Knowledge spillovers and the growth of British cities

John Thornton
Yener Altunbas
Applied Economics Letters
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rael20

Knowledge spillovers and the growth of British cities
Yener Altunbaş a, Edward Jones a & John Thornton a
a Business School, Bangor University, Hen Goleg, College Road, Bangor, Gwynedd, LL57 2DG, UK
Available online: 15 May 2012

To cite this article: Yener Altunbaş, Edward Jones & John Thornton (2013): Knowledge spillovers and the growth of British cities, Applied Economics Letters, 20:2, 162-166
To link to this article: http://dx.doi.org/10.1080/13504851.2012.684773

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: http://www.tandfonline.com/page/terms-and-conditions

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.
Knowledge spillovers and the growth of British cities

Yener Altunbaş, Edward Jones and John Thornton*

Business School, Bangor University, Hen Goleg, College Road, Bangor, Gwynedd LL57 2DG, UK

The relative importance of intra-industry or inter-industry knowledge spillovers for the growth of cities remains an open question. Using a unique data set on the growth of 109 British cities during 1951–1991, we find evidence suggesting that the most important knowledge spillovers occur between rather than within industries, which is consistent with Jacobs (1969, 1985).

Keywords: city growth; inter-industry; intra-industry; knowledge spillovers

JEL Classification: O31; R11

I. Introduction

The relative importance of intra-industry or inter-industry knowledge spillovers for the growth of cities remains an open question. The empirical evidence is ambiguous and relates mainly to the experience of US cities. In this short article, we contribute to the issue by investigating their relative importance to the growth of British cities. We do this by testing for evidence of a relationship between the concentration of industrial structure on the one hand, and the growth of British cities on the other. Our results suggest that the fastest growing British cities have been those with the more diversified industrial structures, which is consistent with inter-industry knowledge spillovers having been most important for the growth of British cities.

II. Literature

Two types of knowledge spillovers are thought to be particularly important for the growth of cities: MARs spillovers and Jacobian spillovers. With MARs spillovers (Arrow, 1962; Marshall, 1966; Romer, 1986) it is the concentration of firms in the same industry in a city that helps knowledge travel among firms and facilitates innovation and growth. Employees from different firms in the same industry exchange ideas about new products and new ways to produce goods: the denser the concentration of employees in a common industry in a given location, the greater the opportunity to exchange ideas that lead to key innovations. In contrast, Jacobian spillovers (Jacobs, 1969, 1985) reflect the diversity of industries in a city. Jacobs argued that an industrially diverse urban environment encourages innovation because it encompasses people with varied backgrounds and interests, thereby facilitating the exchange of ideas among individuals with different perspectives. The empirical evidence is ambiguous. For example, Glaeser et al. (1992) look at employment growth in 1956–1987 across specific industries in a given city and report that industrially diversified cities grow more rapidly than specialized cities; and Feldman and Audretsch (1999) find less industry-specific innovation in US metropolitan areas that specialize in a given industry. On the other hand, Henderson et al. (1995) report that US cities with more specialized manufacturing sectors appear to grow more rapidly; and Carlino et al. (2001) find little evidence that diversity was an important factor in determining the rate of patenting activity in US metropolitan areas in the 1990s. Finally, Kelly and

*Corresponding author. E-mail: j.thornton@bangor.ac.uk

1 The term MARs was coined by Glaeser et al. (1992) who pull together the views on this type of knowledge spillover in contributions from Marshall, (1966), Arrow (1962) and Romer (1986).
Knowledge spillovers

Hageman (1996) report a positive impact of both inter-industrial and intra-industry spillovers on the number of patent applications in US state-level data; and, in one of the few non-US-oriented studies, Maurel and Sédillot (1999) find that diversified and specialized manufacturing industry structures have been beneficial for the growth of French cities.

III. Methodology and Data

Studies exploring the impact of knowledge spillovers on city growth are usually performed using Ordinary Least Squares (OLS) regression techniques, in which city growth is expressed as a function of social and economic variables and a measure of concentration of the city’s industrial structure that allows the impact of inter-industry and intra-industry knowledge spillovers on growth to be determined. However, the existence of a spatial structure in urban data sets implies that the central assumption of independence of observations is not satisfied because a city in any given location may exert an influence on other cities located close by (Haining, 1990). Not taking account of the influence of cities on each other can lead to seemingly statistically significant relationships being found in the data set, when in fact no such relationship exists. Spatial econometric techniques provide a solution to this problem by taking into consideration the lack of independence between cities when determining the significance of relationships between variables.

A spatial regression model can be presented in the following form:

\[ Z_i = \mu_i + \delta \]  

where \( Z_i \) is the random process for city \( i \), \( \mu_i \) is the economic growth of city \( i \) (which is a linear model with covariates), \( \delta \sim N(0, \Sigma) \), and \( \Sigma \) is the covariance of random variables for all cities. Therefore, \( \mu \) can be estimated using a simple linear model with a spatial framework. The small-scale variation is modelled by fitting the Conditional Spatial Autoregressive (CAR) covariance model to \( \Sigma \). The model assumes multivariate normality, and is given as

\[ \text{CAR}: \Sigma = (I - \rho N)^{-1} D \sigma^2 \]  

where \( \rho \) and \( \sigma \) are scalar parameters to be estimated by the spatial regression, \( N \) is a weighted neighbour matrix, and \( D \) is a diagonal matrix used to account for nonhomogenous variance of marginal distributions (Cressie, 1993). Accordingly, we examine the determinants of the growth of British cities using a linear model with spatial dependence and employing generalized least squares regression analysis. The growth of a city is defined by log of the ratio of end-of-period city employment level to beginning-of-period city employment level.

The main independent variables are the degree of diversification of each city’s employment structure, which we measure by calculating the Gini coefficient of concentration of employment in the city, and the total initial level of employment in each city. The Gini coefficient captures whether specialized or diversified industrial structures are more important for the economic growth of cities, with a negative coefficient indicating that inter-industry spillovers are more important. The initial level of urban employment is included to capture the impact of initial conditions on city growth. For example, large cities might be favoured by being able to offer access to a number of markets, distribution networks and input factors encouraging firms to locate in them (Rauch, 1993), or they might be disadvantaged by high rents or high levels of poverty, crime and pollution that drive firms to relocate to smaller neighbours (Glaeser, 1998).

We also include several 0,1 dummy variables as controls, which are intended to capture (i) big city size effects (O’Donoghue, 2000)\(^2\); (ii) the large population movement from the north to the south of the United Kingdom that was driven by factors such as the warmer weather in the south and the reliance of northern cities on traditional industries (Prestwich and Taylor, 1990); (iii) a government policy funding the development after 1946 of 33 New Towns to ease

\[^2\] The Gini coefficient of concentration has been used widely in the urban economics literature to measure the industrial composition of cities (e.g. O’Donoghue, 2000). It takes the form:

\[ G_j = 10^{-4} \sum_{i=1}^{N-1} |C_i D_{i,j} - D_j C_{i,j}| \]

where \( G_j \) is the Gini index for city \( j \) in a particular year, \( N \) is the number of industrial activities, \( C_i \) denotes the cumulated values for the percentages employed in the industries in city \( j \) after these industries have first been ranked by their location quotients and \( D_j \) denotes the corresponding cumulated percentages for the national employment profile.

\[^3\] The major British cities/urban conurbations are Greater London, Tyneside, West Midlands, Greater Manchester, West Yorkshire, Merseyside, Glasgow and Sheffield.
congestion in the major cities (Prestwich and Taylor, 1990); (iv) the establishment of several regional development agencies from the mid-1980s that might have favoured the development of some cities over others (Tallon, 2009); and (v) the absence of a major motorway running through the geographical boundary of the city/urban conurbation, which might disadvantage city development (O’Donoghue, 2000).

We rely on a data set from the British Economic and Social Research Council’s research programme on UK city competitiveness and cohesion, which draws mainly on the UK Population Census for data on demography and household indicators to define ‘cities’, and on the UK Annual Employment Survey to determine each city’s industrial structure. It provides a list of 109 British cities and 32 industry classifications for employment, 20 of which are in the service sector, 9 in the manufacturing sector and 3 in the primary sector. The sample covers the period 1951 to 1991. Information on the Gini coefficient of concentration and employment growth in the largest and smallest cities is presented in Table 1.

### IV. Results

The spatial regression results are presented in Table 2. They suggest that the fastest growing British cities have been those that have benefited from inter-industry knowledge spillovers. The Gini coefficient is negative and statistically significant at the 5% level, indicating that cities with more highly concentrated...
industrial structures are the slower growing cities. Industry growth decreases by 2% over 41 years when the Gini coefficient of concentration is increased by 1 SD. Initial city size is an important determinant of future city growth (significant at the 5% level) with larger cities likely to grow more slowly. This is consistent with the view that large cities are disadvantaged by factors such as high rents, and more crime and poverty. The coefficients on several of the control variables are statistically significant. Britain’s largest cities have grown relatively slowly or declined, which seems likely to have been related to issues of congestion, pollution, poverty and crime. In addition, developments in transportation infrastructure have allowed firms to relocate to smaller cities that suffer less from these problems but still have easy access to major centres. In contrast, cities located in the south of the country and the New Towns have grown faster than other British cities. However, the coefficients on the development agency and motorway proximity dummies are not statistically significant. As robustness checks, we compared the results from the model with the null model consisting only of the spatial neighbours using the likelihood ratio test suggested by Cressie (1993). The test statistics for the $\chi^2$ in each case are significant at the 5% level and confirm that the spatial linear model with the Gini coefficient of industrial concentration included as an explanatory variable represents a significant improvement over the null model. Finally, the Moran coefficient, $I$, which tests for the presence of spatial autocorrelation in industrial employment growth between cities (Griffith, 1987) is 0.043 ($p = 0.010$), which rejects the null of spatial autocorrelation.4

V. Conclusions

In this short article, we have examined the relationship between the industrial structure and the growth of British cities. We find evidence that British cities with a diversified industrial structure experienced faster growth than cities with a more concentrated structure. This finding is consistent with Jacobs (1969, 1985) view that the most important knowledge spillovers for city growth are likely to have been of the inter-industry type. Other factors beneficial to the growth of British cities include location in the south of the country and being a New Town.

References


---

4 Moran’s coefficient ($I$) is given by:

$$\text{Moran's } I = \frac{m}{s} \left[ \frac{\sum_i \sum_j (y_i - \bar{y})(y_j - \bar{y}) g_{ij}}{\sum_i (y_i - \bar{y})^2} \right]$$

where $n$ is the number of cities, $y_i$ and $y_j$ represent the economic growth in conurbations $i$ and $j$, respectively, $\bar{y}$ is the average growth of all the conurbations and $S$ indicates the number of connections in the matrix $g_{ij}$.