. Much of this type of analysis has been done at the national level, but it, and the more limited body of analysis that has been conducted at the regional level, does offer some insights into the validity of the idea of endogenous economic growth.

Much of the early work on spatial economic convergence relied upon aggregate, national data sources and focused on σ–convergence measurements. The findings indicated that labor productivity, and with it per capita income in the world, was converging in the long run and thus rendered support to the neo-classical growth theory. The difficulty with this work was that the data sets used only contained countries that had already industrialized, and even for those there were periods of divergence (De Long, 1988). Improved data, most notably the Heston-Summers panel data set that embraces a large group of countries, subsequently indicated a lack of any general economic convergence (Romer, 1994).

The more recent work that has made use of β–convergence measures, and embraces a number of sub-national studies, tends to find little support for overall convergence, and *ipso facto* the neo-classical model. Robert Barro and Xavier Sala-i-Martin (1991) in a number of studies that, for example, have examined the economies of US states and European Union (EU) regions find that while there is evidence of convergence in per capita income, it is slow – about 2% per annum and well below the 12% or so that neo-classical theory

[6] This approach essentially looks for changes in standard statistical indicators of dispersion – normally the variance.

[7] A standard estimating equation takes the form $D(y_{it}) = a+b(y_{it-j})+D_iG+e_{it}$, where the y_{it} is that being tested for convergence, D_i is a (n x k) matrix of k variables capturing spatial economic heterogeneity, G is a (k x 1) vector of parameters, a and b are constants and e_{it} is a white noise error term. The condition $b > 0$ is a necessary but not sufficient condition for b-convergence.

would suggest. These are also conditional convergence measures that allow for homogeneity between, for example, the regional economies within a EU economy but diversity between countries that would suggest potential differrences in steady-state growth rates for the regions within them[8]. Hence, overall there is little support in this body of work for the exogenous growth idea.

"New Economic Growth Theory"

An alternative to the neo-classical model attempts to circumvent some of these intellectual problems. In endogenous growth models (Romer, 1990) growth over time entails increasing returns to scale for a region. A proportionate increase in labor and capital gives rise to more than proportionate gains in output[9]. This, combined when embodied into the "New Growth Theory" or "New Economic Geography", is consistent with divergence in economic growth along the traditional lines of Gunnar Myrdal's (1957) ideas of circular-and-cumulative causation albeit for somewhat different reasons.

The situation can be illustrated by returning to Figure 1. Taking the initial starting positions for two regions, the endogenous growth approach argues that not only will equalization of real wages and employment levels not be attained but that there may be cases where they diverge further. Labor mobility between regions **A** and **B** may be impeded by the various costs of migration – embracing social and search costs as well as simple financial costs – and heterogeneity in the labor market – the jobs available in region **A** not being compatible with the skills and knowledge of labor in region **B**.[10]

[8] Button and Eric Pentecost's (1999) work on the regional economies of the EU find that there is evidence of divergence when no allowance is made for possible national steady-state growth path differences. The boundaries national boundaries used by Barro and Sala-i-Martin would not seem to correspond to natural economic units.

[9] To indigenize *A*, the Cobb-Douglas production function for each individual firm is defined as: $Y_i = A_i K_i^a L_i^{1-a}$; where the output of an individual firm is related to capital and labor as well as the "augmentation" of labor by A_i. Arrow assumed that A_i, while it looks specific to the firm, is in fact related to "knowledge" in the economy. This knowledge and experience is common to all firms.

[10] Richard Florida (2005) has added to these ideas by arguing that "creative classes" having preference for where they live, and that the attributes required to attract and retain them are more likely found in regions with an established high income and educated labor force. In either the older or more recent formulations of this framework, the implications are often circular-and-cumulative causation; essentially richer regions get richer and poorer regions, poorer.

Equally, capital does not always move from region **A** to **B** because of the higher returns due, not to an actual shortage of capital, but rather to the lesser uncertainty thatis to be found in regions that already have a high level of prosperity and a pool of complementary skilled labor. While the earlier regional models of Nicholas Kaldor (1970) in particular, focused largely on divergent growth rates in the context of traditional style industries, the more contemporary form of the theory pays particular attention to the endogenous growth that occurs in regions that have an established highly-skilled work force and the ability to further develop their knowledge based industries (Lucas, 1993).

The relevance of the emergence of the new thinking, and the empirical analysis that has been found to support at least parts of it, is that it give a role for government in regional economic policy. If there is circular-and-cumulative causation caused by scale effects of one kind or another, combined with imperfections in the mobility of factors of production, very broadly defined to embrace knowledge, then policies can be devised to compensate. Part of this policy may embrace appropriate transportation elements including those relating to air transportation.

So, where does air transportation tie into this? In the neoclassical framework, that largely represents an extension of 18th century trade theory, air transportation, or indeed transportation in general, is not really considered at all. Its existence is either assumed and, if it is lacking in the short-term, then it is assumed a perfectly functioning market would supply the optimal amount. The endogenous approach assumes imperfect markets that need not result in socially optimal outcomes. Again with reference to air transportation, these imperfections may entail, lack of adequate financial markets to construct airports and their associated infrastructure or imperfect airline markets due to either market or government failures[11].

3. The local impacts of an airport

The impacts of enhance air transport access for a region, whether through infrastructure enhancement or the more intensive use of existing capacity, has attracted the attention of policy makers. This has especially been so in regions that have suffered from lagging economic performances in terms of income, industrial structure, and employment growth. In many cases there is a clear

[11] Button (2008), for example, looks at some of the problems that developing countries encounter in financing their airports.

correlation between the transportation infrastructure, including airports, and their poor economic performance that can be contrasted with more dynamic economies. It is often seen as no accident that the major high-technology corridors that developed in the 1980s and early 1990s are located new major international airports – the M4 corridor near London (Heathrow Airport), the Route 28 corridor near Boston (Logan Airport), Silicon Valley (San Francisco Airport), etc. Although, of course, by itself a major airport does not create these pockets of advanced economic activity but they seem important as facilitators to allow latent potential to be realized.[12]

Academic assessments looking at the role of airports in regional development are, despite the policy concerns, relatively sparse (Green, 2008) Evaluation of the local impacts of airports has been done in three broad ways, using survey, multiplier, or econometric techniques (Button, 2004). Surveys are widely used to try to elicit the views on how affected parties are likely to respond to any change in air service provision. The difficulty, as with all surveys, is to both to decide who to question and then how to question. The potential of "political capture" by vested interests is large. Econometric studies are fairly limited in number and often focus on some particular aspect of the link between an airport and economic development – e.g. the study of Button et al (1999) of airports attracting high-technology industry, Button and Samantha Taylor (2000) international air services and regional growth, and of David Benell and Barry Prentice (1999) on role of Canadian Airports. Econometric analysis, however, generally requires considerable data and specifying the appropriate model for estimation can be challenging[13].

Here we focus in more detail on the use of economic multipliers that are relatively extensively used for impact analysis, especially when there are mandatory requirements.

Economic multiplier effects

An airport, or more often the creation of a new airport or the enlargement of an existing facility, has a number of potential effects on the region surrounding it. These impacts are not just associated with the airport *per se* but,

[12] There is also the issue of causality, these technology corridors also emerged in regions that already had high incomes and could afford the development of enhanced airport facilities.

[13] In particular, there are issues of causality – do airports increase the productivity of a region, or do productive regions have more resources to invest in airports. Richard Green (2008) offers one of the few studies that addresses this technical issue.

via extensive ripple effects associated with the income flow that it brings into region, they can have implications for the larger employment and income of the surrounding area. No consensus on the exact role of investment in public infrastructure in general as an aid to economic development, and particularly productivity, has yet emerged. The early macro-level work by David Aschauer (1989) suggesting high rates-of-return from such investments has subsequently been placed in doubt and returns have been found to vary considerably with the level spatial aggregation examined.[14] We begin looking at matters at the more local level.

A new airport, which for simplicity is what we will consider, goes through a number of stages from its planning to becoming fully operational and heavily used. Each of these phases generates it own particular type of income multiplier effect on the region. Figure 2 offers a simply diagram tracing out the temporal and spatial impacts together with some indication (the size of the arrows) of the general their respective magnitudes[15].

- **Primary**. The primary multiplier stems from the income that is associated with the multiplicand inherent in construction of the facility and the rounds of expenditure that emanate as part of that money is recycled through the local economy. The size of the local multiplier is often tempered in the case of an airport, if there is a need for significant inflows of labor, raw materials, and equipment to plan and construct the facility. Leakages of this kind are often substantial because new airports or major extensions are rare events in aggregate let alone in a particular region. As a result there is seldom adequate local expertise or equipment available. Even when local resources are used, there may be crowding-out effects if these are taken from other sectors of the regional economy and, thereby, reduce the multiplier effects of these sectors.

[14] Besides the normal private sector multipliers, most regional economies also have automatic or semi-automatic regimes that bring in additional central government funds as a region develops.

[15] Clearly the nature and scale of an airport, besides larger regional economic considerations, affects the size of these multipliers and the time they take to work their way through the economic system.

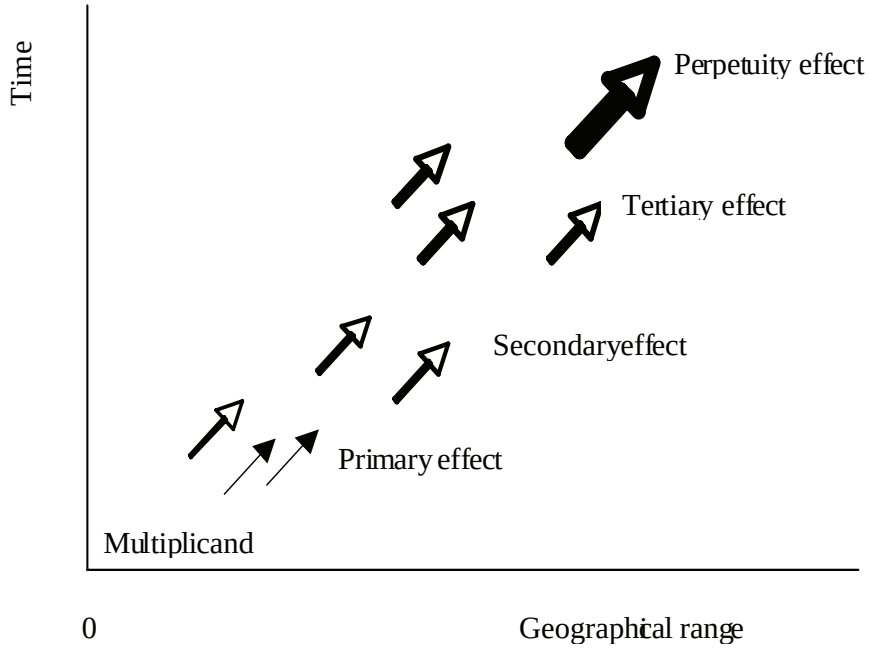

Fig. 2 - The various economic multipliers associated with an airport investment

- **Secondary**. Once an airport is operational, it pumps money into the local economy through the staff that it directly employs and the activities of the airlines that make use of the facility. This income, in turn has multiplier effects on the regional economy. Airports can be major employers but there is a largely bimodal distribution in the labor force. While airports do employ many highly skilled and, thus, generally highly paid workers, many jobs are unskilled or semi-skilled (e.g. in terms of drivers, aircraft cleaners, workers in concessions and baggage handlers.) Equally, the airlines using the airport may maintain a staff to handle ticketing and aircraft maintenance, as well as have aircrew overnight at local hotels, the numbers are generally relatively small compared to the land-take and investment in infrastructure and operational equipment[16].

[16] For an airline like Ryanair in Europe, these crew effects are minimal because they are all based at home and their schedules allow them to return their homes at the end of their duties.