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Financial Agglomerations in the UK: Geographical Cluster Size and Firm Performance

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Abstract

This paper reinforces the premise that cluster size has beneficial influence on performance by using data of 17,535 UK financial services companies. The research issue is whether having a closely related industry cluster is truly beneficial to member firms' profitability, as recent studies alleged that a large cluster creates congestion and has negative implications for performance. However, a myriad of performance measures

were used and notably many still consider financial performance as key measures. By segregating a cluster into its competing and related sectors, I find they work in opposite directions on promoting firm growth prospects and financial performance. I argue related sectors in a cluster allow the firm to draw pecuniary benefits to better its financial performance, while the competing sector promotes its growth prospects.

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EXECUTIVE SUMMARY

Cluster size, measured by two established cluster strength attributes, is found to work in opposite directions in promoting the growth prospects and financial performance of member firms. This study addresses three identifiable gaps in the literature: (a) by providing a more precise measurement of cluster size; (b) by employing financial measurement of returns to capital employed and solvency; and (c) by demonstrating that agglomeration of related sectors creates pecuniary benefits, which can be reflected in the bottom line. Our findings support the need for related sectors to agglomerate in a geographical cluster, despite the arguments of rising congestion costs in earlier models of cluster growth. Policy makers must now concertedly plan for regional development through achieving critical mass in selective types of related sectors in creating pecuniary externalities, as well as ensuring there is critical mass in specific sector to promote the growth prospects of firms.

The relationship between cluster size and firm performance is central to the agglomeration theory, which suggests that the performance of geographically clustered firms improves with cluster size. The research issue is whether having a closely related industry cluster is truly beneficial to member firms' profitability, as recent studies alleged that a large cluster creates congestion and has negative implications for performance.

Previous empirical evidence of firm performance in clusters is limited to en-bloc consideration of the industry and to varied non-financial measurements, including survival and patenting rates. However, a lower level of disaggregation is achieved with en-bloc considerations. This does not advance the development of agglomeration theory, as it does not promote the understanding of different agglomeration externalities at play,

mostly which are clearly identified, except the enigmatic pecuniary externalities. Pecuniary

externalities, in particular, influence the financial performance of firms resulting in improved profits.

Much of London's success in financial services is attributed to clustering and there are reportedly intense interactions amongst its related sectors in recent studies. We investigated the regional UK financial services clusters as financial agglomerations exist in many UK regions, such as a strong asset management cluster in Edinburgh (Southern Scotland) and regional financial centres in Leeds (Yorkshire), Manchester (North West) and Bristol (South West). The veracity of beneficial agglomeration effects is therefore an important question, not least because many governments and regional development agencies are expending vast resources supporting the development of clusters.

We used data on 17,535 UK companies founded between 1900 and 2001 that classifies financial services as their primary activity under the Standard Industry Classification (SIC 1992). By using a cross-sectional frame of companies in financial services, this important industry can be modelled through a larger number of observations and would cater for macroeconomic fluctuations, which affect all business segments.

An established cluster model on lifetime growth is extended to consider a firm's financial performance. The model is appropriate because the net benefits of all the external agglomeration economies can be measured, as a certain externality facing a company may have a gross positive effect while another may have a gross negative contribution. This model makes use of the total employment size in one's own sector and the total employment size of related sectors of the region in investigating the thirteen UK geographical regions. Different financial sectors are controlled as the localised activities represent different benefits to other related sectors. For example, localisation of banks would not create localisation economies

for securities companies. Sources of externalities lie in the workers, as knowledge spill-overs and externalities that are more difficult to measure, occur at the employee level and between skilled workers in an agglomeration. Employment size is particularly important for financial services as its output is based upon specialised labour, knowledge and new knowledge acquisition transferred through the workforce.

Firm financial performance is an important consideration, as key employees of new ventures in clusters are more likely to leave, or companies with marginal performance are more likely to close down. It is clear from this study that most financial services sectors in banking, leasing, trust funds, life insurance, and securities benefit most from being located with other financial services sectors. Competitive sectors form competitive clusters, especially so if the sectors are inter-dependent and their transactions intertwined.

INTRODUCTION

Agglomeration, or clustering, is believed to improve the performance of companies, see Marshall (1920); Porter (1990); and Krugman (1991a) and (1991b); and is a key feature of the global financial services industry (Sassen, 1991; Reed, 1981). However, the extent to which clustering provides a common and persistent benefit to companies is debateable, see Shaver and Flyer (2000) and Folta, Cooper, and Baik (2006). These studies argue that Marshall's (1920) sources of external economies, with varied performance measures used, result in diseconomies as the cluster becomes too large and benefits are disproportionate. We argue that true cluster size should include competing sector, as well as, the lateral and vertical sectors that play

a big part in generating other external economies. However, Beaudry and Swann (2001) contend related sectors add to congestion and could attenuate firm growth.

Whether clustering is beneficial then becomes an important question, as many governments and development agencies are expending vast resources supporting the development of clusters, see McDonald, Huang, Tsagdis, and Tusleman (2007). More particularly, within financial services, Gieve (2007) points out, the Bank of England sees much of London's success in financial services as a result of clustering. It becomes an important question to regional planners as an empirical link between financial development and economic growth is developed, see Levine (1997; 2003).

In spite of evidence that financial clusters display important agglomeration effects (Pandit et al., 2001) and reported interdependencies of activities within a financial cluster (Cook et al., 2007). Many studies ignore sources of external economies, in particular, the sources of pecuniary externality¹ with an influence to the performance of member firms. In fact, the good working of a financial centre and the performance of its incumbents is a central question to many venture capitalists, bankers, and even smaller firms. Agglomeration effects are believed to arise from not only from Marshall's external economies of scale, but also external economies of scope and complexity, with their net effect being more relevant to the member firm's performance, see Parr (2002). In particular, it is the pecuniary externality that remains quite enigmatic; see Parr (2002) and Autant-Bernard and Massard (2005). This paper mainly contributes to the identifiable gaps in empirical studies, which, at this point, fail to demonstrate that agglomeration creates pecuniary benefits that can be reflected in the bottom line.

¹Tibor de Scitovsky (1954) highlighted that technological externalities (knowledge spillovers that result from non-market interactions) and pecuniary externalities are two main agglomeration forces in the new economic geography. Pecuniary Externality is said to exist if the profits of a firm depend not only on its own activity but also on the activities of other firms in upstream and lateral industries that has the effect of lowering the market price of inputs. Due to the indirect interactions of related industries, Antonelli (2008) argued that member firms are also able to exploit pecuniary externalities to innovate on new products due to market knowledge of production factors available to them at prices below their marginal productivity.

The issue on firm's increased revenue, profitability or performance as a main outcome to clustering is rather important, see Parr (2002) and Folta et al. (2006). For example, older established firms, with a greater accumulation of internal corporate resources, could be less reliant on the external economies of scale and scope offered in the cluster. While clustering may offer younger firms parasitic opportunities to feed off the knowledge, skilled labour and infrastructure of its leading competitors. Conversely, older firms may be capable of engineering a more symbiotic relationship with their lateral and vertical sectors by offering new ideas, enterprise and additional depth in skill and service support within the cluster. Evidence has suggested that there are rampant interdependencies of activities within a financial centre. They highlight an important yet fundamental gap to the agglomeration theory - in understanding the relationship between agglomeration effects and firm performance. This paper generally follows Porter's (1990) terminology of industrial clusters, which are "critical masses of competing sector and related sectors in a geographical region that competes and collaborate, but where evidence of improved performance can be demonstrated".

This paper examines over 17,000 UK financial services companies across eight sectors and thirteen regions in the UK. The discussion will proceed in section three with a review of agglomeration externalities and the range of empirical work so far. Section four details the model and method. The discussion presents the data and results in section five, which then followed by conclusions in the last section.

Review of Empirical Literature

Shaver and Flyer's (2000) study on a broad array of industries' investments in the US looks at localisation economies, but point out those agglomeration economies have the potential to enhance firm performance. They use firm survival (after 8 years)

as a performance measure, while the cluster size is measured by plant counts of the industry. Chung and Kalnins (2001) also describe Marshall's localisation economies of the Texan lodging sector, to which they find that similar traits or similar firms result in localized benefits, such as heightened demand, that improves firm performance. Likewise, Folta et al. (2006) combines the number of firms in 12 related biotechnology sectors in their quest for the relationship between cluster size and firm performance, measured through rates of patenting, alliances partnering and private equity partnering in the biotechnology industries. These studies investigated the cluster size mainly through the lens of localisation economies, whilst hugely ignoring other agglomeration economies.

Beaudry and Swann (2001) examine an array of UK industries and find that firm growth is positively related to the total employment of the same sector in the cluster. At the same time, firm growth is attenuated by the total employment of related sectors (through SIC codes at the broad 1 digit level). They interpret the latter as indication of congestion and competition in the supply market. The result does not support the need for related firms to cluster. The exclusion of small and young firms from this study inhibited inferences on how small firms benefit from larger clusters, while the mix of industries made it difficult to identify how service industries benefit from cluster membership.

Parr (2002) distinguishes internally based agglomeration economies and external agglomeration economies. While it may be possible for firms in an agglomeration to benefit from more than one internally based dimensions (scale, scope or complexity), most cluster studies focus on external economies in scale and scope, or externalities. Firms are motivated to locate near one another because of external agglomeration economies, which Arthur (1990) defines, as the net benefits of being in a location together with other firms increasing with the number of firms in the location. Parr (2002: 724-725) points out that the net ben-

efits of all the external agglomeration economies should be measured, as a certain externality facing a company may have a gross positive effect while another may have a gross negative contribution.

Although there are suggestions on the use of financial measures in addressing firm performance in clusters, see Folta et al. (2006) and Shaver and Flyer (2000), few studies have examined this (with exception to Nachum, 2003). More importantly, the literature reveals that empirical studies so far have failed to quantify the determinants at play in terms of pecuniary externalities that can benefit firm economically when firms agglomerate, see Parr (2002) and Autant-Bernard and Massard (2005).

Empirical findings of agglomeration effects carry a mixed message in disproportionate benefits. Baptista and Swann (1998) caution against congestion in established clusters; and Shaver and Flyer (2000) show that for the US biotechnology sector, returns to clustering are not homogeneously distributed across firms, benefiting only younger firms with weaknesses in technology, human capital, suppliers and distributors. Folta et al (2006) further point out that marginal benefits decrease with cluster size and McDonald et al. (2007) show that clusters may not promote growth or performance across a variety of UK industries.

While previous studies focus on how localisation affects firm performance, it is only the works of Swann et al. that look at industrial clusters with reference to its competing sector and related sectors. This model has been established in numerous industries like high tech, computer, biotechnology, media and financial services industries (e.g. Baptista and Swann, 1999; Beaudry, Cook, Pandit, and Swann, 1998, Cook et al, 2001; Pandit et al, 2001). However, they failed to relate to agglomeration externalities, with the simplistic suggestions that related sectors only add to congestion effects. Most importantly, the use of financial measures has been limited. The next two sub-sections will define the externalities arising from groups of competing and related sectors in a

cluster, while section 2.4 will introduce the choice of financial performance measures.

Larger Agglomeration due to More Competing Firms

The agglomeration of similar firms creates localisation economies, which Parr (2002) terms as an external economy of scale. The sources according to Marshall (1920) are several: labour market pooling, creation of specialised suppliers, and the emergence of technological knowledge spillovers. Weber (1929), Hoover (1937), and Rosenthal and Strange (2005) suggest using the specific industry size (e.g., employment or output) as measures, while Henderson (2003) and Shaver and Flyer (2000) suggests using the count of plants of the specific sector.

External economy of scale is possible in an agglomeration as firms can benefit from the pool of resources (e.g. technology, human capital, suppliers and distributors). This would be more likely if more competing firms co-locate, also drawing more opportunities to collaborate for the entrepreneurs. It has been reported that many young companies profit from informal communications and collaborative practices in Silicon Valley, see Saxenian (1994). The entrepreneurs can exploit the environment in creating new organisations, SMEs and innovation; see Rocha and Sternberg (2005). Krugman (1991b) also argue that the localised industry can increase a firm's returns. Labour market pooling benefits both workers and firms on the supply side since a large labour pool helps smaller and younger firms cope with the uncertainty related to individual firm business cycle. An instance would be the agglomeration effects observed in London Financial Centre, where there are a large number of contract workers, who are very mobile (Kuah, 2008). As a strong localised industry can support a greater number of specialised suppliers, the suppliers in turn lowering their supplies costs and increasing its variety can establish economies of scale and scope.

Many studies on the cluster model thereby known as related studies, demonstrate that the

agglomeration of workers (or cluster strength) in one's own sector is an exogenous factor positively influencing the size of incumbents. This measures the extent of localisation economies, as knowledge spill-overs and externalities occur at the employee level and between skilled workers in an agglomeration.

Hypothesis 1: Total employment in one's own sector in an industry cluster has a positive influence on incumbents' growth performance.

In contrast, Baum and Mezias (1992) find that competitors with similar traits in the Manhattan hotel industry are greater threats to each other, to the point of affecting their survival. As the cluster grows, there will be greater competition for workers, for land and for utility services, leading to shortages and increase costs (Folta et al., 2006: 223). Having many similar firms in an agglomeration creates congestion costs on the demand side, resulting in increased competition in the output markets, which can detract a company performance. An increase in the number of competitors in one's own industry at a location may reduce per-firm sales, prices, per-firm profits and per-firm growth (Cook et al., 2001; Pandit et al., 2001). Competition is seen as an exogenous force affecting firm performance (Tallman et al., 2004).

Hypothesis 2: Total employment in one's own sector in an industry cluster has a negative influence on incumbents' financial performance.

Larger Agglomeration due to More Related Firms

Although more firms in an agglomeration may lead to congestion, there are benefits of having competitive supporting and related sectors in a cluster, see Porter (1990). Urbanisation externalities, which Parr (2002) terms as external economies of scope, arise from the diversity of industries in a city or region and would be associated with the benefits that arise irrespective of the firm's activity, see Jacobs (1969, 1984). Thriving industries at a location draw a more diverse labour pool, more supporting

industries, and bring about better infrastructure brought about by diversity of industries in urban concentration. Rosenthal and Strange (2005) suggest that urbanisation economies may be measured by the total employment in a city.

More closely associated to related sectors is the external economy of complexity (Parr, 2002), arising when several related sectors benefit from the presence of each other. For example, the nature of insurance and reinsurance processes involves a chain of insurance firms and private equity holders in the London financial centre to spread the risk acquired of a profitable venture, and therefore may bring net pecuniary benefits to all involved. Banks and financial leasing companies also often transfer (or sell) their acquired loans as financial assets. Furthermore, within proximity, cost savings would arise from communication flows to reduce input-output problems. A pecuniary externality is said to exist if the profits of an incumbent depend not only on its own activity but also on the activities of other companies in vertical and lateral sectors. There are known interdependencies of financial services activities within the London cluster, with profuse lateral relationships in the banking industry and the insurance industry, while fund management and investment banking maintain strong vertical relations to the commercial banks (Cook et al., 2007; Pandit et al., 2001). Another source lies in the transfer and cross-fertilisation of skilled labour between related sectors, hence training provided by one may eventually benefit another. With workers crossing between related sectors, innovation may be more prolific and new entrepreneurs may emerge. Employment is a good substitute for the pecuniary externality as skilled labour and knowledge transfer takes place amongst the workers.

The cluster strength in related sectors, measured by the level of employment, is found to be an exogenous force attenuating the firm's lifetime growth in related studies. The availability of the labour pool in a cluster concerns with what a firm experiences whilst being in the cluster, and is thus an exogenous influence to the firm.

Hypothesis 3: Total employment in one's related sectors in an industry cluster have a negative influence on incumbents' growth performance.

Chung and Kalnins (2001) then find that dissimilar firms gained most in performance due to heightened demand. Barnett and Carroll (1987) also note that proximity of neighbouring firms can be beneficial for a firm's survival when such neighbours are different and have inter-linked demands. This is likened to having related firms in a cluster that not only support and provide services to each other but also have intertwined demand. Such pecuniary externalities may arise as the related labour pool (with transferable skills) move easily across firms in the cluster, hence entrepreneurial firms and new entrants can compete for the same source of labour. Frank (2003) cites that one of the reasons human capital specificity is important for companies' location decisions is because knowledge embodied in workers, and the poaching of workers in concentrated areas is a way for companies to raise their productivity. Seemingly, having dissimilar firms and diversity in a cluster may be beneficial to incumbents' performance. The total employment of related sector in a cluster is particularly important for financial services as its output is based upon specialised labour, knowledge and new knowledge acquisition transferred through the workforce.

Hypothesis 4: Total employment in one's related sectors in an industry cluster have a positive influence on incumbents' financial performance.

Measures of Financial Performance

There are many measures of a company's financial performance. Variables like return-on-capital-employed, return-on-equity, firm growth and firm size are common performance measurements (Bris, Koskinen and Pons, 2004; Chittenden, Hall and Hutchinson, 1996; Jordan, Lowe and Taylor, 1998; Ozcan, 2001 and Hall et al., 2004). Nachum's (2003) research on the London financial centre measures banks' per-

formance solely on the merit of the returns on capital employed (ROCE) as 'it is the most commonly used performance indicator in financial services'. ROCE is chosen as a firm performance indicator defined as profit before tax as a proportion of long-term debt and shareholder equity. As a major and most common measure of profitability, the ROCE measures the rate of return on stakeholders' investment and whether the return made on an investment is better than alternatives available in other firms.

The capital adequacy (or solvency) is the standard used by most governments to identify troubled financial institutions, and central banks use this to maintain sufficient funds in financial institutions, see Ahn and Cha (2004) and Central Bank of Ireland (2000). The solvency ratio (SOLV) is defined as shareholder equity (capital) as a proportion of total assets (credit exposure). Folta et al. (2006) argue that 'acquiring capital on a timely basis' is a key indication of a company's value in a cluster. The ability and rate which firms, especially entrepreneurial and young firms, can obtain private equity to maintain its financial viability is most important. SOLV is a specific kind of gearing ratio: it indicates how much of deterioration in assets can be borne by the bank or financial institution. The higher the ratio, the less risk for general creditors

The overall financial performance of a company should be understood by the inherent risks and potential returns. These measures allow potential stakeholders to understand the level of success or profitability to expect, with a reasonable amount of risk, from their investments. The choice of these two ratios is far superior; say by choosing two profitability ratios, in demonstrating the rigour of the research hypothesis. While a high ROCE represents better profitability and performance of a company, a high SOLV only indicates more shareholder funds and lesser risks to creditors in the firms. The latter does not necessarily equate to better performance, but perhaps could lead to one with a balanced view of risk and returns.

DATA AND METHOD

Data

FAME was the main source of data for identifying the company's attributes, such as its financial performance, location, foundation date and size. FAME captures all UK-registered companies including those yet to file their first set of accounts. More importantly, this commercial database contains rich sources of financial and employment data needed for our models.

Several researchers have defined clusters according to state boundaries (Shaver and Flyer, 2000), whilst others have looked at Metropolitan areas (e.g. Oahey, 1985) or counties (Pandit et al., 2001; Cook et al., 2001) to explicitly link firms to the economic activities of their regions. Similar to related studies, the data was classified according to each widely defined UK geographical regions conforming to the boundaries set by the Office of National Statistics (the "ONS"). Other sources of UK information for computing other independent and dependent variables are from Regional Trends 2001 (ONS, 2001) and Business Clusters in the UK (DTI, 2001).

However, the database has a problem with missing or incomplete data with respect to employment. Although financial statements dated 2001 were available, a number of observations was last dated 2000 or 1999 at time of research. Only 7,473 companies (42.3%) provide employment figures. In order to optimise the amount of employment data, the average firm size (of the last five years prior 2001) is calculated. The aggregated employment figures in financial services per region were compared against the ONS (2001) and the magnitudes were found to be similar.

By using a cross-sectional frame of companies in financial services, this important sector can be investigated using a larger number of observations. The use of average employment of firms would counter for the effects of business cycles on firm size, while the cross section analysis would cater for macroeconomic fluctuations, which affect all business segments to the same degree.

Dependent variables

Three measurement of firm performance are used: employment size, return on capital employed (ROCE) and solvency (SOLV). Firm employment size is used as a first measure of performance, very similar to related studies. The return on capital employed ratio (ROCE) is chosen as the second firm performance indicator similar to Nachum (2003), while the solvency ratio (SOLV) is chosen as it is the standard used by most governments to identify troubled financial institutions (Ahn and Cha, 2004). The FAME database provides good sources of data to estimate the latter two aspects of performance. The database contains 7473 (42.3%) observations on firm employment size, 13,759 (78.5%) observations on firms' return on capital employed and 17,081 (97.4%) observations on firms' solvency ratio.

Independent variables

Parr (2002:721) raises the important question regarding the level of disaggregation. One can consider an industry cluster as en-bloc or by classifying specific sectors. Unlike other works (Shaver and Flyer, 2000; Folta et al., 2006) that classify the cluster size as en-bloc activities only to capture the extent of localisation economy, two main independent variables are used: total employment within the same sector (Slc) and total employment within related sector (Sjc) in each geographical cluster.

Slc, the total employment in one's own sector in a region, measures the localisation externalities. This is a common measure; see Weber (1929), Hoover (1937), and Rosenthal and Strange (2005). Sjc, the total employment of other related sectors in the region, reflects pecuniary externalities due to the intense interaction of related sector in financial services, see Cook et al. (2007) and Pandit et al. (2001). Employment size is particular important for financial services as its output is based upon specialised labour, knowledge and new knowledge acquisition transferred through the workforce.

The two measures of cluster size (using Slc and

SJc) have been found to influence a firm's lifetime growth in related studies, and include only those firms that were active at the given time.

Control variables

Parr (2002: 729) points out that agglomeration of economic activity at a given location may simply be due to coincidence or spatial organisation of an earlier industrial era, rather the presence of agglomeration economies. This presents a landscape to investigate whether a larger financial agglomeration at a certain region produces greater externalities for incumbents. We do not need to adjust for policy effects as there is only one central bank (the Bank of England) and the economy is generally unified with a single regulator (the Financial Services Authority) in the Kingdom. Moreover, a cross-sectional analysis adjusts for any economic and policy effects on the sector. In the attempt to look at how agglomeration externalities (through cluster strength attributes) affect the firm performance, the sector and regional fixed effects are controlled through dummy variables.

The data was classified according to each widely defined UK geographical regions using their registered business postal codes. The sample is divided into 13 geographical regions, as seen in Table 1, as

accordance to the ONS (2001). Consideration was also given to how Pandit et al. (2001) divide the UK into 14 regions under NUT3 system. The main difference between this classification and Pandit et al.'s (2001) studies is (a) North Wales and South Wales are combined as Wales; (b) Northern Ireland is included; and (c) North West London is assimilated into regions of East and South East to better emulate the regional boundaries. The geographical classification for each observation (firm) is verified by the postal code of its registered address, and coded as "1" in one of the 13 geographical regions, and '0' in other regional dummies.

The firms are categorised according to their primary activity (sector) on the basis of classifications found in the literature on UK financial services (Buckle and Thompson, 1998); and the company SIC codes at the four-digit level shown in Table 2. This level of disaggregation into sectors is important as the clearer breakdown may enable the identification of the relevant agglomeration externality (Parr, 2002:721). The eight sectors control for differences in activity type as suggested by Rosenthal and Strange (2005). It is also important not to over-disaggregate unless the study is specific to one sector. Each observation (firm) is coded "1" or "0" based on their primary industry as reported in FAME.

Table 1: Definition of Regions in the UK

NSCOT	Highlands, Islands, Aberdeenshire,	WALES	Clwyd, Dyfed, Gwynedd, Powys,
SSCOT	Angus, Dundee, Argyll & Bute, Perth,	EMID	Gwent, Mid, South & West Glamorgan
NIRE	Kinross & Stirling	WMID	Derbyshire, Nottinghamshire, Lincolnshire, Leicestershire, Northamptonshire, Rutland
NWEST	Borders, Fife & Clackmannanshire, Lothian, Renfrewshire, Ayrshire, Falkirk, Dunbartonshire, Lanarkshire, Dumfries/ Galloway, Glasgow, Edinburgh, Helensburgh & Lomond	EAST	Stoke-on-Trent, Telford, Wrekin, Shropshire, Staffordshire, Warwickshire, West Midlands, Worcestershire.
NEAST	Coleraine, Derry, Ballymena, Strabane, Omagh, Ulster, Belfast, Newry, Craigavon, Dungannon, Eniskillen	SWEST	Luton, Peterborough, Southend-on-Sea, Thurrock, Bedfordshire, Cambridgeshire,
YORKH	Blackburn, Darwen, Blackpool, Warrington,	SEAST	Essex, Hertfordshire, Norfolk & Suffolk
		LON	Bath, Bristol, Bournemouth, Poole, Swindon, Torbay, Cornwall & Isles of Scilly, Devon, Dorset, Gloucestershire, Somerset & Wiltshire

Table 2: Definition of Sectors in the Financial Services Industry

BSBANK	6510 - Monetary Intermediation 6511 - Central Banking 6512 - Other Monetary Intermediation including Banks and Building Societies
CREDIT	6520 - Other financial Intermediation 6521 - Financial Leasing 6522 - Other Credit Granting including Finance Houses, Factoring and Mortgage Finance Com.
TRUST	6523 - Activities of investment trust, unit trust, property trust, bank holding company, venture and development capital companies. 6602 - Pension Funding
LIFE	6601 - Life Insurance
NLIFE	6603 - Non Life Insurance
FINAUX	6700 - Activities Auxiliary to Financial Intermediation 6710 - Activities Auxiliary to Financial Intermediation except Insurance and Pension Funding 6713 - Activities Auxiliary to Financial Intermediation not classified elsewhere
INSAUX	6720 - Activities Auxiliary to Insurance and Pension Funding
MARKET	6711 - Administration of Financial Markets 6712 - Security Broking and Fund Management

McKillop and Hutchinson (1990) point out that the level of economic activity in a given region is the main factor influencing the size of its financial sector. In congruence, the level of financial GDP reflects the specific regional economic activity in this industry and is used as another control variable. The specific industry structure at the region plays an important role in the performance of firms (Porter, 1990; McGahan and Porter, 1997), and the industry concentration of financial services is used to control that aspect. The regional population density has a significant influence on firm growth (Beaudry and Swann, 2001). Hence, control variables include the regional population density, the regional GDP and the concentration index of financial sectors in the thirteen regions. The firm age is used as a control variable on the basis that as the firm becomes older, it is more able to attract and accumulate funds. Also as a firm gets older, it should theoretically be larger in size. Age is correlated with firm performance because of the selection

on efficiency (Jovanovic, 1982). This is again used in all the models.

Other than industry structure and economic activities variables, the study does not include firm status dummy variables, such as a subsidiary or headquarter operations. There are reasons for this: (a) populating a substantial database on firm attributes through company reports was infeasible; (b) a simple dummy variable to account for potential bias would not seem to add value to the fundamental premise that the cluster size has influence on firm performance.

Model specification

Within the literature, equation 1 is an established means of measuring agglomeration effects using two cluster strengths attributes, see related studies. The quest for a simplified and macro model to investigate regional financial agglomerations suggests that a cross-sectional analysis involving a larger sample of available records covering the UK will be better than exploring a single cluster,

say by using input-output analysis, or a longitudinal modelling concentrating on a fewer firms or selected agglomerations. The cluster model with its variables explained in Table 3 can be represented as:

$$\text{Perf}_{n \in \{I:c\}} = a_p + b_p(\text{Age}_n) + g_{1p} \ln S_{1c} + g_{2p} \ln S_{2c} + S_{vp} \ln V_v + n_p$$

removed to examine the significance of the estimators. This was also carried out in the second stage analyses.

The second stage analyses involved dividing the sample according to the eight sectors as specified in Table 1. This addresses the issue raised by Rosenthal and Strange (2005) that one ought to estimate agglomeration economies

Table 3: Definition of Variables for the Performance Model

Variable	Description
Perf n {I:c}	Performance of firm n from sector I at cluster c measured by either the natural logarithmic of firm size, ROCE ratio or SOLV ratio
Age n	Age of firm measured from date of incorporation to time of observation
P	Regression constant for performance regression
P	Coefficient indicating the performance change with age where $P = 1 + \sum_{c=1}^C \sum_{i=1}^I dc_i di_i$ <ul style="list-style-type: none"> • Dc represent cluster control variables (1 or 0), one for each of the UK regions (C = 13) • Di represent sector control variables (1 or 0), one for each sector (I = 8) • dc and di is their contribution to performance
1 P	Coefficient indicating the effect of one's own sector employment on the firm's performance
2 P	Coefficient indicating the effect of related sector employment on the firm's performance
S1c	Total employment of the particular sector I at particular cluster c
Vv	Represents other control variables namely: <ul style="list-style-type: none"> a) Population density: indicating the size of the region in supporting the economic activity, measured by size of population in cluster b) Regional GDP per capita: indicating the general economic activities in the region c) Employment diversity: indicating the regional concentration of the financial services industry measured by Herfindahl index
P	Residual or disturbance term on performance regression

Data Analyses

Two stages of analysis were carried out on the 17,535 financial services companies in the UK for the analysis on firm performance: Employment Size, ROCE and SOLV. The first stage analysis involved pooling all available observations in each of the three models. Cook's statistics were initially used to indicate any influential observation that might generally affect each model. To test the robustness of the models, 1%, 5% and 10% observations were randomly

separately. The sector-specific model will reveal the agglomeration effects and their significance to clustered-industry performance in the UK after the test of robustness.

Limitations

Longitudinal data on employment is difficult to obtain and adopting a time-series study would limit the sample under investigation. Significant events such as shocks and merg-

ers in the history of financial institutions were not really captured through this simple model, and only data on surviving firms were analysed. The supporting industries were not included in this study as it would be impossible to include relevant supporting industries in an extensive study on all the financial services sectors. The existing model assumes random assignments of firms to location, as the fundamental premise is that the size of agglomeration has ultimately some beneficial influence to firm performance, rather than why some firms choose to locate in certain agglomerations.

Beaudry and Swann (2001) also highlighted two potential issues of endogeneity. The first is the overestimate of own sector employment by including the employment of the firm in the aggregate Sic . They demonstrated that by doing so, the model introduces a small bias to the order of $1/n$ (in this case, n is large). The second issue of endogeneity arises if the dependent variable is included in the independent variable Sic which means that the disturbance term, ϵ , cannot be independent of the own sector employment aggregate Sic . This is a potential simultaneity bias from applying OLS to the model. However, they demonstrated that such biases are again negligible.

It is not definitive that unequal variance or heteroscedasticity exists over the range of the dependent(s) using residual plots, although it can be suspected for one of the three-performance model (ROCE). There is no indication of non-linearity between the outcome and the predictor for the three models. White's (1980) correction was used and a non-linear transform (square function of the predicted value) was attempted, but the results did not significantly improve and limited the sample size under investigation. Beaudry and Swann (2001) also attempted to model the problem of unequal variance in firm size by assuming that the variance is proportional to the square of age but claimed

they have only 'touched the tip of the iceberg'. The initial analysis using a correlation matrix showed that collinearity between variables is not an issue, except for non-parametric data of population density and financial GDP that has a value higher than 0.8. The Pearson correlation did not indicate any issues between parametric variables. The models were tested using the RESET test, where multicollinearity was again not perceived to be a problem with VIF values less than 2.5

RESULTS AND DISCUSSION

Cluster Performance by Firm Size

The sector-specific result is shown in Table 4, depicting how the eight sectors perform with differing levels of externalities due to their UK locations. Cook's statistics confirm that only 11 observations (out of 7,473 observations) have a statistic equal or value greater than 0.004, with only one influential case at 0.03. The regression coefficients, shown in Table 4, are mostly significant at the 1% level. The regression constants indicate that BSBANK and MARKET start at a much larger size compared to other sectors. The coefficients on Age indicate that BSBANK (2.7%), CREDIT (3.6%), LIFE (2.2%), and MARKET (3.0%) grew much faster than other financial services sectors in the UK, such as TRUST (0.6%), NLIFE (1.5%), INSAUX (1.8%) and FINAUX (2.0%). The coefficient on $\ln(Sic)$, being positive and significant, points to the effects that a stronger own sector employment in the region promotes the lifetime growth of firms. Also consistent with earlier published studies, a stronger related sectors employment in the region may attenuate incumbents' growth.

Table 5 reveals the outcome on the test of robustness where random observations are omitted at the 1%, 5%, 10% levels, see Section 4.6, with only consistent results being depicted. When a company locates in a region that is

Table 4: Cluster Performance by Industry – Firm Size

Firm Size by Industry	BSBANK		CREDIT		TRUST		LIFE		NLIFE		FINAUX		INSAUX		MARKET	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Variables																
Constant	9.527***	1.988	1.498*	1.045	2.017***	0.243	1.284***	0.331	1.335***	0.295	2.237**	1.164	2.056**	1.164	7.838***	1.627
Firm Age	0.027***	0.008	0.036***	0.008	0.006***	0.002	0.022***	0.003	0.015***	0.002	0.020***	0.009	0.018***	0.009	0.030***	0.009
Ln (S _{ic})	0.403***	0.158	0.358***	0.126	-0.025	0.044	0.195***	0.054	0.132***	0.054	0.289***	0.139	0.000	0.139	0.419***	0.127
Ln (S _{ib})	-0.860***	0.275	-0.163*	0.115	0.068*	0.046	-0.088***	0.042	-0.002	0.057	-0.138	0.156	0.114	0.156	-0.691***	0.194
Adjusted R ²	8.5%		14.3%		0.4%		6.0%		5.2%		8.6%		3.6%		8.0%	
RSS	1364.2		585.9		11001.2		3097.1		3444.5		340.1		493.7		701.3	
Sig F	0.000***		0.000***		0.002***		0.000***		0.000***		0.014***		0.095**		0.000***	
N	246		184		3464		1363		1622		121		176		297	

Table 6: Cluster Performance by Industry – ROCE

ROCE by Industry	BSBANK		CREDIT		TRUST		LIFE		NLIFE		FINAUX		INSAUX		MARKET	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Variables																
Constant	128.228**	77.56	20.619	39.821	29.717***	12.047	98.664***	27.081	64.245***	25.136	65.948	111.76	128.855*	82.598	18.434	129.97
Firm Age	0.387	0.301	0.232	0.348	-0.161**	0.084	-0.327**	0.195	-0.332***	0.155	0.532	0.983	-0.480	0.630	-0.349	0.671
Ln (S _{ic})	-0.366	5.441	2.910	4.957	-5.127***	2.072	-9.061***	4.349	-0.977	4.823	-3.642	9.005	16.786*	10.554	-4.223	10.572
Ln (S _{ib})	-9.951	10.14	-1.580	4.369	4.413***	2.179	2.067	3.278	-1.330	5.124	-1.931	11.596	-19.51**	11.089	5.204	15.865
Adjusted R ²	1.3%		0.1%		0.1%		0.6%		0.2%		0.6%		1.7%		0.1%	
RSS	6634424.2		13088119.3		120723331.4		36565096.1		50114973.2		5716572.2		3931857.6		10214241.3	
Sig F	0.130*		0.845		0.025**		0.017**		0.123*		0.798		0.286		0.942	
N	430		733		7486		1857		2420		184		219		428	

*** Significant at p < 0.01; ** Significant at p < 0.05; * Significant at p < 0.10; ** Significant at p < 0.20

Table 5 Effects of Cluster Strengths on Lifetime Growth

		Lifetime Growth	Positive Effect & Highly Significant	Negative Effect & Highly Significant
MODEL I	MODEL II	Cluster Strength Variable: Employment in OWN sector in region	BSBANK , CREDIT LIFE , NLIFE FINAUX , MARKET	TRUST, INSAUX
		Cluster Strength Variable: Employment in OTHER financial services sectors in region	TRUST, INSAUX	BSBANK , CREDIT LIFE, MARKET
	MODEL II	Control Variable: Regional specialisation in financial ser- vices activities (or industry conc)	None	None
		Control Variable: Regional GDP in financial services	INSAUX	BSBANK LIFE NLIFE
		Control Variable: Regional population density	BSBANK , INSAUX	MARKET
		F Change significant for	BSBANK, NLIFE, FINAUX and MARKET	

Table 7 Effects of Cluster Strengths on ROCE Performance

		Lifetime Growth	Positive Effect & Highly Significant	Negative Effect & Highly Significant
MODEL I	MODEL II	Cluster Strength Variable: Employment in OWN sector in region		CREDIT, LIFE
		Positive Effect & Highly Significant	Negative Effect &	
	MODEL II	Control Variable: Regional specialisation in financial ser- vices activities (or industry conc)	LIFE	BSBANK, TRUST
		Control Variable: Regional GDP in financial services		LIFE
		Control Variable: Regional population density	LIFE	
		F Change significant for	TRUST, LIFE	

Table 8: Cluster Performance by Industry – SOL

SOLV by Industry	BSBANK		CREDIT		TRUST		LIFE		NLIFE		FINAUX		INSAUX		MARKET	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Constant	-14.59	23.738	27.885 ^{***}	11.638	26.146 ^{***}	3.583	29.989 ^{***}	7.166	13.479 ^{***}	5.709	-5.031	24.362	61.555 ^{***}	23.440	29.209	29.179
Firm Age	0.040	0.092	0.326 ^{***}	0.101	0.452 ^{***}	0.025	0.310 ^{***}	0.054	0.317 ^{***}	0.038	0.717 ^{***}	0.224	0.475 ^{***}	0.185	0.410 ^{***}	0.142
Ln (S _{ic})	-2.964 ^{**}	1.658	-1.235	1.414	-1.767 ^{***}	0.620	-1.274	1.147	1.585 [*]	1.119	1.906	1.905	1.220	2.632	-1.797	2.311
Ln (S _{ic})	6.922 ^{***}	3.110	0.560	1.268	2.935 ^{***}	0.655	0.805	0.865	-0.535	1.183	1.746	2.562	-4.043 [*]	3.025	2.394	3.545
Adjusted R ²	1.1%		1.3%		3.5%		1.5%		2.5%		5.5%		3.3%		2.0%	
RSS	840511.5		1598745.8		18258896.9		3688512.8		4223300.6		527261.4		473443.7		678764.9	
Sig F	0.144 [*]		0.012 ^{**}		0.000 ^{***}		0.000 ^{***}		0.000 ^{***}		0.002 ^{***}		0.035 ^{***}		0.022 ^{***}	
N	502		871		9514		2190		2989		255		264		493	

*** Significant at p < 0.01; ** Significant at p < 0.05; * Significant at p < 0.10; * Significant at p < 0.20

strong in its own sector employment, it has a tendency to grow faster than a firm that is not surrounded by its peers. Conversely, a rise in employment in related sectors has a negative effect on firm size. In this analysis, what stands out are the TRUST and INSAUX sectors, which perhaps shed light on the nature of these sectors as 'non-conformists'. In the UK, trust and pension fund firms (TRUST) are set up for many diverse purposes: for investments, savings and protecting particular assets for companies and societies. There are over 3,400 such firms in the sample of 7,473 firms - mostly small and newly formed entities. Growth in such institutions is exhibited by formation of new trust funds when they are substantially successful, instead of growing the firm size in most cases. INSAUX is another sector that displays a negative effect when competing firms are clustered together. Here, it is apparent that there are fewer than 180 such firms in the entire UK and they are notably scattered countrywide. Both INSAUX and TRUST benefit from the activities and growth of other related sectors around them. The large number of TRUST firms would affect the model if the sectors were estimated en-bloc.5.

Cluster Performance by Returns on Capital Employed

The sector-specific result is shown in Table 6, depicting how the eight sectors perform in their returns on capital employed in the UK regions, due to differing levels of externalities. Cook's statistics confirm that 31 cases (out of 13,757 observations) have a statistic equal or value greater than 0.004, with only one influential case at 0.01. However, the fewer significant results initially indicate that the agglomeration effects play a lesser role. A couple of sectors display significant results but they are interesting as these results oppose findings from the first model. Companies are found to perform better financially the region is strong in the employ-

Table 9 Effects of Cluster Strengths on SOLV Performance

SOLVENCY PERFORMANCE		Positive Effect & Highly Significant	Negative Effect & Highly Significant
MODEL I	MODEL II	Cluster Strength Variable: Employment in OWN sector in region	BSBANK, TRUST, LIFE, MARKET
		Cluster Strength Variable: Employment in OTHER financial services sectors in region	BSBANK, TRUST, MARKET
	MODEL II	Control Variable: Regional specialisation in financial services activities (or industry conc)	CREDIT, TRUST, FINAUX
		Control Variable: Regional GDP in financial services	BSBANK, LIFE
		Control Variable: Regional population density	NLIFE, FINAUX
F Change significant for		BSBANK, CREDIT, TRUST, LIFE, FINAUX, INSAUX	

ment of related sectors. When the cluster is strong in its own sector employment, it has a negative influence to the incumbent's financial performance.

Cluster Performance by Solvency

The sector-specific result is shown in Table 8, depicting how the eight sectors perform in terms of their solvency in UK regions, due to differing level of externalities. Cook's statistics reveal that only one case (out of 17,078 observations) has a statistic of 0.004, showing that there is no influential case that would affect the regression coefficients. The effects from external economies are not clear at the first stage of analysis but there is an indication that specific sectors such as BSBANK, TRUST, LIFE, MARKET benefit from high regional employment in related sectors in enhancing incumbent's solvency, meaning the percentage of shareholder equity to to-

tal assets is increased. On the other hand, the negative and significant coefficient for Ln (Slc) in BSBANK, TRUST, LIFE, MARKET suggests that co-locating with firms of own sector results in inhibition of one's financial performance.

CONCLUSION

Earlier studies have hugely ignored the interdependency of related sectors in an industry cluster, and treated the clustering as en-bloc to consider only Marshall's scale economies. A large cluster, consisting of its competing sector and its closely related sectors, provides different sources and types of agglomeration externalities. This paper reinforces the premise that cluster size has beneficial influence on performance, and finds that the clustering of closely related sectors improves the firm's bottom line.

By using the established cluster model, we confirm that the agglomeration of competing firms promoted the growth prospects of incumbents and the agglomeration of related sectors attenuated firm growth in six of the eight sectors. In extending the model to consider financial performance, we find that when firms are in a strong competing cluster, a negative effect on their potential financial returns may be experienced. CREDIT and LIFE companies demonstrate that if they are located in a strong cluster in their own sector, they perform less well in terms of returns on the capital employed. BSBANK, TRUST and MARKET companies have a lowered solvency as a result of locating in a strong cluster in their own sector. The results suggest greater competition amongst similar firms in a concentrated cluster results in profit distribution and equity distribution (on the demand side from shareholders and customers).

Conversely, clustering with related sectors could enhance incumbents' returns on capital employed and solvency. CREDIT and LIFE companies would benefit from better returns on capital employed if they were located in a cluster that was strong in related sectors, indicating these sectors demonstrate strong interdependencies on related sectors for financial intermediation to take place. Also, clustering with related sectors could enhance a company's solvency, especially in BSBANK, TRUST and MARKET companies. It suggests that these sectors benefit from a lowered asset held (possibly from sharing physical resources with vertically related firms in the supply chain) and from

increased funds derived on the demand side from customers. Generally, clustering with related sectors should allow companies to derive synergies and inter-firm networking for ease of transactions and creating greater pecuniary benefits.

Our findings support the need for related sectors to agglomerate in a geographical cluster, despite the arguments of rising congestion costs in earlier models of cluster growth. This paper reveals better insights on the influence of cluster size to firm performance by relating more closely to the sources of agglomeration benefits, providing a more precise measurement of cluster size, and using financial performance measures. The novel contribution to knowledge is that the two main cluster strength attributes are found to work in opposite ways in promoting different aspects of a firm's performance. The model fit of a large sample cross-section model may be lower compared to a longitudinal model focusing on fewer geographical clusters, but this exploratory work has revealed the important influences of the two clustering attributes to firm performance. It is clear that most financial services activities in BSBANK, CREDIT, TRUST, LIFE and MARKET sectors benefited most from being located with related financial services sectors. With this knowledge, policy makers must now concertedly plan for regional development through achieving critical mass in selective types of related sectors in creating pecuniary externalities, as well as ensuring there is critical mass in specific sector to promote the growth prospects of firms.

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