Acquisition, Insolvency and Managers in UK Small Companies

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Abstract

This paper investigates the determinants of involuntary insolvency and acquisition in UK small and medium-sized companies. Using a competing risks model and data from the survey database of the ESRC CBR at the University of Cambridge, we draw specific attention to the impact of managerial characteristics. The explanatory power of financial variables, firm size, and firm age, highlighted by previous studies, is confirmed. In addition, the results indicate that firms run by entrepreneurial managers with higher human capital and intentions to pursue a strategy of growth have greater survival prospects and are less likely to be forced into insolvency or become acquired.

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1 Introduction

Insolvency and acquisition serve an important common purpose in the market selection process by moving assets to their most productive uses. Through insolvency or acquisition firms lose their identity and disappear, and as such both outcomes define the longevity of an independent company. In the case of smaller companies characterised by the unification of ownership and control, the relationship between firm-level exit and owner-managers' entrepreneurial abilities is particularly important.

Although there is no definitive data on numbers of UK small company insolvencies, estimates for 2006 suggest that of the 1.15 million companies from the private sector, 5834 (or 0.5 per cent) exited by compulsory liquidation (BERR (2007), IS (2007)). Hard data on acquisitions of small businesses are even more difficult to come by, but based on a report from the EC, some 3 per cent of small and medium-sized enterprises in Member States are projected to experience ownership transfers through acquisition between 2000 and 2010 (EC (2002), Allinson, Braidford, Houston, Robson, and Stone (2007)).

Given that managers differ in their ability to discern, create, and develop profitable opportunities, the quality of management is generally regarded key to small firm longevity. A high quality manager is more likely to select and implement projects more ably, resulting in better performance, viable growth opportunities, and a greater return from keeping the firm. However, the higher the level of managerial human capital, the greater the return to outside alternative occupations. Therefore, the option to sell looks appealing if an increase in the value of the manager's outside options diminishes the relative return from keeping the firm. In contrast, a low ability manager who fails to convert good opportunities into markets, will face an erosion in his expected return from keeping the business. In this instance, whether the owner-manager can realise the desire to exit by selling control to a new owner hinges on the presence within the firm of a business model and growth opportunities that make an attractive acquisition target.

By differentiating between involuntary termination due to insolvency and voluntary exit via an acquisition we are better placed to understand the relative importance of manager's characteristics and firm-level factors to firm performance and longevity. In the case of acquisition the entrepreneur trades off the expected returns from keeping the firm against the benefits arising from selling and pursuing an outside option. This suggests that *a priori* the human capital of the operating manager has an indeterminate impact on the probability of selling the firm. An empirical analysis of the impact of managerial characteristics on acquisition is therefore essential to understanding the exit behaviour of small firms.

In the case of involuntary insolvency we would expect to see an inverse relationship

between the quality of managerial human capital and exit likelihood since financial failure exposes managerial inadequacies in the firm. Whether a debt default triggers an involuntary insolvency outcome depends on the extent of the debt holders' willingness to support a failing firm, determined in part by the quality of the current management. A better manager with a good project may be able to convey to the lenders the intrinsic value of the distressed firm more credibly, and will increase his odds of extending debt maturity and avoiding a collapse into insolvency.

While the role of managers in determining small firms' longevity has received considerable attention,[1] much of what has been written is concerned with businesses trading as either sole proprietors or partnerships. The extent to which the available empirical results generalise to incorporated small firms, and, in addition, whether the duration determinants exhibit significant differences across common types of exit remains unclear. The motivation for focussing the present paper on small companies with limited liability, stems from the fact that firms organised as limited companies dominate economic activity in terms of wealth and job creation and thus represent an important target of policies aimed at promoting enterprise. However, there has been noticeably little research effort seeking to determine the relevance of owner-manager's characteristics for the exit behaviour of small companies. An indication of how managerial characteristics predict the two exit pathways is of interest not only to owner-managers of small firms, bankers and practitioners involved in insolvencies and sales of companies, but also to policymakers.

This paper contributes to the literature by providing evidence on the impact of managerial characteristics on involuntary insolvency and acquisition for UK small companies. We consider a number of dimensions of managerial human capital, including age, educational background, tenure, previous unemployment, and managerial intentions about future growth. To examine the impact of these characteristics conditional on the influence of firm-specific and contextual factors we use unique survey data on UK small and medium-sized enterprises (SMEs),[2] developed by the ESRC Centre for Business Research at the University of Cambridge.

To motivate the key dimensions of our analysis, Section 2 provides a summary of stylised facts for both insolvency and acquisition. Section 3 presents the econometric method, and in Section 4 we describe the data and variables of the duration model. Section 5 contains the main empirical results, and Section 6 concludes.

[1] See, for example, Bates (1990), Bates (2005), Holmes and Schmitz (1995), Gimeno, Folta, Cooper, and Woo (1997), Taylor (1999), Cressy (2006).

[2] Definitions of 'small' and 'medium-sized' are often based on employment size tests and tend to differ between jurisdictions. In this paper, we adopt the original size bands used in the ESRC CBR surveys.

2 Stylised Facts about Small Firm Exit

Small company exits occur in various ways. An entrepreneur, protected by limited liability, is free to cease operation voluntarily and will close the company down if he expects a loss of equity investment due to current underperformance and bleak prospects for growth. His ability to decide whether to continue the company may be removed in a forced insolvency, arising from a debt default and initiated by creditors. Insolvency typically entails liquidation, upon which the owner loses all of the initial equity investment and the creditors may incur a loss.

In the acquisition outcome, an entrepreneur exits by selling control to an acquirer, at a premium in relation to the liquidation value of the firm. The premium paid reflects the current expectations of the buyer about the intrinsic value of the purchased business. This implies that companies that are sold are always of higher quality in comparison with those that disband voluntarily or are forced to discontinue in the event of an involuntary insolvency.

The existing theoretical literature on reasons for firm exit, including Jovanovic (1982), Jovanovic and Braguinsky (2004), Holmes and Schmitz (1995), and Cressy (2006), is motivated by a specific exit type, such as market exit or acquisition, but offers no encompassing framework. In addition the extant literature on managerial characteristics and small firm exit has generally focussed on unincorporated businesses, with a subsequent neglect of the role of manager's human capital in explaining exit routes among the firms that use the legal form of company with limited liability. In this respect our current understanding of small firm survival is based largely on three sets of stylised facts: the attributes of the firm, the characteristics of the owner-manager, and the conditions of the business environment. Below we briefly review each of these components.

2.1 Managerial Characteristics

In considering the role of managerial characteristics as a determinant of firm exit we base our discussion on a gain-seeking individual who maximises the expected payoffs to both his financial and human capital investments and has claims on residual profits.[3] As both a manager and owner of the firm, the entrepreneur makes decisions about closure or sale by comparing the expected return to keeping the venture with the payoff from an outside alternative. Entrepreneurs differ in their managerial abilities, treated as an acquirable and return-yielding asset, which may be enhanced through investment in human capital. Human capital is referred to as knowledge and skills obtained through formal education

[3]See, for example, Lucas (1978), Jovanovic (1982), Endres and Woods (2006).

and accumulated through work experience (Becker (1964)). Accumulated human capital is likely to be coincident with both higher current earnings and expected continuation cash flows, which may correspond with longer business durations. However, a more skilled owner-manager with a higher level of human capital is also more likely to expect a higher relative potential payoff to an occupation outside the current firm.

Human capital is generally measured by a number of factors including entrepreneur's age, education, general work experience, and tenure with the firm. The importance of these characteristics to exit behaviour has been established in studies concerning small business owners and self-employed, with inferences supporting a negative association between owner's human capital on closure or bankruptcy (see, e.g., Bates (1990), Van Praag (2003), Bosma, Van Praag, Thurik, and de Wit (2004), Colombo, Delmastro, and Grilli (2004), Cressy (2006)). Since age correlates with accumulated human capital and is indicative of skills and experience that make good managers,[4] enterprises operated by older individuals, will *ceteris paribus*, perform better and are therefore less likely to experience distress and insolvency. Age also affects the willingness of the owner-manager to sell a successful firm. Assuming that the discount rate of future payoffs increases with age (Zucker (1967)), older owner-managers have less time to recoup the costs of switching occupations suggesting a negative association between manager's age and sales of firms. On the other hand, an aging individual may have a higher value of leisure and a greater incentive to exit into retirement by selling a successful business. These offsetting effects suggest an *a priori* indeterminate relationship between manager's age and sales of firms.

Empirical studies that explicitly differentiate between generic and specific components of managerial human capital (see, e.g., Gimeno, Folta, Cooper, and Woo (1997)) also support an indeterminate impact of human capital on decisions to close or sell. The indeterminate impact of human capital is usually attributed to its generic component, comprising of skills that are useful both within the current firm and in other potential occupations. In contrast, the fixity of investments in firm-specific human capital, defined as skills useful only in the context of the current business, is expected to motivate managers to keep firms and is found negatively related to exit.

A number of studies have found that previous experience of personal unemployment by owner-managers reduces the probability of a voluntary exit (e.g., Storey (1994), Gray (1998), Van Praag (2003)). Taking prior unemployment as a proxy for the value of human capital in alternative occupations, this evidence is consistent with the view that lack of skills lowers the manager's perceived returns to outside options and serves as a strong incentive for continuing the firm. As an indicator of lower entrepreneurial ability, previ-

[4] Andren, Magnusson, and Sjolander (2003) conclude that managerial skills may be developed through experience, as entrepreneurs adapt their plans iteratively in response to the changing environment.

ous unemployment experience is associated with a higher risk of bankruptcy (e.g., Taylor (1999)). In addition, research on banks' internal rating systems for assessing credit risk for SMEs finds evidence that the use of such 'soft' information as management experience alongside financial factors leads to a more accurate *ex-ante* prediction of default events (e.g., Grunert, Norden, and Weber (2005)). Related, a number of stylised facts point to complementarities between managers' human capital, innovation, and workforce training. In human capital-intensive industries, the quality of a business project is defined by the human capital of workers that develop it. Firms with managers that possess relatively high human capital tend to undertake a greater degree of workforce training. Consequently, such firms can better align resources and capabilities with the changing environment to turn innovation into business success (Jennings and Beaver (1997), Leiponen (2005)).

2.2 Firm-level Attributes

Studies of inter-firm variation in the propensity to exit generally contend that one part of the explanation for exit resides in the differences in a number of firm attributes, including their age, size, capacity for innovation, and cash generating ability.

Firm Age

Although based upon a related literature on firm dynamics where the primary focus is upon *market* exit the *learning-by-doing* model makes no distinction between the manager and the firm and yields the important result that firm's exit rate is a function of firm age (Jovanovic (1982), Sutton (1997)). Younger smaller firms learn about their true production efficiency through economic activity and are more likely to exit the industry, given that they initially enter on a sub-optimal scale and face uncertainty over the profitability of operating in the product market. The relationship between age and survival may reverse itself in some older firms when they become reluctant to change and misaligned with their environments (Barron, West, and Hannan (1994)). In a model of small business closure and sale, age conveys to potential buyers the quality of a business, and correlates positively with the probability that businesses are sold (Holmes and Schmitz (1995)).

Firm Size

Empirical support for the role of firm size seems less conclusive (Audretsch, Santarelli, and Vivarelli (1999), Holmes, Stone, and Braidford (2001)). Larger firms are more likely to avoid exit given that size correlates with market position and facilitates diversification (Geroski (1995)). In turn this will mean on average less volatility of operating income and

less susceptibility of returns to adverse external shocks. The positive effect of firm size conflicts with more recent evidence that technological advance encourages smaller, more specialised firms, eliminating in many sectors (especially within the service sector) the comparative advantage attributable to scale economies (Greenhalgh and Gregory (2001), Carree, Van Stel, Thurik, and Wennekers (2002)). In what concerns smaller privately held companies, the size of a target firm does not help explain takeover likelihood (Camerlynck, Ooghe, and De Langhe (2005)), so there remains considerable uncertainty concerning the relevance of size to sales of smaller companies.

Innovation

Although a number of notable studies support the notion that firms that innovate tend to grow faster, capture higher profit margins and are less likely to exit the industry (Geroski and Machin (1992), Audretsch (1995)), not all studies of small and medium-sized enterprises find a significant and positive link from innovation to profitability and growth (Cosh, Hughes, and Wood (1996), Freel and Robson (2004)).

Cash-Generating Ability

A necessary condition for insolvency is a debt default arising from insufficient internal cash flows combined with the inability of the firm to raise finance externally (Lambrecht (2001)). Among small private firms, which face a relative lack of external financing options simply because share and bond markets are never accessible, of prime importance for survival is cash-generating ability. Furthermore, the unification of ownership and control coupled with owner-managers' aversion to diluting control, renders external private equity unattractive, while informational opaqueness and lack of collateral restrict small firms' capacity to borrow long-term. This exacerbates financing constraints and creates a link to forced exit in situations of liquidity shortfall (Berger and Udell (1998), Watson and Wilson (2002)). However, in so far as lenders are able to infer the longer-term cash-generating ability of firms from characteristics of owner-managers, small firms with greater managerial human capital are more likely to overcome borrowing constraints and less likely to discontinue due to distress (Cressy (1996)).

The literature on mergers and acquisitions takes expected future performance and current financial position of target firms as the main determinants of takeovers (see, e.g., Wheelock and Wilson (2000)). The central precept is that the transfer of control following a takeover should enhance value to the acquirer. A rational acquirer will seek to generate economic rent - additional value that the inefficient manager of a target firm cannot achieve on his own.

An imbalance between a target firm's growth opportunities and the financial and managerial resources it needs, serves as a strong motive for prospective buyers (Palepu

(1986)). In new and expanding industries, underperforming and financially stressed firms that have promising long-run projects tend to attract bids from buyers with large cash holdings and borrowing capacity (Pastena and Ruland (1986), Cosh and Hughes (1998)). It is also noted that among smaller privately-held companies, target firms are free of distress, have more cash but grow slower than the acquirer group and industry average (Camerlynck, Ooghe, and De Langhe (2005)). We may expect that growth-resource imbalances force the owner-manager to sell to an interested buyer.

2.3 Environment: Industry, Location and Macroeconomy

Both insolvency risk and takeover likelihood are influenced by industry-wide conditions. Predictability of demand, level of competition, customer dependence, technology, and sunk costs all affect survival of firms (Mata and Portugal (1994), Holmes, Stone, and Braidford (2001), Andrade and Stafford (2004)).

Insolvency risk is amplified at times of economic shocks when adverse changes in demand, interest rates, and exchange rates hit the profitability and liquidity of a firm and its ability to raise external finance (Young (1995), Bhattacharjee, Higson, Holly, and Kattuman (2002), Bunn and Redwood (2003), Disney, Haskel, and Heden (2003)). While company insolvencies are counter-cyclical, acquisitions are less likely in economic recessions when many buyers are credit constrained and sellers tend to postpone sales until markets become more liquid. Times of stronger economic growth may provide a stronger incentive for takeovers (Shleifer and Vishny (1992), Sudarsanam (2003)).

A substantial part of variation in the incidence of firm exit may be attributed to spatial factors (Reinolds, Miller, and Maki (1993), Anyadike-Danes, Hart, and O'Reilly (2005)). Apart from differences in population growth and costs of factors of production, geographical clustering produces agglomeration externalities,[5] resulting in increased productivity and performance of a firm (Hoogstra and Van Dijk (2004)).

3 Duration Model of Business Exit

To construct our model of business exit we first introduce notation. Let $\mathbf{t}_i^* = (t_{i1}^*, t_{i2}^*, ..., t_{iH}^*)'$ denote a $H \times 1$ vector of latent duration times for firm i for a set Ω_H of H mutually exclusive exit states. The observational rule is given by

$$t_{ir} = \min(\mathbf{t}_i^*; c), \tag{1}$$

[5] These external economies include availability of skilled labour and infrastructure and also extend to localised knowledge spillovers, innovative milieux, social structure, trust, and institutions.

where t_{ir} denotes the exit time for firm i by exit state r, and c denotes a censoring point. When a firm changes status from a trading company to one of H exit routes then $t^*_{il} \geq t^*_{ir}$ $l \neq r \in \Omega_H$, and exit times other than r are censored at the duration time of state r. The scope of the present study is restricted to two types of exit: exit of a firm may occur either from involuntary insolvency or from acquisition.

In a standard continuous time setting survival times are censored either at the beginning or end of the observation window. However, in this study we face an additional problem of *interval censoring.* Exit times and the characteristics of our sample of small and medium-sized firms were recorded during three surveys, varying from two- to four-year intervals. In this instance time to exit is not unique but grouped in that the analyst only observes the time interval in which a given duration is terminated.

The discrete nature of the available survival data leads us to employ a model for discrete times. By transforming an observed duration into K non-overlapping intervals, survival to time a_K is equivalent to surviving each of the intervals $A_k = [a_{k-1}, a_k)$ for $k = 1, ..., K$. In this context each firm is represented by a vector of binary responses for the non-overlapping time intervals (see Shumway (1999)). Using this approach an alternative way to analyse survival data is to define a binary random variable according to survival or exit within each A_k interval and then utilise techniques suitable for binary data.

We now introduce the discrete time analogues of the key objects for duration analysis. For $A_j = (a_{j-1}, a_j]$ denoting interval A_j and $s_j = \alpha_j(a_j|\mathbf{x}_j) = \Pr(T \geq a_{j-1}|\mathbf{x}_j)$ denoting the probability of surviving interval A_{j-1}, then with $\mathbf{x}_j$ denoting a vector of covariates for A_j, $f_j = \Pr(T = a_j|\mathbf{x}_j) = s_j - s_{j+1}$ is the probability of exiting in A_j; $\Pr(T = a_j|T \geq a_{j-1}, \mathbf{x}_j) = \lambda_j = f_j/s_j$ is the conditional exit probability, conditioning upon surviving A_{j-1}. The probability of exit in the j^{th} interval, namely the probability of surviving the first j-1 intervals with exit in the j^{th}, is then written as

$$\Pr(a_j|\mathbf{x}_j) = \lambda(a_j|\mathbf{x}_j) \prod_{k=1}^{j-1} \alpha_k(a_k|\mathbf{x}_j).$$

In the case of $H = 2$ competing risks the likelihood contribution is comprised of three components dependent upon whether the firm went into insolvency, was acquired, or neither. To quantify the likelihood contributions we introduce two censoring indicators for each type of exit: indicator $d_{\mathfrak{Z}ji}$ ($d_{\mathfrak{A}ji}$) takes a value of 1 in interval j if exit of firm i is caused by insolvency (acquisition); and equal to 0 if the observation is censored in terms of acquisition (insolvency). A firm surviving at the end of the j^{th} interval is censored on both causes with zero values for the respective censoring indicators, and likelihood

contribution $s_{\mathfrak{I}}(a_{ji})s_{\mathfrak{A}}(a_{ji})$. The likelihood contribution of a firm insolvent at time t_j is given by $f_{\mathfrak{I}i}(t_j)s_{\mathfrak{A}i}(a_{j-1})$; the likelihood contribution of a firm acquired at time t_j is given by $f_{\mathfrak{A}i}(t_j)s_{\mathfrak{A}i}(a_{j-1})$.

The contribution to the likelihood of firm i assuming independent risks may be written as

$$\begin{aligned} L_i(\boldsymbol{\theta}|\mathbf{d}_{\mathfrak{I}i}, \mathbf{d}_{\mathfrak{A}i}, \mathbf{x}_i) &= \prod_{R_j} \{[f_{\mathfrak{I}}(t_{ji})s_{\mathfrak{A}}(a_{j-1,i})]^{d_{\mathfrak{I}ji}}[f_{\mathfrak{A}}(t_{ji})s_{\mathfrak{I}}(a_{j-1,i})]^{d_{\mathfrak{A}ji}}\}^{w_{ji}} \\ &\quad \{s_{\mathfrak{I}}(a_{ji})s_{\mathfrak{A}}(a_{ji})\}^{1-w_{ji}} \qquad (2) \\ &= \prod_{R_j} \{\lambda_{\mathfrak{I}}(t_{ji})_{\mathfrak{A}}^{d_{\mathfrak{I}ji}}\lambda_{\mathfrak{A}}(t_{ji})^{d_{\mathfrak{A}ji}}\}^{w_{ji}}\{(1-\lambda_{\mathfrak{I}}(t_{ji})^{d_{\mathfrak{I}ji}})(1-\lambda_{\mathfrak{A}}(t_{ji})^{d_{\mathfrak{A}ji}})\}^{1-w_{ji}} \end{aligned}$$

where $\boldsymbol{\theta} = \{\boldsymbol{\beta}, \boldsymbol{\tau}\}$ denotes a vector of unknown parameters: $\boldsymbol{\beta}$ is a $K \times 1$ vector of slope parameters and $\boldsymbol{\tau}$ is a $S \times 1$ vector of shape parameters. $w_{ji} = d_{\mathfrak{I}ji} + d_{\mathfrak{A}ji} = 0$ denotes censoring on both dimensions in the j^{th} interval, and R_j denotes the risk set for interval A_j[6]. The likelihood function over all firms is then $L = \prod_{i \in R_j} L_i(\boldsymbol{\theta}|\mathbf{d}_{\mathfrak{I}i}, \mathbf{d}_{\mathfrak{A}i}, \mathbf{x}_i)$.

In the present study we use the Weibull density to represent the distribution of the time to exit. For the Weibull distribution the hazard function, $\lambda(t) = \tau t^{\tau-1}\omega$, is a special case of the proportional hazards model: $\tau t_i^{\tau-1}$ is the baseline hazard function, ω denotes a term that may be parameterized as a function of covariates, and τ denotes the shape parameter. The survival and hazard function for the jth interval with competing risks $q = \mathfrak{I}, \mathfrak{A}$ are given by

$$\begin{aligned} s_{jq} &= \exp(-\omega t_j^{\tau_q}), \\ \lambda_{jq} &= f_{jq}/s_{jq} = (s_{jq} - s_{j+1q})/s_{jq} = 1 - s_{j+1q}/s_{jq} \\ &= 1 - \frac{\exp(-t_j^{\tau_q}e^{\boldsymbol{\beta}'\mathbf{x}_j})}{\exp(-t_{j-1}^{\tau_q}e^{\boldsymbol{\beta}'\mathbf{x}_{j-1}})} = 1 - \exp(-\boldsymbol{\beta}'(\mathbf{x}_j - \mathbf{x}_{j-1})\alpha_j^{\tau_q}), \end{aligned}$$

where $\alpha_j = t_j - t_{j-1}$, and τ^q is the shape parameter for competing risk q. For $\mathbf{x}_j$ containing a constant we can also estimate interval (and competing risk) specific fixed effects.

The assumptions of independence across the risk set, Ω_H, is analogous to the assumption of i.i.d. errors across a set of H discrete choices. For example, the tractability of the multinomial logit discrete choice model comes with the price that the odds-ratio for any pair of alternatives is invariant to the attributes of any other alternatives in Ω_J. The precise analog in the context of duration analysis is that the time to exit is independent

[6]The risk set R_j comprises firms that are not already dead or censored at the beginning of the j-th interval.

of removing an element in Ω_H. In the context of this particular study the question of interest is whether business longevity and exit via one route, for example insolvency, is conditionally independent of the alternative exit route acquisition. Modelling the likelihood of insolvency and acquisition as conditionally independent risks may be partially justified given that we have access to an extensive set of manager characteristics and firm-level attributes. However, to account for unobserved factors which affect both the likelihood of exit into insolvency or acquisition we use an error components approach. Denoting the vector of error components by $\boldsymbol{\kappa}$ we utilise a bivariate normal distribution $\boldsymbol{\kappa} \sim BVN(\mathbf{0}, \Sigma_{\boldsymbol{\kappa}})$ to represent these unobserved factors.[7]

3.1 Bayesian Estimation

In this study we adopt a Bayesian approach to modelling business exit. In the context of business exit modelling there are a number of reasons for going beyond the confines of the classical frequentist approach in providing statistical inference. First, estimation of survival models when confronted with both complex censoring schemes and data structures can be difficult to carry out. Of central importance is the form of the observational rule, mapping a vector of latent durations, say $\mathbf{t}^*$, and censoring scalars to an observed, state specific exit time. With the exception of the exit state duration, say t_r^*, all other elements of t^* can be considered as missing data.

Following the seminal work of Gelfand and Smith (1990), the application of Bayesian inference to models of survival has grown considerably. Campolieti (2001) notes that in a non-Bayesian framework there are a number of problems for making valid and reliable inference. As soon as one departs from the standard survival model with right censoring, incorporating more complex observational rules involving interval censoring and/or truncation, the complexities can create serious problems for classical analysis. For example, independent of sample size considerations, the calculation of variance estimates in the face of complex censoring and missing data mechanisms require asymptotic arguments which may not be possible for some models. In contrast within a MCMC framework, variance estimates and other posterior summaries are a simple by-product of the Gibbs sampler. The distinguishing feature of the Bayesian approach to survival analysis is the use of a data augmentation procedure in the treatment of censoring (See Kuo and Smith (1992)). One of the important consequences is that we are able to explicitly account for parameter uncertainty conditional upon the *observed* data.[8]

[7] By introducing dependence in this way we do not impose any restrictions on whether duration dependence is increasing or decreasing. We note that this approach is exactly analogous to that used in the mixed logit extension of the multinomial logit model.

[8] Ibrahim, Chen, and Sinha (2001) note that in the context of MCMC techniques, the computational

Combining the likelihood function in (2) with the prior distributions on the vector of slope parameters $\boldsymbol{\beta}$ and the vector of shape parameters $\boldsymbol{\tau}$, we obtain the joint posterior distribution for the hazard model, which we write as

$$p(\boldsymbol{\beta}, \boldsymbol{\tau}|\mathbf{D}_i) \propto \prod_i L_i(\boldsymbol{\beta}, \boldsymbol{\tau}|D_i) p(\boldsymbol{\beta}|\boldsymbol{\beta}_0, \Sigma_0) p(\boldsymbol{\tau}|\boldsymbol{\tau}_0) \tag{3}$$

where $\mathbf{D}_i = (\mathbf{d}_{\mathfrak{Z}i}, \mathbf{d}_{\mathfrak{A}i}, \mathbf{x}_i)$, $p(\boldsymbol{\beta}|\boldsymbol{\beta}_0, \Sigma_0)$ and $p(\boldsymbol{\tau}|\boldsymbol{\tau}_0)$ are, respectively, observed data and the prior distributions for mean and shape parameters. Unless we assume $\boldsymbol{\tau}$ is known, no conjugate prior is available. However, if we partition $\boldsymbol{\theta}$ into blocks, under certain conditions Gibbs sampling may be performed using adaptive rejective sampling (ARS).[9] [10]

For slope parameters we employ noninformative independent normal priors of the form $\boldsymbol{\beta} \sim N(\mathbf{0}, \boldsymbol{\Sigma}_{\beta_0})$, where $\boldsymbol{\Sigma}_{\boldsymbol{\beta}_0}$ is diagonal, with each element set to 0.000001. The shape parameters, $\boldsymbol{\tau}$, capturing the time evolution of the hazard, are given independent exponential prior distributions.

The algorithm we use is summarised as follows:[11]

1. Choose initial values for $\boldsymbol{\beta}$ and $\boldsymbol{\tau}$.

2. For $k = 1, ..., K$ draw a value from the conditional posterior density

$$p(\beta_k|\boldsymbol{\beta}_{-k}, \boldsymbol{\tau}, \mathbf{D})$$

where $\boldsymbol{\beta}_{-k} = \{\beta_p : p \neq k, \quad p = 1, ..., K\}$

3. For $s = 1, ..., S$ draw a value from the conditional posterior density

$$p(\tau_s|\boldsymbol{\tau}_{-s}, \boldsymbol{\beta}, \mathbf{D})$$

where $\boldsymbol{\tau}_{-s} = \{\boldsymbol{\tau}_l, l \neq s, \quad l = 1, ..., S\}$.

4. Repeat steps 2 and 3 for a large number of iterations. After discarding an initial burn-in period, we calculate summary measures of the posterior for $\boldsymbol{\beta}$ and $\boldsymbol{\tau}$.

aspects of incorporating missing data are manifest in one extra layer in the Gibbs sampler. This is in stark contrast to the frequentist paradigm where algorithms for handling missing data are much more computationally intensive.

[9] See Gilks and Wild (1992) and Dellaportas and Smith (1993).

[10] The full conditional posterior density is the distribution of each component of $\boldsymbol{\theta}$ conditional on all other components of $\boldsymbol{\theta}$ and the data.

[11] Given log-concavity Gibbs sampling is performed using the BUGS software (Lunn, Thomas, Best, and Spiegelhalter (2000)) which implements the derivative-free version of ARS.

To deal with non-log concave densities a single Metropolis-Hastings (MH) algorithm step is appended to the Gibbs Sampler. This amounts to adapting the proposal density of the MH algorithm to the shape of the full conditional density (see George and McCulloch (1995)).

4 Data and Variables

4.1 Sample Composition

We use a survey database on UK small and medium-sized enterprises, developed by the ESRC Centre for Business Research based at the University of Cambridge. A panel of over a thousand firms, drawn from the Dun and Bradstreet's list of companies operating in manufacturing and business services, has been surveyed comprehensively on three occasions, in 1991, 1995 and 1997.[12] The panel is unique in that it combines information on managerial characteristics such as educational background, age, tenure, previous unemployment, growth intentions, and use of external business advice, with information on firm-level and industry-level attributes. This includes business performance, ownership structure, innovation, workforce training, and the competitive environment.

Firm exit is documented on an annual basis from 1991 through to the end of 2000, using information on changes in company status due to ownership transfers through involuntary insolvencies[13] and takeovers. In each time interval the firm can either continue as an independent business, be placed into involuntary insolvency, or sold to an acquirer. Table 1 gives a summary of the sample inclusion criteria. To be included in the survival data set, firms must have been independent and trading companies with limited liability, established prior to 1991 and employing less than 500 persons in 1991.[14] The selection rules yielded a survival data sample of 851 firms, of which 495 belong to manufacturing,[15] and the remaining 356 come from knowledge-intensive business services,[16] the sector that is considered a dominant component of structural change and a key driver of growth in the UK economy during the 1990s (Greenhalgh and Gregory (2001)).

[12] See SBRC (1992) and CBR (1998) for a detailed description of the ESRC CBR survey studies and for a discussion of the representativeness of their database.

[13] We consider involuntary insolvencies, namely receiverships and compulsory liquidations.

[14] A state-based sampling scheme is used: all companies on the CBR database, that were either acquired or placed into involuntary insolvency, and met criteria of data completeness and consistency, were included in our survival data set. See, e.g., Manski and McFadden (1981) for a discussion.

[15] Manufacturing examples include mechanical engineering, chemicals, food processing, textiles, clothing, footwear, timber and furniture, and paper and pulp.

[16] Business services in our sample represent both traditional professional and new technology-based services, and include management consultancy, marketing consultancy, advertising, computer services, technical and professional consultancy, and design.

Tables 2A and 2B illustrate exit times of the sample firms for manufacturing and business services, respectively. Times to exit are grouped into three intervals: 1991-94, 1995-96, and 1997-2000. An individual firm first comes under observation in 1991 and by the end of each interval the firm either exits or its duration is censored.[17] Table 2A presents the survival experience of 495 manufacturing firms, of which 411 firms survived to the beginning of the second interval, 47 exit by insolvency over the first interval, and further 37 become acquired between 1991 and 1994. We observe considerable variation in time to exit in our sample, although the overall exit rates for the two sectors are similar. Over the observation period 1991-2000, 37 per cent of manufacturing firms and 43 per cent of business services firms discontinue as independent entities due to involuntary insolvency and acquisition.

4.2 Delayed Entry and Left Truncation

In this study the observation window and the lifetime of the firm are not coincident. If the first point of observation corresponded to the first point of risk, as would be the case if all firms were new firms, then standard survival models with right censoring may be applied. However, in this study we randomly sample from a population of small and medium-sized firms of different ages at the beginning of the observation window.

In this study firms of differing ages, which meet the inclusion criteria set out in Table 1, enter our study at the date of the first survey, and are followed until the end of the observation window or exit into either acquisition or insolvency. This is the problem of left truncation or *delayed entry,* which adds a complication to the standard observational rule. To see this let ζ denote the date of the first survey and a_i the starting date of the firm. Note that the event ζ truncates the distribution of firm lifetimes in the sense that we do not observe duration times for firms not alive at this point. Given that our primary inclusion criteria is the sampling of firms which were trading at the point of the first survey - we need to revise the standard observational rule $T_i = \min(T_i^*, c_i)$ with

$$T_i = \min((T_i^* \cdot \mathbf{1}(a_i + T_i^* \geq \zeta), c_i). \tag{4}$$

For firms whose lifetimes end prior to ζ we will have no information. In a non-parametric setting it is relatively simple to adjust the Kaplan-Meier (product limit) estimator. In parametric studies we face a number of options. Analogous to the non-parametric case, it is possible to adjust the risk set by constructing age (or cohort) specific hazards. For

[17] For firms that have censored lifetimes at the end of an interval, the observed times are less than true durations. In other words, duration (lifetime) is observed only when the event of insolvency or acquisition occurs.

example, Satchell and Shin (1996) in an analysis of mortgage arrears and repossession, estimate a number of hazard functions based upon a classification of when the mortgage was arranged, thereby recognising that mortgages with different years of origin have qualitatively different risk characteristics. A variant of this approach, which is implemented in this study, is to include age of firm at first observation as a control variate. This obviously allows for a mean shift in the hazard but forces the effect of covariates to be equal across cohorts.[18]

4.3 Measurements and Prior Beliefs

In this section we partition the determinants of firm longevity into three groups: i) managerial characteristics; ii) firm-level attributes, and iii) external variables controlling for the influence of market and location. Table 3 presents definitions of these determinants, and transformations of their original values. Descriptive statistics for the sample of firms at start of the observation (the 1991 initial survey) are reported in Table 4.[19]

The relevance of managerial ability to firm exit is examined by separating out the effects of generic and specific components of manager's human capital. We use manager's calendar age and education to quantify *generic* skills, and manager's years with the firm, to measure firm-specific skills. Since manager's age represents a proxy for generic skills obtained through formal education and overall work experience, then *ceteris paribus*, firms run by older and more experienced managers are more likely to perform better and face a smaller risk of insolvency. However, the relationship between manager's age and the likelihood of acquisition is likely to be indeterminate. This follows since the entrepreneur's decision whether to accept a takeover offer is determined in part, by the incremental returns to retaining the firm against the option to sell: the quality of generic human capital affects both the expected returns to keeping the firm and the rewards to the outside alternative. The intuition behind this prior is that an increase in managerial skills enables the manager to take the intrinsic quality of a firm to a higher level, thereby raising the expected return but also increasing the expected returns to outside options. In forming our prior beliefs over the effects of age on exit behaviour we also consider the role of switching costs. As managers age, they will have less time to recoup costs of re-training or losses of non-pecuniary benefits to owning the firm.[20] This generates higher discounts to future payoffs, discouraging movement to alternative occupations. Since the costs of switching are likely to act as a disincentive to sell, we would expect to find a negative link from manager's age to acquisition.

[18] See the discussion in Cnaan and Ryan (1989) for a comparison of different methods.

[19] Descriptive statistics for 1995 and 1997 are not reported here, but are available on request.

[20] Such as a flexible and informal working environment, and lifestyle.

We add a quadratic term to the model specification to test for the presence and direction of the curvature in the relationship between exit likelihood and manager's age. A nonlinear profile is consistent with the learning model,[21] where a firm's growth and survival are determined by the ability of its manager to create and maintain a unique competitive position; and managers do not know their true managerial abilities *ex-ante* and revealing them through operating firms. The age-risk profile for the insolvency exit can be concave and sloping upwards during the initial phase of learning about managerial ability and then sloping downwards.

To examine the influence on exit of *firm-specific* human capital we include a tenure variable measured by the number of years the chief-executive spent with the firm. Investment in firm-specific skills accrued during tenure as the manager are unlikely to be rewarded in outside options, and thereby create an incentive for the owner-manager to retain the firm. We would expect to observe a negative association between tenure and insolvency risk if investments in firm-specific human capital enhance managerial abilities for judging risks and avoiding financial distress.

Managerial education is measured using professional qualifications awarded by professional bodies. In the UK, professional qualifications usually follow after an initial degree and are associated with high levels both of general knowledge and of knowledge that is valuable within a broader group of firms, such as the industrial or activity sector. To the extent that our measure of manager's education captures generic skills, the less skilled would anticipate lower incremental returns to outside options and hence are likely to favour keeping the firm over selling it. An owner-manager with lower education is also more likely to mismanage their firm, resulting in an increased likelihood of financial distress and insolvency.

A noteworthy aspect of this study is that our empirical analysis explores whether variation in managerial intentions about firms' future growth affects exit likelihood. Future growth objectives are measured by a four-level categorical variable, recording the extent to which managers believe their firms will grow. Assuming that managers are rational, growth objectives represent a forward-looking proxy for the quality of a business. Studies that focus on the importance of the personality of the entrepreneur (see, e.g., Gatewood, Shaver, Powers, and Gartner (2002)) argue that expectations of business performance derive from entrepreneurs' perceptions about the level of their own human capital. In particular, they find that entrepreneurs who expect to perform well do. We believe that our measure of expected growth captures a component of the manager's assessment of his worth to the firm. In this sense, behind a proactive business strategy of greater growth lies managerial confidence in their own ability to deliver a higher level of performance and

[21] See Jovanovic (1982).

a greater potential for survival. Therefore higher growth expectancies might be associated with a reduced risk of insolvency, consistent with the argument that good performance brings down the risk of distress but heightens the likelihood of a sale of a firm.

To examine the proposition that previous unemployment creates an incentive for the owner-manager to keep the firm, we use a binary variable indicating if the firm was started as a result of the actual or potential unemployment of the founder. We also include, as a control variable, manager's ownership stake. Concentration of ownership and control in the hands of the entrepreneur is measured by three levels of equity stake held by the chief executive. Table 4 reveals a high level of equity ownership concentration in the sample firms, with the median values at the legal control threshold, giving the manager ultimate power over the firm.

A number of studies (see, e.g., Storey (1994), Barclays (2001)) have indicated that small firm public policy initiatives, introduced in the 1990s, had an impact on both access to finance and growth of UK small businesses. We control for advice on management and strategy by using a dummy according to whether firms report they have approached government agencies that dispense business advice assistance.[22]

To help disentangle the impact of managerial characteristics from firm-level heterogeneity we include in model specifications firm-level attributes, such as innovative ability, workforce training, export orientation, past growth,[23] profitability, need for external finance, firm size, firm age at entry to the study, and being a start-up (Tables 3 and 4). The dummy for competitive advantage and growth opportunities embedded in innovation, is created using information on process and product innovations. Differences in human capital of employees are considered important for the transformation of innovations into profits and, by implication, to exit. We use a dummy for the presence of workforce training to indicate the quality of workers. We expect a positive impact of innovation and workforce training on takeover likelihood and a negative impact on the risk of involuntary insolvency. To differentiate between the firms that operate solely in domestic markets from those that export, we use a dummy variable equal to one for non-exporting firms.[24]

Our primary measure of the financial performance of a commercial enterprise is profit margin before interest, directors' emoluments and tax. Profit margin is a traditional indicator of the cash generating ability of a firm. Financial pressure arising from lack of funds is captured by a binary measure of demand for external finance, set to one for firms

[22] This information is available only for 1991, at entry to the study.

[23] To ensure separation between the effect of expected growth and the impact of actual (realised) growth, we add to the set of independent variables the logarithmic difference in annual sales revenues.

[24] Exporting may be seen as an important dimension of business strategy, reflecting potential for stronger performance. It may also point to a higher operational risk arising from intense competition and a greater exposure to exchange rate risk.

that have attempted to raise funds externally. Since profitability determines liquidity, we might expect an inverse relationship between profitability and insolvency risk. The effect of an increase in demand for external finance on the risk of forced insolvency is likely to be positive due to the fact that for small firms loan finance represents a major source of external funds.

Firm size is measured using four employment bands, the smallest referring to micro firms employing 2-9 persons and the largest including firms with more than 50 persons.[25] To account for left truncation we include the age of the firm in 1991 (at entry to the study), represented by five age cohorts. The first cohort comprises firms who have been in business for five years or less, whereas the fifth category includes firms who have been trading for more than 50 years. Since earlier studies find that newer younger firms have lower survival prospects compared with established enterprises, especially in industries characterised by substantial economies of scale, we also include a binary variable for firms that were launched as new start-ups.

We also control for a number of contextual factors. The influence of market structure is proxied by competition and customer dependence. Intensity of competition is measured by a categorical variable, taking the value of one when firms have two or fewer serious competitors, and four in firms competing with more than ten rivals. Customer dependence refers to the percentage of sales accounted for by the largest customer and is also measured on a categorical scale. Low dependence firms comprise category 'one', where the largest customer accounts for less than 10 per cent of sales, and group 'four' denotes dependence levels of 50 per cent and more. Since industry sector may represent a significant source of exit heterogeneity in our sample of small firms, we segment the data and estimate models for manufacturing and business services separately.[26] The final control variable allows for the differential impact of location and is based on four regional groupings summarised in Table 5.

Since the analysis period spans the UK recession of the early 1990s and the period of subsequent recovery and growth, differences in macroeconomic conditions are accommodated by including time interval-specific fixed effects.

[25] The classification of the employment variable used in this study to proxy firm size (Table 3) reflects the thresholds recommended by the European Commission. Employment thresholds defining 'small and medium-sized enterprise' (SME) differ across countries and jurisdictions. The ongoing debate on simpler accounting standards for SMEs points to the difficulty in setting, and working with, universal thresholds, with some commentators supporting the removal of the employment size criterion in favour of the broader term 'non-publicly accountable entity'(IASB (2007)).

[26] Although we utilise a relatively coarse industrial classification, this helps ameliorate the sparse data problem arising from the use of more disaggregate industry groups.

5 Results

In presenting our results we differentiate between the effects of managerial characteristics, firm-level attributes, and the environment.[27] These are reported in Tables 7A-B, 8A-B and 9A-B, respectively, with subsections A referring to the results for manufacturing, and subsections B to the results for business services. Table 6 summarises the overall pattern of the associations, while Tables 10A and 10B present additional model parameters.

5.1 Managerial Characteristics

In interpreting our findings we return to the idea that a sale of a firm to a new owner is driven, in part, by the current owner's preferences regarding occupational choices. In contrast, an involuntary insolvency indicates creditors' low confidence in the current manager's ability to overcome the illiquidity of the firm, resulting in the creditors' decision to make the owner-manager leave the firm.

Results on the impact of managerial characteristics are presented in Tables 7A and 7B. Measuring the generic component of human capital by the log age of the chief executive, our findings suggest that generic skills are an important determinant of small firm longevity for both exit types in business services and are also linked to the likelihood of forced insolvency in manufacturing. The observed impact of manager's age on exit is summarised as follows:

	Insolvency			Acquisition		
	Age	Age^2	Profile	Age	Age^2	Profile
Manufacturing	−	+	Convex	?	?	?
Business Services	+	−	Concave	−	+	Convex

The question mark symbol (?) indicates where there is no significant effect.

The results for manufacturing firms accord with the predictions of the human capital model (Becker (1964)), in that insolvency risk is a convex function of age. As managers

[27] We attempted to estimate a dependent competing risks model using correlated random-effects but experienced a number of numerical problems with the Gibbs and Metropolis-Hastings sampling. All results are based on *conditionally* independent competing risks. To ensure exogeneity, the time-varying explanatory variables are measured at the start of each interval.

age and accumulate experience, they develop skills that assist in ameliorating the risk of financial distress and failure. A positive quadratic term suggests that willingness to invest in updating risk management skills declines with age, as the present value of future returns to investment in human capital diminishes. In contrast, for business services firms the impact of manager's age on insolvency exhibits a concave profile, consistent with Jovanovic's learning model (Jovanovic (1982)). The probability of involuntary insolvency initially increases with age as younger and less experienced owner-managers learn about their ability to run firms. After initial learning, managers accumulate skills that translate into more competent management of risks, so that among the firms run by the older owner-managers the risk of insolvency falls.

The results for acquisition exit in business services firms also accord with the human capital model. The manager's age profile of the acquisition likelihood is convex and is consistent with the notion that older owner-managers with accumulated transferable skills might expect higher relative returns to outside options. We find no evidence to confirm the link from age of manager to takeover likelihood for manufacturing firms: the linear and quadratic terms are insignificant, even if plausibly signed.

We suspect that the differences between business services and manufacturing in the manager's age-insolvency profile reflect, in part, the distinguishing features of the two sectors. The concave profile with the highest insolvency risk experienced by middle-aged managers is consistent with a sector with relatively low asset tangibility, such as high-skill intensive business-related services. The commercial worth of a firm in advanced business services will largely be determined by its intangible assets, of which manager's skills comprise a dominant proportion. However, low tangibility of assets constrains the firm's ability to rollover debt. As a consequence, in situations where much of managerial human capital is experiential and acquired via *learning-by-doing,* creditors may experience difficulty in placing a value on the intangible assets of a firm operated by a younger manager. As learning progresses, the manager simultaneously accrues skills and firm's assets. In the older age group, once managers have completed the learning, the value of intangibles may become easier to ascertain, making it easier for firms to rollover debt in the event of financial difficulty, decreasing insolvency risk.

We measure the firm-specific component of human capital by the tenure of the chief executive. Our estimates for manufacturing firms confirm the notion that higher levels of firm-specific human capital, as identified by longer tenures, enhances the ability of an owner-manager to avoid the risk of debt default and insolvency, and may also create expectations of higher incremental returns to keeping their firm (Table 7A). The link from educational attainments to exit appears strong only for acquisitions in manufacturing (Table 7A). Firms run by managers with less professional qualifications are associated

with a lower probability of acquisition suggesting lower relative returns to outside options.

In interpreting the observed association between the manager's perceptions of future growth and exit risk, we note that perceived future growth is likely to reflect the quality of both the manager and the business. This follows since rational entrepreneurs will expect growth only if they are confident in their abilities to succeed.[28] In this respect, higher levels of human capital would be implicit in higher growth objectives. In addition, expected growth, as articulated by the owner-manager, can be seen as an indicator of the quality of a firm's investment projects. If having high value investment opportunities facilitates access to finance, then higher expected growth will be associated with a lower risk of distress and insolvency. This prior reasoning receives support from our empirical analysis. Irrespective of the sector in which the firm operates, an increase in expected growth lessens the risk of involuntary exit by insolvency (Tables 7A and 7B).

The negative effect of growth perceptions on acquisition for manufacturing firms suggests that an expected increase in growth raises future anticipated payoffs to owner-managers from remaining in business, relative to the alternative of the immediate payoff from selling firms. This stands in sharp contrast to the results for business services, where we observe a significant positive impact of expected growth on the probability of acquisition (Table 7B). This finding suggests that an expected increase in future income does not outweigh the returns to the owner-manager from switching out of business into an alternative occupation. If we assume that buyers correctly infer the values of acquired firms, the positive effect of expected growth implies that firms that intend to grow are of higher quality. In this instance the positive sign for business services suggests the presence of an imbalance between the quality of managerial human capital and the quality of the firm, to which the current manager responds by selling the firm.

We find that previous experience of unemployment is an important determinant of exit in manufacturing firms (Table 7A). Previous unemployment of the owner-manager is indicative of inadequate levels of human capital and may result in relatively lower returns to outside options, acting as a disincentive to sell their firm. For forced insolvency, the 90% credible interval suggests that unemployment experience is negatively associated with exit. This result highlights the learning aspect of unemployment in the sense that the need to overcome the effects of being unemployed might have spurred accumulation of tacit generic knowledge, which later translated into better management and a sustainable business.

The effects of ownership differs across exit routes. For acquisition exit, the concentration of ownership and control in the hands of the chief executive decreases the probability of selling a business services firm. This finding implies that the amount of financial cap-

[28] See, e.g., Gatewood, Shaver, Powers, and Gartner (2002).

ital committed to an enterprise by the manager serves as a barrier to voluntary exit (Table 7B). The significant positive coefficients on manager's ownership for involuntary insolvency of manufacturing firms (Table 7A) reflects that more concentrated ownership may be associated with a greater risk of default.

Our results suggest that managers who had sought business advice from government assistance agencies were no less likely to exit - by insolvency or by takeover - than those with no agency contacts. However, this finding should be treated with caution since it relies on a single measurement of the agency contact variable.

5.2 Firm-level Attributes and the Environment

5.2.1 Firm-level Attributes

We observe a number of significant effects of firm-specific attributes (Tables 8A and 8B). Our results confirm the standard proposition that insolvency risk is decreasing in profitability. For both manufacturing and business services, impending insolvency is visible in deteriorating profit margins. The finding that current profitability does not affect the likelihood of acquisition is consistent with the firm valuation models, which base valuation on the discounted value of future profits. As shown in Tables 8A and 8B, there is no clear-cut evidence that acquisitions of firms with low profitability are more likely. In neither sector is profitability found to significantly affect the likelihood of acquisition, the only exception being a statistically significant negative impact of profitability among the business services firms belonging to the second from bottom quintile, relative to the reference group of the least profitable firms.

We observe a positive relationship between the demand for external funds and insolvency risk. This finding indicates that distressed firms are more likely to seek finance to overcome liquidity shortfalls, although this effect is significant only for manufacturing firms (Table 8A). One explanation for the observed differences between the two sectors in the importance of the link from demand for finance to insolvency risk may relate to differences in the ability to provide collateral against a loan. Whereas firms in the manufacturing sector have higher levels of tangible assets available as collateral, in knowledge and expertise based firms from business services tangible assets are relatively low, which might prevent these firms from placing requests for loans.

This explanation is also consistent with our finding that the demand for external finance is associated with a higher likelihood of acquisition in business services (Table 8B). In a saleable firm, perceived as viable by a prospective acquirer, a gap between the financial resources that are needed for the firm and the funds available to it, may increase the owner-manager's motivation to take an acquisition deal and sell the business.

Our results highlight the important role of exports in small firm duration. However, the direction of the impact tends to differ between exit destinations and across sectors. For the manufacturing firms, we find that diversification, afforded by exporting, reduces the vulnerability of a firm to insolvency (Table 8A). Conversely, exports enhance the pre-acquisition profile of a target firm in business services (Table 8B). The likelihood of acquisition exit for the average manufacturing firm is negatively affected by past growth in sales revenues, perhaps through lowering the current owner-manager's expected relative returns to outside options which suppresses their willingness to sell.

Workforce training significantly relates to firm duration only for acquisition and only among manufacturing firms (Table 8A). The significant positive effect clearly implies that companies that provide training for their workers are more likely to become an acquisition target. In the case of a technologically intensive sector, such as manufacturing, a high level of workforce skills is crucial to the quality of a firm's investment projects and, by implication, will bear on the perceived value of the firm. Given that training enhances the ability of workforce, this finding is in keeping with the notion that takeovers transfer higher quality firms.

Our analysis also suggests that it is useful to distinguish between manufacturing and business services when measuring the impact of innovation on firm exit. A significant negative association between innovation and exit is a feature of firms in business services (Table 8B), implying that being an innovator could lower the risk of going under or selling up. Although innovation appears vital to survival of independent companies in an industry with a high rate of growth, such as the UK business services sector during the analysis period,[29] this variable lacks the power to distinguish reliably insolvency from acquisition.

Firm size proxied by employment does not appear to affect significantly business longevity in manufacturing, except for the firms belonging to the size group 10-24 employees, where insolvency risk is lower, compared with the reference group of micro firms with 1-9 employees (Table 8A). In contrast, for business services firms, the link from employment size to exit likelihood seems stronger: the risk of involuntary insolvency increases in firm size, and being a larger firm can also raise the probability of being taken-over (Table 8B).

The inclusion of firm age at entry to the study as a variate provides a way of handling left-truncation. In manufacturing, the likelihood of both acquisition and insolvency is higher in younger cohorts (Table 10A), and is consistent with firms learning over time. Older cohorts may have a greater knowledge of the environment and are therefore better equipped for absorbing external shocks. Additionally, more mature businesses may have

[29] See, e.g., Greenhalgh and Gregory (2001), SBS (2003).

fewer growth opportunities which may lower their attractiveness as takeover targets. In business services, the effects on exit of firm age at entry are discernible only for acquisition and also suggest younger firms have higher chances of being sold in comparison with the older than fifty years cohort (Table 10B). For both sectors, the 95% credible intervals for the estimates of shape parameters lie well above unity, which means that the likelihoods of both exits are increasing with time (Tables 10A and 10B).

Neither pathway for exit appears associated with being a start-up firm and, therefore, we cannot lend credence to the view that *de novo* firms are more prone to exit than others.

5.2.2 Environment: Industry, Location and the Macroeconomy

Our analysis supports the view that environmental factors contribute to exit risk. Higher customer dependence increases insolvency risk but reduces takeover likelihood in business services (Table 9B). Firms in the business services sector with three to ten competitors have a lower insolvency risk, relative to firms with two or fewer competitors (Table 9B). The effect of market structure on the exit behaviour of manufacturing firms is less conclusive. Only for the markets with three to five serious competitors is the effect on insolvency risk of seller concentration noticeable and suggests a positive impact of increased competition on asset reallocation through involuntary insolvency (Table 9A).

Differences in location have significant effects only for the firms in the business services sector. Compared to the reference group of small firms based in South East England, being located in Outer Southern England[30] reduces the probability of a sale of the firm (Table 9B).

The results for the interval-specific intercepts, reflecting shifts in exit risk due to factors common to all firms are quite similar across exit types and between sectors. Exit risk decreased once the economy had moved out of the recession of the early 1990s into a period of growth (Tables 10A and 10B). The expected signs of the posterior means of the interval-specific fixed effects together with the associated credible intervals are highly suggestive of the strong effect that changes in the macroeconomic environment could exert on firm survival. For insolvency, the results confirm the prior belief that insolvency risk is counter-cyclical. For acquisition, the pattern of the results for the interval-specific fixed effects implies that the adverse conditions of an economic downturn can influence the decision to sell.

[30] In East Anglia, South West, and the East Midlands.

6 Conclusion

This paper has investigated the role of managerial characteristics in determining involuntary insolvency and acquisition in UK small and medium-sized companies operating in manufacturing and business services. The owner-manager's human capital was cast in terms of firm-specific, profession-specific, and generic components, measured respectively by tenure, education, and age. Additional heterogeneity was captured by previous experience of unemployment, and intentions about future growth.

Our results reveal that after accounting for variation in a wide range of firm-specific attributes and economic and regional conditions, managerial characteristics are important determinants of small business longevity. We find that the links from manager's human capital to insolvency and acquisition vary by industry and exit, and specifically different types of managerial capital matter for different sectors. For example, in the manufacturing sector there is value in the tenure of the chief executive, in that attachment to a firm reduces the risk of insolvency. With respect to profession-specific human capital, only in manufacturing do we find that, after controlling for other dimensions of managerial capital, there is a significant effect of professional qualifications - lowering the probability of acquisition.

We operationalise the notion of generic human capital using age as a proxy, and we observe very different age-exit profiles. In business services the likelihood of exiting through acquisition is relatively higher for firms operated by older entrepreneurs. In manufacturing firms the probability of ending up in involuntary insolvency is greater for younger managers with shorter tenures, the age group often associated with less work experience and lower levels of skills.

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Table 1: Sample Inclusion Criteria

Legal type:	Company with limited liability
Firm size:	Less than 500 employees at the beginning of observation period, in 1991
Industry sector:	Manufacturing or business services
Status at the beginning of observation period, in 1991:	Independent and trading company
Status at the end of observation period, in 2000:	One of the three mutually exclusive states: (i) alive and independent; (ii) gone into involuntary insolvency; and (iii) acquired
Absence of unit non-response in follow-up surveys:	Companies with unit non-response in 1995 and 1997 surveys are excluded
Firm start date:	Established prior to 1991

Table 2A: Exit in the Sub-sample of 495 Manufacturing Firms

1: 1991-1994	Risk Set 1: 495 firms		
At the end	Insolvent	Acquired	Censored
of the interval:	47	37	411
2: 1995-1996	Risk Set 2: 411 firms		
At the end of the interval:	Insolvent	Acquired	Censored
	17	22	372
3: 1997-2000	Risk Set 3: 372 firms		
At the end of the interval:	Insolvent	Acquired	Censored
	21	38	313

Table 2B: Exit in the Sub-sample of 356 Business Services Firms

1: 1991-1994	Risk Set 1: 356 firms		
At the end	Insolvent	Acquired	Censored
of the interval:	45	24	287
2: 1995-1996	Risk Set 2: 287 firms		
At the end of the interval:	Insolvent	Acquired	Censored
	17	28	242
3: 1997-2000	Risk Set 3: 242 firms		
At the end of the interval:	Insolvent	Acquired	Censored
	12	28	202

Table 3: Definitions of Covariates in Tables 6, 7A-B, 8A-B, 9A-B, and 10A-B

Managerial Characteristics:	
Age of Manager	Log number of age of Chief Executive (CE) and the square of the log number of age of CE, in 1991 and 1997
Education	Binary: 1=nil proportion of directors with professional qualifications in 1991 and 1997
Manager's Tenure	Log number of Chief Executive's years with firm, in 1991 and 1997
Previous Unemployment	Binary: 1=actual or potential unemployment of founder
Future Growth Objectives	3-level categorical: 1=become smaller or stay the same size; 2=grow moderately, 3=grow substantially, in 1991, 1995, and 1997
Manager's Ownership	3-level categorical: 1 = CE's equity stake in firm is 10% and less; 2 = 11-50%; 3=51% and greater, in 1991
Use of Government Business Advice	Binary: 1=sought advice, in 1991
Firm-level Attributes:	
Innovation	Binary: 1= innovation in products / processes, in 1991, 1995, and 1997
Workforce Training	Binary: 1= trainer, in 1991 and 1997
Non-exporter	Binary: 1=nil export sales, in 1991, 1995 and 1997
Actual Growth in Sales	Log difference of sales for 1987-91, 1991-95, and 1995-97
Profitability	Categorical: profit margin* quintiles, in 1991, 1995 and 1997
Attempts to Raise External Finance	Binary: 1=sought external finance, in 1991, 1995, and 1997
Employment Size	4-level categorical: 1=2-10 persons; 2=10-24; 3=25-49; 4=50 and more, in 1991, 1995, and 1997
New Start-up	Binary: 1= new start-up as opposed to a purchased business
Environment:	
Seller Concentration	4-level categorical, according to the number of serious competitors: 1=0-2; 2=3-5; 3=6-10; 4=11 and more, in 1991, 1995 and 1997
Customer Dependence	4-level categorical, based on the percentage of sales to largest customer: 1= less than 10%, 2=10-24%; 3=25-49%; 4=50% and more, in 1991, 1995, and 1997
Location	4-level categorical: 1=South East England; 2=Outer Southern England; 3=Industrial Heartland; 4=Periphery: North, Wales, Scotland
Other:	
Age of Firm at Entry to Study	5-level categorical, based on age in 1991: 1=over 50 years; 2=26-50; 3=11-25; 4=6-10 and 5= younger than 5

*Note to Table 3: Profit margin is profit before interest, directors' emoluments and tax expressed as a proportion of sales.

Table 4: Descriptive Statistics

Raw Data, 1991	Mean	Median	S.D.	Obs.
Manufacturing Firms				
Employment Size, total number of employees	66	35	81	495
Sales, £m	3.79	1.50	7.59	479
Exports, £m	0.73	4.50	3.43	486
Firm Age at Entry to Study, in 1991, years	30	17	34	495
Profit Margin*	0.07	0.07	0.15	390
Proportion of Directors with Prof. Qualifications	0.37	0.33	0.34	484
Chief Executive's Equity Stake in the Firm	0.47	0.50	0.28	459
Age of Chief Executive, years	49	49	9	482
Chief Executive's Years with the Firm	15.64	13.5	10.01	486
Previous Unemployment of Founder: binary, 1=Yes	0.29	0	0.45	444
Future Growth Objectives: 4-level categorical*	3.07	3	0.62	490
Use of Government Business Advice: binary, 1=Yes	0.48	0	0.50	495
Innovation: binary, 1=Yes	0.82	1	0.39	466
Workforce Training: binary, 1=Yes	0.72	1	0.45	494
New Start-up: binary, 1=Yes	0.73	1	0.45	494
Attempts to Raise External Finance: binary, 1=Yes	0.65	1	0.48	481
Number of Serious Competitors	10	5	18	452
Customer Dependence*	2.05	2	0.94	467
Business Services Firms				
Employment Size, total number of employees	43	17	66	356
Sales, £m	1.92	0.80	3.38	341
Exports, £m	0.16	0	0.70	346
Firm Age at Entry to Study, in 1991, years	14	9	19	356
Profit Margin*	0.09	0.07	0.15	294
Proportion of Directors with Prof. Qualifications	0.48	0.50	0.40	344
Chief Executive's Equity Stake in the Firm	0.52	0.50	0.30	333
Age of Chief Executive, years	47	45	9	349
Chief Executive's Years with the Firm	10.51	9	7.38	352
Previous Unemployment of Founder: binary, 1=Yes	0.27	0	0.45	350
Future Growth Objectives (4-level categorical)*	3.16	3	0.62	354
Innovation: binary, 1=Yes	0.79	1	0.41	309
Use of Government Business Advice: binary, 1=Yes	0.31	0	0.47	356
Training for Personnel: binary, 1=Yes	0.63	1	0.48	353
New Start-up: binary, 1=Yes	0.75	1	0.43	354
Attempts to Raise External Finance: binary, 1=Yes	0.62	1	0.49	345
Number of Serious Competitors	13	5	21	314
Customer Dependence*	2.26	2	1	335

*Notes to Table 4: Future growth objectives is a 4-level categorical variable which equals to 1 for 'stay the same size'; 2 for 'grow smaller', and 3 and 4 for 'grow moderately and ' grow substantially'. Customer dependence takes values from 1 to 4 according to the percentage of sales to the largest customer, with 1 for '$<$10%' and 4 for '$\geq$ 50%'. Profit margin is profit before interest, directors' emoluments and tax, expressed as a proportion of sales.

Table 5: Sample Distribution by Region

	Manufacturing Firms	Business Services Firms
South East England	178	195
Outer Southern England:		
East Anglia, South West, the East Midlands	104	56
Industrial Heartland:		
West Midlands, North West, Yorkshire and Humberside	161	70
Periphery:		
North, Wales, Scotland	52	35
Total:	495	356

Table 6: Relationships Present in 90% and 95% Credible Intervals

	Manufacturing		Business Services	
	Insolvency	Acquisition	Insolvency	Acquisition
Effects of Managerial Characteristics:				
Age of Manager				
LogAge	−		+	−
$(\text{LogAge})^2$	+		−	+
Education:				
Nil proportion of directors with prof. qualifns.		−		
Manager's Tenure				
Log(Chief Executive's Years with Firm)	−	−		
Previous Unemployment	−	−		
Future Growth Objectives[a]				
grow moderately	−	−		+
grow substantially	−	−	−	+
Manager's Ownership:				
Share of Equity held by Chief Executive[b]				
11-50 per cent	+			−
51 per cent and greater	+			−
Use of Government Business Advice				

Signs ($+$ /$-$) represent positive and negative effects and are shown only for the variables significant in influencing exit. Results are based on a single chain run of iterations 15,001-23,000.

[a] Reference Group: 'become smaller or stay same size'.

[b] Reference Group: '10 per cent and less'.

(continued)

Table 6: *(continued)*

	Manufacturing		Business Services	
	Insolvency	Acquisition	Insolvency	Acquisition
Effects of Firm-level Attributes:				
Innovation			−	−
Workforce Training		+		
Non-exporter	+			−
Actual Growth in Sales		−		
Profitability[c]				
Quintile 2	−		−	−
Quintile 3	−		−	
Quintile 4			−	
Quintile 5 (largest)	−		−	
Attempts to Raise External Finance	+			+
Employment Size[d]				
10-24 employees	−			
25-49 employees			+	+
50+			+	+
New Start-up				
Effects of Environment:				
Market Structure:				
Seller Concentration, Number of Serious Competitors[e]				
3-5	+		−	
6-10			−	
more than 10				
Customer Dependence:				
Proportion of Sales to Largest Customer[f]				
10-24 per cent			+	
25-49 per cent			+	
50 per cent or more				−
Location[g]				
Outer Southern England				−
Industrial Heartland				
Periphery (North, Wales, Scotland)				
Additional Parameters:				
Age of Firm at Entry to Study[h]				
Age 26-50				+
Age 11-25	+	+		+
Age 6-10		+		+
Age $\leq$ 5	+			+

Signs (+ /−) represent positive and negative effects and are shown only for the variables significant in influencing exit. Results are based on a single chain run of iterations 15,001-23,000.

[c] Reference Group: 'quintile 1 (smallest)'.

[d] Reference Group: '2-9 employees'.

[e] Reference Group: '0-2'.

[f] Reference Group: 'less than 10 per cent'.

[g] Reference Group: 'South East'.

[h] Reference Group: '51+'.

Table 7A: Effects of Managerial Characteristics in Manufacturing Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Age of Manager						
LogAge	-7.204	-9.184	-9.065	-7.576	-4.642	-4.245
$(\text{LogAge})^2$	2.821	2.067	2.142	2.798	3.556	3.711
Education: Nil Proportion						
of Directors with Professional Qualifications	-0.081	-0.703	-0.589	-0.080	0.419	0.507
Manager's Tenure						
Log(Chief Executive's Years with Firm)	-1.498	-2.362	-2.207	-1.516	-0.657	-0.470
Previous Unemployment	-0.562	-1.205	-1.118	-0.549	-0.055	0.039
Future Growth Objectives[a]						
grow moderately	-1.327	-2.137	-2.003	-1.310	-0.688	-0.562
grow substantially	-2.292	-3.550	-3.318	-2.263	-1.296	-1.152
Manager's Ownership: Share of Equity held by Chief Executive[b]						
11-50 per cent	1.122	-0.022	0.125	1.067	2.393	3.253
51 per cent and greater	1.243	0.013	0.184	1.193	2.525	3.536
Use of Government Business Advice	-0.167	-0.699	-0.608	-0.168	0.267	0.337
Acquisition						
Age of Manager						
LogAge	-0.830	-3.090	-2.907	-0.939	1.702	1.932
$(\text{LogAge})^2$	0.724	-0.442	-0.319	0.747	1.523	1.664
Education: Nil Proportion						
of Directors with Professional Qualifications	-0.769	-1.496	-1.371	-0.758	-0.194	-0.091
Manager's Tenure						
Log(Chief Executive's Years with Firm)	-1.042	-1.864	-1.748	-1.062	-0.308	-0.115
Previous Unemployment	-1.038	-1.730	-1.630	-1.030	-0.488	-0.402
Future Growth Objectives[a]						
grow moderately	-0.782	-1.579	-1.442	-0.804	-0.020	0.130
grow substantially	-1.193	-2.189	-2.053	-1.207	-0.272	-0.076
Manager's Ownership: Share of Equity held by Chief Executive[b]						
11-50 per cent	-0.064	-0.807	-0.666	-0.057	0.539	0.636
51 per cent and greater	-0.191	-1.012	-0.874	-0.181	0.478	0.641
Use of Government Business Advice	0.208	-0.263	-0.207	0.214	0.599	0.687

[a] Reference Group: 'become smaller or stay same size'.

[b] Reference Group: '10 per cent and less'.

Table 7B: Effects of Managerial Characteristics in Business Services Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Age of Manager						
LogAge	8.579	4.434	4.700	8.387	12.570	12.950
$(\text{LogAge})^2$	-2.781	-4.536	-4.403	-2.794	-1.387	-1.296
Education: Nil Proportion						
of Directors with Professional Qualifications	0.109	-0.510	-0.408	0.109	0.616	0.727
Manager's Tenure						
Log(Chief Executive's Years with Firm)	-0.982	-2.296	-2.055	-1.050	0.398	1.066
Previous Unemployment	-0.018	-0.629	-0.539	-0.017	0.478	0.585
Future Growth Objectives[a]						
grow moderately	-0.435	-1.299	-1.156	-0.417	0.261	0.381
grow substantially	-0.931	-2.022	-1.847	-0.900	-0.089	0.018
Manager's Ownership: Share of Equity held by Chief Executive[b]						
11-50 per cent	0.130	-0.836	-0.667	0.097	1.032	1.202
51 per cent and greater	0.507	-0.495	-0.372	0.484	1.434	1.602
Use of Government Business Advice	-0.263	-0.886	-0.782	-0.256	0.244	0.330
Acquisition						
Age of Manager						
LogAge	-3.508	-6.090	-5.714	-3.323	-1.368	-1.153
$(\text{LogAge})^2$	1.262	0.196	0.321	1.325	1.914	2.000
Education: Nil Proportion						
of Directors with Professional Qualifications	-0.112	-0.834	-0.682	-0.120	0.467	0.570
Manager's Tenure						
Log(Chief Executive's Years with Firm)	-0.655	-1.885	-1.668	-0.644	0.291	0.448
Previous Unemployment	-0.349	-1.058	-0.943	-0.340	0.223	0.309
Future Growth Objectives[a]						
grow moderately	2.936	0.583	0.794	2.876	5.312	6.107
grow substantially	3.707	1.230	1.430	3.663	6.087	6.830
Manager's Ownership: Share of Equity held by Chief Executive[b]						
11-50 per cent	-1.422	-2.435	-2.266	-1.411	-0.679	-0.566
51 per cent and greater	-1.212	-2.361	-2.103	-1.170	-0.410	-0.299
Use of Government Business Advice	0.162	-0.463	-0.365	0.157	0.672	0.766

[a] Reference Group: 'become smaller or stay same size'.

[b] Reference Group: '10 per cent and less'.

Table 8A: Effects of Firm-level Attributes in Manufacturing Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Innovation	-0.060	-0.864	-0.696	-0.072	0.627	0.779
Workforce Training	0.157	-0.453	-0.343	0.165	0.674	0.745
Non-Exporter	0.654	0.028	0.120	0.634	1.219	1.338
Actual Growth in Turnover (Sales)	-1.017	-2.394	-2.207	-1.049	0.063	0.148
Profitability:						
Profit Margin before Interest, Directors' Emoluments and Tax[c]						
Quintile 2	-1.143	-2.159	-1.982	-1.131	-0.372	-0.236
Quintile 3	-1.438	-2.619	-2.448	-1.396	-0.565	-0.417
Quintile 4	-0.904	-2.098	-1.894	-0.907	0.044	0.178
Quintile 5 (largest)	-2.082	-3.474	-3.259	-2.048	-0.992	-0.801
Attempts to Raise External Finance	0.920	0.320	0.400	0.911	1.516	1.597
Employment Size[d]						
10-24 employees	-1.030	-1.986	-1.854	-1.019	-0.239	-0.036
25-49 employees	-0.039	-1.030	-0.867	-0.047	0.859	1.031
50+	-0.147	-1.194	-1.025	-0.169	0.811	1.073
New Start-up	0.329	-0.284	-0.193	0.315	0.882	0.972
Acquisition						
Innovation	0.036	-0.585	-0.493	0.028	0.570	0.699
Workforce Training	0.847	0.191	0.286	0.837	1.415	1.508
Non-Exporter	0.123	-0.479	-0.394	0.109	0.671	0.776
Actual Growth in Turnover (Sales)	-0.618	-1.612	-1.446	-0.535	-0.039	0.018
Profitability:						
Profit Margin before Interest, Directors' Emoluments and Tax[c]						
Quintile 2	-0.093	-1.075	-0.916	-0.080	0.700	0.847
Quintile 3	-0.269	-1.317	-1.128	-0.244	0.596	0.740
Quintile 4	0.293	-0.644	-0.512	0.277	1.112	1.230
Quintile 5 (largest)	-0.303	-1.371	-1.223	-0.300	0.580	0.739
Attempts to Raise External Finance	0.402	-0.086	-0.022	0.399	0.823	0.932
Employment Size[d]						
10-24 employees	-0.396	-1.695	-1.480	-0.451	0.960	1.640
25-49 employees	0.375	-0.900	-0.745	0.290	1.717	2.342
50+	0.775	-0.441	-0.265	0.691	2.070	2.700
New Start-up	-0.177	-0.641	-0.573	-0.183	0.248	0.340

[c] Reference Group: 'quintile 1 (smallest)'.

[d] Reference Group: '2-9 employees'.

Table 8B: Effects of Firm-level Attributes in Business Services Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Innovation	-0.697	-1.327	-1.245	-0.701	-0.141	-0.037
Workforce Training	-0.134	-0.717	-0.610	-0.141	0.366	0.465
Non-Exporter	-0.443	-1.143	-1.030	-0.438	0.168	0.249
Actual Growth in Turnover (Sales)	-0.293	-0.990	-0.844	-0.249	0.101	0.165
Profitability:						
Profit Margin before Interest, Directors' Emoluments and Tax[c]						
Quintile 2	-1.601	-2.728	-2.527	-1.578	-0.734	-0.577
Quintile 3	-1.939	-3.339	-3.103	-1.925	-0.873	-0.692
Quintile 4	-0.889	-1.854	-1.692	-0.892	-0.145	-0.010
Quintile 5 (largest)	-2.567	-4.702	-4.246	-2.468	-1.264	-0.978
Attempts to Raise External Finance	0.477	-0.237	-0.111	0.480	1.068	1.199
Employment Size[d]						
10-24 employees	0.595	-0.234	-0.098	0.588	1.293	1.440
25-49 employees	1.109	0.083	0.249	1.081	1.987	2.094
50+	1.176	0.268	0.409	1.176	1.955	2.104
New Start-up	0.248	-0.377	-0.300	0.234	0.805	0.925
Acquisition						
Innovation	-1.372	-2.275	-2.157	-1.351	-0.639	-0.538
Workforce Training	0.257	-0.472	-0.335	0.276	0.767	0.899
Non-Exporter	-0.772	-1.549	-1.428	-0.793	-0.070	0.044
Actual Growth in Turnover (Sales)	0.349	-0.096	-0.019	0.348	0.676	0.740
Profitability:						
Profit Margin before Interest, Directors' Emoluments and Tax[c]						
Quintile 2	-1.527	-3.043	-2.740	-1.488	-0.437	-0.264
Quintile 3	-0.387	-1.486	-1.305	-0.371	0.512	0.667
Quintile 4	-0.308	-1.415	-1.201	-0.319	0.624	0.785
Quintile 5 (largest)	-0.072	-1.221	-1.030	-0.063	0.848	1.029
Attempts to Raise External Finance	0.688	0.038	0.139	0.679	1.276	1.371
Employment Size[d]						
10-24 employees	-0.885	-2.260	-2.001	-0.856	0.131	0.287
25-49 employees	1.176	0.050	0.222	1.152	2.204	2.386
50+	1.059	-0.037	0.105	1.032	1.970	2.133
New Start-up	-0.153	-0.764	-0.672	-0.156	0.354	0.471

[c] Reference Group: 'quintile 1 (smallest)'.

[d] Reference Group: '2-9 employees'.

Table 9A: Effects of Environment on Manufacturing Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Market Structure:						
Seller Concentration						
Number of Serious Competitors[e]						
3-5	1.588	0.509	0.650	1.596	2.550	2.726
6-10	0.691	-0.464	-0.314	0.685	1.690	1.926
more than 10	0.729	-0.785	-0.578	0.744	1.974	2.168
Customer Dependence:						
Proportion of Sales to Largest Customer[f]						
10-24 per cent	-0.603	-1.407	-1.295	-0.589	0.059	0.183
25-49 per cent	-0.457	-1.367	-1.221	-0.444	0.245	0.352
50 per cent or more	0.374	-0.766	-0.610	0.384	1.266	1.436
Location[g]						
Outer Southern England	-0.230	-1.060	-0.957	-0.212	0.397	0.529
Industrial Heartland	-0.552	-1.289	-1.160	-0.549	0.043	0.167
Periphery (North, Wales, Scotland)	-0.105	-0.962	-0.828	-0.078	0.555	0.682
Acquisition						
Market Structure:						
Seller Concentration						
Number of Serious Competitors[e]						
3-5	0.274	-0.594	-0.493	0.264	1.063	1.195
6-10	-0.142	-1.024	-0.919	-0.144	0.689	0.875
more than 10	0.545	-0.483	-0.330	0.554	1.425	1.563
Customer Dependence:						
Proportion of Sales to Largest Customer[f]						
10-24 per cent	-0.144	-0.773	-0.684	-0.152	0.414	0.528
25-49 per cent	0.130	-0.574	-0.468	0.132	0.722	0.854
50 per cent or more	0.319	-0.908	-0.689	0.340	1.262	1.416
Location[g]						
Outer Southern England	-0.093	-0.743	-0.629	-0.092	0.426	0.490
Industrial Heartland	-0.297	-0.866	-0.764	-0.290	0.144	0.252
Periphery (North, Wales, Scotland)	-0.282	-1.140	-0.957	-0.261	0.374	0.470

[e] Reference Group: '0-2 serious competitors'.

[f] Reference Group: 'less than 10 per cent'.

[g] Reference Group: 'South East England'.

Table 9B: Effects of Environment on Business Services Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Market Structure:						
Seller Concentration						
Number of Serious Competitors[e]						
3-5	-0.756	-1.644	-1.496	-0.766	-0.041	0.108
6-10	-1.032	-2.085	-1.933	-1.024	-0.150	-0.009
more than 10	-0.271	-1.131	-0.979	-0.260	0.417	0.573
Customer Dependence:						
Proportion of Sales to Largest Customer[f]						
10-24 per cent	1.028	-0.030	0.138	1.034	1.947	2.136
25-49 per cent	1.151	-0.024	0.163	1.141	2.171	2.385
50 per cent or more	0.719	-0.635	-0.410	0.732	1.739	1.920
Location[g]						
Outer Southern England	0.226	-0.622	-0.492	0.225	0.952	1.059
Industrial Heartland	0.516	-0.115	-0.032	0.523	1.056	1.163
Periphery (North, Wales, Scotland)	-0.115	-1.262	-1.036	-0.095	0.728	0.909
Acquisition						
Market Structure:						
Seller Concentration						
Number of Serious Competitors[e]						
3-5	0.319	-0.815	-0.639	0.250	1.483	1.777
6-10	-0.446	-1.702	-1.485	-0.475	0.720	1.012
more than 10	-0.588	-1.984	-1.797	-0.626	0.661	0.930
Customer Dependence:						
Proportion of Sales to Largest Customer[f]						
10-24 per cent	0.320	-0.518	-0.381	0.300	1.080	1.262
25-49 per cent	-0.225	-1.357	-1.185	-0.200	0.661	0.849
50 per cent or more	-1.477	-3.461	-3.015	-1.382	-0.129	0.107
Location[g]						
Outer Southern England	-0.947	-2.045	-1.817	-0.942	-0.114	0.006
Industrial Heartland	0.161	-0.605	-0.474	0.155	0.798	0.904
Periphery (North, Wales, Scotland)	0.324	-0.679	-0.527	0.339	1.162	1.300

[e] Reference Group: '0-2 serious competitors'.

[f] Reference Group: 'less than 10 per cent'.

[g] Reference Group: 'South East England'.

Table 10A: Additional Parameters for Manufacturing Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Age of Firm at Entry to Study[h]						
Age 26-50	0.113	-0.991	-0.796	0.101	1.018	1.249
Age 11-25	0.948	0.060	0.185	0.947	1.775	1.968
Age 6-10	0.688	-0.339	-0.176	0.690	1.634	1.866
Age $\leq$ 5	1.284	-0.076	0.153	1.277	2.481	2.696
Interval-specific fixed effects[i]						
1995-1996	-3.584	-4.852	-4.625	-3.558	-2.704	-2.580
1997-2000	-5.861	-7.416	-7.178	-5.830	-4.637	-4.448
Competing risk fixed effect	-7.129	-13.310	-11.710	-7.448	-3.056	-2.162
Shape Parameter	6.077	4.432	4.658	6.012	7.845	8.097
Acquisition						
Age of Firm at Entry to Study[h]						
Age 26-50	-0.118	-0.955	-0.831	-0.119	0.625	0.757
Age 11-25	0.754	0.070	0.192	0.746	1.337	1.458
Age 6-10	0.893	0.134	0.239	0.891	1.560	1.724
Age $\leq$ 5	0.796	-0.314	-0.140	0.790	1.754	1.921
Interval-specific fixed effects[i]						
1995-1996	-3.851	-4.816	-4.652	-3.854	-3.059	-2.928
1997-2000	-6.971	-8.665	-8.461	-7.010	-5.370	-5.144
Competing risk fixed effect	-16.790	-19.000	-18.740	-16.970	-14.400	-13.140
Shape Parameter	8.877	6.746	6.919	9.017	10.570	10.770

[h] Reference Group: '51+'.

[i] Reference Time Interval: 1991-1994.

Table 10B: Additional Parameters for Business Services Firms

Results are based on a single chain run of iterations 15,001-23,000

	Posterior	Posterior quantiles				
	Mean	2.5%	5%	Median	95%	97.5%
Insolvency						
Age of Firm at Entry to Study[h]						
Age 26-50	0.127	-1.726	-1.428	0.077	1.856	2.087
Age 11-25	-0.348	-2.047	-1.847	-0.375	1.305	1.531
Age 6-10	-0.210	-1.967	-1.760	-0.160	1.349	1.685
Age $\leq$ 5	-0.234	-2.188	-1.963	-0.205	1.454	1.705
Interval-specific fixed effects[i]						
1995-1996	-3.708	-4.778	-4.636	-3.732	-2.651	-2.373
1997-2000	-7.113	-9.025	-8.805	-7.248	-4.817	-4.470
Competing risk fixed effect	-18.170	-23.670	-22.880	-19.060	-9.870	-8.982
Shape Parameter	7.074	3.791	4.195	7.276	9.112	9.411
Acquisition						
Age of Firm at Entry to Study[h]						
Age 26-50	2.289	-0.158	0.126	2.205	4.581	5.166
Age 11-25	2.288	0.294	0.554	2.180	4.248	5.021
Age 6-10	2.069	0.058	0.318	2.004	3.963	4.457
Age $\leq$ 5	1.881	-0.130	0.109	1.801	3.867	4.401
Interval-specific fixed effects[i]						
1995-1996	-2.847	-4.316	-4.084	-2.790	-1.851	-1.719
1997-2000	-7.333	-10.350	-9.902	-7.191	-5.479	-5.273
Competing risk fixed effect	-19.990	-24.150	-23.660	-20.350	-15.290	-14.970
Shape Parameter	10.330	7.946	8.236	10.130	13.460	13.890

[h] Reference Group: '51+'.

[i] Reference Time Interval: 1991-1994.