TAKEOVER RISK AND THE MARKET FOR CORPORATE CONTROL:

THE EXPERIENCE OF BRITISH FIRMS IN THE 1970S AND 1980S

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January 1998

Abstract

This paper investigates the determinants of takeovers in a large sample of UK quoted companies. We focus on the channels through which the market for corporate control monitors company performance and discretionary managerial behaviour. Our results indicate that the market for corporate control disciplines poorly performing companies, and that this effect is quantitatively important: a one standard deviation increase in profitability is associated with a fall in the conditional probability of takeover of over 20%. However, we find no evidence that firms without apparent profitable investment opportunities are more likely to be taken over if managers increase investment or reduce dividends, contrary to the predictions of the free cash-flow theory of takeovers.

JEL Classification: L1, G3, C41

Keywords: Takeovers, Market for Corporate Control, Hazard Functions

Acknowledgements: We would like to thank Clive Massey at SWURCC at the University of Bath for his assistance in accessing the data used in this study. Tim Gallagher provided painstaking and conscientious research assistance financed, in part, by the Faculty of Social Sciences Small Grants Committee at the University of Kent at Canterbury. Comments from Alan Carruth have helped to improve the paper.

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1. Introduction

Takeover activity during the mid to late 1980s in both the UK and the US reached a new peak both in terms of the number and, more particularly, the value of takeovers. In the UK, some 36 per cent of manufacturing companies were taken over between 1975 and 1990[1]. In the US, the figure was 30 per cent between 1976 and 1987 (Jensen, 1992). Figure 1 plots the volume and real value of UK takeovers for each year from 1975 to 1990. This clearly indicates the heightened level of activity in general in the mid- to late-1980s.

The extent of takeover activity and its importance in the UK economy raises questions about the factors that explain why companies are taken over. In particular, given the nature of the takeover boom of the late 1980s, it is interesting to investigate the disciplinary motive for takeover and, more generally, the way in which the market for corporate control operates. To date, work for the UK is limited. Franks and Mayer (1996) examine the disciplinary role of hostile takeovers occurring in 1985 and 1986 by focusing on stock market returns. They conclude that there is little evidence of poor performance before the bid, suggesting that hostile takeovers, at least, are not primarily motivated by the correction of managerial failure.

The purpose of this paper is to delve further into the role played by the market for corporate control in the UK during the 1970s and 1980s. In particular, we pose two questions. First, is there any evidence that the disciplinary motive for takeovers is at work during the period?

[1] This figure is based on the data used in this study.

Second, can we identify the channels through which the market for corporate control operates? The literature identifies a number of principal factors which the market may concentrate upon when deciding whether managers are acting in shareholders' best interests, namely profitability, dividends and investment. We investigate these ideas empirically using a rather different approach from that of Franks and Mayer. We use both accounting and stock market data to focus on the determinants of the conditional probability that a firm is taken over. We conclude that whilst there is strong evidence that the market for corporate control operates through monitoring corporate performance as measured by profitability, there is little support for the view that a company's investment and dividend policy are particularly significant.

The rest of the paper is organised as follows. In section 2, we review the extant literature on the various motivations for why takeovers may occur. Section 3 considers our data and methodology. Section 4 discusses our results and section 5 concludes.

2. Takeovers and the Market for Corporate Control

The literature on mergers and acquisitions (or takeovers) recognizes a number of reasons why one company may be acquired by another[2]. They can be divided into two broad categories for our purposes: motives which stem from industry-specific factors (including synergistic effects and the impact of restructuring); and corporate control and agency cost motivations.

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[2] Large theoretical and empirical literatures exist; the former includes Amihud and Lev (1981), Easterbrook (1984), Gort (1969), Jensen (1986, 1988), Mueller (1969), Roll (1986), Schnitzer (1996) and Singh (1971), while Jarrell *et al* (1988), Hughes (1993), Jensen and Ruback (1983), Scherer (1988), Shleifer and Vishny (1988) survey the empirical work. We discuss both the theoretical and empirical literature extensively in Dickerson *et al* (1997).

Early theories of takeover emphasised industry-specific factors as important motives for takeover (Gort, 1969). There are several ideas here. First, takeovers occur in order to reap the benefits of synergy. These include the realisation of economies of scale and the desire to reduce competition and benefit from monopoly power. Both provide motives for takeovers which are either horizontal or vertical. An extension to this theory is provided by Mueller (1969) who argues that conglomerate acquisitions might be explained by the existence of management synergies, by the fact that large, diversified firms might have easier access to finance, and by a desire on the part of management to reduce risk through a pooling of activities (see also Amihud and Lev, 1981). A second industry-specific motive is that mergers and acquisitions can often be a convenient means through which industries are restructured following some economic disturbance (e.g. technological improvement) which requires a reduction in the optimal size of that industry (Gort, 1969)[3]. We attempt to control for such effects largely through the inclusion of industry dummies as well as a number of other factors (such as size[4]) which could well differ systematically by industry[5]. To the extent that

[3] Gort (1969) argues that systematic differences in opinion about the valuation of the firm drive merger and acquisition activity. The differences are systematic since they are more likely to occur when the industry has experienced an economic shock (most commonly, a technological shock); Mitchell and Mulherin (1996) attempt to test some of Gort's ideas. Mueller (1969) also discusses differences in valuation between managers and shareholders of different firms which could result because management knows more about the opportunities than shareholders do (they have some inside information) or because of the existence of "supermanagement geniuses who see hidden economic potentials in the firms they acquire" (Mueller, 1969, p.654). If tangible assets are more easily valued than intangibles (which include goodwill), then there will be more scope for disagreements about the value of a company the lower the proportion of tangibles in total assets. We include such a measure in our analysis.

[4] A further rationale for the inclusion of size is the existence of financing constraints which may prevent large companies from being taken over. There is much evidence that size does indeed provide a hindrance to takeover; see, for example, Rege (1984), Cosh *et al* (1984), Hasbrouck (1985) and Machlin *et al* (1993).

[5] Clearly conglomerate mergers and acquisitions cannot be treated in this way. However, factors such as management synergy are rather nebulous and difficult to measure. To the extent that conglomerate mergers may occur for financial reasons, we include a measure of the

restructuring occurs in a number of industries at similar times, this could also explain the time series variation in acquisition activity[6].

The second broad category of explanations for takeovers explicitly recognises the agency costs that result from a separation of management and ownership: managers will be tempted to pursue their own goals, which might include growth maximisation, in an attempt to benefit from increased prestige, perks or salaries (Marris, 1964)[7]. In the absence of any internal method of control, or where such methods are not successfully implemented, the market for corporate control facilitates the dismissal of managers who are not acting in shareholders' best interests (Shleifer and Vishny, 1988).

To assess the extent to which this agency theory of takeover represents a significantly important explanation of takeover activity, it must be possible to identify the channels through which it operates. The main channel is expected to be the profitability of the firm. If managers are pursuing goals other than profit maximisation, such that they are making investment decisions based on a desire to increase the size of the firm rather than on the principle of value maximisation (or if they are simply poor quality managers) then we would anticipate that company performance as measured by profitability would fall. If the market for corporate control is operating to discipline non-value-maximising managers, then lower profitability

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acquired company's liquidity. If firms are short of finance, then more liquid companies may be attractive (Rege, 1984; Palepu, 1986). Similarly, companies with low leverage offer the combined firm the opportunity of raising funds by borrowing externally (Rege, 1984; Hasbrouck, 1985). Hence we also include a measure of leverage in our empirical work below.

[6] Crook (1993) investigates the time series determinants of aggregate merger and acquisition activity.

[7] Mueller (1969) discusses the possibility that mergers can be explained by managers maximising growth rather than shareholder value. He attributes this behaviour to managers having a lower discount rate than shareholders.

should be associated with an increased probability of takeover.

However, profitability is not the only means through which the market for corporate control might be expected to operate[8]. Jensen (1986, 1988) has provided alternative channels which derive from a specific type of non-value-maximising activity on the part of managers, namely the inappropriate use of a firm's free cash-flow. Free cash-flow is the cash available to a firm in excess of that required to fund the firm's profitable (positive NPV) investment opportunities. According to Jensen, value-maximising managers should distribute this free cash to shareholders in the form of higher dividends (or, alternatively, they could use it in order to repurchase their own shares).

The free cash-flow theory of takeover suggests two additional channels through which the market for corporate control might be expected to exert its influence. In firms with a lack of positive NPV investment opportunities, the payment of higher dividends will signal that managers are not squandering shareholders' assets. Thus, higher dividends should be related to a lower probability of takeover[9]. At the same time, any increase in investment by such firms will necessarily be value-reducing since they have no profitable investment opportunities, and the market should discipline such over-investment behaviour by takeover. Thus Jensen's extension of the agency theory of takeover indicates a role for both investment and dividend policy in influencing the probability of takeover, at least among companies which have no

[8] It can be noted that if takeovers occur because acquiring firms are seeking profitable investments, then more profitable companies may be taken over (Schwartz, 1982; Rege, 1984). If this effect dominates, then profitability could have a positive impact on the probability of takeover.

[9] The idea that managers use dividends as a signal to convey information about their intentions or about the future performance of the firm is one which has been much investigated in the literature (see, for example, Miller and Rock, 1985; John and Williams, 1985).

positive NPV investment opportunities. In what follows, we therefore examine the impact of firms' investment and dividend policies, as well as their profitability, on the probability of takeover.

3. Data and Methodology

We use a large sample of UK quoted companies to investigate the above hypotheses concerning the channels through which the market for corporate control is expected to operate. Since the proportion of companies acquired in our sample (36 per cent) is representative of the population proportion of acquisitions in the UK over the period, our sampling methodology contrasts with that usually employed in the literature on takeovers. Typically, a 'matched' sample of firms is selected such that the proportion of firms in the sample which are acquired is 50 per cent. Matched, or choice-based, sampling has been shown by Palepu (1986) to lead to biased estimates of the determinants of takeover since the sampling is nonrandom with respect to the probability of being acquired.

A further advantage of our sampling methodology is that we do not artificially choose a sample of firms for which we suspect that the probability of takeover was likely to be particularly influenced by the channels that we are investigating in this paper. This contrasts with a number of papers in the literature which focus on one particular industry where, say, extraneous investment is thought to have occurred (Jensen, 1986) and then test the over-investment hypothesis; or where the market for corporate control thesis is investigated by examining only hostile takeovers (Bhagat *et al* 1990). Both approaches have an element of subjectivity and, of course, cannot test the general applicability of specific theories. On the other hand, we acknowledge that our approach is not without its own limitations given that takeovers occur for many different reasons. In particular, we will only be able to identify influences on takeover which are of general relevance, although this will of course allow us to determine whether disciplinary motives are a dominant cause of takeover during the period.

We estimate the takeover hazard function, that is the instantaneous probability of takeover at time *t*, conditional on 'survival' until time *t*. This is ideally suited to our main question since it allows us to investigate whether, given that a firm has survived up to a certain point in time, changes in particular characteristics of the firm will lead to a change in the probability of takeover. Thus, the estimation methodology identifies the characteristics of the firm at the time of takeover as being important, rather than the average characteristics over a firm's lifetime, as in the more traditional logit and probit studies of the probability of takeover. Furthermore, it also allows us to overcome additional problems associated with the more traditional logit/probit approach. In particular, we can incorporate time-varying covariates and also allow for a flexible baseline hazard which, in combination, can alleviate the potential bias that arises from unobserved individual heterogeneity[10]. In addition, we also allow explicitly for unobserved heterogeneity in the hazard, and this enables us to assess the degree to which a flexible baseline hazard can indeed mitigate the impact of unobserved individual firm heterogeneity. Finally, we can control for the well-documented cycles in takeover activity. This is particularly important in our study given that our sample includes periods of low levels of takeover activity as well as the late 1980s boom in takeovers. To the best of our knowledge, this is the first paper to utilise such an approach to address the issue of takeover activity.

The standard proportional continuous time hazard function (Cox, 1972) can be written as:

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[10] See, for example, Lancaster (1979) and Lancaster and Nickell (1980).

$$g_i(t) = g_0(t)\exp[X_i(t)'\beta], \tag{1}$$

where $g_i(t)$ is the instantaneous probability of takeover for company *i* conditional on survival to time *t*, $g_0(t)$ is the underlying or baseline hazard at time *t*, $X_i(t)$ is a vector of (possibly time-varying) explanatory variables and β is a vector of unknown parameters[11].

The underlying baseline hazard, g_0, can be estimated jointly with β if it is parametrically specified with respect to duration (a common specification is the Weibull which implies a monotonic hazard). However, as is well known, this can lead to severe bias in the estimated β, especially for time-varying covariates. Thus we do not adopt this approach here. Instead, we employ the discrete time analogue of equation (1) (Prentice and Gloeckler, 1978). This allows us to overcome two potential weaknesses of the continuous time version (Jenkins, 1995). Firstly, following Meyer (1990), it allows us to estimate the underlying hazard non-parametrically and evidence suggests that this can circumvent the bias that arises from misspecifying g_0 since it generates a very flexible baseline hazard. Secondly, as noted above, evidence also suggests that the familiar negative duration dependence bias arising from unobserved heterogeneity in duration models may be mitigated if a sufficiently flexible baseline hazard is employed (Dolton and van der Klaauw, 1995).

Given that our time observation intervals are whole years, a completed duration of *t* denotes that takeover took place between year *t* and year *t*+1. The probability of takeover by *t*+1, given that it

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[11] The implication of the proportional hazard specification is that the covariates $X_i(t)$ imply a proportional scaling of the underlying hazard $g_0(t)$ rather than affecting its shape.

had not occurred by time t, is the discrete time proportional[12] hazard given by:

$$h_i(t) = 1 - \exp\{-\exp[X_i(t)'\beta + G(t)]\} \tag{2}$$

where

$$G(t) = \ln\left[\int_t^{t+1} g_0(v)dv\right] \tag{3}$$

Thus the discrete time hazard has an extreme value distribution while $G(t)$ yields the underlying hazard at each discrete duration t. Estimation is by maximum likelihood.

Unobserved heterogeneity is incorporated into the hazard in a multiplicative form, such that equation (1) becomes

$$g_i(t) = \theta_i g_0(t)\exp[X_i(t)'\beta], \tag{4}$$

where θ_i is a random variable assumed to be independent of $X_i(t)$. A convenient distribution to assume for θ is the gamma with mean one (as a normalisation) and variance σ^2 since this yields a closed form for the unconditional likelihood once we integrate out over $f(\theta)$ (see Meyer, 1990, p. 770, equation (7)).

The time-varying covariates, $X_i(t)$, include size (log real net assets), leverage (short-term debt plus bank loans and overdrafts scaled by net assets), liquidity (net current assets scaled by net assets), tangible assets as a proportion of total assets, gross (pre-tax) dividend yield, gross investment in tangibles (scaled by net assets) and post-tax profitability (the rate of return on net

12 Note that maintaining the proportionality assumption may not be overly restrictive. It has been shown that, for example, the (non-proportional) logistic hazard converges to a proportional hazard for sufficiently small $h_i(t)$ (Bergstrom and Edin, 1992).

assets)[13]. In addition, we include a vector of 15 industry dummies which correspond to the SIC groups. The inclusion of size, leverage, liquidity, tangible assets and the industry dummies, as we noted in section 2, seeks to control for a number of factors which have previously been found to influence the probability of takeover.

Given that we are primarily concerned with the operation of the market for corporate control, the variables of particular interest here include profitability, dividends and investment. It is through these channels that the market for corporate control is hypothesised to operate. Poorly performing firms should be disciplined through takeover and this is captured by impact of profitability on the takeover hazard. The effect of investment and dividends is more complex. As we argued in section 2, according to the free cash-flow theory of takeover, those firms which undertake marginal investments while having no positive NPV investment projects available should experience an increase in the probability of takeover. In contrast, in firms which do have positive NPV investment opportunities, an increase in investment should reduce the conditional probability of takeover since such investment will generate higher future (expected) earnings. To identify the extent to which firms have positive NPV opportunities, we use Tobin's q. Under certain assumptions[14], it can be shown that $q < 1$ identifies a firm with no positive NPV investment opportunities and *vice versa*. This fact has been exploited by numerous studies in the financial economics literature (see, for example, Hasbrouck, 1985; Lang and Litzenberger, 1989; Lang *et al*, 1991; and Denis *et al*, 1994).

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[13] The flow variables are scaled by the average of opening and closing net assets while the stock variables are expressed as a proportion of closing net assets.

[14] These assumptions are the absence of taxes and adjustment costs and constant or declining marginal efficiency of capital at the firm level (Lang *et al*, 1991).

Since average values of *q* across all companies vary significantly over time, we identify firms with 'low' *q* as being those in the lowest quintile in any year. Thus, we classify firms with no positive NPV investment opportunities as having a relatively low value of *q* rather than an absolutely low value of *q*. Using *q* in this manner, we are able to distinguish between the impact of investment on the takeover hazard for those companies with positive NPV investment opportunities and those without. If the market for corporate control is operating through this channel, then we would anticipate that the impact of investment for low *q* firms will be to increase the conditional probability of takeover.

The effect of dividends on takeovers is handled analogously. For firms with a lack of positive NPV investment projects, a distribution of profits as dividends is the signal that managers are not undertaking value-reducing investments. Thus, for firms with low *q*, an increase in dividends should reduce the probability of takeover. For all other firms, we would not expect any impact of dividends on the takeover hazard according to the free cash-flow theory.

EXSTAT provides information on company accounts. Only UK manufacturing companies were selected. Additionally, we restrict our sample to firms with a minimum of five years of available data. This ensures that there is a reasonable span of data on each company and also allows us to observe acquired companies for some time before acquisition. Information is available from 1970 to 1991[15]. The London Share Price Dataset (LSPD) has stock market information for all quoted British companies. Data are available on dividends, share prices and share capital. From our EXSTAT sample, we retain companies which have LSPD data. This effectively restricts our sample to UK quoted companies.

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[15] The data were taken from the 1992 EXSTAT tape.

We use information from both of these datasets in order to generate a large panel of companies with both accounting and stock market information. The EXSTAT data is largely annual although some companies produce two sets of accounts within 12 months or may have more twelve months between accounts when they change their financial year. The LSPD data is monthly for share prices and (usually) biannual for dividend data. When matching observations in these datasets, it is important to note that the end of the financial year differs between companies and can vary for any one company over time. To derive a single dividend payment for any year, we cumulate dividend payments between successive end financial years for each company. Similarly, a share price value for each company year is calculated from the average (end-month) share price for all months between successive end financial years.

Our primary interest is in acquisitions. The fate of each company is recorded in EXSTAT item B35 which distinguishes between acquisitions, liquidations, de-listings etc. In the case where a company has been acquired by another company in EXSTAT, additional information is provided in EXSTAT items B23-B28. This extra information is used to date the acquisition more precisely since it was clear that, in a number of cases, companies continued to produce separate accounts for several years after having been acquired and thus the acquisition could not be dated simply by using the last accounts available on EXSTAT. For companies which were acquired by companies outside EXSTAT, precise dating in this manner was not possible. However, these only represent around 13 per cent of takeovers in our sample.

Tobin's q is the ratio of market value to the replacement cost of a firm's assets. Calculating the market value of the firm raises a number of issues. Share information in LSPD is available on an end-month basis for ordinary shares only. We generate market value of ordinary shares by multiplying the average share price over each company's financial year by the average of the opening and closing number of ordinary shares. Of course, this neglects other share capital (mainly preference shares). We therefore use the book value of other shares in the calculation of the market value[16]. Finally, the definition of market value includes the market value of the firm's debt. However, lack of information on the maturity of debt and current market prices for debt preclude any straightforward valuation. Instead we are forced to use the book value of debt. An additional problem is that the EXSTAT data on total debt is available only from 1982. Before this date, only that part of debt comprising short-term loans, bank loans and overdrafts is available. However, this does not appear to be particularly problematic as regards our calculation of q. Post-1981, the calculation of q using total debt (q_2) ranks companies in each year almost identically to that using the more restricted measurement of debt (q_1). Since we use relative q rather than the absolute value of q to identify companies with a lack of positive NPV opportunities, a similar ranking of companies by both measures ensures that the same companies are identified as having 'low' q[17]. Moreover, the mean value of q differs only marginally for those years where both measures are available as shown in Figure 2.

The calculation of the replacement cost of total assets is complicated because of the lack of information on replacement costs. Following the algorithm of Lindenberg and Ross (1981), we calculate the replacement cost of total assets (RCTA_t) as:

$$\mathrm{RCTA}_t = \mathrm{BVTA}_t + (\mathrm{RCOTA}_t - \mathrm{BVOTA}_t) + (\mathrm{RCBL}_t - \mathrm{BVBL}_t) \qquad (5)$$

where BVTA_t is the book value of total assets; RCOTA_t is the replacement cost of other

[16] Preference shares are only a small proportion of the firms' total securities (including bonds) - around 3 per cent at end-1990 (Bain, 1992).

[17] The Spearman rank correlation coefficients between the two measures of q range from 0.93 to 0.99 for the years 1982 to 1991.

tangible assets; $BVOTA_t$ is the book value of other tangible assets; $RCBL_t$ is the replacement cost of buildings and land; and $BVBL_t$ is the book value of buildings and land.

To calculate the replacement cost of either other tangible assets (OTA) or buildings and land (BL) at time t, we need to add new investment at t (I_t) to the revalued replacement cost of the stock of assets in the previous period. The extent of revaluation depends on changes in the price of capital goods (φ_t), economic depreciation (δ_t) and the extent of cost savings through technological progress (η_t). Following Lindenberg and Ross, we use the recursion:

$$RC_t = [(1+\varphi_t)(1+\delta_t)^{-1}(1+\eta_t)^{-1}]RC_{t-1} + I_t \tag{6}$$

In period 0, we are constrained to use the book value of assets[18]. φ_t is measured as the rate of change of the gross fixed capital formation deflator in the UK national accounts. The rate of depreciation, δ_t, is measured in two ways. First, we use a measure based on the rate of depreciation of total assets for each firm in each year, computed as the ratio of depreciation to total assets from the EXSTAT accounting data. Second, we utilise the rates calculated by King and Fullerton (1984) for UK manufacturing which are 8.19 per cent for plant and machinery (OTA) and 2.5 per cent for buildings and land (BL). Estimating cost reductions from technological progress, η_t, is difficult. We assume that it is around 2 per cent per annum, although we experiment with using different values. All of the results presented below are robust to the choice of depreciation measure and to the value chosen for η_t.

Figure 2 graphs the average value of q for our sample of companies. It reveals that the average

[18] For the 41 per cent of companies which are in our sample from the start, given that we begin this recursion 5 years before our estimating sample, the difference between book value and replacement cost is likely to be unimportant.

value of q changes significantly over time as found previously by Lindenberg and Ross for the US[19]. It is clearly sensitive to overall developments in the stock market as can been seen from the 1987 peak and subsequent fall. This further justifies our use of relative q's in classifying low q companies[20].

4. Results and Discussion

Table 1 presents our main results. Panel (A) reports the estimated coefficients when the baseline hazard, g_0, is assumed to be monotonic (the discrete time analogue of the familiar Weibull specification). The coefficient on Log(t) is positive and significant, indicating an increasing conditional probability of takeover over time. The negative duration dependence bias on the hazard from neglecting unobserved individual heterogeneity is clearly illustrated when columns (1) and (2) are compared: in column (2) in which we allow for gamma "frailty", the estimated hazard rate is twice as high as in column (1), and the heterogeneity parameter, $\sigma^2(\gamma)$, reveals that there is indeed significant unobserved heterogeneity[21].

Panel (B) reports the results when the hazard is non-parametrically specified as in equations (2) and (3) above. A comparison of the two sets of estimates reveals that the flexible baseline hazard does indeed mitigate the impact of unobserved heterogeneity - in this case, the estimated variance is statistically insignificant, and a test of model (1) *vs* model (2) cannot reject model (1) [p=0.65]. The degree of bias in the estimated βs from imposing monotonicity

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[19] See also Riley, B. "The bulls spell out 'q' for quibble" *Financial Times*, 10 July 1996.

[20] In fact, we use the lagged relative value of q to determine whether a firm has a high or low q, since there is evidence in the literature that q rises sharply on the announcement of a takeover. Moreover, using lagged q is analogous to using end-of-previous-period values which conforms to the standard timing conventions used when measuring q (see Eberly, 1997).

[21] A test of column (1) against column (2) (marginally) rejects the specification in column (1) as shown in the diagnostics at the bottom of the table.

on the hazard rather than allowing for a more flexible duration dependence can be gleaned by comparing the regression coefficients in panel (A) with those in panel (B)[22].

Our main interest is in the determinants of the conditional probability of takeover. As can be seen, this depends non-linearly on log size; the coefficients on log(size) and its square indicate an inverted U-shaped relationship such that increasing size is at first associated with an increase and subsequently with a decrease in the probability of takeover, with a peak close to the mean in log(size). This relationship may reflect the fact that during the 1980s financing constraints were loosened allowing larger firms (although not the largest) to be taken over for the first time.

The proportion of tangible assets in total assets has a negative impact on the probability of takeover perhaps reflecting the fact that different opinions about firm valuation is one reason for takeover and, therefore, a higher proportion of tangible assets (which are more easily valued) is associated with a lower takeover hazard. The coefficients and elasticities (evaluated at the mean) on leverage and liquidity are small and statistically insignificant. The joint insignificance of the industry dummies reveals that there do not appear to be residual significant sectoral differences in takeover activity, although a few coefficients indicate that some sectors experienced significantly lower conditional activity rates than the others. Of course, to the extent that the other variables included differ systematically across industries,

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[22] Although, despite the evident differences, none of the four columns fail the specification test reported in the diagnostics.

this result is perhaps unsurprising[23].

The estimated underlying hazard in panel (B) is fairly volatile with no evident trend over duration. One complication in interpreting its shape is that it conflates duration with time effects for a significant proportion of our companies. Some 41 per cent of our companies are present at the start of our sample period and therefore these companies experience time-specific (such as macroeconomic) effects at the same elapsed duration. We investigate this issue in two ways. First, we condition the hazard on a dummy variable, Start, which takes a value of 1 for all companies which were present at the beginning of the sample. As can be seen, its coefficient is insignificantly different from zero in the estimates presented in Table 1. Second, we incorporate a vector of 17 year dummies, which also allow us to investigate whether there are significant macroeconomic effects on the probability of takeover. These reveal that there are highly significant differences in takeover rates over time and they are consistent with the observed merger patterns in Figure 1, although with their inclusion, the underlying duration effects (as we anticipated), become less significant due to the conflation of duration and calendar time effects[24]. However, more importantly, the inclusion of these calendar time dummies does not detract from the significance of the company-specific determinants of the probability of takeover. Thus takeover activity has both time-series and cross-sectional dimensions.

[23] Using a finer classification of 38 industrial groups as defined in the Stock Exchange classification of industries, rather than SIC groups, produces a similar result and thus there do not appear to be significantly different sectoral takeover rates in this period, *ceteris paribus*. The magnitudes and significance of the other coefficients are robust to the omission of the industry dummies.

[24] Of course, for the 41 percent of our sample of firms which are present at the start, the duration effects and calendar time dummies are collinear.

We are concerned primarily here with the channels through which the market for corporate control monitors corporate activity. The coefficient on profitability is negative and highly significant. For the estimates in panel (B), column (2), the elasticity of the conditional probability of takeover with respect to profitability is -0.17 at the mean. Given the volatility of profitability, this is economically important; a one standard deviation increase in profitability from the mean would lead to a hazard rate which is, *ceteris paribus*, some 24 per cent lower. Thus, profitability appears to be an important channel through which the market for corporate control functions.

The effects of investment and dividends on the hazard are both negative, although the latter is, in general, insignificantly different from zero. While the elasticity of dividends is larger than that of investment (-0.12 *cf*. -0.06), given the much greater volatility of investment, a firm's investment policy can be seen to be a more important determinant of takeover; a one standard deviation increase in dividends from the mean reduces the relative hazard by 8 per cent while the corresponding figure for investment is 14 per cent. However, the important point to note is that these are both considerably less than the impact of increasing profitability[25,26].

Of course, our primary concern with respect to dividends and investment is with their impact on the hazard for companies which have no positive NPV investment opportunities. The results in Table 2 identify the impact of these two variables on the hazard separately for firms

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[25] The figures cited are based upon the coefficient estimates in the final column of Table 1, although given the similarities across the four columns, the elasticities and impact on the relative hazard are similar whichever set of estimates is used.

[26] The negative effect of dividends on the hazard could reflect attempts by management to retain shareholder loyalty by paying out high levels of dividends (see Dickerson *et al*, 1997), although given its statistical insignificance in Table 1, we would not wish to overemphasise this interpretation.

which are characterised by having a relatively low value of *q* (low_q) and those which do not (1-low_q)[27]. The interaction terms between investment and relative *q* reveal that an increase in investment in low *q* companies reduces the conditional probability of takeover by more than it does for the other companies. However, the two coefficients are not significantly different from each other as revealed by the test reported at the bottom of the table. More importantly, we note that for low *q* companies, investment has a negative and significant (at 10%) impact on the probability of takeover, contrary to the *positive* impact that the free cash-flow theory predicts.

For dividends, a similar exercise shows that the direction of the effect is as predicted by the free cash-flow theory, since the impact of dividends on the hazard is more negative for low *q* companies than for companies which do not fall into this category. Thus, higher dividends in low *q* companies appear to signal that managers are not misappropriating the profits of the firm and hence they are less likely to be taken over. However, the difference between low and non-low *q* companies, while large in magnitude, is not statistically significant at conventional levels, and dividends do not have a significant impact on the takeover hazard for either group of companies.

5. Conclusions

In this paper, we have examined the determinants of acquisition in quoted UK manufacturing companies. The analysis is of particular interest in that our period includes the takeover boom of the late 1980s. The results indicate that there is evidence that some takeovers can be

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[27] As in Table 1, non-parametric estimation of the baseline hazard is sufficient to mitigate and/or control for any unobserved individual heterogeneity.

interpreted as having disciplinary motivations; low profitability was found to be associated with a higher conditional probability of takeover, and the magnitude of the impact was both statistically and economically significant. However, our investigation of the other channels through which the market for corporate control might be expected to operate did not uncover any notable effects. Firms without positive NPV investment opportunities (as identified by Tobin's *q*) did not experience a significantly increased takeover hazard if they increased investment or reduced dividends, contrary to the predictions of Jensen's free cash-flow theory[28]. Thus, we can conclude that shareholders appear to focus primarily on current profitability in order to identify those companies in which managerial failures are serious enough to necessitate the takeover discipline of the market for corporate control.

[28] An alternative interpretation of this finding is that, when attempting to assess future corporate potential, the information content of stock market data as captured by *q* is rather weak in general.

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Table 1: Conditional Probability (Hazard) of Takeover

	(A) Weibull Hazard Model				(B) Semi-Parametric Hazard Model			
	(1) without heterogeneity		(2) with heterogeneity		(1) without heterogeneity		(2) with heterogeneity	
Log(size)#	3.445	(0.763)*	3.766	(0.880)*	3.444	(0.765)*	3.571	(0.849)*
Log(size)2#	-0.103	(0.023)*	-0.114	(0.026)*	-0.103	(0.022)*	-0.108	(0.025)*
Tangible assets#	-1.659	(0.509)*	-1.946	(0.607)*	-1.610	(0.512)*	-1.718	(0.598)*
Liquidity#	-0.235	(0.241)	-0.230	(0.272)	-0.262	(0.242)	-0.247	(0.259)
Leverage#	-0.153	(0.178)	-0.136	(0.202)	-0.169	(0.178)	-0.156	(0.192)
Start$	0.051	(0.134)	0.128	(0.177)	0.078	(0.135)	0.098	(0.158)
Profitability#	-1.607	(0.443)*	-1.658	(0.482)*	-1.714	(0.455)*	-1.761	(0.479)*
Dividends#	-2.369	(1.599)	-2.934	(1.757)+	-1.900	(1.629)	-2.080	(1.735)
Investment#	-0.543	(0.176)*	-0.541	(0.203)*	-0.590	(0.186)*	-0.586	(0.195)*
Constant	-31.228	(6.464)*	-33.702	(7.469)*	-31.930	(6.492)*	-32.810	(7.089)*
Baseline Hazard	Log(t)		Log(t)		Non-Parametric		Non-Parametric	
	0.277	(0.080)*	0.559	(0.171)*	$\chi^2(16) = 32.82$ [p=0.01]		$\chi^2(16) = 28.45$ [p=0.03]	
$\sigma^2(\gamma)$	-	-	1.104	(0.598)*	-	-	0.455	(1.062)
	Diagnostics				Diagnostics			
logL	-1318.46		-1316.36		-1305.23		-1305.13	
Pseudo R^2	0.036		0.037		0.045		0.045	
Model χ^2	$\chi^2(10) = 97.60$ [p=0.00]		$\chi^2(11) = 101.80$ [p=0.00]		$\chi^2(25) = 124.06$ [p=0.00]		$\chi^2(26) = 124.27$ [p=0.00]	
Specification test	-0.908 [p=0.36]		-1.106 [p=0.27]		-0.135 [p=0.89]		-0.395 [p=0.69]	
Industry effects	$\chi^2(14) = 16.72$ [p=0.27]		$\chi^2(14) = 14.22$ [p=0.43]		$\chi^2(14) = 16.43$ [p=0.28]		$\chi^2(14) = 10.62$ [p=0.72]	
Year effects	$\chi^2(16) = 51.32$ [p=0.00]		$\chi^2(16) = 50.86$ [p=0.00]		$\chi^2(16) = 45.01$ [p=0.00]		$\chi^2(16) = 43.95$ [p=0.00]	
Model (1) *vs* (2)	$\chi^2(1) = 4.21$ [p=0.04]				$\chi^2(1) = 0.21$ [p=0.65]			
no. companies	892				892			
no. observations	8352				8352			

Notes:

1. Standard errors in parentheses; p-values in square brackets.

2. $^{\$}$ denotes dummy variable; $^{\#}$denotes time varying covariate.

3. * denotes significant at 5% level; + denotes significant at 10% level.

4. The "Baseline Hazard" row indicates the functional form selected for the underlying hazard - monotonic ('Weibull') or non-parametric. The reported statistics are the coefficient (standard error) of the coefficient on Log(t) for the Weibull specification and a test for the joint significance of the duration specific intercepts for the non-parametric hazard.

5. The significance test for the heterogeneity parameter, $\sigma^2(\gamma)$, is a one tailed test since $\sigma^2 > 0$.

6. Model χ^2 is a likelihood ratio test for the joint significance of the regressors.

7. The specification test is due to Pregibon (1980). Similar to a standard RESET test, it is distributed as standard normal N(0,1) under the null hypothesis of no misspecification.

8. "Industry effects" and "Year effects" are tests for the joint significance of industry and calendar year dummies respectively. See text for details.

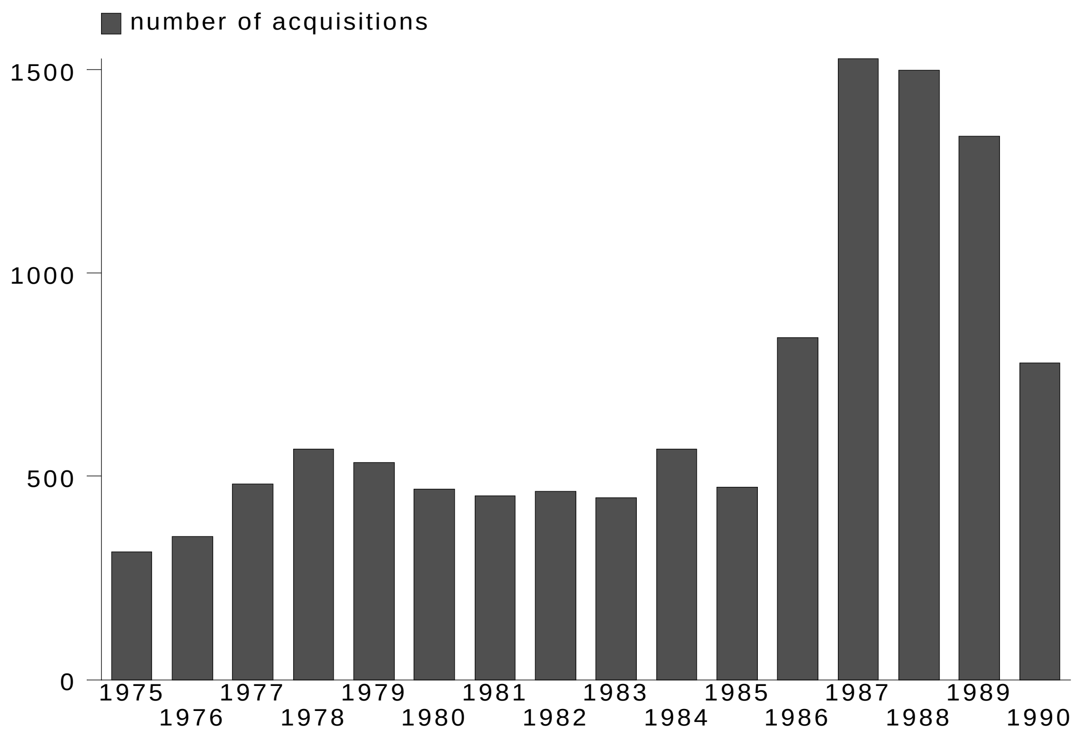
Table 2: Distinguishing Companies with Low q

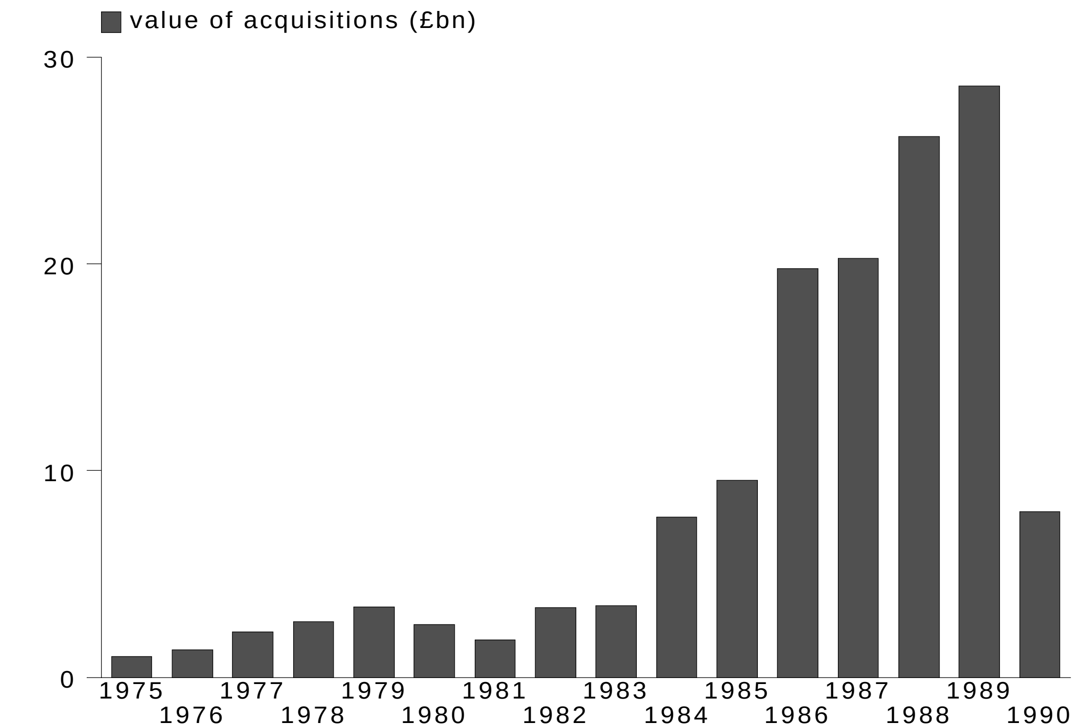
	Semi-Parametric Hazard Model			
	(1) without heterogeneity		(2) with heterogeneity	
Log(size)#	3.438	(0.767)*	3.472	(0.841)*
Log(size)2#	-0.103	(0.022)*	-0.104	(0.025)*
Tangible assets#	-1.588	(0.512)*	-1.618	(0.596)*
Liquidity#	-0.247	(0.245)	-0.244	(0.250)
Leverage#	-0.158	(0.181)	-0.156	(0.185)
Start$	0.077	(0.135)	0.082	(0.148)
Profitability#	-1.746	(0.461)*	-1.758	(0.476)*
Dividends#×low_q#$	-3.018	(2.341)	-3.050	(2.386)
Dividends#×(1-low_q)#$	-1.493	(1.696)	-1.548	(1.795)
Investment#×low_q#$	-0.835	(0.436)+	-0.818	(0.471)+
Investment#×(1-low_q)#$	-0.552	(0.207)*	-0.554	(0.205)*
Constant	-31.916	(6.509)*	-32.149	(6.966)*
Baseline Hazard	Non-Parametric $\chi^2(16) = 32.76$ [p=0.01]		Non-Parametric $\chi^2(16) = 27.66$ [p=0.03]	
$\sigma^2(\gamma)$	-	-	0.113	(1.099)
	Diagnostics			
LogL	-1304.75		-1304.75	
Pseudo R^2	0.046		0.046	
Model χ^2	$\chi^2(27) = 125.02$ [p=0.00]		$\chi^2(28) = 125.03$ [p=0.00]	
Specification test	-0.134 [p=0.89]		-0.186 [p=0.85]	
Industry effects	$\chi^2(14) = 16.00$ [p=0.31]		$\chi^2(14) = 10.01$ [p=0.76]	
Year effects	$\chi^2(16) = 45.06$ [p=0.00]		$\chi^2(16) = 43.71$ [p=0.00]	
Equal dividend effects	$\chi^2(1) = 0.50$ [p=0.48]		$\chi^2(1) = 0.47$ [p=0.49]	
Equal investment effects	$\chi^2(1) = 0.36$ [p=0.55]		$\chi^2(1) = 0.27$ [p=0.60]	
Model (1) *vs* (2)	$\chi^2(1) = 0.01$ [p=0.92]			
no. companies	892			
no. observations	8352			

Note:

1. See notes to Table 1.

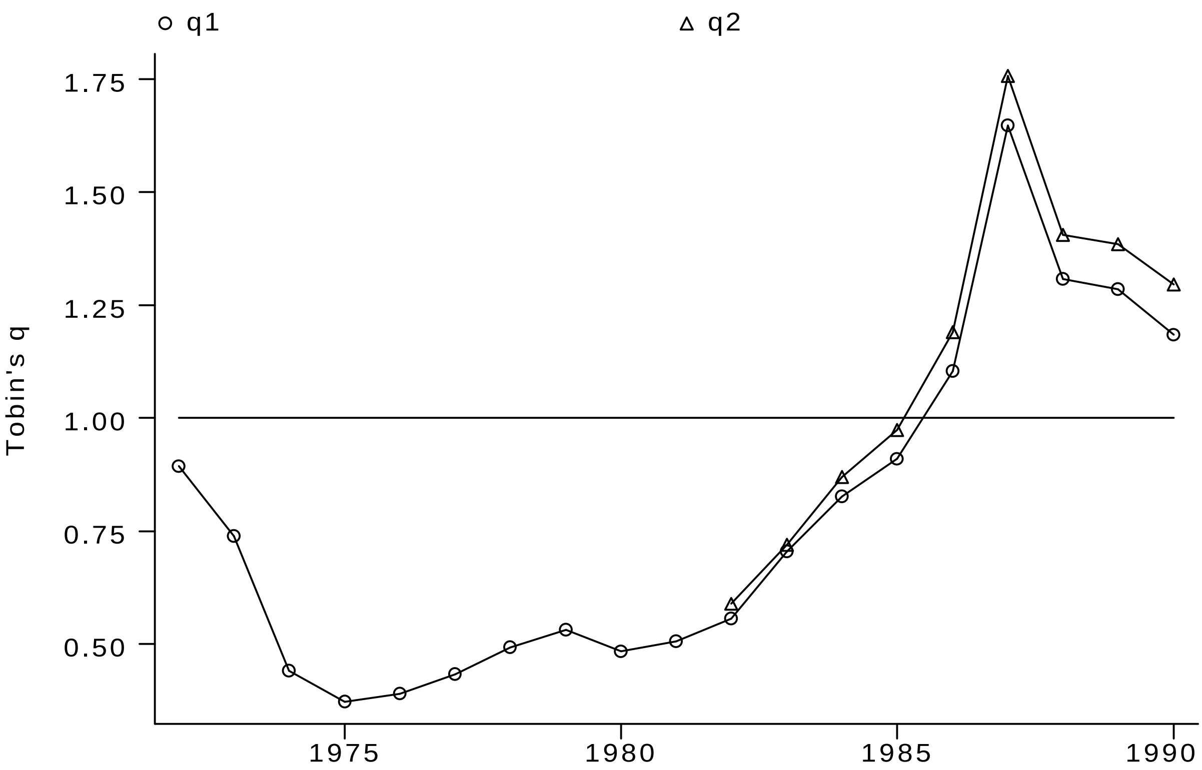
Figure 1: Number and Value of ICC Acquisitions





Source: ONS databank, series AIHA and AIHB respectively. Values are in real (1990) prices, having been deflated by the GDFCF deflator (series GIEH).

Figure 2: Average *q* values



Note:

1. q_1 is Tobin's *q* calculated using the narrower definition of debt defined as short-term loans, banks loans and overdrafts; q_2 incorporates total debt (see text for details).