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Abstract

Firm formation has been advocated by policy-makers and examined by researchers as a vehicle for job creation and economic development. Both industrial structures and the firm formation rates of individual industries vary regionally. For instance, Ashcroft et al (1991) showed that firm formation rates vary significantly between U.K. counties. While shift-share analysis has been used as a decomposition technique (Dunn, 1960) to account for these differences, a shortcoming is that the regional shift is affected by the level of regional employment in a given industry. Also, firm formation rates in each industry are likely to be partly determined by the industrial structure of a region. This paper extends the shift-share methodology developed by Johnson (1983) to incorporate a cluster analysis of the industrial structure of regional employment in order to further separate regional and sectoral components of firm formation in British counties in the1980s and 1990s. Firm formation is measured using VAT registration rates.

Introduction

This research analyses the pattern of new firm formation in the UK regions using a modified form of shift-share analysis. New firm formation is an important policy issue for a number of reasons. Noting the role that new firm formation plays in economic growth, Reynolds et al (2007) suggest that higher firm birth rates are a necessary condition for economic growth as empirical observation shows that higher growth rates tend to be preceded by higher growth rates of new firms. Regional pockets of growth such as Northern Virginia in the U.S. have had higher rates of new firm formation making new firm formation a subject of sub-national level policy.

New firm formation has been associated with growth in employment. Policies that encourage self-employment as a means of escape from unemployment have been implemented in many countries. In addition, higher rates of new firm formation are associated with a culture of entrepreneurship and freedom of economic opportunity, signalling an environment conducive to economic growth.

Start-up firms have been found to be responsible for the gestation of innovatory products and services that can lead to the development of new industries. In an effort to emulate the success of Stanford-Silicon Valley and MIT-Route 128 cluster interactions, governments encourage partnerships between Universities and private businesses to embody and commercialize innovation through the establishment of new business “spin-

outs". Start-ups can also involve knowledge spill-overs from large firms (Audretsch and Keilbach, 2007), such as when someone leaves a large firm to found their own business.

Spatial variations in firm formation rates have been found to be related to factors such as the age profile of the population, the level of unemployment, wealth (including house prices), education levels, the number of small firms, and the effects of local and central government policies (Johnson and Parker, 1996; Ashcroft and Plotnikova, 2007; Audretsch, 1995). They also result from the facts that the relative sizes of industries vary across regions and that new firm formation rates vary widely by industry. A further question of interest for regional policy-makers and analysts is how to account for the differences in new firm formation rates in the same industry in different regions.

Shift-share analysis, originating with Jones (1940) and Dunn (1960), has been used to decompose firm formation rates. In its traditional form it gauges the performance of the region as compared to the country and the industry. It involves decomposing the variable of interest into a) a national component indicating how the region would fare if it had the same industrial structure as the country as a whole, b) an industry component that shows whether the region is performing better with its industry structure than it would if it was identical to the national industry structure, and c) a regional shift that shows the difference that results from the regional versus national performance in each industry. Johnson (1983, 2004), Storey and Johnson (1987), and Ashcroft et al (1991) have used the shift-share technique to analyse new firm formation rates in the U.K. Johnson (1983)

provided a motivation for this paper, concluding that differences in formation rates across regions are dominated by differences in intra-industry formation rates across regions.

However, shift-share analysis has been subjected to criticisms, such as that it lacks a theoretical basis and is sensitive to the aggregation level (Richardson, 1978). Shift-share analysis has been extended in various ways (Haynes and Machunda, 1987). Arcelus (1984) extended the shift-share technique by adding a regional growth effect in order to account for the strength of the local market. Thirlwall (1967) introduced “dynamic” shift-share analysis by suggesting that a study period be subdivided into two or more sub-periods in order to take account of changes in the industrial mix and total employment.

A further criticism of shift-share analysis is that there is interdependence between the regional shift and the industry effect (Rosenfeld, 1959). This can be seen below in the fact that regional employment in a given industry appears in the formula for the fertility component and not just in the structural component. One way in which others have addressed this is by utilising “homothetic” employment weights, which weight the region’s employment in each sector according to national employment patterns (Esteban-Marquillas, 1972). In addition, the traditional shift-share technique uses national rates of the variable of interest (in our case firm formation) as the comparator for each industry, whereas in reality there are linkages between industries within regions, including inter-industry demand effects (Dawson, 1982). Nazara and Hewings (2004) introduced a spatial neighbourhood effect into shift-share analysis in order to account for inter-regional linkages and spillover effects, claiming that regional performance is bound to be

influenced by what is happening in neighbouring regions. While Nazara and Hewings (2004) look at a region's geographical neighbours, in this paper we consider a region's "neighbourhood" in terms of similar sectoral employment structure.

This paper responds to the criticisms that the regional shift is influenced by a region's specialization in a given industry, and that the broader industrial structure of the region is also important by comparing regions with similar structures of employment across industries, using cluster analysis to group regions together. The objectives are a) to provide a method for further decomposition of regional and industrial components of firm formation and b) use the suggested decomposition to account for regional variations in new firm formation within industries in British unitary authorities in the late 1990s-mid 2000s.

Shift-Share analysis

In the Johnson (1983) formulation the number of firms formed in a region is decomposed into three components: the national standard, structural, and fertility components.

$$A_r = NS_r + S_r + F_r \quad \text{or}$$

$$\sum_{1}^{N} e_{ir} f_{ir} = \sum (\frac{E_r e_{in} f_{in}}{E_n}) + \sum_{1}^{N} (e_{ir} - E_r \frac{e_{in}}{E_n}) f_{in} + \sum_{1}^{N} e_{ir} (f_{ir} - f_{in})$$

Where

A_r = the actual number of firms formed in a region during a specific period,

E_r = total employment in region *r*,

E_n = national employment,

e_{ir} = employment in industry *i* in region *r*,

e_{in} = national employment in industry *i*,

f_{ir} = firm formation rate in industry *i* in region *r*,

f_{in} = national formation rate in industry *i*,

$NS_r = \sum (\frac{E_r e_{in} f_{in}}{E_n})$ is the national standard component: the number of new firms that would have been expected if the structure of the region's employment had been that of the nation as a whole *and* if each sector in the region had the same formation rate as its national counterpart,

$S_r = \sum_1^N (e_{ir} - E_r \frac{e_{in}}{E_n}) f_{in}$ is the 'structural component', or industry-mix effect: the element in the difference between A_r and NS_r attributable to the difference in industrial structure between the region and the nation,

$F_r = \sum e_{ir} (f_{ir} - f_{in})$ is the 'fertility component' or the 'regional shift': the element in the difference between A_r and NS_r attributable to the difference in firm formation rates within industries between the region and the nation.

Note that Johnson (1983) found from his data, as noted above, that the fertility component dominated the structural component. Johnson (2004) noted differences in the relative importance of the two over time and between regions.

The fertility component $F_r = \sum e_{ir}(f_{ir} - f_{in})$ has garnered attention as it is a deviation from the value of the region's firm formation rates from national rates and at the region's industry mix. While the fertility component indicates that region-specific factors are conducive to firm formation, it does not further explain the reasons for them being present in some regions but not others. In a contemporary critique of Dunn (1960), Rosenfeld (1959) warns that the regional shift is not only affected by the special dynamism of the sector in the region (the difference in firm formation rates) but also by the share of regional employment accounted for by the industry. One can extend the argument to the set of industry sizes in a region, i.e. to claim that the broader industrial make-up of the region may be an important source of differences.

New firms tend to be small, mainly serving their local area, so from the point of view of a new firm in a given sector, the make-up of the local economy will be important because it will help to determine what potential customers it will have from other sectors. It will also influence the structure of skills and experience in the local population, the number and types of people being made redundant and so potentially pushed towards self-employment, and also the level of economic growth in the region. If one industry is generally expanding nationally and accounts for a large share of employment in a region then it should help to make the region's economy buoyant through demand effects onto

other industry sectors, unless region-specific factors prevent this, though a growing industry will also pull resources, including potential entrepreneurs, away from other local industries.

Further decomposition of the regional shift based on another benchmark, the new firm formation rates in regions with similar industry structures, can be used to respond to the criticism and incorporate the notion that the industrial make-up/industrial structure of a region has an impact on new firm formation (NFF) rates. Groups of regions with comparable industry structures – each region in each group tending to have a similar employment share in each industry – can be identified using cluster analysis (Aldenfelter and Blashfield, 1984).

Shift-share decomposition with cluster analysis

The fertility component for a region, F_r, is decomposed into a cluster fertility component, F_c, and a region-cluster shift, F_{rc}.

$$F_r = F_c + F_{rc}$$

The cluster fertility component is a measure of the difference between the number of firm formations that a region would have if it had the same formation rates as the other members of its cluster and the number of formations that it would have if it had the same

formation rates as the nation as a whole. C is the number of other regions in the cluster (i.e. the total cluster size minus one) and w_c is the inverse of C (note that weighting by employment shares would be an alternative to this).

$$F_c = \sum_{i=1}^{N}\left(e_{ir}\left(\sum_{c=1}^{C} w_c f_{ic} - f_{in}\right)\right)$$

The region-cluster shift is then a measure of the number of firm formations in the region that result from the formation rates of the region being different to those of the other members of its cluster.

$$F_{rc} = \sum_{i=1}^{N}\left(e_{ir}\left(f_{ir} - \sum_{c=1}^{C} w_c f_{ic}\right)\right)$$

And so the number of firms formed in region r during a specific period is:

$$A_r = \sum_{i=1}^{N} e_{ir} f_{ir} = NS_r + S_r + F_c + F_{rc}$$

Or, expanding the above:

$$A_r = \sum_{i=1}^{N}\left(\frac{E_r e_{in} f_{in}}{E_n}\right) + \sum_{i=1}^{N}\left(e_{ir} - E_r \frac{e_{in}}{E_n}\right) f_{in} + \sum_{i=1}^{N}\left(e_{ir}\left(\sum_{c=1}^{C} w_c f_{ic} - f_{in}\right)\right) + \sum_{i=1}^{N}\left(e_{ir}\left(f_{ir} - \sum_{c=1}^{C} w_c f_{ic}\right)\right)$$

For one industry, i, the number of firms formed in region r during a specific period is:

$$A_{ir} = e_{ir} f_{ir} = e_{ir} f_{in} + e_{ir}\left(\sum_{c=1}^{C} w_c f_{ic} - f_{in}\right) + e_{ir}\left(f_{ir} - \sum_{c=1}^{C} w_c f_{ic}\right)$$

Note that the employment-share cluster average formulation is akin to the spatial lag average in Nazara and Hewings (2004).

Measurement of New Firm Formation

VAT registration data, obtained from the Small Business Section of the Office of National Statistics, will be used to measure new firm formation. The data are reported as simple counts by industry classification. Johnson and Conway (1997), who undertook a study of how well VAT registrations measure actual firm births, cautioned that VAT registration data provides an imperfect measure of firm births as it omits very small firms that are not required to register until they reach a certain threshold. In addition, registration may result from business growth, reorganization or acquisition rather than from the births of entirely new businesses. However, it remains an important means of measuring firm births in the UK, with no perfect measure being available.

VAT measurement was not uniform across the years as the turnover threshold for registration was raised substantially above the usual adjustment for inflation between 1991-1992 and 1993-1994. This had the effect of producing an artificial decrease in the number of firms created. There was also a definitional change in 1994 where the number of reporting units was reduced as branches of establishments were no longer counted as separate entities.

British unitary authorities are used below as the spatial units of analysis. Note that in the mid 1990s there was a change in UK county boundary definitions with a number of counties being broken up into unitary authorities (ONS, 1999). For these reasons the time periods for which new firm birth data is available and new firm definitions were least interfered with was the period post 1994 making it most suitable for temporary analysis. The data used below is for the period 1998-2005.

Cluster analysis

Hierarchical cluster analysis was applied to UK data on VAT registrations by unitary authority with the number of clusters determined by the data rather than being imposed. Wards linkage method for cluster identification was performed on seven broad industry sector employment share variables (codes given are for SIC 2003) for each region in a given year. These were shares of employment in:

1) Agriculture (AB);
2) Manufacturing, Mining, Electricity (CDE)
3) Construction (F)
4) Wholesale, Retail Trade, Hotels, Restaurants (GH)
5) Transportation, (I)
6) Real Estate, Finance (JK);

7) Government, Health, Education, Other Services (LOMN).

Through the period 1998-2005 there was a minimum of 16 and a maximum of 21 clusters in each given year. Even though the number of clusters changes from year to year, we observe a core and periphery structure with a few large clusters close to the industry averages, such as a cluster of major cities, and smaller clusters that represent deviations such as some rural Welsh areas. The City of London (London's main financial district) was always in a separate cluster by itself. The islands with their specific economic structures belonged to small clusters with other islands or outlying areas.

It is noteworthy that cluster memberships change across years, i.e. regions do not necessarily move together as part of a single cluster across all years. Other areas generally enter or leave a cluster during the time period. This indicates that the industrial structure, in terms of relative employment shares, changes enough across consecutive years to change the regional clusters. However each cluster formation tends to have what can be described as cluster-core, a group of regions that share same cluster over many consecutive years, for example, North East Lincolnshire, North Lanarkshire, North Lincolnshire, North Tyneside, Oldham and Renfrewshire tend to be together.

Discussion of the Results

Figures 1 to 4 show Reading and its cluster as an example. In Figures 1 and 2 it can be seen that over the period 1998-2005 the Reading cluster fertility component experienced

a decline for the Public Sector and in the Trade & Hotels Sector while the Reading cluster shift improved over the same time period. It can be seen, therefore, that in these industries the Reading firm formation rate improved over the time period relative to areas with similar industry employment shares. It can also be noted that there were significant fluctuations in the Finance & Real Estate Sector in the two figures.

Figure 3 shows the distribution of members of Reading's cluster by industry – Manufacturing, Construction, Trade and Hotels, Public Health and Education in 2005. The cluster fertility component per employee is plotted on the horizontal axis and the region-cluster shift per employee is plotted on the vertical axis. So if the data points are located to the left of the vertical axis it means that the industry on average is performing worse in terms of the NFF rate per employee in the cluster than across the nation as a whole (e.g. in Trade and Hotels in 3c) and if the data points are located to the right of the vertical axis, then the industry has a higher average rate of NFF per employee in the cluster than the national industry average (e.g. Construction in 3b). If a point above the horizontal axis then the unitary authority (UA) is performing better than the average for the cluster. So data points located in the top-right quadrant indicate that the cluster has a higher NFF rate per employee than the national industry and the UA has a higher NFF rate than the cluster to which it belongs. Data points located in the bottom-left quadrant indicate that the cluster has a lower NFF rate per employee than the national industry and the UA has a lower NFF rate per employee than its cluster.

It can be seen that the cluster fertility components for both Public, Health & Education and Manufacturing are very small and that the UAs are grouped tightly with low levels of region-cluster shifts. The cluster fertility component is negative for Trade & Hotels and positive for Construction. Both also have significant dispersion of the region-cluster shifts. In each graph the points have a slightly off-vertical downward slope. This is because the cluster rate is calculated without the UA for each point, so that if the UA's NFF rate is high then without it the cluster average is somewhat lower; conversely if the UA's rate is low then without it the cluster's rate is somewhat higher

Figure 4 shows the cluster fertility component and the region-cluster shift without dividing by numbers of employees. So significant horizontal dispersion is due to differences in the numbers of employees in the industry across UAs. If a data point is located significantly further away from the vertical axis than most of the other points (as in Figure 3c) then it means that the UA's absolute employment is higher than in the most of the other UAs of its cluster. The vertical dispersion of the points indicates that there are substantial differences in either the NFF rate per employee or absolute employment in the given industry in the UA, or both. In Figure 4c, for instance, there are two points which are significantly to the left of the others and are also quite low. They therefore have relatively large employment in the industry but small region-cluster shifts.

Figure1. Reading cluster fertility component

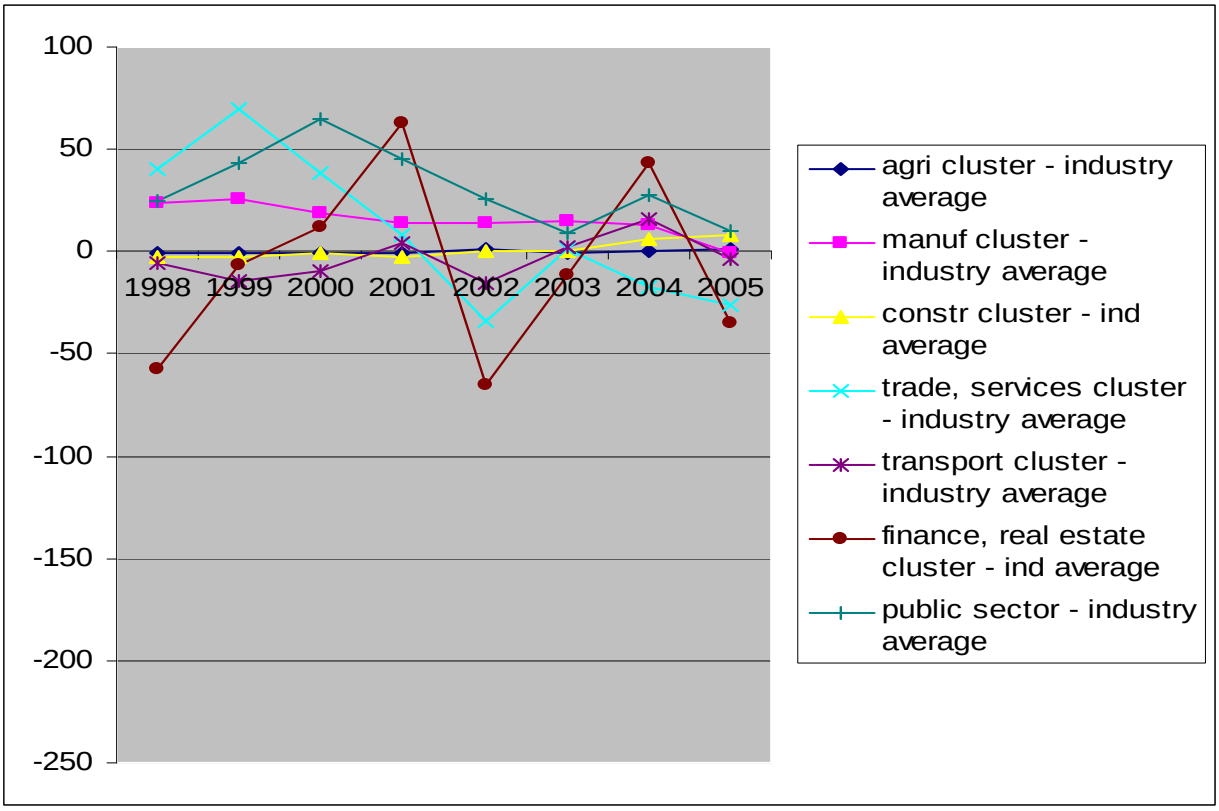


Figure 2. Reading region-cluster shift

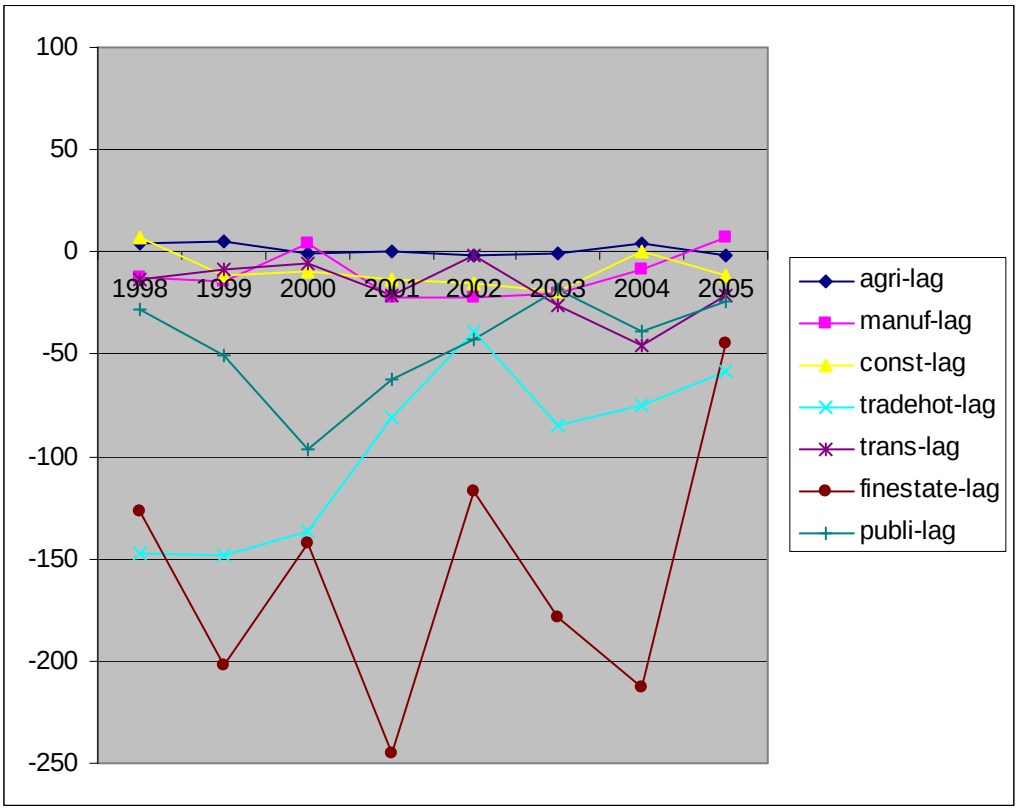


Figure 3. 2005 Cluster fertility component versus region cluster shift for each cluster member: per employee

Figure 3a: Manufacturing

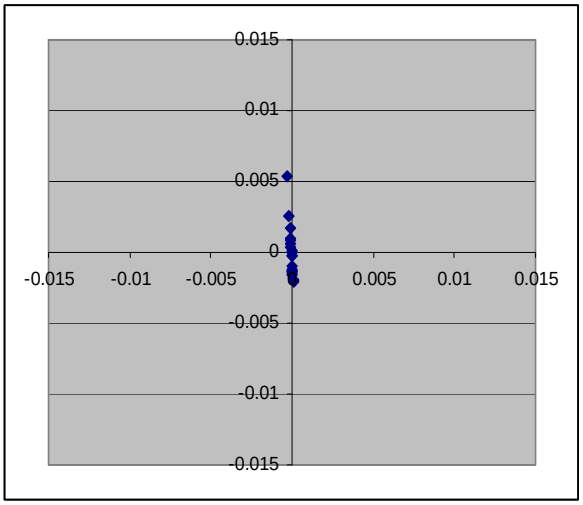


Figure 3b: Construction

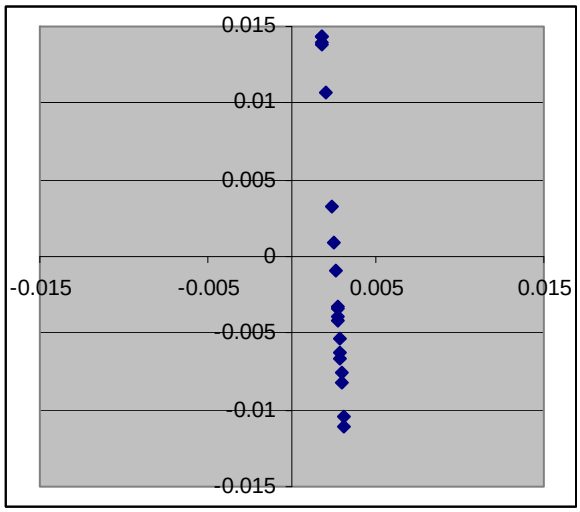


Figure 3c: Trade and hotels

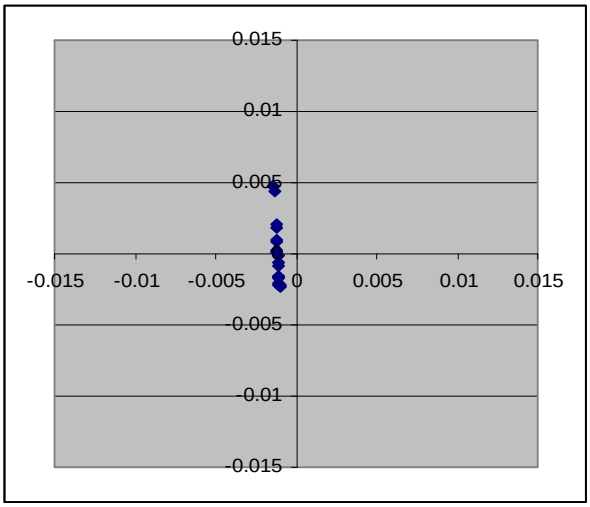


Figure 3d: Public, Health and Education

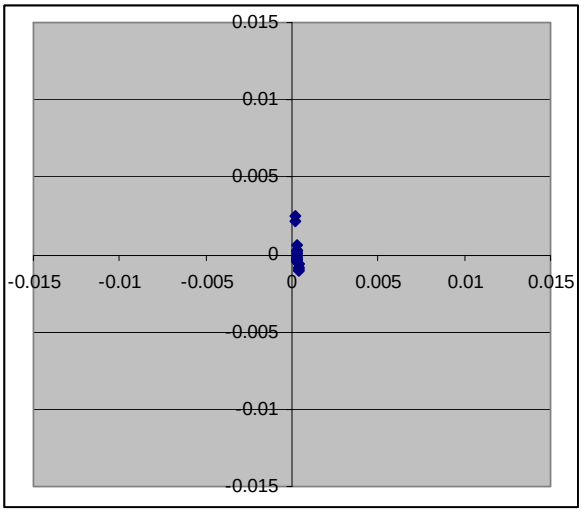


Figure 4. 2005 Cluster fertility component versus region cluster shift for each cluster member

Figure 4a: Manufacturing

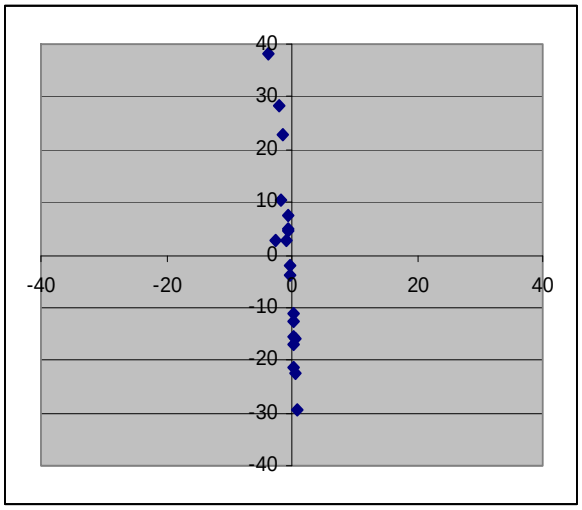


Figure 4b: Construction

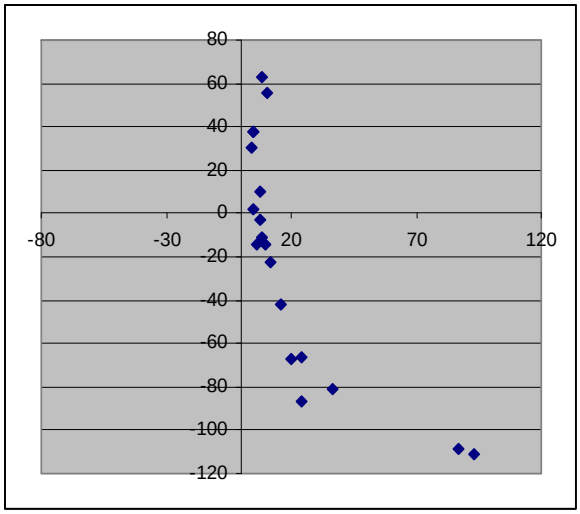


Figure 4c: Trade and hotels

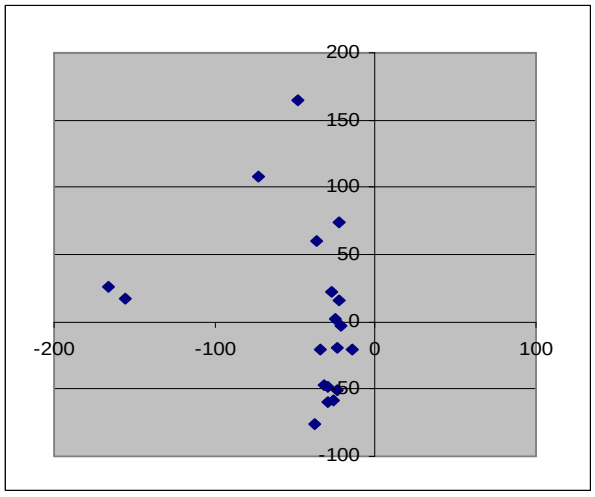
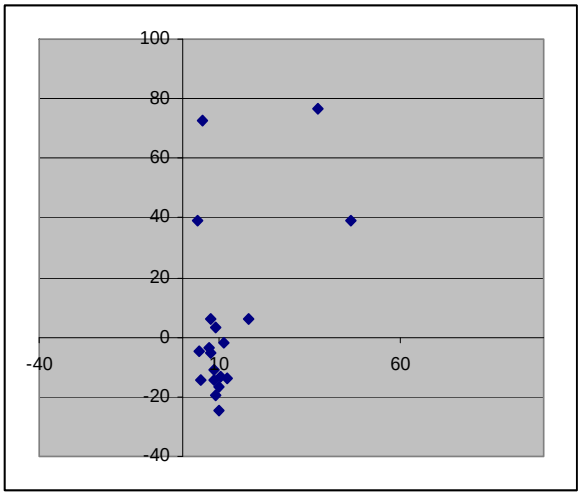


Figure 4d: Public, Health and Education



Conclusion

Shift-share analysis is a decomposition technique and does not allow for causal analysis. Nevertheless it has been used as an exploratory technique and metric by academic researchers and policy makers. One weakness of the technique has been the interdependence of the regional shift and the industry effect. This paper has addressed this concern in the context of new firm formation in British unitary authorities using a cluster analysis to group together those with similar industry employment shares. The technique therefore measures both the performance of the cluster and the performance of the region relative to the cluster.

The technique can be used where central government employs NFF rates as metrics for regional economic performance (Johnson, 2005). Regional governments could also use it to monitor the economic performance of their regions. Once the analysis is conducted, policy-makers can go on to identify causal or qualitative explanations that interpret differences in performance of regions with similar industrial structures. It should be of some interest to policy makers where one region is performing well at the same time as another with a similar industrial structure is performing badly.

A complementary exercise would be to investigate whether firm deaths exhibit similar dynamics to firm births and apply the methodology to net firm birth rate. Further research would also include analysis of (temporal) cluster evolution alongside the analysis of new

firm formation – to explain the link between industry structure (employment shares) and NFF.

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