

Microeconomic foundations of geographical variations in labour productivity

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Abstract

This paper initially presents an exploratory spatial data analysis which indicates the presence of small-scale geographical variations in levels and standard deviations of labour productivity across England and Wales in 2005. We identify the presence of spatial autocorrelation for both measures. This finding motivates a subsequent review and extension of theories which suggest the possible presence of small-scale geographical patterns of labour productivity.

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Keywords: Labour productivity; standard deviation; districts and local authorities; geographical autocorrelation

JEL Classification: R39

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1. Introduction

Variations in plant-level labour productivity are not fully explained by differences in capital stocks per worker or industry-level fixed effects. Theoretical work that attempts to explicate the remaining variation offers a plethora of explanatory factors, including idiosyncratic technology shocks, management preferences, R & D efforts and investment patterns. Recent empirical evidence suggests that a small range of factors can explain variations in labour productivity at the regional scale (Webber *et al.*, 2009) but there still remains a substantial amount of plant-level variation that others have attributed to plant-level heterogeneities and idiosyncrasies (Bartelsman and Doms, 2000; Haltiwanger, 1997) and these can be particularly relevant at the small spatial scale where averages are formed from small samples. There is, in particular, a lack of theoretical reasoning and empirical evidence for small-area variations in labour productivity which may be surprising given that monopolistically competitive markets are typically defined by geography.

This paper is an attempt to fill this gap in the literature. First an exploratory spatial data analysis is employed to identify whether there is any evidence of small-scale labour productivity variations in levels and standard deviations at the district and local authority level within England and Wales. Using the affirmative results as motivation, the paper outlines ten microeconomic explanations for variations in mean and standard deviation measures of labour productivity across small geographical areas. Emphasis resides on the importance of differences in locally-relevant demand and locally-relevant supply factors that can influence customers' (producers') choice of (intermediate) suppliers and so influence observable value-added productivity gaps. The paper presents a theoretical exploration into the importance of geographically defined local markets for area-based labour productivity measures and emphasises that a range of factors, including the complementarity and imperfect substitutability of (intermediate and final) goods, can lead to geographical variations of labour productivity measures.

This paper has the following structure. The next section presents some background information on the perceived importance of geography on labour productivity by academics and policy makers. Section 3 presents empirical evidence which indicates the presence of variations in area-based labour productivity level and standard deviation values. The results in section 3 motivate a collation, review and extension of explanations for these patterns which is provided in section 4 and emphasises the importance of geographically segregated markets in driving spatial variations in labour productivity values. Section 5 briefly debates whether the empirical evidence supports the theory, while section 6 provides concluding remarks.

2. Background

The regional perspective is increasingly recognised to be important by governments. For example, the UK's Department of Trade and Industry (2004) and HM Treasury (2001, 2004) have both begun to increase their emphasis on the regional dimension. The HM Treasury (2000, 2001) perspective usefully outlines five key 'drivers' of productivity and productivity differentials: skills, investment, competition, innovation and enterprise. However public and private sector R&D expenditure may have little explanatory power in accounting for plant-level and small geographical scale labour productivity differentials due to varying time lags before the benefits of expenditures accrue to individual plants and because spending in one area may result in implementation and spillovers to another (Boddy *et al.*, 2005).

Regional analysts frequently examine whether labour productivity differentials exist, how they move in relation to one another and what needs to be done to improve

labour productivity; they do not *always* consider directly the impact of industry composition on spatial labour productivity differentials (see, for instance, Webber *et al.* (2005)). Similarly, industrial analysts frequently examine labour productivity within and across industries, but they do not *always* consider the region in which the plant or industry is located (see, for instance, Griffith *et al.*, 2006). Both approaches may be inappropriate, especially when the focus of attention is on variations in labour productivity at small geographical scales, because plants will compete predominantly with other plants in the same industry and within the same geographically defined market area making each market different and distinct.

In spite of this division the economic geography literature does highlight the potential for Jacob (Jacob, 1969) and MAR (Marshall, 1890; Arrow, 1962; Romer, 1986) externalities that may arise from the agglomeration of economic activities (see, for instance, Fujita *et al.*, 1999; Ottaviano and Puga, 1997). But differences in industrial composition between geographically defined markets will influence the ability of consumers to substitute between goods and shape their consumption patterns; this will make each market distinct with the repercussion being that appropriate policy formulation will be complex and necessarily specific. As in many market economies, the composition of UK industry is dominated by small and medium-sized enterprises (SMEs) which typically lack scale economies and tend to have geographically well-defined markets.

It is important that the place of SMEs in any economy is clearly understood. BERR's (2008) estimates for the start of 2007 suggest that the 4.7 million UK private sector enterprises in the UK economy employed 22.7 million people and had an combined annual turnover of £2,800bn; most of these enterprises (99.3 per cent) were small (0 to 49 employees) with only 27,000 (0.6 per cent) being medium-sized (50 to 249 employees) and 6,000 (0.1 per cent) being large (250 or more employees). Hence, SMEs accounted for more than half of the employment (59.2 per cent) and turnover (51.5 per cent) with small enterprises alone accounting for 47.5 per cent of employment and 37.4 per cent of turnover (BERR, 2008).¹ Given the dominance of SMEs in the UK economy and the inherent costs to the consumer and to the producer of travelling long distances to purchase (final and intermediate) goods, the next section presents an exploratory spatial data analysis in an attempt to identify whether small-scale labour productivity patterns vary across England and Wales. Using the results as motivation the subsequent section explores reasons why labour productivity differentials can exist across small geographical areas and why attention should be focused on analysing small-area economies if we wish to increase our understanding of the microeconomic foundations of variations in labour productivity.

3. Exploratory spatial data analysis

It is imperative to identify whether geographical variations in labour productivity exist so that future case studies can compare and contrast different areas in attempts to identify the different (geographically distinct and idiosyncratic) drivers of labour productivity at the small geographical scale. This section offers such evidence.

Contributions have already been made to this literature. Patacchini and Rice (2007) provide an exploratory spatial data analysis of economic performance at the NUTS3 geographical level while Roberts (2004) analyses county level economic growth within Great Britain. Both are important contributions to the literature but are at geographical scales that may hide important small-scale variations.

¹ The company-size composition of an economy is an important dimension; for instance, Continental Research (2009, p.1) shows that SMEs have not been profitable since quarter 2 of 2008 or earlier.

Rather than using local authority level data which does not provide information on the spread of labour productivity within small areas, this study uses data from the Annual Respondents Database (ARD2) sourced from the UK's Office for National Statistics' (ONS) Virtual Microdata Laboratory (VML). This database brings together a wide range of data relating to individual business units, including the Annual Business Inquiry (ONS, 2002; Barnes and Martin, 2002). Most data are available at the plant level (often referred to as the 'local unit') and there may be more than one plant within a firm. One major advantage of this data source is that it allows for the examination of labour productivity based on microeconomic data.²

The database provides a full survey of larger firms but firms with fewer than 250 employees are sampled on a random basis and hence are not surveyed every year. Given the importance of SMEs to the British economy described above it is decided that the best way to investigate geographical variations in labour productivity would be to examine a single cross-section, as we would include large companies as well as lots of SMEs which would otherwise drop out of the sample due to a lack of observations over time. Here we present results for the most recent year for which data are currently available, 2005.³

Our chosen statistical measures are twofold. First we employ the arithmetic mean of labour productivity to illustrate how the average labour productivity value within an area compares to that of other areas within the sample. Second we use the standard deviation of labour productivity to measure the degree of variability of labour productivity within an area and then compare this with the degree of variability for other areas within the sample. An illustration of the normal distribution's mean and standard deviation properties are provided in Figures 1a and 1b, where Figure 1a shows the normal distribution's properties and Figure 1b shows how observations are distributed around a normal distribution's mean value (in this case, 100); about 68% of the sample lie within one standard deviation (σ) and 95% of the sample lie within two standard deviations (2σ) of the normal distribution's sample mean value (μ).

{Figure 1 about here}

Labour productivity

The labour productivity measure used here is formed by dividing gross value added of individual plants at factor cost by the number of workers in that plant. Then we aggregate the values for labour productivity to form an average value for the district or unitary authority. After data attrition, the sample size is equal to 48,100 plants which are spread unevenly across district and unitary authorities within England and Wales.⁴

Figure 2 is a standard deviation map of labour productivity. Highlighted on the map are those areas where labour productivity is more than one and more than two standard deviations above or below the sample mean. Several observations can be made. First, there are many contiguous areas where labour productivity is within one standard deviation above and below the mean. Second, there are very few areas where an area's labour productivity is more than two standard deviations above the sample mean; these

² Some public sector organizations are included but Standard Industrial Classification 100 (agriculture, forestry and fishing) firms are omitted. Although coverage is incomplete, the response rate is virtually 100% as there is a statutory requirement to participate in these surveys.

³ The 2004 and 2003 results have been generated to check for the stability of the results; we find that the results do not differ substantially and the same patterns are observable from the maps for each year.

⁴ To maintain confidentiality and to avoid disclosure the VML requires that any reported observations are comprised of at least 10 plants and that no observation is heavily biased by the presence of one plant. Such requirements are fulfilled in all areas discussed here.

areas can be found in London and the South East. Third, there are many areas where average labour productivity is more than one standard deviation below the mean and these areas are spread across all regions but by no means equally; Wales and the South West appear to have a particularly high incidence of areas with low average labour productivity. Areas with low average labour productivity occur in expected areas, such as much of Wales that lies north of the Cardiff-Newport industrial area and the relatively inaccessible areas of the South West, including West Somerset, North Devon and North Cornwall. Fourth, areas of significantly low labour productivity are not contiguous to areas of high labour productivity.

{ Figure 2 about here }

Figure 3 presents a Local Indication of Spatial Association (LISA) map that highlights areas with high (low) average labour productivity that are *surrounded by*⁵ other areas with relatively high (low) average labour productivity. It also highlights those areas with high (low) average labour productivity that are surrounded by other areas with relatively low (high) average labour productivity. Several observations can be made. First, there is a core area where average plant-level labour productivity values are high and surrounded by other areas that have similarly high area values; many such areas are located around London (especially West London) and spread West and South West into the South East region and into conurbations such as Reading, Fleet, Camberley and Woking. Second, Wales is characterised by swathes of contiguous low average labour productivity areas. Third, in general, the South West shares this Welsh characteristic, although this is only valid southwards from West Somerset. Fourth, there is a scattering of areas which appear to have high average labour productivity that are surrounded by areas with low average labour productivity. Examples include Truro and Herne Bay, both of which are tourism-hubs, and Exeter and Manchester, which are major regional city hubs.

{ Figure 3 about here }

One further way to examine these data is via a Moran's I scatterplot. This is presented in Figure 4. As the data are standardised the units on the graph are expressed in standard deviations from the mean. The upper right quadrant of the Moran's I scatter plot shows those districts and unitary authorities with above average labour productivity which share area boundaries with neighbouring districts and unitary authorities that also have above average values of labour productivity (high-high). The bottom left quadrant shows districts and unitary authorities with below average labour productivity with neighbouring districts and unitary authorities also with below average labour productivity values (low-low). The bottom right quadrant displays districts and unitary authorities with above average labour productivity values surrounded by districts and unitary authorities that have below average labour productivity values (high-low) and the upper left quadrant shows the opposite. The slope of the regression line through these points expresses the global Moran's I value (Anselin, 1996).

{ Figure 4 about here }

Figure 4 supports the notion given in Figures 2 and 3 that there is spatial autocorrelation in labour productivity, that is to say labour productivity at proximal locations appear to be correlated. The Moran's I statistic is positive and statistically

⁵ The analysis in this paper employs a queen contiguity matrix.

significant at the 99% confidence level with a value of 0.4276. Also noteworthy is that the distribution of points on the scatterplot illustrates a degree of heteroskedasticity suggesting that although there is an important geographical pattern there are also important differences across districts and unitary authorities.

Geographical patterns of labour productivity variation

In addition to examining the geographical variation in average labour productivity the within-region variation in labour productivity may also have a spatial pattern. To investigate this phenomenon we recreate the empirical analysis above but focus this time on the standard deviation of labour productivity within areas rather than the mean labour productivity values. These results are presented in figures 5 – 7.

Figure 5 shows that there are clusters of districts and unitary authorities that have relatively low variations in labour productivity; these are most common in the South West and in Wales. It also shows that there are clusters of districts and unitary authorities that have relatively high variations in labour productivity; these are most common in and around London, along the M4 corridor, etc. This is an important finding because it suggests that the productivity of labour is fairly similar in a lot of places but the variation is much greater in areas where labour productivity appears to be higher.

{Figure 5 about here}

Figure 6 presents the accompanying LISA map. Several observations can be made here too. First, there are areas where the standard deviation of average plant-level labour productivity values are low and surround by other areas that have similarly low area values. These areas can be seen to be located in Wales and along the south coastline to the west of Bournemouth as well as other smaller though similarly-characterised areas to the west of Norwich, in Lancashire and around Newcastle-upon-Tyne. Importantly, when we compare these results with those presented in Figure 3 we can identify that these areas also have low average labour productivity values. Second, there is a scattering of areas which appear to have high standard deviations in average labour productivity around London and Manchester.

{Figure 6 about here}

The appropriate Moran's I scatterplot is presented in Figure 7 and supports the notion given in Figures 5 and 6 that there is spatial autocorrelation in the standard deviation on labour productivity. The Moran's I statistic is positive and highly statistically significant at the 99% confidence level with a value of 0.2629.

{Figure 7 about here}

Spatial autocorrelation in labour productivity levels and spread can be the result of similarities across contiguous areas of the importance of microeconomic foundations of labour productivity. Interestingly areas with low average labour productivity levels also have low within area labour productivity standard deviations.

4. Geographically Segregated Markets

The above empirical section suggests the presence of small-scale spatial variations in labour productivity. Although area based studies, such as Harris (1954), Clarke *et al.* (1969), Keeble *et al.* (1982) and Overman *et al.* (2003) examine market-potential by weighting purchasing-power weighted by transportation costs, few studies consider the microeconomic foundations of productivity for geographically defined economies. Below we present an hypothecated discussion covering five demand-side and five supply-side microeconomic explanations for asymmetries in labour productivity levels and spread. It posits that there can be variations in labour productivity within and between small areas, and that to better understand the geographical pattern of labour productivity a better understanding of the microeconomic foundations of labour productivity is needed.

Labour Productivity

Firms are known to benefit from being located near to each other. Fujita and Thisse (2002) discuss the origins of some sources of gains including knowledge spillovers, proximity to consumers and increasing returns. This section appreciates the developments made by these authors but focuses more on the micro-foundations of variations in firms level productivity.

Geographically defined markets are important examples of a monopolistically competitive market structure. It is typical to assume some degree of product differentiation with each plant having a pseudo-monopoly within a monopolistically competitive geographically-segmented market. In the short run, plants will make some supernormal profits. They will compete with other plants within their geographically defined market and geographical separation will reduce competitive pressures (e.g. spacing of petrol stations). As in perfect competition, awareness of supernormal profits can lead to market entry and this shifts an individual plant's demand curve inwards and makes the firm's demand curve more elastic (flatter). Further market entry ceases when price is equal to average costs ruling out any further supernormal profits. Due to the nature of geographically defined monopolies, the prices such firms charge will typically be above their marginal costs (i.e. allocatively inefficient) and they will not be producing at their minimum average costs (i.e. productive inefficiency).

These characteristics can result in plants adopting pricing and investment decisions designed to deter entry, although if the geographically defined market is small and if the total amount of demand in the area is limited then market forces may result in a lack of space in the market for a competitor irrespective of the plants pricing and investment decisions. This can be the case if opportunities for economies of scale or access to resources or distribution networks are limited. All this results in the lack of available goods between which buyers can substitute their consumption and so geographically defined market boundaries may be seen to stimulate greater plant and brand loyalty reducing the need for locally-focused advertising and marketing initiatives.

Labour productivity can be measured in a variety of ways. In this study labour productivity is measured as the average value added by the worker within the plant. The value added gap will be dependent on a three key factors: quantity, the price which is charged to the consumer (and is strongly affected by *demand*), and the cost of inputs used in the production process (and is strongly affected by *supply*). These issues will be discussed in greater depth below. Particularly relevant here is that the relationship between labour productivity and quantity may be U-shaped, with scant opportunities for high labour productivity measures at both low quantities (due to high input costs, often

associated with high transportation costs, at the market fringe) and high quantities (due to greater levels of competition at the core of the market).

Demand-side forces

This section reviews and extends five geographically influenced demand-side forces that affect the level of and variation in labour productivity at the small geographical scale.⁶

i. Product substitutability

Syverson (2008) argues that inter-plant variations in output market conditions are partially responsible for the observed labour productivity dispersion. He argues that it is the demand-side substitutability of differentiable products that can influence the price that a firm can charge for a good. Greater substitutability between goods shifts consumer demand to lower-cost plants and drives inefficient plants out of business in a market structure relatively close to perfect competition. Conversely, lower substitutability between goods sustains consumer demand for relatively high price goods, puts less pressure on firms to reduce costs and can be seen to have increasing levels of labour productivity if costs are reduced contemporaneously. This latter case can be referred to as a monopolistically competitive situation that is close to that of a geographically defined monopoly and can have ramifications for a number of factors, such as the innovative propensity of the plant (Barnett, 2008).

Syverson's theoretical foundations are based on geographically segmented markets shaped by transport costs, and his example is the concrete sector. It is plausible that pure transport costs can make it inappropriate for consumers (producers) to travel to alternative geographically segmented markets to purchase (supply) an identical, homogenous product. Such an example could be where consumers in isolated conurbations purchase locally available (and may be locally-produced) goods to avoid additional transportation related expenses, but it is equally appropriate to apply the perspective within small areas of cities where other time costs, often but not necessarily associated with congestion, define the market areas for the consumers.⁷ Other non-transport related factors could generate geographical market segregation, such as habit, familiarity, variations in quality of service, social networks, and preferences.⁸

Therefore this line of argument suggests the following. At the local scale, areas with low (high) product substitutability and high (low) product differentiation can experience high (low) prices. Only if output quantities are high will labour productivity values also be high. Meanwhile, at the global scale, the greater the variation in the ease for consumers to switch their demand between competing goods and with a wide range of inter-good product differentiation, then the greater the amount of price variation (and therefore value-added) that the market can sustain. Typically relatively rural, inaccessible areas with low firm density and high good prices, albeit with low output quantities, may be characterised by a geographically defined markets and experience greater levels and standard deviations of labour productivity, with the larger standard deviations being driven by variations in the market demand characteristics.

⁶ The emphasis is on small-scale labour productivity influences, though they can have an impact at larger geographical scales.

⁷ It is entirely possible that the journey provides utility which offsets the time-cost factor and that the value of time is non-linearly related to population density or market peripherality.

⁸ For example, quieter/busier locations, aesthetic factors, etc.

ii. Product complementarity

Demand-side substitutability between goods may not be the entire story. Complementarity in consumption can be an important factor in a consumer's purchasing decision and thus can influence the value-added for individual firms. Complementarity in consumption can occur in a variety of circumstances. For instance, when a woman is searching for an outfit for an evening function, which includes both a dress and a pair of shoes then the lack of local availability of a suitable pair of shoes may result in the woman choosing not to purchase the locally-available dress, even though it may be ideal for the event. Other examples may include the decision to purchase a shirt and a tie, or wine with a meal. Although some goods which are close complements are typically sold from the same shop, this may not be the case in locations where demand is low (particularly relevant for perishable goods), such as when population density is low or if there are other competing suppliers and when specialisation can occur.⁹

Put simply, the more difficult (easy) it is for a consumer to purchase complementary goods then the less (more) likely it is that the firm supplying only one of these goods will survive in the market. Such firms may need to provide a price incentive to reduce the likelihood of consumers venturing to larger conurbations offering a wider range of alternative (substitute and complementary) goods. However this price incentive will reduce the value-added gap and hence reduce measured labour productivity. It is one argument why labour productivity levels and dispersions could be smaller in peripheral markets.

iii. Social networks

Demand-side substitutability and complementarity between goods can be influenced by peer group effects. Such peer group effects can be affected by direct advertising and/or by local social factors. They're relevant to local labour productivity measures is because the strength of peer group effects on consumer loyalty will influence the elasticity of demand and hence the effect of any change in price on value-added margins.

There are at least two ways that social networks in consumption are relevant here. First, there may be joint consumption factors. Pandey and Whalley (2004) consider the effect of location specific network effects that are swayed by interactions with others, which can lead to joint emotional support and to joint consumption. According to these authors, the benefits an individual will receive from membership of a social network will be nonlinearly related to the number of members, while average and marginal network benefits differ between urban and rural areas. Such group preferences will be an important consideration for any supplier, though less important for firms where geographic segregation reduces the ability of the consumers to switch consumption between locations and alternative suppliers.

A second path through which social networks can influence value added is through demand clustering, which is often associated with geographical variations in cultural preferences and trends. Babutsidze and Cowan (2008) present a discrete choice model of consumption that incorporates habit formation and information exchange among consumers in fixed social networks. They show that clustering patterns can be short-term or long-lasting depending on the characteristics of the society. Long-lasting clustering patterns that may be embedded in the local consumer culture, such as regular trips to the cinema by a group of friends where joining in with friends may be as important at the choice of cinema/film itself, will influence the price elasticity of demand

⁹ The relevance of geographic market segregation driven by good complementarity will vary by industry.

and the price to the consumer. Therefore, it will also influence the observed labour productivity gap.

Changes in social networks and local consumption fashions (for both the good and the location of purchase/consumption) will influence the price elasticity of demand. With low good substitutability and high local (geographically defined) monopoly power there will be greater certainty in plant revenues and lower likelihood of market exit of less efficient firms.

Higher than average marginal labour productivity measures could be achieved by a monopolistically competitive firm in a geographically defined market and may not be equalled by firms operating in a more perfectly competitive market with less product differentiation. At high output quantities, social network factors can result in greater local area labour productivity levels and dispersion in peripheral markets.

iv. (High-wage) commuter spending power

The discussion above makes no distinction on whether individuals work and consume in the same locality. This is not necessarily a constraint, but it is worthwhile briefly discussing the impact of commuting on geographical variation in labour productivity measures.

Consider a family where the adults work outside of the area in which they reside. Research has shown that although commuter families spend less on goods and services in their community of residence than families resident and employed locally, a large proportion of commuter expenditures are made locally in small towns (Ironside and Williams, 1980). Using a behavioural approach, Ironside and Williams (1980) examine the notion that the journey to work is potentially an important spread mechanism for expenditure patterns as commuters may transfer earned income from a growth centre to satellite communities.

Part of the expenditures by these consumers will be fluid between the locations of work (assumed for simplicity to be at a Central Business District (CBD)) and residence (assumed for simplicity to be away from the CBD). There will be some goods where expenditure by these consumers will be greater in the core conurbation, especially if the consumer wants variety; examples of such items may include consumer durables. There will also be a large proportion of commuter expenditures made locally in small towns where consumers opt for locally available items rather than arranging for these goods to be purchased after work.

Subject to acceptable price disparities for the commuter, prices will be higher in satellite communities as the firm will wish to maximise their profits and so the value added will also be greater, although the quantity sold will typically be much lower due to fewer potential customers. The result would be higher marginal labour productivity values along with greater labour productivity dispersion in non-core areas. Average labour productivity levels and dispersion can be higher or lower depending on output quantities.

v. Relative thinking theory

Recent work in at the intersection of economics and psychology includes the contribution of relative thinking theory put forward by Azar (2007). He argues that rational choice theory, where people maximize their well-defined utility subject to their budget constraint, is often incorrect.

To emphasize his important contribution, Azar (2007, pp. 1-2) uses the example that if a consumer is asked to consider the purchase of two goods that are identical except

for one difference – the location in which they can be purchased – and then the consumer is asked to make a judgment on how much more valuable is the preferred good between the two, the answer should not depend on the good's price. The good can be purchased either at a store 5 minutes away, or at another store 35 minutes away. He supposed that the good is a baby's cot that costs \$300 at the remote store, and the consumer tells us that he would purchase it at the closer store as long as its price there does not exceed \$340. This means that the consumer's value of time when driving to a shop is valued (by himself) at \$40 per hour (30 min in each direction).

Azar further emphasises that according to the model of rational choice, if the same consumer is then asked about a baby's pram that costs \$20 in the remote store, he should be willing to purchase the same pram for up to \$60 in the closer store. The extra cost of going to the remote store is exactly the same regardless of the good to be purchased. Therefore, the minimal price difference for which the consumer chooses to go to the remote store must be the same regardless of the good's price. In other words, the consumer should only consider the absolute price difference between the goods, and not the relative price difference.

However, in various experiments Azar conducted he found that in practice consumers violate this principle in a significant and systematic way. In the context of differences in store location, consumers make choices that reflect their valuation of time, which increases when the good's price increases. This leads consumers to make too much effort to save money when they purchase low-price goods, and too little effort to save when they purchase high-price goods.

In the context of product differentiation, the extra amount consumers are willing to pay for a preferred characteristic of a good is higher when the good's price is higher, even though the characteristic has the same value regardless of the good's price. If plants are aware of this, especially those plants which sell relatively high priced items, then they could exploit the issue by charging higher prices in geographically defined markets. Such higher priced goods will be reflected in higher value-added gaps. Furthermore, if Azar is correct then the (inter-industry) dispersion in labour productivity will be greater in relatively inaccessible areas.

Supply-side issues

Locally determined supply-side issues can also affect the observable pattern of labour productivity because they can influence firms' input costs and/or the price of competitors' goods, while vertical and horizontal integration can deter market entry. Below we review and extend five supply-side theories that emphasise the importance of local forces that can influence spatial variations in the level and standard deviation of labour productivity.

I. Distance reduces ability to compete in non-local markets

The first and most often discussed issue from the supply-side is that transportation costs incurred by the firm affect profit margins and can insulate firms from non-local competitors. Transportation costs can allow firms to survive in geographically defined markets even when they are less efficient than firms in other geographically separated markets. At the same time, it reduces the ability of local firms to compete in other

geographically separate markets because it incurs transportation costs associated with shipment to the distance market and will reduce their ability to be price competitive.¹⁰

Such arguments are also important from the relative thinking perspective. Having identified that consumers are affected by relative savings (relative to the good's price) when purchasing homogenous goods obtainable from different locations, Azar (2008) extends the relative thinking perspective by analysing the effects of this bias, on firm strategy and market outcomes, using a two-period game-theoretic model of location differentiation. Azar finds that relative thinking causes consumers to make less effort to save a constant amount when they buy more expensive goods. In the location differentiation context, consumers behave as if their transportation costs are an increasing function of the good's price. This gives local firms an additional incentive to raise prices.

When transportation costs are significant, and this will vary with the type and weightlessness of the good, the response of firms to relative thinking is to raise prices, and therefore relative thinking should result in higher average labour productivity values in relatively peripheral locations, ceteris paribus. Given that the importance of transportation costs varies with the type of the good, areas with greater varieties of goods will potentially also have greater variation in average labour productivity values.

II. Local supply chains

It is often assumed that profit maximising firms minimise input costs. This is not always possible when distance is taken into account as not all goods are always available in the quantity required, and alternative intermediate goods are not always available in the same location or close by. Given these considerations, it can often be the case that firms (such as builders and plumbers) will purchase several goods from one supplier (such as a builders merchant), essentially making complementary purchases, often because of convenience and to save time, even though they can purchase the goods at a lower price elsewhere. When there is limited competition in the market for the firms' services then they may be able to pass the higher intermediate good prices onto the consumer in the form of higher prices. At the same time, the tradesperson can strengthen their information networks with their suppliers, which are reciprocated and encouraged by loyalty schemes, frequent user discounts, bulk buy discounts, etc.

Another factor is the ability of firms to substitute between alternative intermediate goods. This is not always practicable in locations where there is not the abundance of intermediate good suppliers. In order to maintain a degree of price competitiveness to the consumer, the firm may swallow the higher input costs and this will be seen as lower value-added and lower productivity.

Geographical variations in the network topology of local supply chains will therefore influence profit margins, and value-added and labour productivity measures. Area average labour productivity values will be higher where competition is weaker at the final stage of production and stronger at the intermediate supplier stage. Where there exists a greater (lesser) mix of industries that possess these characteristics then the standard deviation of labour productivity within an area will be relatively high (low).

¹⁰ In an interesting article by Rietveld and Vickerman (2003) which discusses the notion of the 'death of distance' as a factor shaping the location decision of firms, they find that although the performance of transport has improved enormously in terms of money and time, many economic activities have not become footloose, mainly because of the role of transaction costs that are often positively related with distance.

III. Social networks of suppliers

Given a limited amount of final (intermediate) good substitutability for consumers (producers), plants may make informal connections with other plants that are horizontally, vertically and/or otherwise related to the specific supply chain within their local market; for instance a common phenomenon is for skilled tradespersons, such as plumbers, builders and electricians, to recommend and reciprocate recommendations to their customers. If they are locally concentrated then they will strengthen such links by frequently meeting on building sites. Such initiatives bind producers together into a complex social network with the expectation that consumers will use recommendations when recruiting tradespersons.

There are risks with recommendations because if a recommended firm does not offer the service that a consumer expects and this information is given back to the tradesperson who did the recommendation then the tradesperson will not make the recommendation again fearing that a consumer will take the perspective that 'one is only as good as the company one keeps'. Because of the possibility of such negative feedback loops, it is often the case that such social networks can be strengthened over time, increasingly reciprocal, and corner the local market. Such social networks can make it difficult for non-recommended tradespersons to survive or enter the market and non-recommended tradespersons may leave the local market. Social networks are forces that firms can use to influence demand, by essentially discouraging the substitutability by consumers between firms. It is also a possible method of keeping costs as low as possible because by maintaining a 'fair and low' price to others within the network, and to their collective consumers, then the rate of increase in tradespersons' costs, often associated with competitive advertising and marketing, will be reduced.

Fafchamps and Mintel (2002) emphasise that social capital has a large significant effect on the performance of economic agents that is separate from those of human and physical capital and demonstrate that certain types of social capital are more important than others. Whenever trust is present, economic agents can lower their guard and economise on transaction costs such as the need to inspect quality before buying or the need to arrange payment in cash at the time of delivery. Such reliability will reduce further the switching of consumers between firms.

Supplier social networks are often vital when markets are imperfect. When geographically segregated suppliers exist, such networks can reduce the need for innovation, as competition may not be due to costs. Instead, when suppliers create closely connected networks – such as builders recommending plumbers who recommend carpenters and builders, etc. – then it is not simply the reputation of the individual firm but the reputations of the social network. This can be particularly relevant in rural areas and areas with low population density when there are only a few alternative companies to choose from, but it can be equally relevant for urban areas where word-of-mouth recommendations can influence the choice of firm. Barr (2000) argues that social networks facilitate the circulation of reliable information about technology and market opportunities as well as the blacklisting of unreliable agents.¹¹

¹¹ It is often observed that for some industries production of specific goods resides in a small number of highly concentrated regions; for example, several high-tech industries cluster in Silicon Valley. Explanations for this phenomenon have focused on how the co-location of firms in an industry might increase the efficiency of production. However, Sorenson (2004) argues that industries cluster because entrepreneurs find it difficult to access the information and resources they require when they reside far from the sources of these valuable inputs. Since existing firms often represent the largest pools of these important factors, the current geographical distribution of production places important constraints on entrepreneurial activity. As a result, new findings tend to arise in the same areas as existing ones, and hence reproduce industrial geography. Laursen and Masciarelli (2007) suggest that as new products and

The repercussion of social networks of this type can be that the reputation of a fair price (and good quality) can restrict the price-hikes to consumers, and therefore the labour productivity picture can be represented by relatively low average productivity values. However social networks may be effective enough to deter market entry and then, given the limited number of alternative firms, results in high prices to consumers. The extent of influence of social networks across industries may be extremely variable, and may well be dependent upon distance (in kilometres as well as time). Such variability could also manifest itself as a relatively high variance value for the area's labour productivity.

IV. *Geographical variations in hours worked...preference for leisure...quality of life*

Another factor influencing the productivity of labour is the influence that the environment and peers have on leisure preference and on values that influence the perception of quality of life. These will vary geographically, from city to city, from city to town, from town to village, from rural to urban and from one region to the next. It will also vary across individuals and be dependent on their social (and work) networks. Some argue that it is the variation in quality of life that impacts most on hours worked and work effort.¹² In turn, the main attractors for migrants to rural areas can relate to a good environmental and cultural quality of life. Indirectly, therefore, it might be deduced that environmental and cultural infrastructure has an influence on rural business productivity. While Srinivasan and Stewart (2004) lend support to this line of argument,¹³ Layard (2003) suggests that some people make trade-offs between environmental quality and economic performance and are prepared to tolerate lower productivity occupations (and lower wages) in exchange for living in higher quality environments. Lower work effort (which may be associated through efficiency wage arguments with lower labour productivity) and fewer hours work leads to lower turnover and potentially lower labour productivity measures.¹⁴

In articulating influences on rural productivity, area-based studies often emphasise the importance of 'less tangible' factors on economic performance (Bryden *et al.*, 2000) which concern local comparative economic advantage and tend to explain why rural areas with very similar characteristics in terms of resources often show significant differences in rural economic performance (OECD, 1996). Porter (1990) suggested that

processes are introduced, firms often need to acquire knowledge developed in other firms and organizations. Drawing on social capital and transaction cost theory they argue that not only is the success of such acquisitions for the development of product and product innovations dependent on strategic and economic variables, it may also be contingent on the social capital available in the geographical area in which the firm is located. When social capital is low then the innovations may be of low quality; being located in regions characterized by high level of social interaction leads to a higher propensity to innovate.

¹² Others argue that technological change has a negative impact on hours worked (Whelan, 2009)

¹³ Srinivasan and Stewart (2004) suggest that local amenities play an important role in determining where we choose to live and our overall quality of life. In many cases, however, amenities do not have prices and will therefore be underprovided by the market. They use individual and county level data for England and Wales to estimate implicit amenity prices and to calculate an index of quality of life for each county. Quality of life values across counties are estimated to be in excess of £2,000pa.

¹⁴ Location has long been recognised as an important factor for entrepreneurs, at least since the late 1970s (Fothergill and Gudgen, 1982). They argue that rural areas can have attractive living conditions, good labour relations, lower wage and premises costs, and greater space for expansion. In some rural areas, however, poor services can constrain business formation and productivity growth.

this is because such performance is not so much dependent on the existence of resources, but on how, and where, they are deployed.¹⁵

Such quality of life forces can shape labour productivity values in different ways. For instance, if firms locate because of quality of life factors but supply goods to a range of areas then prices may be competitive and high, but if such firms supply goods mainly to the local area where there are mainly low waged workers whose quality of life is more dependent on environmental quality than on their spending power then the firm's ability to charge high prices (and be viewed as being highly profitable) will be stunted. Such forces further emphasise the uncertainty surrounding the geographical pattern of levels and variation in labour productivity.

V. *Lack of scale economies*

Economies of scale is a principle that is invariably taught during undergraduate economics courses. It concerns the ability of firms to achieve lower average costs as quantities increase. Reasons for some firms not to benefit from economies of scale include static demand levels within areas where the quantity of consumers remain stable. In rural areas, a major factor can be lower population density and lower absolute levels of demand for goods; the same effect can be felt in cities where a plant is located away from the CBD. Although rural firms may pay slightly lower wage rates and so average costs may be lower at the same output level, because output is typically lower the marginal cost will be higher. This will be at a time when prices cannot be significantly higher and so the value-added gap will be reduced.

Such geographical patterns in aggregate labour productivity values will be influenced by the importance of the weightlessness of a variety of goods within and between industries and both between and within given market areas.

5. Does the evidence support the theory?

To recap, the theory discussed above suggests the importance of local demand and local supply forces which vary with market characteristics and shape labour productivity levels and variance within geographically defined markets. For instance, Syverson (2008) suggests that when consumers can easily switch between suppliers then relatively inefficient producers cannot profitably operate and so high-substitutability industries should exhibit lower productivity dispersion.

The geographical market definition is vital here. Geographically defined markets, where monopolistically competitive firms employ and maintain policies to retain their dominant market share, may result in lower productivity variation especially if these areas are away from the core of the market and distance related transportation costs make distant producers and competitors less competitive. However, there are also theoretical arguments which suggest that labour productivity levels and variations should be higher in peripheral areas.

Our ability to identify empirical support for any of these theories is hampered by the need to maintain data confidentiality as well as the desire to empirically investigate small geographical areas. Our particular perspective is geographical because geographically defined administrative areas are often assessed on their labour productivity performance. The issue then remains on what a geographically defined market is, and whether districts and unitary authorities are appropriate geographical

¹⁵ Area-based studies also emphasis quality of life factors that can have a positive impact on competitiveness. Courtney *et al.* (2004) noted that such factors attract better-off and well-educated incomers who dynamize business, political and cultural life, leading to a positive developmental spiral.

definitions. Policy formation is often at a specific level of geography and economic geographers need to be constantly aware of the shifting importance of transportation costs across industries and geographies.

Geographically-defined markets

The influence of distance on different industries' labour productivity measures is non-homogenous, that is to say distance and time influences consumers and suppliers in different ways for different goods, and this has a geographical ramification. For instance, consumers will exercise their market power for a newspaper in a smaller geographical area than if they were looking to purchase a car.

Although the geographical pattern presented in the maps above is contrary to the contribution made by Syverson (2008) for instance, it may well be the result of variations in industrial composition.¹⁶ It is entirely possible that the geographical patterns presented on the maps above are there because we are capturing population density effected local markets, hence the low productivity levels and variation in South West and Welsh areas, as well as the high productivity levels and variation found in more-accessible areas with higher absolute-demand. The latter would have a greater range of industries due to greater population densities and therefore higher productivity variation. Future research should account for both the geographical and the industrial perspectives when investigating the geographical aspects of labour productivity gaps. Greater empirical investigation is required to identify when the importance of one microeconomic theory is surpassed by that of another.

6. Conclusions

This paper has reviewed and developed microeconomic theoretical reasons for differences in levels and standard deviation values of labour productivity and emphasised the importance of geographically defined markets. It is argued that markets can be geographically constrained and this influences the ability of firms to charge different prices, which manifest themselves in labour productivity values. Contemporaneously, there are issues concerning scale effects and variations in input costs, which also influence the value added gap.

Plant level labour productivity data was clustered at the district and unitary authority level across England and Wales and the results of this analysis is a clear pattern in labour productivity with high global spatial dependence and pockets of high (low) average labour productivity in (in)accessible areas with higher (lower) population density. Such areas are also contiguous to each other, suggesting a contiguity effect driving similarities in market structure. Greater empirical investigation is required to identify when the economic significance of one microeconomic justification is surpassed by that of another.

¹⁶ Lower population densities (and therefore higher average costs due to lower quantities) yield equilibria with fewer and more sparsely-populated suppliers and with a greater equilibrium price, which is then in line with Syverson's (2007) argument that average prices tend to be lower in markets where geographical competition is more intense.

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Figure 1a: Plot of a normal distribution

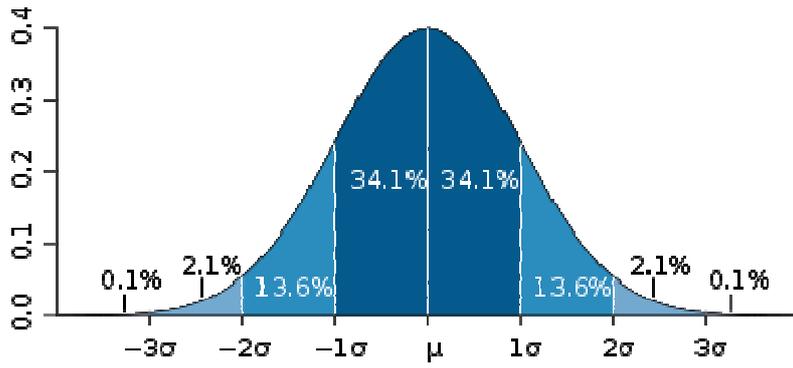


Figure 1b: Scatterplot of values within a normal distribution

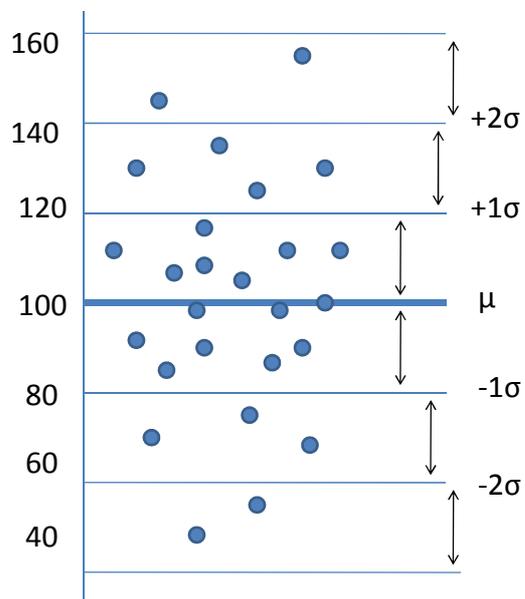
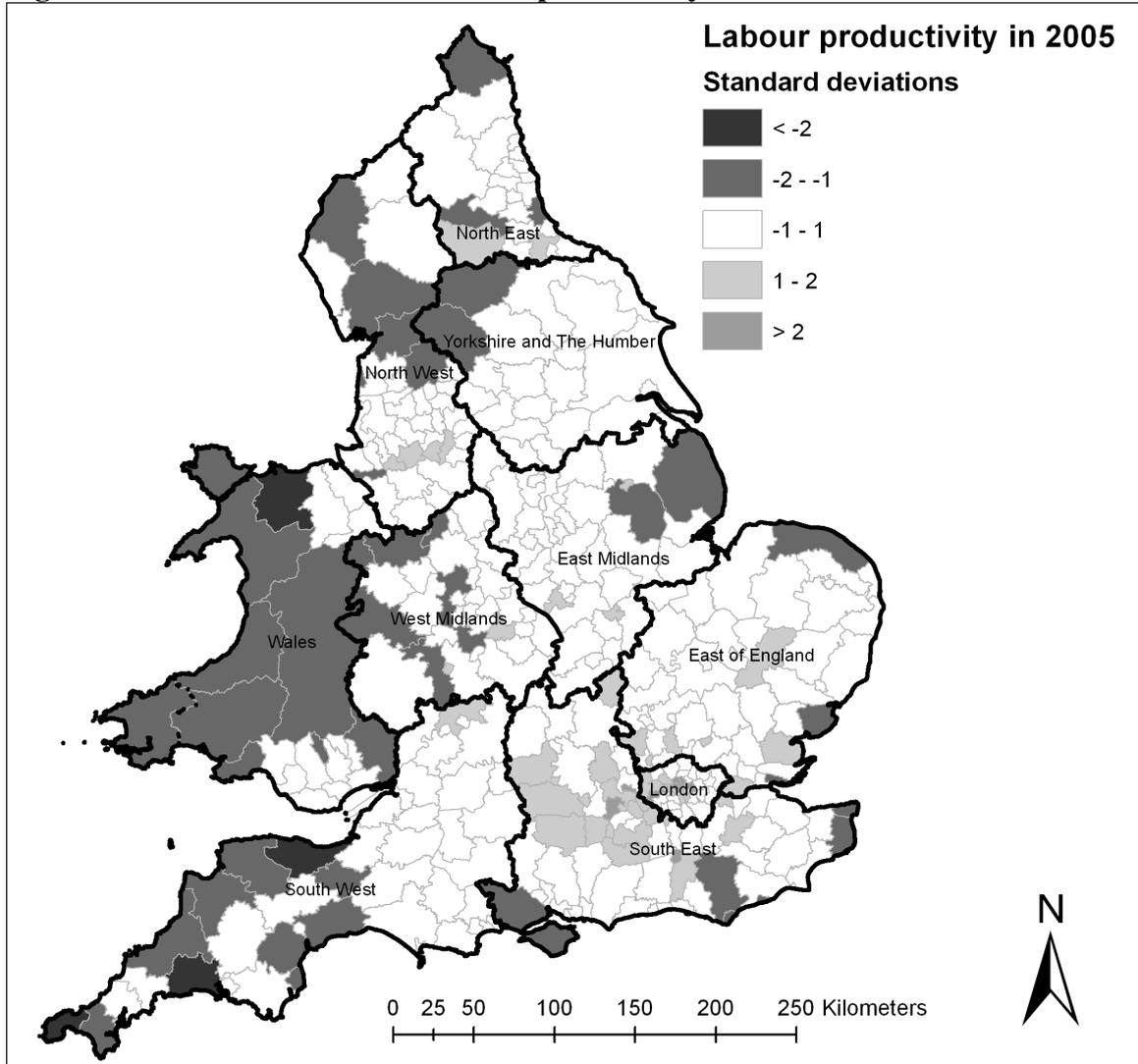
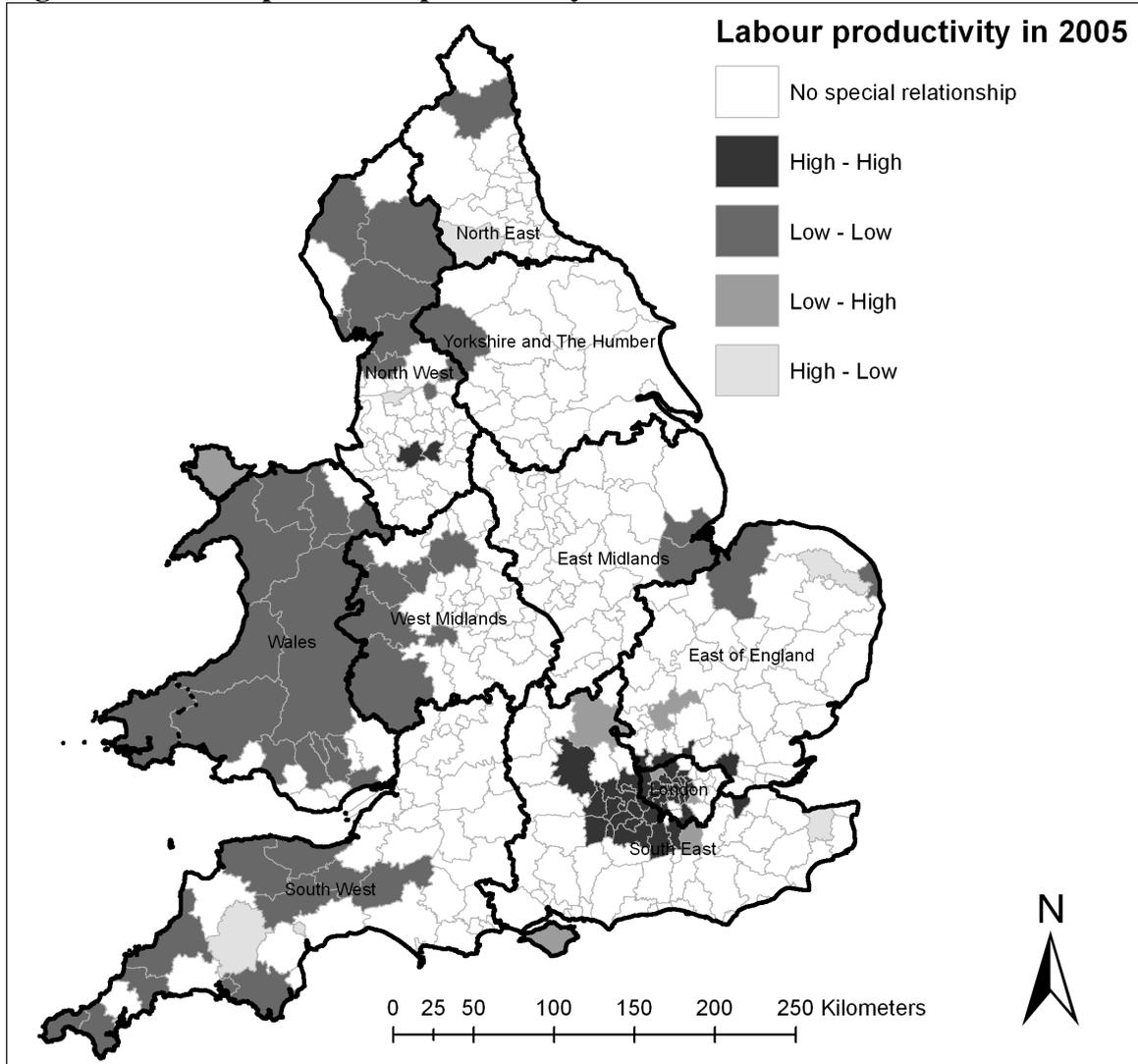


Figure 2: Standard deviation of labour productivity



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Figure 3: LISA map of labour productivity



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Figure 4: Moran's I scatter plot of labour productivity

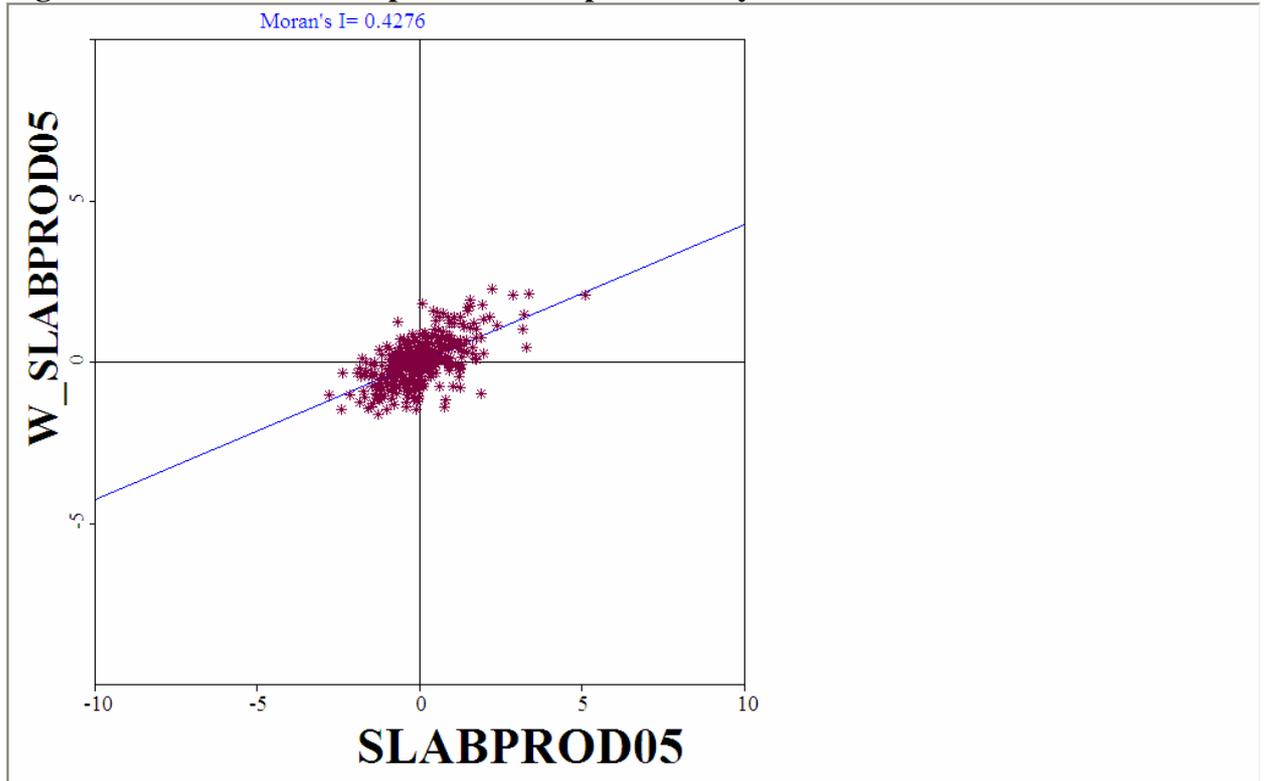


Figure 5: Standard deviation map of variation in labour productivity

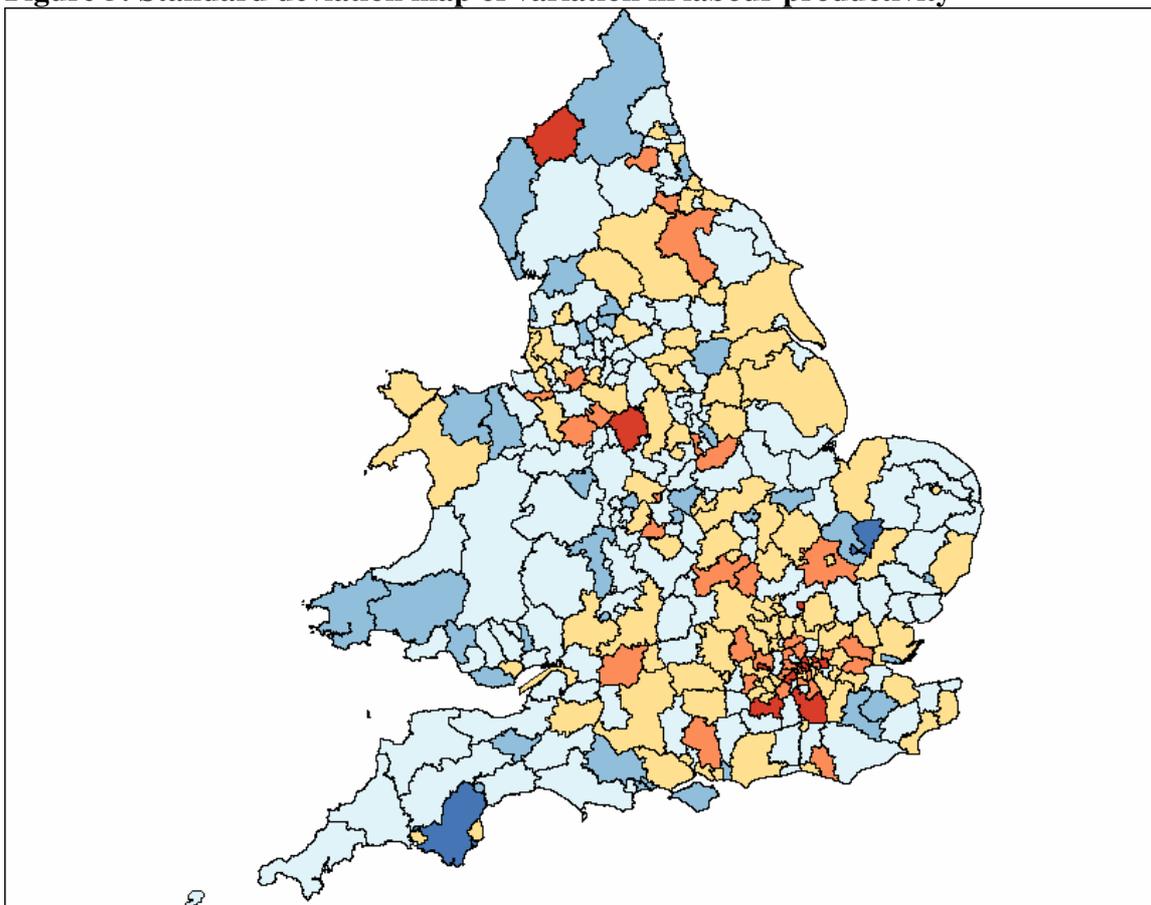


Figure 6: LISA maps of standard deviation of labour productivity

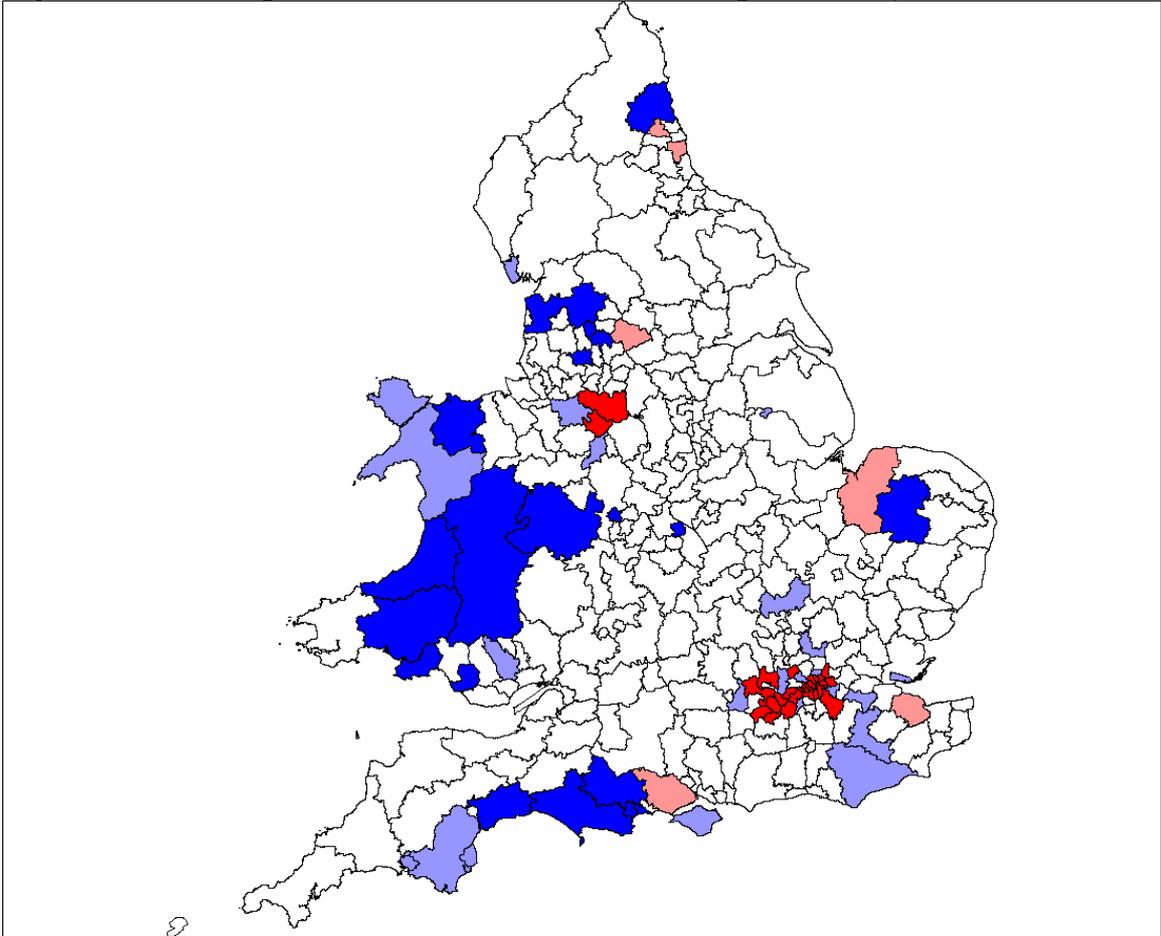


Figure 7: Moran's I scatter plot of standard deviation of labour productivity

