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SME takeovers as a contributor to regional productivity gaps

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Abstract New economic geography models typically predict centripetal economic development. One process by which this might be brought about is if large companies based in the core of the economy buy up and remove small dynamic enterprises from peripheral regions, thereby suppressing development outside the core. This hypothesis is investigated by analysing the very large UK administrative firm-level Business Structure Database. Contrary to the experience of big firms, more productive small businesses are more subject to takeover—although this effect is weaker if they are located in peripheral regions. Takeovers also increase the chances of a small and medium-sized enterprise (SME) closing, but the exit consequence is greater for the core region. Takeovers raise productivity after acquisition in all regions but by less for the most productive SMEs. Ignoring any productivity gains to acquiring firms, the positive impact in the core region during the years considered is slightly larger than in the periphery, principally because takeovers are more common in the core. As this impact is a contributor to regional divergence, policy should aim to improve the operation of the market for SMEs in the periphery.

Keywords SMEs · Takeovers · Regional development · Exits

JEL Classifications L23 · L26 · D21 · R11

1 Introduction

Businesses are less productive in peripheral regions than in the 'core'. Explicitly or implicitly this concept is a key element of new economic geography models (e.g. Krugman 1991a; Krugman and Venables 1995; Baldwin and Okubo 2006). The divergence in productivity between regions can be even greater for small and medium-sized enterprises (SMEs) which account for a large proportion of national output.[1] One possible reason for such spatial differences in SME productivity is the operation of the market for control, or takeovers, of 'second-hand' firms; innovative and faster growing SMEs are the most likely to attract bids (Cosh and Hughes 2003). Since productivity is raised

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[1] For instance, regarding Wales (where SME employment accounted for 75 % of the private sector in 2011) as a peripheral region of the UK, SME turnover per employee in Wales was 79 % of the average for the Welsh private sector whereas for the UK as a whole this measure of relative productivity was 83 % (calculated from Table 9 Business Innovation and Skills (2012).

by the entry and expansion of more productive firms and the exit of the less productive (Disney et al. 2003), the 'culling' of the more productive SMEs in the periphery could be behind regional divergences (Mason and Harrison 2006). In this paper we therefore investigate the contribution that SME takeovers may make to spatial variations in productivity.

Start-up firms, potentially the seedcorn of economic development, may become targets for large firms that are themselves unable to generate organic growth. Such predators scour markets for smaller enterprises with ideas and products that will maintain their growth rates (Baumol 2004). Smith and Nephew, currently a FTSE 100 company, traditionally known for its growth through the acquisition of products such as Nivea, Dove soap, intraocular lenses and hip replacements, is a case in point (Foreman-Peck 1995, pp. 136–137, 212–213). Alternatively, large companies may provide the finance for research and development (R&D) by start-ups in the hope that they will produce innovations that can be absorbed in due course, as with pharmaceutical giants and the biotech industry (Allansdottir et al. 2002). Integrating these companies with the acquirer might well lead to closures of the original plant or research functions. Just such an example is Molecular Light Technology, a Cardiff University spin out formed in 1991. It employed 41 people, had registered 15 patents and published over 80 research papers. In 2003 the business was bought by the largest customer, the U.S. firm Gen-Probe, which invested £2.9 m with a view to doubling turnover to £9 m over 5 years (Molecular Light Technology 2008; PRNewswire 2003). Then Gen-Probe transferred the research function to California, leaving only production in Cardiff.

On the other hand, the net effect of SME takeovers for peripheral regions might be entirely beneficial, as may be concluded by analogy with the Allinson et al. (2007) study of the SME 'transfer market'. Allinson et al. (2007) focussed on simple SME ownership change, not on mergers or takeovers, but concluded that there was evidence of market failure, particularly stemming from inadequately qualified intermediaries and the absence of due diligence. Alleviating the 'business succession' problem has also exercised European Commission policy-makers (European Commission 2006). Were these shortcomings of the market rectified there would be more successful trades and an improvement in well-being. As we demonstrate in this paper, this remains a possibility for SME takeovers as well.

The problem then is whether the acquisition of SMEs detracts from business performance in periphery regions. The contribution of our paper is to test the overarching hypothesis that the regional impact of SME takeovers is adverse and, in any event, to estimate the size of the effect. The takeover impact on regional productivity is divided into three components: (1) the impact of productivity on the probability of being taken over, (2) the effect of a takeover on the probability of exit of the target firm and (3) the effect of takeover on the productivity of the target firm. In Sect. 1 we survey the literature and extract a number of hypotheses relating to these three elements, in Sect. 2 we explain the strengths and limitations of the new data set that permits this topic to be investigated, and in Sect. 3 we outline the model and derive an expression for the quantitative impact of takeovers on the periphery. The estimation of the model is discussed in Sect. 4, and the results of the analysis are expounded in Sect. 5. In the concluding section we propose a policy and consider the robustness of the results, suggesting some caveats.

2 Previous research

The regional impact of SME takeovers depends upon the reasons for SME acquisitions, their effects and the spatial features of these two elements. Most research on mergers and acquisitions implicitly or explicitly tends to consider larger, listed firms (Caves 1989). Q theory is a recent example (Jovanovic and Rousseau 2002), while much theoretical literature has focussed on the consequences of takeovers for market structure and behaviour.[2] Large-firm empirical research on takeovers often uses event studies of stock returns to assess these effects (e.g. Martynova and Renneboog 2011). This literature is not relevant to the issues handled in this paper because almost all SMEs are not publicly quoted. Moreover, the small size of SMEs means that the impacts of both horizontal and vertical

[2] Salant et al. (1983) is a canonical reference for horizontal acquisitions in this context and Greenhut and Ohta (1976) for vertical acquisitions. This last formulation is not of great relevance for SMEs because typically they lack the market power essential to the key result of the elimination of double marginalisation.

takeovers on competition are likely to be much less significant than in the case of publicly quoted and larger enterprises.

More central to our study is the growing body of literature that views mergers and acquisitions (M & As) as a means of transferring and obtaining new technology, or assets, such as management (Ahuja and Katila 2001; Cassiman et al. 2005; Cloodt et al. 2006; Colombo et al. 2006; Hussinger 2010; Lehto and Lehtoranta 2004). Firms can accumulate critical knowledge assets either by internal investment or externally, such as by buying another enterprise (Hall 1988). Acquisitions may then serve as a substitute for in-house innovation and R&D; Dessyllas and Hughes (2005) find that high-technology targets are likely to have a greater stock of patents and substantial accumulated R&D. The more inventive capabilities of SMEs, relative to larger firms, increase their chances of becoming attractive targets (Alvarez and Barney 2001). Consistent with the search for intangible knowledge assets, empirical evidence suggests that innovative, fast-growing businesses are more likely to be bid targets (Cosh and Hughes 2003; Mason and Harrison 2006). For small privately owned firms, patent assets raise the probability of foreign M&A (Ali-Yrkkö et al. 2005). Most technology-intensive SMEs in Sweden have ultimately been acquired, and in most of the European regions surveyed, these same types of firms have been bought by external multinationals (Dahlstrand 2000, pp. 174–176). Targets with these characteristics are likely to be highly productive, which is in contrast, for example, to the predictions of Q theory for large firms. A source of high productivity of interest to acquirers includes knowledge assets, such as patents. In short, when larger firms are looking for acquisitions to offset their inadequate internally generated innovation or management skills, they create a demand for the more productive and innovative SMEs. Hence, we derive the hypothesis;

H1 More productive SMEs are more likely to be taken over.

The degree of technological relatedness of buyer and seller is especially important for the acquisitions of SMEs (Hussinger 2010). In a two-stage, quantity-setting model in which firms first compete on R&D and then on quantity in the product market, Davidson and Ferrett (2007) show that the greater the R&D complementarities between the enterprises, the more profitable will be the acquisition. Acquirers 'inside' the technology or product market of the target are likely to be more aware of the (potential) value of a target (Capron and Shen 2007; Shen and Reuer 2005), especially SMEs (Howells 1990). As such, they can overcome the typical lack of relevant public information. However, moderate levels of relatedness turn out to be optimum (Ahuja and Katila 2001; Cloodt et al. 2006).

High productivity (relative to the industry) is likely to be reflected in profits. Small but profitable companies are usually found to be takeover targets (Ravenscraft and Scherer 1987a, b, 1989). The smaller the firm targeted, the more profitable it is relative to its industry. A study of both privately and publicly traded firms found that acquired businesses were more profitable than their industry average (Matsusaka 1993). Private firm targets are more profitable than their public counterparts, even accounting for size differences. Acquirers of private firms therefore perform better than if they were to purchase a public one (Capron and Shen 2007). Both market and publicly available information are likely to be thinner on a private firm than on a publicly quoted enterprise. Hence, SME prices will be discounted, to the benefit of the buyer. Information about an SME is likely to be a function of whether it is public or private (because of different reporting requirements) and of age and size. Because the performance of private companies, particularly the very young and small, will be relatively less known to potential acquirers, they are less likely to be targets.

H2 Takeover chances increase with information.

Turning to spatial dimensions of takeovers, acquisitions are likely to involve targets close to the acquirer's headquarters. This is particularly so in the largest metropolitan areas, or at locations with a high density of firms, where M&A activity declines with distance (Green 1990; Green and Cromley 1984; Rodriguez-Pose and Zademach 2003). The acquisition of high-technology SMEs can be a means of allowing external buyers (external to the market, the region or the country) to access indigenous knowledge—and perhaps remove it. Intranationally, firms from the most prosperous areas conduct a disproportionate number of acquisitions, but the targets are much less regionally concentrated (Böckerman and Lehto 2006; Leigh and North 1978). The propensity to conduct extra- or

intra-regional acquisitions is linked to the acquirer's size and the target's profit or productivity potential. Small acquirers are more probably within the region, consolidating their existing positions, whereas larger predators may well be from outside. Larger companies, which may have better access to financial resources, are more able to target smaller unquoted firms in more distant locations (Ashcroft and Love 1992). The size of the acquirer also affects the required attributes of the potential targets. Leigh and North (1978) find that regions with large companies seek efficient, small firms to facilitate future expansion. Purchases further afield similarly target well-performing (profitable) businesses and those with fixed assets—that can be made to perform (Böckerman and Lehto 2006). Foreign suitors commonly buy more productive plants or firms (Griffith et al. 2004; Hanley and Zervos 2007; Harris and Robinson 2002; Salis 2008). Agglomeration triggers more intense local competition as well as better information flows in core regions; therefore, there is a stronger demand to acquire SMEs in these core regions than in the periphery. Poor information (here is the relevance of H2) is likely to ensure that predators only notice the most obvious periphery-based targets. Hence:

H3 The effect specified in H1 is stronger in peripheral regions (than in core regions).

After takeover, the integration of the target with the buyer's enterprise may involve closure at the original location or, alternatively, a restriction of activities (e.g. cessation of R&D output) or a deterioration/improvement of performance. The effect of takeover is likely to depend on the original purpose. If the intention is to obtain new or better market access, then the target will probably have an increased chance of survival, perhaps even benefitting from the resources of the acquirer. Even with such a motivation for takeover, new foreign or external owners may be more alien to local market conditions, which can increase the likelihood of 'bedding-in' problems, relative to domestic or local acquisitions. Alternatively, the external firm may value the assets more highly than potential local acquirers; outside owners might be better placed to divest the firm of assets by breaking employment contracts and removing productive capacity (Chapman 2003).

Knowledge transfer motivation can explain why for the successful integration of an acquisition it may be necessary to relocate the target firm assets close to the acquirer; high returns require direct physical or economic contact (Wesson 1999, p. 2). In faster growing, technology-intensive industries, takeovers result in the exit of plants peripheral to the main enterprise (Chapman and Edmond 2000). Again, consistent with the targeting of intangible knowledge assets, there is evidence that plants acquired by the foreign-owned firms have a much higher chance of subsequent exit (Harris and Hassaszadeh 2002). Smaller targets with their intangible assets could be of more benefit than the rationalisation and improved performance of larger targets (Piscitello and Rabbiosi 2005); relatively smaller targets have been found to increase the post-acquisition performance of the acquirer (Ahuja and Katila 2001). Takeovers are an investment decision, an element of which might be relocation or closure to take advantage of synergies with the acquiring firm's assets. Where this is the case, takeovers increase the chances of SME exit. A caveat concerns the case when SME inputs, such as capital, are rationed or otherwise unusually constrained (due to their high costs relative to those of larger firms). In this situation, acquisition may reduce the chances of exit by resulting in injections of capital or other support. However, pursuing the approach of specifying an overarching hypothesis of adverse effects on the periphery, we postulate:

H4 Takeovers increase the chances of SME exit.

Acquiring firms are more probably located in core regions of the economy, where more company headquarters are based. Complementarities between the buyer and the target that can, or must be, exploited by proximity may precipitate closure of the acquisition at the original location. Consequently, after a takeover, acquired SMEs in the periphery are more likely to be closed to take advantage of their knowledge or other asset(s) in the core.

H5 The effect specified in H4 is stronger in peripheral regions.

Some studies of foreign (and therefore extra-regional) acquisitions have established that these can cause a fall in the productivity of the target (Hanley and Zervos 2007; Harris and Robinson 2002), no improvement (Salis 2008) or improvements in productivity only a few years after purchase (Karpaty 2007). This last outcome would be observed in the presence of 'bedding-in' problems and adjustment

costs of the acquisition. Other evidence of foreign acquisitions shows mostly positive effects on productivity or growth (Bertrand and Zitouna 2008; Conyon et al. 2002; Girma and Görg 2007; Griffith et al. 2004; Piscitello and Rabbiosi 2005). Indeed, some researchers find that the targets improve relative to domestic acquisitions (Bertrand and Zitouna 2008; Conyon et al. 2002) and even more if initial productivity is lower (Girma and Görg 2007). Takeovers may provide new resources that aid small firms in improving their productivity and expanding their size. Alternatively, acquisitions may strip SMEs of their dynamism and lower performance when subject to integration problems and other adjustment costs of acquisition. With a view to testing the general proposition that takeovers are harmful, we hypothesise that:

H6 Takeover reduces target SME's productivity.

However, if predators are searching for intangible knowledge assets that they have been unable to build up themselves, when they do make a high-productivity acquisition it is quite plausible that they will have an adverse impact on the target if it stays in business. A transfer of the knowledge assets, such as R&D, to the headquarters, as in the case of Molecular Light Technology described in the Introduction, could have this effect. In this case, the more productive firms acquired lose what ultimately made them high performers, triggering a decline in productivity.

H7 Takeover reduces the productivity of target SMEs at the top of the productivity range the most.

Takeovers may contribute to the concentration of economic activity that is a feature of new economic geography models (Krugman 1991b; Krugman and Venables 1995). Takeovers can reinforce core–periphery divergence (Brouwer et al. 2004) and weaken peripheral locations (Ashcroft and Love 1993), with external takeovers concentrating economic activity within core regions (Holl 2004; Rodriguez-Pose and Zademach 2003). If the birth and indigenous growth rate of high-technology SMEs is insufficient to match the rate of acquisition and absorption by extra-regional enterprise, the centripetal tendency predicted by the new economic geography (NEG) will be reinforced. Corporate control will then converge on the core regions (Ashcroft et al. 1994), and the control of small firms from peripheral areas shifts to large firms based in core areas where the financial centres are located (Chapman and Edmond 2000). On the other hand, it is theoretically possible in an NEG model that institutions and policies lower the costs of information sufficiently to encourage dispersion of economic activity (Baldwin and Forslid 2000). Without information cost reductions, a possible negative productivity effect of takeovers is more pronounced for SMEs located in the periphery, because the new owners may be prone to move resources, assets or expertise into the core where their principal enterprises are located.

H8 The effect described in H7 is stronger in the peripheral regions.

To summarise, SME takeover targets (unlike conventional transfers or mergers) are more likely to be high-productivity, high-profit companies, in contrast to stock market-listed targets. Large firms more probably take over SMEs further afield, raising the chances that the acquirer will be based outside the periphery. The desire of large established firms to acquire intangible knowledge assets may be a key motive. If so, after takeover, target SMEs may: close, lose their intangible assets or relocate. In fact, the evidence available to date is mixed as to whether any of these options actually occurs, or instead productivity rises as a consequence of new resource injections, or on the other hand, 'bedding in' problems drag down productivity for an initial period. Likewise then, the consequences are uncertain for regional or core–periphery development consequent upon takeover. Indigenous growth potential may be enhanced or reduced and core–periphery gaps widened or narrowed.

3 Data, definitions and description

For the UK, the Inter-Departmental Business Register (IDBR) and Business Structure Database (BSD) uniquely allow the identification of SME takeovers. The BSD is a version of the IDBR, which covers 98 % of economic activity in the UK for each year and contains around two million observations that include all but the very smallest of firms (Barnes and Martin 2002). It is a representative data set of nearly the entire population of UK firms—not a sample survey.[3] The

[3] But the data set will not include the smallest businesses according to both employment and turnover (and some

size of the data set is particularly helpful for the study of takeovers which, unlike business succession, are comparatively rare events. By excluding all cases where employment is greater than 249, the data set is restricted to SMEs.[4]

The trade-off for the broad coverage is that the data set contains very few variables, namely, address, industry classification (industrial/economic activity), employment, turnover, legal status (company, sole proprietor, partnership, public corporation/nationalised body, local authority or non-profit body) and Enterprise Group links. Two data-merging operations are necessary to apply the data in the BSD. The first is with the National Postcode Directory to be able to assign enterprises to regions, and the second involves merging successive years of the BSD using the unique enterprise identifier.

The level of analysis is the enterprise, defined as:

> *'the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making…'*(ONS 2006, p. 7).

As all ownership changes apply to the enterprise group level, it is still possible to identify firms that have been subject to these changes at the enterprise level. In our analysis of the three ownership changes, i.e. simple succession, merger and takeover, we employ only the third category—'takeover'. This definition implies that the SME is the target and the likelihood is that it is acquired by a firm larger than itself; hence, the continuation of the acquiring enterprise's identity. When an SME is taken over, the ownership reference number in the BSD changes (for the acquired)—but not the enterprise reference number. The latter is used to track the enterprise over time; the former is used to identify ownership details. As the takeover marker is for acquired firm, it is unfortunately not possible to trace the acquirer.

In the BSD an important distinction is made between types of transfer.[5] For takeovers, the definition is chosen from three categories of ownership change (ONS 2006).[6] These are:

1) a 'pure' change of ownership, such as when an owner manager retires, selling the business to a successor;
2) a 'merger', when for instance two enterprises integrate entirely and lose their identities;
3) a 'takeover', when two enterprises integrate entirely, but only one enterprise retains its identity, by which is meant 'controls the combined operation'. Takeovers are comparatively rare for SMEs, and hence the advantage of the very large data set of almost two million SMEs employed in our study. This ownership change is also the most likely form that SME asset acquisition by large extra-regional firms would take.

The BSD imposes the requirement of using turnover as the output measure.[7] McGuckin and Nguyen (1995, p. 262) maintain that at the firm level gross output will vary with the theoretical output. In the absence of firm level price deflators, turnover change must be assumed to reflect output change. Estimates of capital stock are inadequate for use with the SME sector. This precludes estimating total factor productivity and requires a focus on labour productivity (LP). However, both because of differences in the capital stock and bought-in materials, the level of LP varies markedly between sectors (e.g. Griffith et al. 2004, p. 445). To allow for comparisons across different

Footnote 3 continued
non-profit organisations). The IDBR's coverage is limited by voluntary registration for firms below the value-added tax (VAT) registration threshold and the exclusion of employers whose employees are below the income tax threshold. Businesses with a turnover above the threshold are not required to register if they trade exclusively in exempt goods. If both the criteria concerning VAT and PAYE ('Pay as you earn' for income tax) are not met, then firms are excluded from the Register [Office of National Statistics (ONS) 2007]. It is possible that companies can come in and out of the register between years if they do not meet the above criteria between years.

[4] Turnover must also be positive for inclusion in the sample.

[5] These terminological distinctions matter in order to understand the relationship with a related strand of SME research, entrepreneurial entry. Unlike in our analysis, with respect to entrepreneurial entry the term 'takeover' is employed to mean acquisition; as such, it could cover any of the three categories above. Parker and Van Praag (2010) focus on the determinants of the choice between starting a new business or acquiring an existing enterprise for a sample of Dutch individuals who have either acquired a firm (from a family or non-family member) or started a completely new firm. Block et al. (2010) conduct a cross-national analysis of preferences for the same choice (if the respondent had the means would they prefer to acquire an existing business or to start a new one?).

[6] ONS follow the guidance provided by Eurostat (2003).

[7] This measure will be inadequate for research firms perhaps generating patents but no current revenue.

industrial sectors,[8] the approach we adopt is therefore to estimate each SME's productivity relative to the industry mean. This method removes industry-specific factors to create 'relative labour productivity' (RLP).

Following McGuckin and Nguyen (1995), RLP normalises labour productivity across industries. A figure greater than one indicates greater than the industry average productivity and a value of less than unity shows productivity less than the industry average;

$$\mathrm{RLP}_{ij} = \mathrm{LP}_{ij}/\mathrm{ALP}_{j}$$

where i is each firm and j is each industry, LP is labour productivity and ALP is average labour productivity. Industries are defined at the three-digit level of the 1992 UK Standard Industrial Classification (SIC 92). To improve the robustness of observations within each industry, small industries are removed; industries with fewer than 50 cases, measured at the three-digit SIC 92 level, are omitted.[9] This step helps to ensure that a single firm's LP is not overly influential within the industry average. To maximise observations within each industry, the estimates of productivity include SMEs located in Northern Ireland, but the analysis does not.

3.1 Descriptive statistics

Regions are categorised according to their gross value added (GVA) per head, per worker or per hour worked. All three criteria provide the same ranking of UK regions in 2004. The allocation of regions to the categories of core, periphery and intermediate regions[10] is shown in Table 1. One-third of SMEs were based in the regional core of London and the South East and one-quarter of SMEs were located in the periphery of Wales, the North East, Yorkshire and the North West.

Exits are measured just 1 year after takeover.[11] London experienced the highest proportion of SME exits in 2006 and Wales the lowest (Table 2)—which ensures that the core has a higher exit rate than the periphery—but otherwise there is no clear pattern between regions. The most productive (fourth) quartile of SMEs are most likely to be taken over in 2005 (Table 3). SMEs in the periphery are least likely to be taken over in 2005, while those in the core have the greatest chance of being acquired (Table 4).

4 The model

In the analysis presented here, our aim is to test an extreme version of the hypothesis for the periphery impact of SME takeovers because the benefits to the acquirer cannot be measured with the BSD data set. All acquirers of concern are assumed to be located in the core zone. The periphery will then be harmed by takeovers if they reduce aggregate periphery productivity; this contribution to economic location is centripetal as in the earliest NEG models. The assumption gives an upward bias to the 'harm' estimate if some acquirers benefit from the takeover and are based in the periphery. If the 'harm' hypothesis can be rejected on the basis of this assumption, it is certain that with more information about acquirer benefits, it would be more strongly rejected.

Three equations can be used to test the overarching hypothesis (that takeovers damage periphery productivity) and estimate the effect of SME takeovers on the productivity of the periphery regions, on the assumption of extra-regional acquisition. Respectively, they capture: (1) the effect of productivity on the probability of being taken over, (2) the effect of a takeover on the exit probability of the target firm and (3) the effect of takeover on the productivity of the target firm.

Where Pr is probability, T is takeover, the t subscripts denote dates, 'Prod' is labour productivity u_{i} are disturbance terms, φ is the link function, 'Location' = 1 for periphery, otherwise zero, and i indexes firms, the takeover equation is:

[8] The problems of doing so have been documented by Baumol and Wolff (1984).

[9] There are about 15 of these, amounting to perhaps 200 observations, not many considering the size of the sample (around 0.01 %).

[10] The intermediate regions are very heterogeneous, including the second largest UK conurbation.

[11] Exit must be chronologically close to takeover for credibly assigning causality; the greater the elapse of time from takeover, the less the likelihood of direct causation. Also, this short time interval helps to ensure that post-takeover exits are not wrongly identified through some form of absorption in later years, as acquired business should still be identified, at least initially, after they have been acquired if they are still operating.

Table 1 Location of small and medium-sized enterprises (SMEs)

Location (2004)	*N*	%
Periphery	467,893	24.7
Wales	85,661	4.5
North East	50,117	2.6
Yorkshire & Humber	140,990	7.4
North West	191,125	10.1
Intermediate	807,875	42.6
West Midlands	160,339	8.5
East Midlands	134,121	7.1
South West	185,228	9.8
Scotland	131,365	6.9
East England	196,822	10.4
Core	621,520	32.8
South East	324,909	17.1
London	296,611	15.6
Total	1,897,288	100

Source Office of National Statistics (ONS), authors' calculations. *Note* Core–periphery definition is based on gross value added (GVA) per hour worked or per filled job or per head

Table 2 Exit frequencies of SMEs by region

Region (2004)	Total (2004)	Exit (2006)	% Exiting (2006)
Wales	85,661	17,565	20.5
North East	50,117	11,909	23.8
Yorkshire and Humber	140,990	31,966	22.7
North West	191,125	44,542	23.3
West Midlands	160,339	35,720	22.3
East Midlands	134,121	30,375	22.6
South West	185,228	40,147	21.7
Scotland	131,365	29,474	22.4
East England	196,822	43,647	22.2
South East	324,909	75,874	23.4
London	296,611	78,296	26.4
Total	1,897,288	439,515	23.2

Source ONS, authors' calculations

$$\Pr(T_{it}=1)=\varphi(\alpha_1 \mathrm{Prod}_{it-1}+\alpha_2 \mathrm{Location}_{it-1} * \mathrm{Prod}_{it-1}+\alpha_3 \text{public information}_{it-1})+u_1 \quad \alpha_1>0,\alpha_2>0,\alpha_3>0 \cdots\cdots (\mathrm{H1}-\mathrm{H3}) \tag{1}$$

Table 3 Takeover of SME by productivity

Quartile of relative labour productivity	Proportion of takeovers (%)
First quartile	0.63
Second quartile	0.54
Third quartile	0.55
Fourth quartile	0.91
Total	0.66

Source ONS, authors' calculations. *Note* Sample size 1,897,288

Where X is exit,

$$\Pr(X_{it+1}=1)=\varphi(\beta_1 T_{it-1}+\beta_2 \mathrm{Location}_{it-1} * T_{it-1})+u_2 \quad \beta_1>0,\beta_2>0 \cdots\cdots (\mathrm{H4},\mathrm{H5}) \tag{2}$$

Where Prod is productivity,

$$\mathrm{LnProd}_{it+1}=\gamma_1 T_{it}+\gamma_2 T_{it} * \mathrm{Location}_{it-1}, +\gamma_3 T_{it} * \mathrm{Prod}_{it-1}+u_3 \quad \sum \gamma_i<0,\gamma_2<0,\gamma_3<0 \cdots\cdots (\mathrm{H6}-\mathrm{H8}) \tag{3}$$

Whether the acquisition targets subsequently improve in productivity relative to what they would have achieved, or whether they cease trading after takeover when they would not otherwise, could have an impact on regional economic development, as well as productivity differentials, harmful or beneficial. The effects interact with the process of selecting targets. Selection for low productivity in Eq. 1 and for closure in Eq. 2 would boost productivity. Selection for high productivity in Eq. 1 and for closure could lower productivity. The overall effect also depends on the benefits of the takeover to the acquirer.

The impact of SME takeovers on productivity in the periphery also depends upon the marginal effect of takeovers on productivity ($\Delta\mathrm{Prod}/\Delta T$) and the probability of a firm being acquired $\Pr(T)$. If either of these vary by firm size, then it is not appropriate to multiply the average effect by the number of firms to obtain the aggregate result. The simple approach of ignoring size effects assumes that the smallest SMEs have the same contribution to aggregate productivity as an SME with 249 employees. If both the chances of takeover and its impact vary by size, then using the average figures ignores the possibility that large acquired SMEs disproportionately influence the total impact.

Table 4 Takeover of SME by location

Location 2004	*N*	Takeover frequency	Takeover proportion (%)
Periphery	467,893	2,459	0.53
Wales	85,661	308	0.36
North East	50,117	222	0.44
Yorkshire and Humber	140,990	834	0.59
North West	191,125	1,095	0.57
Intermediate	807,875	4,488	0.56
West Midlands	160,339	974	0.61
East Midlands	134,121	709	0.53
South West	185,228	819	0.44
Scotland	131,365	741	0.56
East England	196,822	1,245	0.63
Core	621,520	5,557	0.89
South East	324,909	2,174	0.67
London	296,611	3,383	1.14
Total	1,897,288	12,504	0.66

Source ONS, authors' calculations

To include the effects of firm size and takeover in the performance model (Eq. 3), Eq. 4 posits that the productivity performance (prod) of firm *i* is affected by takeover (*T*), an interaction of takeover and employment (*T***E*) and other factors to be specified later:

$$\begin{aligned}\ln \text{Prod}_{it+1} &= \gamma_1 T_{it} + \gamma_2 T_{it} * \text{Location}_{it-1}, \\ &+ \gamma_3 T_{it} * \text{Prod}_{it-1} + \gamma_4 T_{it} * E_{it-1} + u_3\end{aligned} \tag{4}$$

If there is a size effect of takeovers for SMEs, $\gamma_4 \neq 0$, and γ_1 will not capture the full effect of takeovers on productivity. This is:

$$\Delta \ln \text{ Prod } /\Delta T = \gamma_1 + \gamma_4 E_{it-1}$$

To obtain the total impact, the marginal effect of takeovers on performance (Δ ln Prod/ΔT) is estimated for every acquired SME, providing a predicted effect of acquisition on its performance. Then, both the chances of takeover and its effect must be weighted to reflect the fact that larger SMEs contribute more to the economy. In short, the aggregate effect of SME takeovers on periphery productivity is the individual firm's chances of takeover multiplied by the productivity impact of takeovers, times the firm's weight or contribution to aggregate productivity within the SME sector, summed across all firms indexed by *i*:

$$Z_1 = \sum \Pr(T_t)_i * (\Delta \text{Prod } /\Delta T)_{it+1} * W_{it-1} \tag{5}$$

where W_{it-1} is the SMEs' share of periphery employment,[12] $E_{it-1}/\sum E_{it-1}$.

Equation 5 measures only the direct impact of takeovers on productivity, assuming that all acquired SMEs survive. However, an additional consideration is that SME exits after takeover may affect productivity. The aggregate effect of SME exits due to takeover depends upon the probability of takeover and the marginal effect of takeovers on the probability of exit. As with the impact of takeover on performance, if size affects the probability of takeover or the takeover–exit effect, then it is not possible to estimate the aggregate effect from the sample means. Larger acquired SMEs have a greater impact on the aggregate than the average, and the total effect must reflect their importance.

The probability of takeover is the same as in Eq. 5, and the effect of takeovers on exit can be calculated from Eq. 2. This is analogous to the productivity equation above; the inclusion of takeover–size interactions can capture any possible size-varying effects (Eq. 6 below);

$$\begin{aligned}\Pr(X_{it+1} = 1) = \varphi(&\beta_1 T_{it} + \beta_2 \text{Location}_{it-1} * T_{it-1} \\ &+ \beta_3 T_{it} * E_{it-1}) + u_2\end{aligned} \tag{6}$$

$$\Delta \Pr(X)/\Delta T = \varphi(\beta_1 + \beta_3 * E_{it-1}) \tag{6a}$$

From Eqs. 6 and 6a it is apparent that the effect of takeovers on the probability of exit includes $\beta_3 \cdot E_{it-1}$ if exit chances vary by firm size ($\beta_3 \neq 0$).

The effect of takeover on exit also depends on the productivity of firms. If takeover–exits involve firms that are less productive than the average, then their departure boosts the overall level of productivity. Therefore, a measure of the impact of SME closures consequent upon takeover must include their productivity relative to the (weighted) average level of productivity.

In summary, the effect of takeover–exits on periphery productivity is the product of a periphery SME's individual probability of takeover, the marginal effect of takeover on its probability of exit, the SME's differential productivity and its employment weight, summed across all firms, or:

[12] Appendix A explains why employment and not output weights are suitable.

$$Z_2 = \sum \mathrm{Pr}(T)_{it} * (\Delta \mathrm{Pr}(X)/\Delta T)_{it+1} * ((\mathrm{Prod}_{it-1} - \overline{\mathrm{Prod}}_{t-1})/\overline{\mathrm{Prod}}_{t-1}) * W_{it-1} \quad (7)$$

where $\overline{\mathrm{Prod}}_{t-1}$ is the (weighted) average of productivity across all firms at time $t-1$. Any impact on the acquiring business is irrelevant to the periphery region because by assumption it occurs elsewhere.

Subtracting Eq. 7 from the productivity impact (Eq. 5) of takeovers yields the total productivity effect, excluding any on acquirers[13]:

$$Z_3 = \sum \left[\left(\mathrm{Pr}(T)_{it} * (\Delta \mathrm{Prod}\ /\Delta T)_{it+1} * W_{it-1} \right) - (\mathrm{Pr}(T)_{it} * (\Delta \mathrm{Pr}(X)/\Delta T)_{it+1} * ((\mathrm{Prod}_{it-1} - \overline{\mathrm{Prod}}_{t-1})/\overline{\mathrm{Prod}}_{t-1}) * W_{it-1}) \right] \quad (8)$$

Equation 8 is a base-weighted (Laspeyres) index and, if the market works well, may understate the impact of takeovers. Takeovers might enhance SME employment (but alternatively they may shed jobs), and more productive SMEs are likely to increase their market share (but again, takeovers can be mismanaged and market share lost).

5 Estimation

Unbiased estimates of the parameters needed to calculate the impact of takeovers require that the disturbance terms (u_I) in the model be uncorrelated with the explanatory variables, if a single equation estimation is used. If unobserved bad management or luck reduces the chances of takeover and increases the likelihood of exit, then $E(u_1, u_2) < 0$. The single equation estimation of (Eq. 2) requires that $E(T, u_2) = 0$. Failure to take into account the disturbance correlation of the exit and takeover equations means that T could be unduly low when X is high because of the disturbance term; consequently, the effect of takeover on exit will be overestimated by single equation methods. Bivariate probit (or biprobit) estimation controls for T and u_2 actually being negatively correlated. Potential endogeneity of takeover in the exit equation can be ignored in the bivariate probit estimation, in contrast to linear simultaneous equations (Greene 1998, p. 295). Bivariate probit estimation requires maximising the log-likelihood instead of using the sample moments.

Higher productivity may be both a cause and an effect of takeover in Eqs. 1 and 3, thereby correlating the disturbance terms and the explanatory variables. Assuming that both structural parameters are positive, the simultaneous relationship implies that takeovers will be high when u_3 is large and that productivity will be high when u_1 is large; $E(T, u_3) \neq 0$ and $E(\mathrm{Prod}, u_1) \neq 0$. An unobserved favourable shift in demand (large u_1) might increase the chances of takeover and, through Eq. 3, also improve productivity. However, through Eq. 1 this higher productivity (Prod) may then be associated with the large u_1.

The difference-in-difference method, which compares productivity before and after takeover, treating enterprises not taken over as controls for those that are, goes some way to addressing this problem (Meyer 1995). Where Prod_1 is the productivity prior to the acquisition of enterprises that are taken over and Prod_2 the productivity after takeover, Prod_3 is the productivity of non-acquired firms at the same time as Prod_1, and Prod_4 is their productivity at the same time as Prod_2, the 'average treatment effect' is $(\mathrm{Prod}_2 - \mathrm{Prod}_1) - (\mathrm{Prod}_4 - \mathrm{Prod}_3)$, which is the difference between the productivity increase of those taken over and those that were not. Enterprises with large (or small) u_I before and after the takeover year would lose such effects by the differencing, by focusing on the increase in 'Prod' rather than on the level.

However, the appropriateness of the control depends on the absence of selection of the takeover target; enterprises taken over would not otherwise have increased their productivity by more than those not acquired. Some of those not acquired cease trading over the period considered for the productivity performance, and these are likely to have been the least productive. Some of the firms taken over were closed but these were not necessarily the least productive if their assets when integrated provided a boost to the purchaser's business. If firms that would have increased productivity to a lesser degree tend to exit, then survivors will be more productive regardless of whether or not they have been taken over. This selection process implies that $E(u_2,u_3) > 0$. A Heckman (1979) estimation procedure is therefore combined with the difference-in-differences to control for

[13] Takeover–relocation effects are ignored here because they are infrequent.

the possible bias in Eq. 3 with, in effect, Eq. 2 as the selector.[14]

To test the subsidiary hypotheses and estimate the parameters necessary to calculate the impact of SME takeovers on the periphery, control variables must be added to the takeover, exit and productivity equations. In the takeover equation, a squared productivity variable is included. Polynomials of 'Employment' up to the fourth degree capture the possibly non-linear effects of SME size on the chances of takeover. 'Entity' measures whether an SME is registered as a sole proprietor (omitted case), partnership or company. 'Age' in 2004 is a set of dummy variables. A total of 49 two-digit 'Industry' controls from UK SIC 1992 are incorporated (though coefficients are not reported). 'Location' identifies whether the SME is in the 'core' (omitted case), intermediate region or periphery of the UK. 'Structure' controls for SMEs that may have multiple local units and is measured as the natural logarithm of the number of local units.

The estimating model of Eq. 1, takeovers, is then:

$$\begin{aligned}\Pr(\mathrm{Tt}=1) = \varphi(&\alpha_0 + \alpha_1 \mathrm{RLP}_{it-1} + \alpha_2 \mathrm{Location}_{it-1} \\ &* \mathrm{RLP}_{it-1} + \alpha_3 \mathrm{Age}_{it-1} + \alpha_4 \mathrm{Employment}_{it-1} \\ &+ \alpha_5 \mathrm{Entity}_{t-1} + \alpha_6 \mathrm{Industry}_{t-1} + \alpha_7 \mathrm{Location}_{t-1} \\ &+ \alpha_8 \mathrm{Employment}_{t-1} + \alpha_9 \mathrm{Structure}_{t-1} \\ &+ \alpha_{10} \ln(\mathrm{RLP}_{t-1})^2 + \alpha_{11} \mathrm{Employment}_{t-1}^2 \\ &+ \alpha_{12} \mathrm{Employment}_{t-1}^3 + \alpha_{13} \mathrm{Employment}_{t-1}^4) + u_1 \end{aligned} \tag{9}$$

Hypothesis 1 is that the demand for SME control targets the more productive businesses ($\alpha_1 > 0$, but also depends upon α_2 and α_{10}). α_2 (>0) tests whether high-productivity firms in the periphery are more prone to takeover; this is hypothesis 3, which also depends on α_7, α_1 and α_{10}. Hypothesis 2 is that the market value of high-productivity and innovative SMEs only becomes apparent when good information is available on the firm. Because of official reporting requirements, better information is available for companies than for sole proprietorships ($\alpha_5 > 0$). In addition, when firms are larger and have accumulated a track record, informational asymmetries are reduced; consequently, the chances of takeover rise (α_3, $\alpha_4 > 0$, but the size effect also depends upon α_{12}, α_{13} and α_{14}).

[14] Actually the mirror image; survival, rather than exit.

The empirical exit equation, where X = exit, is:

$$\begin{aligned}\Pr(X_{it+1}=1) = \varphi(&\beta_0 + \beta_1 T_{it} + \beta_2 \mathrm{Location}_{it-1} \\ &* T_{it-1} + \beta_3 T_{it} \cdot E_{it-1} + \beta_4 \mathrm{lnRLP}_{t-1} + \beta_5 \mathrm{Entity}_{t-1} \\ &+ \beta_6 \mathrm{Age}_{t-1} + \beta_7 \mathrm{Industry}_{t-1} + \beta_8 \mathrm{Location}_{t-1} \\ &+ \beta_9 \mathrm{Employment}_{t-1} + \beta_{10} \mathrm{Structure}_{t-1} \\ &+ \beta_{11} \mathrm{Employment}_{t-1} * \mathrm{lnRLP}_{t-1} + \beta_{12} \mathrm{Location}_{t-1} \\ &* \ln \mathrm{RLP}_{t-1} + \beta_{13} T_t * \ln(\mathrm{RLP}_{t-1} + \beta_{14} T_t \\ &* \ln \mathrm{RLP}_{t-1} * \mathrm{Location}_{t-1}) + u_2 \end{aligned} \tag{10}$$

Hypothesis 4 is that the probability of an SME exiting increases if it has previously been taken over, $\beta_1 > 0$ (but the takeover effect also depends upon β_2, β_3, β_{13} and β_{14}). Hypothesis 5 is that the chances of exit, given that the firm has been taken over, are higher in peripheral regions; the coefficients on the interaction term for peripheral locations are positive ($\beta_2 > 0$) and also increase with productivity ($\beta_{14} > 0$).

The empirical specification of post-acquisition productivity performance is:

$$\begin{aligned}\mathrm{lnProd}_{t-1} - \mathrm{lnProd}_{t+n} = &\gamma_0 + \gamma_1 T_{it} + \gamma_2 T_{it} \\ &* \mathrm{Location}_{it-1}, + \gamma_3 T_{it} * \mathrm{lnRLP}_{it-1} + \gamma_4 T_{it} \\ &* \mathrm{Employment}_{it-1} + \gamma_5 \mathrm{Entity}_{t-1} + \gamma_6 \mathrm{Age}_{t-1} \\ &+ \gamma_7 \mathrm{Industry}_{t-1} + \gamma_8 \mathrm{Location}_{t-1} \\ &+ \gamma_9 \mathrm{Employment}_{t-1} + \gamma_{10} \mathrm{Structure}_{t-1} \\ &+ \gamma_{11} \ln \mathrm{RLP}_{it-1} + u_3 \end{aligned} \tag{11}$$

where Prod is labour productivity and all other variables are as specified above. Hypothesis 6 specifies that takeover reduces SME post-acquisition performance. The impact of SME takeover on productivity can be summarised by differencing Eq. 11 by takeover (T);

$$\begin{aligned}&\Delta(\mathrm{lnProd}_{t-1} - \mathrm{lnProd}_{t+n})/\Delta T_t \\ &= \gamma_1 + \gamma_2 \mathrm{Location}_{it-1}, + \gamma_3 \mathrm{lnRLP}_{it-1} + \gamma_4 * E_{it-1} \end{aligned} \tag{12}$$

Hypothesis 8, which links peripheral location to a deterioration in post-acquisition productivity, is $\gamma_2 < 0$, and hypothesis 7, which is that high productivity targets suffer more of a decline in productivity, is $\gamma_3 < 0$.

6 Results

The bivariate probit parameter estimates of the exit and takeover Eqs. 9 and 10 are given in Table 8 in the

Appendix. The correlation of the disturbance terms (ρ) in the exit and takeover models is statistically significantly different from zero (though small at −0.15), suggesting the appropriateness of estimating the equations jointly. The results for the takeover equations are in the bottom half of the table. Both the productivity coefficient (α_1) and that on squared productivity (α_{10}) are significant and positive; the probability of takeover increases with the productivity of the SME (unless location effects intervene), in accordance with hypothesis 1. The dummies for both intermediate and periphery locations are statistically significant and negative ($\alpha_7 < 0$). SMEs located outside the 'core' (the omitted location) are less likely to be taken over. However, peripheral locations appear to have statistically significant positive interactions with productivity ($\alpha_2 > 0$).

Because of the non-linearity and interaction effects in the empirical model, interpretation of the coefficients is not always self-evident. Across the entire range of productivity, SMEs in the 'core' are most likely to be taken over, significantly more so than in the other locations. This result is consistent with a greater intensity of competition or more ready access to finance in the core—hypothesis 3. The intermediate region has the next highest probability, but Fig. 1 suggests that this might be matched or surpassed by SMEs in the periphery at the high end of the productivity distribution.

Hypothesis 2 postulates that SMEs registered as companies will have a greater chance of being taken over because they are obliged to provide more information, which is what the selection equation of Table 8 in the Appendix shows. Turning to the role of size in acquisition chances, larger SMEs generally have an increased probability of acquisition—also consistent with hypothesis 2.[15] Again in line with hypothesis 2 [assuming that age is a (positive) function of information on targets], age effects generally indicate higher chances of older SMEs being taken over. SMEs between 5 and 19 years old are most likely (0.21 % a year) to be acquired. These results (along with the 'entity' parameter) suggest that the lack of public information can possibly explain the lower takeover chances, offering a potential basis for policy recommendations.

Table 8 in the Appendix tabulates the estimated exit Eq. 10. That takeover stimulates an increased chance of an SME exiting is partly reflected in the statistically significant and positive coefficient of the takeover variable in the exit equation. However, interpretations of the effect of takeover must also include the interactions with location and productivity. Table 5 shows the predicted probability of SMEs exiting by location and takeover. The probabilities are derived from the results in Table 8 in the Appendix, using the sample averages with the exception of those for location, takeover and their interactions.

The positive marginal effect of takeover on exit is in harmony with hypothesis 4. At least some takeovers enable acquirers to take advantage of synergies with their existing assets. On the other hand, the lower marginal effect of takeover for SMEs from more peripheral locations on exit is inconsistent with hypothesis 5. This surprising result may be because acquisitions often serve a periphery market more effectively than could be done from the core.

Exits are measured just 1 year after takeover (i.e. 2006), but for the aggregate effect calculated below, exits are measured in 2007, which is consistent with the productivity equation. There is very little difference between the effects for 2006 and 2007.

The takeover effect includes the exit element when the coefficients are from the selection model (Table 9 in Appendix for the period 2004–2007, where takeovers are identified in 2005). The statistical significance of ρ with 99 % confidence in the selection models is to be expected in the presence of sample selection. Table 9 in the Appendix shows that productivity is affected by the takeover coefficient (γ_1) and that the interactions of takeover are affected by the (prior) level of productivity (RLP) (γ_3) and employment (γ_4). The location impact on post-acquisition productivity (γ_2) is statistically insignificant: periphery location is irrelevant to an the productivity of an SME after takeover.

The estimated coefficients and Eq. 12 suggest that takeovers increase productivity by 38 % for the average SME (contrary to hypothesis 6). However, this is a little misleading because the takeover analysis indicates that more productive and relatively larger

[15] However, at the top of the distribution, the chances of takeover fall, and the highest likelihood of acquisition is for firms with around 200 employees, i.e. a 2.5 % predicted probability. But even the largest SMEs have a higher predicted probability of takeover than micros (businesses with employment of less than ten).

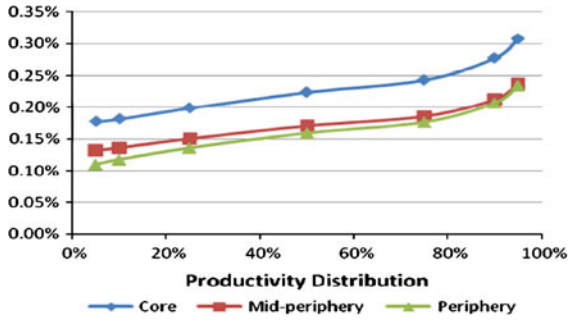

Fig. 1 Predicted probability of takeover by location and productivity. *Notes* Estimated at the sample averages from Eq. 9 and Table 8 in the Appendix

Table 5 Predicted probabilities and marginal effects of location and takeover on SME exit: bivariate probit

Location	Exit	
	Predicted probability given takeover (%)	Marginal effect of takeover (%)
Core	30.61	6.57
Intermediate	28.61	6.06
Periphery	26.18	3.36

Source ONS, authors' calculations, from Table 8 in Appendix. *Note* Estimated at the sample average

SMEs have a higher chance of takeover, both of which reduce the effect of takeover on productivity performance. Takeovers increase productivity for average-sized SMEs with a prior RLP of <1.9. Hypothesis 7 is supported: more productive acquired SMEs are more likely to be adversely affected by takeovers and suffer a deterioration of performance ($\gamma_3 < 0$), as if predatory large firms were 'intrapreneurship' hunting. For firms with a high relative productivity (>1.9 when taken at the average size), takeovers reduce performance. The tipping point beyond which takeover negatively impacts on productivity is lower for larger firms. For example, an SME with employment of 100 has a relative productivity tipping point of only 1.36. Above this relative labour productivity, takeovers reduce productivity for this size of SME; the acquired firms lose what ultimately made them high performers.

Hypothesis 8 is that the takeovers in the periphery are more detrimental to performance than those in the core ($\gamma_2 < 0$). As the location–takeover interactions are statistically insignificant, no location heterogeneity is found in the effect of takeovers upon productivity performance for the period 2004–2007. Hypothesis 8 must therefore be rejected.

Because of the significance of some of the interaction effects of takeover with the variables, such as productivity prior to takeover and size,[16] the coefficients from the above results are used to graph the effects of takeover on productivity by prior productivity in Fig. 2. The period 2004–2007 is shown[17] at the sample average for productivity. Figure 2 shows that the least productive SMEs experience the highest productivity increase due to being taken over and that the highest productivity firms achieved a much smaller rate of improvement.

6.1 The partial impact of takeovers on regional productivity gaps

Equation (8), from which the following results are obtained, excludes any productivity impact on the acquirers of SMEs. For the periphery, this productivity impact is excluded because the acquirers are assumed to be located in the core (outside the region), and for the other regions, it is excluded to provide a comparison with the periphery. Because there is proportionately more takeover activity in the core than in the periphery and because on average productivity increases after a takeover in all regions, the core gains more from this source than the periphery—in fact, an increase in productivity of almost half as much again (Table 6).

To reduce the error from the stochastic component of the takeover Eq. 9, the calculations assume that each acquired firm had a probability of takeover of one, and others a probability of zero. The direct impact of SME takeovers in 2005 was to raise the periphery SME sector's productivity by 0.3 % by 2007 but core SME sector's productivity by 0.42 % (Table 6). In all locations the positive direct takeover effects are diminished by the closure of productive acquisitions. Almost one-fifth of the core direct increase in productivity from takeovers is offset by the exit effect—but this does not take into account the offsetting (but here unmeasured) improvements in the acquiring businesses. For the intermediate region, exits after takeover

[16] The location interactions with takeovers are not statistically significant.

[17] The figures use the estimates from the ML selection model (with robust errors).

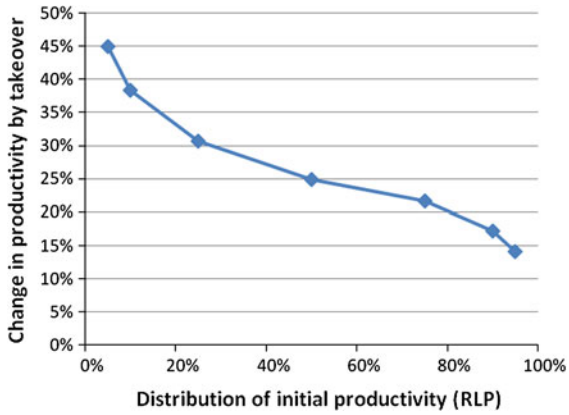

Fig. 2 Impact of small and medium-sized enterprise takeover in 2005 by prior productivity on productivity 2004–2007. *Source* Office of National Statistics, authors' calculations based on Table 9 in the Appendix. *Note* Size taken at the sample average (5.2). RLP Relative labour productivity

Table 6 Partial labour productivity impact in 2004–2007 of SME takeovers in 2005

Location/ method	SME direct productivity effect (%)	SME exit effect (%)	SME total productivity impact (%)
Periphery	0.30	0.056	0.248
Intermediate	0.33	0.121	0.211
Core	0.42	0.078	0.341
UK	0.36	0.099	0.257

Source ONS, authors' calculations using biprobit and selection models Tables 8 and 9 in Appendix parameters and Eq. 8

offset more than a third of the direct effect, suggesting major industrial restructuring in these regions. The intermediate region also has the lowest productivity effect of takeovers of the three regions, perhaps because their distinctive industrial structure provided fewest profit opportunities.

The most plausible explanations for the different experiences of core and periphery must be related to the wealth, density and productivity of the two areas. The higher density of population and business in the core may mean greater competition and/or agglomeration economies triggering more takeover activity. The greater wealth could provide more significant profit opportunities or capital—if information flows attenuate with distance—both of which would motivate acquisitions.

Although the core is the principal beneficiary of SME takeovers, SMEs account for a smaller proportion of (output and) employment there than in the periphery (Table 7). Consequently, the benefit to the regional economy is proportionately greater in the periphery (not taking into account gains to the acquirer). Indeed, the contribution to the regional productivity gap is only (0.127 − 0.116 =) 0.011 %. There is still a contribution, but the regional policy implications appear to be that SME takeover market imperfections in the periphery should be reduced in order to close the gap, rather than that acquisitions should be discouraged. With more takeover activity, productivity in the periphery would be higher.

The intermediate regions experience a smaller boost to the economy from takeovers in 2005 (0.093 %) than either the core or periphery (again not taking into account gains to acquirers based in this area). This lesser effect is primarily caused by the greater (weighted) takeover–exit effect there, perhaps in part due to proximity to the core. Nearness may make external takeovers by larger firms based in the core more likely in the intermediate regions if distance reduces information flow. If so, there could be a faster rate of moving the acquired assets to the core, at least for a few larger SMEs (that matter substantially because the takeover–exit effect is weighted by employment).

7 Concluding remarks

The present exercise has forged a link between the spatial analysis of the new economic geography and SME industrial policy, deriving an expression for the quantitative impact of takeovers on the periphery. An important contribution is the analysis of a new data set (BSD) of nearly all British firms that allows an unprecedentedly detailed study of SMEs in a spatial context, with particular attention to the market for SME control. Contrary to the experience of large companies (and to Q theory), highly productive SMEs are more likely to be taken over—although this effect is weaker if they are located in peripheral regions than in the core. Takeovers also increase the chances of an SME closing. The regional bias is the opposite of that originally hypothesised; in actual fact, takeovers in the core are more likely than in the periphery.

Takeovers raise productivity after acquisition—but by less for the most productive SMEs. This last result would be expected if acquiring firms attempt to compensate for a lack of internally generated

Table 7 Partial effect of SME takeovers in 2005 on economy-wide labour productivity in 2004–2007

Location	SME share of private sector employment (%)	Economy wide effect on productivity (%)
Periphery	46.9	0.116
Intermediate	44.1	0.093
Core	37.3	0.127
UK	42.5	0.109

Source ONS, authors' calculations from Table 6

innovation, management or other assets that they could strip out of the target SMEs. It is in line with a resource-based perspective on takeovers and knowledge transfer, where closure of the target is necessary to relocate and integrate the newly acquired assets with the purchaser. For those businesses that do not exit after takeover, there is no distinctive regional effect on post-acquisition productivity; SME targets in the core and periphery perform equally well on average after acquisition.

Another finding is that the greater information provision of registered companies markedly increases their chances of acquisition. This is in line with the lower propensities to be taken over in the periphery being due to poorer information in the core about periphery SMEs. Consistent with the Baldwin and Forslid (2000) NEG model, policies that remedy such deficiencies would therefore encourage the dispersion of economic activity. In the present case, a policy of improving the information available about SME potential targets in the periphery, as Allinson et al. (2007) recommend, so that takeover rates there more closely match those in the core, would boost productivity.

A feature not captured in the foregoing analysis is to what bought-out owners of SMEs turn their attention subsequently. If they become serial entrepreneurs they may enhance the supply of high-performing, productive small firms. 'Successful' exits may provide entrepreneurs with the finance for other start-ups. It is not possible to identify whether firms that are sold directly trigger a start-up in the same region, and the scale of repeat entrepreneurship from takeovers is not generally known.[18] However, to the extent that serial entrepreneurship is significant, it reinforces the beneficial regional impact found for SME takeovers.

[18] Only limited research currently exists on this topic, see Stam et al. (2008).

The focus of this assessment of the regional impact of SME takeovers has been productivity. If a post-takeover productivity increase was achieved primarily by shedding labour, and the workers remained without employment in the region, it might be contended that the welfare implications of SME takeovers were rather different from that advanced here. In the case of very large firms cutting their workforces, there could be a likelihood of skill mismatches that might contribute to higher structural unemployment. However, the concern here is with relatively small individual employers. Assuming the level of regional demand does not change, it is reasonable to expect displaced workers to find other jobs quite promptly; an SME reducing employment is unlikely even minutely to affect equilibrium unemployment in a region. At least with this neoclassical assumption, the effect on regional productivity, defined as output per member of the actual and potential labour force, is not in doubt. A more definite shortcoming of the productivity measure is that it does not take into account potential or future output and productivity, which may mean that some research-orientated SMEs, perhaps generating patents but little or no current revenue, are not taken into account in the analysis.

In another respect, the impact of SME takeovers estimated is a partial one, not taking into account the gains to the acquiring firm if it absorbs or closes the acquisition. This approach has the advantage of sharpening the overarching hypothesis that the periphery loses out, for it assumes that acquiring firms are all located outside the region. Further research on the benefits to acquiring firms and their locations is highly desirable to provide more complete estimates of the payoffs to takeovers. Ignoring any consequences for the acquiring firm, the effect of SME takeovers in 2005 was to raise labour productivity in the UK by 0.109 % over the years 2004–2007. Perhaps surprisingly, this partial impact was slightly larger in the core region, at 0.127 %, than in the periphery (0.116 %). The driver of the difference is the much greater chances of takeover in the core.

A qualification to this quantification is that it only refers to 1 year's experience. The rate of takeovers of publicly quoted firms fluctuates widely from year to year and so the same may be expected of SMEs. The period considered in our study was one when the stock market was rising and large

firm finance was cheap. As such, SME takeover activity and effects might therefore be expected to be stronger than when the economy is less buoyant.

Regional productivity gaps may be widened by the operation of the SME takeover market more than by the calculated small core–periphery productivity gain difference. If all, or most, acquirers are located in the core, then this will be an unmeasured reason for an increasing differential. But the key finding that the core gains more from a process which should be common to the periphery as well, and is not dependent on the location of large firm headquarters, carries a lesson about the gap. Rather than regarding takeovers as harmful to periphery regions, policy-makers should consider ways of improving the operation of this market for SMEs in these places.

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Appendix A

Appropriate weights for averaging SME's labour productivity

The appropriateness of employment weights with labour productivity can be shown below. There are two firms each with employment (e) and output (q).

$$P = Q/E,$$

where $q_1 + q_2 = Q, e_1 + e_2 = E$ and $p_I = q_I/e_I$

$$\begin{aligned} Q/E &= p_1 * (e_1/(e_1+e_2)) + p_2 * (e_2/(e_1+e_2)) \\ &= (q_1/e_1) * (e_1/(e_1+e_2)) + (q_2/e_2) \\ &\quad * (e_2/(e_1+e_2)) \\ &= (q_1/(e_1+e_2)) + (q_2/(e_1+e_2)) \\ &= (q_1+q_2)/(e_1+e_2) \end{aligned}$$

The inappropriateness of output weights can also be shown;

$$\begin{aligned} P &= Q/E \ / \\ &= (q_1/e_1) * (q_1/(q_1+q_2)) + (q_2/e_2) \\ &\quad * (q_2/(q_1+q_2)) \\ &= (1/q) * \left(\left(q_1^2/e_1\right) + \left(q_2^2/e_2\right)\right) \end{aligned}$$

Given that output weights to productivity do not aggregate appropriately, we recommend using only employment weights when labour productivity is used.

Appendix B

Table 8 Bivariate probit of exit and takeover 2004–2006 (takeover in 2005)

Variable	Coefficient	Marginal effect	Mean value
Dependent variable exit			0.2317
Takeover	0.6727***	0.2397	0.0066
Ln(RLP)	−0.0533***	−0.0158	−0.53532
Ln(RLP)^2	0.0051***	0.0015	1.23034
Age 2–4 years	0.0417***	0.0124	0.247852
Age 5–9 years	−0.1927***	−0.0546	0.224248
Age 10–19 years	−0.4761***	−0.1265	0.236512
Age 20+ years	−0.6451***	−0.1569	0.158742
Ln(local unit)	−0.1562***	−0.0462	0.022771
Ln(local unit)^2	0.0495***	0.0146	0.027224
Employment	−0.0096***	−0.0028	5.18
Employment^2	0.0001***	1.5E-05	220.2
Takeover * employment	−0.0012***	−0.0004	0.115591
Employment * ln(RLP)	0.0005***	0.0001	−2.6012
Company	−0.1353***	−0.0400	0.51009
Partnership	−0.0771***	−0.0223	0.177961
Mid-periphery	−0.0481***	−0.0142	0.425805
Periphery	−0.0364***	−0.0107	0.246611
Mid-periphery * ln(RLP)	0.0049**	0.0014	−0.23745
Periphery * ln(RLP)	0.0088***	0.0026	−0.13971
Mid-periphery * takeover	0.0173	0.0051	0.002365
Periphery * takeover	−0.0738**	−0.0212	0.001296
Takeover * ln(RLP)	−0.0426***	−0.0126	−0.00225
Takeover * periphery * ln(RLP)	0.0092	0.0027	−0.00049
Takeover * mid-periphery * ln(RLP)	0.0252	0.0074	−0.00096
Industry controls	Yes		
Predicted probability (exit = 1)	0.2194		
Dependent variable takeover			0.0066
Ln(RLP)	0.0918***	5.4E-04	−0.5353
Ln(RLP)^2	0.0198***	1.2E-04	1.2303
Ln(local unit)	−0.1478***	−8.7E-04	0.0228
Employment	0.0424***	0.00025	5.1787
Employment^2	−0.0007***	−3.92E-06	220.2
Employment^3	3.96E-06***	2.34E-08	27284.8
Employment^4	−7.84E-09***	−4.63E-11	4.5E + 06
Age 2–4	0.1109***	7.1E-04	0.2479
Age 5–9	0.1647***	1.1E-03	0.2242
Age 10–19	0.1674***	1.1E-03	0.2365
20+ years	0.1184***	7.9E-04	0.1587
Company	0.9655***	0.007218	0.5101
Partnership	−0.0689**	−3.83E-04	0.1780
Mid-periphery	−0.0877***	−5.10E-04	0.4258
Periphery	−0.1035***	−5.69E-04	0.2466
Mid-periphery * ln(RLP)	0.0025	1.49E-05	−0.2375
Periphery * ln(RLP)	0.0193**	1.14E-04	−0.1397
Industry controls	Yes		
Predicted probability (takeover = 1)	0.0019		
N	1,897,288		
ρ	−0.1514***		

Note Constants not reported. Marginal effects estimated at sample average. *Source*: ONS, authors' calculations

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

RLP Relative labour productivity

Appendix C

Table 9 DiD productivity (2004–2007) regressions

Regression model	OLS with (robust SE)	ML selection model (robust SE)
Dependent variable	$LnLP_{07} - lnLP_{04}$	
$Takeover_{05}$	0.120***	0.218***
$Ln(RLP)_{04}$	−0.284***	−0.320***
$Ln(local\ unit)_{04}$	−0.063***	−0.093***
$Employment_{04}$	0.004***	0.003***
$Takeover_{05}$ * $employment_{04}$	−0.001***	−0.001***
Age 2–4	0.184***	0.174***
Age 5–9	0.150***	0.037***
Age 10–19	0.104***	−0.103***
Age 20 + years	0.069***	−0.188***
$Company_{04}$	0.058***	0.077***
$Partnership_{04}$	−0.013***	−0.023***
$Mid\text{-}periphery_{04}$	−0.017***	−0.041***
$Periphery_{04}$	−0.009***	−0.030***
Mid-periphery * $takeover_{05}$	−0.025	−0.027
Periphery * $takeover_{05}$	−0.012	−0.043
$Takeover_{05}$ * ln(RLP)	−0.103***	−0.103***
Industry controls	Yes	Yes
N	1,327,404	1,327,404
R^2	0.11	
Selection equation	Survive 2004–2007	
Age 2–4 years	−0.051***	
Age 5–9 years	0.143***	
Age 10–19 years	0.377***	
Age 20+ years	0.508***	
$Takeover_{05}$	−0.219***	
$Employment_{04}$	0.014***	
$Employment_{04}^2$	−7.27E-05***	
$Takeover_{05}$ * $employment_{04}$	−2.58E-04	
$Ln(local\ unit)_{04}^2$	−0.048***	
$Ln(local\ unit)_{04}$	0.109***	
$Ln(RLP)_{04}$	0.081***	
$Ln(RLP)_{04}^2$	0.032***	
Ln(RLP) * $employment_{04}$	−0.001***	
$Mid\text{-}periphery_{04}$	0.041***	
$Periphery_{04}$	0.020***	
Mid-periphery * $takeover_{05}$	−0.017	
Periphery * $takeover_{05}$	0.067**	
Takeover05 * Ln(RLP)	0.008	
Mid-periphery * Ln(RLP)	0.013***	
Periphery * Ln(RLP)	0.013***	
Industry controls	Yes	
N	1,897,288	
ρ	−0.765***	

Note Constants not reported. Number of observation in productivity equation reduced by exits over the period. *Source* ONS, authors' calculations

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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