



# University of Essex

Department of Economics

## Discussion Paper Series

No. 693 November 2010

### A Portrait of Firm Expansion and Contraction Channels

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# A Portrait of Firm Expansion and Contraction Channels\*

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November 2010

## Abstract

We present a novel set of stylised facts on forms of firm expansion and contraction, using unique business register data for the United Kingdom between 1997 and 2005. We distinguish between adjustments of employment and turnover at existing establishments, expansions and contractions taking place via greenfield investments and disinvestments, and via acquisitions and sell-offs. We document the relative importance of these three channels and how firms choose between them. We interpret our findings in the light of existing theories of firm dynamics, and propose directions for future theoretical developments.

KEY WORDS: Adjustment channels, Mergers and Acquisitions, Greenfield Investment, Investment

JEL CLASSIFICATION: E22, G31, G32, G33, L25

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# 1 Introduction

Firms constantly adapt to changes in their market environment through changes in the scale and scope of their operations. The magnitude and consequences of the resulting micro-level adjustments have been extensively documented in the literature (see Davis et al., 2006, for a recent overview). Building on these empirical facts, a number of theoretical models have been developed over the past decades which have significantly improved our understanding of the growth processes of individual firms and how these map into aggregates such as industry-level employment, productivity or firm size distributions (e.g., Jovanovic, 1982; Hopenhayn, 1992; Hopenhayn and Rogerson, 1993; Asplund and Nocke, 2006).

As we argue in this paper, however, only little attention has been paid to the *channels* through which firm growth and contractions take place. For example, most models of firm dynamics focus on the overall change in the employment or turnover of firms, and are silent about how these changes are achieved. In practice, there are three principal ways in which firms can expand or contract. First, they can adjust employment or output at existing production facilities while continuing to use them ('internal adjustment'). Second, contracting firms can shut down establishments or divisions, and expanding firms can decide to open up new ones ('greenfield investment/disinvestment'). Third, firms can use the market for corporate control to buy or sell parts or the entirety of their operations ('mergers and acquisitions', M&As).

In this paper, we use unique business register data for the United Kingdom to present a novel set of stylised facts on the characteristics and relative importance of these three channels and on how firms choose between them. Among other facts, we show that all three channels are quantitatively important in explaining aggregate firm growth. While external forms of adjustment (greenfield and M&As) were used for only about 1% of expansions and contractions in the UK between 1997 and 2005, they were on average 10-40 times as large as internal adjustments, accounting for almost 25% of turnover and employment changes at the firm level (and substantially more in some industrial sectors). We also find that firms choose between the available adjustment channels in clearly defined patterns, with basic variables such as initial firm size having substantial explanatory power in predicting a firm's choice. For example, larger firms tend to rely more on external forms of adjustment, and in particular on greenfield investment, when expanding their operations. We also show that many firms use extensions and contractions simultaneously, and that this simultaneous use is again increasing in firm size.

We hope that these facts will help to improve our understanding of firm-level growth processes by shedding light on the exact channels through which firms expand or contract. In our view, incorporating different channels of size adjustment into existing models of firm dynamics would be highly desirable. Not only would such models paint a much richer picture of the processes underlying firm growth and contractions; they might also be helpful in understanding the consequences of policy interventions influencing firms' choices of adjustment channels (for example, a more restrictive antitrust policy).

Our paper relates to a number of contributions in the literature. Papers in the corporate finance literature such as Maksimovic and Phillips (2001) and Schoar (2002) have used establishment-level data to document the prevalence and consequences of M&As and asset

sales. However, they do not look at internal adjustment and greenfield investment, and thus cannot compare differences between the adjustment forms.

In industrial economics, a large number of studies have analysed the role of plant-level adjustments in explaining aggregate productivity growth (e.g., Disney et al., 2003; Foster et al., 2006). Because of their explicit and intentional focus on *plants*, however, the resulting findings are only of limited value in understanding the expansion and contraction decisions of *firms*.

Most closely related to the present paper are the contributions by Jovanovic and Rousseau (2002) and Warusawitharana (2008). These authors propose models of firm dynamics which incorporate both internal adjustment and M&As, and present empirical evidence to support them. However, they do not provide a separate analysis of greenfield investment, implicitly treating it as part of internal adjustments. Given the more descriptive nature of the present paper, we are also able to analyse our data in much more detail, and to represent a larger and more complex set of stylised facts than these authors. A final important difference is that we use much more comprehensive data, covering 99% of employment and turnover in the United Kingdom, rather than focusing exclusively on publicly traded firms. We think that this broader focus is essential, given that our results show that the relative importance of the three adjustment channels varies dramatically with firm size.

The rest of the paper is structured as follows. Section 2 describes our data and methodology in more detail. Section 3 presents evidence on the basic characteristics and quantitative importance of the three adjustment channels; it also documents how UK firms choose between and combine these channels. Section 4 concludes.

## 2 Description of Data and Methodology

Our principal datasource is the Business Structure Database (BSD) maintained by the Office for National Statistics (ONS). The BSD is constructed from annual snapshots of the UK's business register, the Interdepartmental Business Register (IDBR). For each year between 1997 and 2005, it contains the universe of British companies which were either registered for Value Added Tax (VAT) purposes or operated a Pay as You Earn (PAYE) income tax scheme. In 2005 the BSD was comprised of 2.2 million live enterprises, representing an estimated 99% of economic activity in terms of employment and turnover (ONS, 2006).

The BSD contains information on the employment, turnover and ownership structure of firms, plants and business sites that make up the British economy using three aggregation categories: the enterprise, enterprise group and local unit. According to the official definition (ONS, 2006), an enterprise “is 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, especially for the allocation of its current resources”. An enterprise group is “an association of enterprises bound together by legal and/or financial links”. Finally, a local unit is “an enterprise or part thereof (e.g., a workshop, factory, warehouse or office) situated in a geographically identified place”.

Upon entry into the IDBR, each local unit, enterprise and enterprise group is allocated a unique reference number which remains with the unit for as long as it stays on the register.

Furthermore, the ONS maintains a list of local units for each enterprise and combines enterprises to form enterprise groups by using information from Dun and Bradstreet, supplemented by the VAT system (ONS, 2006). Thus, every local unit also has an enterprise reference and every enterprise an enterprise group reference number.

Taken together, these identifiers allow the analysis of demographic events over time. We have developed an algorithm to identify these events, following a general typology provided by Eurostat (European Commission, 2003). In our methodology, the most basic event is a change in employment or turnover at a continuing enterprise (“internal adjustment”). This is easily observed from the entries of two adjacent years for the same enterprise. If an enterprise identifier disappears from the data, we code this as an enterprise exit (“greenfield disinvestment”). Likewise, the appearance of a new identifier is coded as a firm entry (“greenfield investment”). Finally, the combination of enterprise and enterprise group references allows for the analysis of ownership changes. For example, if enterprise group A buys enterprise 1 from enterprise group B, the enterprise reference number of enterprise 1 would remain unchanged but its enterprise group identifier would change from A to B. Of course, an enterprise group can carry out several or all of these activities in a given year. For example, it might expand employment and turnover at one of its existing enterprises, create a new enterprise via greenfield investment and buy another one from another enterprise group (“M&A expansion”). Table 1 provides a summary of these definitions.<sup>1</sup>

Our methodology can be implemented at different levels of aggregation. In this paper, we take the enterprise group as the decision-making unit and analyse how it changes turnover and employment through adjustments at its existing enterprises and the acquisition/sale or creation/closure of new ones. Given that many of the expansion and contraction decisions we are interested in here are of first-order importance to a firm, it seems likely that they are made centrally and at the highest level of a firm.<sup>2</sup>

Another reason for working at the enterprise group/enterprise level (rather than at the enterprise group/local unit or enterprise/local unit level) is that there are a number of important data issues related to the local unit level of the BSD. First, the local unit structure of enterprises is updated much less frequently than the links between enterprise groups and enterprises, in particular for smaller enterprises.<sup>3</sup> This makes an implementation of the above methodology problematic, in particular when looking at year-to-year changes in ownership structure, as we will do below. Second, most enterprises with multiple local units only report information on turnover and employment at the enterprise level, preventing the implementation of our

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<sup>1</sup>Note that we are not using the indicators of demographic events contained in the BSD itself. While these are also based on the typology outlined in European Commission (2003), there are a large number of inconsistencies in the preliminary version available so far.

<sup>2</sup>This is particularly true for the two external forms of adjustment, greenfield investment and M&As. While enterprises are defined above as “benefiting from a certain degree of autonomy in decision-making in the allocation of current resources”, this definition does not include strategic investment decisions such as the acquisition or the opening up of new plants or operations.

<sup>3</sup>See ONS (2001, 2003) and Jones (2000, p.51). The local unit structure of enterprises is updated through the Annual Register Inquiry (ARI) which samples large enterprises (100 or more employees before 2003, 50 in later years) every year but only one in four of medium-sized enterprises (20-99 and 20-49 employees before and after 2003, respectively). For smaller enterprises, updating takes place on an ad-hoc basis only. In contrast, the ownership information linking the enterprise group and the enterprise level is updated at least once a year (see Dun & Bradstreet, 2001; ONS, 2006).

methodology at the local unit level for these enterprises (see Criscuolo et al., 2003). Finally, local unit identifiers are considered by the ONS to be less stable over time than enterprise identifiers (ONS, 2006). That is, local units sometimes change their identifiers even though no corporate event has occurred, creating problems of false exit in our methodology. In view of these problems, we have abandoned the use of local unit data in our analysis, and focus on the enterprise group/enterprise level of analysis for the rest of this paper. Given this choice, we will use the expressions “enterprise group” and “firm”, and “enterprise” and “establishment” interchangeably in the following.

A second important issue concerns the choice of variable to measure enterprise group size changes in our analysis. At the enterprise level, the BSD contains employment and turnover information (from PAYE and VAT records, respectively). At first glance, employment might seem to be a better indicator of enterprise group size changes as the number of employees is more directly under the control of a firm. Again, however, data quality makes us opt for turnover for the first part of the paper, in which we work with the BSD only. This is because employment information for smaller enterprises in the BSD is updated less regularly than turnover information.<sup>4</sup> Using employment data as a size change indicator would thus lead to an underestimate of the importance of internal adjustment relative to external adjustment.<sup>56</sup>

### 3 Facts about Firm-Level Adjustment Forms

We start our presentation of stylised facts with an overview of the importance of the different adjustment channels in total firm growth. In line with existing work (e.g., Warusawitharana, 2008) we focus on continuing firms, i.e., firms which existed in the current period, will not exit in their entirety in the next period, and which change turnover between periods.

A useful starting point is to decompose the total change in turnover of continuing firms into gross expansions and gross contractions:

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<sup>4</sup>See Criscuolo et al. (2003) and ONS (2001) for details. While turnover is updated continuously from VAT sources, employment is frozen at the point at which an enterprise arrives on the IDBR. Afterwards, it is only updated through the ARI which mainly covers larger enterprises (see footnote 3). ONS (2001) reports that in the year 2000, enterprises accounting for close to 10% of employment had not had their employment information updated since the Census of Employment in 1993.

<sup>5</sup>In practice, this issue does not seem to matter much. As we demonstrate in unreported results (available from the authors upon request), all of the qualitative results in this paper go through when using employment rather than turnover information.

<sup>6</sup>A final data issue relates to a change in enterprise group identifiers between 1998 and 1999 for a substantial number of firms. This change shows up in our methodology as a large increase in the number of external corporate events. Accordingly, we exclude the year 1998-1999 from our analysis (although results are robust to including it). In the following, when we refer to the period 1997 to 2005, we thus mean the seven one-year periods starting with 1997/1998 and ending with 2004/2005, excluding 1998/1999.

$$\begin{aligned}
& \underbrace{\Delta y_{wt} = y_{wt} - y_{wt-1}}_{\text{net expansion}} \tag{1} \\
& = \underbrace{\left( \sum_{e \in C^+} \Delta y_{et} + \sum_{e \in N} y_{et} + \sum_{e \in A} y_{et} \right)}_{\text{gross expansion}} - \underbrace{\left( \sum_{e \in C^-} \Delta y_{et} + \sum_{e \in X} y_{et-1} + \sum_{e \in S} y_{et-1} \right)}_{\text{gross contraction}}
\end{aligned}$$

where  $y$  denotes turnover and all summations are over the set of enterprises ( $e$ ) belonging to enterprise group  $w$  in periods  $t$  or  $t - 1$ , respectively. The first three terms on the right-hand side of (1) capture the contribution of the three channels through which enterprise groups can expand: internal expansion of already existing and continuing enterprises ( $C^+$ ), the creation of new enterprises (greenfield investment,  $N$ ) and the acquisition of existing enterprises from other enterprise groups ( $A$ ). The next three terms of (1) capture the contributions of these three channels on the contraction side: internal contraction ( $C^-$ ), and the closure or sell-offs of existing enterprises ( $X$  and  $S$ , respectively).

We can also express these figures as a fraction of the overall total net expansion or contraction:

$$1 = \underbrace{\left( \sum_{e \in C^+} \frac{\Delta y_{et}}{\Delta y_{wt}} + \sum_{e \in N} \frac{y_{et}}{\Delta y_{wt}} + \sum_{e \in A} \frac{y_{et}}{\Delta y_{wt}} \right)}_{\text{gross expansion}} - \underbrace{\left( \sum_{e \in C^-} \frac{\Delta y_{et}}{\Delta y_{wt}} + \sum_{e \in X} \frac{y_{et-1}}{\Delta y_{wt}} + \sum_{e \in S} \frac{y_{et-1}}{\Delta y_{wt}} \right)}_{\text{gross contraction}}$$

This shows that we can think of the net expansion or contraction of a firm as the sum of individual (gross) expansions and contractions. In the following, we will first examine gross expansions and contractions separately, and then see how firms combine them into overall (net) turnover changes.

### 3.1 Gross Expansions and Contractions

**Frequency, Size and Aggregate Importance.** If we look at any given gross expansion or contraction, the first question that arises is how frequently the various channels are used. Table 2 displays the fraction of all adjustments which take place through each of the three channels. We show results for the entire UK economy, as well as separately for 18 major industrial sectors. Note that firms can use several channels at the same time so that the percentages do not have to add up to 100%.

It is evident from Table 2 that M&As and greenfield investment are rare events. On average between 1997 and 2005, these two channels were used in only about 1% of turnover expansions and contractions in the UK economy, with the vast majority of both expansion and contractions occurring via internal adjustments. However, the importance of external adjustment varies substantially across sectors, ranging from less than 0.1% in agriculture to close to 40% in

Electricity, Gas and Water Supply (henceforth, “utilities”). Generally speaking, sectors with larger firms tend to rely more on the two external adjustment forms.<sup>7</sup> This suggests that there might be economies of scale in the use of external adjustment, with larger firms being better positioned to carry out acquisitions and greenfield investments or disinvestments.

However, Table 3 shows that, when they take place, M&As and greenfield investments are major events.<sup>8</sup> The average M&A expansion is almost 40 times bigger than the average internal expansion, and the average M&A contraction is 30 times larger than internal contractions. Greenfield investments are smaller than M&A expansions but still around 12 times bigger than the average internal expansion. Greenfield disinvestments, in contrast, are of comparable size to M&As at over 30 times the size of internal contractions. Again, there is substantial sectoral variation in these average size differences. The general pattern is somewhat less clear this time, but it seems that the sectors which use M&As and greenfield investment relatively infrequently tend to undertake relatively large external adjustments (relative to the size of internal adjustments) – the correlation between the ratio of average external to internal adjustment size by sector and the frequency of usage of external adjustment is around -30% for both expansions and contractions. This is consistent with the presence of fixed cost associated with the use of external adjustment as argued, for example, by the “*Q*-theory of mergers” (Jovanovic and Rousseau, 2002). Sectors with high fixed costs will rely less frequently on M&As and greenfield activity, but will undertake larger expansions or contractions when they do.

Table 3 implies that despite their infrequent occurrence, greenfield investment and M&A still account for a large fraction of overall turnover adjustments. Table 4 displays the exact numbers. As seen, the two forms together account for 18% of economy-wide turnover expansions and for 26% of contractions. M&As account for a larger share of overall adjustments – around 15% on both the expansion and the contraction side of adjustment. Greenfield transactions, in contrast, are significantly more important in explaining contractions: 11% of aggregate of turnover reductions are achieved via firm/establishment closures while the corresponding number on the expansion side is just 2%. Again, there is substantial sectoral variation in these figures. The external adjustment forms account for over 25% of aggregate turnover expansions in sectors such as manufacturing, utilities and mining, but for less than 3% in agriculture. On the contraction side, these variations are even larger, ranging from around 4% in agriculture to over 50% in mining and utilities.

**Firm-Level Determinants of the Choice of Adjustment Channel.** How do firms choose between the three adjustment forms? We focus here on two key firm-level variables which have figured prominently in the existing theoretical literature – firm size and the size of a given expansion or contraction (e.g., Jovanovic and Rousseau, 2002; Warusawitharana, 2008).<sup>9</sup>

Tables 5 and 6 provide some initial evidence on how these two variables correlate with the

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<sup>7</sup>In unreported results, we show that the cross-sectional correlation between employment per enterprise and the fraction of total adjustment accounted for by M&As and greenfield investment exceeds +70% for both expansions and contractions.

<sup>8</sup>Here and in the following, all turnover data are in constant 1995 prices, using 2-digit sectoral output price deflators from the EUKLEMS project.

<sup>9</sup>Similarly, the importance of size for individual firms’ growth as well as for the firm size distribution have been documented empirically (e.g., Cabral and Mata, 2003).



choice of adjustment channel. Since the qualitative patterns are very similar across the major sectors analysed earlier, we only present results for the entire UK economy (detailed by-sector results are available from the authors upon request).

Panels A and B of Table 5 show that internal adjustment accounts for close to 100% of the overall expansions and contractions of the bottom 50% of firms in terms of turnover (i.e., those firms with turnover equal to or less than £152,000 in 1995 prices). However, the importance of the two external adjustment channels increases steadily with firm size. For the largest 0.1% of enterprise groups (corresponding to a turnover of more than approximately £150 million), M&As and greenfield investment account for 16% and 13% of overall turnover expansions, respectively (17% and 14% for turnover contractions).

A similar pattern arises when we look at the size of a given turnover adjustment (Table 6). The smallest 50% of expansions and contractions (those changing turnover by less than approximately £27,000) are almost exclusively carried out via internal adjustment. As adjustment size increases, however, M&As and greenfield investment become increasingly more important. For the largest 0.1% of expansions (those expanding turnover by at least £60 million), around 18% of the overall size increase is achieved via M&As, and 4% via greenfield investment. For the largest 0.1% of contractions (those reducing turnover by more than £75 million), M&A accounts for 21% and greenfield disinvestment for 14%.

One shortcoming of the purely descriptive approach in Tables 5 and 6 is that one cannot analyse multivariate correlations in such a setting. In particular, it is likely that large firms carry out large expansions and contractions. Thus, it is unclear whether the correlations displayed in Tables 5 and 6 are driven by firm size, adjustment size, or a combination of both. Also, we showed above that external adjustment forms are more common in sectors with larger firms (which also might undertake larger turnover adjustments). The univariate relations from Tables 5 and 6 might then simply pick sectoral differences in M&A and greenfield activity caused by other sector-wide determinants, such as differences in market concentration.

To address these issues, we employ multivariate fractional regression methods (see Papke and Wooldridge, 1996; Mullahy and Robert, 2008). Denoting the fraction of a gross expansion or contraction carried out by firm  $i$  through adjustment form  $m$  by  $y_{im}$ , we assume that:

$$E(y_{im}|x_i) = \frac{\exp(x_i\alpha_m)}{\sum_{j=1}^M \exp(x_i\alpha_j)} = \frac{\exp(x_i\alpha_m)}{1 + \sum_{j=1}^{M-1} \exp(x_i\alpha_j)} \quad (2)$$

where matrix  $x_i$  contains the independent variables (firm size, expansion size) and  $\alpha_j$  the corresponding regression coefficients (note the normalization  $\alpha_M = 0$ ). The advantage of the multinomial functional form embodied in (2) is that it imposes two conditions which capture key features of our data. First,  $E(y_{im}|x_i) \in [0, 1]$  for all  $i$  and  $m$ ; and secondly,  $\sum_{m=1}^M E(y_{im}|x_i) = 1$  for all  $i$ .<sup>10</sup>

<sup>10</sup>Estimation of the parameters in (2) is carried out via pseudo-maximum-likelihood methods. A desirable feature of the multivariate fractional logit model is that the parameters  $\alpha_j$  will be consistently estimated even when  $y_{im}$  takes on values at the extremes of the bounded range they occupy (i.e.,  $y = 0$  or  $y = 1$ , as is frequently the case in our data). All that is required is that the conditional mean  $E(y_{im}|x_i)$  is correctly specified (see Papke and Wooldridge, 1996, for the univariate case; Mullahy and Robert, 2008, provide an extension to the multivariate case analysed here).

Table 7 presents the results for our full sample.<sup>11</sup> In all specifications, we control for year and industry fixed effects to reduce problems arising from omitted sector characteristics, as discussed above. We have chosen internal adjustment as the excluded category so that coefficient estimates should be interpreted as changes relative to internal expansions or contractions. Looking at expansions first, internal adjustment clearly declines as a fraction of overall adjustment as firm size and the size of the planned expansion increase. Secondly, initial firm size and expansion size have a very different impact on M&As and greenfield. While both forms of external adjustment increase in importance with firm and expansion size, the latter variable has a much stronger impact on M&As and the former on greenfield investment. It thus seems that firms undertaking larger expansions will increasingly rely on M&As. A similar pattern seems to hold on the contraction side, although the differences between M&As and greenfield investment are much less pronounced here.<sup>12</sup>

The finding that firms rely more on M&As for large expansions is consistent with previous empirical results in Jovanovic and Rousseau (2002) and Warusawitharana (2008), and lends support to the theoretical mechanisms proposed in these papers. Note, however, that at least on the expansion side, there also seem to be clear-cut empirical regularities on how firms choose between the two external adjustment forms. To the best of our knowledge, no theoretical mechanism has been proposed to date to explain these patterns.

### 3.2 Net Expansions and Contractions

We now turn to an analysis of how firms combine gross expansions and contractions into overall size adjustments. For example, an enterprise group might use expansions and contractions in parallel because it is expanding some of its operations and contracting others. In this subsection, we investigate how frequent such parallel expansions and contractions are, and through which adjustment forms they are predominantly carried out. We start by restating decomposition (1) for convenience:

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<sup>11</sup>Again, similar patterns also appeared in a sector-by-sector analysis which we omit here for the sake of brevity. We have also experimented with alternative estimation techniques such as Tobit or Poisson, which also allow taking into account the large number of zeros in our data (as said, M&As and greenfield investment are relatively rare on average and the corresponding fractions thus often equal to zero). Again, results were qualitatively similar to the ones discussed here.

<sup>12</sup>In unreported results, we restricted the sample to external expansions/contractions only, in order to compare the relative importance of greenfield investment and M&As more directly. Consistent with the results reported here, firm size had a negative and significant impact on the fraction of expansion carried out through M&As, and expansion size had a significantly positive impact. The same pattern appeared for contractions but the differences between the two external adjustment forms were economically negligible and only statistically significant for firm size.

$$\begin{aligned}
\underbrace{1}_{\text{net expansion}} &= \underbrace{\left( \sum_{e \in C^+} \frac{\Delta y_{et}}{\Delta y_{wt}} + \sum_{e \in N} \frac{y_{et}}{\Delta y_{wt}} + \sum_{e \in A} \frac{y_{et}}{\Delta y_{wt}} \right)}_{\text{gross expansion}} \\
&\quad - \underbrace{\left( \sum_{e \in C^-} \frac{\Delta y_{et}}{\Delta y_{wt}} + \sum_{e \in X} \frac{y_{et-1}}{\Delta y_{wt}} + \sum_{e \in S} \frac{y_{et} - 1}{\Delta y_{wt}} \right)}_{\text{gross contraction}}
\end{aligned}$$

We look at averages across firms, separately analysing firms which expand or contract on net. For each of these two groups, Table 8 reports the average fraction of each of the three expansion and contraction channels in the total net turnover expansion or contraction (that is, six fractions which add up to 100% or -100%, depending on whether we have a net expansion or contraction). Similar to before, we further break down these figures by firm size.

Table 8 reveals some interesting patterns in the simultaneous use of expansions and adjustments. The bottom 50% of firms in terms of turnover very rarely expand and contract at the same time. Not surprisingly given our earlier results, over 99% of their adjustments are made internally.<sup>13</sup> As we move to larger and larger firms, the simultaneous use of expansions and contractions increases substantially. Indeed, contracting enterprise groups which are among the top 0.1% of firms in terms of turnover undertake internal expansions which are on average almost as large as their internal contractions carried out at the same time. Likewise, expanding enterprise groups which are among the largest 0.1% of firms actually shed more workers through enterprise closures than they add through enterprise openings. Clearly, for the larger UK firms, the simultaneous use of all channels of expansion and contraction is a frequent phenomenon. Given that these firms account for the majority of turnover and employment in most economies, it would seem desirable to integrate simultaneous expansions and contractions into existing models of firm dynamics.

## 4 Conclusions

We presented a novel set of stylised facts on forms of firm expansion and contraction, using unique business register data for the United Kingdom between 1997 and 2005. In contrast to contributions in the existing literature, our data enabled us to distinguish between all three principal adjustment channels firms can use to expand or contract the scale and scope of their operations: changes of employment and turnover at existing establishments (“internal adjustment”), greenfield investments and disinvestment, and acquisitions and sell-offs.

We documented the relative importance of these three channels, their main characteristics in terms of occurrence and transaction size, and how firms choose between them. While some of

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<sup>13</sup>Note that Table 8 is not directly comparable to Table 5. Table 5 uses individual gross expansions and contractions as the underlying unit, whereas Table 8 uses total net expansions/contractions of enterprise groups. The averages presented in the tables are thus taken across different subpopulations.

our results confirmed findings in the existing literature, we also documented a number of facts which are entirely novel. We hope that our findings will be helpful in advancing research in areas such as theories of firm dynamics, or the causes and consequences of mergers and acquisitions.

## References

- [1] Asplund, M. and V. Nocke (2006), “Firm Turnover in Imperfectly Competitive Markets”, *Review of Economic Studies*, 73, 295-327.
- [2] Cabral, L. and J. Mata (2003), “On the Evolution of the Firm Size Distribution: Facts and Theory”, *American Economic Review* 93, 1075-1090.
- [3] Criscuolo, C., J. Haskel, and R. Martin (2003), “Building the Evidence Base for Productivity Policies Using Business Data Linking”, *Economic Trends*, 600, 39-51.
- [4] Davis, S., R. Faberman and J. Haltiwanger (2006), “The Flow Approach to Labor Markets: New Data Sources and Micro–Macro Links”, *Journal of Economic Perspectives*, 20(3), 3-26.
- [5] Disney, R., J. Haskel and Y. Heden (2003), “Restructuring and Productivity Growth in UK Manufacturing”, *Economic Journal* 113, 666-694.
- [6] Dun and Bradstreet (2001). Presentation to the Office for National Statistics. November 2001.
- [7] European Commission (2003), “A General Overview of Demographic Events: Business Register: Recommendations Manual”.
- [8] Foster, L., J. Haltiwanger and C.J. Krizan (2006), “Market Selection, Reallocation, and Restructuring in the U.S. Retail Trade Sector in the 1990s”, *Review of Economics and Statistics*, 88(4), 748-758.
- [9] Hopenhayn, H., “Entry, Exit, and Firm Dynamics in Long Run Equilibrium.”, *Econometrica* 60 (September 1992): 1127-50.
- [10] Hopenhayn, H. and R. Rogerson (1993), “Job Turnover and Policy Evaluation: A General Equilibrium Analysis”, *The Journal of Political Economy*, Vol. 101, No. 5 (Oct., 1993), pp. 915-938.
- [11] Jones, G. (2000), “The Development of the Annual Business Inquiry”, *Economic Trends*, 564, 49-57.
- [12] Jovanovic, Boyan. “Selection and the Evolution of Industry.”, *Econometrica* 50 (May 1982): 649-70.

- [13] Jovanovic, B. and P. Rousseau (2002), “The Q-Theory of Mergers”, *American Economic Review Papers and Proceedings* 92, 198-204.
- [14] Maksimovic, V. and G. Phillips (2001), “The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and Are There Efficiency Gains?”, *Journal of Finance* 56, 2019-2065.
- [15] Mullahy, J. and S. Robert (2008), “No Time to Lose? Time Constraints and Physical Activity”, NBER Working Paper 14513.
- [16] Office for National Statistics (2001). Review of the Inter-Departmental Business Register. National Statistics Quality Review Series Report No. 2.
- [17] Office for National Statistics (2003). Review of the Inter-Departmental Business Register, End of Project Report.
- [18] Office for National Statistics (2006), “Business Structure Database User Guide”.
- [19] Papke, L.E. and J.M. Wooldridge (1996), “Econometric Methods for Fractional Response Variables With an Application to 401 (K) Plan Participation Rates.”, *Journal of Applied Econometrics*, 11, 619-632.
- [20] Schoar, A. (2002), “Effects of Corporate Diversification on Productivity”, *Journal of Finance* 57, 2379-2403.
- [21] Warusawitharana, M. (2008), “Corporate Asset Purchases and Sales: Theory and Evidence”, *Journal of Financial Economics* 87, 471-497.

**Table 1: Definition of Demographic Events**

<b>Event</b>	<b>Change in Enterprise Group Identifier, Period t-1 to t</b>	<b>Change in Enterprise Identifier, Period t-1 to t</b>	<b>Change in Enterprise Employment/Turnover, Period t-1 to t</b>	<b>Change in Enterprise Group Empl./Turnover, Period t-1 to t</b>
Internal Expansion	None	None	Increased	Increased
Internal Contraction	None	None	Decreased	Decreased
Greenfield Investment	N/A (enterprise did not exist in t-1, so did not have an enterprise group identifier)	Enterprise identifier appears in data for the first time	N/A (enterprise did not exist in period t-1)	Increased
Greenfield Disinvestment	N/A (enterprise exits, so no enterprise group identifier in period t-1)	Enterprise identifier disappears from data	N/A (enterprise does not exist in period t)	Decreased
Acquisition	Changes to the enterprise group identifier of the new owner	Unchanged	Unchanged*	Increased
Sell-off	Changes to the enterprise group identifier of the new owner	Unchanged	Unchanged*	Decreased

*Notes:* Table shows the definition of demographic events used in the paper. See text for details.

(\*) If employment/turnover changes during an acquisition or sell-off, this is coded as an internal expansion/contraction of the new owner (only the initial employment/turnover of the acquired/sold-off enterprise in period t-1 is counted as a size change through M&As).

**Table 2: Gross Turnover Expansions/Contractions by Sector: Choice of Adjustment Strategy (1997-2005)**

	Panel A: Expansions in Turnover				Panel B: Contractions in Turnover			
	Internal Adjustment (%)	M&A (%)	Greenfield (%)	# Turnover Expansions	Internal Adjustment (%)	M&A (%)	Greenfield (%)	# Turnover Contractions
Agriculture, hunting and forestry	99.98	0.05	0.01	466114	99.96	0.06	0.03	355130
Fishing	99.89	0.32	<0.2*	7895	99.77	0.40	<0.2*	6995
Mining and Quarrying	99.30	2.89	1.67	3702	97.98	3.40	3.26	2973
Manufacturing	99.64	1.40	0.45	447,449	99.03	1.74	1.08	376784
Electricity, Gas and Water supply	97.66	20.50	14.21	556	92.83	21.90	17.44	516
Construction	99.92	0.31	0.12	542877	99.70	0.43	0.34	396138
Wholesale trade	99.62	0.71	0.37	453473	99.39	0.86	0.58	359985
Retail trade	99.95	0.16	0.06	641645	99.81	0.23	0.17	463733
Hotels and Restaurants	99.94	0.23	0.08	396355	99.78	0.33	0.19	268414
Transport, Storage and Communication	99.84	0.70	0.25	198144	99.36	0.97	0.68	130124
Financial intermediation	99.53	1.85	0.85	67655	98.12	3.01	2.43	37580
Real Estate and Renting	99.65	1.20	0.47	201206	98.91	1.54	1.01	132172
Business Activities: Computer and Related Activities, and Research & Development	99.81	0.50	0.21	186181	99.53	0.62	0.42	148049
Business Activities: Legal, Accountancy, Tax consultancy, Architecture, Testing & Advertising	99.87	0.40	0.16	456164	99.59	0.54	0.36	322266
Business Activities: Others	99.82	0.57	0.22	256906	99.57	0.64	0.40	208461
Education	99.71	0.89	0.31	57790	99.52	0.75	0.42	46506
Health and Social Work	99.95	0.19	0.07	262161	99.75	0.31	0.20	111840
Other Service Activities	99.91	0.29	0.11	468010	99.71	0.41	0.28	290088
<b>All Sectors</b>	<b>99.84</b>	<b>0.50</b>	<b>0.20</b>	<b>5044793</b>	<b>99.56</b>	<b>0.66</b>	<b>0.44</b>	<b>3600784</b>

Notes: Table shows the frequency of each of the three adjustment channels used in firm expansions and contractions: internal adjustment, M&As and greenfield investment/disinvestment. Panel A focuses on gross expansions while panel B focuses on gross contractions. The last column of each panel contains the total number of expansions and contractions in each sector. Note that firms can use more than one channel at the same time. The second to fourth columns of each panel are computed as percentages of the total number of expansion or contraction in each sector.

(\*) Exact percentage cannot be reported due to disclosure restrictions (number of observations underlying the cell is smaller than 10).

**Table 3: Average Adjustment Size by Channel (1997-2005)**

	Panel A: Expansions in Turnover				Panel B: Contractions in Turnover			
	Internal Adjustment	M&A	Greenfield	All forms (average)	Internal Adjustment	M&A	Greenfield	All forms (average)
Agriculture, hunting and forestry	67.6	2552.7	2829.7	69.1	57.7	2661.0	1860.9	59.7
Fishing	129.5	2617.0	6408.3	139.8	109.1	2047.6	1070.5	117.1
Mining and Quarrying	4397.6	75852.7	16201.0	6580.0	4254.1	76357.7	48937.3	8003.9
Manufacturing	1044.1	20781.4	13871.7	1374.1	1190.0	21939.4	23670.9	1782.5
Electricity, Gas and Water supply	106804.4	114612.8	135021.9	111005.4	75813.2	283865.9	257511.1	134310.9
Construction	296.7	12728.1	10597.3	348.7	340.3	9593.6	37066.6	495.1
Wholesale Trade	983.7	22600.7	9817.6	1169.3	872.5	15237.1	19477.9	1102.0
Retail Trade	324.1	27937.1	13895.7	376.5	252.4	30532.7	38053.6	387.3
Hotels and Restaurants	125.9	9406.2	10974.0	156.0	142.4	14736.4	15858.5	219.9
Transport, Storage and Communication	781.0	26969.5	12188.9	991.4	673.5	30628.2	27072.5	1145.0
Financial intermediation	33653.1	390029.2	20661.4	40050.9	67449.5	371284.5	312930.8	81965.1
Real Estate and Renting	480.5	4013.4	3125.9	534.7	673.6	4626.5	3854.1	768.1
Business Activities: Computer and Related Activities, and Research & Development	314.9	6399.6	6245.3	357.5	255.0	8214.3	9261.6	341.2
Business Activities: Legal, Accountancy, Tax consultancy, Architecture, Testing & Advertising	217.5	11981.8	4213.6	270.7	218.8	8089.3	5666.9	281.0
Business Activities: Others	386.9	7505.0	5258.0	437.2	366.8	10108.7	10892.9	471.1
Education	969.1	5643.4	3550.0	1018.6	844.1	3399.8	3039.3	871.3
Health and Social Work	370.4	5540.6	3712.0	384.5	457.7	4593.2	4331.3	478.0
Other Service Activities	195.5	8457.5	11553.3	232.2	185.3	16187.7	9747.6	277.1
<b>All Sectors</b>	<b>882.4</b>	<b>34831.7</b>	<b>11108.2</b>	<b>1070.6</b>	<b>1143.4</b>	<b>34164.1</b>	<b>37325.0</b>	<b>1520.1</b>

Notes: Table shows the average turnover adjustment size of firm expansions or contractions for each adjustment channel (in £'000s in 1995 prices). Panel A focuses on gross expansions while panel B focuses on gross contractions. The first three columns of each panel are mean changes in turnover associated with the use of each channel. The last column in each panel is the average expansion or contraction in turnover across the three adjustment channels (weighted by the frequency of the use of each channel, see Table 3).



**Table 4: Aggregate Importance of Adjustment Forms (1997-2005)**

	Panel A: Expansions in Turnover				Panel B: Contractions in Turnover			
	Internal Adjustment (%)	M&A (%)	Greenfield (%)	All forms (£ mill)	Internal Adjustment (%)	M&A (%)	Greenfield (%)	All forms (£ mill)
Agriculture, hunting and forestry	97.83	1.72	0.54	4,600	96.70	2.56	1.01	3,029
Fishing	92.35	5.92	1.74	158	92.76	6.98	0.26	117
Mining and Quarrying	64.03	32.08	3.97	3,614	49.80	30.97	19.06	3,557
Manufacturing	74.52	20.83	4.52	89,143	64.91	20.91	14.08	97,714
Electricity, Gas and Water supply	70.99	16.03	13.10	11,671	39.63	35.04	25.33	13,086
Construction	84.74	11.42	3.71	27,143	68.02	8.27	23.55	28,143
Wholesale Trade	83.15	13.65	3.13	76,286	78.00	11.75	10.23	57,143
Retail Trade	85.95	11.82	2.29	34,571	65.00	18.33	16.83	25,714
Hotels and Restaurants	80.48	13.88	5.68	8,857	64.36	21.79	13.85	8,457
Transport, Storage and Communication	77.78	18.94	3.11	28,286	58.07	25.73	16.07	21,429
Financial intermediation	81.95	17.65	0.43	395,714	78.06	13.17	8.97	455,714
Real Estate and Renting	88.35	8.89	2.70	15,571	85.53	9.12	5.00	14,714
Business Activities: Computer and Related Activities, and Research & Development	87.44	8.90	3.70	9,557	74.02	14.86	11.23	7,257
Business Activities: Legal, Accountancy, Tax consultancy, Architecture, Testing & Advertising	79.92	17.82	2.42	17,714	77.14	15.49	7.29	13,000
Business Activities: Others	87.79	9.73	2.63	16,143	77.02	13.77	9.17	14,114
Education	93.94	4.86	1.09	8,486	95.83	2.89	1.44	5,829
Health and Social Work	96.04	2.76	0.67	14,429	95.34	3.01	1.78	7,657
Other Service Activities	83.85	10.46	5.36	15,571	66.42	24.04	9.64	11,529
<b>All Sectors</b>	<b>81.77</b>	<b>16.10</b>	<b>2.01</b>	<b>775,714</b>	<b>74.41</b>	<b>14.83</b>	<b>10.80</b>	<b>787,143</b>

Notes: Table shows the aggregate importance of adjustment forms in expansions or contractions of turnover by sector. Panel A focuses on gross expansions while panel B focuses on gross contractions. The first three columns of each panel give the proportion of total turnover expansion or contraction that is accounted for by each channel. The last column in each panel is the average annual expansion or contraction of turnover (in £'000s in 1995 prices).

**Table 5: Gross Expansion and Contraction in Turnover by Size of Firm (1997-2005)**

Size Category of Firm	Size (£'000s)	A) Expansions in Turnover			B) Contractions in Turnover		
		Internal Adjustment (%)	M&A (%)	Greenfield (%)	Internal Adjustment (%)	M&A (%)	Greenfield (%)
Bottom 50%	0-152	99.94	0.05	0.01	99.95	0.03	0.02
51% to 75%	153-342	99.90	0.08	0.02	99.87	0.08	0.05
76% to 95%	343-1,782	99.61	0.30	0.09	99.33	0.41	0.26
96% to 99%	1,783-9,976	97.56	1.80	0.64	95.31	2.97	1.72
99% to 99.9%	9,977-147,384	90.86	6.64	2.50	83.94	9.69	6.37
Top 0.1%	>147,384	70.96	15.72	13.32	69.06	17.40	13.54
<b>Total</b>	<b>All</b>	<b>99.64</b>	<b>0.26</b>	<b>0.10</b>	<b>99.32</b>	<b>0.42</b>	<b>0.26</b>

Notes: Table shows the choice of adjustment channel by the size class of firms in terms of turnover (see Columns 1 and 2). Panel A focuses on gross expansions while panel B focuses on gross contractions. The three columns of each panel give the percentage of total turnover expansions or contractions that is accounted for by each channel.

**Table 6: Gross Expansion and Contraction in Turnover by Size of Expansion / Contraction (1997-2005)**

Size Category of Expansion/Contraction	A) Expansions in Turnover				B) Contractions in Turnover			
	Expansion Size (£'000s)	Internal Adjustment (%)	M&A (%)	Greenfield (%)	Contraction Size (£'000s)	Internal Adjustment (%)	M&A (%)	Greenfield (%)
Bottom 50%	1-27	99.99	0.01	0.01	1-24	99.96	0.02	0.02
51% to 75%	28-89	99.91	0.05	0.04	25-75	99.85	0.09	0.06
76% to 95%	90-582	99.52	0.32	0.16	76-514	99.09	0.58	0.33
96% to 99%	583-3,625	97.15	2.15	0.70	515-3,764	94.33	3.49	2.18
99% to 99.9%	3,625-61,593	88.92	8.77	2.31	3,765-74,311	80.46	11.60	7.93
Top 0.1%	>61,593	77.59	18.16	4.25	>74,311	64.17	21.44	14.40
<b>Total</b>	<b>All</b>	<b>99.64</b>	<b>0.26</b>	<b>0.10</b>	<b>All</b>	<b>99.32</b>	<b>0.42</b>	<b>0.26</b>

Notes: Table shows the choice of adjustment channel by the size of turnover expansions/contractions (see columns 1,2 and 6). Panel A focuses on gross expansions while panel B focuses on gross contractions. The last three columns of each panel give the percentage of total turnover expansions or contractions that is accounted for by each channel. The first column in each panel lists the range of turnover changes associated with the percentile ranges listed in the first column of the table.

**Table 7: Firm Size, Expansion/Contraction Size and Choice of Adjustment Form (1997-2005)**  
**Multivariate Fractional Regressions**

	Expansion in Turnover	Contraction in Turnover
M&As		
Firm size (logs)	0.116*** (5.02)	0.419*** (11.49)
Expansion size (logs)	0.712*** (25.39)	0.439*** (14.20)
Greenfield		
Firm size (logs)	0.477*** (12.76)	0.454*** (12.44)
Expansion size (logs)	0.353*** (9.10)	0.413*** (15.48)
Observations	4938769	3600679
<i>Fixed Effects</i>	<i>2-digit industry, year</i>	<i>2-digit industry, year</i>

*Notes:* Table shows results for multinomial fractional logit regressions for all sectors. Figures in brackets are t-statistics, based on standard errors clustered at the 2-digit industry-level (55 industries). The dependent variables are the fractions of M&As, greenfield and internal adjustment in total turnover adjustment. Internal adjustment is the excluded category. The regressors are firm size (measured in terms of turnover) and the size of the overall turnover expansion and contraction (both variables in logs). \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels, respectively.

**Table 8: Net Expansion and Contraction by Size of Firm (1997-2005)**

Size Category of Firm	Size (£'000s)	Expansion in Turnover			Contraction in Turnover		
		Internal Expansion	M&A	Greenfield	Internal Contraction	M&A	Greenfield
Panel A: Expanding firms							
Bottom 50%	0-152	99.971	0.155	0.018	-0.119	-0.012	-0.013
51% to 75%	153-342	100.048	0.277	0.025	-0.253	-0.069	-0.028
76% to 95%	343-1,782	101.063	0.722	0.117	-1.203	-0.274	-0.425
96% to 99%	1,783-9,976	109.794	8.502	0.936	-12.734	-2.386	-4.112
99% to 99.9%	9,977-147,384	152.712	19.013	10.858	-59.543	-10.517	-12.522
Top 0.1%	>147,384	131.927	38.882	18.676	-38.615	-23.828	-27.041
<b>Total</b>	<b>All</b>	<b>101.037</b>	<b>0.802</b>	<b>0.183</b>	<b>-1.365</b>	<b>-0.276</b>	<b>-0.381</b>
Panel B: Contracting Firms							
Bottom 50%	0-152	0.035	0.076	0.003	-100.057	-0.032	-0.024
51% to 75%	153-342	0.148	0.239	0.006	-100.222	-0.108	-0.062
76% to 95%	343-1,782	1.44	0.73	0.097	-101.084	-0.655	-0.529
96% to 99%	1,783-9,976	13.332	2.662	2.701	-105.805	-5.332	-7.557
99% to 99.9%	9,977-147,384	62.855	9.745	4.367	-125.399	-31.738	-19.83
Top 0.1%	>147,384	140.974	79.854	7.024	-162.932	-102.000	-62.919
<b>Total</b>	<b>All</b>	<b>1.733</b>	<b>0.563</b>	<b>0.192</b>	<b>-100.898</b>	<b>-0.851</b>	<b>-0.74</b>

Notes: Table shows the average percentage of the different expansion and contraction channels in the total net expansion or contraction of firms. Panel A focuses on expanding firms while panel B focuses on contracting firms. Firm size is measured as the value of turnover of the firm (see columns 1 and 2 for size bands). Note that gross expansions and contractions add to +100% for expanding firms (panel A) and -100% for contracting firms (panel B).

## **Appendix A: Description of Sectors used in Analysis**

Sectors	SIC 92 codes
Agriculture, hunting and forestry	01-02
Fishing	05
Mining and Quarrying	10-14
Manufacturing	15-37
Electricity, Gas and Water supply	40-41
Construction	45
Wholesale trade	50-51
Retail trade	52
Hotels and Restaurants	55
Transport, Storage and Communication	60-64
Financial intermediation	65-67
Real Estate and Renting	70-71
Business Activities: Computer and Related Activities, and Research & Development	72-73
Business Activities: Legal, Accountancy, Tax consultancy, Architecture, Testing & Advertising	741-744
Business Activities: Other Activities	745-748
Education	80
Health and Social Work	85
Other service activities	90